torians of the future. Science believes either in one world or that it has a world of its own with no barriers. Biography teaches this lesson and here the message is conveyed through Haffkine's life by Waksman's efforts. Haffkine has become immortal in science and his life will continue to inspire microbiologists for a long time.

H. I. JHALA

PLAIN MAN'S GUIDE TO RADIO PROPAGATION

Ionospheric Radio Propagation

By K. Davies. (National Bureau of Standards Monograph 80.) Pp. xiv+470. (Washington: Superintendent of Documents, U.S. Government Printing Office, 1965.) 2.75 dollars.

IONOSPHERIC Radio Propagation is a successor to the National Bureau of Standards Circular 462, published in 1948 under the same title. It is interesting to compare the contents of the two. The new book has more than twice as many pages, but the difference in volume is not great because of the large page size and closely packed layout of the older book.

Not all the new book was written by Dr. Davies, and some sections have been contributed by his colleagues. However, the book is much more of an entity than Circular 462, in which each chapter has separate authorship. The main difference between the books lies in the subjects treated. Some topics such as magneto-ionic theory and an outline of ionospheric physics find an important place in both. The 1948 book fits its title very closely and could be regarded as a handbook for the communication engineer, with substantial chapters devoted to the practical aspects of radio communication. In the 1965 book these topics represent a much smaller proportion of the total. This is largely because they have since been well treated in other publications, to which Dr. Davies refers; but a contributory reason, one suspects, might be that some topics have not progressed sufficiently to warrant extensive coverage. Their place has been taken in the new book by important subjects developed since 1948. These include very high frequency scatter propagation, and low frequency and very low frequency propagation. Another new chapter deals with ionospheric disturbances and their effect on propagation predictions.

With the change of subject-matter has come a change in emphasis. The new book seems to be written not so much for the communications engineer as for a more academically minded readership, the scientific research worker and perhaps the graduate student. So, being personally unfamiliar with some of the topics included, I tried using the book as a tutorial text. In some places the book seemed to fulfil this purpose; in others the exposition did not seem too clear. The book will perhaps be criticized for being too superficial in some places and too detailed in others. In my opinion, books of this type can scarcely hope to escape such criticism, and this one does not seem especially bad in this respect.

The book is provided with 'subject', 'author' and 'place' indexes. The innocent reader might enjoy the index of places; there are naturally experimental stations and scientific institutions (Comfort Cove rubs shoulders with Central Radio Propagation Laboratory), but the entries also include radio stations (GBR, Decca, Loran C); a conference venue (Lindau); and a publishing house (London). The general and the particular are delightfully mixed, as in the consecutive entries, South America, South Ice, South Pole and, again, Scandinavia, Seattle, 75° geographic meridian.

Seriously, this is a useful book. Its clear type, stiff binding and handy page size are a great improvement on the old Circular 462, and at its very modest price it offers excellent value for money.

H. RISHBETH

THE MARINE ATMOSPHERE

Physics of the Marine Atmosphere

By H. U. Roll. (International Geophysics Series, Vol. 7.) Pp. viii+426. (New York: Academic Press, Inc.; London: Academic Press, Inc. (London), Ltd., 1965.) 107*s.* 6*d.*

PHYSICS of the Marine Atmosphere is written by Dr. H. U. Roll, the distinguished German meteorologist and oceanographer. As he claims in the preface, this book sets out to describe marine meteorology as an exact physical science, and so great emphasis is placed on the physical approach to problems of the interchange of properties between the ocean and the atmosphere. The book is probably the first to be published that deals with the subject as a pure science and not as an applied science. There are six chapters which are further sub-divided. The first chapter is an introduction while the second chapter deals with meteorological observations and measurements at sea and contains a review of instruments and methods. The third chapter deals with the composition and properties of the marine atmosphere and includes a discussion of the properties of atmospheric nuclei above the oceans, the chemistry of the marine atmosphere with a sub-section on the still rather contentious subject of carbon dioxide interchange, and also an account of atmospheric radioactivity and electricity.

The backbone of the book is, however, contained in Chapters 4 and 5. Chapter 4 deals with aerodynamic considerations of the interchange of energy between the atmosphere and the sea and contains sections on the geometry of the sea surface and also on the wind profile over the ocean. Chapter 5 gives the thermodynamic approach. Some concluding remarks are given in Chapter 6.

As an oceanographer, I was most interested in Chapter 4. This starts with an account of waves and ripples and gives a brief résumé of recent theoretical work on the subject. I found this part slightly disappointing, however, as the author confines himself almost entirely to theoretical work and to discussing wavelets and ripples, and gives very little attention to the large waves ordinarily found on the sea surface and which must affect the marine atmosphere. It is true that theory cannot as yet fully explain the formation or predict the magnitude of ordinary sea waves and recourse has had to be had to various empirical methods which have not hitherto been in agreement with each other. The problem should not be ignored, however, simply because it has not been solved, especially as recently a much greater degree of agreement has been obtained by various workers about the empirical approach. It is now generally agreed, for example, that the significant height of fully developed waves is given by:

$$H \text{ (in ft.)} = 0{\cdot}018W^2 \text{ (in knots)}$$

where W is the surface wind and full development is reached for fetches less than 400 miles for all wind speeds. This relation should be of interest to both the practical and theoretical marine meteorologist.

The section on the determination of wind profiles over the sea surface is very interesting and it leads on to the evaluation of the wind stress constant over the water surface. There are three traditional methods for determining this parameter. The first obtains it from the wind profile over the first few metres over the surface. The second uses the departure of the mean wind speed from sea-level to the level the geostrophic wind speed is reached from the geostrophic wind speed. The third method is purely oceanographic and involves the measurement of the tilt of the water surface in equilibrium with the wind force. These three methods, however, rarely agree although, to judge from the table shown, there is much better agreement with strong winds. The author criticizes the tilt method generally and in particular a determination in which I had a part, because the effect of the set-up due to wave action is ignored. He suggests that wave set-up