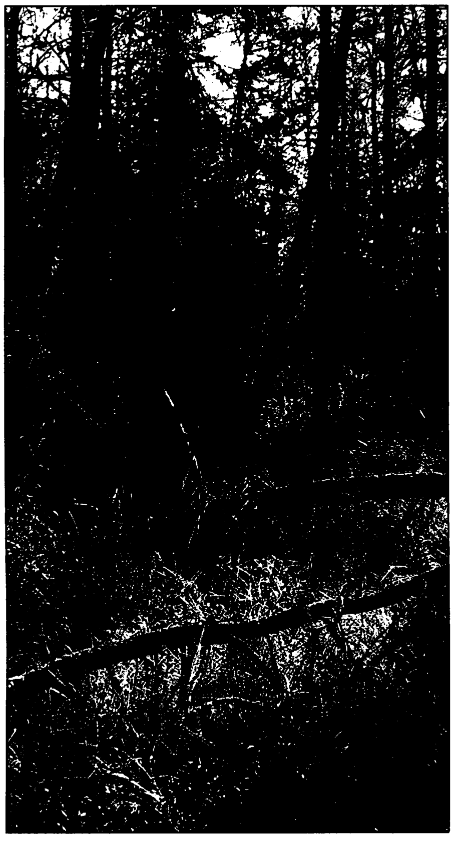
ness. Glaser's excellent chapter on the ecological development of patterned peatlands is superbly illustrated, and his well-written chapter on rare vascular plants should be read by anyone interested in this topic. J. Janssens's contributions are of mixed value. On the one hand, his chapter on bryophytes—plants that are extremely important in peatlands in terms of biomass and nutrient cycling as well as being significant indicators in classification—is superficial, consisting largely of a table showing the landform distribution of Minnesota peatland moss species, along with maps showing the location of collection sites and detailed drawings of some of the species. Although the illustrations are handsome, their value is diminished by the absence of corresponding text. However, Janssens's treatment, with Hansen, Glaser, and Whitlock, of the ecological development of peatlands makes full use of macrofossil indicators to reconstruct peatland history, even though the authors do not use the recently developed approaches that utilize multidimensional responses of species to environmental gradients. C. R. Janssen explains his earlier, pollen-based studies, which contrast with J. Janssens's more modern approach.



"A tree island. The tree islands are dominated by tamarack (*Larix laricina*) and occasional spruce (*Picea mariana*). Notice the substrate of dry moss-covered hummocks and water-filled depressions. The trees are *Larix laricina*." [From *The Patterned Peatlands of Minnesota*; photo by Paul Glaser, Red Lake peatland, 1978]

Of particular interest are the chapters documenting the human influences on the area. Meyer's review of the Red Lake Ojibwe helps us to better understand the complex interactions between the peatlands and the native Americans and early European settlers. And no source provides better coverage of the early history of drainage attempts than Bradof's overview of efforts in the early 1900s in the Red Lake area.

A significant weakness of the book is its lack of material on processes and biogeochemical cycles, in which peatlands play important roles. For example, there is no coverage of carbon, nitrogen, sulfur, methane, or carbon dioxide dynamics, despite the fact that peatlands, including the Red Lake area, serve as important sinks and sources of carbon.

In the early 1970s, when I began to study Michigan peatlands with Howard Crum and Nancy Slack, I frequently referred to Verona Conway's (1949) and Miron Heinselman's (1950s) early works on Minnesota peatlands. At the time I had no idea how extensive these peatlands were. When I first met Herbert Wright at a Friends of the Pleistocene meeting in 1967, my interest was further stimulated. The development of a world-class group of peatland researchers at the University of Minnesota, including Eville Gorham, Paul Glaser, and Jan Janssens, set in motion a program of peatland investigation that is still talked about today. *The Patterned Peatlands of Minnesota*—the culmination of the efforts of all these scientists—establishes a benchmark for North American peatland ecology.

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Fisheries Oceanography

Marine Climate, Weather, and Fisheries. The Effects of Weather and Climatic Changes on Fisheries and Ocean Resources. TAIVO LAEVASTU. Wiley, New York, 1993. xii, 204 pp., illus. $49.95 or £32.50.

