The History of Ecology

The Background of Ecology. Concept and Theory. ROBERT P. MCINTOSH. Cambridge University Press, New York, 1985. xiv, 383 pp. $39.50. Cambridge Studies in Ecology.

Modeling Nature. Episodes in the History of Population Ecology. SHARON E. KINGSLAND. University of Chicago Press, Chicago, 1985. x, 268 pp., illus. $27.50. Science and Its Conceptual Foundations.

History of science serves many purposes. Among them are recounting discoveries and chronicling the development of thought, elucidating personal, social, and philosophical motivations of individual scientists, and clarifying contemporary issues by examining their backgrounds. Modern ecology includes such diverse endeavors as modeling the nitrogen cycles of lakes and interpreting the mating behavior of dungflies. It has borrowed heavily from economics, chemistry, and physics, as well as the life sciences, during its rapid growth in this century. The whole is held together more by the adoption of a name and the cohesion of professional societies than by a commonality of philosophy or purpose. Thus ecology poses special difficulties for the historian.

McIntosh has undertaken the immense task of recounting the history of all of ecology in one volume. His book is "an attempt to provide an account of the background of ecology and suggest its relevance to current problems of ecology as a science." His scope is limited only by geography, primarily to North America and Great Britain, and by starting in earnest with the crystallizing of "self-conscious" ecology during the late 1800's. Kingsland focuses more narrowly on the development of mathematical population ecology, tracing its emergence in the 1920's with Pearl, Lotka, Volterra, and later, Nicholson, through an experimental phase exemplified by the work of Gause, to the application of apparent "principles" of population ecology to evolution and community ecology by Lack, Hutchinson, and MacArthur.

The styles of the two books differ as much as the approaches of ecologists to their science. McIntosh has organized ecology into a rational scheme for historical treatment along lines of major interest groups concerned with particular habitats and areas of inquiry. Having discussed the emergence of "self-conscious" ecology, recognized by the adoption of "ecology" as a label and the founding of societies and professional journals, he reveals more of the institutionalized science than of the ideas that developed within its matrix. Kingsland traces a single thread of intellect, sometimes braided and frayed, that winds its way through the inspired minds of a small number of scientists—diverse in background and purpose and having personalities of different color and power—touching each of them and also being uniquely transformed in the process. Through Kingsland's account, we glimpse the individuals' backgrounds and surroundings nurturing and molding their thought.

McIntosh divides his subject into "dynamic ecology" (including the equilibrium concept of Forbes and the succession concept of Clements), "quantitative community ecology" (statistical description of diversity, relative abundance, biomass distribution), "population ecology" (definition, description, and regulation of populations and theoretical population ecology—Kingsland's topic), "ecosystem ecology" (the International Biological Program, systems analysis), "theoretical approaches," and "ecology and environment." The breadth is admirable, the references are thorough and usefully indexed, and the writing is clear if encyclopedic. McIntosh does, however, rely heavily on secondary sources and quotes to excess the reactions of other ecologists and historians to primary sources. While providing a certain perspective, this approach plays down the development of ideas in favor of the "institutional" reaction to them.

Because *The Background of Ecology* assumes a rather thorough knowledge of ecology on the part of its reader, it will be more useful to professionals and scholars than to students hoping to fathom the mysteries of their chosen discipline. Its peculiar organization and treatment of topics by reporting rather than analysis seem unable to enlighten us about current ecological muddles and the classic problems of ecology from which they spring. It is clear from McIntosh's narrative that the questions whether ecological systems are in equilibrium or not, whether the whole of a system is more than the sum of its parts, whether history leaves its mark on contemporary systems, whether theory and modeling have useful roles in ecology pose alternatives between which ecology has meandered, disunited, and rejoined over the century since its founding. But McIntosh's muted cynicism about his subject precludes the insight that could put us on firmer ground. Indeed, the naive reader might think ecology a failed discipline.

The role of history in ecology is the major conceptual issue in Kingsland's treatment of population ecology. Through lively accounts of a few key individuals, Kingsland shows how, in the 1920's, population thinking provided a natural unification of the separate community-oriented and physiological approaches of classical ecology. Mathematical treatments of demography and population interactions became the controversial showpieces of the new movement. Kingsland sees the subsequent development of population ecology as resulting from a tension between biology and mathematics. Biology represents history and its unique manifestations; mathematics represents equilibrium and determination by contemporary processes.

The hesitant beginnings of population biology in Raymond Pearl's single-minded promotion of the logistic equation of population growth, Alfred J. Lotka's personal disappointment over his failure to gain recognition and fear of losing priority to Volterra, W. R. Thompson 's withdrawal of his early support for mathematical models, are all vividly portrayed. The connections between Russian biologists, especially the gifted and precocious G. F. Gause, who provided experimental verifications of the models, and Pearl's group at Johns Hopkins clearly demonstrate the values of communication, colleagueship, and mentoring.

Kingsland does not even hint at her primary theme, "the eclipse of history," until the process is well under way. Gause's microcosm experiments had deterministic outcomes dependent only upon conditions in the test tube. From Gause's "principle" that two species could not coexist on shared limiting resources, David Lack, the British ornithologist and ecologist, to whom McIntosh gives little recognition, perceived the interaction of competition and evolution in the ecological diversification of species. It was G. Evelyn Hutchinson who foresaw that population thinking could solve the riddle of how community

structure is regulated through the ability of species to coexist by partitioning an array of resources. Hutchinson's brilliant student Robert H. MacArthur fashioned models from the local, contemporary population processes of Lotka and Volterra that predicted qualitative attributes of biological communities, setting off a flurry of empirical and experimental field investigations in the 1960's and 1970's to find support for the ideas. Ecologists, whose attention span is forcibly narrowed to the here and now by graduate school tenure, grant periods, and criteria for promotion, had at last found the largest of ecological systems brought within their own scale of time and space. History was deliberately relegated to the obscure shadows of classical biogeography, systematics and paleontology.

