

A MORPHOLOGICAL STUDY OF SOME OLD AND NEW PLEISTOCENE DISCOVERIES FROM JAVA

Hilde T. Uytterschaut*

This article reports some preliminary results with regard to the morphology of eight hominid mandibles, found in Java. The following mandibles have been studied and compared to each other: S1b (= Mandible B = Pithecanthropus B); S5 (= holotype P. dubius); S6 (= Meganthropus A = Mandible D); S8 (= Meganthropus B); S9 (= Pithecanthropus C); S21 (= Pithecanthropus E); S22 (= Pithecanthropus F); and Mandible A of Kedung Brubus. Metrical and non-metrical characters were included in the analysis. The preliminary results lead to the conclusion that S1b and S9 are very similar to each other, whereas S5 has more features in common with S6 and S8. Apart from the comparison of these Javanese mandibles with each other, they were also compared with mandible KNM-BK 8518 found in Baringo (Kenya) in 1982. This mandible, probably belonging to an early Homo erectus or late Homo habilis, shows most similarity with the mandibles S1b and S9, which suggests that these two might also be assigned to early Homo erectus or late Homo habilis.

INTRODUCTION

This morphological study of some old and new Pleistocene discoveries in Java focuses on mandibles. The impetus to study these Pleistocene mandibles of Java was provided the discovery of a mandible, KNM-BK 8518, in the Kapthurin Formation (Baringo area) of Kenya in 1982 (Figure 1). According to a preliminary study by Wood and van Noten (1986) there are similarities between this mandible and other *Homo erectus* mandibles of primitive form. The Baringo mandible was found in a grey tuff layer for which a preliminary date of 820,000±110,000 years BP has been found, although according to more recent results it might be younger (±600,000 BP).

The comparison of the mandible BK 8518 with mandibles of *Pithecanthropus* and *Meganthropus* found in Java is one part of a much larger project in which KNM-BK 8518 will be compared with mandibles of *Homo erectus* and *Homo habilis* from Olduvai (Tanzania), East Turkana (Kenya), South Africa and China.

The object of this article is to compare the mandibles found in Java with each other, based on a list of measurements and characteristics that were selected for the study of

KNM-BK 8518. Consequently the mandible KNM-BK 8518 and 3 other mandibles of East Africa (all belonging to late *H. habilis* or early *H. erectus*) will be compared with those of Java.

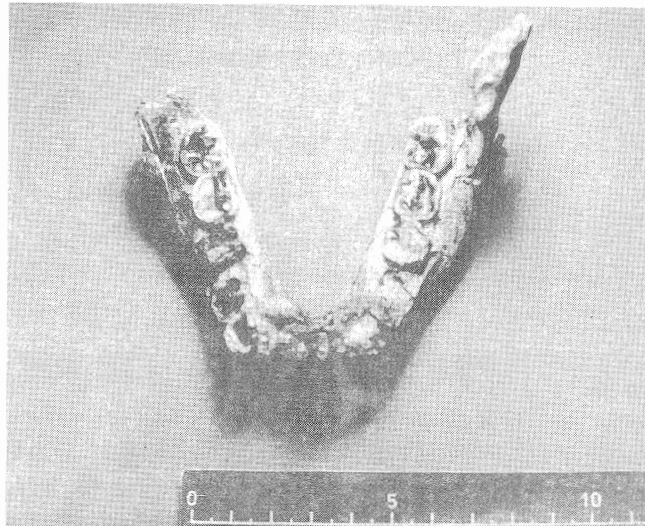


FIGURE 1: MANDIBLE BK 8518 FOUND IN THE KAPTHURIN FORMATION AT BARINGO, KENYA, IN 1982

MATERIALS AND METHODS

The mandibles from Java include S1b (right P4-M3 = Mandible B = *Pithecanthropus* B); S5 (right M1, M2 = holotype *P. dubius*); S6 (right P3-M1 = *Meganthropus* A = Mandible D); S8 (left M1-right M3 = *Meganthropus* B); S9 (right C-P4, M2, M3 = *Pithecanthropus* C); S21 (right M2 = *Pithecanthropus* E); S22 (= *Pithecanthropus* F) and Mandible A (right C, P3) of Kedung Brubus (Figures 2,3,4). All these mandibles were measured and studied by the author from the original specimens. Most of these fossils were discovered before 1960, however S21 and S22 are relatively recent finds and were discovered in 1973 and 1974 respectively. According to the literature, all these mandibles belong to *Pithecanthropus* or *Meganthropus*. With regard to stratigraphy it should be mentioned that S8, S21 and Mandible A were found in the Kabuh formation (Middle Pleistocene) and all the others in the Pucangan formation (Lower Pleistocene). Since all the mentioned mandibles consist of at least one part of the right half of the mandible, most measurements and characteristics were scored on the right side, with the exception of S8 where the right side has been distorted. For a more detailed description of the material see Table 1.

