

materials on this region, Yerbury had redeemed himself. But my commitment to seeing that intelligent historical studies of native Canadians in this region get written leaves me little choice: this book fails. Some may go further, to argue, not without justification, that it does a disservice to the role that careful historical work must play in the construction of an ethnohistory from documents (certainly not the only form of ethnohistory) of native people in the western Canadian Subarctic.

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THE ARCTIC & ITS WILDLIFE. By BRYAN SAGE. London: Croom Helm, 1986. 190 p., 125 plates, 30 tables, 38 figs., index, refs. Hardbound. Cdn\$34.95.

If you "require, in one volume, a reasonably detailed account of the arctic environment and its fauna and flora with plenty of 'meat' in the form of facts, figures and illustrations," this book, says its author, is for you. Acknowledging at the outset that the meat is somewhat unevenly distributed on the carcass, author Bryan Sage makes no apologies: he had to be "selective"; it was "not possible to include the fish"; "for reasons of space, there is no separate discussion [*sic*] of the native people, economics, or development"; and "neither has it been possible to deal with the all-important question of conservation."

Acknowledged deficiencies aside, Bryan Sage, who lives in England, and his four collaborators, Hugh V. Danks and Erich Haber, of the Canadian National Museum of Natural Sciences, Ottawa, Peter G. Kevan, of the University of Guelph, and Thomas G. Smith, of the Arctic Biological Station, Ste. Anne-de-Bellevue, provide a wide-ranging survey of arctic natural history. Most of the book is authored by Sage, who, according to the jacket, "worked for 21 years as an oil industry ecologist" (referring, presumably, to the business of his patrons rather than to a disciplinary specialty), with Haber contributing sections on the circumpolar arctic flora and adaptations of arctic plants, Kevan and Danks on arctic insects and their adaptations, and Smith on arctic marine mammals and their management.

Inside an elegant dust jacket graced by a Dalton Muir photograph of a gyrfalcon and family, the reader will find a diverse mixture of photographs, tables, illustrations and text, encyclopedia style. There are 125 photos (72 in colour), of which 59 were taken by Sage. Almost half illustrate the chapter on birds. Parts of the text are of a descriptive nature, and others favour the manner of the review article, with specific scientific observations incorporated and referenced. Some 436 references are listed.

The references are generally technical, recent and focussed on wildlife. A quarter were published between 1980 and 1985, and half since 1976. Only 16 percent saw the light before 1961. Two-thirds are rather evenly divided between birds and mammals. Fewer than 10 percent are on either plants or invertebrates, and only a few concern climate, terrain, limnology and the sea. The focus of the book is very clearly on arctic birds and mammals.

The chapter headed "Breeding Birds" is nearly 40 pages long and is supplemented by a 7-page appendix showing which species breed in arctic Alaska, Canada, Greenland, Svalbard and the Soviet Union. It covers, in order, faunal elements, migration, breeding biology, tundra bird community structure, nesting densities in arctic habitats, marine birds and "selected species accounts," the latter very briefly treated under family (e.g., Gaviiformes) subtitles. Read alone or in conjunction with other, original material, Sage's survey of recent observations will be useful, but nonetheless it conveys a limited perspective.

In the treatment of zoogeography, there is no mention of variation below the species level. It is explained that bird migration out of the Arctic is due to lethal winter conditions ("there are just two basic alternatives . . . they can move out of the area, or die"), but no

explanation is offered for spring migration north. In spite of considerable description of amazing migratory cycles, there is no analysis of how they might have come to be. Species are treated as static entities, rather than forms whose distribution, appearance and behaviour change over time: in fact, the interesting species whose distributions appear to be wavering at the margins are deliberately omitted from any discussion of faunal elements. Similarly, other kinds of behaviour are treated as static rather than adaptive. It is apparent, for example, to Canadian arctic urban people, that the raven has learned to share their settlements. From its wilderness state as a congener of the wolf, it has found and entered a new niche. Other species have also taken advantage of new circumstances. Black guillemots have adopted abandoned buildings as nest sites on western Canadian arctic coasts, where fissured rocks are scarce. Various tree-nesting songbirds make similar use of structures such as cabins and caches beyond the tree line. The mutability of life in the arctic zone should surely be a major theme: the penetrating insights of Rausch, Manning, Salomonsen and Kurten, among others, seem somehow to have passed unnoticed.

