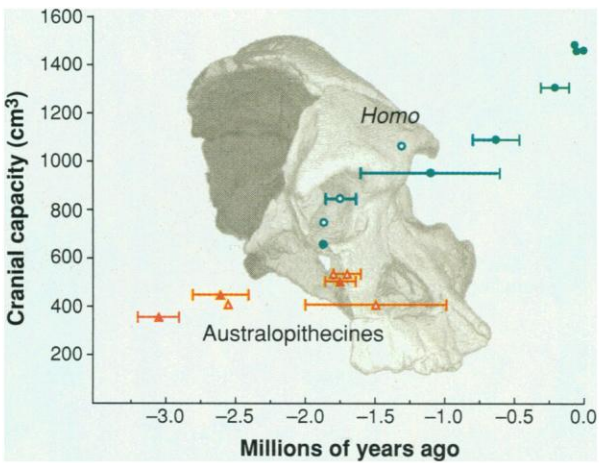
PALEONTOLOGY

Hominid Brain Evolution: Looks Can Be Deceiving

Dean Falk

Every now and then a newly discovered fossil comes along that changes the big picture of hominid evolution. In 1985, the Nariokotome skeleton from Kenya (KNM-WT 15000) created a stir because it was surprisingly tall for early *Homo* (*1*). A year later, a robust australopithecine dubbed the Black Skull (KNM-WT 17000) caused a sea change in how paleoanthropologists drew their family trees because its date was surprisingly early (*2*). Thanks to a report by Conroy *et al.* on page 1730 of this issue (*3*), another new specimen (Stw 505), tentatively assigned to *Australopithecus africanus*, is about to wreak havoc on our view of hominid evolution. This time it is the cranial capacity that is a surprise. The word from the paleoanthropological grapevine (a hardy variety) was that the capacity of this word-of-mouth famous fossil was about to break the australopithecine piggy bank by measuring over 600 cm^3 (compare this with the average modern human skull at 1350 cm^3). It did not. Although the capacity of the Stw 505 skull of 515 cm^3 is the largest for any known gracile australopithecine, it is a far cry from the blockbuster volume we were all expecting.

Stw 505 does not just represent another pretty cranium. Its significance lies in the fact that a larger capacity was expected because of rumors that the interior of its braincase looked enormous compared with those of other australopithecines. Conroy *et al.* now suggest that these other australopithecines may be associated with published cranial capacities that are too large, and that this explains the great, if frustrated, expectations for Stw 505. They note, for example, that Sts 71 has a published capacity of 428 cm^3 but that their water-displacement measurement of a detailed cast renders it closer to 370 cm^3. This sent me running to my own endocast and skull collection. They are right—the published capacity of Sts 71 is clearly too big. If the capacity of Sts 71 is the 370 to 375 cm^3 that my water volume measurements confirm, then my eyes tell me that the approximately 3.2 million-year-old hominid endocast from Hadar, Ethiopia (AL 162-28) must be considerably smaller than its published estimate of 375 to 400 cm^3 (*4*). And so it goes for a number of early hominid casts in my collection, including both gracile and robust australopithecines. But then all I have are my eyes, calipers, and some molding compound. Conroy's team, on the other hand, uses sophisticated three-dimensional computed tomography technology with Seidler and his colleagues in Austria who honed their analytical teeth on the Tyrolean Iceman and then moved on to apply their medical imaging technology to fossil hominids (*5*). Importantly (and not to be lost in all the hoopla), Conroy *et al.* have now validated the use of "virtual endocasts" for estimating cranial capacity by testing the reliability of this procedure on 10 *Homo sapiens* skulls (*3*).



Cranial conundrum. Received wisdom has it that, compared with australopithecines (triangles), cranial capacity in *Homo* (circles) began a dramatic trajectory about 2 million years ago that tapered off only recently with an approximate doubling of brain size. This traditional picture of hominid cranial capacity plotted against time may need revising in light of the findings of Conroy *et al.* (*3*). Filled symbols indicate that more than one individual is in the sample [see (*7*) (pp. 20–21) for identifications of specimens].

The implication of Stw 505's surprising cranial capacity is that something is very wrong with the published record of early hominid cranial capacities. If so, the ramifications for hominid brain evolution may be profound. For example, what now of the received wisdom that cranial capacity took off in early *Homo* relative to australopithecines somewhere around 2 million years ago (see figure) (*6, 7*)? Is this true, or did cranial capacity begin its sharp increase much earlier in (some) australopithecines and simply continue in their *Homo* descendants? To answer this, ideally we need to see verified or revised cranial capacities of all early hominids plotted against time. And what about the capacities of robust compared with gracile australopithecines? Did robust australopithecines have somewhat larger brains as previously believed, or is brain size equivalent in the two types of hominids, or even bigger in gracile australopithecines? The answer to this will determine the encephalization quotients of the two types of early hominids (*8*), which is an important indicator of relative "braininess," an issue that is now up for grabs. Are the published capacities for the earliest *Homo* specimens accurate, or are some of them also too big, as Conroy *et al.* hint? Hopefully, Conroy and his colleagues will now revisit the cranial capacities of as many early fossil hominids from Africa as possible. Come to think of it, they might want to examine the trends in cranial capacity at the front end of the fossil record too, because controversial new dates for some Java *Homo erectus* specimens (*9*) indicate that they (and their cranial capacities) may have occurred much earlier than previously believed. If so, whether different patterns of cranial capacity evolution distinguished *H. erectus* from early *H. sapiens* (*10*) is also ripe for reconsideration. Fortunately, Seidler's team is already collecting computed tomography data from skulls at both ends of the hominid fossil record (*3, 5*), and I, for one, cannot wait to see what if anything the results will do to the big picture regarding evolution of hominid brain size.

References and Notes

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The author is at the Department of Anthropology, State University of New York, Albany, NY 12222, USA. E-mail: d.falk@albany.edu