(in contrast to Antarctic fish). Convey's contribution reaches similar conclusions; both papers contain fairly familiar material.

The last section ('Human impact and environmental change') encompasses two sorts of contribution, those concerned with globally relevant issues (for example, anthropogenic effects on climate, ozone depletion) and parochial Antarctic matters (for example, impact of alien insects, effects of oil spills). It opens with a rather humdrum and familiar consideration of past temperatures (by Karlén) that has an extremely short (and dated) section about future trends. However, there are several excellent papers on UV effects on Antarctic biota, introduced by an excellent overview by Marchant. One of the most interesting 'impact' papers is one concerned with the effects of burgeoning fur-seal populations on terrestrial and freshwater ecosystems (by Lewis Smith). Reasons for the population increases are not clear, but may be related to past patterns of human exploitation of seals and whales. Whatever the reason, clearly physical disturbance and nutrient toxicity have profound effects on terrestrial plant assemblages, causing environmental damage that is probably irreversible.

The book ends with a short postscript that tries to identify future research opportunities. This is coloured somewhat by the Biodiversity Convention and the Antarctic Protocol, both of which were very recent history at the time of the symposium. (John Davenport, University Marine Biological Station, Millport, Isle of Cumbrae KA28 0EG.)

THE CHARTS & COASTAL VIEWS OF CAPTAIN COOK'S VOYAGES. VOL 3: THE VOYAGE OF THE *RESOLUTION* AND *DISCOVERY* 1776–1780. Andrew David (Chief Editor). 1997. London: The Hakluyt Society. cxxx + 319 p, illustrated, hard cover. ISBN 0-904180-55-7. £210.00.

The publication of this third volume of Captain Cook's *Charts and coastal views* is the latest in a series of publications covering Cook's three voyages. In 1955, the Hakluyt Society published the late John Beaglehole's scholarly edition of the journals, to be followed in 1974 by his life of Cook. More recently, a comprehensive and magnificently illustrated three-volume catalogue of the visual art of Cook's voyages has been published under the editorship of Rüdiger Joppien and Bernard Smith. In 1979, Commander Andrew David, formerly of the Hydrographic Department, Taunton, accepted an invitation to edit, in cooperation with Dr Joppien and Professor Smith, three further volumes to cover the charts and coastal views, the first two of which were published in 1988 and 1992, respectively.

The arrangement of this volume closely follows that of its predecessors, opening with an introduction followed by a descriptive catalogue of the charts and views themselves. Here the introduction (pages vii–xxxiii) is divided into a number of themes following on an account of the circumstances leading to Cook's recall from semi-retirement and his appointment to take command of *Resolution*. There follows an account of the Admiralty's detailed instructions, particularly in regard to the probability of finding a water passage linking the Atlantic and Pacific oceans. Subsequent topics embrace a brief account of Cook's officers and scientists and a review of the astronomical, surveying, and navigational instruments taken on board *Resolution* and *Discovery*, along with Cook's navigational and surveying practices.

Notes on the coastal views remind the reader that this volume includes all surviving views drawn on the voyage and that their purpose was partly navigational and partly a scientific record. The account of the scientific results includes a number of references to ice observations, although only one to aurora. Short biographies of the officers responsible for the production of the charts and coastal views form a reminder of the considerable talent attracted by Cook's leadership, artists as talented as William Ellis, Henry Roberts, and John Webber, and, among the hydrographers, William Bligh, James Burney, James King, Edward Riou, and George Vancouver. All three artists enhanced their work with colour, 21 examples of which are here reproduced and discussed. The original publication of the art work was apparently beset with all manner of crises, not the least of which was the loss of a package of Cook's loose papers, which may well have included some of his original surveys. There was the expectable dissension over place-names, and rival versions of the charts threatened to delay publication. In the event, the first edition of the official narrative was published in 1784 and was an instant success, 2000 copies selling within three days.

Following this introduction to the charts and views is an examination of Russian charts of the North Pacific in relation to Cook's third voyage by Alexei V. Postnikov, who discusses Russian charting of the region since Bering's day and pays tribute to the Russian pilot G.C. Izmailov, who shared valuable information with Cook. A select bibliography of references is followed by a descriptive inventory of collections, arranged according to their present location. An introduction to the descriptive catalogue and five appendices relating to Board of Longitude papers in the Cambridge University Library conclude the introduction.

The descriptive catalogue that follows (pages 1–319) lists some 193 charts of coastal views, reproduced in monochrome, together with 10 supplementary charts and drawings relating to all three voyages not previously catalogued plus a list of corrigenda and addenda. The arrangement is chronological, thus forming a visual accompaniment to Cook's main narrative. Each plate is identified by title, artist, a descriptive annotation, and references to expedition and other journals. Cross-references are made to similar views and panoramic sketches together with their provenance. Appended to the catalogue is a transcript of James King's 'Running journal

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