Reviews

(I)

The Threshold of Space edited by M. Zelikoff. Published by Pergamon Press, London, 1957, pp. *i*—*xi* and 1—342, price £ 5-5 *sh*, $15.00.

This is a collection of scientific papers presented by eminent investigators at the Conference on Chemical Aeronomy sponsored by the Geophysics Research Directorate of the United States Air Force Research Centre and held at Cambridge, Massachusetts in June 1956. The contents of this volume deal mostly with our current knowledge concerning phenomena which occur just in that transition region where the earth's atmosphere begins to become really tenuous and ultimately merges into interstellar or rather interplanetary space. In this interplanetary space the outer atmospheres of the various planets and of the sun surely intermingle. Of particular interest from the terrestrial viewpoint is the possibility, which proceeds from this intermingling of the atmospheres of the bodies of the solar system, that the corona of the sun and the ionosphere of the earth are conterminous. Ideas of this sort were put forward by astro-geophysicists in Germany, notably Kiepenheuer, during World War II; after the war such ideas have gained further ground and have been developed by other distinguished theorists like Prof. Sydney Chapman. The choice of the title for the present collection of papers is indeed very apt.

Apart from a foreword by the editor, an opening address and closing remarks by Milton Greenberg, Director of the Geophysics Research Directorate and a list of participants in the conference, the contents are divided into four parts, namely, I. Atmospheric Photochemistry—Earth and Venus; II. Spectroscopy and Photochemistry; III. Rocket Probing of the Upper Atmosphere; and IV. Phenomena produced by Hypersonic Flight, containing in all 45 separate contributions. The first two parts consist of papers dealing with theoretical work and ground-based spectroscopic observations relating to airglow, afterglow, auroral luminescence, chemical reactions in the earth's upper atmosphere and in the atmosphere of Venus, the possibility of the existence of neutral atomic hydrogen as the major constituent of the terrestrial atmosphere at some height above the mesopause and so on. Much of the theoretical work is naturally well supported by pure experimental work in the laboratory, but some of it has yet to be regarded as speculative. In any event, speculation must play an important role in theoretical work concerning the until recently inaccessible outer atmosphere of the earth , as in many fields of astrophysics. It is, however, remarkable that so many theoretical considerations previously thought to be speculative are now found to be verified or at any rate made very plausible by the results of the direct rocket probing of the upper atmosphere; the third part of the volume deals with conclusions that can be drawn from direct observations made on the earth's outer atmosphere with the help of instruments carried up by rockets. The fourth part of the volume concerns matters of importance to designers of hypersonic flight; however, some of the papers in this part are of particular interest also to the pure physicist, for they deal with spectroscopic and electrical phenomena associated with strong shock waves in laboratory shock tubes.

It is impossible in a brief review to do justice to a collection of technical papers by so many different authorities. This is essentially a book for the specialist; nevertheless, any geophysicist or astrophysicist, even though he may specialise in other

fields, will surely obtain from this a very up-to-date idea of the present state of our knowledge concerning the optical and electrical phenomena of the outer atmosphere of our planet. The book conforms to the high standard of production for which the Pergamon Press is known.

A. K. DAS

(II)

Geophysics and the IGY, Geophysical Monograph Number 2, edited by Hugh Odishaw and Stanley Ruttenberg. Published by the American Geophysical Union of the National Academy of Sciences, U.S.A. 1958. pp. 210.

This collection of papers is the second in the series of Geophysical Monographs published by the American Geophysical Union of the National Academy of Sciences—National Research Council. The first one, Antarctica in the International Geophysical Year was published in 1956 and contained 16 papers presented at a symposium held in April 1956*. The present Monograph contains 30 papers discussed in a similar special symposium conducted by the U. S. National Committee for the International Geophysical Year during June 1957. They cover a wide range of subjects of which 18 papers are on Upper Atmospheric Physics, 10 on Lower Atmosphere and the Earth and 2 on Polar Regions.

The Monograph will be welcome to the scientists working on the IGY (now IGC) programmes of investigation as it gives an excellent introduction to the various subjects and also describes some of the most recent observations.

