story of Western science in the Pacific should be melded with that of Western science in Asia. The Pacific is a meeting ground for East and West in a larger sense, as the editors acknowledge. The scientific history of the Pacific now opens onto an even wider stage with an enlarged cast of players.

DAVID PHILIP MILLER
School of Science and Technology Studies, University of New South Wales, Kensington NSW 2033, Australia

Social Insects

Interindividual Behavioral Variability in Social Insects. ROBERT L. JEANNE, Ed. Westview, Boulder, CO, 1988. x, 456 pp., illus. Paper, $39.85. Westview Studies in Insect Biology. Based on a symposium, Hollywood, FL, 1985.

There has been a quiet but significant renaissance occurring in studies of social insects, in which the role of individuals in the structure and function of insect societies has been receiving increasing attention. It has long been apparent that colonies function as highly coordinated units to perform a wide variety of tasks, but the extreme variability characteristic of individual worker behaviors at any given time has been a significant barrier to the development of a comprehensive theory concerning the control of colony-level activities. The concept that colonies operate as "superorganisms" that are more than the sum of their individual workers was articulated by Wheeler and others during the first half of this century, but has languished in recent years owing to the lack of mechanistic explanations of how colonies could control individual worker activities. The empirical studies collected in this volume represent significant progress in understanding this question.

Almost all of the 14 papers were initially presented at a joint symposium of the Entomological Society of America and the North American Section of the International Union for the Study of Social Insects. The contributions are remarkable in their consistently high quality as well as in their uniformity of approach. The latter reflects not only an exceptionally good editorial job by Jeanne but also the sophisticated level of analysis that is being applied to social insect colonies.

Recent studies of social organization have benefited greatly from the techniques and concepts provided by the developing field of behavioral ecology. In this work, the tools of the trade include detailed recording of ethograms, measurement of colony growth and development, analysis of between-task transitions, and some "old-fashioned" natural history. These techniques, when applied in the theoretical contexts of caste polyethism and kin selection theory, have provided some major advances in understanding how social insect colonies function. For example, it is now clear that the extensive variation in what workers do at any age or time has real importance for colony survival, by providing the flexibility to respond to rapidly changing environmental conditions as well as foraging opportunities. Also, there appears to be genetic structure to this variation, so that individuals within the nest have different capacities to perform functions and to develop into reproductives. Finally, specialization by workers to perform particular tasks may be more significant than previously thought. Though few workers are lifetime specialists, those that do specialize for extended periods may provide unique contributions to colony economy, such as the undertaker honey bees, which remove corpses from colonies.

The major criticism I have of this collection has to do with the quality of the book's production. Westview Press has filled an important niche in academic publishing through their series Studies in Insect Biology. Unfortunately, the quality of the content of the books has not been matched in the production; the typeface, paper quality, and printing of this one are so poor as to make reading it a real chore. Also, more rapid publication would have been desirable, as this field is moving so rapidly that some of the contributions in this volume have already been eclipsed by more recent work.

MARK L. WINSTON
Department of Biological Sciences, Simon Fraser University, Burnaby, B.C. V5A 1S6, Canada

Atmospheric Chemistry

Chemistry of the Natural Atmosphere. PETER WARNECK. Academic Press, San Diego, CA, 1988. xiv, 757 pp., illus. $85. International Geophysics Series, vol. 41.

In 1963, Christian Junge's classic textbook *Air Chemistry and Radioactivity* defined the emerging field of atmospheric chemistry. For years there has been a need for a revised version. Other fine books have been published in recent years, especially those by Seinfeld and by Finlayson-Pitts and Pitts, but none has replaced Junge's text. Warneck set out to produce such an update and has succeeded admirably. Reflecting the enormous growth of the field since 1963, Warneck's book is twice the length of Junge's, but Warneck maintains Junge's devotion to general principles that are applicable both to natural and anthropogenic phenomena and to local and global problems. In contrast, the other texts noted above have greater focus on local air pollution problems.

The "radioactivity" in Junge's title refers to his inclusion of information about transport and deposition that was gained from the huge "tracer experiments" provided by atmospheric testing of nuclear weapons in the 1950s and early '60s. Warneck covers the use of radium daughters to determine aerosol residence times and occasionally includes results from fallout of fission products or ratios of carbon-14 to total carbon, but radioactivity is a minor feature of his book. The major addition since 1963 is the explosive growth of knowledge of rates of gas-phase reactions resulting from extensive studies of photochemical smog and of the formation and destruction of stratospheric ozone. Although Warneck's coverage of gas-phase reactions is not as detailed as those of the air pollution books, it is quite good, especially as applied to the natural atmosphere. Not only does he treat kinetics in a conventional way, but he demonstrates the use of tropospheric and hemispheric box models to estimate concentrations of radicals that have so far defied direct measurement. Warneck discusses important reaction pathways in groups of about five elementary reactions, frequently bringing these groups together in diagrams that summarize the big picture. Unfortunately for students, he does not do this in all cases. It would have been helpful if he had assigned a number to each elementary reaction and used it throughout. Also, he could have explained more of the tricks, many involving the steady-state approximation, that kineticists and modelers use to simplify the treatment of complex sets of reactions.

