

Book reviews

The Case for a Stable East Antarctic Ice Sheet. *Geografiska Annaler, Series A Physical Geography*

Edited by D. Sugden, D. Marchant and G. Denton
Scandinavian University Press, Oslo (1993).
351 pages. ISSN 0435 3676.

Students of Antarctic geology will know that a *Festschrift* for David Sugden published in *Geografiska Annaler* is likely to excite passions in at least four continents. The problem is with the seemingly innocent title of “The Case for a Stable East Antarctic Ice Sheet”, the point being that one could equally fill a volume entitled “The Case for a Dynamic East Antarctic Ice Sheet” in the knowledge that this would excite equal passions in as many continents.

The purpose of this volume is not to air both sides of the argument but rather to gather the evidence for one side. The editors (Sugden, Marchant and Denton) believe that “this volume contains a powerful body of evidence showing that the East Antarctic Ice Sheet is stable and has been so at least since middle Miocene time.” (14 million years). The data mostly come from sites in the Dry Valleys of the Transantarctic Mountains. They undoubtedly constitute one of the most unusual areas on the planet, the simple fact that they are the largest area in Antarctica uncovered by ice being demonstration enough, and even more curious is the fact that they appear to have been uncovered for a very long period.

While some of the local glaciers are fed by overspill from the main ice sheet, others are true valley glaciers, and a paper by Hall *et al.* argues that they have not advanced beyond their present margins for at least 3.8 million years, and that subsequent conditions have been those of a cold arid desert, as at present. This is taken as evidence that any deglaciation of East Antarctica, which some argue took place during the early Pliocene, could not have occurred. Modelling results of Antarctica indicate that this could have required a warming of between 15° and 20°C (Huybrechts) which is larger than that which is allowed by the ocean isotope evidence, and presumably would have produced periglacial activity in Dry Valleys where annual average temperatures are today around -20°C. A paper by Kennett & Hodell, who look at data from Southern Ocean cores, concludes that ocean temperatures only increased by 23°C, which is nowhere near large enough to have caused a deglaciation using the Huybrechts assumptions. These papers cover the first version of the stabilist argument.

The second version is a significantly extended viewpoint, which maintains that the East Antarctic Ice Sheet has been in its present configuration for 14 million years, which is principally the viewpoint of the Maine-Edinburgh School, and is based on two strands of evidence from the Dry Valleys. Firstly there is the geomorphological evidence, (Denton *et al.*,

Marchant *et al.*), which to a large extent is based on valley shape (rectilinear slopes) and is used to advance a hypothesis of genesis in an arid environment. The second line of argument comes from volcanic outcrops and supposedly *in situ* ash layers. These data are presented in further papers from the school (Wilch *et al.*, Marchant and two others). The ⁴⁰Ar/³⁹Ar dating of these layers proves minimum ages of these surfaces (if the layers are *in situ*, i.e. the direct result of volcanic activity) of 10–15 million years. Critics will point out that there is clear geomorphic evidence for the motion of these ash layers (presented in the paper by Marchant *et al.*) and will also point to the issue of lithological and structural control on valley form in a rift shoulder like the Transantarctic Mountains.

An introductory paper by the editor reviews the arguments of the main proponents. One of us is a non-combatant (RCAH) and remains as bewildered as ever by the mass of irreconcilable evidence, the other is a guerrilla (FMvdW) operating amongst the fault-blocks of the Transantarctic Mountains and Marie Byrd Land, and remains as baffled as ever by the variety displayed in landscape evolution histories in different areas. Can we expect to extrapolate the evidence from such a singular area as the Dry Valleys to a whole continent?

RICHARD HINDMARSH AND FREDERIK VAN DER WATEREN

The Antarctic; World Bibliographical Series Volume 171

Janice Meadows, William Mills and H.G.R. King
Clio Press, Oxford (1994)
383 pages. £57.95. ISBN 1 85109 121 1.

Reviewing a bibliography is never easy. With 21 volumes of the *Antarctic Bibliography* already published, and the Scott Polar Library catalogue also available in many major libraries what can this volume add? This is volume 171 of the World Bibliographical Series which Clio Press say will eventually cover every country and many major regions of the world. Each volume aims, in its selection of material, to provide “an interpretation of its culture, its place in the world and the qualities and background that make it unique”. How well did the authors do in their 1195 annotated references?

