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The ES-11693 Cranium from Eliye Springs, West Turkana, Kenya

This paper provides a detailed description of the new fossil hominid cranium KNM-ES-11693 from Eliye Springs, Kenya. The specimen comes from reworked deposits which exclude its being stratigraphically located. However, in spite of the dating problems, the well preserved and heavily mineralized fossil exhibits many morphological features by which it can be assigned to archaic *Homo sapiens*. ES-11693 is compared to African early and late archaic *Homo sapiens*. Although the new hominid presents a unique mosaic of archaic and modern features, it appears to have a closer relationship with the late archaic *H. sapiens* grade, in which such hominids as Omo 2 and Laetoli H. 18 can also be grouped.

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In a preliminary report (Bräuer & Leakey, 1986), the new fossil cranium KNM-ES-11693 from Eliye Springs at the western shore of Lake Turkana was presented as a further representative of archaic *Homo sapiens*. The aim of this article is to give a more detailed analysis of the morphology of the specimen and to discuss its phylogenetic relevance.

The Hominid Site and the Problem of Dating

The cranium was discovered and collected by Dr and Mrs Till Darnhofer who were walking along the beach of Lake Turkana near the fresh water springs known as Eliye Springs. The occipital was protruding above the sediments and the rest of the cranium was buried in wet mud and beach deposit. The coordinates of the site are 35° 57′E, 3° 22′N (Figure 1). Subsequent investigation at the site of discovery revealed that the cranium, together with several faunal elements, was probably not in primary context but had been reworked by wave action on a sequence of late Pleistocene deposits exposed nearby. The identified fauna was modern and no extinct species have been recovered. The fauna collected from the immediate vicinity included *Syncerus caffer, Hippopotamus* and *Crocodilus niloticus*; all the bone showed a heavy degree of mineralization similar to the human cranium suggesting that the fossils were part of the same unit.

Unfortunately, there is no basis for locating the cranium in a stratigraphic context. There is a strong indication that the deposits which underlie the Holocene sequence of Galana Boi beds are the source of the fossils reported here but no studies have yet been undertaken which can be used to suggest an age for the fossil bearing strata.

Description and Comparative Analyses of the ES-11693 Cranium

The cranium is in quite good condition and is heavily mineralized (Figure 2). The cranial vault is lacking the supraorbital region as well as the major part of the right temporal

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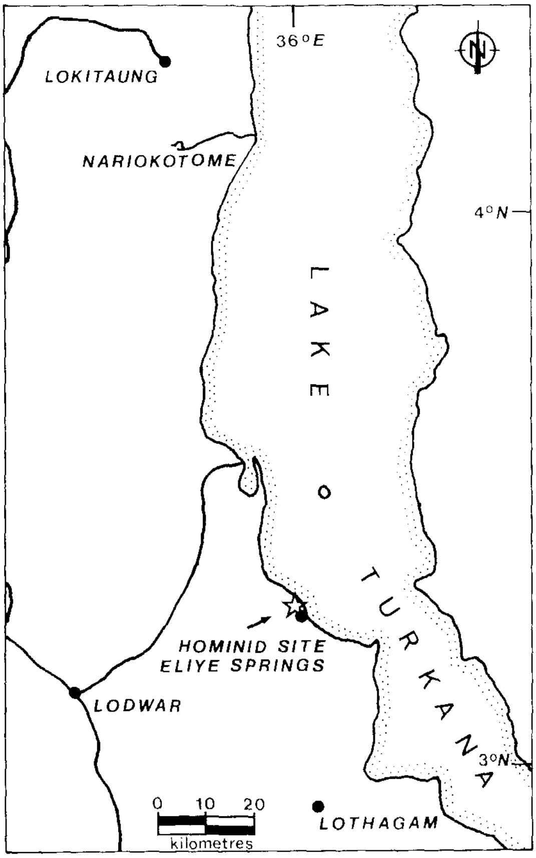
Figure 1. Map of the Turkana area and the hominid site, Northern Kenya.

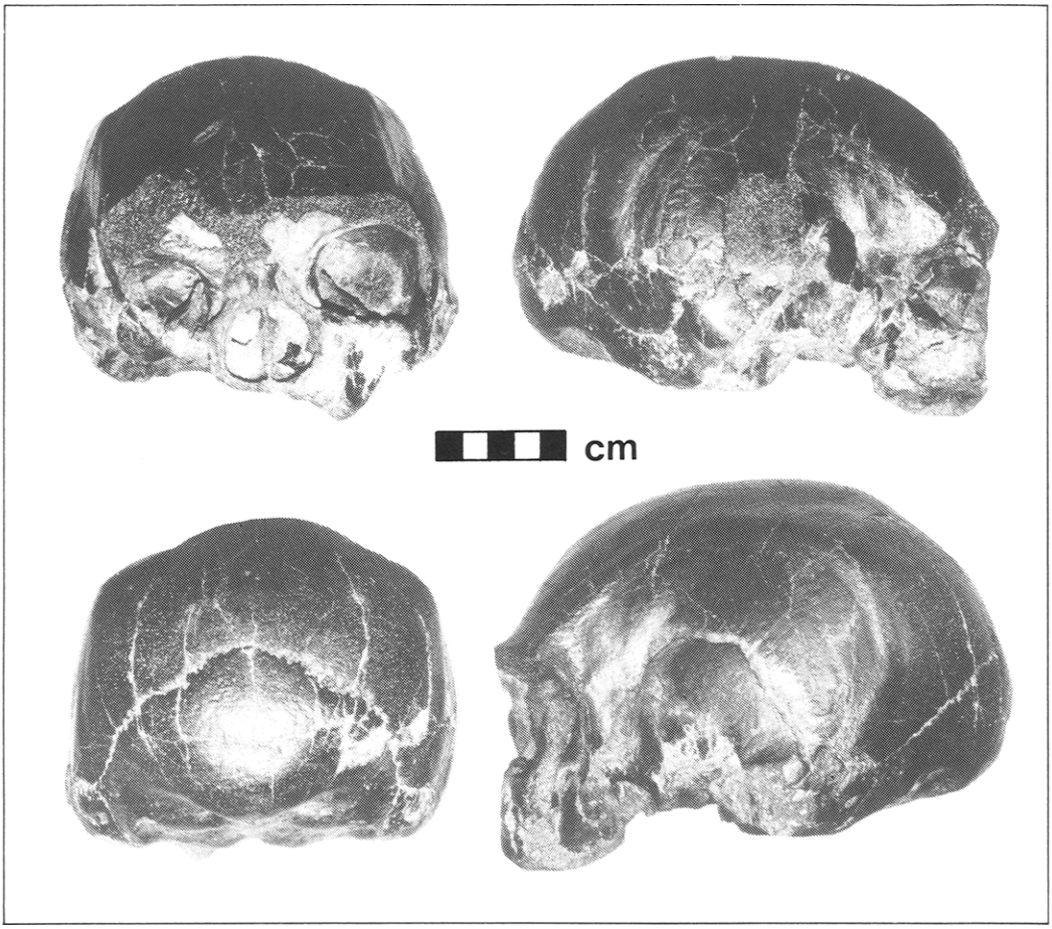


squama. Most of the right half of the face is also missing, while its left side is heavily damaged. The cranial vault is covered by a large number of small fractures which are due to a post-mortem plastic inward distortion of the right side. This distortion causes the face to be slightly twisted, as can be seen in the interorbital region and at the nasal bones. As there are no apparent deformations visible on the left half of the vault, the cranium allows a quite reliable assessment of shape characteristics as well as measurements.

Overall Cranial Vault

While some of the major vault dimensions can be exactly determined, others may only be approximated (see Table 1). Although the glabellar area is missing, the mid-sagittal curvature of the preserved part of the frontal together with the completely preserved upper part of the nasal bones allows a reasonable estimation of the possible extent of glabellar prominence (Figure 3). For this purpose, a number of comparisons with the curvature of some modern and non-modern specimens (Hopefield, Laetoli H. 18, Florisbad, Jebel Irhoud 1, Afalou-bou-Rhummel, Dar-es-Soltan C1, and others) were carried out. These indicated that the glabella-opisthocranion length might have been between 201 and 204 mm. This range also encompasses the possibility of a very prominent glabellar region.

Figure 2. Standard views of the ES-11693 cranium. Upper: frontal and right lateral; lower: occipital and left lateral.



In spite of the post-mortem plastic deformation of the vault, the maximum cranial breadth, situated very low on the supramastoid crests, can be determined by mirror-imaging the relevant coronal section (Figure 4). In the non-deformed condition, the breadth might have been about 162 mm, by which ES-11693 is broader than any other African representative of archaic and early anatomically modern *Homo sapiens*. Among these hominids, Singa is the second broadest (155 mm), although its greatest breadth is found high on the parietals. It thus exhibits a completely different architecture of the cranial vault. The maximum breadth is also situated on the supramastoid crests with Ndutu, Broken Hill 1, and Omo 2.

