Dental Perspectives on Human Evolution: State-of-the-Art Research in Dental Paleoanthropology

Shara E. Bailey and Jean-Jacques Hublin (eds.)

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Dental paleoanthropology involves the study of the development, variation, and evolution of modern and fossil primate dentitions. The extensive hominin dental fossil record not only provides dental paleoanthropologists with the possibility to analyze human evolutionary morphology, ontogeny, and paleodiets, but also allows them to assess intra and inter-population variability and sexual dimorphism. Recently this sub-discipline has greatly benefited from major methodological and technological advances which paved the way to new research directions. These include the utilization of state-of-the-art equipment such as micro-computer tomopgraphy (mCT), new digital 3-D microscopy, and various other high-resolution digital imaging methods. These allow researchers to quantitatively analyze microscopic variations in dental topography, structure, and ontogeny.

The edited volume is based on the Dental Paleoanthropology symposium which was held in 2005 at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. It is divided into four major themes, each preceded by an introductory chapter—dental evolution and morphology (seven chapters), dental microstructure and life history (five chapters), dental development (four chapters), and the interface between dental structures and diet (five chapters). The volume provides invaluable new results, discussions, and synthetic approaches which demonstrate how the study of dentitions can greatly contribute to our knowledge on past human variability and evolution. However, many of the contributions are very technical and utilize a jargon which best suit a target audience of postgraduate and professional anthropologists.

The first section contains contributions on various aspects of dental evolutionary morphology. In Chapter 2, Pilbrow applies dental morphometrics to the assessment of molar variation within and between species of extant great apes. Bailey and Wood (Chapter 3) analyze non-metric traits in order to address evolutionary trends in postcanine dental morphological complexity among chimpanzee, australopith, *Paranthropus,* and early *Homo* species. In Chapter 4, Moggi-Cecchi and Boccone analyze metric variation in cusp areas and proportions in South African australopithecines. In Chapter 5, Martinón-Torres et al. provide new results on dental variation within and between the two Atapuerca populations—Sima de los Huesos (SH) and Gran Dolina TD6. They specifically address the phylogenetic relationship of these hominins in the context of other European archaic *Homo* populations.

Manni et al. (Chapter 6) assess the phylogenetic relationship of Lower-Middle and Late Pleistocene human fossils based on the study of artificial neural networks using dental non-metric traits. The next two chapters utilize advanced imaging methods to examine dental structures. In Chapter 7, Olejniczak et al. examine molar surface models, volume, and enamel cap thickness of hominoid primates using mCT. In Chapter 8, Gantt et al. utilize high-resolution x-ray computer tomography (HRXCT) to study similar aspects of hominoid teeth.

The second section contains five contributions which focus on the study of dental microstructure and life history. Chapter 2 (Schwartz et al.) examine dental development of the extinct lemur *Megaladapis edwardsi*. In Chapter 3, Ramirez-Rozzi and Lacruz provide a histological assessment of the upper incisor and molar of bonobos. In Chapter 4, Smith et al. carry out a comparative study of enamel formation in the molars of chimpanzee and human populations with a particular focus on within population variation and sexual dimorphic trends. In Chapter 5, Bromage et al. utilize portable canfocal scanning optical microscopy in order to examine the growth process of enamel in the *Australopithecus africanus* taxa. In Chapter 6, Guatelli-Steinberg et al. assess aspects of imbricational enamel formation in Neanderthals and recent modern humans from diverse regions.

The third section contains contributions which focus on the study of dental ontogeny and genetics of various hominoid taxa. In the first contribution, Hulsko and Mahaney present preliminary results from quantitative genetic analyses of tooth size variations in pedigree populations of baboons and mice. The next two chapters address interpopulation variability in dental development in modern human populations. In Chapter 3, Braga and Heuze examine a novel analytical approach to the interaction between growing teeth using dental panoramic radiographs of children. In Chapter 4, Monge et al. assess dental calcification stages of the first and second permanent molars in children of African-American and European–American ancestry. In Chapter 5, Smith et al. apply a study of the dynamic process of tooth development in human populations by looking at mCTs of the topography of the dentin-enamel junction (DEJ).

The last section centers on the contribution of dental paleoanthropology to the study of paleodiets. In Chapter 2, Humphrey et al. evaluate whether there is a consistent pattern of change in strontium/calcium (Sr/Ca) ratios across

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the neonatal line in human deciduous teeth in formula fed and breastfed children. In Chapter 3, Ungar examines the contribution of dental topographic analysis to the study of occlusal functional morphology in hominin species. Teaford (Chapter 4) reviews the advantages and pitfalls in paleoanthropological studies of dental microwear. In Chapter 5, Ulhass et al. analyze occlusal relief wear patterns of hominid molars using 3-D digital models and quantified topographic relief. The last contribution, by Estebaranz et al., involves the utilization of 3-D procedures for the study of buccal microwear patterns in great apes and hominids.

Overall it is an excellent volume which contains high quality contributions and is therefore essential to paleoanthropologist, anthropologists, and scholars from various related disciplines. While most contributions are technical and occasionally difficult to follow, they indeed, as the editors suggest, provide an invaluable and timely comprehensive account of state-of-the-art research in dental paleoanthropology.