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Book Reviews

The Arctic and Environmental Change

Edited by P. Wadhams, J. A. Dowdeswell and A. N. Schofield
Gordon and Breach Science Publishers SA, Amsterdam (1997).

193 pages. £31. ISBN 9 0569 90209.

This book contains papers presented at a Royal Society Discussion Meeting held in October 1994, and their discussion after each presentation. It follows a similar Discussion Meeting on the Antarctic held in 1992 by the Royal Society. The proceedings of both meetings were originally published in journal form in the Philosophical Transactions of the Royal Society (1992 and 1995).

By environmental change the organizers of the meeting mean climate change and its effects. There is very little discussion of environmental change caused by other factors, such as the direct effect of pollutants on biota or the environment, except on ozone loss, or discussion of other anthropogenic effects. This is not unreasonable, however, since climate change probably poses the greatest threat to the Arctic environment. Of the fourteen papers five deal with the atmosphere, four with biota and the ocean, three with snow and ice and two with the paleoclimatic record.

The first paper by H. Cattle *et al.* quantifies this threat by outlining future climate scenarios due to the greenhouse effect, as derived from numerical models. Papers on tropospheric and stratospheric circulation and dynamics by M. Serreze *et al.* and M. McIntyre follow, the latter leading to a short description by J. Pyle of the ozone loss in the Arctic and mid-latitudes. Observations of decreasing solar irradiance in the Arctic are shown by G. Stanhill to correlate with increasing Arctic haze pollution. Unfortunately, there is no paper on observed Arctic climate trends in recent decades, such as Chapman & Walsh (1993), which is a serious omission in my opinion.

A good description of the effects of climate change on vegetation and trace gas sources and sinks in the tundra regions of the Arctic is provided by T.V. Callaghan. The effects of climate change on under-ice biological productivity and the thermohaline circulation of the Arctic Ocean are discussed by R. Gradinger and B. Rudels, respectively. P. Wadhams documents the changes in sea ice extent and thickness, showing small reductions in both. The book deals primarily with the high Arctic and hardly touches on the vast boreal forest and permafrost-underlain land areas and the marginal seas which are also part of the Arctic. This is regrettable since changes are already observed in this region and the greatest climate-related impacts are predicted for there .

The paper on glaciers in the high Arctic by J. Dowdeswell documents glacier retreat and mass balance reductions since the Little Ice Age; again, the small glaciers of Arctic Alaska and larger systems of the sub-Arctic which show the same trends are outside the geographical scope of the book. The southern Greenland ice sheet shows a different trend, by thickening, as described by D. Wingham. Permafrost continues to experience major changes due to climatic warming, particularly in the discontinuous permafrost zone, and the geotechnical implications of this are described by P. Williams.

Finally, two papers, by J. Dowdeswell *et al.* and J. Thiede *et al.* respectively, describe the paleoclimatic record in terms of the Greenland ice core results with their surprising rapid climate changes, and the onset and variability of Northern Hemisphere glaciation derived from ocean sediment cores.

In the interval since the discussion meeting took place in 1994, i.e. more than three years ago, future satellite launches referred to in the book have occured, numerical models have improved, research expeditions and conferences on the Arctic have taken place, and many papers have been written. Our understanding of climate change and its effects in the Arctic has become more sophisticated. Some of the material in the book is therefore already out of date. An illustration of recent insights, for example, is the paper by Overpeck *et al.* (1997) which synthesizes the paleoclimatic data in the Arctic over the last 400 years and explains it in terms of climate forcing due to solar variability, volcanic influences and the greenhouse effect. This breakthrough paper presents results on a topic that the book did not and perhaps could not address.

The need for timely publication of new results is not unique to the Arctic, of course. Journal publications seem to provide a better vehicle for this than most books. Moreover, in the case of this book its purpose is somewhat puzzling since the entire record of the meeting was already published in full in 1995 in the Philosophical Transactions. All in all, however, the book presents a good collection of relevant and interesting papers on climatic effects in the Arctic. For those who like to have such papers as a handy reference under one cover the book will serve the purpose well, but one can always look up the same material in one of the journal volumes.