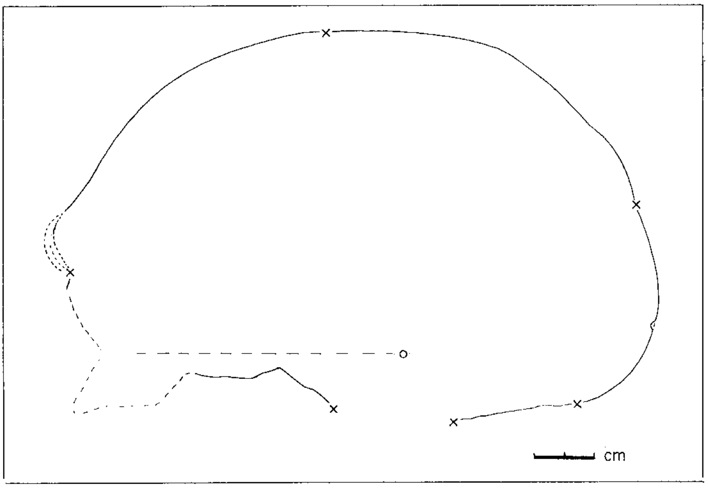
In relation to its length, the vault is very low. This can be clearly seen in the sagittal profile [Figure 5(a), (b)]. Taking both the maximum and minimum estimations of length into consideration, the index basion-bregma height/glabella-opisthocranion length lies between 61 and 62 and is thus less than the value for Broken Hill (63·1). As the

Table 1 **Cranial measurements of ES-11693**

Measurement	Martin No.	Howells' Abbreviation	mm
Nasio-occipital length	(1d)	(NOL)	195·0
Maximum cranial breadth	(—)	(—)	(162·0)*
Minimum frontal breadth	(9)	(—)	107·0
Maximum frontal breadth	(10)	(XFB)	118·0
Bistephanic breadth	(10b)	(STB)	105·0
Biasterionic breadth	(12)	(ASB)	(119·5)
Basion-bregma height	(17)	(BBH)	(124·5)
Porion-bregma height	(20)	(—)	109·5
Basion-nasion length	(5)	(BNL)	96·5
Bregma-lambda arc	(27)	(PA)	128·0
Lambda-opisthion arc	(28)	(OA)	120·0
Nasion-bregma chord	(29)	(FRC)	116·5
Bregma-lambda chord	(30)	(PAC)	116·5
Lambda-opisthion chord	(31)	(OCC)	93·0
Nasion-bregma subtense	(—)	(FRS)	25·2
Bregma-lambda subtense	(—)	(PAS)	23·0
Lambda-opisthion subtense	(—)	(OCS)	34·5
Nasion-subtense fraction	(—)	(FRF)	57·0
Bregma-subtense fraction	(—)	(PAF)	58·0
Lambda-subtense fraction	(—)	(OCF)	39·0
Bregma-asterion chord	(—)	(BAC)	139·0
Biorbital breadth	(—)	(EKB)	(120·0)
Interorbital breadth	(49a)	(DKB)	(32·0)
Simotic chord	(57)	(WNB)	10·0
Simotic subtense	(—)	(SIS)	3·0

* Measured at the supramastoid crests.

Figure 3. Mid-sagittal curvature of ES-11693 and different possibilities to reconstruct glabella prominence as explained in the text.



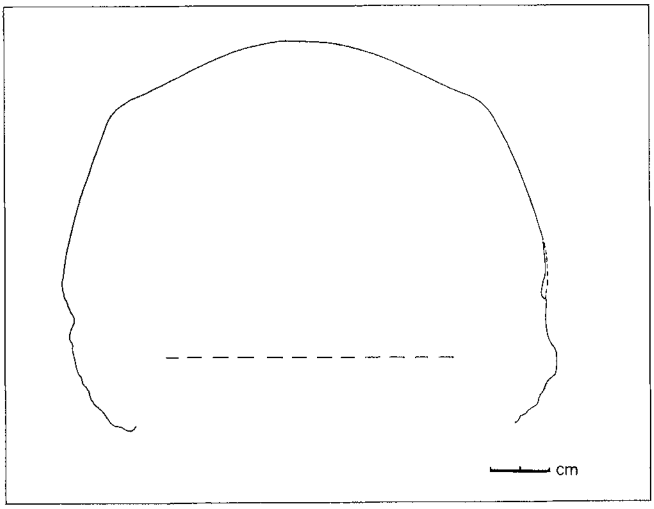


Figure 4. Coronal section of ES-11693 at the level of maximum cranial breadth.

basion-bregma height can only be measured on a very few other fossil skulls, the auriculo-bregma height was also related to the glabella-opisthocranion length. According to this, ES-11693 appears somewhat higher (*ca* 54) than Broken Hill 1 and exhibits strong similarities to Omo 2 and LH 18, which have values around 55.

With regard to its breadth, the vault is extremely low (basion-bregma height/maximum cranial breadth: 76·9), being considerably lower than Broken Hill 1 and Salé. This also holds for the index auriculo-bregma height/maximum cranial breadth. Here, ES-11693 has a value of 67·6, whereas Broken Hill 1 and Salé possess values around 70, and those of LH 18, Omo 1 and Omo 2 are greater than 75. Thus, ES-11693's breadth/height proportion also lies below the range (71–93) found among a large sample (n = 65) of late Upper Pleistocene and Holocene material from all parts of Africa (Bräuer, unpubl.), while Omo 1 and 2 as well as LH 18 lie near the average of this sample. With its long, very broad and low cranial vault, ES-11693 exhibits clearly archaic proportions (see Figure 5).

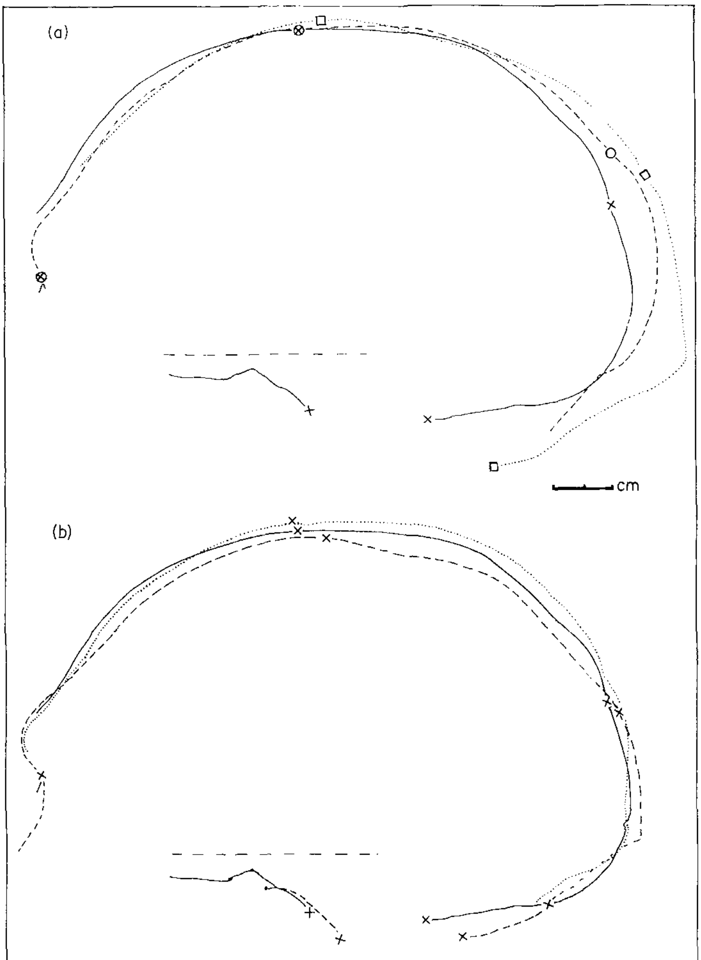
The low height of the skull can also be seen in the angles of the nasion-bregma-basion triangle. The nasion angle (NBA) measures 70·8° which lies outside the range (71°–84°) of the anatomically modern sample (n=32) from Africa mentioned above, although it does approach its lower limits. Broken Hill 1 and Petralona also have small angles similar to that of ES-11693. With regard to the basion angle (BAA), ES-11693 lies near the limits of the range of the studied modern sample from Africa.

Archaic affinities are probably also indicated in the wall thickness of the vault. The thickness, however, has been approximately determined at only one small, cleaned area of the parietal—above the parietosquamous suture—as the interior is still almost completely filled with matrix. Measurements yielded a value around 10 mm, which suggests a quite thick cranial wall.

