THE TAXONOMIC STATUS OF THE "MEGANTHROPUS" CRANIUM SANGIRAN 31, AND THE "MEGANTHROPUS" OCCIPITAL FRAGMENT III

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ABSTRACT

Among authorities there is no agreement concerning the taxonomic status of the mandibular specimens that have been assigned to the genus "Meganthropus". Despite morphological differences, mostly related to extreme size, these mandibles have been assigned by most authorities to a proposed highly sexually dimorphic population of early Homo erectus *in Java. During the summers of 1991 1992 and 1993 I examined, measured, photographed and cast both described and undescribed cranial material that has been tentatively assigned to the proposed genus "Meganthropus". New evidence of cranial material has made this proposal even more problematic. Sangiran 31 was recovered from the Upper Pliocene Kalibeng beds of Sangiran, Java. It consists of nearly complete left and right parietals, part of the left temporal and an occipital. The overall morphology is different from known* H. erectus *specimens within and outside Southeast Asia. The cranium is smaller and thicker than any known specimen of* H. erectus. *It also possesses such large expansive temporal muscles that a double sagittal crest is present, which is not found on any* H. erectus. *Its endocranial capacity is estimated at no more than 700 cc. An additional specimen, consisting of an unnumbered occipital fragment, is morphologically similar to Sangiran 31. Either these cranial remains represent a new specimen of hominid in Southeast Asia similar to the late gracile australopithecines including* H. habilis, *or the range of* H. erectus *needs to be redefined.*

Most authorities refer to the genus "Meganthropus" as just another variant of *Homo erectus*, due to the fact that the only skeletal evidence readily available so far consists of mandibles. Because of the morphological variation of these mandibles, these authorities consider the "Meganthropus" specimens to constitute a highly sexually dimorphic population of *H. erectus* (e.g., Le Gros Clark 1955; Lovejoy 1970; Wolpoff 1975, 1980; Howells 1980; Pope and Cronin 1984; Kramer 1989; Rightmire 1990). However, as well as mandibles we now have several cranial fragments that have been tentatively placed into the genus "Meganthropus".

The well-fossilized skull cap known as Sangiran 31 (Figure 1) was recovered in Java by a local collector at the beginning of 1980. It probably originates from the Upper Pliocene Kalibeng beds of Sangiran. This date was arrived at by matching the minerals found in the fossil and those of the Kalibeng layers (Sartono *et al.*. 1981, 1983, 1993; Hyodo, *et al.* 1993). If this specimen really is from the Kalibeng layers, then it may be more than two million years old. This specimen is by far the most complete "Meganthropus" skull part recovered so far, and also the most damaged. It consists of approximately the rear half of the braincase. The entire occipital is present behind the foramen magnum. Most of the left parietal is preserved, lacking only a right triangle around Bregma, with legs of maybe 50 to 55 mm. About half of the right parietal is present, covering an area out from Lambda to a radius of about 60 mm. The left temporal is represented by a 25 by 40 mm portion of the mastoid region, and apparently also a strip along the squamous suture.

The skull shows considerable damage and distortion but most of its anatomy can be observed or reasonably inferred. It must be described on two levels - firstly as it is, then as reconstructed.

In its present condition, the cranium has the overall appearance of a *Homo erectus* skull of excessive size, thickness and platycephaly. It is just the kind of skull that Weidenreich would have predicted for the stage of evolution preceding his "Pithecanthropus robustus" (Sangiran skull IV [Sangiran 4] and mandible B [Sangiran 5]; Weidenreich 1945; Weidenreich and von Koenigswald 1951). At first glance it would appear that this skull should be associated with the giant "Meganthropus A" mandible (Sangiran 6) that was found in 1941.

The fossil would originally have had a total breadth of braincase in excess of 180 mm, if its contours were to be extended. Its likely height from Basion to Bregma would have been somewhere between 100 and 110 mm. Its breadth would have been at least 164% of its height, and could have been as much as 200%. This is greatly outside the range of *H. erectus*. There is no reasonable way to estimate the original length from the present condition, but continuing the extant contours would certainly make it at least 200 mm.