GUNTER WELLER

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Foundations for Ecological Research West of the Antarctic Peninsula

Edited by Robin M. Ross, Eileen E. Hofmann and Langdon B.Quetin
Volume 70, Antarctic Research Series, American Geophysical Union, Washington (1996).
448 pages. Price $85 (AGU members $59.50)
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The Antarctic Research Series fills a key niche in Antarctic publications. No one else provides the continuing opportunity to publish both monographs and thematic collections of commissioned papers on key subjects without page limitations. This book is a worthy addition to the previous 69 volumes and one can only wonder why, given the interest in the area, it has not appeared earlier.

This is a more international volume than most in the series, with authors from the UK, Germany, Australia, and South Korea as well as the USA. The 23 chapters are grouped into six sections. The first section is an historical introduction by S.Z. El-Sayed, going from the discovery of the Peninsula by Edward Bransfield through to the present GLOBEC and EASIZ programmes. The title suggests that the overview will be of all research in the region whereas the chapter covers only the marine biology and oceanography. The treatment is different to that of Deacon (1984) and Fogg (1992) and admirably concise. Whilst it leaves the reader feeling he knows what the major milestones might have been for the Southern Ocean there is no clear indication of why the Antarctic Peninsula region should be considered important for marine biology. One might have expected some more detail about the contributions to marine biology made by Palmer Station.

The second section reviews the habitats and describes some of their characteristics. I felt that including a major chapter by R.I.L. Smith on the terrestrial and freshwater ecosystems was a very good idea. It underlines the linkage between marine and terrestrial systems and provides the reader with a much broader view of the progress of biological understanding for the region than might have been expected. Smith very clearly demonstrates the ecological value of the region and highlights the opportunities it presents to study the effects of regional change. His paper is the most extensive review and synthesis to date of all the published information for this region, to which he has added a great deal of his own unpublished data. The chapter on water masses and circulation by E.E. Hofmann *et al* brings together various disparate data sets to characterize water types, asses heat budgets and derive flow patterns. The area offers opportunities to study Circumpolar Deep Water which is seen as critical for understanding its relationship to productivity in the Southern Ocean. The identification by the authors of a lack of bottom current data and their discovery that most of the oceanographic data was not optimal as it had been collected on cruises dedicated to biological sampling clearly indicates opportunities for the future.

The chapters by S.E. Stammerjohn & R.C. Smith on sea ice and R.C. Smith *et al* on air temperature patterns provide more detailed regional analyses than previously to characterize the LTER (Long-Term Ecological Research)environment. The sea ice patterns are demonstrated to be specifically distinct from those characteristic of both the Southern Ocean in general and East Antarctica in particular. The satellite data run is for only 16 years and not yet long enough to determine long-term trends with any reliability, and a linkage to ENSO events remains an important area for further investigation. This feature is picked up in the climate paper which attempts to link air temperature patterns and trends to sea ice extent and duration. There is, as usual, heavy reliance on the Faraday data set for trend analysis and the paper makes clear how limited even now the meterological data are for such a key area of change.

The final two chapters in this section are a short account by A. Clarke describing the general characteristics of Antarctic benthic habitats and a longer one by E. Domack & C.E. McClennen on glacial marine sediments. Interesting though the latter was it seemed rather poorly connected with much of the rest of this section, possibly since the historical timescale concerned was not reflected in any of the other chapters.

The next two sections deal with the distribution of biological populations and the factors that control these patterns. They are at the heart of the LTER activities and comprise the bulk of the book. I appreciate why the editors broke the material into the two sections but I would have preferred the chapters grouped by functional group. My comments on them will do just that.

D.L. Garrison & S. Mathot give an excellent introduction to the importance of the sea ice microbial communities and then demonstrate how complex the communities are – but using data from almost anywhere except the West Antarctic Peninsula! The difficulties of working in the pack ice, the extreme heterogeneity of the habitat and the difficulties of adopting an experimental approach have clearly dissuaded many researchers from what is a key area of biogeochemistry in our understanding of the Southern Ocean. There seems no special reason why such studies should be undertaken around the Peninsula except that there is an LTER site and more than one well equipped biological research station in the area. R. Bidigare *et al* provide both qualitative and quantitative assessments of phytoplankton, looking at the problems associated with each of the common methodologies in use.

