

1821, his edition of the private journal of Robert Hood, midshipman to John Franklin on the first Arctic Land Expedition. Ten years later, Houston has come out with the journal of John Richardson, Franklin's surgeon-naturalist on that same expedition. Thanks to Houston's considerable efforts, readers now have access to three firsthand accounts of that ill-fated geographical undertaking, for Franklin's own narrative version was published in 1823 and has been recently reprinted. Reading all three accounts would not be redundant, for Hood, Franklin, and Richardson were not always together, and one account often fills in where another leaves off. More importantly, though, even a single experience achieves numerous facets as it is refracted through the media of multiple consciousnesses. One can, as W. Gillies Ross suggests in the Foreword, use the three perspectives to "assess the effectiveness of the operation," or if one is less inclined to judgement, simply to become more familiar with the personalities of the men engaged in this exploratory journey that ultimately led to the death of over half the party.

Arctic Ordeal, unlike the journey it documents, is rich and luxurious. Several features of the book demonstrate that it has been designed with the reader's pleasure in mind, features that distinguish it from many scholarly editions of exploration records. The most obvious distinguishing characteristic is the strong visual component. Profusely and finely illustrated with drawings by H. Albert Hochbaum, *Arctic Ordeal* is an attractive book, regardless of the tale it tells. Another feature that distinguishes Houston's book is the use of modern topographical maps upon which Franklin's daily progress is charted. The editor has gone to great lengths to mark every compass bearing and measurement that Richardson's journal records. It is most unfortunate, however, that the maps themselves are barely legible, appearing more like grey rectangles across which heavy black lines and numerals are traced. Even on close examination, when the grey "blanks" reveal themselves as maps, the topographical markings are too vague to be of use. Not only does this production error interfere with the attractive visual format intended, but it also confounds Houston's desire to impress upon the reader the great accuracy of the expedition's bearings in comparison to modern geographical survey work.

The arrangement of Richardson's journal also sets *Arctic Ordeal* apart. Tedious botanical and zoological descriptions have been excised from the journal itself, an editorial deletion that enhances the narrative vigour of Richardson's account, although Houston is regrettably vague about whether deleted passages can always be found in the appendices or if they have been discarded. In a similar move calculated to maintain the energy and flow of Richardson's account, Houston has interspersed — within the texture of the daily journal entries — a report Richardson prepared for officials in Great Britain. No journal entries appear for the period October 8–29, 1821, in Richardson's manuscript, and as the events of that same period are dealt with in Richardson's official report, Houston has dovetailed the report into the journal. The alteration of (and addition to) the journal makes it more accessible and appealing as a self-contained tale.

An editor of historical documents must decide the extent to which he wishes to manipulate his material and the extent to which he wishes to transcribe it faithfully. Houston has chosen wisely, I think, as *Arctic Ordeal* maintains the excitement and tension that were essential characteristics of the experience Richardson documents. No doubt, some will disagree with Houston's decision and will object to such manipulations of what they claim is an autonomous and inviolable text. But Houston willingly risks such charges so that he may re-create Richardson's experiences for the lay reader. *Arctic Ordeal* is not merely a scholarly edition of an historical document, but as was Franklin's *Narrative of a Journey to the Shores of the Polar Sea*, it is a book designed to satisfy the curiosity of an intelligent and educated audience that wishes to know what brought about the dramatic events that took place on the first Arctic Land Expedition and how they affected the men involved.

I should like to clarify one issue. On page 216 of *Arctic Ordeal*, Houston refers to "the recent reprint of Franklin's journal." In fact,

Franklin's journal remains in manuscript form in the Scott Polar Research Institute; it has never been published, much less reprinted. Houston means, of course, Franklin's "narrative." Although nothing more than a slip of the pen in this particular instance, the failure to distinguish between Franklin's "journal" and his "narrative" has, at other times, led to unfortunate circumstances. Franklin kept a daily journal of events as they transpired, as did the officers under his command. But upon returning to England, only Franklin prepared a shorter narrative version tailored for public consumption. Upon numerous occasions, Houston remarks that Franklin is more timid in his description of events that might offend his audience than is Richardson, as when the practice of eating warble fly larvae is mentioned or when the abdominal or scrotal incisions to relieve Adam's oedematous swelling are reported. But had Richardson been writing for a general audience, he too might have been less frank in his descriptions. To compare Franklin's published narrative to Richardson's official journal and then to draw conclusions about the authors on this basis is treading on ice thinner than Franklin would have cared to cross.