Cranial Capacity

Before the interior of the endocranium is cleaned, it will only be possible to make some rough estimates of the cranial capacity on the basis of exocranial measurements. Olivier & Tissier (1975) have given regression formulae and correlation axes with regard to two

Figure 5. Mid-sagittal curvatures of ES-11693(——) compared with other hominids: (a) Laetoli Hominid 18(– – –), Omo 2(······); (b) Broken Hill 1(– – –), and Hopefield(······). Orientation along the Frankfurt plane as far as possible.



groups of hominids. These are first, a *Homo erectus* sample, which also includes a number of specimens classified as early archaic *Homo sapiens* by other authors, and second, a sample of Neandertals, which also encompasses pre-Neandertals, Steinheim, Swanscombe and Skhūl. Although ES-11693 is surely not a typical representative of either of these fossil groups, it is nevertheless possible to gain an idea of its cranial capacity by using the correlations determined for the two groups. If, as Olivier & Tissier suggested, one uses the correlation axes for estimating the capacity and takes the product of the three variables glabella-opisthocranion length, maximum cranial breadth, and basion-bregma height, then a range between 1300 and 1325 cm^3 is obtained using the *Homo erectus* sample, and one between 1550 to 1600 cm^3 on the basis of the Neandertal sample. Making use of the correlation between the cranial capacity and the product of the glabella-lambda chord, the maximum cranial breadth, and the maximum height of the vault above the glabella-lambda chord, estimates of 1400–1450 cm^3 (*Homo erectus*) and 1575–1600 cm^3 (Neandertals) result for ES-11693. According to these and further calculations using other combinations of variables, the most likely capacity appears to lie between 1300 and 1450cm^3. This large capacity thus clearly supports an assignment of the Turkana hominid to the species *Homo sapiens*.

Frontal Bone

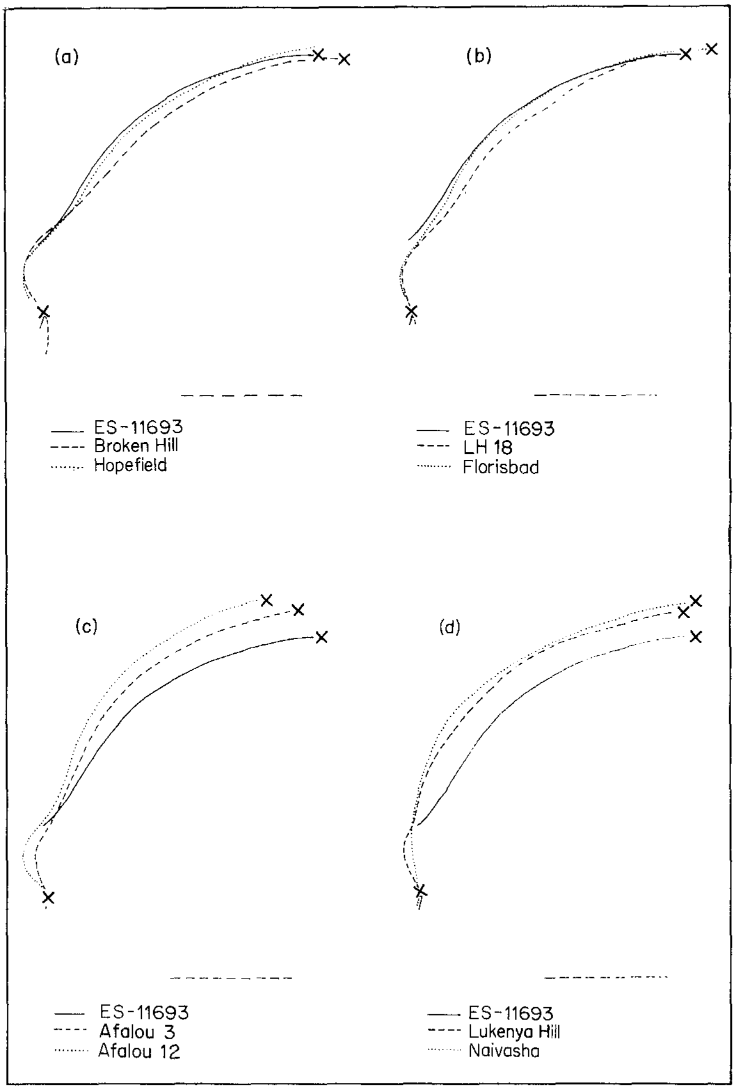
Because almost the entire supraorbital region is missing, it is not possible to make a reliable reconstruction of this important area. Nevertheless, there are some clues which give at least a rough idea of this region. On the left side, the fracture may partially run through the supraorbital region. Above, there is a shallow, but clearly visible sulcus. The considerable thickness of the bone at the anterior fracture, both in the mid-orbital area as well as laterally, virtually excludes a modern configuration of the supraorbital region. Florisbad and LH 18 exhibit similar thicknesses in the supraorbital region, while Broken Hill's torus is considerably thicker.

The most anterior part of the frontal above the mid-orbit and also somewhat laterally from this shows a clear tendency to curve upwards and outwards in the lateral as well as in the frontal views (Figure 2). Considering the small degree of postorbital constriction, the shape of the sulcus, and the dimensions of the whole region, the supraorbital morphology could have been quite similar to that of LH 18's; it might even have been somewhat more prominent. The external tables of both Omo 2 and Florisbad are less concave above the mid-orbit than is that of ES-11693. Thus, the supraorbital region might have had the form of either a continuously running torus, or have been at least torus-like (cf. Bräuer, 1984*a*). There are considerable differences from the robust-modern conditions as they exist, for example, in Lukenya Hill.

With regard to its mid-sagittal profile, the frontal of ES-11693 is well rounded. When compared to the representatives of African archaic *Homo sapiens*, it exhibits the strongest similarities to Hopefield and Florisbad [Figure 6(a), (b)]. The profiles of Broken Hill 1 and LH 18 are flatter. In terms of its supraglabellar area the strongest affinities are to Hopefield. The relatively strong sagittal curvature of the frontal of ES-11693 can also be seen in the rather low value of its frontal angle (FRA = 133·2°). Similar and even greater values can be found with numerous Afalou specimens as well as with Holocene skulls from various parts of Africa. However, if one orientates the crania according to the Frankfurt plane, then the frontal squama shows a steeper rise in the Afalou specimens [Figure 6(c)]. The differences from the late Upper Pleistocene specimens from Lukenya Hill and Naivasha Railway Rockshelter in Kenya are evident as well [Figure 6(d)]. Concerning the frontal angle, there are also affinities to the early anatomically modern skull Omo 1 (*ca* 135°), while Florisbad's frontal is somewhat less curved (137·9°), and LH 18's frontal even flatter (142·4°).

ES-11693's frontal shape was also compared with that of other specimens by means of a principal components analysis. Besides a sample of 14 anatomically modern specimens from the final Upper Pleistocene, LH 18, Broken Hill 1, and Petralona were also included. Figure 7 shows the distribution of the individual factor scores concerning the first two principal components. PC I, which is determined mainly by the variables of curvature (the two frontal angles, the nasion-subtense fraction, and the nasion-bregma subtense have

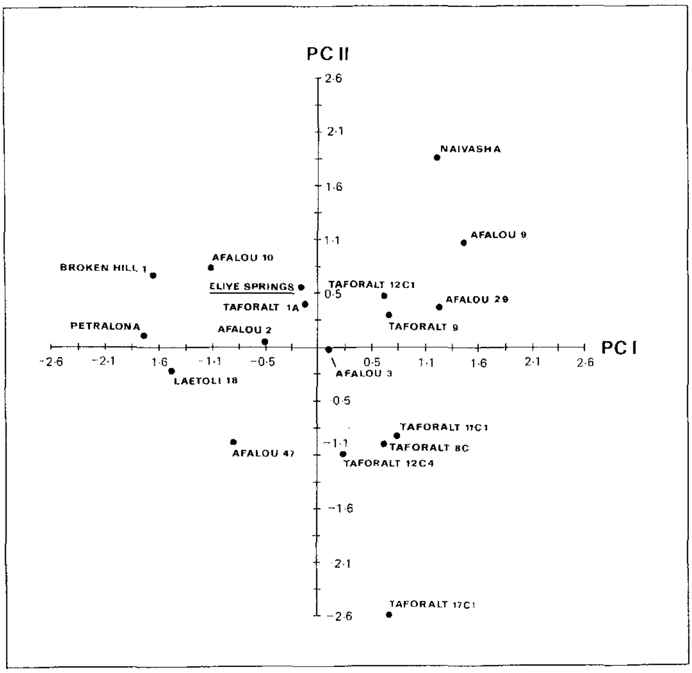
Figure 6. Mid-sagittal profile of the frontal: ES-11693 compared with archaic and anatomically modern *Homo sapiens*. Orientation along the Frankfurt plane as far as possible.



loadings >0·8), makes a clear distinction between the archaic and modern specimens. PC II is largely an expression of the length of the frontal (frontal chord), and it makes little contribution to the distinction. The curvature of the frontal appears to be quite different from that of Broken Hill and Petralona, as well as that of LH 18, and falls within the range of the modern specimens from Taforalt and Afalou. There are greater similarities to these robust moderns than to the Naivasha specimen from Kenya.

