

## What constitutes *Homo sapiens*? Morphology versus received wisdom

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**Summary** - Although Linnaeus coined *Homo sapiens* in 1735, it was Blumenbach forty years later who provided the first morphological definition of the species. Since humans were not then allowed to be ante-Diluvian, his effort applied to the genus, as well. After the Feldhofer Grotto Neanderthal disproved this creationist notion, and human–fossil hunting became legitimate, new specimens were allocated either to *sapiens* or new species within *Homo*, or even to new species within new genera. Yet as these taxonomic acts reflected the morphological differences between specimens, they failed to address the question: What constitutes *H. sapiens*? When in 1950 Mayr collapsed all human fossils into *Homo*, he not only denied humans a diverse evolutionary past, he also shifted the key to identifying its species from morphology to geological age – a practice most paleoanthropologists still follow. Thus, for example, *H. erectus* is the species that preceded *H. sapiens*, and *H. sapiens* is the species into which *H. erectus* morphed. In order to deal with a growing morass of morphologically dissimilar specimens, the non-taxonomic terms “archaic” (AS) and “anatomically modern” (AMS) were introduced to distinguish between the earlier and later versions of *H. sapiens*, thereby making the species impossible to define. In attempting to disentangle fact from scenario, I begin from the beginning, trying to delineate features that may be distinctive of extant humans (ES), and then turning to the fossils that have been included in the species. With the exception of Upper Paleolithic humans – e.g. from Cro-Magnon, Dolni Vestonice, Mladeč – I argue that many specimens regarded as AMS, and all those deemed AS, are not *H. sapiens*. The features these AMS do share with ES suggest the existence of a *sapiens* clade. Further, restudy of near-recent fossils, especially from southwestern China (~11-14.5 ka), reinforces what discoveries such as *H. floresiensis* indicate: “If it’s recent, it’s not necessarily *H. sapiens*”.

**Keywords** - *Homo sapiens*, Extant humans, “Archaic” versus “anatomically modern”, *sapiens* clade.

### Introduction

In 1735 Linnaeus created the genus and species *Homo sapiens*, which he defined not morphologically, but with the phrase *nosce te ipsum* (know thyself) (Linnaeus, 1735). Since designating type specimens was not then required, Notton & Stringer (2010) are the most recent to argue that Linnaeus should be regarded as the lectotype of *H. sapiens*, and *H. sapiens sapiens* specifically. Their argument: Since Linnaeus described all races but *H. s. sapiens*, he saw himself as representative that group. Although

making some sense of *nosce te ipsum*, this intriguing proposal does not address defining *sapiens* much less *Homo* because, even if Linnaeus had described himself, he would have done so as with other races, in terms of geography, behavior, skin color, and hair type.

Thus it fell upon Blumenbach (1969) to provide the first morphological diagnosis of *Homo sapiens*. Although he believed he could identify races by different cranial shapes, he argued that they all belonged to *H. sapiens*, which he distinguished from other mammals by such features as a chin, small jaws, small canines abutting small

incisors, a large braincase balanced atop a vertical vertebral column, erect posture, bipedalism, a bowl-shaped pelvic girdle, “buttocks,” and a long thumb. Since creationist dogma denied the existence of human-like fossils, Blumenbach’s features defined both the species and genus.

Although Schmerling (1833) first identified fossils as remains of extinct humans, debate about human antiquity lay fallow until the discovery of the Feldhofer Grotto Neanderthal (Schwartz, 1999). In opposition to Schaaffhaussen’s (1861) claim that this specimen was a recent, but pathological human, Huxley (1863) accepted Lyell’s (1863) determination of the antiquity of the Neanderthaler. Using only the skullcap, Huxley asserted that the Neanderthaler constituted an extension into the past of a hierarchy of living *Homo sapiens* that descended from the most modern to the most primitive – which made unnecessary considering the impact of this specimen on the definition of the genus, or species. Subsequently, King (1864) argued that the cranial and postcranial morphology of the Neanderthaler warranted its place in a new species, *H. neanderthalensis*. However, by first assuming a close, intrageneric relationship between the Neanderthaler and *H. sapiens*, King sidestepped addressing the impact of his act on defining the genus.

As discoveries of Neanderthals continued, Dubois confronted the possibility of generic differences between living and extinct humans in light of the Trinil, Java calvaria and femur. The low and long, non-*sapiens* calvarial profile of the Trinil skullcap conflicted with the *sapiens*-like morphology of the femur. At first making these specimens the holotype of a new taxon, *Anthropopithecus erectus* (Dubois, 1892), Dubois (1894) subsequently referred them to *Pithecanthropus erectus*, taking the genus name (= ape-man) from Haeckel (1876), who had created it for a hypothetical ancestor lacking such human qualities as language. Why Dubois should think this composite individual warranted its own genus and species is likely due to his broad training in vertebrate paleontology and comparative morphology, wherein animals (e.g.

sheep and goat) that are externally but skeletally often imperceptibly different, are considered separate genera (Boessneck, 1969).

