

As a review of Antarctic science, the book is evenly documented and compiled and is generously illustrated (but not at the expense of the text). Reproduction quality is superb (there is a good mix of colour and black-and-white figures) and the page format is attractive, with clear type. It is very readable and in the greater part should be readily understood by the general reader. It is probably most useful to scientists and students for its breadth beyond the boundaries of disciplinary interest, rather than as a specialist reference.

To a scientist with Antarctic experience (G.J.W.), it is the first easily comprehended statement I have read on what some of my colleagues have been doing. As a reviewing team, we hope also that it will be read by the administrators, politicians and support personnel of Antarctic programs. To read it is to better understand the place of sector and disciplinary interests in the context of more global issues. Thus ecological food webs are linked to the effects of Antarctic exploitation (overfishing and oil pollution are examples); the Antarctic ice sheet and its historical record are related to current world climate; physiological adaptations of species such as icefish are linked to survival at the cold extremes; the importance of temperature is traced in the tragic outcome of Scott's last journey; and seemingly esoteric topics such as CO<sub>2</sub> levels, magnetic fields and solar winds are shown to really matter if we are to look to the future well-being of our planet. Only by the uniqueness of Antarctica are some research technologies even possible.

Although the British Antarctic Survey is clearly a highest authority in Antarctic science, the book does not cite references and the text must stand on its own merits. In this it is hard to fault, and we have little criticism beyond minor points. Sadly missing, however, is a large, detailed map of Antarctica. As the one reviewer without Antarctic experience (E.G.W.), I found it difficult to cope with geography at numerous points in the text. For example, not until chapter 13 does one of the many topical maps locate the Transantarctic Mountains!

A table referred to on page 109 is missing, and the Antarctic inference does not match the sub-Antarctic photo on page 67. An incorrect photo caption (57°54'N) appears on page 254, and the diagram on page 146 could have been helpfully placed earlier in chapter 10. Some figures are only marginally related to the text but enhance the book's appearance, bulk and, no doubt, price.

Restrictive use and clear definition of technical terms is commended but a little jargon escapes definition here and there — e.g., firm (p. 42), euphotic zone (p. 78), gyre (p. 148), to mention a few. Some acquaintance with technical language renders easier reading of the core science chapters, but should one chapter appear more difficult than another, this is likely to reflect the reader's background more than a difference in presentation standards. There are a mere handful of typographic errors, but "Antarctica" (p. 161) and "Antarctic Plate" (map, p. 176) are the most arresting. On page 174, "southern Africa" might be intended rather than "South Africa"?

It is most helpful that Appendix 3 lists the names and addresses of 19 national bodies to contact for information on Antarctic activities. Appendix 1 presents the full text of the Antarctic Treaty.

Fairer mention might have been made of the negative environmental impacts of some good science when less systematic science was addressed (e.g., p. 64), and greater coverage might have been expected of the BIOMASS program (Biological Investigations of Marine Antarctic Systems and Stocks) — there is only passing reference in chapters 9 and 18. However, there are many different programs cited, and given the book's compact coverage within its 280 pages, their treatments appear consistent. Any overemphasis of British achievements is slight, and for such an international overview the editor prefaced the following caveat:

The authors have considered the breadth of studies in their respective subjects and chosen from amongst them those that appear to have been the most important scientific developments. The choice is necessarily subjective.

Not until the final chapter, "Science, the Treaty and the Future," is there a hint of deviation from the scientific rigour of earlier sections. In the light of chapter 12, it here seems hard to reconcile the preciseness of a 60 m rise in sea level if the Antarctic ice sheets completely melted (p. 253). This author is also relatively brief in countering the concepts of

Antarctica as a "common heritage" and as a "world park." The one concept is freely aligned with exploitation and the other is dismissed as politically unacceptable.

Today, the direction of scientific research in Antarctica is clearly in flux. With the likely advent of a "minerals regime" and exploitation of Antarctic resources for commercial gain, there is a fear that collection of information on resources will proceed at a rate faster than information on the environment. Politicians argue in urgency that the risk of an unregulated scramble for such resources is too great and that a minerals regime should therefore be concluded.

The authors of this text do not emphasize this urgency. They do, however, emphasize the lack of political power scientists have (second-class status at Treaty meetings) in formulating conventions. Scientists fear that a minerals regime would be to the detriment of scientific research, particularly if the pristine Antarctic laboratory is perturbed by industrial activity.

