ENVIRONMENT

Gaia: The Growth of an Idea

By Lawrence E. Joseph. 1990. St. Martin's Press, New York. 276 pp. U.S. $19.95; $27.95 in Canada.

Anyone interested in the conservation of our planet should become acquainted with the "Gaia concept." Named for a Greek Goddess roughly equivalent to "mother earth", the Gaia concept hypothesizes that our planet Earth behaves as a self-regulating organism with an outer membrane. As a corollary, the evolution of living organisms and their environment is an inextricably coupled process with feedback mechanisms. Such biological homeostasis is nicknamed "Daisyworld."

Lawrence Joseph gives us a balanced historical account of the development of the Gaia and "Daisyworld" concepts by the eccentric British genius, James Lovelock, whose greatest invention, in 1957, was the electron capture detector (ECD). The ECD allowed detection of chemicals such as DDT in part per trillion and made possible Rachel Carson's 1962 landmark book, *Silent Spring*. In 1971-72 Lovelock and two collaborators on a voyage to Antarctica used Lovelock's homemade gas chromatograph to measure gases in sea and air. They were the first to demonstrate that indestructible chlorofluorocarbons (CFCs) were accumulating worldwide — but three times as common in air blown from Europe as from the open sea. Lovelock also discovered that tiny ocean phytoplankton release the dimethyl sulfide that rises into the atmosphere and, transformed into condensation nuclei, aids cloud formation and transports needed sulfur to land.

To Lovelock and his co-worker, bacteriologist Lynn Margulis, symbiotic cooperation between organisms is more important than competition. Margulis has studied bacteria that desalinate tidal pools, varnishing salt so that it can't redissolve; lipids secreted by the bacteria in turn reduce the impact of waves that crash onto the lagoon. Lovelock believes that self-regulating systems have maintained the earth's oxygen at an ideal 21% and the ocean at optimal salinity over 500 million years. Biodiversity has practical survival value; destruction of marine life would destroy the earth's thermostat.

Our ozone layer, part of the protective membrane around our planet, is threatened by CO_2, by CFCs, and by methane. Biologists studied termites without appreciating the amount of methane they released, while upper atmosphere scientists noticed the methane there but didn't realize its origin. Lovelock's approach ties everything together. Lovelock, although he invented the instruments and designed the experiments to show the hazards of CFCs, which deplete the stratospheric ozone layer, at first had too much faith in Gaia's self-regulating ability.

Lovelock draws our attention to the dangers of the "four Cs: cars, cattle, chainsaws, and coal." He fears the ill-effects of agriculture (cows pass a lot of methane) as much as those of industry. He stresses that nuclear energy is environmentally friendly as compared to coal as an energy source.

We can benefit from opening our horizons even if the Gaian concept is as much metaphor as science. Read Lawrence Joseph's interesting account and decide for yourself. We violate Gaia, mother earth, at our peril.

C. STUART HOUSTON

863 University Drive, Saskatoon, Saskatchewan S7N 0J8

Dynamic Biogeography

By R. Hengeveld. 1990. Cambridge Studies in Ecology, Cambridge University Press, New York. xiv + 249 pp., illus. U.S. $54.50

Dynamic biogeography is defined by the author as the analysis and understanding of spatial biological phenomena in terms of past and present factors and processes. This broad subject was approached with the condition of being "very much a personal synthesis". Although this is an interesting perspective, it makes for a book that is neither novel nor comprehensive. The format of the book takes a top-down approach of exploring species' distributions by first examining broad-scale biogeographic patterns and processes, and then finer-scale phenomena.

The book reviews a selection of methods used in biogeographical classification. This review is not exhaustive, and the discussion of the methods varies from a detailed explanation of cluster algorithms to a brief comparison of ordination techniques. Despite an attempt to avoid a "cookery book", the author falls into the trap of limiting the readers' options by limiting the number of methods discussed. One interested in quantitative methods of biogeographical classification would be better served by more extensive works such as Ludwig and Reynold's *Statistical Ecology* (1989).

