Book reviews

Encyclopedia of the Solar System edited by Paul R. Weissman, Lucy-Ann McFadden and Torrence V. Johnson (Academic Press, 1998). ISBN 0-122-26805-9. US$99.95.

During the past five decades, our knowledge about our solar system has increased dramatically as a consequence of increasingly sophisticated Earth-based and Earth-orbital observations, robotic space probes, and the Apollo missions to the Moon. A large literature ranging across diverse scientific disciplines including astronomy, chemistry, geology, meteorology, and physics describes the results of mankind's recent exploration of the solar system. This book is one of two recently published specialised encyclopedias summarising this vast body of knowledge.

The *Encyclopedia of the Solar System* is organised into 40 chapters, each averaging 24 pages in length, that cover the following topics: an overview of the solar system, the origin of the solar system, the Sun, the solar wind, Mercury, Venus (atmosphere, surface and interior), Earth (atmosphere and oceans, surface and interior), the Moon, Mars (atmosphere and volatile history, surface and interior), the Martian satellites Phobos and Deimos, the gas giant planets (atmospheres, interiors), outer planet satellites (Io, Titan, Triton, icy satellites), planetary rings, planetary magnetospheres, Pluto and its satellite Charon, comets (physics and chemistry, dynamics), the Kuiper belt, asteroids and near-Earth asteroids, meteorites, interplanetary dust and the Zodiacal cloud; observational results and methods (ultraviolet, infrared, radio, radar), solar system dynamics and chaotic motion, planetary impacts, planetary volcanism, planets and the origin of life, planetary exploration missions, and extra-solar planets and brown dwarfs. Each chapter is written by one or more experts. A short glossary is given at the start of each article. Most chapters have a brief bibliography with references to books in the University of Arizona Press space science series, textbooks, monographs, and to the refereed literature. The web site for this encyclopedia has links to other web sites containing more information about the topics covered in each chapter.

The chapters should be intelligible to interested laymen and provide useful reviews for non-specialists. Not surprisingly, the chapters about topics such as solar system dynamics, radio observations, and planetary magnetospheres contain more mathematics and quantitative detail than the chapters dealing with planetary geology. Atmospheric scientists should find the sections on Venus' atmosphere, the atmospheres of the giant planets, and on Titan particularly interesting. Less attention is given to the atmospheres (and oceans) of Earth and atmospheres of several other planets and satellites (e.g., Mercury, Mars, Pluto, Io, the Moon, Triton). Curiously, basic data (e.g., atmospheric thermal structure and composition, geochemical analyses of other planets, composition of sea water) is absent from several chapters and the interested reader must consult other sources. Comparative discussions of the atmospheres and interiors of the giant planets and of planetary magnetospheres are given and are quite useful. Analogous descriptions of the chemistry, structure, and meteorology of terrestrial planetary atmospheres and of the geology and geophysics of terrestrial planets are missing but would also have been desirable.

Most chapters are illustrated with photographs as well as figures. Although the photographs and figures are generally of high quality, not all illustrations were reproduced with the same quality throughout the book. Several sections of colour photographs are interspersed throughout the book. Unfortunately, the colour plates often interrupt the text in a chapter instead of being gathered together at one (or more locations) between chapters. It is also difficult to locate a specific photograph because they are not listed in the table of contents.

Readers of this journal are probably most interested in the coverage of planetary atmospheres. This is less comprehensive than that in other recently published encyclopedias, textbooks, and handbooks. To some extent the limited coverage of atmospheric science is unavoidable given space limitations; however, another one or two chapters on planetary atmospheres (e.g., of Venus, Earth, Mars, and Titan; and the tenuous atmospheres of Mercury, the Moon, Io, and Triton) would not increase prohibitively the size of this volume. With the exception of the gas giant planets, where the two comparative chapters are well written, very limited information is given on comparative planetology. But, overall, this volume gives a good introduction to and a broad discussion of many important results from exploration of the solar system, and provides references to more specialised literature. This encyclopedia is a useful, though not essential, addition to personal libraries and a good addition to institutional libraries.