The frontal of ES-11693 is especially characterized by two additional features: the medial keeling and the massively developed temporal crests (Figures 8 and 2). Above the

Figure 7. Principal components analysis based upon 8 frontal variables [maximum frontal breadth, nasion-bregma chord, nasion-bregma subtense, nasion-subtense fraction, minimum frontal breadth, frontal angle (Rightmire, 1970), frontal angle (Howells, 1973)]. PCI represents 46·9% and PCII 21·3% of the total variance.



supraglabellar flattening, the bone heaps up around the medial plane. This ridge becomes less pronounced towards the coronal suture. The frontal keeling is not as restricted to the medial plane as is the case with Broken Hill, but is somewhat more extended transversely. Salé has an even broader medial heaping up of the frontal. In this characteristic ES-11693 is more similar to LH 18, although the slight keeling does not appear to be as prominent there, since the frontal is less strongly curved transversely. Omo 2, as well, has a slight keeling in the extant upper part of the frontal.

Also significant are the marked and broadly developed temporal crests on both sides. The crest-like thickenings run relatively straight to the coronal suture and then go on to the parietals. Omo 2 possesses similar strongly developed temporal crests, but only on the frontal (Figure 9). There are also clear but less prominent temporal crests in LH 18.

The anterior part of the temporal line on the left zygomatic process is only slightly damaged, so that the post-orbital curve can still be quite reliably determined. Hence, the post-orbital constriction might have been rather slight, similar to the conditions in Omo 2.

The minimum frontal breadth of ES-11693 is situated relatively far back on the temporal crests, between the zygomatic process and the coronal suture. Its value (107 mm) is nearly identical with that of Omo 2, but such a value can also be found among late Upper Pleistocene moderns from North and East Africa.

Some information can also be given with regard to the frontal sinuses. The left sinus has been preserved as an endocast, while the cavity is visible on the right. There are no direct

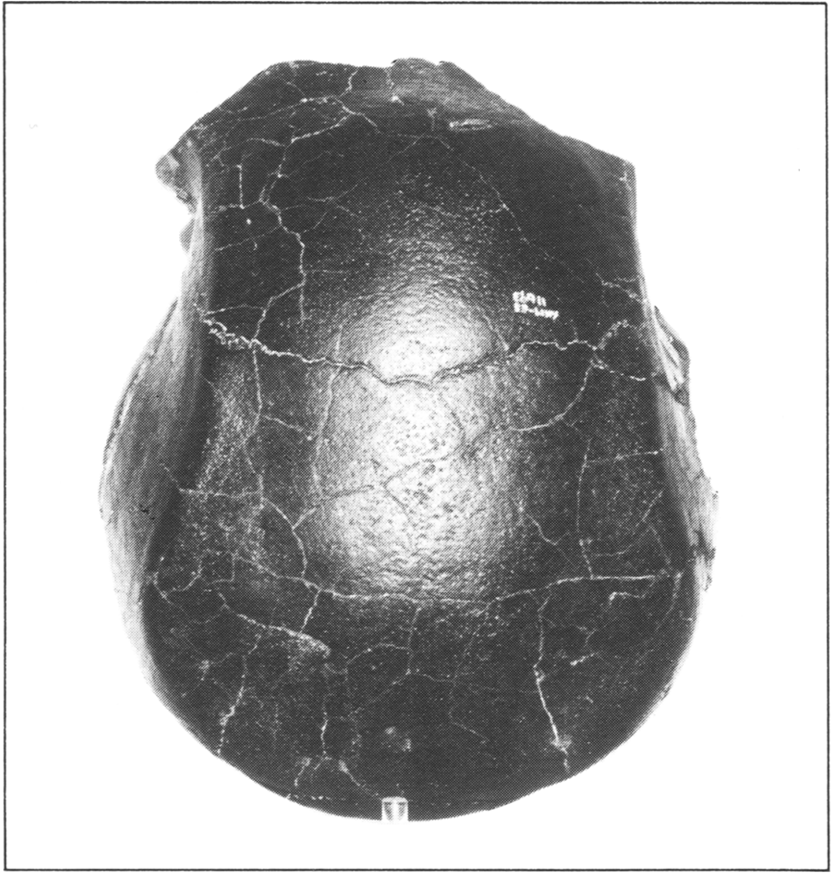


Figure 8. Vertical view of ES-11693, showing the medial heaping up of the vault and the prominent temporal crests.

connections between the right and the left sinuses. Laterally, the sinuses, each of which has several chambers, extend over about a third of the orbital roof. Vertically, they probably did not protrude into the frontal squama. The morphology of the frontal sinuses is rather variable within African archaic *Homo sapiens*, as Tillier (1977) has shown.

Finally, a small frontal groove 3 cm long should be mentioned (Figure 2). It runs directly above and nearly parallel to the left temporal crest and might have been formed by the supraorbital nerve as the bone grew.

Parietal Bones

The medial heaping up of the vault also continues on to the parietals. It possesses a considerable breadth at the coronal suture, nearly reaching the temporal crests. The heaping decreases in breadth posteriorly and disappears just before the obelion depression. In vertical view, the heaping exhibits an almost semi-elliptical shape (Figure 8). Salé exhibits a similarly broad heaping but on the frontal, not on the parietals. Here, the heaping reaches only a little beyond the coronal suture. The parietals of Omo 2 exhibit a slight keeling and parasagittal flattening.

The shape of the vault of ES-11693 in occipital view is also significant. Figure 4 shows a

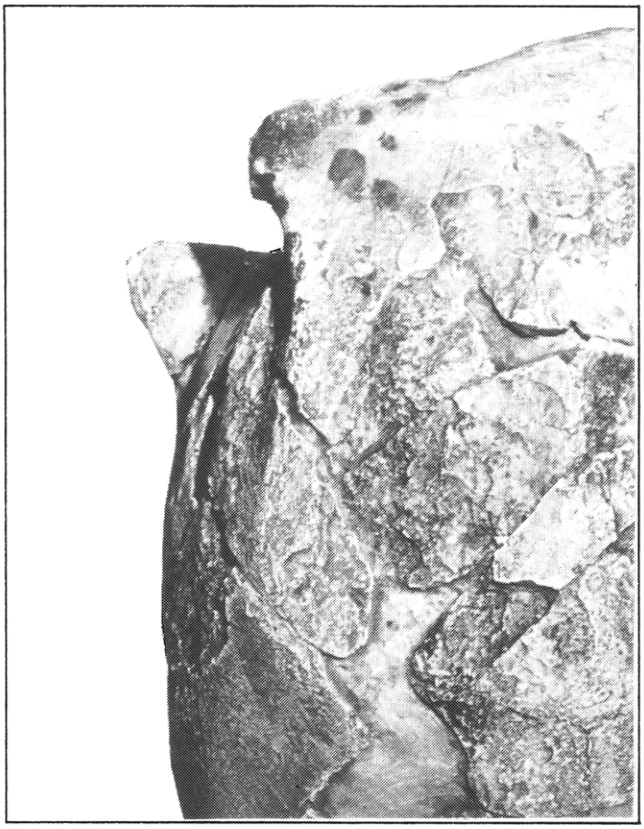


Figure 9. Left frontal section of the vertical view of Omo 2, showing the well developed temporal crest.

cross-section at the level of the supramastoid crests, whereby the skull has been approximately orientated in the Frankfurt plane. Proceeding from the shape of the non-deformed side, the profile line first runs vertically in the lower half above the supramastoid crests. Then, in the upper half, both sides strongly converge to the temporal crests, where they become markedly angulated to the medial plane. The broad central heaping up of the vault can also be clearly seen here. This cranial shape is obviously distinguishable from that of anatomically modern man and shows affinities to such archaic hominids as Salé and even to the *Homo erectus* condition, although in contrast to the latter, ES-11693's parietal bones have more pronounced bosses and are orientated more vertically in their lower parts. Altogether, the shape in the occipital view exhibits the strongest similarities to the heterogeneous spectrum of archaic *Homo sapiens*.

In the mid-sagittal plane, however, the parietals appear to be obviously more modern. The parietal arc, with a value of 128 mm, is relatively long and similar to those of LH 18 and Omo 1. While such lengths can be found frequently in modern skulls (e.g., Naivasha, Afalou 12, Taforalt 17, Elmenteita J), Hopefield possesses the longest parietal arc (120 mm) among the representatives of early archaic *Homo sapiens* from Africa.