The remainder of the book examines geographical trends at various scales from species richness to intraspecific variation; areography (the analysis of species ranges); and, the dynamic structure of species ranges. These topics are surveyed largely through a series of interesting examples. However, a more detailed discussion of the concepts underlying

these examples, as provided in Myers and Giller's *Analytical Biogeography* (1988), would have been useful. On an editorial note, a glossary of the biogeographical terms used in the text would benefit the readers. Scientific names are often presented without a common name or any indication of type of taxon being discussed. Captions often inadequately explain the figures, and legends (e.g., Figure 36, p. 137) and units of measurements (e.g., Figure 19, p. 85) are frequently missing on the figures.

The author succeeds in demonstrating that the dynamic nature of species distributions is integral to the understanding of biogeographic processes and the explanation of biogeographic patterns. However, he fails to formulate a comprehensive dynamic model of species distributions. This book has many shortcomings, but the lack of stimulating ideas is not one of these. The Cambridge Studies in Ecology series is aimed at upper-level scientists, and *Dynamic Biogeography* will appeal to only those with the keenest interest in this subject.

NICHOLAS E. MANDRAK

Department of Zoology, University of Toronto, Toronto, Ontario M5S 1A1

Mathematical Modelling in Ecology: A Workbook for Students

By Clark Jeffries. 1989. Birkhauser, Therwil, Switzerland. x + 193 pp., illus. SFr 49.50.

This book introduces ecology students to the construction of dynamic models (models which change with time) to describe stable ecosystem development in terms of energy flow. The approach is to study deterministic models and then to look for the same patterns in nature. The author assumes a background in differential calculus and liner algebra. Systems of difference equations are introduced in the first chapter. More advanced mathematical topics are covered as examples of more realistic models are developed. Some of the advanced topics include Lyapunov theory, linearization theorem, Hurwitz stability test, matrix methods, digraphs, attractor region theorem, and chaotic dynamics.

This is not a cookbook of ecological modelling. There are no examples of large ecosystem models to serve as templates for other projects. Rather, the emphasis is on mastering several key mathematical concepts used in modelling. This is made more palatable for the ecology student by its presentation in an ecosystem context.

Each concisely written chapter is followed by a set of exercises and explanatory answers, to the relief of many students frustrated by other modelling texts. Many of the exercises are drills in mechanical skills. These drills give the beginner ample opportunity to develop the skills needed to understand modelling. Then the beginner can fairly assess the potential of mathematical modelling to serve as a framework in which to organize knowledge about ecosystems.

Many of the exercises require a microcomputer. Example programs are listed in BASIC, LOTUS, and for a Hewlett Packard 41 CV calculator. Beware, at least one program contains a typographical error that prevented the program from running.

The small size of this well illustrated book is deceptive. The novice will need to spend an ample amount of time doing the exercises in order to fully understand the material. Each exercise set takes two to six hours to complete. This book can serve as a good textbook for upper division undergraduate and graduate courses in ecosystem modelling.

BLAINE H. M. MOOERS

7045 N.W. Grandview Drive, Corvallis, Oregon 97330

At the Water's Edge: Nature Study in Lakes, Streams, and Ponds

By Alan M. Cvancara. 1989. John Wiley and Sons Inc. 232 pp., illus. U.S.$10.95.

Cvancara, a Professor of Geology and author of *A Field Manual for the Amateur Geologist,* shows further expertise as he thoroughly explores the various types of freshwater environments and their unique characteristics.

The content of the book is well researched, very readable and the format allows quick and easy reference. Though primarily directed at the aquatic naturalist, it can be of great value to parents and children, or any outdoor enthusiasts.

Initially you are introduced to "Water, The Elusive Substance", its composition, the different forms it takes, and the formation of water molecules. After the reader has obtained this basic understanding, Cvancara delves into the subject matter with such topics as flora, fauna, aquatic life, and seasons in a manner that educates and arouses the interest of the reader.

The inclusion of correct pronunciation for difficult or uncommon words is useful as is the chapter on taking field notes and recording observations. Unfortunately, Appendix A, the Listing of Selected National Wildlife Refuges to observe freshwater and shorelife, would not be used frequently by Canadian naturalists as it is restricted to American locations. It would however, be an invaluable source of reference for those planning vacations in the United States.