and geodesy, and (iii) Quetelet's background as mathematician and astronomer and the arguable irrelevance to substantive sociology of his dedication to the normal, we may feel that theories about influence at a distance in matters of ideas should be regarded as no more than entertaining conjectures.

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Microscopy Enhanced

Video Microscopy. SHINYA INOUÉ with contributions by ROBERT J. WALTER, JR., MICHAEL W. BERNS, GORDON W. ELLIS, and ERIC HANSEN. Plenum, New York, 1986. xxviii, 584 pp., illus. $65.

The capabilities of the light microscope in partnership with closed-circuit television and, sometimes, digital computers have dramatically expanded in recent years, enabling the capture and recording of formerly inaccessible images. A biologist or other researcher who wishes to obtain a clearer view of microscopic structures by using a television system must achieve a degree of competence in several diverse technologies. Shinya Inoué has done a superb job in conveniently packaging detailed information about these technologies in one volume. He covers the operation of light microscopes, television cameras and monitors, video tape and disk recorders, and analog processors and analyzers. A chapter by Walter and Berns treats digital image processing and analysis, a technique that harnesses the power of the computer to heighten image contrast and extract quantitative information from images. Appendices by Ellis, Hansen, and Inoué treat video line removal, modulation transfer function and the optical diffraction pattern, and biological polarization microscopy.

As well as presenting the background and essential features of television and light microscopy and describing the human visual system in relation to these instruments, Inoué compares the performance of competitive equipment, thereby providing information vital for deciding what components to purchase. Names and addresses of commercial suppliers are listed.

A researcher who reads this book from cover to cover will be exposed to a wealth of information about the video microscope and its applications. More likely, however, the book will be used as a reference manual for learning about individual details. To this end Inoué has provided a detailed table of contents and a 40-page glossary to help the reader through the jargon of these technologies. Entries in the glossary are keyed to sections of the text.

In my opinion, the book has only two flaws. The first is that in presenting a huge quantity of information it fails to highlight what is most essential to a researcher with a problem to solve within a limited time. The second flaw, obsolescence, is common to such books. Video and especially computerized imaging are changing so rapidly that a manual is obsolete the day it is published. Inoué has reduced this problem by presenting the operational principles of the devices and by including a "last minute before press" appendix on computerized video image processors.

This book is a necessary addition to the libraries of biological researchers or industrial engineers who are engaged in video microscopy or who wish to master the basics and explore applications of this powerful combination of techniques.

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Atmospheric Science

Atmospheric Chemistry. Fundamentals and Experimental Techniques. BARBARA J. FINLAYSON-PITTS and JAMES N. PITTS, JR. Wiley-Interscience, New York, 1986. xxx, 1098 pp., illus. $59.95.

Atmospheric Chemistry and Physics of Air Pollution. JOHN S. SEINFELD. Wiley-Interscience, New York, 1986. xxvi, 738 pp., illus. $59.95.

For years there has been only one comprehensive textbook for students of atmospheric chemistry: C. E. Junge's *Air Chemistry and Radioactivity*, published in 1963. Although that marvelous book, which defined the field, is still valuable, there has long been a need for a new textbook. Two books have appeared to help fill the void, though in different ways. Both are much larger than Junge's book, reflecting the explosion of knowledge in the field. Both present material at the level of graduate students and above. Although both contain more material than could be covered in a one-semester course, most students would want to keep them as reference books. Despite their greater sizes, neither is as comprehensive as Junge's book; both focus on urban-scale problems, with only brief coverage of the "clean" troposphere or the stratosphere. Both books contain a chapter on acid deposition, but neither chapter is particularly good; however, Seinfeld's book contains the background needed for a detailed treatment.

In view of their history of outstanding research on gas-phase atmospheric chemistry, it is not surprising that Finlayson-Pitts and Pitts focus on that subject. Taking full advantage of the massive database on kinetics and photochemistry developed in studies of photochemical smog and stratospheric ozone over the past decade or so, they treat smog chemistry in great detail, including smog-chamber and modeling studies. Unlike many authors of reviews, they follow reactions of examples of various organic compounds all the way to the final products rather than merely showing how these reactions relate to ozone formation. Their treatments of polynuclear aromatic hydrocarbons and related classes of compounds are valuable in view of the increased attention being paid to airborne mutagens today. Researchers and modelers will find the tables and appendixes on reaction rates, spectral light intensities, and the like useful.

Finlayson-Pitts and Pitts's book is not ideal as a textbook, however, since it has no problem sets and the order of chapters is not very logical. Even in their own field of gas-phase chemistry, they do not present the fundamentals adequately for the uninitiated. To its credit, the book covers experimental methods of laboratory kinetics and smog-chamber studies and of field measurements and sample collections. It gives rather short shrift to airborne particles, atmospheric structure, meteorology, and dispersion and deposition phenomena.