Unravelling the role of *Phaeocystis*, present in unicellular and colonial forms, apparently antagonistic to other phytoplankton and bacterioplankton and the dominant species in the spring bloom, will be a key task for the future. A chapter by D. Karl *et al.* looks at microbial oceanography more generally and is specifically meant to complement the previous one by providing an integrated review of processes and cycling. Although it does cover material already reviewed by Karl and Knox fairly recently, it attempts to do significantly more. In particular they insist that the traditional focus just on bacteria is inappropriate and unlikely to be helpful in attempts to find the elusive general model of the "microbial loop" to understand nutrient cycling in the Southern Ocean. Finally, there is a chapter by R.C. Smith *et al* on phytoplankton productivity in the LTER. Their comparison of ship and satellite data is important in constraining some of the more recent estimates for phytoplankton production and they conclude that the average primary production of this coastal area is comparable to other productive coastal areas of the world' oceans. What at present bedevils progress with modelling is not only the limited spatial and temporal data sets but a lack of understanding of what initiates the episodic events with massive phytoplankton blooms that characterize the system.

The larger zooplankton are covered by R. Ross *et al* in two chapters, using both historical and new data to indicate that even for the most studied species in the Antarctic – *Euphausia superba* – there are still serious holes in our understanding. They demonstrate the high seasonal and annual variability making it essential to conduct long-term studies before any understanding of the drivers of change can be expected.

A. Clarke contributes two short chapters on benthic communities. The first, on the distribution of benthic communities, shows how limited all Antarctic data are for this field and to what extent all generalizations heavily depend on three major sources – British work at Signy Island, US work at McMurdo and German work from *Polarstern*. Aside from some early data from Arthur Harbour there is very little from the west side of the Peninsula, although this should begin to be rectified now by new studies at the UK Rothera station. The second chapter looks at processes and points out that there is too great a reliance on summer only data for many analyses. What little year-round data exist suggests that many important things happen after researchers have fled north to avoid the winter!

A.K. Kellerman has a rather easier job dealing with midwater fish where there is much more data from the area. He proposes a nice model linking pack ice persistence and life cycle adaptations in larval notothenoids.

The only two chapters on birds are both by W.R. Fraser & W.Z. Trivelpiece and concentrate on populations and adaptations in Adélie penguins. The species is a key component of the CCAMLR Environmental Monitoring programme and the two chapters provide very useful summaries of what we know about natural variability.

The chapter by D.P. Costa & D.E. Crocker on marine mammals is a very general summary of their biology with only one specific reference to the Antarctic Peninsula area, which appears never to have been used as a research area for seals or whales. There is little attempt at systhesis with other data but the authors do note the need for co-ordinated studies of foraging, prey distribution and oceanography.

The fifth section covers human disturbance with papers by R. Naveen on tourism impact, M.C. Kennicutt & S.J. McDonald on marine pollution and D.J. Agnew & S. Nicol on fishing. Naveen briefly describes his site inventory as a tool for measuring visitor impact. Rather too much of this chapter was taken up with verbatim extracts from the Environmental Protocol and Antarctic Treaty Recommendation XVIII-1. Marine pollution considers both long-range transport and localized damage, utilising the *Bahia Paraiso* incident as a case study for hydrocarbon effects. By setting the Antarctic data within a wider context the authors show that the region remains, for practical purposes, pristine with pollutants halo effects around stations. This is clearly an important finding to underpin the choice of location of the LTER. Finally, an examination of CCAMLR data shows that although fishing for both finfish and krill has continued in the area for over 20 years, the present take does not seem to be affecting predator populations. I liked this chapter for synthesizing the detailed data in CCAMLR reports into a much more accesible overview for non-ichthyologists!

The Palmer LTER group have jointly written the final section – a closing summary which attempts to gather the many strands together. I would suggest that if readers were to read this first they would gain more from the rest of the volume! The case they build for the value of integrated and long term study is a powerful one and yet again I want to applaud the foresight of the National Science Foundation in establishing and maintaining the LTER network against the pressures to reallocate the resources into short-term research.

It would have been nice to see something on the other birds in the region and perhaps more integration between some of the chapters – but these are small matters against the achievements of the volume. In my view an excellent volume, which should not only provide a strong basis for the future development of the Palmer LTER but also highlight for other countries the value of the west side of the Antarctic Peninsula as an excellent area for biological research.

D.W.H. WALTON