Although lip service is often paid to "environmental factors" in fisheries management forums, most people would be shocked by how little information is actually used to make management decisions, and by the general state of fisheries in North America. Cost-conscious politicians have contributed to the problem over the last few decades. Since catch statistics are less costly to obtain than complex environmental information, fisheries managers have relied on methods of assessing fish stock that are based on conventional equilibrium theory instead of considering the many ecological factors that directly affect fisheries production. These factors include natural physical processes such as weather and volcanism as well as human factors such as overharvesting, pollution, and habitat destruction. Conventional assessment models do not acknowledge that fish live in dynamic habitats or that they are harvested by fishermen concerned with day-to-day practicalities, both within and beyond their control. Consequently, conventional fisheries management is fraught with unpleasant "surprises."

In 1962 Taivo Laevastu and his colleague I. Helle published the first book on applied fisheries oceanography. The revised 1970 edition remains the leading source of wisdom about the different ways in which various fishing methods must take account of and respond to environmental processes. In more than 30 years of thinking about these issues, Laevastu has developed insights that only firsthand oceangoing experience and great concern for the fisherman's perspective can bring. Armed with only their own experience and knowledge of the price of fish, each day fishermen make decisions about where to fish, which species to target, and what kind of gear to use to optimize their catch. Knowledge of the behavior of fish in response to climate-driven oceanographic variability is essential for their success. In his new volume, *Marine Climate, Weather, and Fisheries*, Laevastu describes climatic, meteorological, and ecological factors that affect fisheries production, first from the perspective of at-sea fishing operations and then from that of resource managers. Throughout the book he suggests ways to better integrate the fishing industry and make it more attuned to environmental variabilities on all time and space scales.

Critics of fisheries oceanography often cite its failure to contribute significantly to an understanding of population responses to environmental variation. Yet Laevastu argues that this failure can be attributed largely to misguided approaches to the problems. He discusses the pitfalls inherent in interpretation of sea surface temperature, which is the most frequently referenced ocean variable but the one measured by the greatest number of methods, with different results. At any rate, fisheries oceanographic research should be conducted with the understanding that "surface water temperature is an integrator of action of several past weather elements on the sea surface layers" and that few if any of the critical processes for most fish populations take place in the top few meters of the ocean, the area that yields surface temperature data. Laevastu suggests that one among many possible explanations for year-to-year population variations is simply "differential predation" patterns. Aggregations of prey cause aggregations of predators; thus any physical processes that affect opportunities for prey to aggregate will affect local fishery production. He also reminds us that variations in fish development (differences in growth rate or size at maturity) provide information about local environmental patterns, because they constitute responses to those patterns.

Laevastu is a true advocate of ecosystem management practices. However, in this book he seems unclear about what is and is not known about the early life history and survival of pelagic fish. In 1975 Lasker proposed that the survival of larvae to the first-feeding stage, owing to their limited mobility, depended on the existence of natural concentrations of appropriate food, which could be dispersed by any climatic or weather event that mixed the upper ocean. It follows that there are relatively rare periods when all the right conditions are met; fish larvae that hatch into these environments enter a "survival window," from which they can proceed to subsequent developmental stages provided that they evade the many other threats to survival with which they are confronted. Laevastu refers to an absence of support for Lasker's starvation hypothesis as well as for the concept of a survival window.

In fact, strong evidence has been presented for both hypotheses. Gail Theilacker of the National Oceanography and Atmospheric Administration (NOAA), for example, has shown that for numerous samples of ocean-caught larval anchovy as many as 65 percent of individuals in any given sample are in a state of starvation. For many years the Fisheries Oceanography Coordinated Investigations (FOCI) have synthesized NOAA's physical and biological sampling capabilities to study recruitment-related processes in Alaskan pollock that reproduce in the Shelikof Strait. Some of FOCI's recent reports use data on earbone growth to show that fish two years old and older that they studied were born at different times during the spawning period, with different survival, a finding that supports the survival window hypothesis. Similar data sets from several other well-studied fisheries provide further evidence.