In most places the vault is more than 12 mm thick. Where both inner and outer tables are preserved it is between 12 and 14 mm. This reflects an increase in the thickness of the inner and outer tables of bone, not just of the diploe. The occipital ridge is typically 15 to 16 mm thick on the left side and over 20 mm on the right. At Inion a thickness of just over 30 mm can be found. The nuchal plane below that is mostly around 18 mm thick - a most peculiar feature.

The occipital ridge is the most prominent example to be found in any hominid skull, its closest match being the much later Ngandong 5. The central part of the ridge stands out as much as 12 mm from the projected curve of the occipital surface above and below. In Ngandong 5 this projection is 10 mm and in Sangiran 4 it is only 8 mm. In all these skulls, the occipital ridge is reduced in prominence to both sides of Inion. Vertical thickness of the ridge can be estimated at locations 20 mm to each side of midline. This amounts to close to 20 mm in Sangiran 31 and about 18 mm in both Ngandong 4 and Sangiran 4. In all these three skulls the superior nuchal line is evident as a sharper crest running along the lower edge of the occipital ridge. This nuchal line never reaches the most posterior part of the ridge, but is located below and set forward by several millimeters. At Inion, this inset is about 12 mm in Ngandong 5, 10 mm in Sangiran 4 and only 8 mm in Sangiran 31 (Santa Luca 1980; Sartono *et al.* 1983). Looked at another way, the nuchal muscles are set more to the rear in Sangiran 31. Overall, its occipital ridge exceeds the others compared here, but not overwhelmingly so.

The midline ridge of Sangiran 31, passing down the nuchal plane, is clearly evident and not remarkable. To each side of this ridge, and about midway between the normal locations of Inion and the mastoid processes, are found the prominent bulges that cover the cerebellar hemispheres. Normally, this bone is much thinner than in the vault above, but here it is not. In the heavily-built Sangiran 4 skull this region is only 3 or 4 mm thick in its central area, but in Sangiran 31 it is at least 12 mm on the left and up to 20 mm on some parts of the right, where there is some distortion. The "Meganthropus III" occipital fragment, described below, also shows this same thick area.

Hominid skulls are normally thinner where muscle occurs on the braincase. A rough rule of thumb is that 1 mm of bone is worth 2 mm of muscle as a shock absorber, so their inverse relationship is reasonable. But here we find the unexpected coincidence of one of the thickest parts of the braincase covered by at least a 30 mm thickness of muscle. Reconstructing the skull does not alter this situation.

The upper part of the occipital shows a strong flexion, running from side to side, just below the lambdoid suture. The upper occipital and lower parietal planes meet at 130 degrees. Between them, a broad band of apparent matrix is interposed. Various *H. erectus* skulls measure between these extremes. Sangiran 4 is 150 degrees, ER 3883 and the Kabwe skulls are 140 degrees; none matches the tight 130 degrees seen here. Actually, as is explained below, this extreme sub-lambdoid flexion is an artifact of its damaged condition .

On the parietal bones themselves there is no visible trace of temporal lines. A slight flexing begins halfway-up the parietal in front and runs directly back, then turns down and fades toward Asterion. In *H. erectus* skulls the temporal line almost invariably follows along this slight ridging. We find the only exception in the Kabwe skull, where the temporal lines rise above this parietal ridging on the anterior half of that bone. Evidently, this is because of the large size of the Kabwe individual, where muscle size increase surpasses that of brain size. Australopithecines normally do not have a perceptible parasagittal flexure of the parietal, whether the temporal lines top there or go on to build a sagittal crest. However, the habiline ER 1805 shows some mid-parietal flexure and its temporal muscles pass beyond that line to reach a low sagittal crest.

With the Sangiran 31 skull it appears that the temporal muscles reach over the entire parietal area and attach to a double sagittal crest, which is clearly evident in its least damaged parts. The crest stands about 4 mm tall. The crests of the two ridges run 13 mm apart and the whole structure is about 25 mm wide. A careful study of