Although Blumenbach’s diagnosis of *Homo sapiens* remained unaddressed, during the first half of the 20<sup>th</sup> century, the differing morphologies of newly discovered hominid fossils were typically interpreted as representing taxic diversity. For example, Schoetensack (1908) allocated a very robust mandible with a broad, flat, sloped symphyseal region and large teeth to *H. heidelbergensis*; Woodward (1728) created *H. rhodesiensis* for a very robust skull with medially tall, flat-surfaced brows confluent across glabella, and a long, slightly sloped frontal; and Dreyer (1935) assigned to *H. (Africanthropus) helmei* a partial cranium that, while more gracile than the *H. rhodesiensis* specimen, presented a similarly configured brow. But as species were generated to house European and African specimens within *Homo*, Asian specimens were often afforded generic distinction. For instance, although Black (1927) based *Sinanthropus pekinesis* on a single molar, Weidenreich (1943) subsequently referred a number of partial crania and dentognathic specimens to this taxon; Weidenreich (1937) elevated *H. (Javanthropus) soloensis*, in which Oppenoorth (1932) had placed the Ngandong specimens, to *Javanthropus soloensis*; and von Koenigswald and Weidenreich (1939) allocated some specimens from Sangiran to *Pithecanthropus*, while Weidenreich (1945) placed others in the genus *Meganthropus*.

This taxonomic proliferation, however, made meaningless Blumenbach’s defining features of *Homo*. Although some of his criteria could still be used to define the species *sapiens*, Linnaeus’s *nosce te ipsum* became the paleoanthropological modus operandi: i.e., because we are *sapiens*, and ‘know’ our species, it is sufficient to document how other hominids differ from us. But in 1950, Mayr (1950) squelched all hope of sorting out hominid systematics. Using adaptation as the criterion for defining a genus, Mayr declared that, being bipedal, all hominids belonged to a single genus, *Homo*, which subsumed three chronologically transitioning

species: *H. transvaalensis*, *H. erectus*, and *H. sapiens*. Although Clark (1955) acknowledged the separateness of *Australopithecus* before Mayr (1963) did, the former scholar still defined the genus *Homo* in terms of the time-successive species, *H. erectus* and *H. sapiens*: e.g. bipedal gait dissimilar to australopiths, erect posture (although also in australopiths), cranial capacity  $\geq 800$  cm<sup>3</sup>, and the ability to make tools. The weight of Clark's definition of the genus, with its emphasis on tool making and bipedalism, must have informed Leakey and colleagues' (Leakey *et al.*, 1964) allocation to it of the earlier species *H. habilis*, which, in turn, demanded lowering the cerebral threshold of *Homo* to  $\geq 600$  cm<sup>3</sup>. In the end, Mayr's conception of transformation from one species of *Homo* into another remained unchanged, with the result that specimens were assigned to species primarily on the basis of their geological age.

### The problem

With chronology taking precedence over morphology, the terms "archaic" (AS) and "anatomically modern" (AMS) emerged as a means of accounting for the profound morphological differences between the specimens that were attributed to *Homo sapiens* (Trinkaus, 1982). Specimens deemed AMS were described in generalities, e.g. skeletally more gracile, with rounder cranium, and smaller face, jaws, and teeth. Specimens considered AS were the morphological opposite of AMS. Nevertheless, because these terms were also wedded to geological age, allocating any fossil to AS or AMS became arbitrary and without morphological basis. The Omo I and II partial crania serve to illustrate.

In 1967, Omo I was recovered from the upper part of Member 1, Kibish Formation, and dated to ~130 ka. Omo II was a surface find ~3.3 km away. Although both specimens were initially regarded as *Homo sapiens*, Day & Stringer (1982) suggested and then reaffirmed (Day & Stringer, 1991) that Omo I was *H. erectus*-, and Omo II more *sapiens*-like. Subsequently, Upper Member

I was redated to ~195 ka and Omo II firmly associated with it (McDougall *et al.*, 2005). With Omo I and II now indisputably penecontemporaneous, McDougall and colleagues concluded that both specimens were AMS, thus contributing to a picture of "morphological diversity among...hominids from the Middle and Late Pleistocene...[that]...is of major importance in understanding the tempo and mode of modern human origins" (p. 736).

Belief in a continuous transformation from early-to-recent *Homo sapiens* also led to perceiving in various specimens an amalgam of archaic and modern features: e.g. from Tianyuan (Shang *et al.*, 2007), Panxian Cave (Liu *et al.*, 2012), Zhirendong (Liu *et al.*, 2010), and Mladeč (Frayer *et al.*, 2006). Further, denial of human taxic diversity made possible asserting that there had been a co-mingling of archaic and modern features, due to prolonged hybridization between AS and AMS [e.g. Abrigo do Largo Velho (Duarte *et al.*, 1999)].

Since allocating specimens to species of *Homo* bypasses the first necessary step of questioning the integrity of the genus, it may be informative to temporarily put aside the fossils and, in the shadow of Blumenbach, try anew to delineate at least some features that may be potentially apomorphic of *H. sapiens*.

### Toward defining *Homo sapiens*

From Blumenbach's list of *Homo sapiens* features, only possession of a "chin," small jaws and teeth, and a large neurocranium, but not aspects related to bipedalism, warrant consideration.