The overriding message that emerges from this book is that fisheries science is not well in the world. There are important differences in quality between fishery forecasts based on well-defined cause-and-effect relations and statistical inferences derived from means, correlations, and curve-fitting procedures. These are often confused within conventional stock assessment paradigms, where unverified and unverifiable hypotheses abound. Until there is a clear acknowledgment of the effect on fisheries of environmental processes as well as destructive human behavior, fisheries will continue to "surprise" managers. Despite its minor lapses, Laevastu's work is a major contribution to the effort to improve fisheries management through greater awareness of ecological factors, and it should be required reading for all resource managers. Beyond serving as a primer for mariners, novice managers, and fisherfolk wishing to better understand the relationship between environmental processes and fisheries production, it offers poignant commentaries on marine systems such as the Black Sea and the Baltic, where humanity has shown itself to be a curse on nature.

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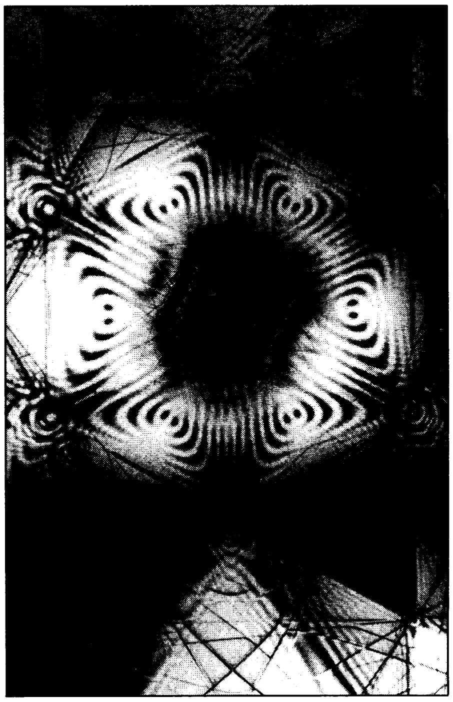
The New Microscopy

Electron Microdiffraction. J. C. H. SPENCE and J. M. ZUO. Plenum, New York, 1992. xxiv, 358 pp., illus. $49.50 or £59.40.

It has been argued that the electron microscope is one of the key inventions of the 20th century, having contributed more than any other device to our understanding and control of materials on an atomic scale. In recent years, in a gradual shift of emphasis from real to reciprocal space, the popular image of an enhanced optical microscope has been complemented by the emergence of the electron optical column as a uniquely flexible tool for diffraction physics. Twenty years ago, electron diffraction was regarded as a sensitive method for investigating crystal structures but one that was more qualitative than quantitative, at least in comparison with x-ray or neutron methods, because the interactions of charged particles with the specimen were too complex for exact interpretation except by elaborate computer calculations. Given that the physics of electron diffraction is no different today, one may ask what new developments warrant a reexamination of the subject.

First, smaller and smaller probe sizes have become available on commercial microscopes. It is now possible to obtain a probe of subnanometer dimensions; hence microdiffraction patterns may now be obtained from ideal crystalline areas of even the most complex specimens. This advance alone has made possible the routine identification of crystallographic space groups by simple inspection of diffraction patterns. Simultaneously, other barriers to quantitative interpretation have been surmounted by the use of spectrometers to remove the inelastically scattered electrons, as well as



"Large-angle convergent beam pattern recorded at 100 kV from silicon in the [111] orientation. The Omega filter of the Zeiss 912 has been used to remove most inelastic scattering, together with a very small selected area aperture, resulting in high contrast." [From *Electron Microdiffraction*; courtesy of Dr. J. Mayer, M.P.I., Stuttgart, Germany]

improvements in the theory of dynamical diffraction and the widespread employment of computer workstations for online image processing and calculations.

Even today, only a few laboratories have been able to incorporate all of these advances in the field. Yet there is no doubt that a new baseline has been established for the next century. Thus the authors of *Electron Microdiffraction* not only are uniquely qualified to describe the new developments by their experience of the field, they have demonstrated a keen sense of timing. In essence, they have written a user's manual for the new microscopy, aimed at both experimentalists and theorists, to help the next few generations of researchers exploit the opportunities that are within sight. Among these, we may expect that electron diffraction patterns will be used to infer the bonding charge distribution between atoms for a wide range of crystals. Further, the introduction of field-emission electron sources has generated a new field based on coherent, phase-sensitive diffraction and imaging related to optical holography.

To establish a solid background for future research, Spence and Zuo present a detailed analysis of the intensity distribution within convergent-beam electron diffraction patterns from crystals, with emphasis on a unified approach from dynamical