THE EVOLUTIONARY POSITION OF THE NGAWI CALVARIA

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ABSTRACT

The skull of Ngawi 1 was discovered, out of stratigraphical context, in August 1987 on the left bank of the Solo river near Selopuro village in Ngawi, East Java, Indonesia. According to S. Sartono (1991), it could have come from the fluviatile deposits of one of the Pitu terraces, 5 km west of Ngawi. These terraces are estimated to have the same age as the Ngandong terraces. The general cranial morphology of Ngawi 1, and characters such as the receding frontal squama, the shape of the supra-orbital torus, the post-orbital constriction, the sagittal keeling, the position of the maximum cranial breadth, and the angular torus on the parietal, allow the integration of Ngawi 1 within the Homo erectus fossil group. Compared to the Trinil and Sangiran fossils, the Ngawi specimen has a more elevated and shorter skull, a more accentuated cranial curvature, and a smaller post-orbital constriction. These characters allow us to associate Ngawi 1 with the Ngandong and Sambungmacan group.

During the IPPA Congress held in Yogyakarta in 1990, the late Professor Sartono announced the discovery of a fossil Solo-like skull near Ngawi, East Java (Sartono 1991). That fossil was subsequently studied by the present authors, who presented a description of it at the IPPA Congress in Melaka in 1998. The skull was found in August 1987 by a student on the left bank of the Solo river in the village of Selopuro, Ngawi, East Java. The fossil corresponds to a *calvaria*, complete with its skull base. Only two specimens from Ngandong (7 and 12) and one from Sangiran (Sangiran 17) retain a cranial base. The majority of the other Javanese hominids finds (from Trinil, Sangiran, Ngandong, Sambungmacan, and Mojokerto) present only the skull cap.

Unfortunately, the stratigraphical origin of this perfect *calvaria* is unknown. According to Sartono (1991), this skull may have been found in one of the Pitu terraces at Watualang, some 5 km west of Ngawi. This specimen, called then Ngawi 1, is at present conserved at the Mpu Tantular Museum in Surabaya.

A detailed description of this *calvaria* has not been published as yet, except for the announcement of the discovery by Sartono (1991) and short reviews by Widianto and Grimaud-Hervé (1993) and by Sartono *et al.* (1996). This article provides deeper observation and analysis of the biometrics and morphology of Ngawi 1, and interprets its position in the general evolution of fossil hominids in Indonesia.

MORPHOLOGICAL FEATURES

Ngawi 1 is an almost complete *calvaria,* although its skull base (*basis cranii*) shows some abrasion, starting from the *clivus* up to the *exterior prominencia cruciformis*. At the time we made the observations, a part of the skull base was still covered by hardened sediments and some deformation occurred in the postero-inferior portion.

The outline of the *torus supra-orbitalis* from *norma verticalis* (Figure 1) is straight and shows a glabellar depression. Backwards, this contour forms a constriction behind the orbits, comparable with that of the Ngandong *Homo erectus* specimens, but not as strong as in the other specimens from Trinil and Sangiran. Then it widens towards both parietal walls. The maximum cranial breadth lies on the temporal part at the *crista supra-mastoidea*. The cranial outline from *norma verticalis* lies between the sphenoid and bursoid scheme of Sergi (1919), which is the basic scheme of all Ngandong *H. erectus* skulls. This outline is very different from those of the Trinil and Sangiran specimens, that show the sphenoid scheme.

From the *norma lateralis* (Figure 2), the skull cap shows a high rounded outline. Such a cranial contour is characteristic of Ngandong skulls and differs from all skulls from Sangiran and Trinil which are flatter and shorter. This contour, very convex at the frontal, protrudes slightly at the bregma, then becomes relatively concave at the *depressio postobelica*. This inflexion starts the bulging of the *torus occipitalis*, and is weaker than Sambungmacan 1. The *torus supra-orbitalis*, which is less developed than that of Sangiran 17, Sambungmacan 1 and Ngandong 12, but very similar to Ngandong 7, is followed by a *sulcus supra-toralis* that is also similar to that of Ngandong 7.