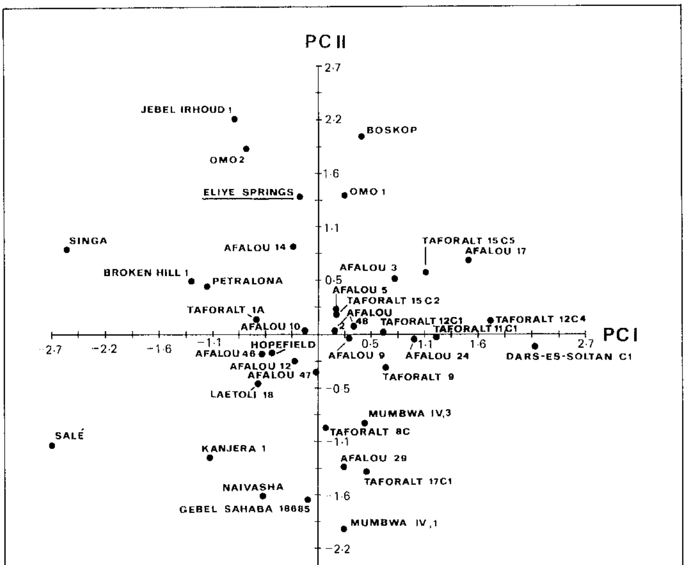
The parietals are not only long, but also relatively strongly curved in the medial plane (see Figure 5). Thus, the values for the parietal index (91·0) and the parietal angle (PAA = 136·9°) clearly fall within the modern range, again showing special similarities to Omo 1.

The profiles of LH 18, Broken Hill 1, Omo 2, and Salé are considerably flatter (see Figure 5) with values between 142° and 148° and indices between *ca* 93·5 and 95·0. Among the representatives of African archaic *Homo sapiens*, it is again only Hopefield which possesses a sagittal profile (PAA = 135·4°) curved similarly to that of ES-11693 (cf. Bräuer, 1984*a*).

On the basis of six parietal variables, a principal components analysis was carried out which included ES-11693 and other representatives of archaic and early anatomically modern *Homo sapiens* as well as numerous modern specimens from the major regions of Africa dating from the late Upper Pleistocene. The distribution of the factor scores of the first two principal components is shown in Figure 10. In PC I, where the variables describing the curvature are highly loaded, ES-11693 takes up a marginal position with regard to the late Upper Pleistocene modern spectrum. Of the representatives of archaic *Homo sapiens*, Hopefield is closest to ES-11693, followed by LH 18 and Omo 2. With regard to PC II, which is principally determined by the maximum cranial breadth, the specimen exhibits even greater differenes from the modern group.

The prominent temporal crests continue on to the parietals. Behind the coronal suture, they diverge towards the well developed parietal bosses and then become less prominent. The posterior parts exhibit marked impressions of the inferior and superior temporal lines. The latter do not reach the lambdoid suture, but rather run to the mastoid region. While Omo 2 has no prominent crests on the parietals, LH 18 does. These, however, are not expressed as strongly as in ES-11693. Nevertheless, there is no prominent angular torus like that found on Broken Hill 1.

Figure 10. Principal components analysis based upon 6 parietal variables [maximum cranial breadth, parietal arc, parietal chord, parietal subtense, bregma-subtense fraction, parietal angle (Howells, 1973)]. PC I represents 59·6% and PC II 17·2% of the total variance.



The ratio for bregma-asterion chord/biasterionic breadth in ES-11693 is 1·16. Similar relatively low values can also be found for Petralona, Omo 2, Hopefield, and some of the European Neandertals, as well as with various of the Upper Paleolithic moderns from Europe (Stringer, 1978). Stringer (1984) gives a value < 1·14 for *Homo erectus*. However, the values of certain archaic *Homo sapiens* specimens also fall into this category (e.g., LH 18: 1·11).

Finally, the presence of two parietal foramina should be mentioned. They probably lay on the right and left of the sagittal suture which, however, has been completely obliterated. The foramina are surrounded by a shallow obelion depression.

Occipital Bone

The occipital is nearly completely preserved. There is only some slight damage near the left condyle and on both lateral parts. Besides a number of vertically running post-mortem fractures, there is a transverse fracture across almost all of the occipital plane, whereby the upper edge of the fracture juts slightly beyond the lower in the central part (see Figure 3). This dislocation amounts to about 1 mm, and it can be disregarded with respect to the occipital measurements.

The mid-sagittal profile (Figure 3) illustrates the low and very strong curvature of the occipital, especially of the occipital plane. This strong curvature leads to very low values of the chord/arc index (77·5) and the occipital angle (OCA = 105·9°). Both figures lie below,

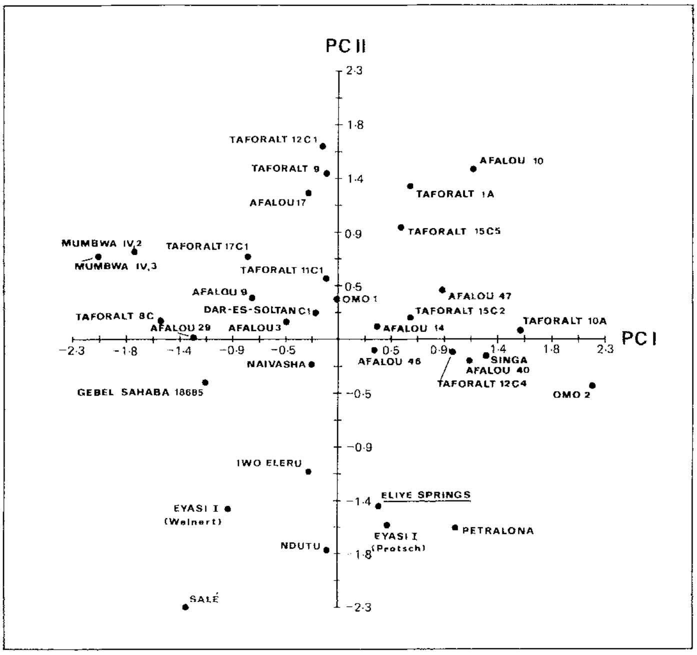


Figure 11. Principal components analysis based upon six occipital variables [occipital arc, occipital chord, occipital subtense, lambda-subtense fraction, occipital angle (Rightmire, 1970), occipital angle (Howells, 1973)]. PC I represents 46·7% and PC II 35·4% of the total variance.

Figure 12. Basal view of the posterior part of the ES-11693 cranium showing the strongly marked nuchal plane.

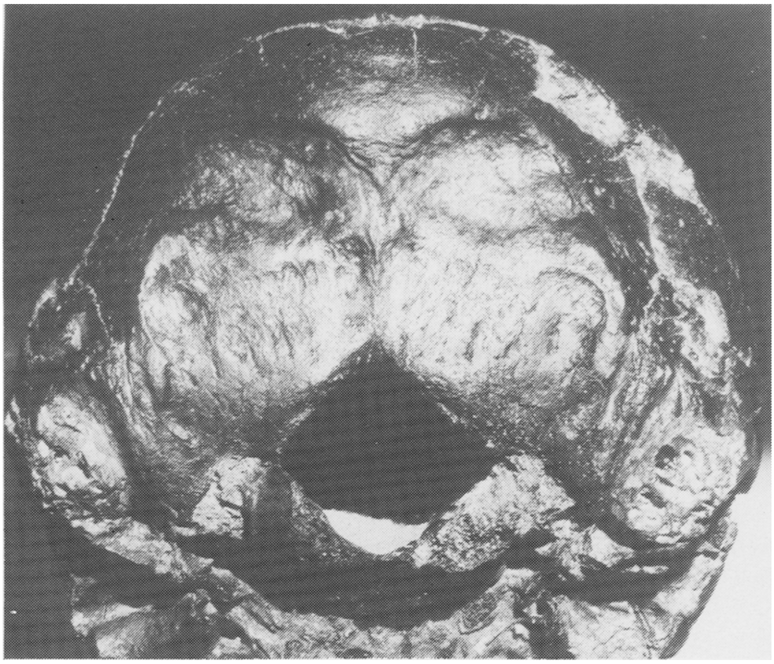
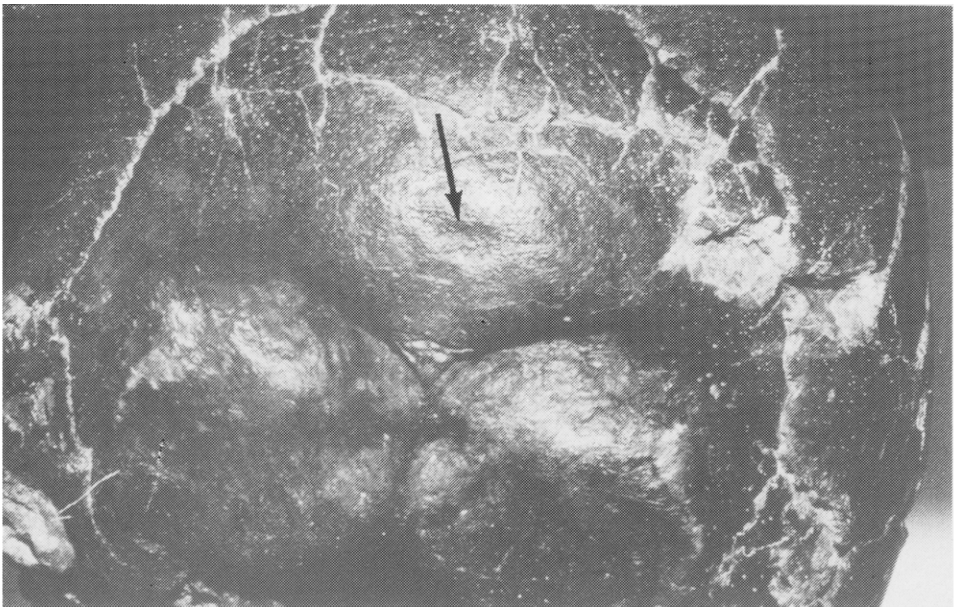


Figure 13. Occipital plane of ES-11693 with suprainiac fossa indicated with an arrow.



although near, the limits of the range of the studied late Upper Pleistocene and Holocene sample from Africa (cf. also Fig. 13 in Bräuer, 1984*a*). Angles close to that of ES-11693 are possessed by Omo 2 (105·1°), Eyasi 1 (106°), Ndutu (107·2°), and Salé (107·6°).