#### *The "chin"*

Historically, any bulge in the symphyseal region of the mandible has been identified as a chin; [witness Enlow's (1982) claim that extant *Homo sapiens* (ES) and elephants are the only chin-bearing mammals]. It is therefore not surprising that various fossil AMS (e.g. Qafzeh 7 and all adults from Skhul) have been described as



**Fig. 1 - Fetus (4-5 months) with unfused mandibular symphysis; note everted symphyseal and inferior margins (arrows), that will form the inverted T when united. Mandibles of a 2 year old (left below), a 5 year old (middle), and an adult (right): note persistence of the inverted T configuration and a symphyseal region that is a/p thicker than the bone to its sides. (Not to scale) Copyright © Jeffrey H. Schwartz. The colour version of this figure is available at the JASs website.**

having “true,” and some Neanderthals (e.g. Spy 1 and Krapina 59) “incipient” chins (Wolpoff, 1996). First, “incipient” is meaningful only in the context of a presumed continuum of transformation. Second, in terms of morphology, the alveolar regions of Krapina 59 and Spy 1 protrude beyond the bone below, resulting in a shallow sulcus that gives the impression of a slight inferior bulge. Nevertheless, the infra-sulcul region is broad, relatively flat, featureless, and either vertically or slightly antero-obliquely oriented. The symphyseal regions of Qafzeh 7 and adult Skhul mandibles bear versions of a teardrop-shaped bulge that descends from below the alveolar margin, expands laterally and anteriorly, and, in lateral profile, curves posteriorly toward the inferior margin.

In adult ES, a thin, vertical, variably supero-inferiorly (s/i) tall midline keel descends from below the alveolar region [which, unlike the basilar bone in which it is situated, derives from tooth-forming cells (Ten Cate & Mills, 1972)], and then expands bilaterally, delineating a variably triangular structure that, in lateral profile, is most protrusive at the inferior symphyseal margin. In non-*sapiens* anthropoids, this profile is either anteroposteriorly (a/p) inclined, or vertically oriented. Viewed from below, the ES corpus is a/p thicker across the symphyseal region than to its sides (Fig. 1). In monkeys, apes, Neanderthals, Qafzeh 7, all Skhul adults, and most other hominids, the bone across and to the sides of the symphysis is -uniformly thick a/p (Schwartz & Tattersall, 2000).

In human fetuses, the crest-like symphyseal and inferior margins are continuous and everted (Fig. 1). Viewed laterally, the symphyseal region is vertically oriented. As the mandibular symphysis fuses with growth, the symphyseal/inferior marginal crests coalesce, forming an inverted-T-like structure. With differential bone deposition/resorption the inverted-T becomes variably protrusive anteriorly and inferiorly (Fig. 1). Postnatal variation is noted in the clarity of the triangular inverted “T” and midline keel, and the development of (mental) tuberosities defining the termini of the a/p thickened interior margin. In all cases, however, when viewed from below, the symphyseal region is a/p thicker than the bone to its sides (Fig. 1).

In contrast, the symphyseal region of juvenile and adult non-human primates is smooth and featureless throughout, and, in inferior view, generally as ~thick a/p as the bone on either side. Since ES symphyseal morphology is well defined in juveniles, and in essence retained in adults, its absence in other juvenile hominids would exclude them, and their adult counterparts, from *H. sapiens*. This obtains to Neanderthals, for whom several juvenile specimens are known, and also to the Skhul 1 child, which, if representative of the Skhul population, demonstrates that the tear-drop-shaped adult symphyseal structure emerged from a smooth surface (Schwartz & Tattersall, 2000).

Among other fossils regarded as *Homo sapiens*, the symphyseal regions of Fish Hoek, Boskop and Klasies River Mouth KRM13400 and 14695 are smooth and variably swollen. Only KRM41815 appears to present a central keel; inferiorly its symphyseal region is not significantly thicker a/p than the bone lateral to it. The midline of the Zhirendong mandible lacks a midline keel and bears a laterally constricted, roundedly subtriangular, and minimally swollen bulge that is most prominent well above the inferior margin (personal observation). Interestingly, the symphyseal region of the Tuinplaas mandible presents an inverted “T,” although, inferiorly, it is not appreciably thicker than the bone lateral to it (Schwartz & Tattersall, 2000).

Thus, in addition to Upper Paleolithic specimens, e.g. from Abri Pataud, Grimaldi, Dolni Vestonice, Predmosti, Ohalo, and Isturitz (including juveniles that are morphologically similar to extant humans of the same age), only AMS Tianyuan PA1281, KRM41815, and Tuinplaas present features of a “chin.”

#### *The “brow”*

Possession of a bipartite brow has been promoted as a unique feature of *Homo sapiens* (Stringer, *et al.*, 1984). It is characterized by a circum-glabellar swelling that extends laterally just beyond the midline of each orbit; on each side, and in the vicinity of the supraorbital foramen/groove, this swelling is undercut obliquely by a flat plane that continues to the lateral supraorbital extremity (Schwartz & Tattersall, 2003). The development of a three-dimensional bipartite brow follows the general anthropoid pattern: i.e., it emerges postnatally from an initially featureless frontal bone (Schwartz, 1997; Schwartz & Tattersall, 2010) (Fig. 2). Not surprisingly, the continuous, “double-arched” brow of adult Neanderthals also develops from a featureless frontal (Schwartz & Tattersall, 2005a) (Fig. 3). But a bipartite brow is only one expression of *H. sapiens* supraorbital morphology.

