

Of special interest is the chapter on age, sex, race and species differences. This chapter provides an excellent summary of data on age, sex, and race associated variation in the mechanical properties of bone. The data are largely derived from adult specimens. Ultimate tensile, compressive, shearing, bending, torsion and cleavage strength of cortical bone decrease with age, maximum values being attained in the third and fourth decades. Data for infants and children are extremely limited; thus a developmental perspective is lacking. Lower age limits for most comparisons begin in the 15-19 age group. Sex and race differences in mechanical properties are variable. For example, mean tensile strength of cortical bone specimens for Swedish and Japanese subjects shows no significant sex differences. Ultimate tensile strength data for American materials, on the other hand, show different results. Tensile strength is greater, on the average, in White males than in White females, while it is greater in Black females than in Black males. Interestingly, there do not seem to be any racial data on the properties of cancellous bone. The need for continued study of population differences, as well as differences associated with various stressful states (e.g., nutritional, specialized physical activity) is obvious.

Bone and bones mean different things to different people. Evans' work provides an excellent consideration of the mechanical aspects of bone both as an integral component of a living organism and as an experimental specimen. The book should be of especially relevant interest to those concerned with skeletal biology and human engineering.

ROBERT M. MALINA

University of Texas, Austin

Human Adaptation to a High Andean Energy Flow System. By R. B. THOMAS. Occasional Papers in Anthropology No. 7, Department of Anthropology, The Pennsylvania State University, University Park, 1973. \$10.00 (cloth), \$5.00 (paper).

This monograph was first submitted as a Ph.D. dissertation to the Department of Anthropology at the Pennsylvania State University, and then edited for publication by Dr. William T. Sanders of the same Department. It is without doubt a valuable and pioneering work and de-

serves careful attention. The author notes that "while adaptation to the energy flow system has long been a concern of animal ecologists, the application of this concept to human groups has received relatively little attention" (p. 14). He finds the energy flow system a useful way of defining subject matter for a study of human adaptation, and therefore looks for a particular type of energy flow system where adaptive processes may be expected to be highlighted.

For a combination of cultural and environmental reasons he chooses the Nuñoa district of the high *puna* ecozone in the *altiplano* region of southern Peru. The population here tends to be isolated from the national culture, and various environmental factors tend to disrupt or inhibit energy flow. For example, the altitude allows only low net primary production and reduces the possibilities of replacing the natural flora with more productive cultigens. Further, the climate of the high *puna* is highly unstable. The antiquity of human occupation in this region suggests that processes of human adaptation have led to successful responses to their marginal energy flow system. The study area is considered as an ecosystem in which the human population operates as an important primary and dominant secondary consumer. This functional role has been achieved historically by replacing less productive natural plant and animal populations with predominantly Andean derived domesticates. Such modification of the biotic community gives the human population access to a greater proportion of the total energy flowing through the ecosystem. Even so, dietary surveys indicate that caloric consumption is considerably below FAO recommendations. In the course of a normal annual cycle, Nuñoa men and women consume an estimated 2,100 and 1,600 calories per day, or about 75% of FAO values. The percentage appears to be even lower for children.

This work is, then, a case study of human adaptation to an energy flow system in an ecological situation that is relatively unfavorable to human occupation. While it produces information that increases our understanding of human adaptation generally, it is particularly interesting for the purposes of comparison with other marginal situations, with similarly low net primary production, such as deserts, and is therefore highly significant for the various national and international programs concerned with land use and human adaptation in arid zones, that are currently being pursued in other parts of the world.

The specific objectives of Thomas' study were 1) to estimate the amount of energy flow through the population, 2) to assess this flow as a potential environmental stressor, and 3) to identify principal socio-

technological, demographic, and biological pathways which have enabled this population to adapt successfully to the energy flow system. His approach to these questions appears generally sophisticated. He notes the existence of detailed demographic information in church records dating back to 1650. He sees his study area in a state of critical interdependence with neighboring and other ecozones, such that if it were disrupted, the ability of the Nuñoa population to support itself could be seriously affected. He discusses (pp. 14-16) the few comparable studies that exist, starting with Audrey Richards work on the Bemba in the thirties, and he is aware of the interdisciplinary nature of the problems he is investigating.

Unfortunately, however, the reader is led to wonder whether some of his statements on these counts may simply be lip service, added after the field study with the advantage of hindsight, rather than an integral part of the original research plan. The field study itself—the actual data collected—appear on careful reading to have been minimal, and it is not in fact clear from the text just how long the author spent in Nuñoa or how long the study took. It is clear that the dietary information was not carefully organized to take account of socio-cultural variation, and protestations that everybody said the diet did not vary appear to be used as an excuse for not having asked specific questions about such variation or about feast day or other special diets. Similar criticisms could be made of the information on fertility. Generally, the methods used to choose and limit samples should have been made more explicit, and the sample size included in all tables. And it would have been useful to have more comparative information from culturally similar populations from lower altitudes. It would also have been interesting to have some attention paid to assessing the ecological efficiency of the adaptation. That is, given the millennia of human occupation, how has the adaptation modified the renewable natural resources of the area, especially the vegetative cover? And what are the present trends? The question is only begged by the statement on page 38 that there is no “apparent degradation of the environment” in the high *puna* ecozone.

By far the most significant and obvious lacuna in the study is the absence of any attention to cultural variables. The author defines adaptation to include “biological, cultural or demographic patterns” and lists the identification of socio-technological pathways among his specific objectives, but culture and particularly ideology and values appear to be assumed to be entirely dependent variables, which the ecologically oriented student need not bother about unless he is concerned to answer specifically cultural questions. It may be argued of course that it is beyond the

abilities of one student to cope with all these variables, but the text does appear to suggest that the "cultural" as well as the "socio-technological" variables are being included in the study (as they surely should be)—and anyway others have worked on cultural variables in the same area. The lacuna appears therefore to be due simply to this author's lack of a holistic interdisciplinary view of the problems.

This study is therefore highly significant but highly limited. And the question arises whether this is the most suitable form of publication. What advantages does this form of publication have over the normal channel for the distribution of dissertations: University Microfilms? Certainly this has been edited, and so presumably differs to some extent from the dissertation. There was, however, room for much more rigorous editing. Apart from technicalities such as style, spelling, references to wrong figures, non-standardization of measurements, the use of vernacular terms without gloss, careful professional editing would produce a much better presentation of the argument.

BRIAN SPOONER

University of Pennsylvania
Philadelphia, Pa.

The Ainu Ecosystem: Environment and Group Structures. By HITOSHI WATANABE. ix + 170 pp. University of Washington Press, Seattle and London, 1973.

Ethnohistorical studies have been important for some time in anthropology. Far too few, however, have taken an ecological approach. This study of the Ainu does. It attempts to relate belief systems, subsistence activities, technology and group structure to the ecosystem of Hokkaido Island. Considerable emphasis is placed on factors involved in subsistence. This is reflected in the chapter titles of the book: (1) Group Structure, (2) Food Getting Activities, (3) Cooperation and Division of Labor, (4) Territories and Gathering Areas, and (5) the System of Social Solidarity between Man and Nature. Basic discussions are oriented around each of these topics; but more specific information is included in a series of notes. These are organized at the end of the text and make up half the book.

There are a number of limitations inherent in ethnohistorical studies.