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.

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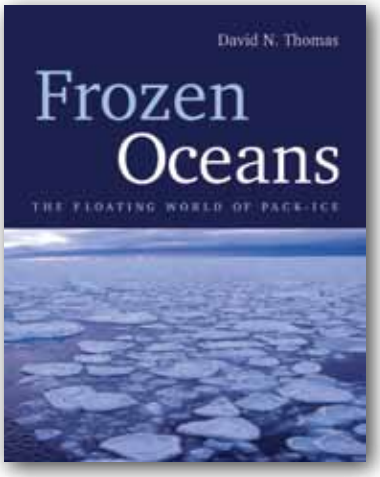
Frozen Oceans

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

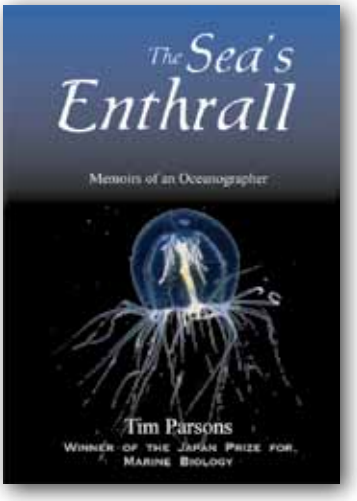
they are in snow south of the polar pack. Ready movement of contaminants from the industrialized northern hemisphere to the ice is one very important difference between the Antarctic and the Arctic. Another important difference is the presence of *in situ* oil and gas development in ice-covered northern 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