Cranial deformation is clearly visible from *norma occipitalis* (Figure 3), with the right temporo-parietal surface more vertical than the left. The skull cap clearly shows a more rounded contour than those from Trinil and Sangiran. Laterally, on the position of the *planum temporalis*, the outline is narrowing upwards, whereas in the middle, above the *linea temporalis*, it becomes convex. Therefore, the profile of Ngawi 1 in *norma occipitalis* is pentagonal, with both lateral sides narrowing upward. This is the typical profile of *H. erectus* skulls.

From *norma facialis* (Figure 4), we observe a post-orbital constriction which is weaker than in the Trinil and Sangiran *H. erectus* fossils, but very comparable with Ngandong and Sambungmacan. On the other hand, the development of the *torus supra-orbitalis* is strong in relation to the size of the skull. This *torus*, as on all Ngandong fossils, shows a shallow glabellar depression, whereas the sulcus of the *supra-toralis* is moderately wide and deep forward near the trigone. There is a thin sagittal keeling at the frontal, which joins the bregma and forms a thickening. This sagittal keeling is stronger than that of Sambungmacan 1 but weaker than that of Trinil 2. The frontal of Ngawi 1 is characterized by the presence of a 28 mm long metopic suture, located 5 mm left of the bregma. Usually this suture will close and disappear at the age of 5 years.

The relief of the left *linea temporalis* is more developed than the right, and is located very low on the lower part of the parietal bone. The end of the superior temporal line thickens, forming the *torus angularis* that still continues up to the occipital while penetrating the *sutura lamboidea*. The character of this *torus angularis* is specific to the Ngandong *H. erectus* skulls (Santa Luca 1980), and cannot be found in the fossils from Trinil and Sangiran. The sagittal keel, only 34 mm long, is accentuated by two parasagittal depressions. On the other hand, there is a *depressio postobelica* and two other depressions behind the *torus angularis*. Such morphological features are once again features of the Ngandong and Sambungmacan 1 skulls, but not of the Trinil and Sangiran skulls.

The upper part of the *squama temporalis* is broken. The external acoustic meatus is oval. The *mastoidea incisura* is moderately large, like that of Ngandong specimens. The mastoid process is not developed and is smaller than that of Sangiran 17, whereas the digastric groove is narrow.

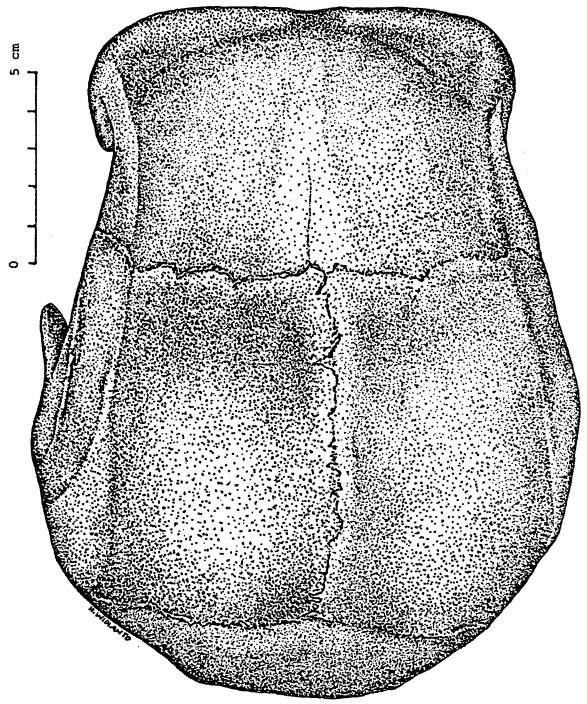

Figure 1: Ngawi 1 - Norma verticalis.

