

scintillation method largely as applied to gamma-spectroscopy. Particle detectors are then covered, chiefly proportional and Geiger-Müller counters, together with special techniques of low background and 4π geometry counting. A short section briefly mentions the recently developed semiconductor detectors. A highly practical section on experimental methods deals with window and sample techniques, photographic intensity determinations, the use of multi-channel pulse-height analysers and measurement of source strengths. Much further practical information follows in a section discussing methods for investigating disintegration schemes, the subsections dealing with scintillation spectra analyses and coincidence techniques being especially worthy of note. Nuclear models are considered, the shell and unified model together with a section on collective nuclear motion. Alpha-decay is then reviewed in a chapter dealing not only with the decay process but also the shape of alpha-spectra. Volume I is concluded by three chapters dealing with the gamma radiation arising from charged particle bombardment, neutron capture, and from fission. Here again many experimental and practical data are presented.

The second volume opens with two short chapters devoted to the theory of multipole radiation and of internal conversion. An excellent section on coincidence techniques, with much experimental detail, is followed by consideration of experiments on internal conversion and transition rates. A well-balanced section deals with the angular distribution of radiation again with many experimental data. The remaining chapters are rather more theoretical in nature although much experimental evidence is presented. Topics covered include the Mössbauer effect, theory of beta-decay, conservation laws in beta-decay, the shape of beta-spectra and internal effects in nuclear decay (internal Compton interaction, internal bremsstrahlung, internal pair production).

The general impression conveyed is that this work is a valuable contribution to nucleonic literature and is to be recommended as a useful reference book. The volumes are profusely illustrated and both text and illustrations are well printed, the standard of proof reading has been high and there are very few discernible errors although a humorous misprint refers to a critical 'angel' in a section on angular correlation. It is rather strange to find the German abbreviations 'tg.' and 'ctg.' used in formulae in a book written in English and, in one curious exception, 'cot.' and 'tg.' occur in the same expression. The appendices are sometimes set in very small type, and one case, apparently due to photographic reproduction, borders on illegibility. These are, however, but trivial blemishes in an excellent work.

G. L. REED

A MODERN TREATISE ON SUNSPOTS

Sunspots

By R. J. Bray and R. E. Loughhead. (The International Astrophysics Series, Vol. 7.) Pp. xvi + 303 + 39 plates. (London: Chapman and Hall, Ltd., 1964.) 84s. net.

SOLAR research and especially solar physics have developed enormously during the past two decades and are progressing with an ever-increasing speed. This special field of astronomy has now widened to such an extent that even for an expert it is scarcely possible to master the whole subject. Indeed, it is quite significant that a book of some 300 pages could have been written which is limited to sunspot phenomena only. *Sunspots* is the seventh volume of the valuable international astrophysical series edited by Sir Bernard Lovell and Prof. Z. Kopal, both of the University of Manchester. Here we have been presented with the first comprehensive modern treatise on sunspots. Its two authors are both working at the National Standards Laboratory at Sydney, Australia,

where active solar research has been going on for a considerable time; both of them have taken an active part in this research.

The book starts with a short, but concise and well-written, historical introduction. The next chapter deals with new methods of observing the surface of the Sun by special techniques, including air-borne photography, which have recently achieved a high standard in spatial resolution on the surface of the Sun, and have produced much new knowledge about sunspots, which recently has been confirmed by high-resolution spectroscopy. The authors give lucid descriptions of these techniques and of the results obtained so far, accompanied by typical photographs and diagrams of the special instrument and technique which they themselves have used so successfully at Sydney. The chapters that follow form the monograph 'proper' dealing with the observational facts and physical conditions of individual sunspots. They, too, are illustrated by a large number of most instructive half-tone reproductions, selected from the authors' own extensive observations. A general survey of the physical conditions in sunspots provides a good cross-section of the rather difficult and complex studies related to the theory of the solar atmosphere. It has been known for more than half a century that all sunspots are associated with relatively large magnetic fields; only in the past 20 years, however, have great efforts of research work been directed towards the detailed study of the obviously very involved magnetic conditions in the Sun's atmosphere. The fifth and the eighth chapters of the book deal with the magnetic field of individual sunspots and with modern magneto-hydrodynamic theories of the Sun. They are both well written and certainly represent one of the most comprehensive surveys of our present knowledge of the magnetic conditions on the Sun. They are carefully documented by references to the large and widespread modern literature on this subject. These chapters again show clearly how complicated the sunspot phenomena are, and how little we yet understand the reasons which cause a large region, which is considerably cooler than its neighbourhood and which is associated with extensive magnetic fields over its whole area, to develop and to exist for days and weeks within the surrounding much hotter atmosphere of the Sun. Two further chapters are devoted to sunspot groups and to the relation of spots to the so-called 'active' regions of the Sun. While these chapters seem to be somewhat short, one must nevertheless bear in mind that certain restrictions within these large fields were necessary and that, on the other hand, for example, for the important phenomena of solar flares, so closely connected with sunspots, we already possess a good book by H. I. and P. S. Smith.

The wide field of solar terrestrial relationships, as well as the recently discovered properties of sunspots in the radio-frequency spectrum, have been intentionally excluded from this book. Though these are admittedly extensive fields in their own right, it might nevertheless be advisable to incorporate in a future edition an additional chapter these interesting and important subjects.

The arrangement of the book under review is attractive; some cross-references and repetitions are scarcely avoidable, due to the interwoven structure of the subject. I found the short introductions at the beginning of each chapter most helpful. It is characteristic that in a book on such a restricted subject about 500 publications (mostly modern) could be quoted. These references, together with the numerous instructive illustrations, accompanied by good captions, and the well-arranged index, make the book most valuable and recommendable not only to the professional worker, but also to readers in the adjacent fields of research, such as ionospheric problems, meteorology or geophysics. In general the book does not make excessive specialized demands in physics and mathematics, and it can therefore also be recommended to the advanced amateur.

H. VON KLÜBER