

bibliography, this encompasses no fewer than 155 pages. It is destined to be a first point of reference for any scholar studying the region for years to come. There are 11 appendices, and some of them are considerable achievements in their own right. Appendix D, 'Biographical notes,' sets out details of the lives of some 220 persons referred to in the text. The entries for a depressing number of them end with the word 'shot,' possibly with the date of execution. But there are some curiosities here. Bering and Chirikov are omitted — presumably the author considered that they were well enough known — but Kreuzenstern is included, as is the eccentric Briton, John Dundas Cochrane, who walked across Russia in 1822–1823. A surprising omission is I. Ia. Gutman, who wrote the only detailed account of the Nikolaevsk incident of 1920.

Other appendices cover such subjects as 'Far eastern party secretaries, 1922–91,' 'Commissars of state security in the far east, 1922–53,' and 'Far eastern delegates to the 17th and 18th Party Congresses.' The last appendix may be the most immediately useful, since it is a compilation of alternative place names in the region, in the different languages, with their dates of currency.

There are comprehensive footnotes, collected together at the end of the book, and a full index. The illustrations are excellent. The maps are clear and the photographs have been carefully selected to illustrate the text.

To sum up: an excellent book, the first real history of the area in any language, compiled by an author who has immersed himself in the subject for decades. Yet, as was the case with Stephan's earlier books, it wears its scholarship lightly and is a pleasure to read; indeed, it is difficult to put down. It is highly recommended to all with interests in the region. (Ian R. Stone, The Registry, University of Kent at Canterbury, Canterbury, Kent CT2 7NZ.)

MARINE MAMMALS AND THE EXXON VALDEZ. Thomas R. Loughlin (Editor). 1994. San Diego and London: Academic Press. xix + 395 p, illustrated, hard cover. ISBN 0-12-456160-8. \$US49.95.

Just after midnight on 24 March 1989, the supertanker *Exxon Valdez* ran aground on Bligh Reef in Prince William Sound, about 40 km outside Port of Valdez in Alaska. Eight of the 11 cargo tanks were ruptured, and heavy, black crude oil began to spill out into the surrounding water. Within a few hours, an estimated 11 million gallons (258,000 barrels) had been lost, and oil continued to leak until the tanker's damaged tanks had been off-loaded several days later. The grounding of *Exxon Valdez* resulted in the largest oil spill in United States history.

It is estimated that supertankers like *Exxon Valdez* had successfully navigated the reefs and icebergs in Prince William Sound for 8700 separate journeys during a period of 12 years. However, although at least eight contingency plans were in place in the event of a disaster, none of them anticipated the scale of the *Exxon Valdez* spill. Necessarily, the ensuing clean-up operation was vast, and involved a large number of organisations, ranging from wildlife experts who assessed and attempted to protect sensitive

areas, to the flotilla of boats that was involved in the containment and collection of the oil.

As consumer demand for fossil fuels increases, and as more tanker traffic takes to the high seas, it is only a matter of time before another spill of equal or greater severity occurs. In 1993 the grounding of *Braer* in northern Scotland resulted in the loss of 84,000 metric tonnes of oil around the environmentally sensitive coastline, underlining the very real need for an efficient and rapid initial response to such disasters. *Marine mammals and the Exxon Valdez* is a summary of the response and natural resource damage assessment (NRDA) activities that were undertaken in relation to whales, seals, sea lions, and sea otters in the wake of the *Exxon Valdez* disaster. It describes plans that were developed to deal with the situation and summarises lessons that were learned. It is the hope of the editor, Thomas Loughlin, that *Marine mammals and the Exxon Valdez* will be of use to marine mammalogists when the next spill occurs, in order that damages to these animals and their habitats will be minimised.

The book comprises 21 chapters written by marine scientists involved either in the clean-up operation or in examining specimens and samples collected afterwards. The first chapter provides an overview of the disaster between March 1989 and the summer of 1992, when the clean-up operation was deemed to be completed. A geographical description of the area and its ocean currents is followed by a brief summary of the methods used to attempt to contain, clean, and retrieve oil from the shoreline. The chapter concludes with a diagrammatic representation of how the oil slick dispersed, the process of its degradation, the settlement agreement imposed on Exxon, and continued damage-assessment activities.

The second chapter is also general, and provides an overview of response activities, including a description of the regulatory framework for response (liberally scattered with an impressive collection of acronyms of the kind that usually accompany government agencies), and an assessment of the start-up problems that are inevitable when a massive environmental disaster overtakes a small town (in this case, with a population of approximately 4000). The chapter then provides information collected from initial surveys of Steller sea lions, harbour seals, sea otters, and the five species of cetacean in the area. From these surveys and other information regarding tides, currents, and wind speed and force, it was possible to predict the oil-spill trajectory, and to identify areas that required special protection.