The mandibles of East Africa include mandible KNM-BK 8518 from Baringo (Kenya), a fairly complete mandible with heavily worn teeth; KNM-ER 992 and KNM-ER 1805

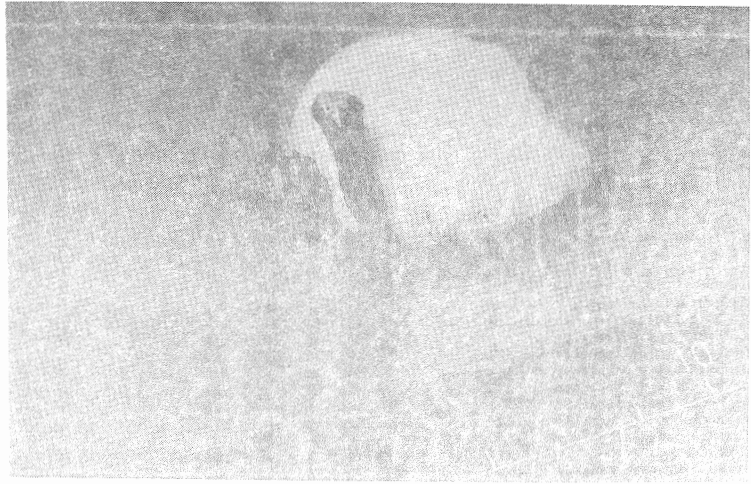


FIGURE 2: MANDIBLE A FROM KEDUNG BRUBUS AND ISOLATED LEFT PREMOLAR



FIGURE 3: MANDIBLE S1b AT THE LEFT AND MANDIBLE S9 AT RIGHT (OCCLUSAL VIEW)

4 H.T. UYTTERSCHAUT

	S1b	S5	S6	S8	S9	S21	S22	Mand. A.	BK 8518	ER 992	ER 1805	OH 13
1. Height of the corpus (till alveolar margin)												
at M1	349	[378]	[467]	329	-	-	295	-	296	(333)	-	278
at M2	321	[341]	-	-	301	(322)	274	-	300	334	298	246
2. Thickness of the mandibular corpus												
at P4	161	196	276	189	201	-	159	127	188	210	239	169
at M2	179	215	-	-	232	206	181	-	213	235	230	231
3. Length of premolar tooth row	-	-	205	(212)	189	-	171	-	(182)	180	(180)	183
4. P4: mesiodistal length	88	-	100	-	85	-	81	-	[92]	86	-	88
P4: buccolingual breadth	[108]	-	119	-	106	-	100	-	[105]	113	-	98
P4: neck: mesiodistally	88	-	106	-	93	-	100	-	78	-	-	-
P4: neck: buccolingually	75	-	85	-	79	-	64	-	73	-	-	-
5. M1: mesiodistal length	132	[139]	148	-	-	-	116	-	125	125	-	127
M1: buccolingual breadth	129	[134]	134	-	-	-	123	-	121	110	-	121
M1: neck: mesiodistally	111	125	124	-	-	-	117	-	-	-	-	-
M1: neck: buccolingually	110	115	121	-	-	-	100	-	-	-	-	-
6. M2: mesiodistal length	133	145	-	-	138	124	130	-	127	134	138	133
M2: buccolingual breadth	134	147	-	111	124	111	122	-	115	123	128	120
M2: neck: mesiodistally	111	134	-	100	121	107	121	-	-	-	-	-
M2: neck: buccolingually	122	131	-	126	121	121	121	-	-	-	-	-
7. M3: mesiodistal length	142	-	-	151	126	-	124	-	144	129	151	149
M3: buccolingual breadth	122	-	-	128	126	-	120	-	121	122	124	126
M3: neck: mesiodistally	111	-	-	109	114	-	115	-	-	-	-	-
M3: neck: buccolingually	126	-	-	129	117	-	109	-	-	-	-	-
8. Distance between centres of M1 & M2	134	140	-	[148]	-	-	126	-	123	122	-	128
Distance between centres of M1 & P4	115	-	105	[100]	-	-	99	-	132	96	-	104
9. Distance between the base of the mental foramen and the alveolar margin (1)	234	230	[241]	-	234	147	-	-	170	[180]	-	126
10. Distance between the base of the mental foramen and the mandibular base (1)	128	195	293	-	177	190	-	-	175	170	-	136
11. Distance between the lateral prominence and alveolar margin	170	[201]	-	232	(227)	-	-	-	191	187	-	-
12. Position foramen mentale(1)	P3/P4	P4	P4/M1	-	P3/P4	-	P3	P4	P3/P4	P3/P4	P3	P3/P4
13. Lateral prominence; marked? (2)	1	1	-	1	2	0	0	-	2	1	-	-
14. Chin (3)	1	-	-	-	1	-	0	-	0	0	-	-
15. Width extramolar sulcus (4)	1	-	-	-	1	1	-	-	1	2	1	1
16. Dental arcade shape	± U	-	-	V	± U	-	V	-	V	V	V	V
17. Roundness/sharpness anterior region (5)	-	-	-	1	1	-	1	-	2	2	-	2
18. Roundness/sharpness corpus base (6)	1	3	-	3	3	-	1	1	2	2	3	3
19. Thickness of corpus base (7)	1	2	3	2	2	-	1	-	2	2	2	2
20. Development superior transversal torus (8)	-	-	-	1	1	-	1	-	1	1	1	1
21. Development inferior transversal torus (9)	-	-	-	2	1	-	1	-	2	1	2	2
22. Steepness planum alveolare (10)	1	-	-	3	2	-	3	-	2	3	1	2
Roundness of planum alveolare at lower end (11)	0	-	-	2	2	-	2	-	2	1	2	2
Horizontal position posterior to the planum?(12)	0	-	-	1	1	-	0	-	1	-	-	1
23. Development alveolar process (13)	1	1	-	1	1	1	0	-	2	2	2	2