Bioarchaeologists assign human crania to sex on the basis of differences in supraorbital prominence. In males, the more medial, circum-glabellar region is typically described as being well defined and noticeably swollen, and the supraorbital margins as being palpably blunt. In females, the supraorbital margins are thinner (even palpably sharp), with the circum-glabellar/supraorbital region varying from smooth and flat, to minimally bipartite (Schwartz, 1997). Thus, ES brow configurations span the gamut from neotenually unembellished, to prominently bipartite (Fig. 4). This continuum is consistent with differential hyperostotic growth (Schwartz, 1997), as likely are differences in robusticity of Neanderthal brows (cf. Vindija-77-206-73 and Vi-81-93, La Ferrassie I, Monte Circeo).

The implications of this realization are far reaching. For example, brow-size diminution has

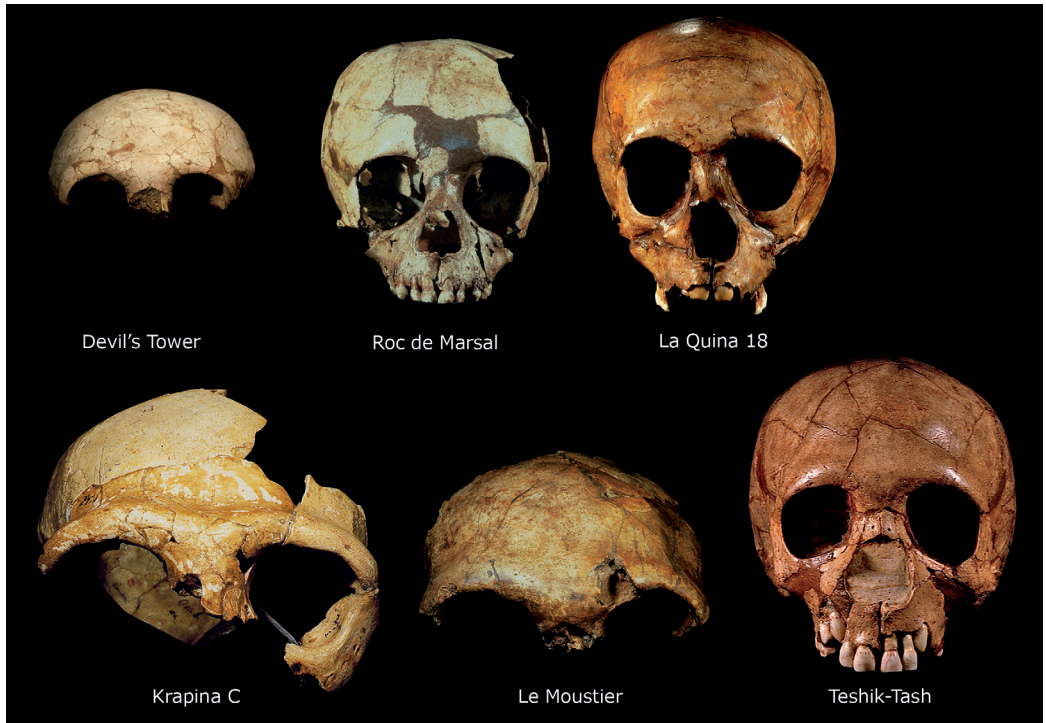


**Fig. 2 - ES crania arranged according to age, demonstrating emergence of adult brow morphology from an initially featureless supraorbital region. Note the persistence of a bipartite configuration even though the brow is very prominent (lower left). (Not to scale) Copyright © Jeffrey H. Schwartz. The colour version of this figure is available at the JASS website.**

long been a cornerstone of human evolutionary scenarios (Frayer *et al.*, 2006; Trinkaus, 2006). Yet, as conceived, this transformation is purely Haeckelian in assuming that a sequence of adult specimens is a reflection of evolutionary, as well as of developmental, change (also see Lieberman *et al.*, 2002; Bastir *et al.*, 2008). Nevertheless, development demonstrates that the adult ES brow is not the result of evolutionary or growth-related change from an adult Neanderthal “brow.”

The range of variation in ES supraorbital morphology also redounds on the concepts “AS” and “AMS.” First, no specimen ever regarded as AS presents any version of an ES brow. Rather, although differing in detail, these brows are similar in being continuous across glabella, with *s/i* thick and rounded supraorbital margins: cf. crania

from Eyasi, Eliye Springs, Omo Kibish, Guomde, Laetoli (LH18), and Ndutu (East Africa), Florisbad (South Africa), Jebel Irhoud and Dar es-Soltane (North Africa), Dali and Jinniushan (China) and Narmada (India) (Schwartz & Tattersall, 2003). Second, among specimens deemed AMS, the brows of the Border Cave, Qafzeh 6, and all Skhul adults are neither flat or smooth, nor bipartite. Rather, they are continuous across glabella, with moderate-to-very *s/i* tall, rounded supraorbital margins (Schwartz & Tattersall, 2003). Further, while the adult specimen from Herto, Ethiopia (BOU-VP-16/1) assigned to *Homo sapiens idaltu*, was described as having a bipartite brow (White *et al.*, 2003), as illustrated, it is not an ES brow. For instance, medially and on each side, the brow is *s/i* tall, flat, latero-obliquely facing, and circumscribed supero-medially by a distinct edge.