Chapters three to five concentrate on sea otters, comprising an overview of sea-otter studies resulting specifically from the disaster, a description of methods developed to conduct boat-based population surveys, and a presentation of an intersection model for estimating mortality rates. Chapters six to ten assess the impact of the oil spill on harbour seals, Steller sea lions, killer whales, and humpback whales in terms of population, health, breeding biology, and survival of young. These studies highlight

several issues, including the importance of reliable historical data on the populations in the affected region, and the observation that neither sea lions nor whales made attempts to avoid oiled areas, but that it was difficult to assess whether subsequent population declines could definitely be attributed to the spill.

The next ten chapters present data collected from observation and analysis of affected animals. Subjects range from behavioural studies — such as foraging strategies and prey-composition in sea otters and the impact of increased noise levels on killer whales — to the pathologies that developed as a result of oil contact. Information is also provided on the mechanisms by which sea mammals become oil-fouled, and on the rehabilitation criteria that were developed for reintroducing animals to the wild.

Throughout *Marine mammals and the Exxon Valdez*, the contributors convey a sense that, even after the extensive research and assessment that took place, the precise impact of the spill will never be known. Although the bodies of 1011 sea otters, 19 harbour seals, 12 Steller sea lions, and 37 cetaceans were recovered, it could not be determined what percentage of the death toll these animals represented. It was also difficult to assess whether some animals had actually been victims of the spill. In addition, harbour seal and Steller sea-lion populations in Prince William Sound were declining before the spill, making estimates even more difficult. However, while Frost and others (Chapter 6) estimated the total loss of harbour seals from seven haul-out sites to be 302 animals — a significant loss from an already dwindling population — Calkins and others (Chapter 7) suggest that the sea-lion population escaped any significant impacts.

Perhaps more significant than the reports of the impacts on specific populations are the findings of the pathology analyses, which provide a better understanding of the toxic effects of oil on sea-mammal tissues. For example, it was found that sea otters are vulnerable to death by inhaling fumes from evaporating oil, as well as from hypothermia when oil damages the insulating qualities of the fur. Behavioural changes in harbour seals — lethargy and a reluctance to swim away when approached — were found to relate to degenerative lesions in the brain (Chapter 17). At the same time, although understanding of some aspects of marine-mammal biology has taken great steps forward, many chapters underline the paucity of information about these animals, and stress the need for further research.

Marine mammals and the Exxon Valdez will prove to be an important book, not only for state and federal agencies developing contingency plans for the next oil spill, but for researchers interested in marine-mammal biology and populations. There are plentiful tables presenting original data, clear charts, and maps showing sightings and distributions. It is occasionally difficult to interpret the black-and-white photographs, but this is a minor complaint, and not one that detracts from the value of the text. In short, Loughlin's edited volume is a

significant contribution to sea-mammal studies, and will be an invaluable source of information for specialists faced with containing or reducing oil-spill damage in the future. (E. Cruwys, Department of Zoology, University of Cambridge, New Museums Site, Cambridge CB2 1EJ.)

THE ROSS OROGEN OF THE TRANSANTARCTIC MOUNTAINS. Edmund Stump. 1995. Cambridge: Cambridge University Press. xv + 284 p, illustrated, hard cover. ISBN 0-521-43314-2. £60.00; US\$99.95.

There have been a number of books written about the geology of Antarctica, most of them being proceedings volumes of symposia, or, in one case, a collection of chapters by specialists on various aspects of the geology of the continent. With a few exceptions, there are no volumes written by a single individual about the geology of the entire continent, an overview as it were. Most attempts at doing so have been the products of field geologists who have worked there, and have relied on multitudes of references by others to tie them together. A number of these syntheses have appeared as chapters in books or comprehensive articles in journals. As the evolution of geologic information from Antarctica has progressed, more has become known about a continent covered almost completely with ice (probably more than 99%). Thus, the availability of outcrops is rather sparse, and field geology introduces genuine challenges toward deciphering correlations between outcrops, to say nothing about simple survival in the field.

Here, in one book, is the result of numerous austral summer seasons in Antarctica by a leading geologist, one who paid his dues in the field, working in many parts of the Transantarctic Mountains in order to resolve the time period in the rocks when the 'basement' of the East Antarctic Shield experienced a major orogeny. It is thought now that this continental margin 'was created by the rifting and subsequent drift of Laurentia from Gondwanaland.' This revolutionary concept could not have come about without the adoption of plate tectonics theory, nor detailed field studies since the 1960s. This 'Ross orogen' commenced in the Neoproterozoic with passive margin sedimentation and progressed through a series of tectonic events that culminated in the Ross orogeny about 500 million years ago. Alex du Toit, the South African geologist who predicted the importance of Antarctica in the jigsaw fit of Gondwanaland when he published his book *Our wandering continents* in 1937, would be ecstatic with the fit of the Transantarctic Mountains into this regional pattern. In the 1930s there was very little known of the geology of Antarctica, and close to nothing about the interior.

Ed Stump has done a remarkable job of putting all this together into a coherent analysis of the Pacific margin of the shield. His work in Antarctica began 25 years ago, when he was a graduate student at Ohio State University, and in later summers as a leader of his own field projects. He is presently at Arizona State University.