sensitive to reject the hypothesis of randomness in this case.

In fact, Kitchell and Estabrook tested in a rigorous fashion the appropriate null hypothesis. Given their result that 7.9% of 10,000 random walks appear more periodic than the actual pattern of extinctions, one may conclude that my model is not unlikely to provide an adequate explanation for the empirical pattern.

As explicitly stated in my original article, there may be periodicity in late Permian to Quaternary extinctions, but the evidence is as yet insufficient. On the basis of my analysis, which is now confirmed by Kitchell and Estabrook's result, I concluded that I could not reject the hypothesis of randomness of the pattern of extinctions. I suggest that Raup and Sepkoski might have done the same if they had considered the appropriate null hypothesis.

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Endocast morphology of Hadar hominid AL 162–28

ACCORDING to Falk[1], the endocast morphology of the Hadar hominid AL 162-28 is ape-like, contrasting with Holloway's[2] original conclusion that this specimen exhibits important human-like cortical features. We contend that Falk's interpretation is the result of a major error in her orientation of the endocast.

A comparison of Falk's Fig. 1 (redrawn here as Fig. 1*a*) with a photograph of the AL 162-28 calvaria in norma lateralis (Fig. 1*b*) demonstrates Falk's error. In her orientation, the middle arched portion of the squamosal suture, clearly identifiable on the calvaria (SS in Fig. 1*b*; see also ref. 3), lies below the level of asterion, and the planum occipitale faces almost directly superiorly with the planum muchale almost vertical. Clearly, this combination of features does not characterize any normal hominoid cranium (nor is it found in any other hominid crania from Hadar or elsewhere), and it is apparent that the endocast must be rotated some 40° in a clockwise direction to achieve correct anatomical orientation. When this is done, the cerebellar fossae are tucked under (and are rostral to) the occipital poles, as in all hominids and almost all apes. Falk[4] has defended her orientation by citing Kimbel[3] to the effect that the cerebellar fossae are deeper than the cerebral fossae. Correcting the specimen's orientation, the cerebellar fossae are deeper, but certainly not more posteriorally projecting, a position Kimbel never claimed.

Figure 1 indicates Falk's identification of the cortical features on the endocast.

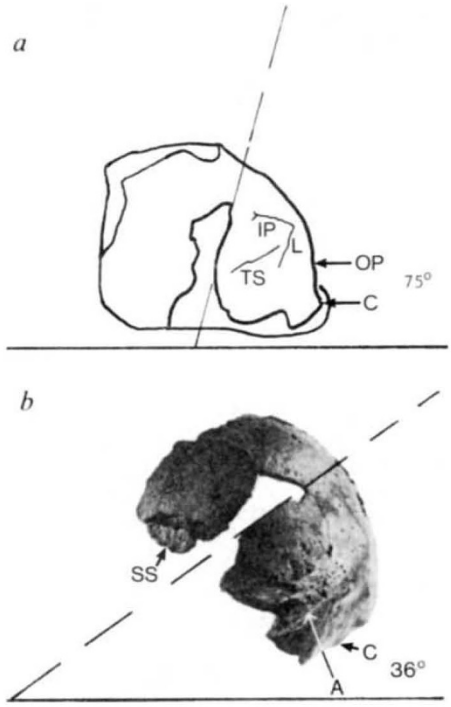

Fig. 1 Diagrams showing the error in Falk's[1] orientation of the Hadar AL 162-28 endocast. *a*, A tracing from Falk's Fig. 1; *b*, a lateral view of the AL 162-28 original cranial fragment correctly oriented. The difference between the two orientations is approximately 39° as measured from the dashed lines intersecting the horizontal planes, using the notch created by the missing bone as a landmark. Falk rotated the endocast 39° in an anticlockwise direction, thereby erroneously positioning the cerebellar lobes posterior to the occipital poles of the cerebrum. SS, squamosal suture; A, asterion; C, cerebellum; OP, occipital pole; IP, interparietal sulcus; TS, the superior temporal sulcus, and L, the lunate sulcus are Falk's designations[1].

The rostral position of the lunate sulcus (L in Fig. 1*a*) is said to be an ape-like condition. When the endocast is correctly oriented, however, L (as identified by Falk) crosses the posterior aspect of the endocast in a more caudal position than on ape brains[5]. The relative caudal location of Falk's L is confirmed by its close proximity to the occipital pole (OP); the distance between L and OP on the AL 162-28 is approximately half that separating these structures in a sample of 10 chimpanzee brain casts (the hominid falls 5.5 s.d. below the ape mean), despite the fact that eight of these brain casts have volumes less that the 375–400 cm^3 estimated for the Hadar endocast, including one chimpanzee infant. (See data in ref. 6, in which the distance from the interparietal sulcus (IP) to OP is the same as the OP-L distance.)

The lambdoidal suture is discernible on the internal aspect of the Hadar calvaria[3], where, on both sides, it is 2 mm (not 5 mm, as claimed by Falk[1]) below the feature corresponding to Falk's L. We suggest that Falk's L may be a manifestation of the lamboidal sutural complex which is frequently reproduced on chimpanzee endocasts as a distinct furrow (feature 'x' in ref. 7). Holloway[2,6] recognized the likelihood that feature 'x' masks the position of L on the AL 162–28 endocast. We do not, therefore, believe that L can be identified unequivocally on this specimen. But if Falk is correct in her identification of the lunate sulcus, and does accept Holloway's[2] identification of the interparietal sulcus, then both the correct orientation of the specimen and metric data[6] confirm that this structure occupies a caudal position on AL 162–28, a major derived hominid condition.

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FALK REPLIES—Holloway and Kimbel claim that my interpretation of the sulcal pattern of AL 162-28 is due to an error in the orientation of the endocast because "in her orientation, the middle, arched portion of the squamosal suture, clearly identifiable on the calvaria . . . , lies below the level of asterion . . .". Kimbel *et al.*'s photograph of the left side of the calvaria shows neither the apex of the squamosal suture nor the external (temporal bone) portion of that suture[1]. What it does show is a 13.5 segment of the temporal margin of the parietal bone that is, by their own description, *posterior* to (where) the apex of the squamosal suture (would have been). Furthermore, because of overlap at the squamosal suture, the temporal margin of the parietal bone which is present in AL 162-28 would have been *below* the external (temporal bone) portion of the squamosal suture. Unfortunately, "a long, narrow strip of external table is lost just above the left parietal's temporal margin"[1]. Neither the squamosal suture nor asterion is reproduced on the endocast, and I do not think the calvaria of AL 162-28 is complete enough to allow speculation about where the locations and relative positions of both features would have been on the (whole) endocast. Even if Holloway and Kimbel's SS and A identifications (Fig. 1*b* above) could be