Changes in the treatment of aerosols, which Junge covered in depth, are not as extensive. Today better devices are used more routinely for collection of size-segregated particles, and more detailed chemical analyses are now possible with use of x-ray fluorescence, neutron activation analysis, ion chromatography for inorganic species, and techniques such as gas and liquid chromatography and mass spectrometry for organic species. Warneck explains the use of enrichment factors in relation to the crustal abundance pattern; they have been helpful in identifying sources of airborne particles. The aerosol chapter is followed by one that covers the thermodynamics of uptake of water by particles and the subsequent growth of droplets in fogs and clouds, and goes on to treat scavenging and the composition of rain. As is typical of his approach,

Warneck does not dwell on acid rain problems but provides the fundamentals needed to deal with them, including explanations of the uptake of gases by droplets and the solution-phase kinetics of S(IV) oxidation to sulfate.

The final two chapters are novel. The treatment in chapter 11 of the geochemistry of carbon dioxide is thorough, covering the atmosphere, the layers of the ocean, sediments, carbon-bearing minerals, and the biosphere. Although Warneck does not deal much with the radiation balance aspects of the greenhouse effect, he provides all of the chemical background on the carbon cycle. The final chapter, "The evolution of the atmosphere," contrasts conditions on Earth with those on Venus and Mars, showing why different final stages evolved.

This is a wonderful textbook for senior and graduate courses on atmospheric chemistry, although it contains too much material for a semester course. Problem sets would have been useful.

This is also a valuable reference book that few atmospheric chemists will want to be without. It contains information from research and review papers that has not been collected in one place before. For example, the treatment of each important trace gas typically contains data on source strengths, vertical concentration profiles, and the important sink mechanisms. The appendixes contain data on the "standard" atmosphere, vapor pressures of water and ice, solar fluxes versus wavelength, and rate constants. The book is well documented, with 85 pages of references.

In summary, this is indeed the long-awaited update of Junge's book. Its appearance is timely in view of the recent greatly enhanced interest in global problems such as the greenhouse effect and stratospheric ozone.

GLEN E. GORDON
Department of Chemistry and Biochemistry, University of Maryland, College Park, MD 20742

Reprints of Books Previously Reviewed

The Great Devonian Controversy. The Shaping of Scientific Knowledge among Gentlemanly Specialists. Martin J. S. Rudwick. University of Chicago Press, Chicago, 1988. Paper, $19.95. *Reviewed* **230**, 432 (1985).

Inward Bound. Of Matter and Forces in the Physical World. Abraham Pais. Clarendon (Oxford University Press), New York, 1988. Paper, $17.95. *Reviewed* **234**, 619 (1986).

Selling Science. How the Press Covers Science and Technology. Dorothy Nelkin. Freeman, New York, 1988. Paper, $9.95. *Reviewed* **236**, 973 (1987).

The Signs of Language. Edward S. Klima and Urusula Bellugi with 10 others. Harvard University Press, Cambridge, MA, 1988. Paper, $12.95. *Reviewed* **205**, 1253 (1979).

Books Received

Additive Groups of Rings. Vol. 2. S. Feigelstock. Longman Scientific, Harlow, U.K., and Wiley, New York, 1988. xvi, 100 pp. Paper, $39.95. Pitman Research Notes in Mathematics, vol. 169.

Advances in Neuroblastoma Research 2. Audrey E. Evans *et al.*, Eds. Liss, New York, 1988. xxviii, 748 pp., illus. $130. Progress in Clinical and Biological Research, vol. 271. From a symposium, Philadelphia, PA, May 1987.

Advances in Non-Linear Spectroscopy. R. J. H. Clark and R. E. Hester, Eds. Wiley, New York, 1988. xx, 363 pp., illus. $159. Advances in Spectroscopy, vol. 15.

Advances in Periglacial Geomorphology. M. J. Clark, Ed. Wiley-Interscience, New York, 1988. xxiv, 481 pp., illus. $125. Based on a conference, Paris, France, Aug. 1984.

The Aging Population in the Twenty-First Century. Statistics for Health Policy. Dorothy M. Gilford, Ed. National Academy Press, Washington, DC 1988. xvi, 323 pp. Paper, $19.95.

