tions. It is indeed a pleasure to read Van Mieghem's *Atmospheric Energetics*, which explicitly presents the time-averaged governing equations and analyzes the effect of Reynolds stresses on the energy of the mean and turbulent motions, exactly the things that should be emphasized.

The monograph consists of two parts. The first, which provides the theoretical background for a general understanding of the atmospheric energetics processes, presents essentially the basic equations for the energy of the mean and turbulent motion and for the eddy flux of sensible and latent heat. The second, which presents the atmospheric energy processes in various space and time scales, deals with the Boussinesq approximation, the energetics of forced and free convections and of small- and large-scale motions, Lorenz's cycle of energy conversion and transfer, and quasistatic and ageostrophic motions in the atmosphere. The space and time averages are precisely defined and applied to atmospheric motion of various scales. Energy balance in both the boundary layer and free atmosphere is analyzed carefully and in detail.

Although the book is handsomely produced, a number of misprints appear. For example, the term on the left-hand side of eq. 11.2 (p. 115) should be time-averaged and in the first term on the right-hand side a divide sign is missing.

In spite of the misprints, the material of the monograph is well organized and presented, and the book is both detailed and comprehensive. It is suitable for students at the graduate level and for researchers in atmospheric dynamics.

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The Sun

Solar Activity Observations and Predictions. PATRICK S. MCINTOSH and MURRAY DRYER, Eds. M.I.T. Press, Cambridge, Mass., 1972. xvi, 444 pp., illus. $17.50. Progress in Astronautics and Aeronautics, vol. 30.

The extensive solar observations now being conducted by the astronauts on Skylab are giving beautiful new results and insights into the nature of the sun. Each day's observing schedule is prepared on the previous day at Houston by the group of experimenters who have supplied the instruments for Skylab. To prepare the most efficient observing schedule it is necessary to have a good anticipation of the location and extent of solar activity on the following day. The supplying of the solar forecasts to the Skylab experimenters is probably the most intensive use of the solar physics and techniques that are described in this book. The terrestrial results of solar activity and the associated need for forecasting this activity become increasingly significant as our globe shrinks and we become increasingly dependent on long-range communications, power networks covering an appreciable portion of a continent, and travel in high-altitude jet aircraft. All of these may be seriously disturbed by solar activity, and there is also increasing evidence that our weather and climate may be significantly influenced by solar activity.

The attempts to forecast solar activity provide a meeting place for solar physics research and the operational forecasting techniques. Forecasting looks to solar physics for the fundamental knowledge on which the daily specific techniques will be based, and the resulting degree of success provides an evaluation of the solar physics involved. Both the solar physics and the forecasting techniques are far from perfected, but the past few years have seen significant improvements as a result of spacecraft observations, improved ground-based observations, and the use of modern digital computers.

A basic dichotomy in solar physics is discussed in the present volume. In the classical picture, sunspots and flares are comparatively localized and short-lived features deriving their energy from magnetic fields that have been amplified by differential rotation. The newer half of the dichotomy, discussed by Schatten, involves large-scale and long-lived sectors within each of which the solar magnetic field is predominantly directed either inward or outward. This sector structure is carried outward by the solar wind and flows past the earth, causing an appreciable portion of the total terrestrial response to solar activity. The sector structure tends to recur from one solar rotation to the next, enhancing the forecasting possibilities.

This book is an excellent encyclopedia of the basic solar physics and of the resulting forecasting techniques. I would recommend it to a new student of solar physics, and it would be obligatory for a practitioner of forecasting. Each of the chapters is concise yet complete, with a rather uniform technical level, showing evidence of a firm editorial hand.

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Metal Chemistry

The Chemistry of Platinum and Palladium. With Particular Reference to Complexes of the Elements. F. R. HARTLEY. Halsted (Wiley), New York, 1973. xiv, 544 pp., illus. $45.

Now for the first time a book has been written assembling practically all of the available information about the chemistry and structures of platinum and palladium compounds in one place. The subjects covered range from the isolation of these elements from ores to inorganic complexes, to substitution mechanisms, to organometallic complexes and their reactions.

Particular emphasis is placed upon spectral and structural information. Not only the usual infrared and nuclear magnetic resonance data but, where available, electronic, vibrational, and photoelectron spectra and nuclear quadrupole absorptions are given. An appendix gives the bond lengths and angles for essentially all of the platinum and palladium complexes that have been investigated.

The book is more than just a compilation of data, however. The author discusses many relevant subjects in detail while presenting the data. For example, the concept of hard and soft acids and bases is used to predict the formation and relative stabilities of complexes. The bonding involved in the various complexes is considered in detail in an attempt to explain the observed bond lengths and spectral data. Reaction mechanisms are discussed where information is available to explain the many new and unusual reactions these complexes undergo.

The formation and chemistry of the inorganic complexes are the concern of the major part of the book. An entire chapter is devoted to hydrides, since these complexes are involved in many commercially important catalytic reactions of platinum and palladium. Other topics include complexes with boranes and group IV B, V B, and

VI B compounds. There are large sections dealing with complexes containing chelating ligands with oxygen, nitrogen, and sulfur bonds. While most of these subjects are not of particular importance by themselves, they do form a coherent picture of the chemistry of these elements when viewed together. A very useful appendix gives in detail methods of preparation for many of the most useful complexes.