There are 19 subject and geographical sections and a further 22 devoted to each island or island group around the Antarctic including the Falklands and Gough Island. The emphasis throughout is on books but a wide range of journal references are included to cover some of the more esoteric areas. The index is extensive, occupying 66 pages.

For those who think of Antarctic literature as entirely scientific there are some surprises - sections of fiction

(including children's books) art, photography, philately and living in the Antarctic. There is detailed coverage of logistics, expedition planning and survival (61 references) but only 15 references on station design and construction. The section on Science and Policy contains only four references on SCAR, and only 15 on reviews of national programmes with a further 16 on science policy. This does seem surprising for a continent devoted to scientific research.

Not surprisingly History is a large section, accounting for almost 20% of all the references. Both here and in the biographical section there are only a few references to non-English publications yet there are significant volumes not yet translated which might have been included.

I acknowledge the diligence of the authors in listing some obscure publications which the average librarian will have great difficulty in obtaining. However, at least their existence is acknowledged and the determined reader will find them.

To me the most unusual feature of this bibliography is the apparent paucity of the books on science when compared with the rest of the Antarctic literature. Indeed, the coverage of the literature in geographical sections is especially misleading. For example, under South Georgia a bibliography of 1344 references is not treated as a major item but included only as a comment and the whole island only has 14 cited references. For the South Orkney Islands there are only six references (only two biological) and yet this has been the site of intensive biological work since 1947 resulting in hundreds of papers. Whilst the intention of the series is to be selective it is meant to emphasize the qualities and background that make it unique. The authors have done a good job and the book will be an excellent source for reference librarians all over the world. I am not, however, convinced that it really reflects the scientific output on Antarctica - surely its truly unique quality?

DAVID WALTON

Antarctic seals: research methods and techniques

Edited by *R.M. Laws*.

Cambridge University Press (1993).

390 pages. £50.00. ISBN 0 521 443024

Antarctic waters are unquestionably the present-day stronghold for healthy, widely distributed populations of pinnipeds. The pristine conditions and inaccessibility of their habitat are the major reasons. Few higher vertebrates exist in such undisturbed conditions, and the seals of Antarctica, as a consequence, are an exceptional world treasure. This places a responsibility on investigators studying this group that is akin to custodians of the crown jewels. This book provides comprehensive coverage of some research procedures that scientists are using to study seals in Antarctica today.

The volume begins with a subtle touch by showing what is probably the first photograph of a Ross seal on the jacket cover

of a book. After reading Chapter 1 on seal identification, the reader will be able to recognize this beautiful seal. There are 15 chapters with topics ranging from general identification of seals to genetic-based studies. Various Antarctic species are exceptionally well illustrated using pen and ink sketches done by Laws, the editor. Eighteen authors, all well known representing a comprehensive report to promote the standardization of techniques should be achieved if current and future investigators use this volume as a guide.

The book is generally divided into five major topics with many inter-relationships. They are: 1) population assessments, 2) behaviour, 3) morphometry and related subjects, 4) age-correlated variables, and 5) energetics. The population chapters are detailed presentations of some of the most important measurements for population counts, and the problems of analysis. Chapter 3 on Immobilization and Capture presents perhaps the most comprehensive table ever assembled on the results of drugs usage. This is essential reading for anyone contemplating the use of drugs on pinnipeds. The difficult problem of permanent marks on seals discussed in Chapter 4 seems 'not to have advanced much since the inception of such programmes in the 1950's and 1960's. This is in sharp contrast to Chapter 5, which describes the various telemetry and electronic devices developed by numerous laboratories and companies, which have capitalized on advances in microchip technology. Data are now being collected that would have been hard to imagine 20 years ago, and Bengston does a good job of summarizing many of the devices now available for seal research. The other chapter in this section, simply called Behaviour, is a brief summary of standard behavioural methods of data collection.

The age-correlation topic comprises two detailed chapters adequate for anyone wanting an overview of this area of pinniped biology. The figures on tooth structure and counting of annual bands are especially helpful to the uninitiated. It is clear that what at first seems like a straight-forward technique actually requires much skill and training.

