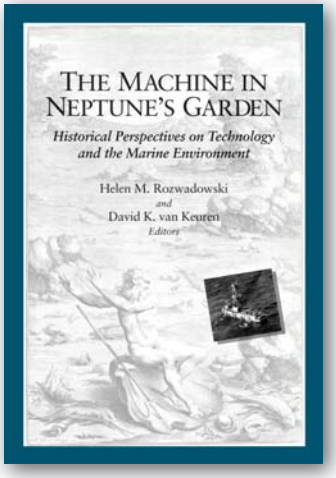
The Machine in Neptune's Garden

Historical Perspectives on Technology and the Marine Environment



Edited by Helen M. Rozwadowski and David K. van Keureni
Science History Publications, 2004, 399 pages, ISBN 0-88135-372-8, $49.95

REVIEWED BY JOHN KNAUSS

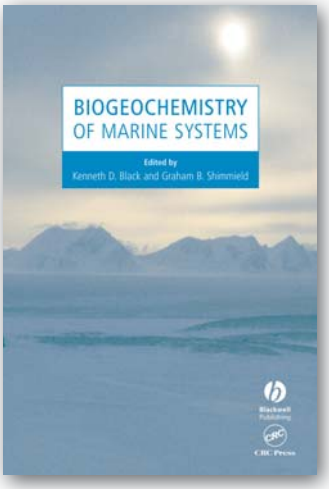
One measure of our science's maturity is that there are now a small but growing number of historians of science specializing in oceanography. In the United States, they meet periodically at Maury conferences where papers are presented and discussed. This volume contains the results of Maury III held in June 2001 at the Monterey Bay Aquarium Research Institute. The subtitle, "Historical Perspectives on Technology and the Marine Environment" is an apt description of nearly all ten contributions that comprise this text.

Except for the first two papers, the development of tide recorders and tidal records in Great Britain in the first half of the nineteenth century and the contributions of Henrick Mohn (1835-1916) to our understanding of oceanic circulation, the remaining eight chapters focus mostly on post World War II work. In order, they discuss: (3) Woods Hole director Columbus Iselin and his institution's heroic efforts to assist the navy in a variety of ways during World War II; (4) the role of Scripps in the first atomic bomb tests, the use of radioactive fallout as an oceanographic tool, and, later on, Scripps scientists' use of radioactive material for studying oceanic processes; (5) the combined efforts of many, including a number of false starts, to establish a systematic system of recording instruments in the North Pacific that in time became the TOGA/TAO array that, today, successfully monitors El Niño events; (6) a crisp history of ocean drilling beginning with the first tentative efforts of the oil industry in the Gulf of Mexico and culminating with the Ocean Drilling Program and the *Glomar Challenger* drilling ship that has contributed so much to the scientific revolution of plate tectonics; (7) a once over lightly survey of Norwegian fisheries science with emphasis on the use of sonar acoustics in that development; (8) Mary Sears (one of the first women oceanographers, a long time staff member at Woods Hole, and an early editor of *Deep Sea Research*), mostly focusing on her time in the Navy as a Wave officer during World War II; (9) the hydraulic model of Chesapeake Bay (first proposed in 1965, finally completed in 1978, and scrapped in 1983), possibly the largest hydraulic model ever built, certainly the largest in the United States—more than 1000 feet long, 650 feet wide, and at its largest dimension held 450,000 gallons of water; at the time of conception, computers were not large enough or fast enough to compete, but by the time the model was completed they were gaining fast; (10) the planning during the sixties of an artificial island some 2000 feet offshore of Scripps, connected by a causeway or bridge, and how, in time, enthusiasm waned, estimated costs increased and the project abandoned.

Many of the authors of the post World War II papers emphasize the growing role of oceanographers and oceanography both politically and scientifically. For one who grew up during this period (I began my oceanographic career in 1951), I found these articles interesting and, with a few minor exceptions, I have no quarrels to pick with either the stories the authors tell or their interpretations. As professional oceanographers, we have some responsibility for knowing a bit about the history of our field. This book will contribute to that education.