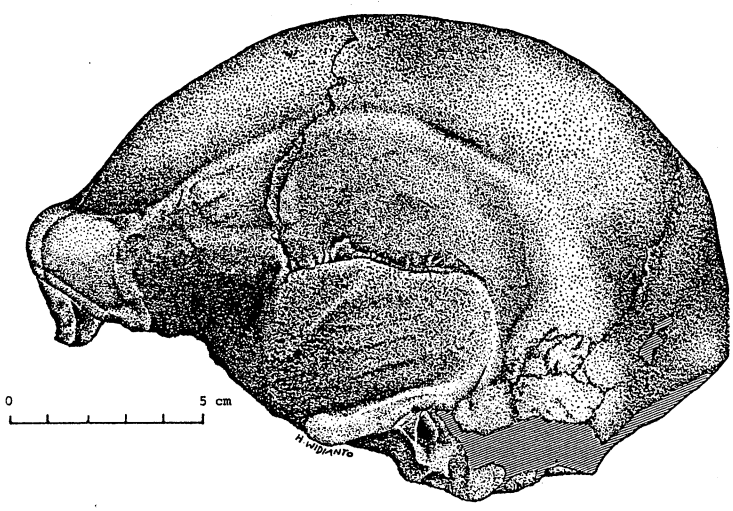

Figure 2: Ngawi 1 - Norma lateralis.

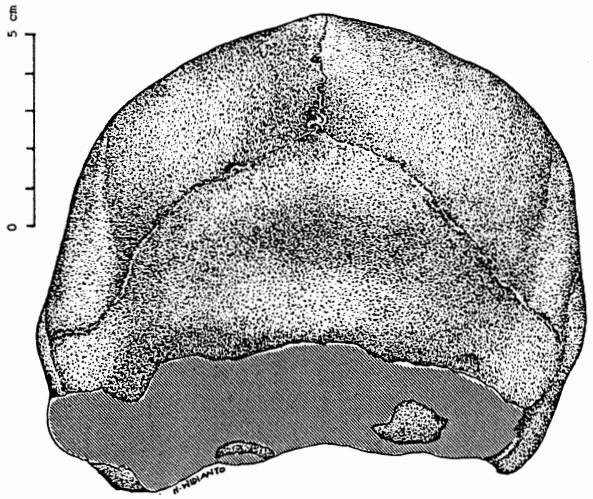

Figure 3: Ngawi 1 - Norma occipitalis.

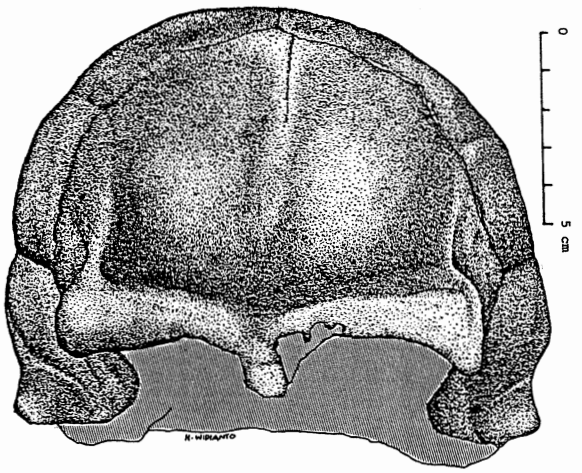

Figure 4: Ngawi 1 - Norma facialis.

The Ngawi 1 *calvaria* is broken at the line between the nasio-basion and the *sutura sphenobasilaris* (Figure 5), although the *pars basilaris* is still well-preserved. The *foramen magnum* is elliptical antero-posteriorly, more rounded at the posterior part. The two *condylus occipitalis* and the *pars petrosa* are eroded. The left *fossa mandibularis* is deeper and larger than that of modern humans, but smaller than that of Sambungmacan 1. On the other hand, the *tuberculum zygomaticus* is not well developed.

These morphological characters of Ngawi 1 show that this fossil is very close to the Ngandong and Sambungmacan skulls, and are very different from those of the Trinil and

