

written in conjunction with Raymond Priestley and subsequently to become a fundamental work of reference in this field. The publication of these diaries is a fitting tribute to a pioneer of Antarctic science. (H.G.R. King, Scott Polar Research Institute, University of Cambridge, Lensfield Road, Cambridge CB2 1ER.)

**THE STRUCTURE AND DYNAMICS OF ANT-ARCTIC POPULATION.** Juan Carlos M. Beltramino. 1993. New York: Vantage Press. xvii + 105 p, illustrated with tables and maps, hard cover. ISBN 0-533-10205-7. US\$16.95.

Knowledge about Antarctica is rapidly accumulating, but demographic research has not received much attention, even from the SCAR Working Group on Human Biology and Medicine. Data are not registered centrally by the UN or World Bank, which cover all other regions, and Dr Beltramino has done a service in writing this slim book that contains much of interest; the lengthy acknowledgements reflect the extensive correspondence that has been necessary to obtain data (to 1990) from all the countries involved. The author draws attention to the uniqueness of Antarctic demography, characterised by its international nature, the short residence times of individuals relative to other regions, the sex and age biases, the lack of natural increase, and the special nature of mortality. This means that full demographic procedure cannot be applied. Two chapters then describe the natural setting and the historical and political background; it is the one region on Earth that, for obvious reasons, never had an autochthonous population. Unfortunately, a table of historical events makes no mention of SCAR, which predated the Antarctic Treaty and has served it well, and Beltramino does not make clear the primary intention to create 'a continent for science.'

The remaining five chapters contain the meat of the book. The populations are broken down by wintering and summer, including tourism and small adventure expeditions, but largely omitting whaling, sealing, and fishing operations. The results are summarized in six maps, eight tables, and a number of additional tables in the text. Appendices list the primary data on wintering expeditions starting with *Belgica* in 1898; on scientific stations operating in winter, their location and breakdown by station and year; similar information about summer scientific and support expeditions; and mortality rates at scientific stations and on summer expeditions. The author emphasises the approximate nature of some of the data, which is beyond his control.

From the beginning of this century it took 50 years for the wintering population as a whole to reach 100, only a further five years to reach 500 (influenced by the IGY), and 80 years in all to reach 1000. Women increased from two in 1974 to 74 in 1990 (from only six countries and Greenpeace) and children from 14 in 1978 to 29 in 1990 (from only Argentina and Chile). The largest number of stations was present in the IGY. Summer populations are more difficult to establish, but the approximate totals are

given; numbers increased from 75 in 1941/42, jumping to 6167 in 1956/57 representing IGY activities, and then increasing to 8340 in 1989/90. The number of women in summer increased from eight in 1947/48 to 260 in 1989/90 (from 14 countries and Greenpeace).

There are many other interesting points brought out by Dr Beltramino in his analysis. I would like to mention three. First, mortality rates: in wintering expeditions, almost all in the 'heroic era,' the rate 25.9‰; on scientific stations from 1904 to 1990, it was 2.5‰; and on summer expeditions 0.55‰. The causes of deaths in winter were 87% due to environmental hazards; in summer 61% to aviation accidents (greatly influenced by the 257 deaths in the crash on Mt Erebus in 1979) and 33% to other accidents, mainly involving air staff, seamen, and vehicles. Deaths due to medical problems are minor. Second, brought out clearly, is the very low winter density of people — a mere .000081/km<sup>2</sup> in winter (compared with a world average of 39/km<sup>2</sup>). Third, meteorology is the predominant scientific discipline in winter, whereas biology is in summer.

This is a useful contribution, written in an engaging style, well-produced with clear maps, graphs, and tables, and commendably free of typographic errors. However, I must declare a prejudice against the irritating term 'wintering over'; why not the simpler 'wintering'? The author clearly defines his terms and draws attention to the deficiencies of the data. It is a worthy contribution to an emerging topic. (R.M. Laws, St Edmund's College, Mount Pleasant, Cambridge CB3 0BN.)

**HIGH LATITUDES: A HISTORY OF SWEDISH POLAR TRAVELS AND RESEARCH.** Gösta H. Liljequist. 1993. Stockholm: Swedish Polar Research Secretariat in collaboration with Streiffert Förlag AB. 607 p, illustrated, hard cover. ISBN 91-7886-102-0.

To the majority of English-speaking individuals interested in polar exploration, the period 1857 to 1859 is most notable for Francis Leopold McClintock's expedition in *Fox*, which helped finally to resolve the fate of John Franklin's Northwest Passage expedition. However, during the same years, a series of expeditions that have rarely even been mentioned in English-language books on polar exploration helped to lay the foundations for much of modern polar research. At the center of these scientific developments was Otto Torell (1828–1900), a Swedish glaciologist who was the first major figure to propose scientific study of the Arctic as a goal and not just an addendum to commercial or geographical investigations. Torell's expeditions to Iceland (1857), Spitsbergen (1858), and Greenland (1859) served as preparatory work for his leadership of the Swedish Arctic Expedition of 1861, which included nine scientists, among them Adolf Erik Nordenskiöld, Karl Chydenius, and Nils Dúner. The expedition had three main goals: interdisciplinary studies of Svalbard and the seas adjacent to it; a reconnaissance for establishing a triangulation network for future measure-