**Fig. 3 - Neanderthal crania arranged according to age, demonstrating emergence of adult brow morphology from an initially featureless supraorbital region. (Not to scale) Copyright © Jeffrey H. Schwartz. The colour version of this figure is available at the JASs website.**

The unembellished supraorbital region of the Herto child (BOU-VP-16/2) is consistent with the pattern of anthropoid supraorbital development. Non-Neanderthal specimens of the European Upper Paleolithic present benignly (e.g. Abri Pataud) or markedly configured (e.g. Mladeč) bipartite brows, as also does the Tuinplaas partial cranium. As with Abri Pataud and Tuinplaas, many of these crania are associated with mandibles bearing definitive ES “chins.”

Clearly, these observations impact how one interprets phylogenetically a skull with a smooth, supraorbital region that is associated with a “chinless” mandible (e.g., the ~6700 B.P. Fish Hoek specimen).

#### *Brows and chins*

Study of ES crania (N=500), comprising  $\geq 100$  year-old specimens of geographically far-flung,

but indigenous groups from North and South America, China, India, sub-Saharan Africa, and western Europe (American Museum of Natural History), as well as ~24 European/European-derived skulls (University of Pittsburgh School of Dentistry), illustrates how different configurations of brow and chin can be expressed in the same individual (Fig. 4): Whether a specimen has “female/neotenic” or “male/hyperostotic” supraorbital morphology, all present inverted-T-shaped chins, whether subtly or robustly expressed. Consequently, while a bipartite brow may identify some individuals as *H. sapiens*, only the development of an ES chin provides definitive evidence of membership in this species.

#### *If it's recent, is it Homo sapiens?*

In spite of the prevailing assumption that hominids 200 ka are likely *Homo sapiens*,



**Fig. 4 - Various ES crania and mandibles. Note in each the persistence, from subtle to marked, of the inverted T configuration, while only some specimens present a bipartite brow. (Not to scale) Copyright © Jeffrey H. Schwartz. The colour version of this figure is available at the JASs website.**

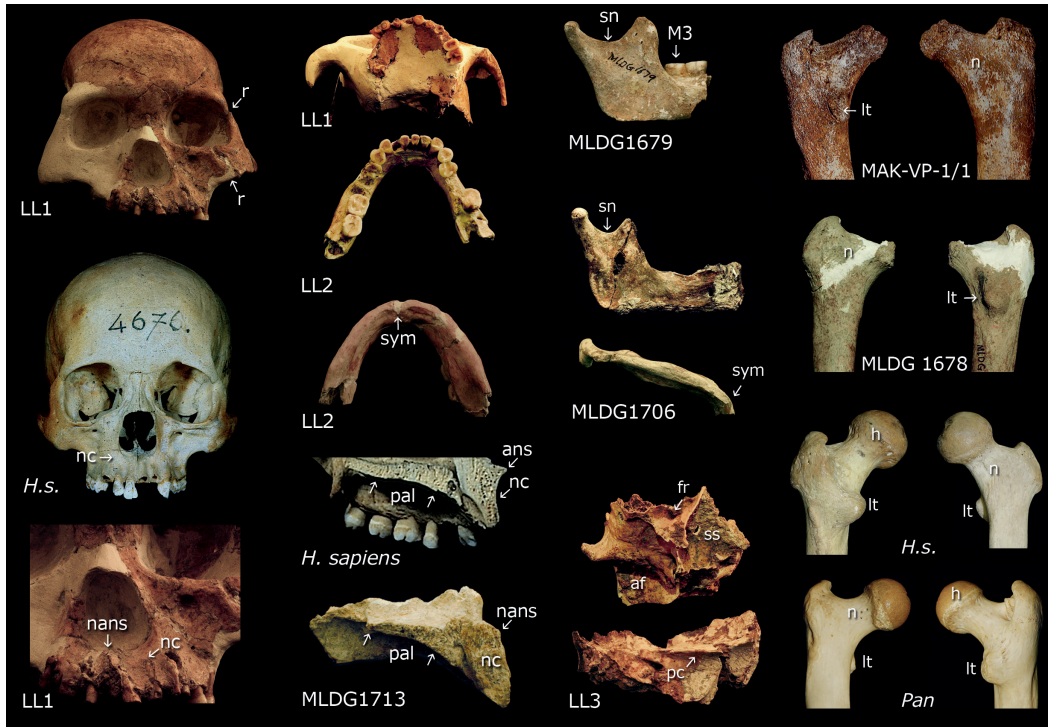
specimens from Flores (Brown *et al.*, 2004), Fish Hoek and Boskop (Schwartz & Tattersall, 2003), as well as from Penghu (Chang *et al.*, 2015), provide a picture of near-recent hominid diversity. Near-recent hominid taxic diversity is also corroborated by detailed restudy (JHS) of the ~11-14.5 ka specimens from Longlin (LL) and Maludong (MLDG), southwestern China that were claimed to represent a single population derivative of either AS or African AMS (Curnoe *et al.*, 2012).