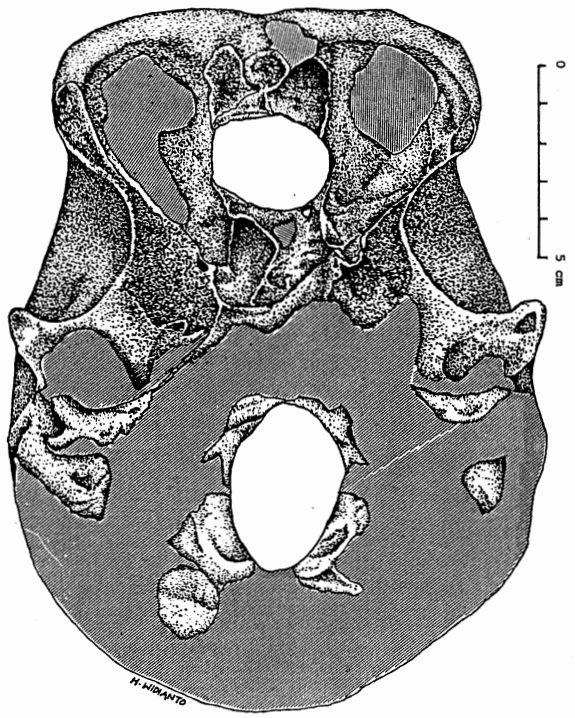

Figure 5: Ngawi 1 - Norma basilaris.

Sangiran *H. erectus*. The skull cap is rounder and higher, indicating that Ngawi 1 has undergone a more progressive evolutionary process than Trinil and Sangiran. The morphological aspects of Ngawi 1 indicate a young adult individual, based on the degree of the spheno-occipital synchondrose. On the other hand, underdeveloped muscular insertions like these on the *planum nuchalis* or the small mastoid process indicate a female individual.

BIOMETRICAL FEATURES

The well preserved condition of Ngawi 1 permits us to make craniometrical measurements easily. The data are compared with those for the *H. erectus* fossils from Trinil, Sangiran, Ngandong and Sambungmacan, together with a *H. sapiens* skull from Wadjak (Wadjak 1) and 30 modern skulls from Java, Madura and Kalimantan.

Maximum cranial length (M1)

The maximum cranial length is taken as the distance between the glabella and the ophisthocranion (OPC), since the OPC coincides with the inion (IN) in most Asian and African *H. erectus* specimens, including Ngawi 1. In modern humans, including Wadjak 1, the inion is separate and located below the OPC. The maximal cranial length of Ngawi 1 is 184 mm, longer than the two female individuals of Trinil 2 and

Sangiran 2 but shorter than the male individual of Sangiran 17 (Table 1). Compared to the Ngandong skulls, Ngawi 1 shows a shorter antero-posterior length. This could be related to its feminine character.

Maximum transversal breadth (M8)

The maximum transversal breadth consists of two dimensions – the maximum cranial breadth and the biparietal breadth. In the *H. erectus* group, the maximum cranial breadth is located at the postero-inferior part of the temporal, most often located at the *crista supra-mastoidea.* It is very different for modern humans because the maximum cranial breadth is located at both parietals, usually at the parietal eminence. This difference relates to evolutionary features of brain development (Grimaud-Hervé 1997). The Sangiran-Trinil group, with a smaller cranial capacity (929.8 cc for n=6, Holloway 1981), has a more robust cranial superstructure compared to modern humans, for whom cranial capacity is about 1200-1400 cc, with reduced cranial superstructures.

The maximum cranial breadth of Ngawi 1 is 144 mm (Table 2). This fossil is wider than the female individuals of Trinil 2 and Sangiran 2, but narrower than the male fossils from Sangiran, for instance Sangiran 4, 12, 17 and 38. Compared to the Ngandong group, Ngawi 1 has the smallest maximum breadth dimension and this may relate to its feminine nature.

Maximal biparietal breadth (M8-1)

The biparietal breadth in *H. erectus* is relevant for interpretative discussion of brain development since, except on the sagittal keel and *torus angularis,* it does not undergo such heavy thickening as the temporal. Therefore, the biparietal breadth is more reflective of evolutionary character than the maximum cranial breadth. Even so, both cranial breadth dimensions in *H. erectus* have postero-inferior locations, different from modern humans in which they tend to be higher anteriorly. This situation reveals the widening of the frontal and the parietal areas in modern humans as a consequence of brain development (Grimaud 1982; Grimaud-Hervé 1997). The biparietal breadth on Ngawi 1 (138 mm) is located in the middle part of the *sutura parieto-temporalis*, exactly similar to the specimens from Ngandong (except Ngandong 3) and Sambungmacan (Table 3).