Among the non-African fossil hominids, similarly low index values are found predominantly among archaic *sapiens* specimens (e.g., Gibraltar 1, La Chapelle, Tabun I) and, occasionally, also among anatomically moderns (Předmost IX, Solutré V) (Tobias, 1959). The average value of six Ngandong crania is about 72·0, that of 19 European Upper Paleolithic specimens 80·7 (Tobias, 1959).

The close relationship between ES-11693 and Eyasi 1 in the occipital curvature is also clearly expressed in the principal components analysis based on six variables of the occipital profile (Figure 11). Here, it is the second principal component which represents 35·4% of the total variance and separates the archaic from the modern shapes. This component is primarily determined by the occipital chord and angle.

There are also archaic affinities with regard to the index lambda-opisthion chord/ biasterionic breadth. The value of 77·8 is relatively low and is similar to that of Ndutu (77·0), and to that of such other archaic hominids as Swanscombe (76·4) or La Chaise "Suard" (75·7) (Hublin, 1984). Broken Hill, with a value of about 68 (Weidenreich, 1943) exhibits an even more *erectus*-like proportion: this also holds for Salé (66·4). In contrast, modern humans generally possess relatively long occipital chords, and the indices of Omo 1 and 2 also lie above 85·0.

While the occipital of ES-11693 clearly differs from the modern condition in its overall shape and major proportions, this is not true for a number of other occipital features. The occipital plane is considerably longer than the nuchal plane. The lambda-inion chord measures 67·0, the inion-opisthion chord 40·5, and the corresponding arcs 79·0 and 41·0, respectively. The inion was determined according to the definition given in Martin & Saller (1957). It lies on the middle of the linear tubercle, where the superior nuchal lines unite. In ES-11693, this tubercle is quite large and has a triangular shape. The occipital planes of Omo 1 and Ndutu are also considerably longer than the nuchal planes.

Hublin (1982) gave some figures for the variation of the lambda-inion-opisthion angle in various hominid groups. The value for ES-11693 of 116° is quite similar to that of La Chaise "Suard" and lies clearly above those of *Sinanthropus* and the Ngandong crania, whose largest angle is 106°. Thus, ES-11693 is situated closer to the lower range of modern variation, for which mean values between 117° and 128° were given.

The morphology of the nuchal plane is especially significant (Figure 12). The superior nuchal lines form strong arches and unite in the well defined, but not projecting, linear tubercle, which merges into the prominent external occipital crest. The superior nuchal lines form the posterior limits of the extremely heavily excavated insertion planes for the semispinalis capitis muscle. Such deep concavities are seldom found with modern humans.

The superior oblique muscles also have strong impressions and form lateral crests. Moreover, the insertions of the rectus capitis posterior major and minor muscles are well marked and limited by the well defined inferior nuchal lines. The insertion lines of the splenius capitis and sternocleidomastoid muscles are also visible.

There is no transverse torus above the superior nuchal lines. About 2 cm above or behind the inion is the centre of a slight depression, which probably corresponds to a suprainiac fossa (Figure 13). The fossa, which is distinctly rough, has a nearly transverse oval shape and is about 10 mm broad and 4 mm high.

Above the fossa, the bone is very slightly thickened and it appears as if the supreme nuchal lines—the insertion lines for the trapezius—run across it, first approaching the superior nuchal lines more laterally. Here they are more clearly visible. However, it cannot be completely determined whether the supreme nuchal lines divided and ran above and below the fossa. An external occipital protuberance does not exist.

Due to the special morphology of the nuchal plane of ES-11693, comparisons with other specimens are difficult. In spite of some differences—especially in the lower degree of angulation of the occipital and nuchal plane in LH 18—there are nevertheless certain similarities. The probably different sexes of the two crania must also be considered. Both have strong concavities below the superior nuchal lines, while the above lying areas project posteriorly and then continue into a more or less strong curvature of the occipital plane.

Temporal Bone

Most of the squamous part of the left temporal of ES-11693 has been preserved. Its height above porion, which can only be roughly located, is about 53 mm and thus considerably greater than those of Omo 2 (*ca* 36 mm) and LH 18 (*ca* 37 mm). With regard to both its height and overall shape, the squamous part looks quite modern (Figure 2). Thus, the superior limb of the parieto-temporal suture is convex and the posterior limb continues the curvature to the parietal notch. The upper part of the parietotemporal suture of Omo 2 is convex as well, while the suture of LH 18 descends more obliquely.

The mastoid processes are laterally and caudally damaged; nevertheless, they do not appear to have been very long. The breadths of the processes at their bases, however, appear quite large when compared with LH 18, Omo 2, Ndutu, and Broken Hill 1. Medially, the processes are bordered by rather long and relatively shallow digastric grooves (Figure 14). The medial walls of these grooves form the major part of prominent occipitomastoid crests. The crests of Omo 2 and LH 18 are much more projecting, and they are also extended even farther back (see also Magori & Day, 1983).

The right glenoid fossa (Figure 14) is damaged laterally and at the articular tubercle. In contrast, the glenoid fossa is better preserved on the left side and has only a lateral defect due to the complete absence of the zygomatic process. The fossa is deep and anteroposteriorly quite broad: the main axis is orientated obliquely forward. As a whole, the fossa exhibits strong similarities to that of LH 18 in contrast to Broken Hill 1, Omo 2, and Salé where the main axis runs more transversely.

The articular tubercle is quite prominently developed, as is the case with a number of representatives of African archaic *Homo sapiens* (e.g., Salé, Ndutu, LH 18, Omo 2). In Broken Hill 1, however, it is only weakly developed.

The entoglenoid processes are well developed on both sides and are traversed by the sphenotemporal suture. The sphenoid spine is short and does not contribute to the medial wall of the glenoid cavity and in this it appears to be similar to Omo 2, whereas LH 18 as well as Broken Hill 1 exhibit prominently developed sphenoid spines.

The post-glenoid tubercle is broken off in its basal and lateral parts. Nevertheless, the preserved part of the tubercle allows the conclusion that it might have been of medium size. Compared with it, the tubercle in Omo 2 projects much more.

Due to lateral damage, the tympanic parts as well as the zygomatic roots can only be examined with qualification. It can, however, be seen that the tympanic plate was quite