Air Pollution and Acid Rain. The Biological Impact. Alan Wellburn. Longman Scientific, Harlow, U.K., and Wiley, New York, 1988. xvi, 274 pp., illus. $48.95.

Air Pollution, the Automobile, and Public Health. Ann Y. Watson, Richard R. Bates, and Donald Kennedy, Eds. National Academy Press, Washington, DC, 1988. x, 692 pp., illus. $60.

Alcoholism and Women, Genetics, and Fetal Development. William J. Haugen Light. Thomas, Springfield, IL, 1988. xx, 170 pp., illus. $27.50.

Algorithm Design. A Recursion Tranformation Framework. Marvin C. Paull. Wiley-Interscience, New York, 1988. xvi, 490 pp., illus. $44.95.

Automated Theorem-Proving in Non-Classical Logics. Paul B. Thistlewaite, Michael A. McRobbie, and Robert K. Meyer. Pitman, London, and Wiley, New York, 1988. vi, 154 pp. Paper, $19.95. Research Notes in Theoretical Computer Science.

The Basics of Technical Communicating. B. Edward Cain. American Chemical Society, Washington, DC, 1988. xiv, 198 pp., illus. $29.95; paper, $19.95. ACS Professional Reference Book.

Bellinson's Conjectures on Special Values of *L*-Functions. M. Rapoport, N. Schappacher, and P. Schneider, Eds. Academic Press, San Diego, CA, 1988. xxiv, 373 pp. $37.50. Perspectives in Mathematics, vol. 4. Based on a workshop, Oberwolfach, F.R.G., April 1986.

Biological Applications of Raman Spectroscopy. Vol. 3, Resonance Raman Spectra of Heme and Metalloproteins. Thomas G. Spiro, Eds. Wiley-Interscience, New York, 1988. x, 565 pp., illus. $85.

Biological Determinants of Reinforcement. Michael L. Commons *et al.*, Eds. Erlbaum, Hillsdale, NJ, 1988. xxiv, 280 pp., illus. $45. Quantitative Analyses of Behavior, vol. 7. Based on a symposium, Cambridge, MA, June 1984.

The Biology of Hearing and Deafness. Robert V. Harrison. Thomas, Springfield, IL, 1988. x, 432 pp., illus. $67.50.

Biomass Energy. From Harvesting to Storage. G. L. Ferrero, G. Grassi, and H. E. Williams, Eds. Elsevier, New York, 1988. xii, 327 pp., illus. $61.25. From a workshop, Rome, Italy, Nov. 1986.

Biomass for Energy and Industry. G. Grassi *et al.*, Eds. Elsevier Applied Science, New York, 1988. xxviii, 1391 pp., illus. $171. From a conference, Orleans, France, May 1987.

Birds of the Middle East and North Africa. A Companion Guide. P. A. D. Hollom *et al.* Buteo Books, Vermillion, SD, 1988. 280 pp., illus., + plates. $32.50.

The Birth of History and Philosophy of Science. Kepler's *A Defence of Tycho against Ursus* with Essays on Its Provenance and Significance. N. Jardine. Cambridge University Press, New York, 1988. x, 301 pp., illus. Paper, $16.95. Reprint, 1984 edition.

Chemical Physics of Intercalation. A. P. Legrand and S. Flandrois, Eds. Plenum, New York, 1987. xii, 517 pp., illus. $95. NATO Advanced Science Institutes Series B, vol. 172. From an institute, Castera Verduzan, France, June 1987.

Choice and Morality in Anthropological Perspective. Essays in Honor of Derek Freeman. G. N. Appell and T. N. Madan, Eds. State University of New York Press, Albany, NY, 1988. xvi, 248 pp. $34.50.

Chromium in the Natural and Human Environments. Jerome O. Nriagu and Evert Nieboer, Eds. Wiley-Interscience, New York, 1988. xvi, 571 pp. illus. $95. Advances in Environmental Science and Technology, vol. 20.

Circuits, Signals, and Devices. Michael Julian. Longman Scientific, Harlow, U.K., and Wiley, New York, 1988. xii, 515 pp., illus. Paper, $37.95.

Climate Shocks. Natural and Anthropogenic. K. Ya. Kondratyev. Wiley-Interscience, New York, 1988. xx, 296 pp., illus. $52.50. Wiley Series in Climate and the Biosphere. Translated from the Russian by A. P. Kostrova.

The Collapse of Ancient States and Civilizations. Norman Yoffee and George L. Cowgill, Eds. University of Arizona Press, Tucson, 1988. xii, 333 pp., illus. $35. Based on a seminar, Santa Fe, NM, March 1982.

Colloidal Systems and Interfaces. Sydney Ross and Ian Douglas Morrison. Wiley-Interscience, New York, 1988. xviii, 422 pp., illus. $49.95.