Bruce Fegley

Bruce Fegley is Professor of Planetary Sciences at Washington University in St. Louis. His research group studies a wide range of topics involving applications of chemistry to planetary science and astronomy.

Winds of Change: Fifty years of achievement in the CSIRO Division of Atmospheric Research 1946-96 by John Garratt, David Angus and Paul Holper (CSIRO Publishing, 1998). ISBN 0-643-063633. $39.95.

This well-written, copiously illustrated and immaculately printed hardback volume has been produced to commemorate the 50th anniversary of the appointment in 1946 of C.H.B. (Bill) Priestley by the Council of Scientific and Industrial Research (CSIR) and the achievements of his Section/Division in the fifty years which followed. Bill's initial task was to establish and develop a Section of Meteorological Physics within CSIR. Bill was recruited by the CSIR executive following distinguished service in the British Meteorological Office involving research in U.K. and Canada on turbulent diffusion, and forecasting in the upper air unit of the Office in Dunstable which provided meteorological advice to the RAF for bombing missions over Europe.

Winds of Change tells the fascinating story of the development of the Section (later Division) of Meteorological Physics following Bill's arrival in Australia just before Christmas 1946. It covers the wide-ranging research programs during the following 50 years, the personalities and activities of the staff of the Section/Division, the experimental work at various field sites and the development of special instruments and equipment to support research in the field and in its laboratories. Description also includes office accommodation, social activities and many other subjects.

Particularly intriguing is the story of the early years of the Section when the CSIR executive gave Bill Priestley ample time and considerable freedom to prepare plans for a research program, to recruit staff, and to arrange office accommodation. His original office was a small room in an old building in Flinders Lane, Melbourne. By 1949 he had recruited nine staff, acquired a few small and somewhat dilapidated buildings in suburban Highett to serve as office accommodation, and had chosen some vacant farmland at Edithvale for field experiments. That year also saw the creation of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to replace CSIR.

Staff numbers had increased to about 30 late in 1953 when more suitable office accommodation was obtained in Aspendale. By this stage the Section was becoming recognised as a focus of an increasing range of valuable meteorological research. In 1955 the Section became a Division of CSIRO. Bill Priestley became a Fellow of the Australian Academy of Science and his academic achievements and qualities of leadership were becoming increasingly recognised both in Australia and overseas.

When Bill retired as Chief of the Division in 1973 the staff numbers had increased to about 100 and the quality and scope of their research was outstanding. Bill had become increasingly involved in activities of the World Meteorological Organisation and the International Association of Meteorology and Atmospheric Physics. One of the most distinguished awards he received in recognition of his achievements was his Fellowship of the Royal Society. For some time after his retirement as Chief of the Division, Bill continued with CSIRO in an advisory capacity.

Brian Tucker took over as Chief in 1973 and on his retirement in 1992 Graeme Pearman became Chief. Winds of Change pays tribute to their initiative and guidance in maintaining the high reputation of the Division, which acquired the new title of Atmospheric Research.

The authors of *Winds of Change* were assisted by a number of contributors whose work included preparation of additional text, which appears in the volume in grey-shaded panels. Some of the authors of the panels are identified, others not. Approximately 35 panels contain life histories of some staff members, descriptions of field experiments, instrumentation, workshops, computers, studies of climate change, cloud seeding, staff social club, public relations, administration and various other activities. Some peripheral activities also featured in the panels include CSIRO participation with the Bureau of Meteorology in the initiation and operation of the Commonwealth Meteorology Research Centre, the creation of the Cape Grim baseline air pollution station and the formation of the Australian Branch of the Royal Meteorological Society. Two delightful panels are those containing poems by David Beardsmore.

At first reading I found the panels somewhat distracting but I soon became accustomed to them and later found them interesting for browsing and useful for reference.