The chapter headed "Terrestrial Mammals" is, at 36 pages with a 2-page appendix on the same theme as that for the birds, of comparable length. Its introduction touches on distribution, faunal elements, population cycles and effects of grazing. It then treats the various species by order (e.g., Insectivora). This section provides quite detailed species accounts, again with some emphasis on the Alaskan North Slope, and a corresponding neglect of other areas, particularly arctic Quebec, which rates not a mention in the section on caribou. In fact, Sage's map, "Ranges of Caribou Herds in the North American Arctic," includes a Quebec devoid of the species and a Greenland lacking both *groenlandicus* and *pearyi*. Other subjects I have some knowledge of, such as the history of caribou in the Arctic Archipelago and on Southampton Island, of the muskox on Banks Island and of the red fox on Baffin Island, are superficially and inadequately addressed. The relevant appendix leaves out the Svalbard column present in the one for birds.

Sage's collaborators have contributed strong review articles on their specialties. Kevan and Danks in a six-page chapter for the most part ignore geographic specifics in favour of broader perspectives (" . . . sex is almost, or completely, unknown in a number of Arctic insects"). However, one can hardly quarrel with that when they tell us, "very few species in the High Arctic are not circumpolar"!

Haber's eleven-page chapter on the "Flora of the Circumpolar Arctic" provides the most thorough treatment of biogeography and diversity gradients. Other sections of his chapter are on habitats and plant cover, distributional patterns, plant dispersal and reproduction and genetic specialization. Haber's first sentence runs, "North beyond the fringe of the nearly continuous expanse of predominantly coniferous forest that encircles the Northern hemisphere lies a treeless barren. . . ." That will surely puzzle many northerners, from Norway, southern Greenland, Yukon and Alaska particularly. Even on the Canadian barrens, tree-scale willows occupy sheltered havens far to the north of where demoted spruces expose their all to the driving snow and understandably fail to rear their kind. Sage's own treatment of vegetation and zonation, in a chapter on defining the Arctic, gives a more balanced perspective. Haber chooses not to mention fire as an ecological factor: over time, fire surely mediated northward borders of Boreal and Little Sticks zones.

"Marine Mammals," Smith's contribution, runs for ten pages. It starts with an impression of the arctic marine mammal scene, then provides separate and expert species accounts, ending with a statement on management. It frankly emphasizes marine mammals of Canadian waters.

A minor and perhaps entirely personal dislike of mine lies in the use of the negative superscript to denote rates and ratios, in expressions such as "90,000 m³ s⁻¹" and "10,000 organisms m⁻²", instead of the word "per" or the sign "/", as in "10,000 organisms per m²."

Bryan Sage has gone to a lot of trouble to provide those who require this "reasonably detailed account" with the information reviewed above, but to what end? He explains, "The Arctic is threatened, and

nobody should be under any illusions as to the seriousness of the situation." Well, perhaps it is, in the sense that the biological productivity of the world is threatened. But, comparatively, what is the extent of the threat? Is it life-threatening, as in the Sahel? Are whole ecosystems disappearing, as they are in the clearing of tropical forests? Are the lakes being killed, as in Norway and Ontario? No: Sage's concern is that "the wilderness atmosphere of large areas has been destroyed," and "nobody really knows what effects industrial activity in the Arctic will have in the long term on the fauna and flora."

The current, unprecedented rate of degradation of the world, well illustrated in the report of the World Commission on Environment and Development (the Brundtland Commission), is consequential on pressures on the resources of the biosphere caused by high levels of resource use by humans and high rates of human population increase. Solutions, even theoretical ones, are difficult and paradoxical: in practice, the imperatives of political and religious leadership put the problems beyond the capacity of democratic institutions to resolve. However, the Arctic is as well buffered from these pressures as is any geographic zone: indigenous populations were extremely sparse until recently, and industrial growth has been slow.

Now that the populations of arctic peoples are expanding, and material expectations escalating, many look to economic development for their future well-being. Development will indeed entrain some loss of wilderness among the costs. However, the decisions must be made by northerners, and not for them. Southerners can be confident that conservation is close to the hearts of their cousins in the North. The problem will be one of balance.

The Arctic & Its Wildlife is a book most people will like, for its many illustrations and informative text. It is attractively presented and largely free of errors (except for Canadian place names on page 18). Its deficiencies are due mostly to its ambitious scope, its emphasis on cataloguing information and the weak relationship it between the factual information it displays and the facile message it attempts to deliver.

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EXPLORATORY HUMAN CRANIOMETRY OF RECENT ESK-ALEUTIAN REGIONAL GROUPS FROM THE WESTERN ARCTIC AND SUBARCTIC OF NORTH AMERICA: A NEW APPROACH TO POPULATION HISTORICAL RECONSTRUCTION. By GARY M. HEATHCOTE. Oxford: B.A.R., 1986. BAR International Series 301. xiv + 332 p. £12.50.