The location of the biparietal breadth in other *H. erectus* specimens is variable, being on the *torus angularis* in Trinil 2 and Sangiran 4, on the posterior of the *sutura parieto-temporalis* in Sangiran 2 and Sangiran 10, and on the extension of the *crista supra-mastoideus* in Sangiran 12, Sangiran 17 and Ngandong 3. Its location in Ngawi 1, Ngandong and Sambungmacan reveals a more progressive evolutionary stage when compared to the fossils from Trinil and Sangiran. With a biparietal breadth of 138 mm, Ngawi 1 is wider than the female *H. erectus* specimens from Trinil and Sangiran, similar to the male *H. erectus* specimens from Sangiran, and narrower than all specimens from Ngandong, except for Ngandong 1, and Sambungmacan.

Horizontal Cranial Index

Based on the lesser significance of the maximum cranial breadth for determining evolutionary status, the horizontal cranial index will be calculated using the biparietal breadth, as in Table 4.

Table 1: Maximal Cranial Length (M1) of the Ngawi cranium and other specimens (values in brackets are estimates)

	Max. Length in mm	OPC coincides with IN
Ngawi 1	184	Yes
Trinil 2	(180)	Yes
Sangiran 2	(177)	?
Sangiran 17	205	yes
Ngandong 1	196	yes
Ngandong 6	220	yes
Ngandong 7	192	yes
Ngandong 10	201	yes
Ngandong 11	203	yes
Ngandong 12	200	yes
Sambungmacan 1	(194)	yes
Wadjak 1	(202)	No
Modern human (n=30)	168 to 198, average 180	No

Table 2: Maximal cranial breadth (M8) of the Ngawi cranium and other specimens (values in brackets are estimates)

	Max. breadth in mm	Location
Ngawi 1	144	Temporal
Trinil 2	(134)	Temporal
Sangiran 2	(140)	Temporal
Sangiran 4	146	Temporal
Sangiran 10	(131)	Temporal
Sangiran 12	(146)	Temporal
Sangiran 17	157	Temporal
Sangiran 38	(146)	Temporal
Ngandong 1	149	Temporal
Ngandong 6	149	Temporal
Ngandong 7	149	Temporal
Ngandong 10	157	Temporal
Ngandong 11	159	Temporal
Ngandong 12	150	Temporal
Sambungmacan 1	147	Temporal
Wadjak 1	151	Temporal
Modern human (n=30)	124-149, average 135.1	parietal

Table 3: Maximal biparietal breadth (M8-1) and its location on the parietal for the Ngawi cranium and other specimens (values in brackets are estimates)

	Biparietal breadth	Location on the parietal
Ngawi 1	138	Middle part of the sutura parieto-temporalis
Trinil 2	(130)	*Torus angularis*
Sangiran 2	(136)	Posterior part of the *sutura parieto-temporalis*
Sangiran 4	137	*Torus angularis*
Sangiran 10	(127)	Posterior part of the *sutura parieto-temporalis*
Sangiran 12	139	Extension of the *crista supra-mastoidea*
Sangiran 17	143	Extension of the *crista supra-mastoidea*
Sangiran 38	138	Middle part of the *sutura parieto-temporalis*
Ngandong 1	(143)	Middle part of the *sutura parieto-temporalis*
Ngandong 3	(128)	Extension of the *crista supra-mastoidea*
Ngandong 5	140	Middle part of the *sutura parieto-temporalis*
Ngandong 6	143	Middle part of the *sutura parieto-temporalis*
Ngandong 7	141	Middle part of the *sutura parieto-temporalis*
Ngandong 9	138	Middle part of the *sutura parieto-temporalis*
Ngandong 10	145	Middle part of the *sutura parieto-temporalis*
Ngandong 11	152	Middle part of the *sutura parieto-temporalis*
Ngandong 12	140	Middle part of the *sutura parieto-temporalis*
Sambungmacan 1	142	Middle part of the *sutura parieto-temporalis*
Wadjak 1	150	Posterior part of the *sutura parieto-temporalis*
Modern human (n=30)	124-149, average 135.1	Parietal eminence

Table 4: Horizontal cranial Index for the Ngawi cranium and other specimens (values in brackets are estimates)

