needs are for policy makers to become knowledgeable about the potential impacts of rising sea level, for high risk areas to be identified, and for information about sea-level change to be translated into various languages.

This comprehensive volume should be of interest to researchers and policy-makers from a variety of disciplines, including climate modelers, coastal geomorphologists and sedimentologists, governmental environmental agencies, and federal emergency management agencies. It is a valuable reference for both professional and graduate level researchers and provides chapters adaptable as reading or lecture material for graduate and undergraduate courses in global change. (Julie Brigham-Grette, Quaternary Studies Program, University of Massachusetts, Amherst, MA 01003, USA.)

THE CANADIAN HABBAKUK PROJECT. Lorne W. Gold. 1993. Cambridge: International Glaciological Society. 323 p, illustrated, soft cover. ISBN 0-946417-16-4. £33.00; US$60.00.

At a cursory glance, the casual reader might be excused for thinking that on picking up Lorne Gold's *The Canadian Habbakuk Project* he has in his hands a work of science fiction. To the uninitiated the very 'possibility of building ships of ice' (page 9), which comprises the subject of this work, might seem to be more appropriate to the pages of a Jules Verne novel than to those of a meticulously written account of one of the Second World War's more unusual scientific projects. Throughout, the author is concerned to dispel the 'science-fiction nature of the project' (page 58), and as a social history of technology the text does its utmost to allay any residual temptation to judge the wisdom of the project by modern-day standards.

The inspiration of ice as a construction material of war was that of Geoffrey Pyke, an 'eccentric individual' (page 19) as richly complex and unpredictable as the project that was to develop out of the 35,000-word proposal that he delivered to Mountbatten in October 1942. A man with a 'natural ability to do the unexpected and unorthodox' and whose 'ideas often bordered on the bizarre' (page 19), Pyke had nevertheless already successfully provided the imaginative impetus for 'Project Plough,' from which 'evolved the versatile all-terrain tracked vehicle' (page 19).

Pyke's proposition to Mountbatten was deceptively simple. He reasoned that winning the war required total mastery of the oceans and the provision of floating airfields. To achieve this required the construction of a radically new vessel built from an unusual but common material — ice. Ice, he argued, was cheap, easily produced, and could be used to construct 'bergships' that could be formed in any size, insulated and cooled to prevent melting, and made practically invulnerable to attack. In a context when Britain was suffering heavy losses at sea, Mountbatten was 'intrigued' (page 9) and Churchill 'impressed' (page 10). The former commented: 'Someone in Canada is alleged to have said "this scheme is so damned crazy that one has to take it seriously" ' (page 38).

Despite the project's British origins, it was immediately evident that substantial research would have to be undertaken on a large scale and in cold conditions. Canada was thus quickly involved. Contrary to Pyke's original assertions, this research revealed that ice alone was too brittle and uncertain in its properties as a construction material, precipitating a search for a reliable means of reinforcement. Extensive experimentation revealed that a combination of wood chips and ice formed a material sufficiently durable for the purpose of the project. It was named 'pykrete' in honour of the man who conceived the project. This new substance was repeatedly tested to destruction and on two separate occasions during high level meetings repelled revolver bullets with dramatic consequences. Once the bullet 'glanced off one of the senior officers' (page 55) and on another occasion 'the bullet that bounced off the block of pykrete struck the shoulder of the Chief of the Imperial Staff' (page 58).

The great potential and strategic significance of 'bergships,' coupled with the sketchy knowledge of the properties of ice and of experience in using it as a structural material, effectively neutralised opposition to the scheme. In combination, though, these factors were to prove its undoing. The move away from the initial concept of building 'bergships' from ice to the use of artificial pykrete compromised the simplicity of Pyke's original plan. Further complications arose as natural freezing was too slow for the size of the vessel envisaged and artificial refrigeration was required to produce sufficient quantities of reinforced ice. In addition, the projected size of the construction site; the amount of steel, timber, and machinery required; and a necessary workforce of 35,000 were sufficient to cause R.E. Chadwick, leader of the senior construction men in Canada, to comment that '[Habbakuk] is so far removed from the simple structure originally conceived that the project has lost all prospect of being either cheap or easy to construct' (page 52).

The radical new technology necessary for 'bergship' construction, although theoretically feasible, could neither be developed rapidly nor cheaply to be practical in a time of war. The project was consequently terminated on 14 December 1945. Perhaps the most fitting epitaph for the Habbakuk Project is embodied in a 1946 press release: 'A scheme of this magnitude undertaken in wartime is necessarily a gamble....Its failure, therefore, only serves to demonstrate the inevitable cost of pursuing a policy involving the backing of new and ingenious ideas. Such a policy appears fully justifiable in war' (page 314).

In many respects the structure of Gold's book reflects the meticulousness of the Habbakuk experiments that he details in the book's latter half. The work is clear, concise, well indexed, illustrated, and devoid of retrospective sentiment. The book is divided into two halves: the first a seven-chapter history of the project and the second comprising 13 appendices that constitute the bulk of the original scientific research carried out, complete with tables,

diagrams, and photographs. This material has been carefully edited and occasionally compressed. Appendix 4 is a conflation of two concluding reports, while Appendix 6 appears in an abridged form.