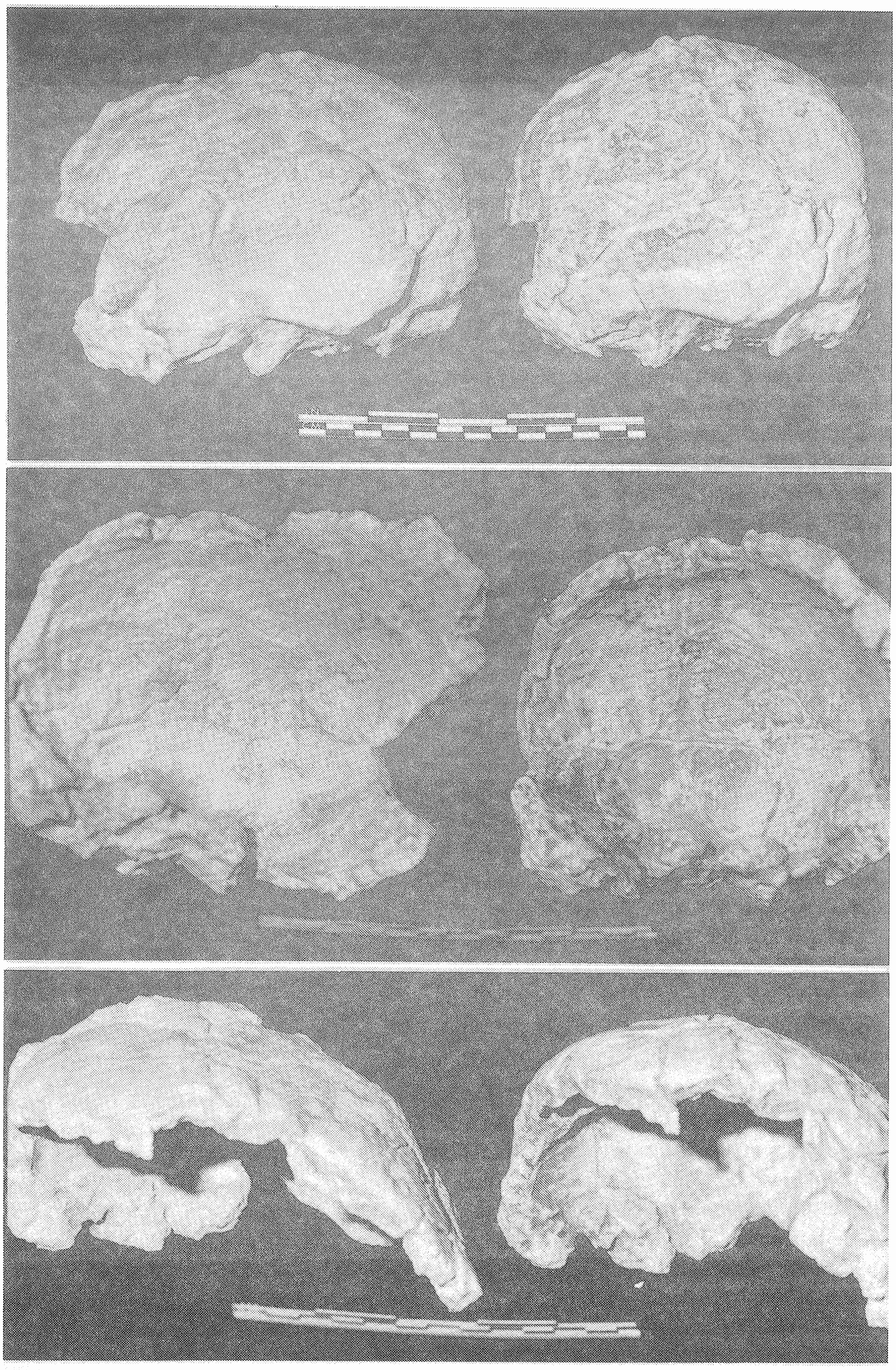

Figure 1: Sangiran 31; cast of the original on the left, reconstruction on the right.
Top: rear view; centre: interior view; bottom: front view

the breakage pattern does not offer any other explanation for the visible crests. An x-ray photo of this part of the skull does not indicate the existence of a fracture in this Bregma area, so that the double crest could not have been formed during its fossilization. Given the considerable size of this braincase, even when reconstructed, the size of the masticatory apparatus is very great - well in excess of that found in any *H. erectus* or australopithecine.