The first part of the Monograph deals with Upper Atmospheric Physics. The paper by W.O. Roberts on Solar Terrestrial Relationships focusses attention of the need for simultaneous observations at different places on earth of the optical and corpuscular emissions from the sun producing radio fade-outs, aurorae, magnetic storms and ionospheric disturbances. Gerson's paper on High Atmosphere gives an admirable summary of the present state of knowledge of the temperature, pressure, electron density and atmospheric constituent at different heights. It also attempts to summarise information on ionosphere, aurora and airglow, terrestrial magnetic field and its variations. It would have been better to restrict the number of topics but elaborate them individually. I.G.Y. Solar Instrumentation by J. W. Evans describes the more recent advances in astronomical equipment like Lyot coronagraph and Lyot heliograph. There are two articles on Whistlers, one by M.G. Morgan and the other by R.A. Helliwell. The study of whistlers, investigated recently in great detail at the Cavendish Laboratory, Cambridge, has given surprising results; we came to know for the first time from these studies that the electron density at the fringe regions (1000 km) is of the order of 600 c.c. These results have been corroborated even more recently from observations on sputniks and artificial earth satellites (Van Allen radiation). It is encouraging that the study of whistlers has formed a part of programme of the IGY. Two papers on Ionosphere, one by A.H. Shapley and R.J. Slutz and the other by H.W. Wells, describe the various analytical and experimental programmes of investigation for the IGY. Earth's magnetic field and its variations have received equal attention in two papers, one by E.B. Roberts and D.G. Knapp and the other by J.A. Simpson. Simpson's article gives an extremely interesting account of the determination of cosmic ray equator from high

*Reviewed by Dr. A. K. Das, *Indian J. Met. Geophys.*, 1957, **8**, p. 351.

level cosmic ray measurements. Chasson's paper on Cosmic-Ray Monitor Observations is an extension of Simpson's work and deals with correlation between solar flares, magnetic storms and cosmic ray intensities. High altitude cosmic ray measurements have been dealt with in the next paper by E.P. Ney and J.R. Winckler. Some observations on aurora and night airglow are described in the next two papers by C.W. Gartlein and F.E. Roach. A considerable portion of the Monograph has been developed mostly to the instrumentation side of the rocket exploration and satellite programme of U.S.A. There have been numerous publications in recent years on these important subjects which have received additional impetus after successful launching of satellites from 1957 onwards. But at the time the symposium was held, already extensive results on the physics of the upper atmosphere have been obtained from rocket exploration. One is somewhat disappointed that a little more emphasis has not been given in the series of papers on rockets and satellites to the results achieved so far.

The next ten papers are on Lower Atmosphere and the Earth. They contain useful information on synoptic meteorology, oceanography, polar ice caps, seismology and gravity measurements during IGY. The reviewer is not competent to comment on them but he believes that they should prove informative to the workers in the field.

The last two papers describe the United States programmes during IGY, in the Arctic and the Antarctic regions. The difficult task of establishing a network of observing stations at both the polar regions was already achieved and scientific personnel with large consignment of scientific equipment took up their positions before the IGY began. Life would be very unpleasant there specially when the temperature goes below—100°F. But man's thirst for knowledge knows no bounds and this gallant effort is sure to be amply rewarded by the new discoveries of these polar expeditions.

The book is illustrated by figures and photographs. References to important published papers have been given at the end of each article. Certain amount of unavoidable overlapping has occurred specially in the first part. This is inevitable when the investigations themselves are somewhat allied to one another. What has specially appealed to the reviewer is the attempt, throughout the book, to explain complicated hypotheses, observations and deductions without the use of elaborate mathematical equations. The Monograph will, it is hoped, find a very wide circle of readers irrespective of their participation in the IGY programme of observation.

S. N. MITRA

(III)

Oceanographic Atlas of the Polar Seas, Part I Antarctic, H. O. Pub. No. 705, by U. S. Navy Hydrographic Office, Washington, D. C., 1957; 70 pp., 78 figs. Price $ 2·50.