The scope of the text is diverse – micrometeorology, the atmospheric boundary layer, the dynamics of the general circulation, evaporation, frost, solar and longer-wave radiation, cold fronts, fire weather, atmospheric chemistry, air pollution, computers, computer modelling, remote sensing, field experiments, climate change, radioactive fallout, ozone, radars and instrumentation. The authors have skillfully avoided detailed discussion of scientific and technical details. Such would have required a much larger compendium; and this information is mostly available in the published scientific literature.

If the demand for *Winds of Change* merits publication of further editions, consideration might be given to including a list of illustrations, references and an index.

Winds of Change provides a useful addition to a number of existing publications on the history of meteorology in Australia, including those of the Bureau of Meteorology, various universities, ANZAAS, Academy of Science and AMOS, in which there are numerous references to meteorological research in colonial days and in the present century.

This publication commemorating CSIRO's 50 years of involvement in meteorological research will be of interest to a wide range of meteorologists, to other scientists and to historians, both in Australia and overseas. Its significant contribution to the history of meteorology in Australia will also deserve a place on the shelves of many Australian and overseas libraries.

Bill Gibbs

W.J. (Bill) Gibbs was a member of the Bureau of Meteorology from 1939-1978, Director of Meteorology 1962-1978, was directly involved in the international work of IMO, WMO and ICSU from 1946 to 1978, had a wide range of interests as a meteorological practitioner and researcher and had close and frequent contact with CSIR/CSIRO during his career. Since his retirement in 1978 he has maintained a keen interest in the history of meteorology in Australia and has been executive editor of the Bureau's Metarch Papers, an important series of historical notes.

From Turbulence to Climate: Numerical Investigations of the Atmosphere with a Hierarchy of Models by Martin Beniston (Springer-Verlag, 1998). ISBN 3-540-63495-9. DM128.00.

Numerical models are currently used widely to help understand a number of atmospheric phenomena ranging from local pollution dispersion to global climate change. This book is about numerical modelling in the atmospheric sciences, but its content cuts across a range of scales, from the atmospheric boundary layer to global coupled GCM (Global Climate Model) simulations of climate. The author emphasises the fact that numerical models are used to help understand the interactions taking place in the real climate system at various temporal and spatial scales. He rightly points out that a model is a tool which allows one to test understanding of a particular system using a physical representation of the real system in the form of numerical equations, and that the processes simulated by the model need to be confirmed by observational evidence.

The book is a summary of the work that the author has been involved with since 1978, at a number of European research centres. Throughout the book there is an interesting thread relating his research work to societal relevance. In particular, the author lives in Switzerland, which is a small and mountainous country. Most of the global coarse resolution climate models represent Switzerland at best as a single grid-cell. The author describes his efforts to make climate information more relevant at the local level by applying high-resolution GCM simulations as well as using limited area models. This illustrates well the current difficulty facing climate modellers where the need exists for information at higher spatial resolution than most global climate models can deliver in order to be useful for a range of regional applications in both climate change impact assessment and seasonal climate forecasting. A number of research groups are attempting to bridge this gap by applying downscaling techniques consisting of both statistical methods and high-resolution limited area models, as well as developing new variable-resolution global GCMs.

The brief introduction gives an overview of issues related to numerical modelling such as the issue of various scales of atmospheric motion and the chaotic nature of the system. Chapter 2 summarises the fundamental concepts related to numerical modelling of the atmosphere, explaining the governing equations and numerical schemes used in atmospheric modelling. The author lists and briefly describes the key processes which need to be incorporated in an atmospheric model, such as the Earth's surface, boundary layer turbulence, radiation, clouds and precipitation.

Chapter 3 describes the Deardorff-Sommeria ABL model and the governing equations. The chapter illustrates in some detail how the ABL model is used to verify the assumptions of parametrisations for cumulus clouds. Chapter 4 deals with investigations using the DREAMS Mesoscale Meteorological Model as applied to simulations of cellular cloud convection over domains on the order of hundreds of kilometres in size. The chapter contains detailed descriptions of both the mesoscale model formulation and numerous experiments conducted with it. The author states that the purpose of this lengthy chapter is to illustrate the manner in which subgrid-scale parametrised processes play a key role in the temporal and spatial evolution of the mesoscale atmospheric thermodynamic and kinetic fields.

