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 Kozo. 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 blowout. 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 soluable 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

shorter core from the same place showed the enormous potential of ice cores for paleoclimatic studies. For the first time it was clear that the large ice caps were archives of more than just the last few thousand years of climate. Very recently the Russians have penetrated through the last Interglacial in eastern Antarctica. Perhaps several glacial pulses are buried there.

Some of the problems confronting ice drillers include the world's lowest temperatures and the fact that ice, unless compensated, will fill the hole behind the drill if the hole exceeds about 400 m. This means the design of very special drills working in toxic liquids that keep the borehole open.

The Calgary workshop brought together some of the world's experts on ice drilling to present and discuss their various approaches to wresting ice cores from the world's ice caps and ice sheets. This book presents the papers presented at the second workshop on ice drilling. It comes almost a decade after the first workshop, which was held in Nebraska. An introductory overview of ice drilling technology by Hansen briefly looks at the history of ice drilling in a statistical way and serves to introduce the reader to the volume.

There are two basic types of ice drill, one that melts and the other that cuts its way down through the ice. The drills may differ slightly, depending on whether they are used for temperate glaciers (i.e., where the temperature throughout is close to 0°C) or polar ice. Boreholes of less than 300 m can be drilled without a filling liquid. Below that, the requirement for a filler to prevent borehole closure increases design complexity. This volume shows that there is still no agreement on whether the thermal drill is superior to an electro-mechanical drill for deep (>500 m) holes. The very complete paper by the Danes on their drill initially slants the reader in favour of cutting rather than melting. They successfully drilled just over 2000 m in southern Greenland with excellent core recovery. This drill is the only one that packs its cutting power at the drill head rather than transmitting it the full length of the cable from the surface. This feature has obvious benefits when compared to all the other drills. It carries a very light cable and its total weight, including the winch and tower, can be packed in a STOL aircraft, which has an obvious advantage for operations in the world's most remote regions. However, the French (Donnou *et al.*) appear to be moving in the thermal direction in their Antarctic operations. Furthermore, the Russians (Kudryashov *et al.*, Bogorodsky *et al.*) have already exceeded 2000 m depth in the world's coldest ice in Eastern Antarctica with a thermal drill. Drilling continues there with a thermal drill of improved design.

Rufli's contribution to drilling is seen in at least three papers, where the electro-mechanical intermediate (20–500 m) drills owe something to his designs.

New materials that can be used to decrease the weight but not the weight of drills are discussed (Koci) and have been used in an encouragingly light shallow-drill. This drill has been used in Greenland, Peru and Antarctica (Koci) as well as Alaska (Benson). It has already proved its worth and should be used for any cores destined for analysis of recent pollutant trends in polar ice.

Hot water drills are being used increasingly these days either for access holes to the water underneath ice shelves or to string sensors between the ice surface and bedrock. Taylor considers the theoretical approach to these drills and describes their use in temperate ice. There is, however, an astonishing range in the power requirements of these drills. These range from megawatt inputs in the Browning jet-drill (Koci) to a blowtorch in the Russian one (Morev *et al.*). One needs several C-i30s to transport it, while the other needs only a small sled. They do, of course, have quite different performances, but the larger one seems guilty of overkill.

The main value of this book is that it brings together, more than any other single volume, the latest state of the art in ice drilling. Any organisation starting in this discipline can use the volume to guide it toward the most appropriate approach, using, of course, the associated references. There are no papers on handling or the analysis of ice cores; this could be the subject of a workshop in itself. Many of the papers are well backed up with drawings of the equipment, although a few of these are barely readable. My main criticism is that it is sometimes difficult to get at all the information. Some authors do not give a meaningful weight of the equipment, and this is important in a field discipline. Some give total equipment weights but others only give the drill weight or the tower and winch weight. If each author had been asked to include a formatted table of drill specifics the volume would be worth a lot more. The Japanese drills (Suzuki) are well described in this respect, with a page-length table. It is similarly difficult to find the power requirements of many drills, although it is clear that some of the PICO and Russian drills have power requirements that only a major or well-established station provide. As might be expected with multi-national authorship, the units are inconsistent. For example, in one operation we are told that 89 *m* of casing was removed one year but 45 *ft* added the following year. Breaking loads are quoted in N, KN, kN and kg. Considering that engineers with their unconventional units are involved, one should, perhaps, not complain.

The volume is not expensively produced and not sturdily bound. I would not criticise the modest quality of production but I would much prefer a sturdier binding; pages will soon come out if you use the book a lot.

To sum up, if you are in the business of ice drilling you should have this book. The organisers, especially Holdsworth, deserve congratulating on convening the workshop and putting together such a useful volume.

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OUR ARCTIC YEAR. By VIVIAN and GIL STAENDER. Anchorage: Alaska Northwest Publishing Co., 1984. 149 p. Softbound. US$12.95. Cdn$15.50.

This book is an intimate anecdotal record of a "once-in-a-lifetime" experience shared by two persons who have a profound reverence and respect for wild life and its habitat. The story they tell shows their deep concern about the damage that can so easily and thoughtlessly be done in a region where the balance of nature is extremely delicate and scars heal slowly. To read this book is to have much more than an intellectual experience.

The objective is surely to convey to the reader a sense of awe at the beauty of the Arctic and to arouse concern that a great natural resource could easily be lost. A main theme is the growth of a feeling of deep satisfaction when one's life is lived in harmony with nature, realizing that all life is a consistent system in delicate balance.

The less environmentally sensitive but intellectually curious reader would be well served if the narrative were set in a framework of broad factual knowledge of the Brooks Range region of Alaska, where the Staenders spent their arctic year, and of the Arctic in general. The introductory chapter of the book in its present form is inadequate, in the opinion of this reviewer. As the reader gets into the book, curiosity is aroused as to the locale of this adventure in wilderness living. We can understand the necessity for official silence, but it would be satisfying to see a map of Alaska in the book, with the general area of the Brooks Range clearly designated in relation to the Arctic Circle. We would like to have a comprehensive basic framework of meteorological, geographical and biological facts of the region. Is −70°F likely to be the thermometer reading some morning in the depth of winter? What about blizzards and the likelihood of being "snowed in"? How rugged and high are the mountains? What threat to human habitation do wolves present? What great migrations are likely to be observed? What is of special interest about the geology of northern Alaska?

We would like to know something more about the unique threats to