

metals and their compounds are discussed. The last two chapters give a short account of the use of uranium and thorium as nuclear fuels and current trends in fuel-element design in each of the countries interested in nuclear power reactors.

The subject-matter is largely drawn from the proceedings of the 1955 Geneva Conference. Although there has now been a second conference (1958), the book is still surprisingly up to date, and in a second edition it is the chapters dealing with fuel elements which will require more extensive revision. There is also an increasing amount of work being carried out on uranium alloys, for example, with zirconium, molybdenum and silicon, but these receive only a mention. The physical properties of such systems are of interest to the physical metallurgist, and their applications are of special interest to the nuclear technologist. This is a subject which might well merit a chapter to itself.

The author, who at the time this book was written was chief metallurgist to the Industrial Group of the United Kingdom Atomic Energy Authority (he is now chief metallurgist at Harwell), is well qualified to produce such an authoritative account. The book, which is reasonably priced, is strongly recommended to all those interested in the use of uranium and thorium in nuclear power production.

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## SATELLITE RESEARCH

### Scientific Uses of Earth Satellites

Edited by James A. Van Allen. Second, revised edition. Pp. x+316. (Ann Arbor, Michigan: University of Michigan Press; London: Chapman and Hall, Ltd., 1958.) 75s. net.

**T**HIS book contains an account of experiments which were proposed for the American satellite programme to be carried out mainly during the International Geophysical Year. The various chapters are based upon papers presented at a meeting of the Upper Atmosphere Rocket Research Panel in 1956 by a number of experts in the field of planetary physics. In the first edition, now almost two years old, the experiments were presented as proposals, no satellites having been launched at the time, but since then several of those suggested have been successfully carried out, and others are upon the point of being tried. The second edition now under review, coming so soon after the first, could scarcely be expected to give an account of the results so far obtained, and in fact no new material has been added. Some of the thirty-three chapters have, however, been revised and brought up to date, although this has not altered the total number of pages in the book (316). Revisions may be found in Chapter 1, where, for example, equation 42, p. 9 (which gives the motion of the line of the apsides of a satellite orbit) and the sentence following it, have been corrected. A short addendum has been made to Chapter 24, and in Chapter 33 the discussion of electron accretion by an interplanetary dust particle has been rewritten. There are other changes of a similar nature throughout the book.

The real value of the book, which must be judged to be considerable for those working in the various fields covered, lies in the basic nature of the treatment of each subject. Chapters 1, 5 and 11 discuss in some detail satellite orbits with perturbations

due to the Earth's oblateness and atmospheric drag. Further perturbations arising from time and latitude variations of air density and from winds are perhaps too scantily treated to satisfy those interested in the behaviour of the recent *Sputniks* and their rockets. The visibility of satellites and optical tracking problems are the subjects of Chapters 2, 3 and 4, although no detailed mention is made of systems now in use. Satellite instrumentation is covered in a general way in Chapters 6 and 7, power sources being given considerable attention, and particular experiments for the study of the density and pressure of the Earth's atmosphere from a satellite, namely, by an accelerometer recording drag on an orbiting inflated sphere and by an ion gauge of special design, are detailed in Chapters 10 and 12.

The study of the meteorology of the Earth by observing tropospheric weather systems as revealed by clouds is proposed in Chapter 13. The method involves scanning the Earth by narrow-angle photoelectric detectors in a spinning satellite, the detector outputs being telemetered to a chain of ground stations. Chapter 14 describes a method whereby it should be possible to obtain the temperature of the atmosphere as a function of the optical depth by observation of the thermal radiation from the Earth and its atmosphere in the far infra-red.

Four chapters are devoted to investigations in the ultra-violet, which include continuous monitoring of the Lyman alpha-emission from the Sun, observations of the resonance radiation at 1216 Å. arising from sunlit hydrogen atoms in interplanetary space, and a prediction of the appearance of the sky in the ultra-violet based upon the study of ultra-violet stellar magnitudes. (No mention is made in the latter of the recent discovery of hitherto unsuspected ultra-violet emitting objects.)

Chapters 20, 21 and 22 are concerned with cosmic rays and auroral radiations. It is here again that a suggestion that the second edition might be somewhat premature could arise, owing to the absence of a discussion of the extremely important Van Allen radiation belt discovered by an American satellite vehicle.

The four succeeding chapters describe proposed geomagnetic measurements of the main field and atmospheric current systems, Chapters 23 and 24 being particularly extensive. Instrumentation is given in some detail, and the importance of establishing the presence or absence of an extra-terrestrial ring current is naturally stressed.

Ionospheric studies occupy five chapters, mainly from the aspect of propagation experiments. Chapter 28 briefly describes possible temperature and electron density measurements using a Langmuir probe.

Chapter 32 reviews work on the acoustic detection of meteoric particles, already carried out using rockets, and recommends the technique for satellites. An alternative meteor detector based on the erosion of resistive elements on the outside surface of a satellite is briefly described in Chapter 8. Interplanetary dust is further discussed in Chapter 33, particular attention being paid to the motion of charged dust particles near the Earth.

Each chapter includes a list of references, in general very extensive, but there is no index. Diagrams are clearly reproduced, and chapter sections and sub-headings well displayed.

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