[] = ± 0.5 mm

() = ± 1.0 mm

(1) S1b has 3 mental foramina; the most anteriorly situated one has been considered

(2) '0' = not marked; '1' = medium; '2' = marked

(3) '0' = no chin; '1' = very little

(4) '1' = not so wide but clear; '2' = rather wide

(5) '1' = not so very round, medium; '2' = round

(6) '1' = rather sharp; '2' = medium; '3' = round

(7) '1' = medium to rather thin; '2' = thick; '3' = very thick

(8) '1' = medium

(9) '1' = slightly developed; '2' = medium

(10) '1' = shallow; '2' = medium; '3' = steep

(11) '0' = no; '1' = medium; '2' = yes

(12) '0' = no; '1' = more shallow than horizontal

(13) '0' = not developed; '1' = medium; '2' = well developed

TABLE 1: METRICAL AND NON-METRICAL DATA OF EIGHT JAVANESE (*PITHECANTHROPUS* AND *MEGANTHROPUS*) AND FOUR AFRICAN (*HOMO HABILIS/HOMO ERECTUS*) MANDIBLES

(both from Turkana, Kenya); and OH13 from Olduvai (Tanzania). The three last mentioned mandibles are rather complete, meaning that parts of the left as well as the right halves have been preserved. They all probably belong to late *H. habilis* or early *H. erectus*.

The data include metrical and non-metrical scores ("discrete" and discontinuous traits). The metrical scores consist of the height and width of the corpus, the dimensions of the teeth, and the positions of the mental foramen and the lateral prominence. The non-metrical scores include observations about the chin, extramolar sulcus, lateral prominence, dental arcade shape, corpus base, transverse torus, planum alveolare and alveolar process. These data are only one part of the total data base and were selected because a large number of the eight Javanese and four African mandibles scored completely on these characters.

