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The ca.1.8-0.8 Ma African human fossil record: taxonomic and evolutionary issues

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Since the discovery of "early Man" in 1960s at Olduvai Gorge, Tanzania, the African human fossil record from the Pleistocene Calabrian Stage (1.086-0.781 Ma) has remarkably increased in raw amount, preservation quality, anatomical diversity, sex- and age-related individual representativeness of the collected remains. Nonetheless, the taxonomic and related phylogenetic and evolutionary issues remain of stinging actuality in paleoanthropology.

Besides the fossil assemblages derived from long-standing field research work historically developed in a number of sites/localities in southern, eastern, and northern Africa, more recent discoveries at Ileret, Koobi Fora, Olorgesailie, in Kenya, Konso, Daka, Gona, in Ethiopia, Uadi Aalad and Mulhuli-Amo, in Eritrea, among the others, have added evidence for significant morphodimensional variation even among comparable specimens sampling penecontemporaneous horizons. Accordingly, together with the traditionally major issue of the origin and most likely direct ancestor of the genus Homo (Kimbel 2013, in Nature 497), currently debated fundamental questions concern how many human species (co)existed during the Early Pleistocene; the early Homo adaptive radiation and evolutionary biohistory under increasingly fluctuating climatic and environmental conditions (Magill et al., in PNAS 110); the taxonomic status of the habilines s.l.; the origin of H. erectus/ergaster and its phylogenetic relationships with the habilines, on one hand, and with the taxon likely representing the evolutionary transition towards H. sapiens, i.e., H. heidelbergensis/rhodesiensis, on the other hand. In this framework, the key issue of paleobiodiversity schematically opposes a "saguaro cactus" to a "creosote bush" model (White 2013, in Curr. Biol. 23 contra Wood 2012, in Nature 488).

With special reference to the H. erectus s.l. assemblage, an interpretative scenario identifies this taxon by a set of features shared by African and Eurasian representatives. Accordingly, local differences are interpreted as uniquely intra-specific, reflecting regional and temporal variation expressed within a polymorphic and polytypic evolving species. Alternatively, variation is seen as locally reflecting genuine genotypic differences resulting from isolation. Following this latter view, the nomen H. erectus is only appropriate for the Asian samples and for a limited number of African specimens (notably, the cranium OH 9 from Olduvai Gorge), while most of the African record should be subsumed under the H. ergaster label.

While the difficult task in paleobiology of appropriately and coherently sorting distinct evolutionary lineages is commonly affected by a number of disturbing factors, and also the methodological exercise of splitting or lumping the arbitrarily set chronospecies is still unresolved, nonetheless the currently available record unambiguously documents extensive morphological and morphometric diversity within the African H. erectus s.l. assemblage, associated with a more marked degree of body size variation and sexual dimorphism that had been anticipated (Lieberman 2007, in Nature 448), thus suggesting the possibility that some taxonomic attributions should deserve critical revision (Ruff 2010, in J.H.E. 58). Finally, the matter of which among the late Early Pleistocene African specimens/samples discovered so far may better represent the paleo-population ancestral to the Middle Pleistocene derived humans - including our own species - is still far from being consensual.

Faced to a similar amount of complex issues, paleoanthropology has recently enlarged its traditional investigative toolkit by increasingly integrating new techniques and technologies of high-resolution imaging in the routine analyses of the fossil specimens, thus shifting its focus from the outer to the inner, hidden structural morphology by the noninvasive characterization of subtle but

highly informative morphostructural details. Through the virtual extraction and comparative exploitation of previously inaccessible information stored inside the mineralized tissues, this technical and conceptual analytical "revolution", which will likely break some consolidated paradigms on the tempo and mode in human evolution, has the potential to disclose new perspectives in the qualitative and quantitative assessment of the evolutionary pathways and phylogenetic relationships, adaptive strategies and fluctuating variation patterns, seasonally-related health conditions, sex- and age-related timing and patterning of development and growth (including fragments of individual life-histories) distinctly characterizing the extinct human taxa.