John Knauss (*jknauss@gsosun1.gso.uri.edu*) *is Professor and Dean, Emeritus, Graduate School of Oceanography, University of Rhode Island, Narragansett, Rhode Island, United States of America.*

Biogeochemistry of Marine Systems



Edited by Kenneth D. Black
and Graham B. Shimmield
Blackwell Publishing, CRC Press,
2003, 384 pages, ISBN 0849328187,
hardcover: $139.95

REVIEWED BY ADINA PAYTAN

Steamy, humid mangrove forests; clear blue waters with colorful coral and fish; large river mouths and iceberg-covered coasts; meter-long tubeworms in the dark oceanic abyss: what is common to these very distinct marine environments? They all represent complex systems where biogeochemical processes take place to shape Earth's surface. Biogeochemical research, the balanced study of the mutual interactions (and feedbacks) between the biology and chemistry of the Earth system, is fundamental to our understanding of global change and its consequences and thus assumes a pivotal role for society.

The book *Biogeochemistry of Marine Systems*, edited by Kenneth Black and Graham Shimmield, gives an unusual and unique perspective: "a system approach" rather than the more traditional overview of biogeochemistry centered on "element cycling" or "global processes." This is a well-written, up-to-date review of the fundamental mechanisms and interactions operating in some representative marine systems. The book could serve as a nice introduction, reference guide, and source of current literature for students and researchers interested in an overview of any of the specific systems presented in the book (mangroves; coral reefs; fjords; the Mediterranean, Arctic, Arabian, and European shelf seas; the Northeast Pacific; and hydrothermal vents and seeps). It is unlikely to be used as a textbook or read by students or researchers interested in a global, general perspective of marine biogeochemical processes as it fails to emphasize the common aspects fundamental to all systems.

The book is an assembly of rigorous case studies of specific systems chosen to emphasize different marine settings, and thus covers a range of forcing factors and processes. The first chapter, "Mangroves of Southeast Asia," presents a high-productivity, low-dissolved-nutrients coastal system with a high capacity for retaining and recycling nutrients within the system. The nutrient dynamics are linked to the mangrove forest vegetation and structure. The second chapter, "Coral Reefs," also pertains to a high-productivity, low-nutrients coastal system; however, different processes, spatial arrangements, and rates are at work. The chapter discusses the stoichiometry and mechanisms that govern nutrient dynamics in coral reef systems, in particular, the hydrodynamic controls on nutrient mass balance. Chapter three, on "Fjords," deals predominantly with biogeochemical processes that result in oxygen depletion, denitrification, and sulfate reduction in both sediments and the water column. In the fourth chapter, "The Eastern Mediterranean," an oligotrophic, land-enclosed basin is described with significant emphasis on links to water circulation. In Chapter five, the geographic (small sea with a wide, shallow shelf area) and climatic characteristics (strong seasonality, sea-ice cover, large river discharge) are related to ecosystem structure and function of "The Arctic Seas." The "Arabian Sea" chapter (six) represents a highly productive area with severe oxygen deficiency in the water column. Bacterial productivity and heterotrophic abundances are also discussed in relation to the pelagic food web. The remote, deep, cold, dark habitats of the abyssal plain of the Pacific (corresponding to two-thirds of the global seafloor) are discussed in chapter seven, and the deep-sea hydrothermal vents and their unique characteristics are presented in chapter eight. The last chapter assumes a different flavor, and rather than emphasizing a specific system, it provides a summary of nutrient sources, sinks, and cycling and of the control of nutrient distribution on plankton composition.

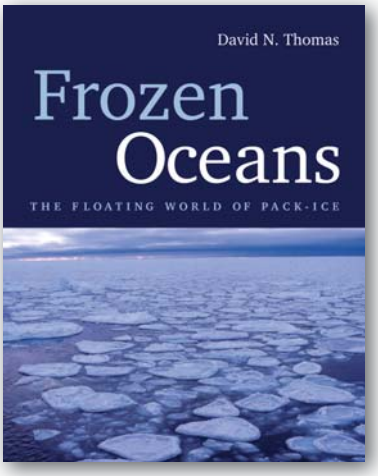
Thus, the biogeochemical forcing and ecological consequences of nutrient dynamics on ecosystem structure are examined with emphasis on the coupling between coastal and pelagic, and terrestrial and marine environments.

