rotating cylinder constitutes a time machine.

Of course, this time machine, like that described in ref. 1, requires an infinitely long object, and it may be that the properties of a very (but not infinitely) long cylinder would be different. The particularly intriguing feature of van Stockum's time machine, in contrast with others in general relativity, is that it is made of such homely material, namely dust.

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Earliest *Homo* debate

SIR — The report by Hill *et al.*[1] of the "earliest" *Homo* from near Lake Baringo in Kenya betrays a common misconception about the relationship between fossils, isotope dates and the strata from which they are recovered. The widespread discussion[2-4] of the finding of Hill *et al.* demonstrates the need for some critical interpretation of the actual data.

The fossil specimen, KNM-BC1, was recovered from the Chemeron formation in 1965 (ref. 5). Although no isotope dates were then available, its stratigraphic position was documented, and this allowed Hill *et al.*[1] to attempt to assign it an age. The local geological context allowed its source to be ascertained with "little doubt"[5], and the source was "about 8 ft from the base of the Upper Fish Beds"[5]. Hill's team returned to the locality (JM85) to collect dating materials from close proximity to, and in sequence with, the hominid level. This is fairly typical of important hominid sites, where geologists attempt at a much later date to control the age of significant finds.

The next step is to produce isotope ages, both accurate and reasonably precise, with which to control the age of the fossil. In this respect the report by Hill *et al.*[1] is exemplary. Replicate $^{40}Ar/^{39}Ar$ dates on two samples of pumice from a tuff, lying about 2.5 m below the stratum from which the hominid was recovered, each produced weighted means of 2.45 ± 0.02 megayears (Myr), and an isochron of 2.43 ± 0.02 Myr. The dating of this unit appears to be both accurate and precise, and is well supported by the data.

The problem with the age of the fossil comes from a failure critically to evaluate the relationship of the dated stratum to the hominid-bearing level. The date of 2.45 Myr does not apply to the fossil, but rather to a level 2.5 m below its resting place. Were a modern hominid to go to JM85 and recline on the dated tuff, he/she would overlie the 2.45-Myr level, but would not be 2.45 Myr in age. Similarly, the fact that the fossil was stratigraphically above the dated tuff does not make it 2.45 Myr old.

Although the case for an age of 2.4 Myr for the fossil is unfounded given the data presented, this does not necessarily mean that it is not close to that age. It simply means that the fossil has only been documented to be younger than 2.45 Myr. Units within the Chemeron formation range as young as 1.6 Myr[1], and as no stratigraphic sections are provided for the site, its relationship to these younger strata is unclear. This does not lend credence to the claim that KNM-BC1 is the "earliest" *Homo*. The figure required to support that assertion is a date on a unit which stratigraphically overlies the hominid level. The statement in ref. 1 that "(p)reliminary age results from tuffaceous units higher in the sequence (A. H., S. W. and A. D., manuscript in preparation) are consistent with these results, and support an age of about 2.4 Myr for the hominid" is misleading. It was misinterpreted by Gibbons[3], who commented that the authors "used a new technique . . . on volcanic deposits above and below" the fossil. This implies that dates were determined for both levels. If the data "in preparation" provide the conclusive control on the fossil, and show it to be 2.4 Myr in age, then they should have been included. If such results are only anticipated to support the age, then they are irrelevant.

The case for the "earliest" *Homo* at Lake Baringo is unsupported. Careful consideration of isotope age data, stratigraphic context and the limits of interpretation[6] are necessary in any discussion of such evidence critical to understanding the ancestry of man.

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SIR — A fragment from the right temporal bone of a fossil hominoid (KNM-BC1) from the Chemeron formation of Kenya was recently dated by Hill *et al.*[1] to approximately 2.4 Myr and attributed to the genus *Homo*. If the date and generic attribution are correct, the fossil is important because it represents the earliest securely known fossil from our own genus. The attribution of the temporal fragment rests on the assertion that it manifests two features unique to *Homo*: a sharp petrous crest, and a medially positioned mandibular fossa. But the observations regarding both features were offered without supporting measurements.

Hill *et al.* overlooked an earlier observation[7] that the angle of the petrous crest (just lateral to the posterior margin of the internal accoustic meatus) is sharp in the robust australopithecine OH-5 (*Zinjanthropus*), as is the case for modern humans. However, that earlier study did not provide specific angles for the petrous crests of OH-5 or modern humans, possibly because of the difficulty of measuring this angle in intact (closed) skulls. We have now overcome this problem by measuring the petrous crest angle reproduced on the right sides of endocasts representing *Pan troglodytes* (n = 5), *Gorilla gorilla* (n = 4), *Pongo pygmaeus* (n = 6) and *H. sapiens* (n = 4). In addition, we measured the petrous crest angle from endocasts of five fossil hominids including OH-5 and SK-1585 (robust australopithecines), STS-60 (a gracile australopithecine), KNM-ER 1805 (either *Australopithecus* or early *Homo*) and KNM-ER 3883 (*Homo erectus*).

Endocasts, which accurately reflect the external shape of the brain (and other morphology), were prepared from ape and human skulls using liquid latex[8]. Each hollow endocast was filled with plaster, taking care to preserve its original shape. To measure the angle of the petrous crest, a second cast was prepared from the right petrous temporal region (on the exterior of each endocast) using alginate casting material. The resulting casts clearly reflected the bony morphology of the entire petrous region of the internal skull.

The angle of the petrous crest was measured before the alginate cast dried and possibly changed shape. In order consistently to measure the same part of the petrous crest, we recorded its angle at a location just lateral to the posterior margin of the internal acoustic meatus, using an apparatus consisting of two straight edges joined at a rotatable pivot. After the edges were rotated so that they conformed to the angle of the petrous crest, the apparatus was removed and the angle read with a protractor. This procedure was repeated four times on each cast, and the mean of the measurements taken as the angle for that cast. A remeasurement analysis revealed that the measurements for each specimen departed from that specimen's mean by an average of less than 1.7°. When this error is expressed as a fraction of the mean for each specimen, and the data are then averaged across the 24 specimens, the mean remeasurement error is less than 1.6%.

Despite our small sample sizes, several conclusions may be drawn from our