region. An important conclusion of this volume is that although research and conservation must be intimately interwoven, the obvious gaps in our knowledge about these complex species must not stand in the way of applying what we already know to conservation activities. This book is aimed at ornithologists, ecologists, and conservation biologists. For those participating in coordinated efforts, such as the international, interagency "Partners in Flight—Aves de las Americas" program, the analyses in this book provide an important scientific basis for informed decision making.

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Sea Measurements

Ocean Acoustic Tomography. WALTER MUNK, PETER WORCESTER, and CARL WUNSCH. Cambridge University Press, New York, 1995. xiv, 433 pp., illus., + plates. $59.95 or £45. Cambridge Monographs on Mechanics.

Acoustic tomography is one of the most potent techniques at the disposal of present-day oceanography. To measure climate-relevant natural or anthropogenic changes in the ocean, temperature signals of the order of a tenth of a degree Celsius and hundreds to thousands of kilometers in horizontal scale have to be detected against the background of large-amplitude but small-scale local temperature fluctuations that are caused by mesoscale eddies of about 100-kilometer scale and internal waves ranging from less than one to tens of kilometers in scale. The book demonstrates that acoustic tomography can accomplish such objectives. Why then is the technique not widely applied?

The main reason is obvious from studying this book: Acoustic tomography, by comparison with other oceanographic observational techniques, is probably the most challenging (and expensive) to start up, and a number of hurdles have to be overcome before even arriving at oceanographically relevant data. First, the technical level necessary to make the instruments work reliably is very demanding, and past tomographic experiments had their share of technical problems at sea. Second, the identification and analysis of ray-arrival patterns and their correction for mooring motion, that is, for separation changes of instrument pairs, is complicated. And third, the sound-propagation anomalies have to be converted into changes of temperature structure (and currents for reciprocal transmissions). However, these are now integrals through the slice of ocean traveled by the sound waves, distorted by various effects of stratification, currents, and topography, and new ways to interpret them had to be found. It is this analysis that makes up the major part of the book. The book is a thorough compendium of the possible methods and approaches in application to various case studies of ocean stratifications, with hypothetical cases always accompanied by practical physical scaling arguments, which makes it interesting to read.

Because of the inherent technical difficulties, tomography was, in the first part of its history, during the '70s and early '80s, too much applied in an engineering sense—that is, experimental sites were selected in ocean areas where the sound-propagation conditions were right, but in which in the end there was not much interest on the part of the oceanographic community in the scientific questions the tomographers posed. Consequently, the section on past oceanographic results in the book is short compared to the presentation of methods. In addition, as the authors also mention (p. 28), tomography in its first decade, rather than making use of the integral qualities of the measurements, tried to compete with conventional (point) measurements in the ocean by scanning through a volume from all sides and then decomposing the products by inverse methods into small sub-elements for which the results would presumably resemble point oceanographic measurements—hence the name tomography. Only recently has it been used to its full potential by scanning through winter convection areas of the Greenland Sea or the northwestern Mediterranean and thus obtaining volumetric time series of changes in water-mass distributions that could not have been obtained in such quality by conventional means.

The authors are the leaders of the field, having worked together over the past two decades to develop it. Munk, as the godfather of tomography, has continuously pushed it to new limits. Now his ultimate objective is to install a global system entitled "Acoustic Tomography of Ocean Climate" (ATOC) for monitoring the ocean's role in climate, and operations are already under way in the Pacific (the difficulties recently uncovered in interpreting long-range acoustics are explained in the book). Worcester is the expert on instrumentation and signal analysis, and Wunsch has developed the inverse technology for ocean applications, an essential element for successful tomography.

At this time, when tomography is needed more than ever for monitoring the ocean's role in anthropogenic and natural climate fluctuations, the unfortunate fact is that the community of ocean tomographers is small. May this excellent book help to give new impulse to this exciting technique, which should play a key role in forthcoming ocean-climate observing programs within the context of the Climate Variability and Predictability Study (CLIVAR) and the Global Ocean Observing System (GOOS).

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Quantum Optics

Optical Coherence and Quantum Optics. LEONARD MANDEL and EMIL WOLF. Cambridge University Press, New York, 1995. xxvi, 116 pp., illus. $49.95 or £30.

During the last two years several books in the rapidly developing field of quantum optics have appeared. D. F. Walls and G. Milburn's *Quantum Optics* (Springer-Verlag, 1994), W. Vogel and D. G. Welsch's *Lectures on Quantum Optics* (Akademie Verlag, 1994), and E. R. Pike and S. Sarkar's *The Quantum Theory of Radiation* (Oxford University Press, 1995) are only a few of the efforts that have been made to summarize this field. The latest addition is *Optical Coherence and Quantum Optics* by Leonard Mandel and Emil Wolf. But—what is quantum optics?

The idea that light is a wave, supported by the numerous observed interference phenomena, was generally accepted during the last century. Then, at the end of that century (1889) Max Planck postulated that light is not continuous but comes in bunches or, as he called them, quanta. This discovery marked the beginning of a new era in physics. In 1917 Albert Einstein found that the process of stimulated emission of radiation, that is, a light quantum interacting with an excited atom, can stimulate the emission of a second light quantum. This is the fundamental process driving a laser. The theory of quantum mechanics as developed by Paul Dirac, Werner Heisenberg, and Erwin Schrödinger in the mid 1920s describes the microscopic world, comprising such entities as atoms and molecules, where Isaac Newton's theory of classical mechanics fails. However, quantum mechanics also applies to the electromagnetic field, and the resulting quantum theory of radiation puts the insights of Planck on a solid foundation.