ments of an arc of meridian; and a sledge excursion to the north over the pack ice of the Arctic Ocean, with the hope of discovering new lands. The plan, 'unique in both its emphasis on science and in the careful distinction of its scientific and geographical aims, was designed so that the first goal of the expedition (the scientific studies) could be accomplished even if the geographical survey proved impossible. Indeed, despite the failure of the survey, the scientific program exceeded all expectations and resulted in a wealth of geological, glaciological, zoological, botanical, magnetic, meteorological, and hydrographic data' (Riffenburgh 1993: 37).

Although this was Torell's last expedition to the Arctic, his pattern of comprehensive investigation was taken up immediately by Nordenskiöld and eventually became a model for other European and American scientific expeditions. In fact, it has been stated that, 'With Torell's expedition of 1861 scientific polar research had been founded. The radical influence which this research had on the various areas of research in the natural sciences can only be hinted at...' (Nathorst 1900: 458).

That the name of Torell is not even mentioned in most histories of Arctic exploration and science is an example of an unfortunate tendency of English-language books to concentrate on perceived 'major players' in exploration — that is, Britain, the United States, and Norway — at the expense of other countries that actually were very significant, such as Russia, Denmark, and Sweden.

*High latitudes* goes a long way toward rectifying this problem with regard to Sweden. Written by Gösta Liljequist, himself an important figure in Swedish polar research and the leader of the Swedish–Finnish–Swiss expedition to Nordaustlandet during the International Geophysical Year, it is an authoritative study of Swedish exploration and scientific work in the polar regions. It covers the period from 1758, when Anton Rolandson Martin, a student of Carl von Linné (Linnaeus), sailed north on *De Visser* from Göteborg to become the first Swedish polar scientist, until 7 September 1991, when the Swedish icebreaker *Oden* and the German research vessel *Polarstern* became the first two western ships to reach the North Pole.

In between these voyages, several Swedish polar scientists and expeditions received significant international acclaim. The most notable of these was Nordenskiöld, whose career and contributions are documented in a large section (130 pages) entitled 'The Nordenskiöld epoch 1864–1883.' Nordenskiöld started as a protégé of Torell, and in 1864 he followed up his mentor's work by leading another scientific expedition to Svalbard. This was only the first of a number of expeditions on which Nordenskiöld made scientific, geographical, or commercial contributions. In 1868, aboard *Sofia*, he established a farthest north by a ship (81° 42' N); in 1872–1873 his party completed the first wintering of a scientific expedition in Spitsbergen; and in 1875 and 1876 he made expeditions to the Yenisey River to demonstrate the feasibility of a trading route

between Sweden and Siberia via the Kara Sea. Then, in 1878–1880, in *Vega*, he completed his greatest combination of science and exploration with the first navigation of the Northeast Passage.

Thirteen years after Nordenskiöld's last Arctic expedition (1883) made a lengthy excursion onto the Greenland ice sheet, another Swedish explorer, Salomon August Andrée, gained the attention of the world by proposing to fly a balloon to the North Pole. Liljequist gives thorough coverage of the background, planning, and departure of the expedition; of the subsequent search for Andrée and his companions Knut Fraenkel and Nils Strindberg; and of the ultimate discovery, in 1930, of their fate on the desolate island of Kvitøya.

Perhaps an even more significant contribution than these assessments of well-known explorers and scientists, however, is the author's examination of many important individuals and expeditions with which much of the English-language readership might be less familiar. Two examples stand out. One chapter concentrates on Sven Lovén, who, in 1837, was the first to discover animal fossils from the Carboniferous and Jurassic periods in Spitsbergen, and who later became a major contributor to Swedish polar research by encouraging younger scholars, most notably Torell. Another section examines the role of Oscar Dickson, the Göteborg businessman who became the most important benefactor in the history of Swedish polar research, including sponsoring at least a dozen major expeditions.

Liljequist ranges far and wide in his attempt to include all of Swedish polar travel and research. For example, he covers the paleontological research of A.G. Nathorst and the geological expeditions of Gerard De Geer; the Swedish Antarctic Expedition of 1901–1903 under Otto Nordenskiöld; the rise and fall of Swedish coal mining in Spitsbergen; and the Swedish contributions to the International Polar Year (1992–1883), the Second Polar Year (1932–1933), and the International Geophysical Year. He even examines the role of Swedes in non-Swedish expeditions, focusing, for example, on the life and research of Finn Malmgren, the brilliant young meteorologist and oceanographer who participated in the second *Maud* expedition and was part of the first crossing of the North Pole in *Norge* before perishing on Umberto Nobile's *Italia* expedition.

