

Letter to the Editor: Reply to Holloway and Broadfield's Letter to the Editor Regarding the Taung Endocast

Holloway and Broadfield (H&B) state that Falk and Clarke's (F&C) "mirror-imaging was asymmetrical" and "they never defined a midsagittal plane." Both assertions are untrue, as anyone who reads our articles can see. Thus, H&B's comment that they "stand by these claims" is disturbing. Once again, we reiterate: our virtual endocast includes some parts that were mirror-imaged and some parts that were not (Falk and Clarke, 2007, 2012). The mirror-imaged portion is perfectly symmetrical (indeed, it would be oxymoronic if it were not). The bilaterally reconstructed (not mirror-imaged) frontal lobes reveal a slight left frontal petalia, since revealed in 3D-CT images from two other teams [Fig. 1 of Falk and Clarke (2012); Fig. 1 of Falk et al., (2012)]. We explicitly described our computerized methods for defining the midsagittal plane (Falk and Clarke, 2007 p. 530, 2012 p. 483–484), and discussed why they are preferable to Holloway's method (Holloway and Broadfield, 2011) of sanding the medial surface of a cast down to a plane that contains three preselected points (Falk and Clarke, 2012).

H&B acknowledge that the midline of Holloway's reconstructed hemicast is "slightly tilted," and offer two explanations. First, they say it was tilted to show three points along the midsagittal plane. But in the next sentence, they say the region to the left of the midsagittal plane is "an artifact of being a 3rd generation cast." Whichever explanation is correct, it would have been helpful if it had been explained in their figure caption. Nor are we reassured about the placement of the three points by H&B's reference to photographs that *Science* did not publish in 1970 (and that, to our knowledge, have never been published). The midline of the Wenner-Gren endocast that H&B show next to the sanded hemicast deviates markedly from the vertical [Fig. 2 of Falk and Clarke (2012)]. This is unfortunate because others who rely on various publications of this particular image (Holloway et al., 2004; Holloway and Broadfield, 2011) are almost certain to mistake the vertically oriented flash line from the molding process for the midline. It is especially important that the midline be accurately oriented in a commentary that criticizes other workers' definition of it. H&B state that "Neubauer et al. (2012) found that Holloway's midline was accurate." However, Neubauer et al. did not address Holloway's midline, and nothing in their paper constitutes an endorsement of Holloway's methodology.

F&C's estimate for Taung's endocast is 382 cm³, while Neubauer et al.'s estimates range from 402 to 407, which is, indeed, close to Holloway's (1970) estimates. Neubauer et al. (2012 p. 507) "mirror-imaged the entire right

hemi-endocast to the left side and discarded the left prefrontal portion," while F&C included both the right and left frontal lobes in their reconstruction. Another difference is that Neubauer et al. used semilandmark-based geometric morphometrics (with endocasts from Sts 5 and 60 chimpanzees as reference specimens) to reconstruct the missing portions of Taung's endocast, whereas F&C used the morphology of Taung and other australopithecine endocasts as guides for manually sculpting these missing parts. As Neubauer et al. (2012 p. 507) note, 23 cm³ is a "fairly small" difference. Nothing herein should be construed as criticism of the contributions of Neubauer et al., and we look forward to more refined volume estimates for Taung's endocast from future virtual reconstructions that incorporate all of the data that are available from both sides of the fossilized face and natural endocast.

In sum, the object of our letter was to correct untrue statements published about our work (Holloway and Broadfield, 2011), rather than to belittle Holloway's original methods, which were the accepted ones before CT scanning. The intention of our 2007 communication was to show that we had newly revealed Taung endocast data and that these, in conjunction with modern methods, yield a different endocast volume than the old water-displacement method. Anybody is entitled to provide valid arguments against our result, but not to publish untruths about our work or to claim falsely that we did not define our procedures and landmarks.

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