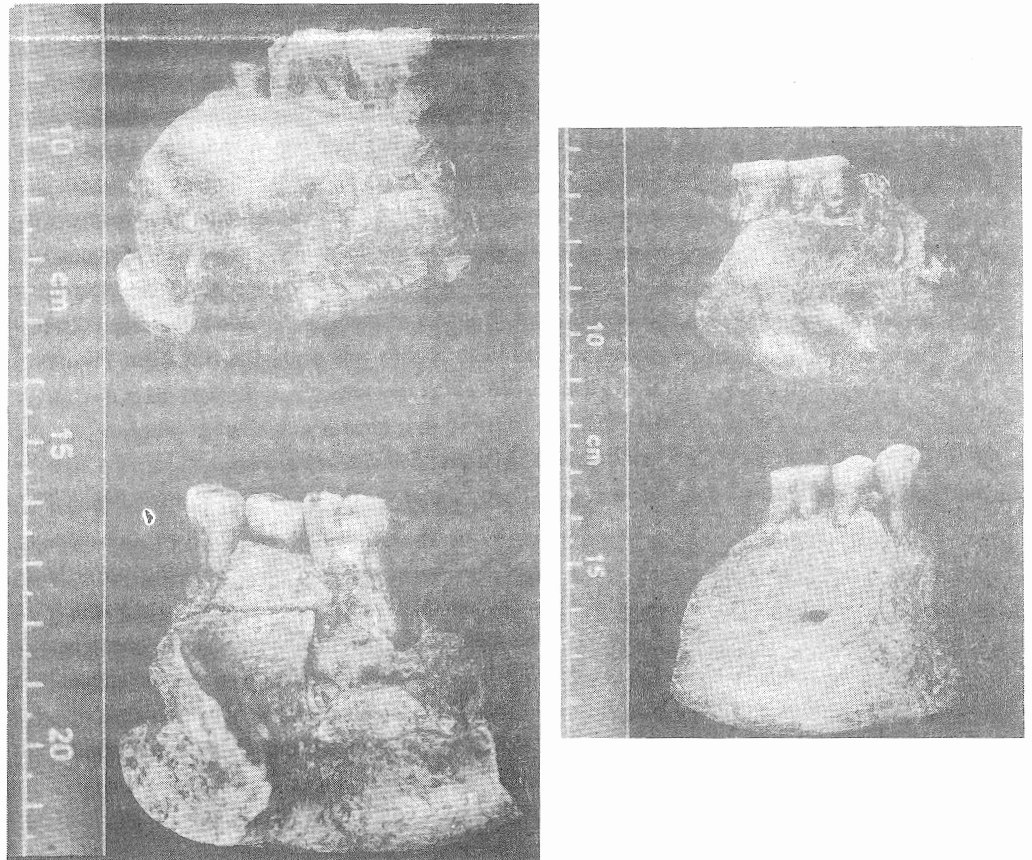


FIGURE 4: LATERAL VIEW (RIGHT) AND INNER SIDE (LEFT) OF THE MANDIBLES S5 (ABOVE) AND S6 (BELOW)

Until now only one statistical method has been applied to the data; a cluster analysis based on the squared Euclidean distance using the average linkage method. Apart from the cluster analysis the correlations between the metrical scores and between the non-metrical scores have also been calculated.

PRELIMINARY RESULTS

The data for the Javanese and African mandibles are summarized in Table 1, firstly the metrical and then the non-metrical scores. Concerning the metrical scores, the highest correlations were found between the height of the corpus at M2 and the buccolingual breadth of P4, between the length of the premolar tooth row and the mesiodistal length of M1, and between the mesiodistal length of M1 and the buccolingual distance at the neck of M1. For the non-metrical characters the highest correlations were found between the position of the foramen mentale and the development of the inferior transversal torus, between the steepness of the planum alveolare and the position of the foramen mentale, and between the horizontalness posterior to the planum and the chin development.

With regard to the Javanese mandibles, S21 and mandible A appear to be too incomplete to be considered in this analysis. Comparing the six remaining Javanese mandibles with each other it can be said that, with regard to size (including the teeth), mandibles S1b and S9 appear to be strikingly similar; S5, S6 and S8 are clearly much larger and more robust; whereas S22 is much smaller and less robust than all the others. The height of the corpus of S6 is significantly larger than the height of the other mandibles, 1 cm larger than the second largest measurement (for S5). Unfortunately, the data are too incomplete to do a cluster analysis with all of the mandibles, but from Figure 5 it can be seen that, with regard to the Javanese mandibles, first S9 and S1b cluster together, and then S5 and especially S22 only join the first cluster at a deeper level.