The last section on energy includes two excellent chapters. Croxall's discussion on how to determine the diet of seals illustrates well the formidable task before biologists taking on this challenge. How does one identify fish otoliths that change in size and shape as they pass through the gastrointestinal tract? Not easily is the answer and, in addition, passage rates also vary between common items such as squid beaks and fish parts. Chapter 15 on bioenergetics may be less discouraging, especially the section on the application of isotopes for the study of free-ranging seals. This chapter provides a useful summary of the current procedures and terms. My attention was caught by the curious spelling of carcass (carcase) and the occasional reference to stable isotopes as radioisotopes.

Laws concludes the book with a final chapter on research needs. There is probably no one better qualified to do such a summary. Laws and Siniff selected their authors well. The

book is an excellent reference for anyone engaged in or contemplating research on Antarctic seals.

G. L. KOOYMAN

Southern Ocean Ecology: the BIOMASS Perspective

Edited by *Sayed Z. El-Sayed*.

Cambridge University Press, (1993).

399 pages. £45.00. ISBN 0 521 443326.

The Southern Ocean ecosystem has been the focus of research activities for some 75 years. Given that it has always been expensive to get to, hazardous to work in, and is of circumglobal extent, this long enthusiasm has been fuelled primarily by the potential for harvesting its resources. The first of these were the great whales, whose long term scientific management was the objective of the Discovery Investigations, set up soon after the First World War when already "grave apprehension was felt regarding the future of the great whaling industry". The ecology and distribution of *Euphausia superba* were at the core of the Investigations, whose costs were largely borne by revenues raised from the industry itself.

In 1976 a second programme was formulated: the Biological Investigations of Marine Antarctic Systems and Stocks (BIOMASS). Krill was again the main focus and marine mammals were by then the subjects of the Seal and Whaling Conventions were excluded from the research plan. Work was concentrated particularly on the Western Atlantic sector (including the Antarctic Peninsula) and the Indian sector. The programme formally ended in 1991. This volume is the product of the colloquium which was held to review and assess its results. It begins with a succinct account of the *history, organization and accomplishments of BIOMASS* by its chairman, S.Z.El-Sayed, who comments that the programme is still too close in time to pass judgement on its overall success or shortcomings. Nevertheless one of the great strengths of the volume is that in the subsequent six main sections the various authors assess both what has been achieved and its limitations. This is reinforced at the end of each section by a discussant who draws together both the achievements of the past and the questions for the future.

The first section contains two papers covering the *Antarctic marine environment, the physical oceanography* of, respectively, the West Atlantic sector and the Prydz Bay area of the Indian sector. The authors identify the huge range of temporal and spatial scales in the physical phenomena regulating the ecosystem, and the problems these pose in relating them to the biology. This is a theme that recurs throughout the volume and the discussant (E.Fahrback) suggests a combined hierarchy of models and observations as the future means to address it.

The next three sections deal with *Antarctic marine stocks*. The first has two pairs of papers, one each on the phytoplankton and zooplankton of the two sectors. The vexed question of whether the phytoplankton is limited by grazing, light (through turbulent mixing), or iron, is not yet resolved, nor did BIOMASS specifically target the role of the picoplankton and microheterotrophs. Use of the whole phytoplankton data set has identified regional patterns and time-series variability, despite some limitations in the comparability of chlorophyll and nutrient data. Multivariate analysis of the zooplankton data from Prydz Bay has identified specific communities and their indicator species. Both here and in the larger scale studies in the West Atlantic sector the importance of copepods and salps is emphasized, particularly in the oceanic areas. The discussant (E.Sakshaug) compares the Antarctic data with the Barents Sea, with the provocative conclusion that, if the ecosystem processes are similar, the biomass of herbivorous zooplankton in the Antarctic should be five times that of the krill.

The second stock section deals with krill, its three papers covering mesoscale distribution, demography and small-scale processes, and energetics. The data derive mainly from the cruises of the First and Second International BIOMASS Experiments (FIBEX and SIBEX). These papers describe how the critical relationship between acoustic target strength and krill size has been reassessed with time, leading to changes in the standing stock estimates based on acoustic data. The commercial krill fishery expanded from minimal levels to over half a million tonnes during the BIOMASS programme. Seldom can a standing stock assessment programme have been of such immediate relevance. The demography of swarms and super-swarms is becoming known, yet the environmental controls of swarming behaviour remain contradictory. There is more agreement on growth rates and longevity, but the ageing of individuals remains problematic. Larval krill critically depend on sea-ice as a habitat; for adults its significance is less clear. Adults have an energy throughput of c. 20% of body carbon per day and *E. superba* is now viewed as more like a schooling fish than a scaled-up copepod. This work is the core of the BIOMASS programme and the discussant (D.G.M.Miller) identifies the success of its integrated approach on any assessment criteria.