The scientific appraisal of the Hutchinson-MacArthur revolution has begun, and its basic position on history is becoming a major source of controversy. For Kingsland, this is not yet history. Even as she takes up Hutchinson and MacArthur there is a perceptible change in tone, seeming to expose a dispassionate historian struggling against the seductive power of intellectual excitement and promise. But the ultimate value of history derives from the absence of a boundary between it and the present. Although neither *The Background of Ecology* nor *Modeling Nature* lectures ecologists on their concepts, perceptions, or methods, the lessons of history will not be lost on readers of either book.

ROBERT E. RICKLEFS
Department of Biology, University of Pennsylvania, Philadelphia 19104

Trends of Chemistry

Chemistry in America, 1876–1976. Historical Indicators. ARNOLD THACKRAY, JEFFREY L. STURCHIO, P. THOMAS CARROLL, and ROBERT BUD. Reidel, Boston, 1985 (distributor, Kluwer, Hingham, Mass.). xxiv, 564 pp., illus. $79.50. Chemists and Chemistry.

Those of us in the humanities find it hard to avoid feeling at least an occasional pang of envy as we survey the magnificent facilities and resources available to our colleagues in the natural sciences. We know, of course, that the sciences have not been immune from budget cuts in recent years. Nevertheless, to the outsider the natural sciences appear to enjoy an impregnable position in our society; their history seems like a tale of mounting status, wealth, and power punctuated only occasionally by such events as the depression of the 1930's and the inflation of the 1970's.

Chemistry in America, 1876–1976 does not overthrow all these conceptions, but it does make some of them untenable, at least as regards that science which has the largest community of practitioners, chemistry. The authors, four historians of science, have accumulated quantitative data whereby trends in the development of chemistry in America might be analyzed. They look at indicators as diverse as the employment of chemists, the pages devoted to chemistry in newspapers and encyclopedia yearbooks, and the frequency with which chemists have been appointed to college presidencies. Their conclusions are both simple and provocative. Chemistry, they tell us, has indeed grown steadily during the past century if its dimensions are measured in absolute terms; but when viewed against the growth of other occupations, disciplines, or professions, it has been in decline for the past half-century or more. Some examples may illustrate this point. Although chemists in the labor force have increased more than a hundredfold since 1870, chemists today represent a much smaller percentage of all professional and technical workers than they did in 1950 or even in 1920. In 1921 one out of every three persons engaged in industrial research was a chemist; in 1957 one out of every 19. Chemistry departments awarded one of every five doctoral degrees in 1940, but only one of every 15 in the early 1970's. The authors' tables yield scores of similar statistics. Where chemists used to hold leading roles in industrial laboratories, federal agencies, and universities, they now have been reduced to positions in ever larger supporting casts. Though they may still enjoy greater opportunities and privileges than colleagues in the humanities, their standing vis-à-vis engineers, physicists, and biologists has suffered erosion for decades.

What one makes of these findings will depend, at least to some degree, on one's disciplinary affiliation. If chemistry is indeed losing its share of the American market for scientific expertise, is that erosion a symptom of serious illness in the chemical profession? Does it, for example, indicate a loss of intellectual vitality? Or does it simply reflect a process whereby the science that was the first to become fully integrated into American institutions is now being joined by others that grow alongside it, but not at its expense? The authors refrain from making an explicit choice between these interpretations. On the one hand, they detect no sign that American laboratories are abdicating their position of leadership in research; although the American share of the world's chemical literature has declined in recent decades, the lion's share of the most frequently cited papers continue to come from American institutions. On the other hand, the authors repeatedly call attention to evidence of decay in exactly those things which any discipline requires for enduring prosperity: patronage, career opportunities, and public interest. Extrapolating from these trends, it seems improbable that intellectual leadership can long be maintained.

The authors, however, neither prognosticate nor prescribe. Nor, for that matter, do they attempt to interpret the past. Repeatedly they skirt precisely those questions which the historian would most like to see explored. Why was it chemists who played such a crucial role in the development of graduate education in America? What accounts for the extraordinary rapidity with which laboratory training established itself in schools and colleges at the end of the 19th century? How does the evolution of this science in the American setting compare with its history in Europe? The authors describe their goal as being akin to that of the medievalist who seeks to establish a pure text; they wish to establish reliable quantitative information that might serve as a prologue to more satisfying work on the history of science and science policy. In this they have succeeded richly; through painstaking effort they have retrieved an immense yield of valuable data. Nevertheless, I wish they had been less ruthless in suppressing their interpretative instincts and more forthcoming in discussing those issues which, after all, give those data meaning.

JOHN W. SERVOS
Department of History, Amherst College, Amherst, Massachusetts 01002

The Stress Response

Changes in Eukaryotic Gene Expression in Response to Environmental Stress. BURR G. ATKINSON and DAVID B. WALDEN, Eds. Academic Press, Orlando, Fla., 1985. xviii, 381 pp., illus. $65. Cell Biology.

It has been 23 years since Ferruccio Ritossa discovered that heat and chemical treatments induce the formation of puffs in the polytene chromosomes of the salivary glands of *Drosophila* larva but only seven years since clues began appearing in the literature that virtually all