Also, there are clearly similarities between S1b and S9 with regard to the shape of the dental arcade, steepness of the planum alveolare, shape of the chin and the position of the mental foramen. The shape of the dental arcade for S1b and S9 resembles more a U-form, whereas in S8 and S22 it expresses more a V-form. The steepness of the planum alveolare is highest in S8 and S22, and less steep or even shallow in S9 and in S1b. In both S1b and S9 we can observe a slightly marked incurvatio mandibularis, which contrasts with S22, in which there is no chin at all. With regard to the position of the mental foramen it has to be mentioned that S1b has three mental foramina, of which one, the most anteriorly situated, has the same position as in S9 (between P3 and P4). In S5 and S6 the foramen is situated more posteriorly, under P4 or between P4 and M1, whereas in S22 the foramen is shifted more towards the anterior part of the mandible, under P3. The lateral prominence is more marked in S9 than in the other mandibles (S1b and S8), whereas in S21 and S22 this prominence is not or hardly developed.

If we compare the mandibles of Java with the four African mandibles, the data in Table 1 point in the following direction. With regard to size (including the teeth) there are some similarities, especially between KNM-BK 8518, S9 and S1b. Also, the position of the

mental foramen is the same in S9, S1b, KNM-BK 8518, KNM-ER 992 and OH13. The lateral prominence is as well marked in KNM-BK 8518 as it is in S9. In virtually all completely scoring Javanese and African mandibles the scores on the development of the superior transversal torus and the width of the extramolar sulcus are the same (except for KNM-ER 992). However, there are also clear differences between the Javanese and the African mandibles. These concern the development of the alveolar process, the roundness of the anterior region of the mandible, and the development of a chin. The alveolar process is less developed in the Javanese specimens than the African ones. With regard to the roundness or sharpness of the anterior region of the mandible the African mandibles are rounder than the Javanese. Although there are similarities between S9, S1b and BK 8518, as mentioned before, the development of the chin is different (no chin in BK 8518 and a slightly marked incurvatio mandibularis in S9 and S1b).

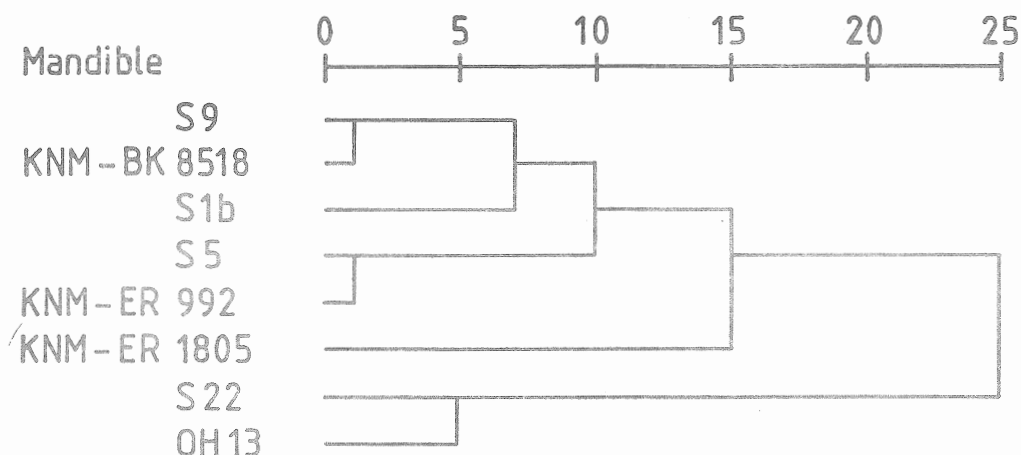


FIGURE 5: DENDROGRAM BASED ON THE AVERAGE LINKAGE CLUSTER METHOD USING THREE SIZE VARIABLES (HEIGHT AT M2, THICKNESS AT P4 OF THE MANDIBULAR CORPUS, AND MESIODISTAL LENGTH OF M2).

MANDIBLE A FROM KEDUNG BRUBUS

Although partly beyond the scope of this article (since it is too fragmentary for comparison with the others), I would like to make some remarks with regard to this specimen (Figure 2). This mandible only consists of a small part of the right corpus and includes some remains of the right canine and first premolar. Although its dimensions are rather small, this does not necessarily mean that it has to belong to a juvenile. The mental foramen is situated under P4. Apart from this part of the mandible, one isolated first premolar has been found, probably from the left side of this specimen. According to

Tobias (1966), the remains of the right P3 not only include the root but also a substantial portion of the crown. He makes a distinction between two different areas on the buccal surface; the upper part which is whiter, much eroded, pitted and rugose (enamel part) and which ends below at a clear line (probably the cervical enamel line), and the buccal surface below that line which is yellowish and smooth (the root). In order to make sure if the remains of P3 do include part of the crown or not, more X-rays and also CT-scans need to be made. From a first series of X-rays it looks as if parts of the crown are present and the whole piece only includes part of the root.