A quotation from page 137 leaves a fitting (and hopefully lasting) impression of this fragile continent:

The slow growth of Antarctic mosses means that the mark of a footprint remains in a moss bank for some considerable time. The break in the surface at the edge of the footprint allows the wind to grip the surface and tear the moss bank apart, causing erosion far faster than the rate at which the moss can grow.

We highly recommend *Antarctic Science* as the title because its reading dimension is Antarctic science *in process*.

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THE GREENLAND CARIBOU — ZOOGEOGRAPHY, TAXONOMY AND POPULATION DYNAMICS. By MORTEN MELDGAARD. Kommissionen for Videnskabelige Undersøgelser i Grønland (The Commission for Scientific Research in Greenland). Meddelelser om Grønland, Bioscience 20, 1986. 88 p., tables, figs., appendixes. Softbound. Dkr158.60.

This monograph is for the most part a greatly needed comprehensive review of the voluminous zoogeographical information, much of which is scattered in various reports. Eighty-four years have passed since the zoogeography of the caribou in Greenland was last monographed in any detail. Everybody can recognize a caribou or even a caribou antler, and the animal is the one with the most extensive literature record in Greenland. The historical record from this part of the Arctic can be traced back to the old Norse document *Kongespejlet* (*The King's Mirror*), written about 1260. The modern record begins c. 1720 with the new colonization of West Greenland.

The caribou has been — and still is, at least periodically — a major prey for the Greenlanders, and its bones have been recovered from many archaeological sites. This aspect is extensively dealt with. The archaeological record goes back to c. 2500 B.C., when the first hunting cultures arrived in Greenland. At this time most, if not all, of the present-day mammals had immigrated to Greenland. The knowledge of the mammalian fauna prior to this event is very sparse. And knowledge of the caribou of that period is virtually restricted to a few radiocarbon dated remains found in geological contexts.

Today natural populations of caribou are only present in southwest Greenland and in Inglefield Land in northernmost West Greenland. However, shed antlers and bones, which testify to its previous presence, can be found virtually everywhere in Greenland. In central East Greenland historical sources show that the caribou became extinct sometime between 1890 and 1920, probably close to 1900.

Domestic animals are present in southwest Greenland, but animals from this herd have been introduced to a number of places. The modern

range of caribou, reindeer (domestic animals) and "feral reindeer" is shown on 11 separate maps scattered in the book. Unfortunately the complete range of the species is not compiled on a single map.

The volume is divided into two parts, one descriptive and the other analytical. Although this division is practical in some aspects, it leads to repetition. In the descriptive part Greenland is divided into 20 caribou regions of vastly different sizes. The West Greenland regions are much smaller than the North and East Greenland regions, because much more is known about the recent history of the caribou in West Greenland. For each region the geological, archaeological and historical records are reviewed, followed by the present status. In the analytical part the 20 regions are assembled in 5 broader regions, which are discussed with respect to zoogeography. Finally, there is a discussion on the causes of the large fluctuations in the caribou population size in West Greenland.

When Meldgaard started his work only five radiocarbon dates on Greenland caribou remains had been published. One of these (K-3865:  $7980 \pm 115$  years before present [B.P.]) proved that the species was already present in North Greenland in the early postglacial (Holocene). Meldgaard presents eleven new dates. Unfortunately, he has not been able to extend the history of the caribou in Greenland back in time, but it now appears that caribou were present in North Greenland during much of the Holocene, although perhaps intermittently. Meldgaard also shows that the caribou remains from southeast Greenland, which represent dwarfish animals, were present in that area from c.300 to c.1200 A.D. Meldgaard has overlooked an important date from East Greenland, Lu-1096:  $6200 \pm 70$  years B.P., which shows that the species was present in this vast region in the middle Holocene. This date is hidden in a list of dates in the journal *Radiocarbon* (Vol. 18:302), which might not be an obvious place to look for data on the history of the caribou in Greenland. However, numerous other dates on Greenlandic organic material are published in this journal, including several bone dates.

In Canada and the United States the presence of a Peary Land refugium or North Greenland refugium, where many animals and plants survived the last glacial period — the Wisconsinan or Weichselian — is often taken as a well-established fact. However, although recent work on the glacial geology of the region indicates that large areas did remain unglaciated, I agree with Meldgaard that such large mammals as the caribou probably did not survive. Meldgaard suggests that the species immigrated to Greenland primarily via Nares Strait. In the early Holocene most of Greenland was populated by small animals (*Rangifer tarandus pearyi* size). In the middle Holocene larger animals (*R. tarandus groenlandicus* size) immigrated to West Greenland. Some animals may also have arrived from Baffin Island via the Davis Strait or from Svalbard.