Although all LL specimens were presented as being from the same individual because they came from the same sedimentary block (Curnoe *et al.*, 2012), the sample actually consists of an adult partial cranium (LL1) and partial mandible (LL2) with incompatible dental-arcade shapes and tooth-wear patterns, subadult sphenotemporal (LL3) and basioccipital (LL4) fragments, and an infant/neonatal petrosal (LL13). Interestingly,

while the supraorbital region of LL1 is ~neotenually ES-like, it is otherwise not ES-like in its a/p flattened infraorbital region, marked postorbital constriction, horizontally parallel optic canal and anterior clinoid process, flat, superiorly narrow nasal bones, and a/p long, ~ horizontally oriented, prognathic nasoalveolar clivus (nc), as well as in its lack of a conchal crest (cc), anterior nasal spine (ans) and defined lateral and spinal crests (Gower, 1923; Schwartz, 2007; Schwartz & Tattersall, 2005b; Schwartz *et al.*, 2008); the latero-obliquely oriented zygoma is an artifact of reconstruction (Fig. 5).

In further contrast to ES, LL2 exhibits a retromolar space and an a/p uniformly thick symphyseal region; LL3 lacks a foramen lacerum, and has a poorly excavated mandibular fossa, a short, posteriorly oriented auditory tube, a low-lying vaginal process, a sphenoid sinus that





**Fig. 5 - Specimens from Longlin and Maludong with comparisons as labeled. H.s. = *Homo sapiens*; r = reconstruction; nc = nasopalveolar clivus; ans = anterior nasal spine; nans = no ans; pal = palate; sym = symphysis; sn = sigmoid notch; fr = possible foramen rotundum; ss = sphenoidal sinus; af = articular fossa; pc = petrosal crest; n = neck; h = head; Lt = lesser trochanter. Anterior femoral view: Mak and H.s. right column; MLDG and Pan left column. (Not to scale) Copyright © Jeffrey H. Schwartz. The colour version of this figure is available at the JASs website.**

extends beyond the region of the hypophyseal fossa, a flat “arcuate eminence,” and an expansive ledge protruding medially from the region of a superior petrosal sinus (Fig. 5) [also visible in Curnoe *et al.* (2012)]; and the a/p short but unusually broad LL4 bears an m/l broad, a/p short occipital condyle and an internally flat clivus (Schwartz, 2007; Schwartz & Tattersall, 2005b). If, in LL3, a foramen well separated from, and very anterior and somewhat lateral to the foramen ovale is a foramen rotundum, its position is unique for any hominid (Schwartz & Tattersall, 2002, 2003, 2005b).

Noteworthy among the Maludong specimens is edentulous partial left maxilla MLDG1713, which differs from ES in lacking a cc and ans,

and in bearing two low, blunt crests emanating from the “corner” of the nasal margin (one descends onto the nc, and the other courses to the intra-nasal-cavity spinal ridge) that do not interrupt the ~smoothly curved transition from the nasal sill onto the nc (Gower, 1923). Further unlike ES, the palate thins markedly posteriorly and the nc is ~parallel-sided and antero-inferiorly oriented (Fig. 5) (Schwartz, 2007).

Reconstructed calottes MLDG1704 and 1705 are long a/p and low s/i (Curnoe *et al.*, 2012). As better seen in MLDG1705, the s/i low, wide, and broadly V-shaped lambdoid suture reflects a similarly configured occipital. Unlike ES, Maludong brows are protrusive and continuous, and cranial vault bone characterized

by cortices that are indistinguishable from very thick, extensively micro-pneumatized, diploe (Schwartz, 2007).

Right partial mandible MDLG1679 (preserved from  $M_2$  posteriorly) is reminiscent of ES in its shallow, a/p long sigmoid notch, but differs in exposure of  $M_3$  anterior to the ramus and in having large  $M_{2,3}$  protoconids and small, mesially situated metaconids (Schwartz, 2007; Trinkaus & Howells, 1979). Partial mandible MLDG1706 is unlike ES and MLDG1679 in its relatively s/i tall, a/p narrow ramus, deeply concave sigmoid notch, and posteriorly angled anterior ramal margin. The ramal differences between MLDG1706 and 1679 mirror those suggested as being taxically distinct (Rak *et al.*, n.d.). The inferiorly intact MLDG1706 symphyseal region is unlike ES in being uniformly thick a/p (Fig. 5).

Interestingly, the MLDG1678 proximal femur that Curnoe *et al.* (2012) identified as *Homo sapiens* with Neanderthal features (Curnoe *et al.* 2015) is actually similar to numerous non-*sapiens* specimens, including the australopith MAK-VP1/1 (Fig. 5, Appendix) (Lovejoy *et al.*, 2009; Schwartz, 2014). For example, in *H. sapiens*, Neanderthals, and non-human anthropoids, the femoral head is large, the neck short and proximo-distally parallel-sided, and the lesser trochanter medially directed. In MLDG1678 and australopiths, however, the femoral head is (or was) small, the neck long, a/p compressed, and sometimes medially tapered, and the lesser trochanter posteriorly oriented. If MAK-VP-1/1 is excluded from *H. sapiens*, so, too, is MLDG1678. Indeed, if *H. floresiensis* can possess “australopith-like” features, why not other near-recent hominids?