In achieving this level of clarity, Gold has followed the wishes of Dr C.J. Mackenzie, President of the National Research Council of Canada, who 'expected the story of the Canadian involvement in the Habbakuk project would be written up as soon as the work was declassified' (page 7). The synthesis of the 'single-drawer locked filing cabinet' (page 7) described by the author containing the Habbakuk records is far from a modest achievement, rendering this book of interest to technical and non-technical audiences alike. (Ian N. Higginson, Unit for the History of Science, University of Kent, Canterbury, Kent CT2 7NR.)

ARCHEOLOGY OF THE FROBISHER VOYAGES. William W. Fitzhugh and Jacqueline S. Olin (Editors). 1993. Washington: Smithsonian Institution Press. xvi + 271 p, illustrated, hard cover. ISBN 1-56098-171-7. £34.95; US$45.00.

This volume presents the preliminary results of a multi-disciplinary project investigating the physical remains of Martin Frobisher's three expeditions to Baffin Island in 1576–1578. Frobisher's first expedition was concerned with the discovery of a Northwest Passage, while the second and third were conducted expressly for the purpose of establishing mines to extract 'gold' ore (assays of which in 1578 revealed it to be worthless, thus ending the enterprise). The project was initiated in 1981 by William Fitzhugh of the Smithsonian Institution, and followed an earlier, preliminary investigation of several Frobisher sites by Walter Kenyon of the Royal Ontario Museum in 1974.

The various chapters in the volume explore four central themes that have guided the research: specific historical issues relating directly to the Frobisher voyages; a detailed inventory and assessment of associated archaeological remains; the environmental context of the voyages; and the effects of Elizabethan (and later) contact on the indigenous Inuit of southern Baffin Island. Each of the 14 papers addresses one or more of these themes.

The first four chapters briefly outline the archival history (Fitzhugh, Laeyendecker, and Hogarth) and Inuit oral accounts (Rowley) of the three voyages, as well as the history of research on previously collected Frobisher artifacts (Washburn; Olin), including the 'Smithsonian bloom,' a 10-kg mass of smelted iron collected by the explorer Charles Francis Hall in 1861–1862 from the Frobisher site on Kodlunarn Island.

Chapters 5–8 present results of archaeological (Fitzhugh; Auger) and geological (Hogarth) field studies conducted in 1981, 1990, and 1991. Included are detailed site and feature descriptions of various prehistoric and historic Inuit, as well as Frobisher, localities.

Chapters 9–13 concentrate upon the analyses of the iron blooms and other iron artifacts (Harbottle, Cresswell, and Stoenner; Unglik; Wayman and Ehrenreich; Ehrenreich), and of associated wood and charcoal (Laeyendecker), recovered from the Frobisher sites. Certainly the most interesting results of the analyses are the anomalously early dates of the five blooms recovered to date. These dates, ranging from AD 640–760 to AD 1250–1440, result in several conflicting interpretations for the origin of the blooms: Norse (Harbottle, Cresswell, and Stoenner; Unglik); Frobisher, and used as carpenter's 'dollies' (Ehrenreich); or unknown, but used and left by Frobisher (Laeyendecker).

In the concluding chapter, Fitzhugh discusses a number of questions remaining for future research, including the problem of five men and a ship's boat that disappeared in 1576, and that of the origin of the iron blooms. Included in the discussion of the latter problem is the suggestion by Ivor Noel Hume that the blooms originated in Russia.

Although reporting primarily on preliminary results only, the book represents an excellent contribution to northern archaeology and the history of northern exploration, and is highly recommended. (James M. Savelle, Department of Anthropology, McGill University, 855 Sherbrooke Street West, Montreal, Quebec H3A 2T7, Canada.)

EAST OF THE SUN: THE CONQUEST AND SETTLEMENT OF SIBERIA. Benson Bobrick. 1992. London: William Heinemann. 542 p, illustrated, hard cover. ISBN 0-434-92889-5. £20.00

This book is history with a broad sweep, and, in view of the current situation in Russia, its publication is very timely. Bobrick attempts to present an account of Siberia from the first crossings of the Urals by the Russians to the present. Its scope is, in fact, somewhat wider than indicated by the subtitle and includes the history of Russian Alaska, the diplomatic relations between Russia and its neighbours, and Russian exploration and other activities in the Pacific, notably in Hawaii.

The subject is handled chronologically and in a straightforward and attractive manner well suited to hold the attention of the general reader, to whom the book is primarily addressed. The breadth of the material presented is impressive and the sources used are comprehensive. Good accounts are given of all of the obvious topics and some of the less obvious ones. For this reviewer, the most impressive sections are those that deal with the relations between Russia and China concerning the Amur valley, with the Great Northern Expedition, and with the exile system, both under the tsars and under the Soviets. The latter is quite impossible to read without shuddering.

This said, the book has its deficiencies. There are several trivial errors and indications of inadequate or hasty proof reading. One example of this is on page 223. The reader is informed that the Russian authorities at Petropavlovsk agreed 'to safely convey copies of Cook's Journal overland to St Petropavlovsk' and in the very next paragraph that Macao (*sic*) is a Portuguese colony on the Chinese coast, when it is referred to two pages previously without this qualification.