There is an attempt to provide a common structural thread to all chapters. Each chapter starts with a description of the main geographic and hydrographic features of the system, continues with a presentation of the biogeochemical interactions, and concludes with some remarks about environmental change. This structure, although providing a link among the different chapters, necessitates that a large fraction of the book be devoted not to biogeochemistry, but rather to the physical setting unique to each system. On the other hand, because the fundamental biogeochemical interactions (e.g., primary production, respiration, assimilation of nutrients, redox chemistry) have parallels in all the systems, some redundancy could not be avoided when taking the "system approach." Despite these limitations, the book certainly provides a comprehensive introduction to the major biogeochemical processes operating in the various systems presented, and it serves as a great starting point for any one interested in learning more about and conducting research in these specific marine systems. The bottom line: this book is a wonderful resource for students or researchers, especially those desiring an introduction to specific marine systems, and a list of the primary literature related to those systems. However, the reader will need to search elsewhere for a more global picture of marine biogeochemistry.

Adina Paytan *(apaytan@pangea.stanford.edu) is Assistant Professor, Geological and Environmental Sciences, Stanford University, Stanford, California, United States of America.*

Frozen Oceans

The Floating World of Pack Ice



A Book by David N. Thomas
Firefly Books Ltd., 2004, 224 pages,
ISBN 1-55407-000-7, hardcover: $45.00

REVIEWED BY HAROLD WELCH

Frozen Oceans by scientist David N. Thomas is a glossy, well-produced book with nearly 200 color figures and photos, an introduction to polar and subpolar pack ice regions of the northern and southern hemispheres. Pictures are generally high quality but the reader will wish there were a few more that illustrate specifics. The writing is straightforward and concise, reminiscent of scientific papers, with little deviation from the presentation of facts. There is a great deal of information given in an accessible, if somewhat dry, manner. None of the material is referenced, which makes the book easier to read, but this means there is no way to access the sources for the facts given—they have to be taken on faith. However, I noted only a few minor factual and editorial errors, which gives one confidence that the content is well researched and accurate.

The layperson who perseveres will find the book very rewarding, even if not always easy to understand. Oceanographers and people with some first-hand knowledge of either the north or south polar regions, or science in general, will find the going easy and interesting. The subject of frozen oceans is covered very thoroughly, with virtually every aspect touched upon no matter how cursorily.

Dr. Thomas approaches the subject logically. The first third of the book is

a thorough presentation of the physics, chemistry, meteorology, and geography of sea ice formation, within an overall global climate setting. If you are unsure what nilas is, or the keel depth of an iceberg, you will find the answer here. Did you know that ice from icebergs off Newfoundland is used to make vodka? I didn't either. There is even a description of the ice cover on the Caspian Sea, something few oceanographers know anything about. The book has an excellent discussion of the seasonal extent of ice cover, and the currents and winds that drive the movements of pack ice in the Arctic and Southern oceans. The author discusses the implications of recent changes in sea ice thickness and distribution for climate change, summarizing much of the knowledge generated by satellite coverage and putting it in historic context.

Dr. Thomas then proceeds to the microbiology of sea ice, beginning with a good description of life within a block of ice, in-depth coverage that is at least as detailed as the previous chapters on physics. The roles of protozoa, bacteria, and even viruses in the internal ice community are discussed. Primary production (photosynthesis) by diatoms and other ice-adapted algae, and nutrient sources and sinks, are presented and put in context both within the polar oceans and for the globe, where the polar oceans account for some 6.5 percent of Earth's total productivity.

