taining good reviews that include appropriate theory. A very brief description of aurora is given.

Part 3, entitled 'Disturbances and Waves,' comprises presentations on solar plasma, geomagnetism, aurora, the structure of the exosphere, whistlers, and motions in the ionosphere. S. Chapman presents a rather complete review of geomagnetism, which includes a summary of observational data taken at the Earth's surface, a description of the interplanetary medium and its probable effects on the outer limits of the Earth's field, and a description of the nature and effects of ring currents. There is almost no mention of aurora, except in connection with auroral magnetic variations. Considerable space is devoted to the treatment of interactions between the geomagnetic field and sheets of solar plasma, a technique that is of some historical interest but not used in modern treatments. However, a good account of the modern treatment utilizing plasma physics is also given. The velocity distribution for neutral and ionized particles in the exosphere is discussed by J. W. Dungey, along with the resonance effects of plasma waves on charged particles and the propagation of magnetic disturbances through the exosphere by hydromagnetic waves. He also presents a picture of the interaction between the geomagnetic field and the solar wind that is much at variance with the generally accepted picture presented by Chapman earlier. Some observational data on whistlers and a rather detailed discussion of propagation theory are presented by R. Gallet, and MacDonald briefly discusses the general circulation of the atmosphere below about 100-km altitude, and tidal theory in more detail.

The volume contains eleven review articles designed to describe the Earth's environment and the relevant physics. It accomplishes this in a generally commendable way, as would be expected from such a distinguished group of contributors. On the negative side, however, there is some repetition and significant omissions; there is also a lack of uniformity in style and detail of presentation. Differing conventions are used for vector operations, for units, and for references (Nicolet's presentation includes no references at all; Barbier lists four general references at the beginning, but none in the main text; Dungey has a number of unidentified references in his text). The Van Allen radiation belt and aurora are largely neglected in the book, although Chapman does show the magnetic field of a model of a radiation belt. There are no discussions of the interesting problems relating to electron temperature in the ionosphere or of the results than can be obtained by radar incoherent backscatter experiments. The book contains no index, which will be sorely missed, but there is a good and fairly detailed table of contents. There are an average number of typographical errors, but the book has a generally handsome appearance, and the publishers are to be commended for offering it at a modest price. Although most of the material can be found elsewhere, research scientists and students should find it a convenient volume to keep at hand.

Francis S. Johnson

JUNGE, C. E., *Air Chemistry and Radioactivity* (vol. 4 of International Geophysics Series), Academic Press, New York, 382 pp., 1963, $13.50.

The chemistry and physics of atmospheric gases and particulates is one of the many areas in which research has increased so rapidly in recent years that it is difficult for any but the specialist to keep track of where the field is going. Even then it is hard to keep track of more than one or two subdivisions. A compendious summary has become badly needed. Junge's book now provides just such a summary for a number of the principal subdivisions of the broadening field of atmospheric chemistry.

For the purposes of his book, Junge defines air chemistry as the "branch of atmospheric science concerned with the constituents and chemical processes of the atmosphere below the mesopeak" at 50 km, above which high-energy photochemical and corpuscular processes dominate the ordinary chemical processes so much as to require the separate approaches of aeronomy. 'Air chemistry' has come to embrace more that is physics and less that which is predominantly chemistry, but the appelative will doubtless survive for lack of a better term. In all events, the field is an active and fascinating one, and Junge's handling of it is capable and comprehensive.

It may be a helpful measure of Junge's relative emphasis to note that page counts reveal some 30 per cent of the book to be devoted to the atmospheric gases, 27 per cent to aerosols, 22 per cent to atmospheric radioactivity, 17 per cent to precipitation chemistry, and 4 per cent to topics in air pollution. The book summarizes development up to about the middle of 1961, with approximately 450 literature references, which comprise a very valuable feature. Liberally provided with figures and tables, and well indexed, it also includes a complete author index, which is so convenient in summary books of this type.

The characteristic conceptions of the field of air chemistry are those of the 'budget' and the 'cycle' of the nonpermanent atmospheric constituents. Twenty years ago meteorologists scarcely thought in such terms; today budgets, cycles, and mean atmospheric residence times are known, at least approximately, for a host of constituents whose importance is belied by their typically low absolute concentrations.

In the particular case of air chemistry, pressing questions concerning atmospheric radioactivity from weapons tests and urban air polution have forced increased attention on fundamental studies. Many branches of the atmospheric sciences are profiting from the resultant findings, and it is for this reason that Junge's book will prove useful to workers in cloud physics, atmospheric optics,

stratospheric meteorology, and other meteorological areas.

