

1. Introduction

R. MACCHIARELLI

*Laboratoire de Géobiologie, Biochronologie
et Paléontologie humaine,
Université de Poitiers
86000 Poitiers, France
roberto.macchiarelli@univ-poitiers.fr*

S.E. BAILEY

*Department of Human Evolution
Max Planck Institute for Evolutionary Anthropology
Deutscher Platz 6
D-04103 Leipzig, Germany
and
Center for the Study of Human Origins,
Department of Anthropology, New York University,
25 Waverly Place
New York, NY 10003, USA
sbailey@nyu.edu*

Because of their structural nature, teeth undoubtedly constitute the most abundant fossil evidence for mammal evolution, and are the most investigated elements in paleoanthropology. Recent and ongoing advances in developmental biology, quantitative genetics, and structural microanatomy illustrate the extraordinary amount of information preserved in their tissues (e.g., Dean, 2000; Jernvall and Jung, 2000; Jung et al., 2003; Hlusko, 2004; Mitsiadis and Smith, 2006; Pereira et al., 2006). However, a critical portion of this invaluable record, which is crucial to model/reconstruct the phylogenetic relationships, dispersal routes and evolutionary pathways, paleoecological contexts, adaptive strategies, health conditions, age- and sex-related growth and variation patterns of extinct taxa, and even to outline at

least fragments of individual life-histories – is hidden at microstructural level within the crown and the root(s). Additionally, because of taphonomic dynamics and diagenetic changes, fossil signals from this record are almost invariably intermittent and noisy.

During the last two decades, routine research in dental (paleo) anthropology has extended from the outer tooth surface to the inner microstructural morphology. Accordingly, researchers agree that the possibility to properly exploit the hidden dental archive for reliable comparative investigation and unambiguous paleobiological interpretation is reliant on at least two issues: a detailed knowledge of the extant and recent reference evidence and of its pattern of (normal and pathological) variation based on large,

controlled series, and the development of appropriate research strategies and sharper analytical tools.

In this perspective, the five papers forming the section on dental microstructure and life history of this volume (Bromage et al., 2007; Guatelli-Steinberg et al., 2007; Ramirez Rozzi and Lacruz, 2007; Schwartz et al., 2007; Smith et al., 2007) are of paradigmatic value.

Schwartz et al. provide an excellent example of the kinds of information teeth can provide about the life history of extinct primates. Dental development has been shown to be a good proxy for the pace of life history and recent studies have shown there is a high correlation between tooth development and age of weaning, age of first reproduction, and lifespan, among other variables. Life history has long played an important part in the study of evolutionary patterns and processes. Of particular interest is the question of when, during the course of human evolution, did hominins achieve a *Homo sapiens*-like life history pattern. *Homo sapiens* is remarkable among primates because of its long lifespan, early weaning of infants and late age of first reproduction, which is later than would be expected for a great ape of the same body mass. Schwartz et al. use long-period markings within the tooth enamel to reconstruct the life history of a gorilla-sized extinct lemur, *Megalapadis edwardsi*. Schwartz et al. clearly show that, while often used as a predictor for life history variables, body size may not be a good proxy for dental development. They find that *M. edwardsi* differs from other larger bodied hominoids in crown initiation, crown formation and eruption sequence. And while gestation length in this mega-lemur may be as long as that in the similarly-sized gorilla, other life history variables differ considerably (e.g., weaning time). Schwartz et al. suggest, as others have before (e.g. Hammer and Foley, 1996), that it may be more appropriate to use brain size

rather than body size as a predictor of life history.

The recent landmark publication of the draft DNA sequence of the common chimpanzee (*Pan troglodytes*) genome has opened new perspectives in the quantitative study of hominid evolution (see Li and Saunders, 2005). In fact, 365 years after the first formal description of an ape by the Dutch anatomist Nicolaas Tulp, key biological aspects of our closest living relative remain poorly known. This is notably true for the comparative growth patterns in *P. troglodytes* and *P. paniscus* (e.g., Heltne and Marquardt, 1989), the latter having been the least investigated taxon to date. Ramirez Rozzi and Lacruz (2007) add a quality building block to the understanding of dental growth in the bonobo.

The authors (Ramirez Rozzi and Lacruz, 2007) finely detail the enamel microstructural features on two modestly worn permanent teeth from a young female individual. Interestingly, while quantitatively limited, their histological results show a relatively high appositional rate for both crowns compared to that reported for the common chimpanzee (cf. Reid et al. 1998). Of course, additional research on larger *P. paniscus* dental samples is needed to confirm this evidence, but this preliminary signal points to the potential value of subtle investigations on extant interspecific primate variation for appropriately interpreting the hominid fossil record.

Both inter- and intraspecific variations in tooth development are investigated by Smith et al in the paper that follows. Although chimpanzees and humans have substantially different life history patterns, previous studies have found that they have similar crown formation times (e.g., Reid et al., 1998). This is surprising given that tooth development is said to correlate highly with life history variables. Focusing on the internal structures of the crown - including Retzius line periodicity, daily secretion rate and Retzius line number - Smith et al employ larger