On the base there survives what may be a tiny part of the posterior rim of the foramen magnum. A chord from Opisthion to the most prominent Inion point is 62 mm. There is some damage in this area, which has shifted the midline about 6 mm to the left; this might have increased the chord length, but probably not more than 1 mm. That chord is the same length as on the Kabwe skull. On Sangiran 4 it is 60 mm, on Sangiran 17 it is 59 mm and on Ngandong 11 it is only 49 mm; on modern skulls it measures between 30 and 60 mm. Thus, the nuchal plane of Sangiran 31 is certainly large, but not exceptionally so.

The skull's interior shows few features of note. The occipital poles of the cerebrum are clearly marked, as is the prominent crest between them. This crest stands up 7 mm between the poles and continues down and forward toward the foramen magnum at a slightly lessened height. There are some irregularities on each side of the cranial floor, well below the occipital poles. These may represent the transverse occipital crest separating the cerebral from cerebellar fossae, but they cannot be made out clearly. The right occipital pole is vertically compressed, curving down from the upper right side by at least 5 mm, making the two poles artificially very asymmetrical.

The entire skull interior is divided into at least 18 sections that show some signs of breakage on their margins, along with a shifting of orientation. The largest such division is a filled-in split on the left side, forming a 65-mm-long wedge that reaches 10 mm at its widest (lateral) end. All other divisions are 2 mm or less in displacement. Along the midline the parietal edges turn inward, thus raising a slight internal sagittal ridge. There is only a trace of a narrow sulcus along the sagittal line itself.

It appears this skull was damaged by a severe blow that struck around the region of the right Asterion. Much of the right side is crushed inward, while the rest of the vault (especially the left side) is spread mostly outward. The impact area does not show localized damage as from a weapon, but rather it implies a firm contact over an area with a diameter of about 40 mm. Much of the exterior damage consists of conspicuous cracks - small ones on most of the vault, but some very wide ones on the occipital. Internally we can see these same cracks, except that on the right occipital we see the only evidence of bending rather than just breaking. We interpret this bending as evidence that the damage occurred when the bone was fresh. The most likely scenario is that this individual fell from a great height (a tree or cliff) and struck this part of his head on firm ground. The damage would have been more than enough to be lethal.

"MEGANTHROPUS III"

"Meganthropus III" is an occipital fragment, mostly of the right side, with the occipital ridge running across its middle part (Figure 2). The piece measures 84 mm diagonally from the top corner (in midsagittal plane), angling down 60 degrees to the lower right corner. Roughly perpendicular to that maximum length, it measures 59 mm. In thickness it ranges from 7.2 mm in the cerebellar fossa (near the edge) and 8 mm in the cerebral fossa above, to 24 mm where the external occipital ridge crosses a internal, vertical occipital crest. The edges are generally broken at right angles to the bone's outer surface, and sometimes the breaks angle inward to take out even more of the inner table. Endocranially, the preserved surface measures 62 by 49 mm following nearly the same axes as for the external measurements.

The occipital ridge is evenly rounded and stands out as much as 8 mm from the general surface curve of the bone near the midsagittal line. It reduces to 5 mm outstanding near the edge of the piece, after which it almost fades out at 50 mm from Inion. The occipital ridge is remarkably smooth, showing no discernable markings for muscular insertions on its inferior surface. Its upper and lower surfaces are almost mirror images, except that the most outstanding edge of the structure appears to be just a trace lower than the center of the overall ridge.

An internal vertical crest projects prominently into the intercerebral fissure (Figure 2, bottom). This crest stands 7 mm tall at the level of Inion and fades to no more than 2 mm at the upper edge of the piece. Inferiorly, this crest maintains its height of 7 mm to the lower edge of the piece.

Identifying the midsagittal line from this internal crest may be less than certain, though it is overwhelmingly probable. Both internally and externally all surface contours are bilaterally symmetrical on both sides of this line. That this is a single crest, lacking a sinus along its top, is somewhat unusual in itself. Also, there is no hint of a sulcus running along either side of the prominent crest. The only possible alternative interpretation is that