#### *Is there a Homo sapiens clade?*

Although the allocation of some specimens to AMS may be questionable, other specimens do present one or more generally ES-like features, e.g. an s/i tall, rounded lateral cranial profile, with a steep, high-rising frontal curve, a steeply descending, shallow parieto-occipital curve, and a more rounded occipital-nuchal plane curve,

and, in rear view, an s/i tall, ~parallel-sided profile, with an s/i tall, ~narrow occipital that is delineated by a similarly configured lambdoid suture that peaks high up: e.g. Qafzeh 6, Skhul V, Fish Hoek, Guomde, Border Cave, LH 18, and Liujiang. If one considers the frontal and occipital bones alone, regardless of s/i height, Jebel Irhoud I and Boskop, for example, are relevant. For, while lacking ES-like brows, their ES-like frontal and occipital profiles suggest affinity to a potential *H. sapiens* clade, whose members exhibit different craniaofacial configurations.

Tattersall (Tattersall, 2012) suggested that ES and AMS differ from AS (e.g. the Petralona skull) in having a relatively s/i and m/l small face that is tucked under the neurocranium (e.g. BOU-VP-16/1). But while this also describes, for instance, the Fish Hoek, Qafzeh 6, Jebel Irhoud I, Dar es-Soltane, Border Cave (inferred from the right zygoma), and LL1 crania, it does not encompass Skhul V, with its anteriorly protruding face, moderately long palate, and a/p long mandibular retromolar space (Trinkaus & Howells, 1979; Lieberman & McCarthy, 2013). Skhul V also differed from ES in having a short nasopharynx (Lieberman & McCarthy, 2013).

In consideration of all possible morphs that have been included in AMS, the following hypotheses emerge. Specimens with

- 1) a true chin (e.g. ES, Tuinplaas) should be regarded as *Homo sapiens*,
- 2) a true chin, a variant of an ES brow (smooth and crisply edged-to-robustly bipartite), a relatively small, non-protruding lower face, and an s/i tall, vaulted cranium should be regarded as *Homo sapiens* (e.g. ES, Upper Paleolithic),
- 3) some combination of a relatively small, non-protruding lower face, and an s/i tall, vaulted cranium, but not a true chin, represent one or more morphs whose closest relationships lie somehow with *H. sapiens* (e.g. LL1, LL2, Qafzeh 6 and 7, Fish Hoek, Boskop, BOU-VP-16/1),
- 4) an s/i tall, vaulted cranium, and protruding face, but not a true chin (e.g. Skhul V), constitute the sister morph of the latter group.

### *Further toward diagnosing Homo sapiens*

Beyond a true chin and bipartite supraorbital region, other features have been proposed as distinctive of *Homo sapiens*: 1) extension of an *s/i* tall, sheet-like vaginal process to the lateral margin of the auditory tube; 2) approximation of the vaginal and mastoid processes; 3) very laterally situated styloid process, with a stylomastoid foramen posteromedial to its base; 4) retention in the adult of a defined arcuate eminence; and 5) segmented and sometimes deeply interdigitated coronal, sagittal, and lambdoidal sutures (Schwartz & Tattersall, 2005b). Additionally, even if primitively retrained (Schwartz & Tattersall, 2003, 2005b), *H. sapiens* displays 6) an angular demarcation between the nasal cavity floor and nc, 7) a -uniformly thick palate, and 8) an nc that is lengthened a/p by a distinct ans. In light of the preceding discussion, the systematic significance of these features should be tested, and other cranio-dental features explored. Similarly, although there are far fewer postcranial specimens, the example of the Maludong femur emphasizes the need to consider in detail what does exist, e.g., differences in femoral trochanter size and orientation (Schwartz, 2014).

### Conclusions

For more than a 50 years, specimens have been attributed to *Homo sapiens* more on the basis of chronology than morphology, with scenarios generated to justify an ever-expanding species that far exceeds the realm of variation seen in any other vertebrate. Although accepted paleoanthropological practice, it would not pass systematic muster in any other area of paleontology. Consequently, it should be interesting to revisit the species *sapiens*: start from scratch, abandon taxonomic and non-taxonomic names, compare specimen to specimen in morphological detail across taxic boundaries that go well beyond hominids, and even hominoids. But this also means revisiting the integrity of genus *Homo*. For, if the suggestion of a clade that includes *H. sapiens* is correct, it follows that *Homo* should be

restricted to members of this clade. By logical extension, hypothetical *neanderthalensis* and *heidelbergensis* clades, regardless of their relationship to a *sapiens* clade, should be regarded as separate genera. Further, questioning the validity of *Homo* must also include questioning the notion of "*H. erectus*." But, while the latter especially remains a hard systematic nut to crack (Antón, 2003; Lordkipanidze *et al.*, 2013; Zollikofer *et al.*, 2014), one can hope that reassessing the question "What constitutes *Homo sapiens*?" will eventually lead to re-evaluating the undefined notion "*Homo*," under which paleoanthropology has labored for so long (Schwartz & Tattersall, 2015). In the end, the emergent picture of human evolution may be as taxically diverse as earlier paleoanthropologists, in their recognition of different genera, thought possible.

