from Petropavlovsk to the Cape of Good Hope 22nd August 1779 to 12th April 1780.' The journal is edited by David, who discovered the manuscript in the Hydrographic Department archives. Considered too slim for the Hakluyt Society's Ordinary Series, it is published here and dedicated to the late Dr Helen Wallis. Librarians will need to make certain that it is separately indexed in their catalogues.

It is almost impossible to avoid hyperbole when appraising this truly professional and dedicated work of scholarship; this and the previous two volumes of charts and views taken in conjunction with the three volumes covering the art of Cook's voyages constitute a true magnum opus. In this final volume, students of polar history will find much to stimulate research. Interestingly enough, of the four charts that can be 'confidently attributed to Cook himself,' three depict the sub-Antarctic Prince Edward Islands and Kerguelen and are reproduced here. Outstanding for their accuracy of detail and for their artistic virtuosity are the charts and views depicting Cook's running survey of Alaska and the northeast coast of Asia.

Inevitably a publication of this nature cannot come cheap, but the price should prove no deterrent to the dedicated Cook enthusiast. (H.G.R. King, Scott Polar Research Institute, University of Cambridge, Lensfield Road, Cambridge CB2 1ER.)

ANTARCTIC SEA ICE: PHYSICAL PROCESSES, INTERACTIONS AND VARIABILITY. Martin O. Jeffries (Editor). 1998. Washington, DC: American Geophysical Union (Antarctic Research Series 74). xi + 407 p, illustrated, hard cover. ISBN 0-87590-902-7. $US80.00.

Sea ice is just a thin veneer on the ocean surface, but capturing its spatial and temporal variability, including its physical attributes, is central to improving understanding of ocean–ice–atmosphere interactions and validating climate and sea-ice model simulations, the basis for future climate prediction. The 19 contributions in this AGU Antarctic Research Series volume advance knowledge and understanding of Antarctic sea ice, with equal emphasis being placed on remote and *in situ* observations. Key themes are: new observations in the Pacific, seasonal and interannual evolution of pack characteristics, and exploiting remotely sensed information. Reading this volume provides an excellent overview of current directions in Antarctic sea-ice research, not least in the Pacific sector, where sea-ice processes are only just beginning to be studied.

Reading the various papers leaves one in no doubt about the impact of the atmosphere on the underlying ice through a variety of dynamic and thermodynamic processes that include the action of wind and waves and snow processes. With the text reading well, along with clearly reproduced figures, this book is essential reading for all Antarctic sea-ice researchers.

The first section looks at snow cover on ice. Sturm and others discuss *in situ* observations in the data-sparse Pacific region made from cruises of *Nathaniel B. Palmer*. The authors note considerable local-scale snow-depth variability, but emphasise regional-scale properties, including relatively high winter snow depths peaking near the coast, widespread flooding giving larger snow-ice thicknesses than the Arctic, and total ice thicknesses as great as in the eastern Weddell Sea. Derived surface heat flux estimates attest to the impact of the snow cover on heat exchange. Markus and Cavalieri report a new method for inferring snow depths from satellite passive microwave data, giving a correlation of 0.8 between their estimated values and Antarctic-wide *in situ* firn measurements made in different seasons. Antarctic snow-depth maps indicate a distinct summer maximum in all perennial ice areas and confirm that snow depths peak near the coast in much of the Pacific sector. Large interannual variability here is also noted.

In the second section, on ice formation, thickness, and drift, Worby and others provide the most authoritative account yet of East Antarctic sea ice, showing it is more mobile than that in the Weddell Sea and, like many regions, heavily deformed. Ice-extent variations are largely wind-driven. High spatial variability in quantities like ice thickness, however, renders gauging of interannual variability from *in situ* data difficult. An analytical study of ice cores from the Amundsen and Ross seas during late austral winter by Jeffries and others confirms that heavily deformed ice is commonly indicative of wind and wave action, and extensive ice flooding, and that snow-ice formation is a key thermodynamic process for ice thickening. Processes favouring ice flooding are discussed.

Using upward-looking sonars (ULS), Strass and Fahrbach provide major new insights into Weddell Sea sea ice, including its interannual variability. Apparently, the ice is thicker than previously found (large contribution from rafting), and a delay of several months exists between seasonal ice coverage and thickness reductions. Spring concentration reductions in the northern Weddell Sea permit northward drift of thick floes from farther south. Intriguingly, such observations may help to explain why thick ice (>1m) persisted around the South Orkney Islands in the 1997/98 austral summer. Geiger and others use Ice Station Weddell data to demonstrate the contribution of winds and tides to ice drift and deformation, and Eicken considers in detail the factors that influence ice texture, salinity, and isotopic characteristics.