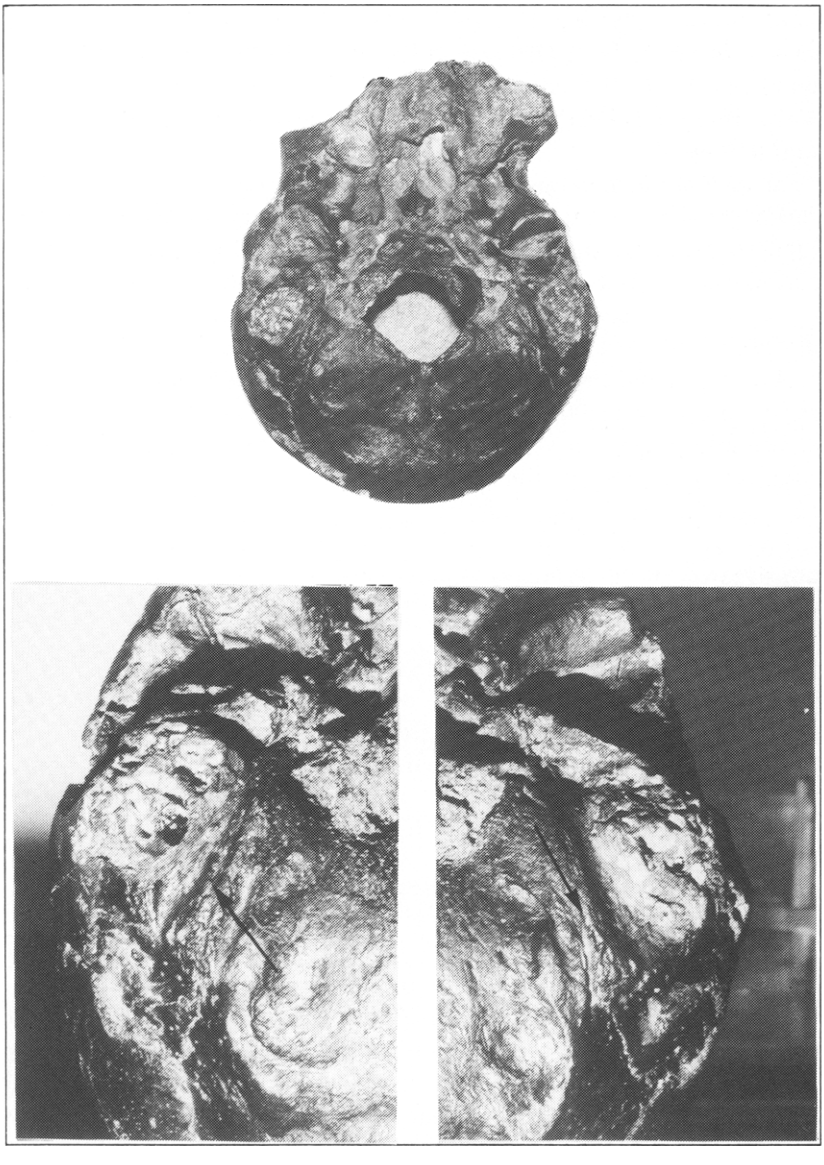


Figure 14. Upper: basal view of ES-11693; lower: right and left lateral sections of the basal view showing the digastric grooves and occipito-mastoid crests. The latter are indicated with arrows.

massively developed inferiorly and anteriorly, similar to that of LH 18. The tympanic plate of Omo 2 is even more massive and broader inferiorly.

The long axis of the lateral part of the auditory meatus is inclined obliquely forward and is only slightly angulated with relation to the petrous part. The strong angulation of both parts, typical for *Homo erectus*, is missing here, as it also is with other representatives of archaic *Homo sapiens* (e.g. Broken Hill 1). Omo 2's tympanic part is also inclined slightly forward, while the petrous part is completely missing. The shape of the auditory meatus cannot be determined with certainty for ES-11693. The edge of the fracture appears elliptical with the major axis orientated nearly vertically.

The stylomastoid foramina are preserved on both sides. As the auditory meatus has been damaged laterally, the distance between the foramen and the lower edge of the meatus cannot be precisely determined. It was probably between 15 and 17 mm on the right, thus lying well above the values generally found in modern humans (*ca* 10 mm, according to Vandermeersch, 1981). The distance measures some 15 mm in Broken Hill and *ca* 16–17 mm in Omo 2.

In spite of the damage to the posterior roots of the zygoma, the right side indicates that this part did not greatly overhang the auditory meatus. The zygomatic root of Omo 2, as in modern humans, overhangs the meatus only slightly. In contrast, the overhang is considerable in Salé and Broken Hill 1.

The styloid processes have been broken off on both sides. On the left side, the basal part of the sheath of the styloid process still exists, as does a small part of the styloid process.

As the mastoid processes are especially damaged in the lower part, it is not possible to reach any conclusions as to the development of the mastoid crests. However, the supramastoid crests are preserved and quite prominent, similar to those of Omo 2. The supramastoid crest on the non-deformed left side appears to run towards the inferior temporal line on the parietal.

Finally, it should be mentioned that both sides possess a large mastoid foramen. These are situated on the temporal bones.

Sphenoid Bone

This bone is well preserved and it need only be pointed out here that ES-11693 does not possess prominent infratemporal crests as found, for example, in Broken Hill 1. Instead, the transition between the upper temporal and the lower infratemporal surface is rounded, yet strongly angulated. The infratemporal fossa—where the upper head of the lateral pterygoid muscle inserts—is very broad, being even larger than is the case with Broken Hill 1.

Facial Bones

Although the upper face is very fragmentary, enough is preserved to permit certain statements about shape and size (Figure 2). Of the maxilla, areas around the anterior nasal aperture as well as fragments of the anterior facies and the alveolar process in the area of the premolars and molars have been preserved. The existing part of the alveolar region, however, is so heavily eroded that one can only recognize some tiny fragments of the alveoli. A part of the palatine process has also been preserved. With regard to the other facial bones, the upper parts of both nasal bones, a part of the nasal septum, the lacrimal bones, the greater part of the left zygomatic bone, and a smaller part of the left palatine bone, including the greater palatine foramen, are present.

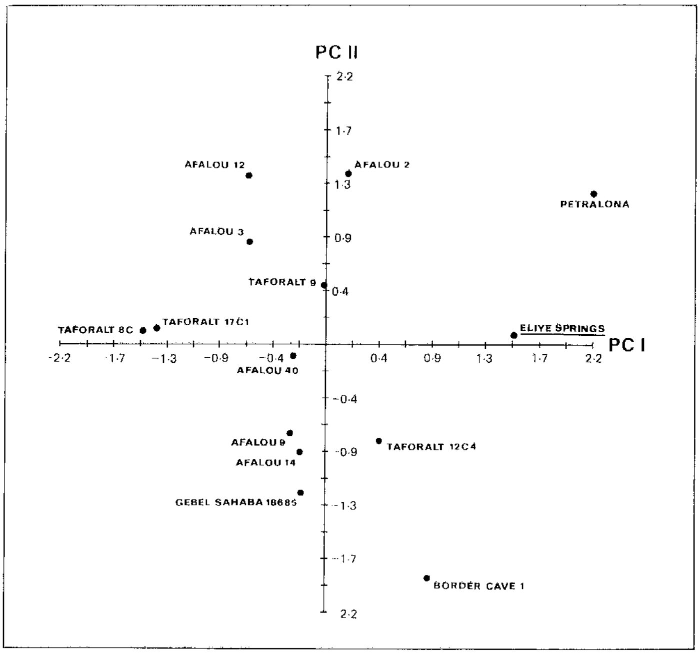
The face shows only a very slight post-mortem plastic deformation, which has had little influence on its overall shape. The face is very broad. The biorbital breadth, which can be determined with relative certainty on one half, probably measured about 120 mm and thus lay above the range established for the later Upper Pleistocene and Holocene sample from Africa. With its very broad face, ES-11693 resembles such hominids as Florisbad, Bodo, and Broken Hill 1. In contrast to these representatives of archaic *Homo sapiens*, however, the face of ES-11693 is obviously substantially shorter. A precise value of the upper facial height cannot be determined. It was probably around 65(±)mm, whereas the values of Bodo and Broken Hill are about 88 and 96 mm, so that its upper face is extremely short and broad.

Not only is the face as a whole very broad, but the bidacryal breadth (*ca* 32 mm) also lies near the upper limits of variation of the modern sample from Africa. The bidacryal/biorbital breadth index has a very large value: 0·27. The dental arcade might have been very broad as well, as can be concluded from the dimensions of its left half.

Some statements are also possible with regard to the nasal region. The nasal bones are relatively small (see Table 1) and form a distinct angle to each other. The lower parts of the nasal bones have been broken off. The nasal aperture is low and nearly round. The nasal height can only be approximately estimated due to the missing anterior edge of the aperture, but it may have a value of around 43 mm. The nasal breadth can also only be estimated, although the left lateral internal facies is still nearly intact. The breadth of the nasal aperture may have been at least 33 mm.

Only a few small fragments of the anterior facies of the maxilla have been preserved. As the maxillary sinus is filled with sediment, most of the fragments of the bone surface still appear to be in their original positions.

Figure 15. Principal components analysis based on three facial variables (biorbital breadth, interorbital breadth, orbit breadth) and one frontal variable (minimum frontal breadth). PC I represents 88·4% and PC II 8·6% of the total variance.



Of the left zygomatic bone, a part of the maxillary process as well as most of the orbital facies have been preserved. The lateral edge of the orbit and a small part of the lateral facies are also intact. The zygomatic bone thus appears to be directed obliquely posteriorly. Due to the spatial orientation of the preserved parts of the maxillary process as well as of the fragments of the anterior facies of the maxilla, it can be concluded that there was only a slight concavity of the maxillary surface, i.e., a very slight canine fossa (Figure 2). Such shallow concavities also exist in differing degrees among African archaic *Homo sapiens* (Bräuer, 1984*a*). A comparison with various hominids shows that the low degree of concavity in ES-11693 is probably more similar to the conditions of Bodo and Broken Hill 1 than to the deeper canine fossae of LH 18.

Due to the fragmentary condition, it is not possible to give any quantitative data with regard to the degree of prognathism of the mid-face or the alveolar part. However, based on the positions of the nasion, the anterior facies of the maxilla, and the alveolar process, a certain degree of prognathism can be assumed.

A principal components analysis was carried out on the basis of three measurements of the breadth of the face and the minimum frontal breadth (Figure 15). The first component alone represents 88·4% of the variance, and all variables have high loadings (> 0·9) on this component. Although only Petralona could be included from among the archaic *Homo sapiens* specimens because of this specific combination of variables, the distribution of the factor scores clearly shows that ES-11693 is dissimilar to the late Upper Pleistocene moderns from Northern Africa. The extraordinary facial breadth of ES-11693 is clearly expressed through the affinities with Petralona.