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*Appendix - Proximal femur: neck/shaft angle and morphology.*

SPECIMEN	NECK ANGLE (°)	RELATIVE NECK LENGTH	NECK PROFILE (ANTERIOR)	RELATIVE HEAD SIZE	HEAD EXTENSION DISTAL	HEAD EXTENSION PROXIMAL
<b>STW 25</b>	n.a.	n.a.	Likely tapered	Small	No	No
<b>STW 30A</b>	n.a.	n.a.	Taper	Small	Yes	No
<b>STW 30B</b>	n.a.	n.a.	Taper	Small	Yes	No
<b>UW 88-89</b>	n.a.	n.a.	n.a.	Small	Some	Some
<b>OH 28</b>	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
<b>ARA-VP-1/701</b>	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
<b><i>H. sapiens</i></b>	111-140	Short	Parallel	Large	Yes	Yes
<b><i>H. neander.</i></b>	113-127	Short	Parallel	Large	Yes	Yes
<b>D4167</b>	113	Long	Slight taper	Moderately large	Yes	Yes
<b>MLDG 1678</b>	115	Likely long	Taper	Likely small	Likely no	Likely no
<b>UW 88-04/05/39</b>	120	Long	Slight taper	Medium?	Yes	No
<b>OH 20</b>	120	Long	Taper	n.a.	n.a.	Likely
<b>BAR 1002'00</b>	120	Moderately long	Slight taper	Moderately large	Yes	Yes
<b>KNM-WT 15000(R)</b>	120	Long	Some taper	Medium	Slight	Slight
<b>SK 97</b>	120	Long	Taper	Medium	Yes	Some
<b>MAK VP1/1</b>	120	Long	Taper	Likely small	No	No
<b>AL 333-3</b>	120	Moderate	Some taper	Large	Yes	Yes
<b>KNM-ER 1472</b>	120	Moderate	Some taper	Large	Yes	Yes
<b>KNM-ER 1481</b>	120	Moderate	Some taper	Large	Yes	Yes
<b>Trinil 3/Pith I</b>	120	Short	Parallel	Large	Some	Some
<b>KNM-ER 815</b>	125	Very long	Some taper	Probably small	Slight?	None?
<b>KNM-WT 15000(L)</b>	125	Long	Some taper	Medium	Slight	Slight
<b>Trinil 6/Pith II</b>	130	Long	Some taper?	Small-medium?	n.a.	n.a.
<b>AL 288-1</b>	130	Long	Some taper	Small	Yes	Yes
<b>KNM-ER 999</b>	130	Very long	n.a.	Probably small	Likely yes	Likely yes
<b>AL 128-1</b>	130	?	Taper	n.a.	n.a.	n.a.
<b>KNM-ER 738</b>	130	Very long	Some taper	Moderate	Noted	Some
<b>OH 62</b>	130	Long	Some taper	Likely small	No	No
<b>LB1</b>	130	Moderate	Slight taper	Large	Yes	Yes

<sup>1</sup> from Schwartz (2014), with MLDG added.

## Appendix (continued).

SPECIMEN	LESSER TROCHANTER POSITION	LESSER TROCHANTER SHAPE	GREATER TROCHANTER HEIGHT	INTER-TROCHANTER CREST	SPIRAL LINE	GLUTEAL LINE
STW 25	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
STW 30A	n.a.	n.a.	n.a.	n.a.		
STW 30B	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
UW 88-89	Medioposterior	Slight point	n.a.	n.a.	n.a.	n.a.
OH 28	Posterior	n.a.	n.a.	n.a.	Faint	Stouter
ARA-VP-1/701	Fairly medial	Large blunt	n.a.	n.a.		
<i>H. sapiens</i>	Very medial	Large blunt	Well above	Distinct	Marked	Marked
<i>H. neander.</i>	Medial	Large blunt	Above	Distinct	Marked	Marked
D4167	Medioposterior	Blunt	Above	Moderate	Marked	Marked
MLDG 1678	Very posterior	Large blunt	Well above	Faint	Almost absent	Faint
UW 88-04/05/39	Very posterior	Large	n.a.	Faint		
OH 20	Posteromedial	Likely pointy	No	Faint	Marked	Faint
BAR 1002'00	Fairly medial	Long	Likely above	Faint	Faint	Faint
KNM-WT 15000(R)	Very posterior	Slight point	n.a.	n.a.	None	Faint
SK 97	Posteromedial	Pointy	Slight	Distinct	Visible	Faint/damaged
MAK VP1/1	Posteromedial	Blunt	Well above	Faint	Absent	Faint
AL 333-3	Posteromedial	Long?	Some	Faint	n.a.	n.a.
KNM-ER 1472	Medioposterior	Pointy	Noted	Moderate		
KNM-ER 1481	Postero-medial	Blunt	Noted	Moderate	Faint	Faint
Trinil 3/Pith I	Medial	Pointy	Noted	Distinct	Marked	Marked
KNM-ER 815	Posteromedial	Pointy	n.a.	Faint	Faint	Blunt
KNM-WT 15000(L)	Very posterior	Slight point	Slight	Faint	Faint	Faint
Trinil 6/Pith II	Medioposterior	Not long	n.a.	None?	Faint	Faint
AL 288-1	Posteromedial	Pointy	Noted	Faint	Very medial	Very lateral
KNM-ER 999	Posteromedial	Pointy	n.a.	Faint	Faint	Faint
AL 128-1	Posteromedial	Long	Slight	Faint	Marked	Faint
KNM-ER 738	Posterior	Pointy	Some?	Faint	Moderate	Faint
OH 62	Very posterior	Long	n.a.	n.a.		
LB1	Medial	Blunt	Above	Distinct		