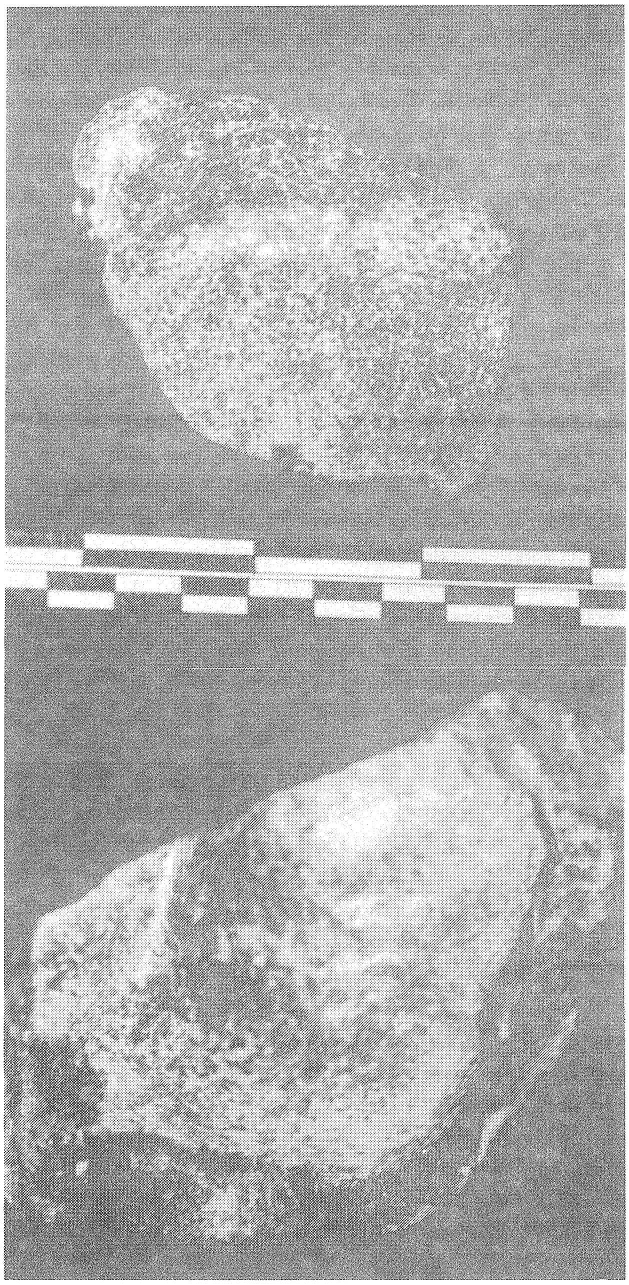

Figure 2: "Meganthropus" III right occipital
Top: exterior; bottom: interior.

what is identified as the small left portion of the piece is actually half of a truly enormous sagittal sinus, and the preserved crest is just the right side of a double crest. The extant width to the left of the crest is 12 mm, which must be more than doubled because it has not yet bottomed out. This also presupposes that the sagittal sinus was of the uncommon type that drained off to the left side.

A lateral occipital crest is faintly marked on the right side. It is a double crest, preserving just a trace of the lateral blood sinus along its top. It stands only about 1 mm into the endocranial space. The sulcus originates at that spot, showing no continuity with a sagittal sinus. This lateral crest angles oddly with the vertical crest, turning down about 25 degrees from the more usual horizontal orientation.

Near the lower right corner of the specimen there are some surface irregularities that may represent the inferior nuchal line. Below that line would be the insertion of the superior oblique muscle. Nothing else can be identified with any assurance.

The dimensions of this piece are quite large and generally outside the range of known *Homo erectus*. Most particularly it is thicker than the primitive Sangiran 4 braincase. What seems most unusual is the great thickness of its inferior portion, most of which exceeds 10 mm.

The angling between its upper and lower parts can be roughly measured in a parasagittal plane, set 19 mm to the right of the apparent midline. Here one may observe a conspicuous sulcus both above and below the occipital ridge, both reaching maximum depths of 2 mm. Lines laid from the ridge to both the upper and lower surfaces are 120 degrees apart. This is a common angulation for pithecanthropine occipitals. ER 3733 and Vertesszollos are more open-angled, while Sangiran 17 and at least one Ngandong skull are more tightly angulated.

RECONSTRUCTION OF SANGIRAN 31

The first step in reconstructing Sangiran 31 involved cutting a cast into 24 pieces with a thin scalpel blade. These pieces were then trimmed as appropriate and shifted into what appeared to be their original orientations. For most of the vault pieces this involved a position shift of no more than one millimeter and a direction shift of only two or three degrees. When four or five such tiny changes are added up in the same direction, this results in a considerable reshaping of the vault into a much more domed structure (Figure 1).