The nearly one-third of the book devoted to nonpermanent atmospheric gases is particularly slanted toward budgets and cycles, emphasizing quantitative aspects of time and space distributions and outlining what is known of the principal sources and sinks for these gases, both within the body of the atmosphere and at the Earth-air interface. Over half of the space devoted to gases deals with the three whose varying concentrations are most intimately involved in fundamental atmospheric processes, namely water vapor, carbon dioxide, and ozone. (The treatment of water vapor might be thought more suited to hydrometeorology, but the recently discovered and extremely puzzling *upward* increase of water vapor mixing ratios in the lower and middle stratosphere is the topic given leading emphasis. This problem, plus questions of deuterium, oxygen 18, and tritium content, clearly falls in this realm.) Attention is given next to the budgets of sulfur dioxide, hydrogen sulfide, hydrogen, helium, the nitrogen compounds, the halogens, methane, carbon monoxide, and formaldehyde. Difficulties of compartmentation were settled by approaching these materials from the viewpoint of the gaseous and solid phases.

The chapter on aerosols summarizes information on particle-size distributions, sedimentation and coagulation, condensation nuclei, optical and electrical properties, and chemical composition. The principal components of the tropospheric aerosols, Aitken nuclei, sea-salt particles, and the still vaguely identified continental aerosols, are treated. Problems of vertical distribution receive more attention than those of horizontal distribution, but growing concern with large-scale dispersion of megalopolitan air pollution may soon stay that tendency in air chemistry. The 'worldwide stratospheric aerosol,' recently identified and probed by Junge and his collaborators, was summarized as far as was possible in mid-1961.

Atmospheric radioactivity is treated in three main subdivisions: first, the classical area of the 'emanations,' radon and thoron; second, the recently opened area of the cosmic-ray-induced, high-altitude activities; and third, the equally recent area of weapons test debris activities. The half-lives of the natural crustal emanations (radon, 3.8 days; thoron, 55 seconds) relegate them to tracer roles on a scale less grandiose than the global scale on which circulations may be traced with cosmic-ray and bomb activities. The status of bomb debris meteorology is well summarized, but this is an area where we still have much to learn. Large areas of meteorological ignorance suddenly assumed critical importance less than a decade ago when fallout hazards became appreciated. Moratoria are as useful as new rounds of bomb tests, so perhaps the new moratorium under discussion will, if effected, usher in important new findings.

Precipitation chemistry, a field where Junge has done much original work, is particularly well reviewed. 'Rainout,' comprising removal processes within clouds, and 'washout,' removal by raindrops falling through the subcloud air, are treated in considerable detail for both particulates and gases. Chemical composition of precipitation and its aerological implications are discussed in terms of a number of the ions of principal importance.

This reviewer could not name any material included in the book that might better have been omitted. Although sheer availability of material would have permitted more exhaustive handling of the topics, he also feels that the depth of treatment actually used was quite well balanced. A single suggestion is this: a theoretical discussion of the quantitative aspects of the kinetic processes by which atmospheric *gas* reactions among trace constituents (in the parts per million concentration range) lead to the production of *particulates* would have been desirable. This reviewer knows of no other reference to which an interested reader might turn to gain insights into this crucial process. The brief discussion of this general question (pp. 154–155) leaves the point almost entirely open; for example, can particle formation occur as a result of solely homogeneous nucleation processes, or are heterogeneous nucleants essential in some or all cases? If the latter, will not budgets and rates be imperfectly understood until the relevant theory is developed?

In Junge's handling of cloud physics, some important omissions or underemphases were noted. One is the unjustifiably slight attention given to the extended series of observational, experimental, and theoretical studies on the make-up of the continental and maritime condensation nuclei populations carried out by Squires and Twomey in Australia.

Finally, a single flaw of more mechanical nature obtrudes. The publisher has permitted too many typographical errors. There do not seem to be so many errors in the mathematical symbolism or quantitative tabulations.

Junge has rendered a distinct service to the atmospheric sciences in preparing this review volume. It is the first such book in its field, and should serve as a catalyst to promote still more rapid growth of knowledge in coming years.

James E. McDonald

Ross, Herbert H., *A Synthesis of Evolutionary Theory*, Prentice-Hall, Englewood Cliffs, N. J., 387 pp., 1962, $10.00.

Herbert H. Ross, an entomologist who divides his time between the Illinois Natural History Survey and the University of Illinois, has attempted to survey the whole evolution of life upon the Earth, emphasizing the evolution and development of ecological units, or landscape areas dominated by a few distinctive types of growth, called biomes. It is not surprising that the book should