	Max. cranial length (a)	Biparietal breadth (b)	Index (b) x 100/(a)
Ngawi 1	184	138	75.0
Trinil 2	(180)	(130)	(72.2)
Sangiran 2	(177)	(136)	76.8)
Sangiran 17	205	143	69.8
Ngandong 1	(196)	(143)	72.9
Ngandong 6	220	143	65.0
Ngandong 7	192	141	73.4
Ngandong 10	201	145	72.1
Ngandong 11	203	152	74.9
Ngandong 12	200	140	70.0
Sambungmacan 1	(194)	142	(73.2)
Wadjak 1	(202)	(150)	(74.2)
Modern human (n=30)	168-198, average 180	124-149, average 135.1	68.5-86.5, average 75.1

With an index of 75.0, Ngawi 1 is more rounded than Trinil 2, Sangiran 17 and all fossils from Ngandong and Sambungmacan, but comparable to the average of modern humans (75.1). On the other hand, the correlation between the maximum cranial length (184 mm) and the biparietal breadth (138 mm) places Ngawi 1 in the mesocranic skull group, while Ngandong 6 falls in the hyper-dolichocranic skull group.

Cranial height

As the skull is still well preserved with an almost set of complete craniometric points, several variants of cranial height can be measured: the basion-bregma height, the auriculo-bregmatic height, and the *calotta* height. Unlike the basion-bregma height, that is directly measured from the basion to the bregma, the auriculo-bregmatic height is measured at the projection of the bregma towards the two porions. This height dimension is comparable to between 79 and 91% of the basion-bregma height (Olivier 1960). The *calotta* height is measured from the vertex (highest point of the skull cap) perpendicular to the axis of the glabella-opisthocranion.

Basion-bregma height index

Three indexes (height-length, height-biparietal breadth and mid-biparietal height) calculated with the basion-bregma height are shown in Table 5.

Comparative data for Ngawi 1 exist only for Sangiran 17, Ngandong 7 and Ngandong 12, since these three still have the basion. The values for the three variations of the basion-bregma height index for Ngawi 1 (respectively 59.8, 79.7 and 68.3) indicates that Ngawi 1 is always higher than Sangiran 17 and lower than Ngandong 7 and Ngandong 12. In other words, Sangiran 17 is the lowest skull in relative height and those from Ngandong are the highest, with Ngawi 1 between.

Compared to the *H. sapiens* group, Ngawi 1 is clearly lower than Wadjak 1 and the average modern human.

Auriculo-bregmatic height index

The auriculo-bregmatic height index in the same three variations as the basion-bregma height index can be seen in Table 6. Due to the well-preserved condition of the two porions on the *H. erectus* skulls from Indonesia, many crania allow these indices to be calculated; 2 from Sangiran, 6 from Ngandong and one from Sambungmacan.

In accordance with the results of the basion-bregma height indices, the three auriculo-bregmatic height indices for Ngawi 1 (respectively 56.5, 75.4, and 64.6) indicate a higher skull than those from Sangiran and close similarity to Ngandong and Sambungmacan. This supports the interpretation that Ngawi 1 does not belong to the Sangiran group, but to the Ngandong and Sambungmacan group. Moreover, Table 6 shows that in the auriculo-bregmatic height dimension, Ngawi 1 is comparable to Wadjak 1 but far shorter than the average modern human.

Table 5: Basion-bregma height indices (M17) for the Ngawi cranium and other specimens

	Height Basion-Bregma	INDICES		
		Height-length	Height-biparietal breadth	Mid-biparietal height
Ngawi 1	110	59.8	79.7	68.3
Sangiran 17	107	52.2	74.8	61.5
Ngandong 7	124	64.6	87.9	74.5
Ngandong 12	124	62.0	88.6	72.9
Wadjak 1	137	71.3	91.3	77.8
Modern human (n=30)	120-148 average 134.9	68.1-84.5 average 75.1	88.9-110.6 average 100.0	74.1-93.2 average 85.4

Table 6: Auriculo-bregmatic height indices for the Ngawi cranium and other specimens