For at least ten years, judging by his own entries in the 50-page bibliography here, Gary Heathcote has been pursuing the history of arctic populations by consideration of skeletal remains. The present book, a revision of his Ph.D. dissertation (and typed variously in pica and elite), is essentially a large-scale confirmatory study of this kind. From within a sufficiently rich suite of cranial measurements, the author has found a subset that, collectively, are highly concordant with population "distance" scores as reconstructed from "geographic as well as genetic linguistic criteria." He hopes (p. 196) that his findings, after temporal and spatial extension, will "enable a more robust attempt than heretofore allowed at unraveling human population historical relationships in the Arctic and Subarctic zones of North America, Siberia, and Greenland."

As I am a morphometrician by trade, my interest was particularly piqued by the major subordinate theme of this work: the enrichment of craniometrics within the bounds of its present caliper-based tradition.

The [overriding] reality is that researchers in human osteology will continue, for some time, to have universal access to only the simple tools used in this study. Pioneering works . . . will eventually compel osteologists to abandon their calipers, but for the immediate future, 'old

fashioned' osteology will persist. Certainly, a case can be made that there is room for improvement within the constraints of the currently widespread, caliper-wielding approach to morphological questions. This study strives for such improvement. [p. 63-64.]

In this aspect of his project, Dr. Heathcote's timing was most unfortunate. After he gathered his 35 000 measures, but before publication of this volume, there began to appear major revisions of the foundations of morphometrics and its relation to multivariate statistics, changes that could have saved the author a great deal of effort. The emphasis on "nonstandard measures," of which he is justly proud, is but a way-station toward the exploitation of strictly patterned sets of caliper measures as the equivalent of explicitly recorded Cartesian coordinates exploited in turn to construct optimal measurement schemes for particular group differences. Heathcote's principal finding (p. 193) is that his taxonomically optimal trait battery is dominated by breadths, mainly of the neurocranium. This finding could very likely have been generated wholly automatically by a direct construction of distance measures most sensitive to the distinction between Aleut and Inupiaq language groups or between the Kagamil sample and the Kittigazuit. The appropriate method is mean tensor analysis, the ninth of nine "other more rigorous approaches to morphological description" listed, but not adopted, on page 63. And the findings would then appear in a coherent diagram of typical deformations instead of being a list of motley discrete variables.

As much as I would like to dilate on the new morphometric developments (see Bookstein *et al.*, *Morphometrics in Evolutionary Biology*, 1985), it would be inappropriate to dwell overmuch on them here. But I must caution the reader not to adopt certain of Heathcote's "unconventional" variables, notably the perpendiculars from chords to arcs of the vault. His goal, the representation of curving form, is sound, but it is not achieved by a suite of measures all confounded with the position of Bregma, Lambda, or both. I should point out that any analysis, however modern, of these skulls would be well served by the author's immense caution and competence in matters of measurement execution. The approach to data screening and precision testing recounted here is superb.

It is more useful to turn from the slightly obsolete morphometric details of this project to a consideration of the contribution that morphological data, according to whatever biometric canon, might make to studies of population history and prehistory, arctic or otherwise. Let us inquire generally whether morphology has any special contribution to make to such studies. In my morphometric view, the answer is a somewhat qualified "no," for two reasons.

1. Paradoxically, morphometrics offers too great a richness of measurements for the a-posteriori association of variable lists with predetermined classes to be meaningful. From any reasonably well-distributed scheme of landmarks (the author's 80 measures here are roughly equivalent to the digitizing of 28 separate points), almost any group separation having a biological basis can be corroborated by a suitably constructed morphometric descriptor extracted via analysis of deformation. But these are no more automatically meaningful than are the variables of a precisely analogous set, ratios measured at 45° to the first set, which are variables on which a pair of populations precisely agree in mean value: the "invariants" of the comparison, by contrast with the "covariants" found by Heathcote. The existence of both such sets is guaranteed by theorem, regardless of the nature of the populations.

2. The human head is highly constrained in its morphology. There exist mutually unintelligible languages, but, so to speak, no mutually nondeformable heads. The variability of normal heads is quite small, and much of that is epigenetic. Then morphological distances measured using skulls are too unreliable a function of variable selection to serve as evidence of interjacency in lineage studies. Indeed, the subject of Heathcote's book is in effect the unreliability of morphometric distance as adumbration of population history.

I would argue, instead, that morphology serves most usefully as a *dependent* variable in human biological studies. It is morphology that is to be "predicted," and ultimately explained, by group membership, not the other way 'round. Heathcote studied skulls deposited before