The occipital was broken into three major pieces. The right one-third had displaced inward and now was turned back out, hinging on its interior joining with the central part. The left one-third had been displaced outward and now was turned back in, this time hinging on its exterior joining with the central part. The pieces of left temporal and adjacent parietal corner apparently had been separated from each other and from the left edge of the occipital by 5 to 10 mm. Some space apparently had been filled in with matrix, which was removed from the cast to rejoin the pieces .

The upper part of the occipital, as already noted, shows a long side-to-side split. The inner table of bone is somewhat bent along this line, while the outer table had its upper and lower parts separated by as much as 7 mm. The reconstruction involved removing the presumed matrix from within the split and moving the pieces together. The inner face was not entirely corrected here and a considerable mismatch still remains where the lower part was strongly bent inward. In its original condition, the vault showed a 130 degree angle between the surfaces of the upper occipital and the lower parietal. On the reconstructed vault this has been straightened to 145 degrees (Figure 1, middle).

Much of the center and left side of the occipital was not properly matched in this reconstruction. The "shelf" on the inner face, which resulted from bending on the right side, continues across to the left side incorrectly.

Some dimensions of the reconstructed braincase can be estimated at this point. Maximum vault breadth appears to be 130 mm, Opisthion-Bregma height is 120 mm, and Basion-Bregma height could be the same or as much as 5 mm less. Biasterionic breadth of the occipital is about 125 mm. A serious estimate of cranial length cannot be made, but judging from its new curvatures it would be much less than the 200 mm indicated for its fossil condition (Figure 1, bottom).

No direct measure has been attempted of endocranial volume but a good estimate is possible. In its major dimensions the cranium is smaller than the braincases of Sangiran 2 and 4. Since these other skulls are measured at 815 and 908 cc respectively, it would seem that Sangiran 31 is smaller. Its excessive thickness also argues for the lower end of its likely range.

The taxonomic significance of the apparent endocranial capacity is not immediately evident. If it is as much as 800 cc, this would put it within the *Homo erectus* range and larger than two known specimens (Lantian and "Pithecanthropus 2"). If it is below 800 cc, it would be barely larger than the largest-known australopithecine specimen (ER 1470). The actual body size of this individual should help determine whether the degree of encephalization is of an australopithecine or *Homo erectus* level.

There are several indications of body size in the extant "Meganthropus" material, but none is truly definitive. The indicated musculature, especially on Sangiran 2, is more prominently developed than in any *H. erectus*. This suggests a larger body than any of the Ngandong or Kabwe specimens. The great thickness of the nuchal plane of the occipital is a puzzling feature, as already noted, and might be taken as an indication of considerable size. The reasoning here is that an exceptionally large body, with correspondingly large nuchal musculature, would put great strains on the cranial base in active movements of the head. The same reasoning might apply to the rest of the vault, where mechanical strains called for a thickness even greater than that of *H. erectus* skulls.

The fact that the temporal muscles reached to the sagittal area indicates that Sangiran 31 had a face of extraordinary size. In robust australopithecines we find faces far out of proportion to body size, but this evidently is not the case here. The "Meganthropus" type specimen mandible A (Sangiran 6), which most likely is of the same species and sex as Sangiran 31, does not show the diagnostic traits of robust australopithecines. Instead, its dentition is demonstrably similar to that found in the so-called gracile australopithecines and genus *Homo* (Tyler 1991). If this skull is viewed as a gigantic australopithecine, it is one of the "Homo habilis" (*Australopithecus africanus*) design that does not disproportionately emphasize the crushing cheek teeth. In this case, the evident facial size also argues for a correspondingly large body size.

The degree of encephalization (less than 700 cc), the shape of the braincase (domed, hypsicephalic and with a double sagittal crest) and the age (presumed to be greater than 2 million years) could suggest that Sangiran 31 was a habiline rather than a *Homo erectus*. However, the braincase is thicker than in *H. habilis,* which may indicate a behavioral change to hunting, similar to that hypothesised for *H. erectus*. Given the uncertainty of the dates of all of the Sangiran specimens and the morphological differences with both *H. habilis* and *H. erectus,* it can only be concluded that the taxonomic assessment of the "Meganthropus" specimens from Java remains unclear.

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