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Human Senescence
Evolutionary and Biocultural Perspectives

Much current research on the biology of senescence is on cell lines, nematodes, or fruit flies, which may be only of peripheral relevance to the problems encountered in human senescence. *Human Senescence* reviews the evolutionary biology of human senescence and life span, and the evolutionarily recent development of late-life survival. In examining how human patterns of and variability in growth and development have altered later life survival probabilities and competencies, how survival during mid-life contributes to senescent dysfunction and alteration, and the possibilities of further extending human life span, it gives a better understanding of how humans came to senesce as slowly as they do. Bringing together gerontological, anthropological, and biocultural research, it explores human variation in chronic disease, senescence, and life span as outcomes of early life adaptation and the success of humankind's socio-cultural evolution. It will be a benchmark publication for all interested in how and why we age.

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Preface

Before writing this volume, I first asked if there really is any need for another volume on the evolutionary biology of senescence. The answer was an emphatic no. The basic evolutionary biology underlying senescence is fairly well described (Rose 1991; Arking 1998), as are evolutionary tradeoffs between the soma and the germline (Kirkwood and Kowald 1997) that push reproductive success over somatic survival in sexually reproducing species. The second question I asked had a positive response, however, and that is whether there was a need for a volume examining the evolutionary biology of human senescence from an evolutionary and biocultural perspective. Prior reports on the bioanthropology of human life span and senescence generally have been in chapters in edited volumes (Weiss 1981; Crews 1990a; Beall 1994; Crews and Garruto 1994) and journal articles (Borkan *et al.* 1982; Weiss 1984, 1989a, b, 1990; Crews 1993a). Although there are numerous volumes addressing life span and senescence from the perspectives of sociocultural anthropologists, none examines these issues from an explicitly bioanthropological perspective. Upon reading Bengtson and Schaie's edited volume *Handbook of Theories of Aging* (1999) as I was working on this book, I was further convinced of the need for a volume on the biological anthropology of senescence and life span. The Handbook is a quality publication whose contributors represent many current leaders in gerontological research and the latest ideas and theories on life span and senescence. However, two aspects of this representation of current theory building in gerontology bothered me. There is no explicitly evolutionary chapter at the beginning of the volume and the entire field of anthropology is represented by only one chapter in the social science section. This chapter includes none of the contributions of biological anthropology to research on senescence, life span, or longevity. Even fellow anthropologists seem unaware of biological anthropologists' contributions to issues related to human senescence and survival, menopause, chronic degenerative diseases, the evolution of senescence, and variation over the life span.

There are two additional reasons for writing this volume. The first is the lack of information from biological anthropology that characterizes most volumes and publications by mainstream gerontology. While social/cultural anthropologists' contributions to aging are well known to social gerontologists, most

gerontologists have little if any exposure to the methods, data, and analytical results used and generated by biological anthropologists. Conversely, most biological anthropologists are likely to have had too little exposure to mainstream gerontologists through our basic journals and publications. Hopefully, this book will fill in the gap from both directions and will interest biological anthropologists as well as gerontologists who have begun to move away from their traditional emphasis on normal and normative aging and to appreciate areas of long-standing concern to biological anthropologists, i.e. the influences of individual variation and population heterogeneity on senescence and aging. Human variation is a mainstay of bioanthropological research and theory formation and provides the foundation for our studies of life span, chronic degenerative diseases, and adaptability. Thus, biological anthropologists are likely to contribute not only methods and techniques, but also background information and data as gerontology turns its attention toward understanding human variation over the life span.

Biological anthropologists have been leaders in the field of human variation and adaptability over most of the twentieth century, studying worldwide variation in growth and development, fertility, blood pressure, body habitus and physique, genetics, and degenerative processes, along with biocultural, sociocultural, political, and religious inputs to such processes. Biological anthropologists rely on the triangle of biology, environment, and culture when developing explanatory models for empirical observation (Baker 1991). Mainstream gerontology is now recognizing the heterogeneity and variation that characterize the aged of all species; with this recognition has come a call for integrative models that examine senescence as a complex system in whole organisms rather than as isolated cells and tissues (Kirkwood and Kowald 1997). Human beings are unique in the world, and in gerontological research, in their reliance on culture as a major mode of adaptation to the environment. For no other species is there a necessity to invoke culture as an explanatory variable in theory development. Biocultural interactions have structured the life history of humankind such that understanding human senescence will require an integrated examination of environmental, genetic, and cultural factors.

Biological anthropologists, and particularly human biologists, should be keenly interested in how humans have managed to attain their post-reproductive vitality, and why some individuals show great post-reproductive vitality, while others exhibit high frailty with respect to survival. In addition, biological anthropologists are interested in how evolutionary biology and human culture have interacted, and currently interact, to produce current human life history and variable life spans, and how late-life survival influences inclusive fitness in humans. Biological anthropologists not only have the tools and methods to examine such questions, but also background data and theory on human evolution,

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growth, and development, and a biocultural approach to understand better such aspects of human variation. Few other disciplines have as much experience examining human life history and accumulated data on human variation over the life course from conception to maturity as do biological anthropologists. Data such as those of the Krogman and Fels studies of growth and development provide baselines for assessing how early aspects of life history are associated with later developments during reproduction, maturity, and old age.

Human biologists have also collected extensive data on risk factors and chronic degenerative diseases from a variety of populations over several decades throughout the twentieth century. Today, these data form the baseline for follow-up studies of innumerable person-years of life span and longevity across a wide variety of environmental and cultural settings. Finally, biological anthropologists and human biologists have contributed to understanding population aging. Throughout the twentieth century, population aging has characterized almost every population group on the globe. Only among populations with high fertility are the elderly not an increasing proportion of the total. At the beginning of the twenty-first century, several low fertility populations have exceeded the 20% mark for the proportion of people over age 65 (e.g. Sweden, Japan, Norway) and many are well over 15% (U.S.A., Canada, U.K., France), while some high fertility populations (e.g., India, Ecuador) far exceed 10%. Many individuals survive for decades past their reproductive years, and variabilities in physiological, biological, and molecular factors along with environment and culture influence this survival. As a discipline, biological anthropology is poised to make substantial contributions to assist the understanding of such trends in survival and variations in human senescence, and to assist gerontologists in applying results from laboratory and animal models to humans.