	Height Auri-Bregma	INDICES		
		Height-length*	Height-biparietal breadth‡	Mid biparietal-height#
Ngawi 1	104	56.5	75.4	64.6
Sangiran 2	90	50.8	66.2	57.5
Sangiran 17	104	50.7	72.7	59.8
Ngandong 1	106	54.1	74.1	62.5
Ngandong 6	115	52.3	80.4	63.4
Ngandong 7	102	53.1	72.3	61.3
Ngandong 10	111	55.2	76.5	64.2
Ngandong 11	115	56.6	75.7	64.8
Ngandong 12	115	57.5	82.1	67.6
Sambungmacan 1	107	55.2	75.3	63.7
Wadjak 1	112	55.4	74.7	63.6
Modern human (n=30)	106-127 average 13.9	56.8-72.0 average 63.5	73.8-92.4 average 84.4	67.7-78.6 average 72.3

* Auriculo-bregmatic height x 100 / maximum cranial height
‡ Auriculo-bregmatic x 100 / biparietal breadth
\# Auriculo-bregmatic x 100 / 0.5 (maximum cranial biparietal breadth)

Calvarium height index

All fossils used for the measurements and the calculation of the auriculo-bregmatic height are once again available for the calvarium height index. The skull cap Trinil 2 is also involved here. The raw measurements and the three calvarium height index variations can be seen on the Table 7.

This set of indices shows results similar to the other two height indexes. The values for Ngawi 1 (39.7, 52.9 and 45.3) indicate a skull that is higher than Trinil 2 and Sangiran 2, and lower than Sangiran 17 and the majority of the Ngandong and Sambungmacan skulls, except for Ngandong 7 that has the same value. The lower position of Ngawi 1 (a female) than Sangiran 17 (a male) reflects the height of the calvarium (73 *vs* 78 mm). Ngandong 7 is comparable to Ngawi 1 because it is also a female. But in terms of this index, Ngawi 1 is lower than Wadjak 1 or the average modern human.

Main dimensions of Ngawi 1

The main dimensions of Ngawi 1 (Table 8) include the maximum cranial length, the biparietal breadth and the cranial height, the latter having three components in the forms of the basion-bregma height, the auriculo-bregmatic height and the calvarium height respectively. These main dimensions are given in Table 8 in order to compare them with the interpretations already presented from the index values.

Based on the data in Table 8, the maximum length of Ngawi 1 (184 mm) is lower than the Trinil-Sangiran group (187.3 mm, N=3) and significantly lower than the Ngandong group (202 mm, N=6) and Sambungmacan 1 (194 mm). A similar situation exists for the biparietal breadth. For the auriculo-bregmatic and *calotta* heights (average basion-bregma heights for the Trinil, Sangiran, Ngandong and

Sambungmacan skulls cannot be determined because the basion is not always preserved), Ngawi 1 is higher than the Trinil and Sangiran crania, but lower than the average Ngandong cranium as well as Sambungmacan 1. The values obtained for the average modern human are always the highest. These data in combination indicate that Ngawi 1 is bigger than the Trinil-Sangiran group, but smaller than the Ngandong and Sambungmacan specimens.

THE NGAWI 1 CALVARIA VERSUS THE TRINIL - SANGIRAN AND THE NGANDONG - SAMBUNG-MACAN GROUPS

The above analysis of morphological and biometrical characteristics allows several important interpretations for the *H. erectus* skull of Ngawi 1. The morphological characteristics indicate that from all *normae*, its cranial contour is more rounded and higher than the *H. erectus* fossils from Trinil and Sangiran. All skulls of this group have a lower but longer skull than Ngawi 1. On the other hand, the cranial contour of Ngawi 1 is similar to those of the Ngandong and Sambungmacan fossils. In the process of human evolution during the Lower and Middle Pleistocene, two main developments occurred in the skull - changes of form and volume of the neurocranium as the result of the brain development on one hand (Grimaud-Hervé 1997), and the movement of the occipital downwards on the other hand (Delattre and Fenart 1960), without any modification of basic *H. erectus* characteristics (Widianto 1993). When these two developments work together they make the skull shorter, higher and more rounded. Brain development in the frontal area will reduce the post-orbital constriction, so that the two parietal walls behind the orbits will be wider and more open. Movement of the occipital downwards will give a greater occipital angle, formed by the *planum occipitalis*