Next come the animals in and around the ice. The all-important crustacea, primarily amphipods, copepods, and krill receive adequate treatment, but here the author becomes a bit more superficial. Ice-associated fish, for example, are covered in three short paragraphs. There are two pictures of Antarctic fish, but none of the polar cods. In the next chapter, "Life under the ice," the author has a good discussion of the fate of organic matter released from the ice, but relatively little information on the benthos of polar seas, which will come as a disappointment to those who know that benthic biomass is remarkably high in ice-covered polar seas, often reaching a kilogram or more per square meter. There is discussion whether oxygen controls organism size but no mention of the vast quantities of brittle stars, bivalves, and other benthos that consume a high percentage of the primary production in shallow polar waters and entirely support populations of bearded seals and walrus. A single chapter is devoted to mammals, birds, and the ice. Given the high general interest in ice-associated macrofauna, this chapter is again a bit sparse, and the author misses some opportunities to present interesting facts, such as walrus sucking off several thousand of *Mya truncata* siphons and *Serripes groenlandica* feet daily—without ingesting any of the shells of these arctic bivalves.

The book ends with chapters on studying the pack ice, and pack ice threats and potential. Of some 195 illustrations, about 30 show various scientific activities, so you know that the scientists, at least, are well covered.

I have only one major criticism of *Frozen Oceans*; it emphasizes the south polar region about three-fold over the north polar region. For example, there is no picture of the typical meltpond seascape that characterizes all flat Arctic ice in summer. Circumpolar Inuit are the only people that heavily depend on the products of sea ice, yet there is no discussion of this important top consumer and their traditional knowledge of fish, mammals, and seabirds in the Arctic. An Antarctic food web, with four trophic levels from primary producers to top predators, is shown, but no food web for the Arctic. This is an important omission because one characteristic of north polar food webs is that the food chain is very long, with five trophic levels from primary producers to the top predators, bears and humans, and four to seals and the toothed whales. The long food chain in turn concentrates mercury and fat-soluble organic pollutants that threaten the existence of narwhal and polar bear, and make Inuit mothers' milk toxic to their children.

The role of Arctic cod, a strongly ice-associated fish, is barely mentioned, yet it is a keystone species that mediates energy flow from herbivorous crustacea to ringed and harp seals, narwhal, beluga, northern fulmar, and thick-billed murres. Ringed seals are a quintessential ice species, but little of their biology is presented. The spectacular Arctic bird cliffs, where millions of ice-associated guillemots, murres, dovekies, fulmars, and gulls congregate to breed are not shown.

Threats to the Arctic ice-associated ecosystem also receive cursory treatment, with no mention of the typical air currents that transport Eurasian pollutants into the Arctic. For example, on 12 April 1988 a single event dropped 12,000 tonnes of soil from the deserts of western China onto the northwest coast of frozen Hudson Bay. Mercury concentrations in the snow over Arctic ice are often one hundred times higher than

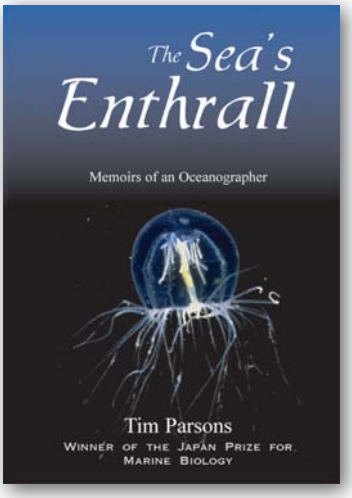
they are in snow south of the polar pack. Ready movement of contaminants from the industrialized northern hemisphere to the ice is one very important difference between the Antarctic and the Arctic. Another important difference is the presence of *in situ* oil and gas development in ice-covered northern seas. One wonders how the Northwest Passage will fare if liquefied natural gas tankers transit the Passage day and night throughout the year, as has been proposed. The Antarctic is mercifully free of such resource-extraction issues.

These are, however, relatively minor criticisms of an overall very good book. There is much in here for anyone interested in some aspect of frozen oceans, and no matter how qualified the reader, it will definitely be a learning experience. *Frozen Oceans* will be an important popular reference as well as a fun read for anyone remotely interested in polar oceanography.

