AGE MARKERS IN THE HUMAN SKELETON

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Edited by

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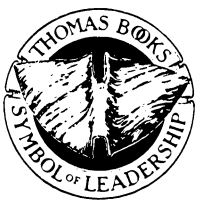

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To
My beloved mother, Ayşe
and
daughter, Meryem Ayşe, my pride and joy

PREFACE

Every so often it is imperative that our knowledge in a particular area of science be reviewed and synthesized in order to gain a clear perspective of the degree of development and direction of a scientific field. In disciplines like paleodemography and forensic anthropology, progress depends on the accuracy of skeletal assessment techniques, and one of the most difficult of these is the estimation of age from the skeleton and dentition. Therefore, this book was planned to provide a comprehensive presentation and evaluation of available technology in this specialty. The chapters provide reviews of the literature with emphasis on recent advances in the methodology of age determination and, where appropriate, actual aging standards. This information should be very helpful to a number of professionals, including forensic scientists, anatomists, biological anthropologists, etc.

It is important to keep in mind that progress, innovation, and expertise are not limited by the borders that separate one country from another. In human osteology, the pursuit of knowledge and excellence is an international objective. Therefore, when the list of individuals with the best qualifications and backgrounds for this book was compiled, the authors chosen represented three continents and seven countries, including Czechoslovakia, Egypt, England, France, Hungary, Norway, and the United States. All of the authors are internationally known and have published significant empirical research on the subject.

The author is most grateful to Susan R. Loth for her editorial work throughout the book and for composing the "Contributors" section from the data provided by each author. William Sheehan helped proofread and check references and figures. Some of the manuscripts were word processed by Leona Glass and Marjorie Wolf, and several papers were first image processed for the computer by Paula Fainberg and Pauline Kartrude. My students and associates, Carol Sheikh, Raymond Martucci, Morton Kessel and Frederick Rose were very helpful with last-minute adjustments of the manuscript. William King and Mahesh Neelankanta

developed a program to index the book. I thank all of these individuals wholeheartedly for their assistance.

Without the diligence and hard work of the contributors themselves, this book would not have materialized. Therefore, they deserve many thanks for their enthusiasm and full support. The cooperation of their publishers in granting permission to reprint their tables and illustrations is also appreciated. As with all editions of this nature, there were unavoidable delays in publication. I am grateful for the patience and understanding of Mr. Payne Thomas, the publisher, and particularly, the authors themselves, especially those who finished promptly and had to wait so long.

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AGE MARKERS IN THE HUMAN SKELETON

PART I: INTRODUCTION

Chapter 1

ASSESSMENT OF AGE AT DEATH IN THE HUMAN SKELETON

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In order for a discipline to grow and evolve, it is essential that we periodically assess what has been done and provide for an exchange of methods, ideas, and experiences. One area in which such an assessment is seriously needed is the development and evaluation of criteria for the determination of age from the skeleton and dentition. In forensic, archaeological and demographic studies, the estimation of age at death from the analysis of human skeletal and dental remains is crucial. This has been stressed in a number of books (Acsádi and Nemeskéri, '70; Stewart and Trotter, '54; Stewart '79; Rogers, '82; Krogman and İşcan, '86; Zimmerman and Angel, '86) and review articles (Todd, '39; Cobb, '52; Krogman, '62; Kerley, '70; McKern, '70; İşcan and Loth, '89). Many aspects of the subject of aging have been investigated by various biological scientists (Shock, '60; Woolhouse, '67; Dirken, '72; Behnke et al., '78; Bittles and Collins, '86). However, there are few, if any, books dealing solely with the discovery and delineation of age markers in the human skeleton and the assessment of the morphological variation inherent in the aging process. Furthermore, this decade has witnessed a resurgence of research activity in skeletal aging.

With the advancement of the forensic sciences in the last two decades, a number of "new and improved" skeletal aging techniques have been developed. These include updated studies on bone histology, tooth transparency, histology, and cementum annulation, radiography, gross morphological observations of new structures (e.g., sternal extremity of the rib and auricular surface of the ilium), and adjustments of traditional methods (e.g., pubic symphysis, dental attrition, cranial sutural

closure). Thus, it is essential to have a book whose sole purpose is to integrate the sum total of our knowledge of age assessment and critically reexamine our expectations and perspective in light of new advances.

To this end, this book presents 15 chapters dealing with aging from the skeleton and dentition. Its treatment of traditional as well as the most modern assessment techniques range from fetal beginnings to the extremes of old age.

This book is divided into two parts. The first section contains seven chapters focusing on age estimation from the skeleton beginning with the fetus and continuing with the three major forms of assessment in the adult: direct morphological analysis, radiology, and histomorphometry. The second part presents five chapters analyzing the aging process in the dentition from eruption through tooth wear.

With the exception of growth studies (Flecker, '32; Tchaperoff, '37; Hill, '39; Noback and Robertson, '51; Drennan and Keen, '53), analyses of the fetal and neonatal skeleton have been rather limited, especially in the area of age estimation (Redfield, '70; Weaver, '79). Weaver's work on an American Indian sample shows age-related changes in the development of the tympanic plate until the age of 2.5 years. Redfield classified the development of the occipital bone into four stages, however, only two appear in the fetal period and all four bones of the os occipitalis unite by the age of 7 years. Others associated age with crown rump length estimated from the long bones (Balthazard and Dervieux, '21; Olivier and Pineau, '58; Scheuer et al., '80). By far the major work in not only age estimation but total fetal skeletal analysis is **Forensic Fetal Osteology** by Fazekas and Kósa ('78). In Chapter 2, Ferenc Kósa gives us the benefit of his many years of experience in the field to discuss bone size variation in relation to body size and, in turn, the age of the fetus. Besides his landmark book, the author published numerous papers on this topic and many others. The results presented in this article are based on a simple anthropometric method applied to 138 fetuses ranging in age from the 3rd to the 10th lunar months. Kósa used regression analysis for measurements from the bones of the skull, ribs, shoulder and pelvic girdles, vertebrae, and extremities to relate them first to body height, then to age.

In contrast to the fetal period, bone growth and associated age-related changes in infancy and childhood have been studied extensively (Ubelaker, '87). In Chapter 3, Douglas Ubelaker presents a synthesis of what has been accomplished including the latest advances in the field. His analysis begins with the appearance of ossification centers and concludes with