The organometallic complexes of platinum and palladium are the subjects of another significant section. Molecular structure of these complexes is the major concern of the chapter, although reactions and reaction mechanisms are adequately covered as well. Mechanisms of the commercially important catalytic reactions such as the Wacker acetaldehyde process are also discussed.

This volume will be of the most value to the research worker in this field of chemistry. Students and teachers will also find much of value, especially in the sections illustrating how minor changes in structure affect bond lengths, angles, and spectra.

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Materials and Applications

The Science and Technology of Superconductivity. Proceedings of a course, Washington, D.C., Aug. 1971. W. D. GREGORY, W. N. MATHEWS, JR., and E. A. EDELSACK, Eds. Plenum, New York, 1973. Two volumes. Vol. 1, x pp. + pp. 1–432, illus. Vol. 2, xii pp. + pp. 433–816, illus. Each volume, $22.50.

In 1971, a summer course on superconductivity was given at Georgetown University by 25 invited speakers. They have set forth the course material in this book. Volume 1 consists of two parts with approximately equal length. The first part is an introduction to the basic thermodynamic and electromagnetic properties of superconductors, the theoretical background, and refrigeration. The second part is a description of superconducting materials. Volume 2 is devoted to technological applications and a summary of the course. The book as a whole provides a comprehensive and authoritative view of the subject. The main emphasis is on materials and applications; for the most part, the fundamental scientific aspects are presented by the various authors only to the extent necessary to explain the technology, to which most of the present research work on superconductivity is now being devoted.

The general reader will be interested in the wide range of applications which are described in detail. These include the measurement of voltages as small as 10^{-16} volt or magnetic fields as small as 10^{-11} gauss by tiny devices. The detection of very small magnetic fields enables one to observe electrical currents in the human heart or brain or to search for weakly magnetic materials in the ground. Large-scale applications of superconductivity include the construction of giant superconducting coils to create magnetic fields in excess of 5×10^4 gauss in large regions of space for generating power by nuclear fusion or for magnetically supporting high-velocity intercity trains. It is expected that superconducting transmission lines will be built in the 1980's for handling very large power loads, in excess of 10^9 watts. Many of the most fascinating applications are based on the Josephson effect, which accompanies the passage of electrons from one superconductor to a nearby one through a thin barrier or weak link. This effect is being used to develop revolutionary ways of storing information in computers and of gathering, modulating, and detecting electromagnetic signals.

The first five chapters of the book present the three types of superconductivity theories. These types are phenomenological, quantum mechanical, and advanced quantum statistical. All of them have played a vital role in the history of the subject, and they are all still useful in thinking about superconducting phenomena and in doing calculations. Among the phenomenological theories discussed is that of Ginzburg and Landau (1950). Its general methods were used and extended by Josephson (1962) to predict the effect which now bears his name. The theory of Bardeen, Cooper, and Schrieffer (1957), for which the Nobel Prize was awarded last year, is of the second type, quantum mechanical. The theory provided a foundation for the phenomenological theories and enabled their limitations to be explored. It also made possible the development of theories of the third type, advanced quantum statistical. These employ so-called thermodynamic Green's functions. A detailed account of them takes up almost 50 pages of chapter 3 in the book, but the average reader will find this material far too subtle and abstract to comprehend. He may if he wishes skip over it; although theories of the third type have been of vital interest to researchers in the field of superconductivity, they are not at all necessary for understanding the book's other chapters.

Of particular interest to this reviewer is an unusual chapter by R. A. Hein. It describes in a balanced and thorough way the history of empirical rules which have led to the gradual development of materials which are superconducting at ever higher temperatures and in ever larger magnetic fields. This technologically crucial process was carried out by many people, in particular by B. T. Matthias and his co-workers. The empirical rules involve the average number of conduction electrons per atom, crystal structure, atomic volume, lattice parameter, melting point, electropositivity, electronic density of states, Hall coefficient, and stoichiometric and crystallographic perfection. Hein describes how the rules were discovered and how some of them had to be altered or discarded as more materials were investigated.

Among the many other chapters which should be of wide interest is one by T. F. Finnegan, in which he describes in detail the development and operation of a new voltage standard, based on the Josephson effect, which now has replaced the standard cell as the nation's standard of the volt. The technological implications of superconductivity in the next decade are summed up in a chapter by D. N. Langenberg.

The book contains a transcription of a panel discussion among the authors. The main topic considered is the role of theory, new materials, and inspired guesswork in making technological advances. The panel members also talked about the large effort which is required to develop a practical device from a technologically sound idea. Some of the panel members felt that applied superconductivity is being pursued more vigorously in Europe than in the United States.

The book is very legible. It contains approximately 280 figures and 625 references, an author index, and a good subject index. It should be of interest to any reader who wants a glimpse of some of the technology of tomorrow.

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