1. Introduction

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Teeth convey information about a number of interesting and potentially significant biological phenomena. Because the development of the dentition is closely related to that of the individual possessing it, teeth may reveal aspects of somatic development and life history (Dean et al., 1986, 2001; Smith, 1989; Smith et al., 1994, 1995; Bermúdez de Castro et al., 1999; Kelley and Smith, 2003; Ramirez Rozzi and Bermúdez de Castro, 2004; Nargolwalla et al., 2005). These revelations, in turn, may be of some importance to questions relating to the taxonomy of extinct hominins.

By virtue of differences in size and/or morphology, teeth might also be informative to the biological distinctiveness of the organisms that possess them (Rosenberger et al., 1991; Suwa et al., 1996; Ramirez Rozzi, 1998; Carrasco, 2000; Hlusko, 2002; Bailey, 2004, 2005; Scott and Lockwood, 2004; Bailey and Lynch, 2005). Such features may say something about population affinities (Irish and Guatelli-Steinberg, 2003; Manabe et al., 2003). They also may reflect phylogenetic relations (Stringer et al., 1997; Strait et al., 1997; Strait and Grine, 2004; Kimbel et al., 2006), although recent work on the genetics of dental development and morphology suggests that these laudable goals may be rather more complex tasks than has been realized heretofore (Weiss et al., 1998; Jernvall and Jung, 2000; Salazar-Ciudad and Jernvall, 2002; Kangas et al., 2003, 2004; Line, 2003; Hlusko et al., 2004).

Teeth also might be informative to the levels of systemic physiological stress experienced by recent as well as fossil populations (Oglivie et al., 1989; Skinner, 1996; Dirks et al., 2002; Cunha et al., 2004; Skinner and Hopwood, 2004; Guatelli-Steinberg et al., 2004; Corruccini et al., 2005).

Ultimately, however, the fact that teeth can be related to somatic development and species life-history, that their developmental histories might reflect systemic physiological stress, and that their morphological attributes are taxonomically and potentially phylogenetically informative are all merely fortuitous happenstances. This is because the only reason teeth exist is as part of an individual's trophic apparatus. This is no less true for humans and their close relatives than for any other order of dentate gnathostomes. Indeed, it is precisely because teeth serve a vital trophic function that they have proven to be such difficult characters with which to deal in attempts to disentangle the complicated form-function-phylogeny embranglement.

S.E. Bailey and J.-J. Hublin (Eds.), Dental Perspectives on Human Evolution, 291–302.

Teeth exist to process food, and this is their biological significance. At the same time, diet is central to a species' ecology and behavior. The seasonal availability of items comprising the dietary repertoire may impact attributes such as mobility patterns, population size and social organization. The distribution and mechanical properties of food items may selectively affect postcranial and cranial morphologies related to their procurement, ingestion and mastication. It is, therefore, quite understandable that considerable effort has been expended to elucidate the dietary proclivities of our extinct hominin relatives.

Paleodietary reconstructions have been attempted from a number of disparate sources of information, including (1) the archaeological record, (2) biomechanical models of cranial and mandibular morphology, (3) tooth size and morphology, including enamel thickness and structure, (4) isotope chemistry, and (5) dental microwear. Each of these approaches has its own particular strengths, and each is beset with its own attendant weaknesses.

The archaeological record is relevant only if there is one. At present, lithic flakes and/or cores that are identifiable as having been purposefully manufactured, and animal bones with stone tool cutmarks are known only as far back as some 2.5 Myr ago (Kimbel et al., 1996; de Heinzelin et al., 1999; Domínquez-Rodrigo et al., 2005). This leaves well over half of the hominin fossil record devoid of any durable artefacts that might be informative of dietary habits.

Even when there is an archaeological record, its relevance depends upon the attribution of particular artifact assemblages to a particular taxon. Unfortunately, it is not always clear who was responsible for archaeological debris (e.g., Brain et al., 1988; Susman, 1988). Thus, in both eastern and southern Africa, for example, lithic (Oldowan and Developed Oldowan) assemblages are known from sites and/or temporal horizons between about 2.5 Myr and 1.5 Myr that contain the remains of two (or more) hominin species.

Even if the question of species attribution is left aside, the interpretation of archaeological remains vis-à-vis diet is not always straightforward. Thus, for example, the bone tools from the Early Pleistocene deposits at Swartkrans, South Africa, have been interpreted by some authorities (Brain and Shipman, 1993) as evidence for digging-up edible bulbs such as those of grass stars (*Hypoxis costata*) and lilies (*Scilla marginata*). Other workers (Backwell and d'Errico, 2001, 2003), however, have argued that they were used to excavate termite mounds implying a very different food resource. Furthermore, the interpretation of other archaeological traces can be equally contentious, as illustrated by the seemingly endless debate that has surrounded meat-eating versus scavenging by extinct hominins (Binford, 1981; Bunn, 1981, 1983, 1994; Bunn and Kroll, 1986; Shipman, 1986; Marean, 1988; Potts, 1988; Gifford-Gonzales, 1991; Stiner, 1994; Blumenshine, 1995; Stanford and Bunn, 1999; Domínguez-Rodrigo, 2002; Domínguez-Rodrigo and Barba, 2006).

Biomechanical models (Rak, 1983, 1986; Demes and Creel, 1988; Hylander, 1988; Daegling and Grine, 1991; McCollum, 1994; Chen and Grine, 1997; Wood and Aiello, 1998; Hylander and Johnson, 2002; Daegling and Grine, 2007) are appealing because the material properties of dietary items almost certainly influence cranial and mandibular anatomy on an evolutionary timescale. However, the exact relationships between loading environments and particular morphologies are unclear. Indeed, because it is the mechanical properties of ingested items rather than diet *per se* that impacts jaw morphology, even a full appreciation of cranial and mandibular design can provide only limited insight into diet.

Aspects of dental morphology such as molar cusp height and alignment, as well as enamel thickness and structure are appealing for the