*High latitudes* is illustrated with numerous photographs, drawings, and maps; includes lists of participants on major expeditions; and has occasional charts of data, such as that from the 1883 ice-march of Nordenskiöld, the monthly mean temperatures from the second *Maud* expedition, and the meteorological observations from an expedition to Swedish Lapland in 1914–1915. It has a comprehensive index and bibliography, although the many and extensive contemporary quotes that are used are not referenced in a form usable by scholars. It also has occasional lapses in grammar, as if to remind the reader that it is not a book about English speakers by an English speaker.

Nevertheless, it is an exceedingly valuable publication, and it is hard to imagine that it will not be the authoritative source on its subject for many years to come. (Beau Riffenburgh, Scott Polar Research Institute, University of Cambridge, Lensfield Road, Cambridge CB2 1ER.)

#### References

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**CLIMATE AND SEA LEVEL CHANGE: OBSERVATIONS, PROJECTIONS AND IMPLICATIONS.** R.A. Warrick, E.M. Barrow, and T.M.L. Wrigley (Editors). 1993. Cambridge: Cambridge University Press. xvi + 424 p, diagrams and charts, hard cover. ISBN 0-521-39516-X. £45.00.

Among the many books written on aspects of global change, few take issue with the real problems of measuring sea-level change and estimating the effects of greenhouse-gas-induced warming on sea level. This book is an outgrowth of a multi-national workshop on 'Climate change, sea level, severe tropical storms and associated impacts' (sponsored by the United Nations, the Directorate General XII of the European Commission, the US Environmental Protection Agency, and the UK Water Resources Centre) held in Norwich, UK, at the Climate Research Unit, University of East Anglia, in September 1987. The chapters therein attempt to summarize and synthesize what is known of historical and modern sea-level change and then forecast the amplitude and impacts of future sea-level change given the enormous uncertainties in the natural system. Topics are masterfully organized into four sections: records of sea-level change during various time scales; modeling and future projections of sea-level change; impacts and case studies of sea-level change; and summaries of workshop panel discussions.

Five years is a long time to wait for synthesis papers from a workshop on such a timely topic. However, publication of this volume was purposely delayed to allow many authors to update their contributions in light of new greenhouse-gas emissions scenarios first published in 1990 and later revised in 1992 by the Intergovernmental Panel on Climate Change. With few exceptions, all of the chapters are as up to date as one might expect in such a rapidly changing research field. For example, recent work on post-glacial sea-level change by Tushingham and Peltier is included in several chapters, but references to revised sea-level curves produced by Fairbanks and colleagues at Lamont-Doherty and new modeling insights into the stability of the West Antarctic Ice Sheet by MacAyeal are not included in critical summaries on long-term sea-level change and the melting of ice sheets. This criticism should not detract from the quality of the work. One will find thorough reviews that are nicely cross-referenced from

one chapter to another, much to the credit of the authors.

The first section is a chapter by Warrick, who provides a much needed summary of the linkages addressed in subsequent sections between climate change (mainly temperature) and sea-level change. He concisely contrasts estimates made by various authors of sea-level rise from different sources (such as thermal expansion and melting ice), highlighting inherent uncertainties. Notably, most scenarios project that sea-level rise will amount to less than a meter by the year 2100, but the range of best estimates is wide (20 to 100 cm). The second section includes five chapters assessing the quality of tide-gauge data and processes that confound both the accuracy and precision of these data. Two chapters in this section focus on methods of sea-level measurement and programs to establish regional and global networks of monitoring tide-gauge stations with geodetic baselines tuned by satellite. One chapter by Tooley reviews the Quaternary record of eustasy and demonstrates why the term global eustasy has become obsolete in favor of regional eustasy (à la Mörrer) reflecting glacial/interglacial cycles modified by hydroisostatic, geodetic, and steric processes.

The third section in the book includes six chapters on future projections of sea-level change based on modeling simulations and best estimates of contributions from steric effects, the melting (or growth?) of the Antarctic and Greenland ice sheets, and contributions from small glaciers. All of these projections are dependent on estimates of the magnitude of greenhouse-gas-induced warming, making it difficult to come up with anything but low, median, and high values. Given the inevitable rise of sea level predicted, the chapter by Wrigley and Raper, among others in this book, should be required reading by politicians and planners worldwide.

The fourth section includes 10 chapters that focus on impacts and case studies of sea-level rise. The global distribution of these studies is impressive. Moreover, all studies emphasize the need to understand local processes mitigating sea-level rise, as well as the socio-economic impacts of permanent land loss, temporary flooding, and salt-water intrusion.

The final section of the volume consists of three brief chapters that summarize panel discussions by scientists attending the 1987 workshop. The first panel summarized the complex record of sea-level and climate change, predicting that during the next 40 years total sea-level rise will be about  $13 \pm 4$  cm; during the next 100 years sea level will likely rise by about 61 cm, or four times the present rate. The second panel reviewed the linkage between increased sea surface temperatures associated with rising sea level and the severity of tropical storms and storm surges. Unfortunately, the relationship is not unidirectional, as model simulations suggest that positive and negative correlations vary from region to region. The third panel compiled a comprehensive list of sea-level issues, including physical effects, environmental and social/economic impacts, and necessary responses, to be urgently addressed by scientists and politicians. Probably the most important