Seinfeld's more general book is a true textbook; most chapters have problem sets, which are essential for teaching and learning the subject. Seinfeld's treatment of gas-phase kinetics, though less extensive than Finlayson-Pitts and Pitts's, is quite adequate and probably easier for students to follow. He provides thorough coverage of aerosol physics, dynamics of particle interactions, atmospheric structure, turbulence and mixing, dispersion and deposition, and source-based air-pollution models. These subjects are treated with more physics and engineering rigor than needed for most courses, but researchers will be delighted to find the derivations and equations collected in one book. The thermodynamics and kinetics of water droplets in contact with gases are explained thoroughly. Seinfeld makes no attempt to cover experimental methods.

Neither book devotes much space to the newer receptor modeling approaches to source apportionment, unfortunately, but Seinfeld includes a brief section on the most widely used example, chemical mass balances. Although he does not proceed to

factor analysis and other multivariate methods, he has a chapter on statistics and probability distributions of air-pollution measurements.

In summary, Seinfeld's book is the more appropriate as a textbook for courses on air pollution or atmospheric chemistry except for courses that focus mainly on gas-phase phenomena. Both books will be of value to researchers in atmospheric science.

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Clonal Organisms

Population Biology and Evolution of Clonal Organisms. JEREMY B. C. JACKSON, LEO W. BUSS, and ROBERT E. COOK, Eds. Yale University Press, New Haven, CT, 1986. xiv, 530 pp., illus. $60; paper, $30. Based on a symposium, New Haven, Feb. 1982.

Living organisms can be classified by their mode of reproduction and by their construction. *Clonal* organisms reproduce by some form of asexual replication such as budding, stolon formation, or parthenogenesis, whereas *aclonal* species reproduce solely by sexual means. The body of a *unitary* organism is a single physiologically integrated unit, whereas the body of a *modular* species is composed of an organically connected assemblage of similar repeated units, called leaves, zooids, or polyps in various taxa, each of which functions at least semi-independently of its neighbors. Modular organisms, all of which employ some form of clonal replication, constitute the majority of the biosphere, and clonal unitary species have evolved independently in several unrelated animal and plant lineages. It is therefore fair to regard clonal organisms as an ecologically important group.

Most of the major paradigms in the fields of population ecology and evolution, by contrast, concern species whose basic ecological and evolutionary unit is the sexually produced individual organism. Such species are aclonal and unitary. Clonal species differ from aclonal ones in so many ways that assimilating them into ecological and evolutionary thought will require major extensions in both mathematical theory and methods of field study. Many ideas about the ecology and evolution of clonal organisms have appeared in the literature in recent decades, but their emergence from many unrelated research efforts has diffused their impact. In this volume of 13 chapters by botanists, zoologists, morphologists, physiologists, paleontologists, and theorists, these scattered ideas have finally been organized into a coherent description of the population biology of clonal organisms. These papers provide not a finished synthesis but rather a series of tantalizing, partly solved problems, and to my mind the publication of this book marks the formal debut of the exciting field of clonal organism population biology.

The strongest chapters present highly creative reinterpretations and syntheses of extensively reviewed existing knowledge. Harper's introductory chapter clearly contrasts clonal and aclonal organisms, discusses the biological significance of genets and ramets, and extracts from the agricultural literature useful insights into the adaptive significance of clonality. Silander observes that, contrary to expectation, clonal plants exhibit high genetic diversity, and he discusses evolutionary mechanisms unique to clonal organisms that probably cause this pattern. Hughes and Cancino describe the occurrence of clonal and aclonal lifestyles throughout the entire animal kingdom and clearly separate adaptive advantages of clonal reproduction from those of modular construction. Jackson concludes from a close examination of aquatic animals that clonality is a widespread adaptation to life in stable, crowded environments. Buss painstakingly documents clonal replication at several suborganismal levels of organization, highlights implications for ecology and evolution of certain molecular and immunological advances, and convincingly portrays the individual organism as an idealized abstraction that only approximates the organically self-contained units of real biological species.

Other chapters contain penetrating insights concerning branching patterns and physiological integration of clones, the roles of predation and physical habitat disturbance in shaping the evolution of clonal organisms, the connection between clonality and the evolution of intimate mutualistic associations, and the evolutionary history of clonality in corals and in the entire plant kingdom. The book's weaknesses include a fairly high redundancy among chapters, excessive wordiness and murky thinking in certain chapters, and rather poor development of mathematical theory. This last problem is not the fault of the authors, for their contributions do represent the current state of the art of ecological modeling. Rather, the problem arises from the formidable challenge of creating, essentially from scratch, a whole new theory for a diverse and very complicated group of organisms. Perhaps these tentative early attempts will help inspire development of a versatile and robust mathematical theory with close enough resemblance to biological reality to be genuinely useful in field studies of nature.

The editors and authors of this volume deserve vigorous applause for bringing so important a subject to the attention of population biologists. Their efforts have provided exciting reading, especially for graduate students, because understanding the contrast between clonal and aclonal organisms helps broaden one's perspective of the basic principles that underlie population biology and evolution.

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