The third stock section deals with fish and birds, krill predators the latter of which were hardly considered by the earlier Discovery Investigations. The fish populations, particularly the notothenioids, had become increasingly exploited and the two papers here review their general biology and distribution, particularly the ichthyoplanktonic stages. The mesopelagic species, particularly myctophids, were also assessed and the papers emphasise that fish are a major food of birds and seals in the Indian sector, thereby having an intermediate role in the transfer of carbon between krill and higher predators. In the Atlantic sector the transfer is more direct. The two ornithological papers both emphasize the uncertainty involved in quantitative estimates of bird

populations at sea, and the very limited correlation with krill abundance. Nevertheless from FIBEX and SIBEX data a mean population of some 34 million birds in the Prydz Bay area consumed approximately 1 million tonnes of krill during the summer (37% of the standing stock). The discussant (J.-C. Hureau) notes the relatively shallow sampling in the BIOMASS programme and the unknown significance of the non-myctophid meso- and bathypelagic species.

The fifth main section deals with trophic interactions and relationships under the general title of *Antarctic marine systems*. One paper covers the lower levels of the food web including the microbial loop, the other the higher predators, including the whales and seals. The quantitative role of squid as krill predators is still a matter of speculation. A third contribution to this section deals with the BIOMASS database, its history and evolution. No punches are pulled and it is clear that there were many adolescent agonies on the path to its present maturity. The discussant (R.M. Laws) notes the limited coordination between workers on different groups and identifies the future need for whole ecosystem studies.

The final group of papers deals with future developments. One emphasizes the links between the BIOMASS programme and global change research, particularly the JGOFS programme. Another deals with BIOMASS-CCAMLR links. The CCAMLR was ratified in 1980; while committed primarily to harvested and dependent species it was greatly influenced by BIOMASS (from which its Scientific Committee evolved) to maintain an ecosystem perspective. One paper deals with the ice edge zone and in another the Antarctic is compared globally with other large marine ecosystems. The discussant (G.Hempel) notes how objectives have changed during the course of BIOMASS. The emphasis is now on rates not stocks, fluxes not compartments and variations not steady states.

The concluding contribution (G.E. Fogg) is a critical appraisal of BIOMASS, which he describes as "a venture in search of understanding, carried out by some dozen nations in as many ships over the best part of ten years in the world's most remote and hostile seas". This is a thought-provoking essay on the values and limits of "big" science and international programmes. It identifies as key areas for progress both

modelling and closer understanding of the effects of different scales of water movement on plankton distributions. He concludes, however, that "Only the acute observation and intuitions of the biologist actually working with living organisms in their natural habitat can ensure the sound development of our science".

BIOMASS has ended. It was an outstanding achievement of politics, economics, scientific collaboration and endeavour, with a very high P/B ratio. This book offers every oceanographer and marine biologist both science to intrigue and lessons to be learned.

PETER J. HERRING

Other books received

Wilkinson, P. Warrior - one man's environmental crusade. Lutterworth Press, Cambridge 1994. 142 Pages. £17.50. ISBN 0 7188 29107. Includes the inside story of Greenpeace and its Antarctica project. It is unlikely to please the author's friends!

Araya, B. & Chester, S. The birds of Chile - a field guide. Latour, Santiago 1993. 400 pages. Price not stated. ISBN 956 7309 019. A revised and extended version of an earlier edition in Spanish. Illustrations as line drawings only. Brief description, habitat and range for each species. No keys. Covers species from the maritime Antarctic to the desert at 18°S. A book for the experienced birdwatcher.

Chester, S.R. Antarctic birds and seals: a pocket guide. Wandering Albatross, San Mateo, California. 1993. 80 pages. US\$15. ISBN 09638511 28. In full colour. Covers 47 birds and six seals, many with photographs. Brief identification details, range and some general comments for each species. Excellent guide for tourists, with useful bibliography for those who need more information.