

non-specialists; the need is more than purely academic, it is driven by concerns about the future of the environment. The final four chapters on hazards and climatic and global change make this clear.

The book is well-edited and well-written, comparatively free of drafting and typing errors, and enjoyable reading. It is certainly appropriate for upper-level undergraduates and should be read by a much wider audience. It handily accomplishes its task of expanding and enlivening the understanding of the cold north. (William N. Mode, Department of Geology, University of Wisconsin Oshkosh, Oshkosh, WI 54901, USA.)

THE GREAT RUSSIAN NAVIGATOR, A.I. CHIRIKOV. V.A. Divin. Translated and annotated by Raymond H. Fisher. 1993. Fairbanks: University of Alaska Press (Rasmuson Library Historical Translation Series VI). xiii + 319 p, maps, soft cover. ISBN 0-912006-63-3. US\$20.00.

Bering's expeditions, which lasted from 1725 to after his death in 1741, are still relatively unknown in the western world, although they permitted a great leap forward in the knowledge of the North Pacific coastline, including the discovery of Bering Strait and part of the Alaskan coast. Even less known is the man who served as Bering's deputy for 17 years and his successor after his death, Alexei I. Chirikov, a bright Russian naval officer who had specialized in navigation. Therefore one can only welcome Raymond Fisher's translation of a biography of Captain Chirikov, first published by V.A. Divin in Moscow in 1953. In 1925 an American, F.A. Golder, had already published two volumes on Bering's voyages in the American Geographical Society research series, giving some information about Chirikov's accomplishments; then, in 1951, a Russian author, D.M. Lebedev, published a full version of Chirikov's logbook for the voyage to Alaska on board *Sv Pavel*.

In reviewing Divin's book, one must first acknowledge Professor Fisher's tremendous work of notes and translation, although it is also necessary to concur with his introductory statement that 'Divin's monograph contains serious flaws.' Divin's book was published shortly before Stalin's death, and this may explain in some measure his attack against foreigners — including Bering, a Dane by birth who had been personally selected by Peter the Great — and his labelling of pre-revolutionary Russian historians as 'bourgeois' whenever he does not agree with them. An alternate explanation to these tendencies could be the practice during Stalin's era of having an editor introduce Marxist statements in a manuscript without the author's knowledge.

The book is actually an account of Bering's two expeditions more than it is a study of the life of Chirikov. There are in the naval archives in St Petersburg many materials about Chirikov, including his personal notebooks, which seem to have been ignored. This is also true of logbooks where astronomical observations could be found and that could be used to show the expertise of Chirikov as a

navigation officer, including during the crossing of Siberia on riverboats. A possible explanation for these omissions may be found in a statement by the great Arctic historian M.I. Belov, who commented that Divin's book was really 'a popular science book.' Professor Fisher is, of course, fully aware of all this and succeeds in making the book attractive with 65 pages of notes, supplementary biography, and exhaustive index. At this point one should also point to Professor Fisher's very interesting chapter 'To give Chirikov his due' in the book edited by O.W. Frost on the occasion of the 250th anniversary of Bering and Chirikov's American voyages (Frost 1992: *Bering and Chirikov*, Anchorage: Alaska Historical Society).

Chirikov was born in 1703 and enrolled in 1715 in the school of mathematics and navigation, a kind of secondary school for children of nobility, which had been created by Peter the Great. Four years later Chirikov was selected to join the new Naval Academy. In 1722, aged 19 and a sub-lieutenant, he was again assigned to the Naval Academy, but as an instructor of navigation. In 1725 he joined Bering's first expedition, which was to last three years, mostly because of the hardships of crossing Siberia with the equipment, craftsmen, and crew needed to build a ship in Kamchatka and to sail it in northern waters.

Wintering in Bolcheretsk in Kamchatka, Chirikov observed and accurately recorded an eclipse of the moon, and was therefore able to obtain the first astronomical longitude of Kamchatka with the help of J.N. Delisle (described as a spy by Divin). Delisle had come from Paris to St Petersburg at the request of Peter the Great to build an observatory and to improve the maps of the Russian Empire.

When sailing from Kamchatka to Bering Strait on Bering's ship *Sv Gavriil*, Chirikov made a survey of the coast; this was highly praised by Cook when he sailed in the same waters in 1778. In 1741 Chirikov discovered the North Pacific coast of America while with Bering's second expedition, but the two ships they commanded were soon separated and never met again. Chirikov approached the American coast south of Bering and three days ahead of him. Due to the loss of 15 men and his two boats Chirikov returned to Kamchatka, arriving in October 1741 with great difficulties, due to death or ill health of the crew from scurvy. Bering died in December 1741, his vessel wrecked on what is now Bering Island, although some survivors succeeded in sailing back to Kamchatka a year later, just after Chirikov had left for Okhotsk.