H. O. Publication No. 705 was issued recently as the first in a series of oceanographic atlases which eventually will cover all ocean areas. There is no other known atlas which covers exclusively and in such exhaustive detail the oceanography of the waters surrounding Antarctica. Several atlases are available which contain charts extending to the southern limits of Antarctica but usually the material presented for areas south of 60°S is sketchy, being based on only scattered observations. Probably the best previous charts of the marine environment of the Antarctic Seas are contained in the German Antarctic Expedition and Discovery Reports. However, these charts were limited in scope summarizing only the results of observations taken during the exploration period.

This atlas is introduced with a brief recap of U. S. exploration, most of which has, in recent years, been done by the Navy.

The publication appears to be appropriately arranged in seven sections, systematically covering the various oceanographic and related marine climatic elements; section titles in the same order as presented are: Tides and Currents; Physical Properties; Ice; Wind, Sea, and Swell; Marine Geology; Marine Biology; and Distribution of Oceanographic Observations and Bibliography. Each section is preceded by a brief textual treatment which amplifies the charted presentation.

The tide and current section contains the usual co-tidal, co-range and general circulation charts. Actual range values for approximately 30 locations are included on the co-range chart; apparently all stations with adequate length of record are shown.

The surface temperature charts, in the physical properties section, are analyzed only for representative months of each season and the salinity-density charts only for the extreme months (February and August). Air-sea temperature difference ogives, overprinted on the surface temperature chart for selected locations, are not as satisfactory for the user as an isoline analysis; undoubtedly the lack of basic data prohibited a more extensive presentation. A series of cross-sections along several different radial approaches to Antarctica provides the only information on sub-surface characteristics.

As might well be expected, the section on ice is the largest in the atlas; it contains more than one-quarter of all the charts presented. Mean ice conditions are analyzed for the summer months (October-February) only, using five ice concentration classes; only the mean limit is shown for the winter months. Other ice presentations include a treatment of icebergs and superstructure icing and two series of synoptic charts, one each for the Ross and Waddell Seas. The superstructure icing charts appear to offer useful information for whaling, fishing, and other vessels operating continuously in the area. It is almost impossible to appraise the accuracy of these charts but the relationship of selected environmental conditions to degrees of icing as described in the text seem to be in the right order of magnitude.

The wind, sea, and swell charts summarize observations of these three phenomena in the classical "rose" form. The isolines of sea greater than 5 feet and swell greater than 12 feet duplicate in some degree information obtainable from the roses; however, this format is probably much more usable for the mariner. Here, too, a brief synoptic series of charts is presented.

The marine geology section includes not only the usual bottom sediments and rock type charts but also charts of earthquakes, volcanoes, and magnetic anomalies. All are based on very limited amounts of data and provide only spotty information with extensive areas of no data. Probably the greatest use of these charts is as an index to the observational coverage for the Antarctic region.

The marine biology section includes one of the first known attempts to analyze deep scattering layer data areally. The presentation is understandable, but it lacks the simplicity of an isopleth chart. Other biological presentations include charts on algae, bioluminescence, and whales. The general lack of quantitative biological data appears to dictate qualitative type presentations; however, there appears to have been a special effort made to treat whale data statistically.

The final section includes charts showing the distribution of oceanographic observations and the principal reference sources. These charts point up most effectively areas of sparse

oceanographic observations. They are also a valuable tool for atlas users, serving not only as a reliability index for charts included in this atlas, but, as separate charts, they represent the latest summary of quantitative observation material available for the area. These charts should be particularly useful in planning future oceanographic work in this area. A few errors were noted in the textual treatment, but all are considered of minor significance. Probably the most serious shortcoming is the lack of monthly charts; undoubtedly a result of the general lack of observed data.

In the preparation of this volume, it is understood that some 400 to 500 references were consulted, of which only about 100 of the source documents are listed. Among those listed are several voluminous marine punch-card decks which are on file at the U.S. Weather Bureau and U.S. Hydrographic Office. Obviously many basic data were obtained from these sources.

The publication is of a convenient size ($12\frac{1}{2}'' \times 16''$) for desk and shipboard use, it is printed on a substantial non-absorbent type paper that should be serviceable for marine use. The lithography is of quality caliber as are most U.S. Hydrographic Office products; it is permanently bound, but the paper cover leaves something to be desired. The volume is reasonably priced.