Satellite-based observations are highlighted in the third section, with Gloersen and Mernicky, as well as Parkinson, looking in detail at passive microwave data. Decadal and El Nino-Southern Oscillation (ENSO) time-scale (2.4 and 4.2 years) signals in sea-ice concentration are identified. Similar ENSO periodicities in surface winds indicate a likely route by which ENSO signals appear in the ice. Pronounced interannual variability in ice-season lengths both within and at the outer reaches of the pack are also discussed, along with long-term trends. Morris and others provide the first account of the seasonal behaviour of the

backscatter signal from SAR in the Bellingshausen Sea. The signature of first-year ice is similar to that in the Weddell Sea, but they note that flooding precludes distinction of thick first-year and multi-year ice. Relatively young and new ice types are identifiable, providing a basis for quantifying ice growth. Interestingly, short-term changes in backscatter values can be used to trace the passage of weather systems. The utility of combined satellite synthetic aperture radar and scatterometer data for deducing ice-drift regimes in the Weddell Sea is considered by Drinkwater.

In the fourth section, on ice–ocean–atmosphere interactions, Martinson and Iannuzzi derive spatial estimates of various sea-ice diagnostics, including *in situ* ice growth (pre- and post-summer pycnocline elimination), ice-growth/melt ratio, and ocean heat flux for the Weddell Sea. These fields are empirically deduced from basic observations of temperature and salinity gradients through the pycnocline, mixed-layer, and pycnocline thickness, etc. Their findings are discussed in relation to understanding ocean–sea-ice processes. Markus and others and Comiso and Gordon detail techniques for deriving sub-pixel scale information on Weddell Sea coastal polynya open-water (or low ice-concentration) areas from passive microwave data. The first paper obtains smaller estimated polynya areas, with sea-ice production suggested not to exceed 5% of the total Weddell Sea ice volume. The notion of coastal polynyas being 'ice factories' may thus need to be reviewed. The second paper finds that summer ice extents do not precondition those in the following winter but do relate to ice extent in the previous winter. The impact of the wind on ice and polynya areas is discussed, and potential links between the Antarctic Circumpolar Wave and deep-water production are proposed.

The penultimate section considers ice characteristics and processes in the marginal ice zone. Fukamachi and others describe mesoscale features in summer ice using satellite data. Ice tongues and wave-like features are found when surface winds are light, indicating their likely oceanographic origins, but progress in understanding processes depends on improved oceanographic measurements. Shen and Squire report on a new, entirely physics-based model to account for wave damping by the motion and interaction of floes. Model performance is assessed using Weddell Sea observations.

In the final section, on landfast and marine ice properties, Fedotov reviews the spatial and physical attributes of landfast ice in East Antarctica. The complexity of ice composition, and hence of the controlling processes, is emphasised here and in other comprehensive papers by Gow and others and Tison and others, looking at landfast ice in McMurdo Sound and marine ice near Terra Nova Bay. The utility of studying marine ice near the shelf-ice edge in understanding oceanographic processes and ice-shelf mass balance is emphasised in the last paper. (S. Harangozo, British Antarctic Survey, High Cross, Madingley Road, Cambridge CB3 0ET.)

GLACIER HYDROLOGY AND HYDROCHEMISTRY. M. Sharp, K.S. Richards, and M. Tranter (Editors). 1998. Chichester: John Wiley. vii + 342 p, illustrated, soft cover. ISBN 0-471-98168-0. £40.00.

Publisher John Wiley has developed a series of books on topical themes in hydrology. The volumes comprise papers formerly published in the journal *Hydrological Processes* and are edited by principal scientists in the particular field. This new book, the sixth volume in the series, represents a collection of recent research papers concerning hydrological aspects of glaciology.

To cover recent major advances in glacier hydrology, the editors have selected 18 papers on aspects of the subject. Glacier research in the Arctic, sub-Arctic, and Alpine environments is included. Moreover, the book includes several theoretical (modelling) contributions. Thus, the book represents a well-balanced collection of material highlighting important research in glacier hydrology.

The book has one major positive aspect. That is that all the papers (or chapters as they are known in the book) were formerly peer-reviewed and are therefore of a good quality. It therefore seems appropriate to collect the leading papers within a given field in a single volume such as this. The papers also were previously style-edited by John Wiley, and so figures are of a generally high standard.

However, there are numerous negative aspects to this book. First, these papers have been lifted verbatim from the original journals. There is absolutely no sign of 'editing' of any of the papers. In fact, the only job the editors appear to have done is a one-page preface and the opening introduction. Second, 10 of the 18 papers in the book already appeared in the same volume of *Hydrological Processes*. The book is thus not so much a collection of 18 papers as rather eight new papers supplementing an existing volume of the journal. Moreover, intentional or not, the original reference to these papers in *Hydrological Processes* is very difficult to find. It is not enough to mention simply that all of the papers have appeared before in *Hydrological Processes*; the original date, volume number, issue number, and page numbers for each paper should be given. If a student wished to cite a paper in this volume, they should by rights cite the original source, not this secondary level of publication.

Third, the academic affiliations given at the start of each chapter are not consistent across the volume. In order for readers (including students, presumably) to write to authors, the addresses should have been updated. Fourth, the index is woefully short. Fifth, the book will cost far too much for students to purchase. A simple calculation indicates that if a student were to send off 16 letters (the number of different first authors) asking for reprints (assuming they can find the original reference and correct address), it would cost £4.16. The book costs £40. The only difference between the book and a collection of papers is the preface (one page), the introduction, and the index (which in my opinion is poor anyway). Sixth, the