Combinatorial Configurations. Design, Codes, Graphs. Vladimir D. Tonchev. Longman Scientific, Harlow, U.K., and Wiley, New York, 1988. xii, 189 pp., illus. $77.95. Pitman Monographs and Surveys in Pure and Applied Mathematics, vol. 40. Translated from the Bulgarian edition (Sofia, 1984) by Robert A. Melter.

Comets to Cosmology. A. Lawrence, Ed. Springer-Verlag, New York, 1988. x, 415 pp., illus. $44.20. Lecture Notes in Physics, vol. 297. From a conference, London, July 1987.

Digital Signal Processing. A System Design Approach. David J. DeFatta, Joseph G. Lucas, and William S. Hodgkiss. Wiley, New York, 1988. xxiv, 661 pp., illus. $61.67.

A Dream of Maya. Augustus and Alice Le Plongeon in Nineteenth-Century Yucatan. Lawrence Gustave Desmond and Phyllis Mauch Messenger. University of New Mexico Press, Albuquerque, 1988. xxii, 147 pp., illus. Paper, $19.95.

The Economy of the Earth. Philosophy, Law, and the Environment. Mark Sagoff. Cambridge University Press, New York, 1988. x, 271 pp., $29.95. Cambridge Studies in Philosophy and Public Policy.

The Eighth Day. Social Evolution as the Self-Organization of Energy. Richard Newbold Adams. University of Texas Press, Austin, 1988. xx, 292 pp., illus. $35; paper, $12.95.

Electron Liquid Theory of Normal Metals. V. P. Silin, Ed. Nova Science, Commack, NY, 1988. viii, 241 pp., illus. $89. Proceedings of the Lebedev Physics Institute of the Academy of Sciences of the USSR, vol. 174, supplemental vol. 2. Translated from the Russian edition (Moscow, 1985) by Kevin S. Hendzel.

The Encyclopedia of Field and General Geology. Charles W. Finkl, Jr., Ed. Van Nostrand Reinhold, New York, 1988. xxviii, 911 pp., illus. $89.95. Encyclopedia of Earth Sciences, vol. 14.

Endorphins, Opiates and Behavioural Processes. R. J. Rodgers and S. J. Cooper, Eds. Wiley-Interscience, New York, 1988. x, 361 pp. $92.

Fishery Development. William F. Royce. Academic Press, San Diego, CA, 1987. xii, 248 pp. $24.95.

Foundations of Statistical Mechanics. Walter T. Grandy, Jr. Reidel, Dordrecht, 1988 (U.S. distributor, Norwell, MA). Vol. 1, Equilibrium Theory. xvi, 380 pp., illus. $79. Vol. 2, Nonequilibrium Phenomena. xii, 307 pp., illus. $79. Fundamental Theories of Physics.

Frontiers in Particle Theory. Yi-shi Duan, G. Domokos, and S. Kovesi-Domokos, Eds. World Scientific, Teaneck, NJ, 1988. xiv, 324 pp. illus. $46. From a workshop, Lanzhou, China, June 1987.

Fully Abstract Models of Programming Languages. Allen Stoughton. Pitman, London, and Wiley, New York, 1988. vi, 123 pp., illus. Paper, $19.95. Research Notes in Theoretical Computer Science.

Galactic and Extragalactic Radio Astronomy. G. L. Verschuur and K. I. Kellermann, Eds. 2nd ed. Springer-Verlag, New York, 1988. xxii, 694 pp., illus. $79.95. Astronomy and Astrophysics Library.

Game Theory and National Security. Steven J. Brams and D. Marc Kilgour. Blackwell, New York, 1988. xiv, 199 pp., illus. $49.95; paper, $19.95.

Gemstones. Michael O'Donoghue. Chapman and Hall (Routledge), New York, 1988. xiv, 372 pp., illus. $55.

Glial Cell Receptors. Harold K. Kimelberg, Ed. Raven, New York, 1988. xiv, 274 pp., illus. $79.

The Great Temple of the Aztecs. Treasures of Tenochtitlan. Eduardo Matos Moctezuma. Thames and Hudson, New York, 1988. 192 pp., illus. $29.95. New Aspects of Antiquity. Translated from the Spanish by Doris Heyden.

Handbook of Plants with Pest-Control Properties. Michael Grainge and Saleem Ahmed. Wiley-Interscience, New York, 1988. xx, 470 pp. $44.95.

Hematopoesis. Long-Term Effects of Chemotherapy and Radiation. Nydia G. Testa and Robert Peter Gale, Eds. Dekker, New York, 1988. xviii, 413 pp., illus.

(Continued on page 124)