HAROLD W. DUBACH

(IV)

Design of Hydrological Networks by Max A. Kohler, *WMO Tech. Note*, 25, pp. 1-16, and *Techniques for Surveying Surface-Water Resources* by Ray K. Linsley, *WMO Tech. Note*, 26, pp. 1-41. Published by WMO, Geneva, 1958, price Sw. fr. 4.

The WMO have issued two technical notes Nos. 25 and 26 under a common cover dealing with two very live problems of the hour in hydrology.

The first note is by Max A. Kohler. It is a 16 page (revised) working paper prepared by him for the meeting of the WMO pannel on "Water Resources" held in July 1957. We find in Section II that while listing the types of hydrological data under soil moisture which is of such basic importance in the storm rainfall and surface run-off relation, he says "Hydrologists have made only limited use of soil moisture largely because reliable, long term records, are virtually non-existent".

Commenting on the investigations of Network Design he classifies the available studies (which according to him are not particularly realistic) under two heads, *i.e.*, (1) statistical theory of sampling error; (2) the average of the observations from a very dense network as the "true" mean for comparative analysis. He supports the concept of a flexible group of temporary or secondary stations supported by a firm network of base stations for not only stream flow observations as put forward by Langbein but also for precipitation, evaporation etc.

One must draw particular attention to Section IV, True Essence of Network Planning, where he gives very correct diagnosis of the difficulty, namely, the acquiring of funds required for the collection of adequate basic data. Under the conclusions we note with some amount of mixed feelings the remarks "The installation and operation of fully automatic equipment at relatively inaccessible stations is extremely expensive. Most of such types of stations must be located where local residents can serve as observer if at all possible", which checks very well with our rather limited experience in outlying areas.

In the next section he briefly mentions the usually employed techniques for estimating hydrological data. Being a working paper four "recommendations", which reveal a great deal of shrewd and realistic thinking, have been added in conclusion.

In Technical Note No. 26, Prof. R. K. Linsley discusses the techniques for surveying surface water resources. This note is a little over twice the length of the other Technical Note and in portions comparatively quite exhaustive. The note is divided into ten sections followed by an exhaustive bibliographical reference. Section IV is of particular importance. Here he gives very just critique of the problems of measurement, and the relative accuracy of the different methods of assessments of evaporation and evapotranspiration; it is felt that it takes us a little beyond the two very thorough surveys on evaporation recently published by Deacon, Priestly, Swinbank (1958) and Etienne A. Bernard (1956). A few typographical errors in numbering of the equations appear on pages 14 and 15, but fortunately, these do not interfere with the reading of the sections.

Sections have been devoted to Hydrological Balance, Streamflow, Sediment Transport and Water Quality, and Precipitation, including sub-sections on adjustment of precipitation data, estimation of precipitation in the absence of record and precipitation variation. While discussing the theoretical considerations involved in planning the hydrological network, he says "It is probable that there are few places in the world where station density now approaches a reasonable maximum". He proceeds on to give a definition of hydrological station. But the requirements of observations laid down for hydrometeorological station is perhaps a little too high for most countries.

His recommendations in section IX, Procedure for Water Resources Survey, under sub-para (*e*), are "If the available data are very limited and there is prospect of collecting information of value before the completion of the survey, recommend the immediate installation of stations. Crude raingauges can be fabricated of tin cans or oil drums etc." Admitting the utility of employing such expedients, our experience in outlying areas shows that at times it is necessary to exercise some amount of caution in using such expedients because the data so collected may be so greatly vitiated that it may be worse than no data at all.

The publication of these two notes on a subject of such vital importance to many countries is very opportune. Although one does not naturally expect the author to give any complete solution to the problems of design of hydrological networks or techniques of surveying surface-water resources, they have by their analysis succeeded in throwing clear light on many of the fundamentals involved in these branches. Workers in many countries will feel very thankful to the authors and to WMO for the publication of the two Technical Notes.

U. K. BOSE