Table 7: Calotta height indices for the Ngawi cranium and other specimens (figures in brackets are estimates)

	Calvarium height	INDICES		
		Height-length*	Height-biparietal breadth‡	Mid- biparietal height#
Ngawi 1	73	39.7	52.9	45.3
Trinil 2	60	(33.3)	46.1	38.7
Sangiran 2	63	(35.6)	45.0	40.3
Sangiran 17	78	38.0	54.5	44.8
Ngandong 1	83	42.3	55.7	49.0
Ngandong 6	86	39.1	60.1	47.4
Ngandong 7	74	38.5	52.5	44.4
Ngandong 10	80	39.8	55.2	46.2
Ngandong 11	83	40.9	54.6	46.7
Ngandong 12	82	41.0	58.6	48.2
Sambungmacan 1	80	(41.2)	56.3	47.6
Wadjak 1	90	44.6	60.0	51.1
Modern humans (n=30)	73-96 average 83.4	41.0-54.8 average 46.4	48.9-74.6 average 61.9	44.6-61.3 average 52.7

* Calvarium height x 100 / maximum cranial length
‡ Calvarium height x 100 / biparietal width
\# Calvarium height x 100 / 0.5 (maximum cranial length + biparietal width)

Table 8: Average main dimensions values for the Ngawi cranium and other specimens

	Maximum length	Biparietal breadth	Height		
			Auriculo - bregmatic	*Calvarium*	Bregma – basion
Ngawi 1	184	138	104	72	110
Trinil - Sangiran	187.3 (n=3)	135.7 (n=7)	101 (n=7)	69.3 (n=3)	-
Ngandong	202 (n=6)	141.81 (n=9)	111 (n=6)	83.7 (n=6)	-
Sambungmacan 1	194	142	107	82	-
Modern human	180 (n=30)	135.1 (n=30)	113.9 (n=30)	83.4 (n=30)	134.9 (n=30)

and the *planum nuchalis,* and will push the *foramen magnum* anteriorly so that the position of the skull over the spinal column becomes more erect. These evolutionary processes are clearly visible in the *H. erectus* skulls from Java, with a significant separation between the Trinil and Sangiran group on one hand and the group of Ngawi 1, Sambungmacan 1 and all of the Ngandong skulls on the other. The first group is more archaic in evolutionary terms.

The similarities between Ngawi 1 and the Ngandong - Sambungmacan group are shown only in the cranial contours but also in cranial superstructural characteristics. The *torus supra-orbitalis* of Ngawi 1 and the Ngandong-Sambungmacan group has undergone reduction, as have the *arcus superciliaris*, the *sinus frontalis*, and the trigone on both sides. There is also a depression in the glabella region (*depressio glabella*) in Ngawi 1 and the Ngandong group which is not visible in the Trinil-Sangiran group. The same situation exists in the *depressio postobelica* in the lambda region. Furthermore, the similar cranial superstructures in Ngawi 1 and the Ngandong-Sambungmacan group are also emphasised in the form of the *torus angularis* on the parietal. The *torus angularis,* a thickening on the posterior part of the parietal at the end of the *linea temporalis,* is only present in *H. erectus* (Weidenreich 1943). The Ngandong group shows a remarkable development in that this *torus* occupies the whole *mastoidea* region, penetrating the *sutura lambdoidea* and joining the *torus occipitalis* (Weidenreich 1951, Santa Luca 1980). This trait is visible on Ngawi 1 but does not occur on the Trinil-Sangiran skulls. This remarkable development of the *torus angularis* caused a depression in the posterior part of the *torus,* also visible on Sambungmacan 1, but not on the Trinil-Sangiran skulls.

CONCLUSIONS

It can be concluded that Ngawi 1 is a member of the Ngandong and Sambungmacan group of *H. erectus* fossils. In relation to the three evolutionary stages that occurred in the Javanese *H. erectus* lineage during the Pleistocene (Widianto 1997), Ngawi 1 occupies a more progressive stage than the Trinil-Sangiran group of the Lower-Middle Pleistocene. In accordance with its placement within the Ngandong group, it may be assumed that Ngawi 1 dates from the late Middle or Upper Pleistocene.

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