The more serious consequence of not distinguishing between journal and narrative, however, is that the public easily forgets that the journal of the commanding officer remains in manuscript, while the journals of two of the three officers under him have been published and the journal of the third officer — George Back — has, according to the Preface of *Arctic Ordeal*, been recently transcribed. This irony arises, no doubt, because of the availability of Franklin's *Narrative of a Journey to the Shores of the Polar Sea*. But that account is no substitute for his official journal; it is less than half the length of the unpublished daily record and is directed at a totally different audience.

I should not wish to close this review of *Arctic Ordeal* on anything but an affirmative note. After all, Houston is now single-handedly responsible for publishing two of the four daily logs kept by officers of the 1819–1822 Franklin expedition. And Houston's book will undoubtedly gain the wide readership for which it is designed and that it deserves.

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THE ALASKAN BEAUFORT SEA: ECOSYSTEMS AND ENVIRONMENTS. Edited by PETER W. BARNES, DONALD M. SCHELL, and ERK REIMNITZ. Orlando, FL: Academic Press, 1984. 466 p. US\$39.

"The period of most direct contact between scientists and public policy makers in the Beaufort Sea, 1977–1981, was also marked by pioneering approaches to arctic field studies and to analyses of the resulting information. Some of these innovative approaches (and results) are documented in the present volume" (p. 16). This quote from the Introduction conveys the essence of the book. Most of the information was collected to assess the consequences of offshore oil exploration along the Alaskan Beaufort Sea coastline. The usefulness of the information for these purposes is clearly demonstrated by its inclusion in the special conditions for arctic leases, as mentioned in the Introduction on research history by Weller and Norton.

The information collected for assessment is valuable for inherent scientific reasons; thus, publication of the book is scientifically significant. Most of the information has appeared previously in government reports, but publication of the book makes significant research results much more available. The following paragraphs describe some of the results.

The general westward drift of the Beaufort Sea gyre's southern edge is well known. A subsurface easterly counter-current, the Beaufort

Current, and its driving forces are analyzed by Aagaard. The current is below 30 m, the "Ekman depth" in the Beaufort Sea. Other papers show that the subsurface current carries biologically productive water from the Chukchi Sea and Bering Strait into the western Beaufort Sea.

The monsoon characteristics of the seasonal winds are described by Koza. Although the value of his paper is not affected by the small printing error, the dashed line in Figure 3 of his paper should be solid, and vice versa.

Regional ice motion in the Beaufort Sea gyre is modelled by Pritchard. Interestingly, during each month the mean movement is always greatly exceeded by even the relatively short-term (50 yr) statistical variance, especially in the eastern U.S. portion of the Beaufort Sea.

Two papers discuss the potential hazards of ice motion to structures: the forces responsible for ice ride-up and pile-up on shores are analyzed by Shapiro *et al.*, and the thickness of ice blocks in piles and ridges is analyzed by Tucker *et al.* The latter paper shows that in the grounded ice zone (20–40 m), where the movement of the pack ice becomes restricted, over 30% of the ridges are composed of ice blocks over a meter thick.

The book contains three papers that discuss gouging of the seafloor by ice keels. Reimnitz and Kempema examine the relationship of the location of offshore shoals to the formation of grounded ice ridges that resist the shoreward advance of the thick pack ice. This paper documents the extensive shoals in the Alaskan Beaufort Sea and their widespread influence on the formation of the grounded ice zone.

A paper by Barnes *et al.* includes the first regional maps on the densities of gouges on the western Beaufort Sea shelf. As diagrammed humorously by Barnes on page 193, the maximum observed gouge relief can exceed the height of a typical highway bus.

A third paper on ice gouging by Weeks *et al.* is a statistical analysis of gouge depths and the recurrence rates of gouges near Prudhoe Bay. Analyses of this type are crucial to the safe burial of offshore pipelines, which may be up to 7 m deep over a project lifetime of 100 yr.

One other very interesting paper on the physical environment is an assessment by Thomas of the probable fate of an under-ice oil blow-out. He concludes that most of the oil is likely to freeze into the local ice cover. One shortcoming of the assessment is a lack of discussion of the probable fate of hydrocarbons that dissolve rapidly into the water. Recent research by J. Payne and L. Hachmeister (pers. comm.) shows that some soluble fractions of hydrocarbons may be transported to deep water in weak under-ice currents, similar to the subsurface current described by Aagaard in this book.