Population size of the West Greenland caribou fluctuates dramatically. Meldgaard documents these changes in detail, using historical, ethnohistorical, game-statistical sources and recent work by game biologists. He believes that the fluctuations are cyclic, with a periodicity of 65-115 years, and that fluctuations in different populations are synchronized. The population builds up over a period of only about 10 years, followed by a population maximum of 10-25 years. The population crash takes about 10 years, while the population minima last from 35 to 70 years. Three possible causes for this pattern are discussed, namely, predation, overgrazing and climate, and it is concluded that climatic changes are the driving force. Although weather and climate may to some extent explain the fluctuations, I believe that some intrinsic factors may also be of importance and that the caribou may overutilize the vegetation at the population maxima.

No new taxa (species, subspecies, races) are proposed and no previously described taxa are considered synonyms, although it is questioned whether the caribou in northernmost Canada (*R. tarandus pearyi*) and the one formerly living in central East Greenland (*R. tarandus eogroenlandicus*) should be maintained as separate subspecies.

Concerning Meldgaard's use of place names, some names, at least in North and Northeast Greenland, are misspelled, inconsistently spelled or are not the official names authorized by the Greenland Place Name Committee. This inaccurate use of place names may easily lead to

confusion. Also, the use of a very old map of Greenland that predates modern maps of North Greenland (published c.1960) is unfortunate.

The work is very well documented, with a long list of references. The volume is rather expensive, but it is of interest not only to those interested in arctic mammals and their history, but also to those interested in the Holocene history of the Arctic, and it forms a background to archaeological and ethnographical studies.

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BERING'S VOYAGES: THE REPORTS FROM RUSSIA. By GERHARD FRIEDRICH MÜLLER. Translated with commentary by CAROL URNESS. Fairbanks: The University of Alaska Press, 1986. 221 p.

Scholarly interest in and research on 18th- and 19th-century Russian explorations in the North Pacific has been spotty. This is true of Russian literature both before and since the 1917 revolution. It is even more true of works that have been produced in the West. The few studies that appeared were marred by the failure of their authors to consult original sources; by careless research; by inadequate familiarity with the problem or the language; by ideological blindfolds; by Russian official secrecy and often deliberate disinformation concerning their explorations; and by an erroneous feeling among some Western scholars that the Russians somehow were incapable of the achievements their explorers actually had made.

The situation has changed for the better in recent years with the emergence of a small group of competent scholars (in the U.S.S.R. and in the West), the publication in the Soviet Union, Canada and the United States of a number of documentary collections, memoirs and classic works, and the appearance of a good number of original analytical studies (monographic and periodical). Space will not allow the listing of all these efforts. For the record, however, it should be noted that a number of scholars and publishers in the United States, Canada, the Soviet Union and the United Kingdom have played a vital role in promoting the current renaissance of interest in Russian activity in the greater Pacific Northwest. Likewise a series of international conferences in the United States, England and France concerning this problem have contributed to the development of a positive climate.

While these efforts have been a step in the right direction, they still fall short, because the new breed of Western and Soviet scholars have not coordinated their research and because the complexities of Soviet relations with the West have hindered the exchange of scholarly views and the undertaking of scholarly joint ventures. Yet such cooperation is essential in illuminating the problem of Russian explorations in North Pacific because the bulk of source material is divided among Soviet, American, Canadian, British, Spanish and French repositories. It follows, therefore, that no definitive study of this topic can be undertaken without cooperative involvement of the foremost experts from these countries.

The volume under review is one of the latest examples of the growing interest in Russia's North Pacific explorations. Its stated purpose is to reexamine the writings of Gerhard Friedrich Müller (1705-83) in order to ascertain his role in the interpretation of Bering's and of Russia's achievements that have elicited both praise and criticism over the years. Focusing on Müller is important because he initiated true scholarly interest in Russian expansion to the Pacific and to North America. He achieved this through three efforts. First, as a member of the celebrated Second Kamchatka Expedition (1733-43) he examined, copied and gathered thousands of documents on historical, geographic, ethnographic, linguistic, legal and other topics. Second, he was the first scholar to use this evidence in writing the first comprehensive history of