Chapter 5 describes simulations of climate and climate change, starting with an overview of the global climate system and the greenhouse effect. The discussion of the impact of climate change follows, including brief descriptions of the impacts in several key areas such as water resources and agriculture. The chapter presents an overview of general circulation models and in particular the ECHAM GCM and its parametrisation. A brief review is given of the performance and validation of several GCMs based on the Atmospheric Model Intercomparison Project (AMIP), with an emphasis on the performance of the models over Europe. More detailed analysis of ECHAM model results, both for present-day and enhanced greenhouse climates, is also presented. Near the end of the chapter a description of high-resolution ECHAM experiments is given, as well as the rationale behind this work. The principal objective of the high-resolution modelling work in Switzerland has been to develop a methodology to deal with spatial resolution limitations. This sets the scene for Chapters 7 and 8, which discuss regional aspects of climate change.

Chapter 6 deals with mesoscale air pollution transport simulations conducted with DREAMS-2. A number of case studies in various parts of Switzerland are described and the impact of various physical properties such as clouds and orography were tested.

Chapter 7 presents the observational evidence for regional climate changes in Switzerland. The author lists the principal factors influencing mountain climates, such as altitude, continentality, latitude and topography. Secular trends in a number of climatic elements are discussed from the long-term records and the links between regional climate change and global climate change outlined. The possible causal mechanisms of observed climate change in Switzerland are reviewed, including links to the North Atlantic Oscillation phenomenon. The chapter is quite an exhaustive review of observed regional climate change over Switzerland. These observations are used in the next chapter where the regional climate model results are presented.

Chapter 8 describes the use of the regional climate model RegCM2 to simulate the regional climate over the European Alps. The model was nested within the ECHAM T106 GCM and results from several experiments with this model are presented. The sensitivity of the model to convective parametrisation, initial soil moisture and the representation of orography is evaluated in this chapter. These results are compared with observations and GCM statistics. In addition, the results from simulations of present and future climate are presented; only five perpetual January and July simulations are used to derive an average climate, however.

A brief summary is presented in Chapter 9, where a need for a more interdisciplinary approach to regional climate change is emphasised. The author postulates that the future progress in regional climate predictions cannot be achieved solely by increased computer power and higher resolution models. Progress will have to be made in the interdisciplinary integration of various elements and processes of the climate system.

Some minor complaints are as follows: the number of typos, the size of the equations, and the misplacement of Chapter 6, since Chapter 7 follows most logically from Chapter 5. The cover is a nicely designed colour hardback and most graphics in the work are informative.

This volume combines personal experience with an overview of the field of numerical modelling in atmospheric sciences and as such is interesting reading. The shortcoming of this approach perhaps is the fact that some of the material dates back to the eighties and therefore is not very relevant today because of rapid progress in the field. I see this text likely to be partly useful to both students and researchers; however, the historical and personal perspective makes this text not detailed enough to be used as a textbook for students. Also, for the text to be useful to researchers more references to recent related research by others in the field would be required. However, I found the book to be interesting reading and I like the effort put towards the linking of the spatio-temporal scales of the atmosphere and the emphasis on the interdisciplinary nature of climate change issues.

Jozef Syktus

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ERRATUM

The paper 'Physics, mathematics and the environment: the 1997 Priestley lecture' by J. R. Philip, which appeared in *Australian Meteorological Magazine 47 No. 4* of December 1998 requires the following corrections:

1. The values on the vertical axis of Fig. 1 (p. 274) should be reduced by a factor of 100.
2. Figure 9 (p. 281) should be viewed rotated 90 degrees in a clockwise direction to be consistent with the caption.