C. N. Hewitt, A. V. Jackson, *Atmospheric science for environmental scientists*

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This new publication is an introductory to medium level text designed to cover both the physics and the chemistry of the atmosphere in an integrated fashion. According to the Preface, the aims of the book are to educate and train scientists on the workings of the atmosphere and the changes that are predicted to occur in the future, and to provide easily accessible information to policy makers and the general public. In pursuing their aims the editors have enlisted a group of well-known experts and educators to prepare 11 chapters dealing with the individual subject areas.

Four chapters are devoted to topics of meteorology. *The Climate of the Earth* reviews atmospheric circulation systems, glacial and interglacial periods during the last 700 thousand years, regional and continental climates, tropical storms, the southern oscillation and El Niño, the monsoon circulation. *Atmospheric Energy and the Structure of the Atmosphere* begins with the vertical distribution of temperature and pressure. There follows an in-depth discussion of solar and terrestrial radiation, individual absorption processes, the origin of the ozone layer, a simple treatment of radiative transfer, and various types of scattering processes. Convection, the stability of air, global heat budgets, and climate feedbacks are discussed as well. *Global Warming and Climate Change* adds further material on the effects of infrared-active trace gases. Models integrating atmospheric composition, human activities, ecosystems management and climate complete the picture. *Boundary Layer Meteorology* treats concepts of momentum flux, friction velocity, stability parameters, etc., as well as the dispersion of pollutants from isolated sources. These four chapters provide a well-rounded overview on standard knowledge generally found in textbooks of meteorology.

Tropospheric Chemistry and Air Pollution initially considers natural and anthropogenic sources of several trace gases before entering into a discussion of oxidation reactions involving OH radicals, methane, nitric oxides, ozone, and hydrocarbons in general. Two sections describe the chemistry of halogens, their potential effect on ozone, and the oxidation of SO₂. Here, some aqueous chemistry, acidification of rain, and a brief survey of particulate matter is included. A companion chapter *Biogeochemical Cycles* treats sources

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and sinks of trace gases in more detail including some budgets. Unfortunately, an annoying error occurs in the presentation of reservoir theory. While the text and a figure refer to concentrations (units kg m^{-3}), the unit used is that of mass (kg). Tropospheric mass content would be the preferred quantity in this context because the volume of the troposphere is not well defined. On the other hand, concentration is the quantity that is measured. The equations are applicable to both quantities. The treatment of carbon dioxide also is inadequate because the geochemical cycle is not considered at all, and the biological cycle is mentioned only to indicate a mechanism for the uptake of excess CO_2 from the anthropogenic perturbation. A chapter on *Urban Air Pollution* is added to familiarize the reader with specific problems of pollution arising in the cities and the legislation required to mitigate them.

The chapter *Stratospheric Chemistry and Ozone Depletion* describes the behaviour of total ozone, the role of the tropopause, the circulation of air in the stratosphere and the polar vortex. Then, the formation of ozone and its depletion by radical cycles are considered in detail. Additional topics are polar stratospheric clouds, volcanic aerosols and heterogeneous reactions. It is a pity that concentrations and distributions of trace gases are not discussed. A better understanding of stratospheric chemistry definitely requires a treatment of source gases and their chemical conversion to end products, which ultimately serve as reservoirs for the production of radicals involved in the chain reactions.

Two chapters are devoted to aerosols and clouds. *Particulate Matter in the Atmosphere* describes the physical characteristics of the tropospheric aerosol (size distributions, optical properties, hygroscopicity, etc.), aerosol sources, the role of aerosol particles in the radiation balance, and some measurement techniques. The chemical composition of urban, continental, and marine aerosols is summarized in a table without much indication of how the data were derived. Heterogeneous reactions on aqueous particles are discussed, although those of marine halogens are largely speculative. *Cloud Formation and Chemistry* provides an excellent presentation of how clouds develop, how solids and trace gases get dissolved in the aqueous phase, and what the chemical consequences are. A balanced account is given of chemical reactions in both gas and aqueous phases including the oxidation of sulphur dioxide, the behaviour of nitrogen and halogen compounds, photochemical processes and some organic compounds.

Finally, *The Chemical Evolution of the Atmosphere* presents an excellent review of our knowledge—as speculative as it may be—regarding the origin of Earth's atmosphere and the changes in composition brought about by the advent of life and the accumulation of oxygen. Earth is the only planet in the solar system endowed with an ocean, a prerequisite for the dissolution and eventual burial of carbon dioxide in the form of lime stone deposits. The time table for the changes and the individual processes involved remain largely uncertain.

A very welcome feature of the book is the inclusion in many chapters of worked examples to acquaint the reader with how to make use of equations for calculations. Each chapter is backed up with citations from the current literature, where the reader will find supplementary material. This book is therefore a very useful educational guide for atmospheric and environmental scientists alike.

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