Harold Welch *(buster@fishquilt.com) is a retired marine biologist with Fisheries and Oceans Canada. He has worked seven winters and twenty five summers conducting research in the Arctic, most recently spending fourteen months aboard the Canadian icebreaker* Des Grosseiliers *as leader of the biological component of the SHEBA (Surface Heat and Energy Balance of the Arctic) ice drift experiment.*

The Sea's Enthrall

Memoirs of an Oceanographer



A Book by Timothy Parsons
Ecce Nova, 2004, 187 pages, ISBN 0-9731648-7-5, paperback: $19.95

REVIEWED BY DAVID W. TOWNSEND

The name Timothy R. Parsons is immediately recognizable to biological oceanographers. Most of us have routinely used one or both of his manuals of sea water analysis (the first published with J.D.H. Strickland in 1965; the second with Y. Maita and C.M. Lalli in 1984), or we used as students (or teachers) the first *bona fide* textbook on biological oceanography, published with M. Takahashi in 1973 (and which also saw later revisions). In nearing the end of a remarkable career, Parsons tells us here, in simple language and few words, a short story of his life, from his early childhood years in England and Ceylon, up to and including his winning The Japan Prize in 2001. He brings us through his life's landmark events—both personal and professional—and introduces us to his most unforgettable characters, including that special science teacher to whom he credits his pursuing a career in marine science (most of us can relate, I am sure). He shares with us intimate aspects of his personal life and high points in his scientific career, all the while weaving in his political views on the environment.

Having decided that he wanted a career in "something in biology," Parsons left England for Canada and McGill University where he would study the only field of biology he was aware of at the time—agriculture. His interest in analytical chemistry subsequently led him to pursue his Ph.D. in biochemistry. From McGill, Parsons took his first job in Nanaimo, British Columbia, working under John Strickland at the Pacific Oceanographic Group of the Fisheries Research Board of Canada. Those early years helped to form the scientist we have come to know today. "Violently seasick and retch[ing] constantly..." on

his first oceanographic cruises, Parsons' career would soon take off. Time spent at UNESCO shored up his international perspectives on fisheries and environment-related matters, while exposing him to cultures and political bureaucracies of various nations. Those experiences appear to have served him well when he made his transition to academia, taking a post at the University of British Columbia where he would spend much of the remainder of his career.

Parsons' general views on the philosophy of science surface in several places, and his anecdotal accounts are at times reminiscent of episodes that many of us can recall having experienced at one time or another. In his early attempts to win research grants (e.g., in 1972), he became frustrated with the same pervasive focus held today by many funding agencies: that scientific research must be hypothesis-driven. His views on ocean pollution may surprise some readers: he argues for what he feels to be a more even-handed perspective with regard to environmental policies, stressing that we will not "kill the planet," and indeed, that the ancient ocean was also polluted as a result of greater volcanic activity long ago. No doubt some readers will be taken aback by Parsons' seeming defense of the harvest of harp seals, and his almost relegating to insignificant the environmental damage caused by oil spills. But no one can accuse Parsons of not speaking his mind. Whether it is his views on fields of oceanographic research ("mud sucks"), or university politics, he lays bare his feelings.

The field of fisheries oceanography became for Parsons almost a passion, and he describes his work to advance the scientific study of fisheries as his most significant. While successful in advancing the field, he did not prevail, ironically, in his attempts to establish an institute at his own university that married fisheries science and oceanography. His limited ability to maneuver in the murky world of university politics would thus represent one of his greatest failures; in frustration, he took early retirement.

Travel, family affairs, and professional consulting now occupy his time. Parsons relates some of these stories to the reader, almost as an afterthought, before he concludes his memoirs by sharing with us his winning the prestigious Japan Prize.

That the book is too short and spotted with typographical errors does not detract from Parsons' having achieved his goal, which, I presume was to reveal who he is and what he believes in. But, I wish he had written more.

David W. Townsend *is Professor of Oceanography and Director, School of Marine Sciences, University of Maine, Orono, Maine, United States of America.*

Books Received for Review

An Introduction to Ocean Remote Sensing
by Seelye Martin, Cambridge University Press, 426 pp.

Changing Sea Levels: Effects of Tides, Weather and Climate
by David Pugh, Cambridge University Press, 258 pp.

Surf Science: An Introduction to Waves for Surfing
by Tony Butt and Paul Russell with Rick Grigg,
University of Hawaii Press, 142 pp.

Upcoming Events

American Meteorological Society
85th Annual Meeting & Exhibition
January 9-13, 2005
San Diego, CA USA
www.ametsoc.org/meet/85annual