Chirikov was called back to St Petersburg, where he arrived in March 1746. He had but two years to live, but he still produced some very interesting documents that are well described in Divin's book: general charts of the discoveries, including the Arctic shores, and a number of proposals for the development and administration of the Siberian and American regions. The publication of this book marks the first time, thanks to Professor Fisher, that these proposals have been translated and annotated in a western language, giving us unique insights into Chirikov as an able strategist encompassing social, economic, and

defence measures. On the same lines, but possibly with less vision, Bering had made proposals to the Russian Senate 16 years earlier, when arriving back from his first expedition. In his document, presented to the Admiralty College and dated June 1746, Chirikov emphasized the need to use the Amur River, then in Chinese territory. He recommended developing farm land in the Ilimsk region and in Kamchatka, where he also wanted to protect the rights of native inhabitants against merchants and even servicemen; in his opinion this measure would strengthen the Russian presence. He also recognized the economic value of fur-bearing animals and different minerals, not only in Siberia but in the newly discovered American land. Finally, he wanted to develop the Russian naval presence in the North Pacific waters as a sign of sovereignty and to contain possible foreign interferences. In other words, Chirikov was truly a visionary, as everything he proposed materialized in the region, at least until Alaska was sold to the United States in 1867. (Bertrand C. Imbert, 116 Boulevard Raspail, Paris 75006, France).

FLUCTUATIONS OF GLACIERS 1985–90 (Vol. VI). Compiled by W. Haeberli and M. Hoelzle. 1993. Zurich: World Glacier Monitoring Service. xii + 322 p, maps, hard cover. ISBN 92807-1370-1. US\$50.00.

This volume, number six in a series sponsored by several international scientific organizations, deals with observations of glacier fluctuations and mass balance during the period 1985 to 1990. The previous five volumes follow a largely similar, although not identical, format and cover five-year periods back to 1959. The publication, like those that preceded it, is a repository for glaciological field data from glaciers worldwide, where systematic observations on mass balance, glacier terminus position, and other ancillary evidence have been collected on a regular basis.

If the data presented in a volume such as this are to be of use to, for example, the glaciological community modelling glacier–climate interactions, the material contained in the numerous tables must be presented clearly and the methods by which data are obtained documented. The compilers are at pains to achieve this goal, and have sent out both data sheets and instructions to the many national correspondents who make returns to them. I looked up several glaciers with which I am familiar in the field in order to provide a brief check on the compilation, and found reference to these ice masses to be dealt with clearly and precisely.

Data on the position of glacier fronts are presented for 624 glaciers in 23 countries. Mass balance observations, a more complex field task, come from 78 glaciers in 11 countries. Other suites of glaciological observations, for example on the changing volume, area, and thickness of ice masses, are available for smaller numbers of glaciers. Fourteen maps are also included in a large pocket at the rear of the volume. These are largely a result of donations by individual countries or institutions. Clearly any attempt to produce large numbers of such maps centrally would be prohibitively costly.

This is not a book for the generalist, but for the practising glaciologist. It is also a volume for reference libraries rather than individuals. The compilers and their national correspondents are performing a considerable service to the glaciological community and should be congratulated for doing so. (Julian A. Dowdeswell, Scott Polar Research Institute, University of Cambridge, Lensfield Road, Cambridge CB2 1ER.)

ADVANCES IN ICE TECHNOLOGY. T.K.S. Murthy, W.M. Sackinger, and P. Wadhams (Editors). 1992. Southampton: Computational Mechanics Publications. 365 p, illustrated, hard cover. ISBN 1-85312-175-4.

This book is a compilation of 28 papers presented at the Third International Conference on Ice Technology, held at the campus of Massachusetts Institute of Technology, Cambridge, Massachusetts, in 1992. Though there are a few papers that describe experiences related to operating an icebreaker in the Arctic, the majority of papers deal with some technical problem related to ice technology or ice mechanics. Because the papers contained in the book were either invited by the organizers or contributed by the authors, the subjects discussed in the technical papers are quite diverse. The editors have compiled the book in five sections, but this reviewer would like to list the technical subjects discussed in the book.

There are seven papers associated with various aspects of creep deformation in ice. In four of these papers, the authors have presented their constitutive model and obtained values of some parameters from experimental results. One paper discusses safe landing and parking of large aircraft on a floating ice sheet near McMurdo Station, Antarctica. The remaining two discuss the closure of a borehole and the bending of ice sheets.

Next there are two papers on the propagation of waves in an ice–water system. One of these presents a comparison between theoretical and experimental results, whereas the other presents a solution of nonlinear equations associated with large amplitude waves. There are two papers on the subject of indentation tests. One paper presents the results of tests conducted on lake ice, and the other discusses the propagation of a macro crack during a test conducted in a large test basin.

The other subjects discussed in the book are: dynamics of river ice, topside icing of ships due to sea spray, freezing of sea water in harbors, full-scale trials of a Finnish icebreaker, field determination of strength properties of ice via sonic tests, model tests of hovercraft to break floating ice sheets, and ship operations and ice conditions in the Arctic.

With few exceptions, there is no common theme among the papers. However, all papers are related to ice technology or ice mechanics. Some of the papers present real advances in current knowledge, while some other papers discuss the current state of marine transportation in ice-covered waters. (Devinder S. Sodhi, Ice Engineering Research Branch, Cold Regions Research and Engineering Laboratory, US Army Corps of Engineers, Hanover, NH 03755-1290, USA.)