The papers on biological processes include an enumeration of Beaufort Sea phytoplankton by Horner. She discusses two new perspectives: (1) cold-water oceanic phytoplankton may only rarely be nutrient-limited, and (2) a typical spring and summer bloom of phytoplankton may not occur on the outer part of the shelf.

A second paper by Dunton regarding primary production focuses on an unusual arctic kelp community and the carbon budget of its consumers. Much kelp production occurs before the ice cover breaks up. Production during this period may be reduced 30% if sediment is incorporated in the ice cover, effectively blocking light transmission. The processes by which sediment becomes incorporated into the ice cover are the subject of a separate paper by Osterkamp and Gosink.

An excellent review of information on bacterial populations is provided by Atlas and R. Griffiths. They found higher densities of viable bacteria in Beaufort Sea coastal surface waters than in similar waters of the eastern Bering Sea or northern Gulf of Alaska. The authors attribute the high density partly to the magnitude and briefness of the inner-shelf plankton bloom, which is grazed inefficiently and subsequently becomes food for bacteria. They also document a seasonal metabolic shift for bacteria from rapid utilization of carbohydrates during the brief summer to slow utilization of primarily carboxylic acids from detritus during winter. The seasonal metabolic shift, and possibly the high observed density of bacteria, are related to peat that erodes into coastal waters during fall storms, an input that is described by Schell (1983) as a "fossil fuel subsidy."

The paper on the distribution of seabirds by Divoky describes the

relatively dense concentration of seabirds in the western Beaufort Sea, which demonstrates the influence on plankton production (seabird food) of the Beaufort Current described by Aagaard. Divoky also describes the typical decrease in seabird biomass with increasing distance from the shore. Diving species are rarely sighted offshore in the Beaufort Sea because, as he explains, "surface feeders are able to feed where prey densities are low because they can search for food while flying, whereas diving species require more abundant and reliable food sources" (p. 431).

Two thorough syntheses of trophic information are included in the book, one for a shallow coastal lagoon by Craig *et al.* and another for the adjacent nearshore waters by Frost and Lowry. In the coastal lagoon the primary upper-level consumers are birds and fish, while in the adjacent nearshore waters upper-level consumers are primarily marine mammals. Additionally, food is apparently always abundant during summer in the coastal lagoon, while food supply may be limited at times in the nearshore waters. However, food in the coastal lagoons may become depleted during the late winter (Newbury, 1983; Craig, 1984), suggesting that consumers in both food webs may be vulnerable to long-term declines in food supply.

The above two biological syntheses are excellent; however, I miss the emphasis on review and synthesis in some of the other subjects. One subject in particular that is not well reviewed is the abundant information from recent studies of the distribution and behavior of bowhead whales. While an emphasis on review is missing in some papers, their complementary nature is an impressive aspect of the book. The interrelationship of the papers reflects excellent editing, research program planning, and synthesis meetings attended by all of the investigators, as mentioned in the Preface and Introduction. The quality of all of the papers is as high as those in international journals. Considering the potentially broad appeal of the book, the exclusion of the titles from the references is unfortunate, especially since some of the references are in relatively obscure government reports. Regardless, this book will be useful to arctic scientists and research managers in all countries. It is certainly the best reference work on the Beaufort coastal shelf that has appeared in a decade and very effectively conveys the uniqueness of arctic shelves.

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ICE DRILLING TECHNOLOGY, PROCEEDINGS OF THE 2nd INTERNATIONAL WORKSHOP/SYMPOSIUM ON ICE DRILLING TECHNOLOGY, CALGARY, ALBERTA, CANADA. 30-31 AUGUST 1982. Edited by G. HOLDSWORTH, K.C. KUIVINEN and J.H. RAND. Hanover, New Hampshire: U.S. Army Cold Regions Research and Eng. Ab. Special Report 84-34, December 1984. 142 p. 24 papers, Preface, Introduction, List of Registrants.

Over 30 years ago the first modern approach to studying ice masses by drilling was made by the British-Swedish-Norwegian expedition to Antarctica. Since then both drills and the methods of analysing the cores have improved. A major advance was made with the CRREL thermal drill in Greenland when a surface to bedrock core was drilled to over 1000 m depth at Camp Century in 1966. Dansgaard's ambitious and successful analysis of the 100s of oxygen isotope samples and Langway's earlier analysis of the chemistry and structure of a