Classification and Interpretation of the ES-11693 Hominid

As has been shown by the comparative analyses, the new hominid differs from all of the known African fossil hominids in its individual mosaic of features. Thus, in some characters it exhibits affinities to representatives of late archaic *Homo sapiens*, as, for example, Omo 2, LH 18, and Florisbad, while in other features there are similarities to such early archaic *Homo sapiens* specimens as Broken Hill 1, Bodo, Eyasi 1, and Ndutu. Moreover, besides a number of completely modern features, there are also characters which are quite similar to the *Homo erectus* condition.

In order to more precisely classify this hominid, it is necessary to consider which of the characteristics can be regarded as features of *Homo erectus* and which are apomorphic derived features of *Homo sapiens*.

Stringer (1984) presents a list of 27 metrical and non-metrical characters—based on different authors—which are supposed to be characteristic for the species *Homo erectus* (Africa and East Asia). Some of these features cannot be seen as autapomorphies of *Homo erectus*, but rather as primitive retentions from an earlier common ancestor (Andrews, 1984). A comparison of the characters of ES-11693 with those described by Stringer (1984) as *erectus* conditions shows that there are only a few characters which exhibit certain, although rather marginal, affinities:

(1) With a value of 105·9° the occipital angle (OCA) just falls within the limits mentioned for *Homo erectus* (≤ 107°). As has already been mentioned, the angles of some other representatives of archaic *Homo sapiens* (e.g., Omo 2) also fall near this

limit of *Homo erectus*. Moreover, the occipital and nuchal planes of ES-11693 are not angulated, as is the case with *Homo erectus*.

(2) The interorbital breadth is very large. The DKB/FMB value (0·27) again falls near the limits of the range given for *Homo erectus* (> 0·25).
(3) The cranial vault is long and very low. With regard to the ratio basion-bregma height/glabella-opisthocranion length (0·61–0·62), ES-11693 again lies quite close to the upper limits given for *Homo erectus* (< 0·62).
(4) Although the parietal walls clearly converge superiorly, this does not begin directly above the supramastoid crests, but rather only in the upper half.
(5) The sphenoid spine is not prominently developed.

Despite some uncertainties due to the fragmentary condition of ES-11693 (facial proportions, prognathism) and the fact that the matrix still covers some features (e.g., thickness of cranial wall, endinion/inion), it can still be seen that there are only a very few features which exhibit affinities to the range of variation of *Homo erectus*. In addition, almost all of these features lie in those areas where the *Homo erectus* and *Homo sapiens* ranges overlap.

In addition to these marginal relations to the *erectus* condition, ES-11693 exhibits a number of apomorphic characters of *Homo sapiens*:

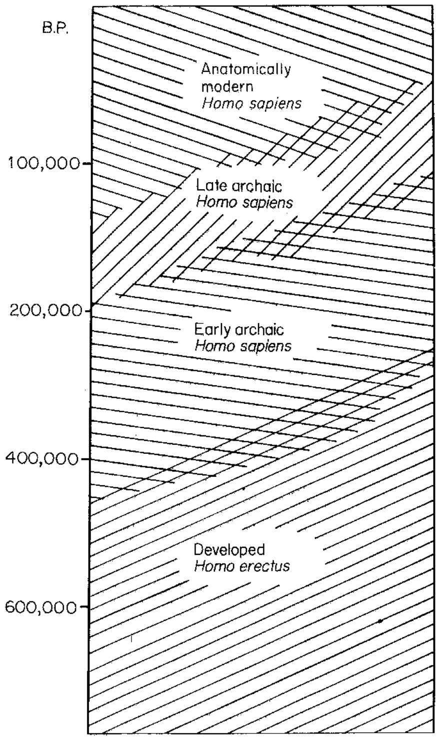
(1) A large cranial capacity (> 1300 cm^3)
(2) Small frontal angle (FRA)
(3) Small parietal angle (PAA)
(4) Temporal squama high and curved
(5) Small angulation between the tympanic and petrous parts
(6) Occipital plane considerably larger than nuchal plane
(7) Inion and opisthocranion do not coincide
(8) No occipital transverse torus

Summarizing this analysis of plesiomorphic and apomorphic characters, it appears justified to classify the new hominid ES-11693 as archaic *Homo sapiens*.

In a total revision of *sapiens* evolution in Africa which was recently carried out (Bräuer 1984*a*, *b*), two grades could be distinguished in the evolution of archaic *Homo sapiens* (Figure 16). On the one hand, there is the "early archaic *Homo sapiens*", which originated out of the "developed *Homo erectus*" and which, in spite of a certain brain enlargement, still exhibited essentially primitive features. Such hominids as Bodo, Hopefield, Broken Hill 1, Eyasi 1, and Ndutu have been included in this early grade, which was primarily defined by morphological criteria. On the other hand, the grade of "late archaic *Homo sapiens*" was also defined. This comprises that phase of *sapiens* evolution which gave rise to the "early anatomically modern *Homo sapiens*". The specimens which can be counted among this more developed and essentially more modern grade include LH 18, Omo 2, Florisbad, and others. These two grades correspond essentially to the *Homo sapiens* grades 1 and 2 of Stringer *et al.* (1979), even though there are differences in the assignment of certain individual fossils to the grades (see Bräuer, 1984*a*).

Such a division of archaic *Homo sapiens* into two grades is, of course, only an artificial distinction, but it is one which reflects our current knowledge and makes the process of morphological development more graphic. This division certainly does not imply that all new specimens can be clearly assigned to one of these two grades.

Figure 16. Scheme of human evolution in Africa during the last 600,000 years indicating first appearances and time ranges of the various grades of *Homo sapiens*.



Dating is also considered by some to be an important factor for the phylogenetic interpretation of a hominid. In the case of ES-11693, however, there is no such information available. Thus, any conclusions must be based solely upon morphology. Nevertheless, it appears reasonable to examine to which of the two grades of archaic *Homo sapiens* ES-11693 seems to possess the most affinities. It must be kept in mind, however, that this discussion does not imply any statements about a probable date.

Firstly, when the cranial vault is taken as a whole, its low height and its extreme and low-lying breadth exhibit stronger affinities to the spectrum of early archaic specimens. Judging from its cranial capacity, however, ES-11693 appears to be nearer to the late archaic specimens.

In spite of some justified assumptions concerning the supraorbital morphology, no clear evidence can be obtained with regard to the question as to whether a continuous torus or only a torus-like structure was present. However, a torus as massive as that of Broken Hill can probably be ruled out. The existing part of the frontal exhibits nearly modern conditions in its profile; sagittally, it is somewhat more curved than with either LH 18 or Florisbad. Remarkably, it is only Hopefield which in contrast to all the other representatives of early archaic *Homo sapiens*, exhibits a profile curved similarly to that of ES-11693. With regard to the prominent temporal crests and the low degree of postorbital constriction, there are strong similarities to the conditions of late archaic specimens, especially to Omo 2.

The form of the heaping up or keeling on the frontal and on the parietals is quite variable in early and late archaic *Homo sapiens* as well. The archaic outline of the parietals in occipital view, including the strongly converging side walls in the upper part, cannot be found in any of the late archaic hominids, at least not to this degree. Yet the mid-sagittal profile of the parietals is as distinctly curved as that of the frontal, as is also the case with modern specimens. Here again, it is only Hopefield among the archaic specimens which exhibits a similarly strong curvature. Archaic affinities do also exist concerning the ratio bregma-asterion chord/biasterionic breadth.

In spite of the stronger curvature, the occipital probably has closer affinities to late archaic shapes, e.g., to LH 18. In its lack of a transverse torus and the positions of inion and opisthocranion, the occipital even approaches modern conditions. Nevertheless, the total morphological pattern cannot yet be regarded as anatomically modern.

The temporal is practically modern in a number of important features. The occipitomastoid crest is less prominent than in Omo 2 and LH 18. The characters of the glenoid fossa exhibit great similarities to LH 18. The features of the auditory meatus also point to stronger relationships to the late archaic grade.

Due to its fragmentary condition, the facial morphology can be compared only with reservations. A face as broad as that of ES-11693 can be found among early as well as late archaic hominids. One characteristic feature of ES-11693, however, is the very short face. In this respect, it appears to clearly differ from all the other known representatives of African archaic *Homo sapiens*. With regard to the degree of pneumatization of its maxillary sinuses, ES-11693 seems to be closer to the early archaic condition.

In summarizing this analysis, it can be concluded that ES-11693 exhibits a new mosaic of archaic and modern features which, when considered as a whole, may be closer to the late archaic grade of *Homo sapiens*. More definite conclusions concerning its phylogenetic position will only be possible when further hominid discoveries have clarified the present quite general view of the evolution of *Homo sapiens* and its morphological changes.

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