CONCLUSIONS AND DISCUSSION

According to the results, S1b and S9 seem to be very similar (Figure 3) in size as with regard to some other non-metrical characteristics. Mandible S5 does not show much similarity with S9, but has more features in common with S6 and also S8. Mandible S22 is much smaller and less robust than the other mandibles and is probably more recent. According to some authorities (amongst others von Koenigswald 1968a and Franzen 1985), S5 and S9 both belong to "*Pithecanthropus dubius*", with S5 being the holotype (von Koenigswald 1950). However, our results do point more in the direction of von Koenigswald's first classification in which S5 was assigned to *Meganthropus* (von Koenigswald, in Weidenreich 1945). The mandibles S1b and S9 were also linked together in one cluster according to Jacob's study (Jacob 1980), in which the material of Sangiran was grouped in 4 clusters with regard to the stratigraphy of the fossil localities. Moreover, an earlier article of Sartono does report morphological similarities between S9 and S1b (Sartono 1961). So, perhaps after all mandible S5 is not as dubious as has been thought, whereas S1b fits more into the *dubius* classification because of its resemblances to S9. Of course, we have to keep in mind the proviso of Jacob (1975): "if there are not many fossils available, one does not really know for certain whether the variations revealed are individual or interspecific".

A comparison of KNM-BK 8518 with the Javanese mandibles leads to the conclusion that this mandible is most similar to S9 and S1b. As was mentioned before, KNM-BK 8518 (and also the three other African mandibles) probably belongs to an early *Homo erectus* or late *Homo habilis*. This means that on the basis of these results, S1b and S9 probably also belong to early *Homo erectus* or late *Homo habilis*. According to some authors (e.g. Tobias and von Koenigswald 1964; von Koenigswald 1968b), at a certain stage we can find parallelisms in hominid evolution between East Africa and Asia. Already in 1964, Tobias and von Koenigswald referred to S1b as a late paratype of *Homo habilis*, comparable with OH13 and "*Telanthropus*" of Africa. Of course, more research has to be done, and in my opinion, should be done in order to make a good comparison between the African and the Asian specimens.

ACKNOWLEDGEMENTS

I would like to thank Professor Sartono, Professor Jacob, Professor Franzen and Dr de Vos for giving me permission to study the original Javanese fossils. Also Professor

Soejono and Dr Bartstra for introducing me to the people in charge of the fossils and for showing me the different sites where the fossils were found. With regard to the African fossil hominids I am grateful to R. Leakey and Professor van Noten for giving me the opportunity to study the original specimens. This study was made possible by a grant from the National Fund for Scientific Research of Belgium and the support of the University of Groningen. Finally, I want to thank R. Stewart for helping me with the cluster analysis.

REFERENCES

- Franzen, J.L. 1985. What is "*Pithecanthropus dubius* Koenigswald, 1950? In E. Delson (ed.), *Ancestors: the Hard Evidence*, pp. 221-226. New York: Liss.
- Jacob, T. 1975. The Pithecanthropines of Indonesia. *Bulletin et Mémoires de la Société d'Anthropologie de Paris* 2, série 13: 243-256.
- 1980. *Meganthropus, Pithecanthropus* and *Homo sapiens* in Indonesia: evidence and problems. *Colloques Internationaux du C.N.R.S.*, 599: *Les Processus de l'Homínisation*, pp. 81-84.
- Koenigswald, G.H.R. von. 1950. Fossil hominids from the Lower Pleistocene of Java. *Reports of the 18th Session, International Geological Congress, Great Britain, 1948*, part IX:59-61.
- Koenigswald, G.H.R. von. 1968a. Observations upon two *Pithecanthropus* mandibles from Sangiran, Central Java. *Proceedings Koninklijke Nederlandse Akademie van Wetenschap* 71B:99-107.
- Koenigswald, G.H.R. von. 1968b. Das absolute Alter des *Pithecanthropus erectus* Dubois. In G. Kurth (ed.), *Evolution und Hominisation*, pp. 195-203. Stuttgart: Gustav Fisher Verlag.
- Sartono, S. 1961. Notes on a new find of a *Pithecanthropus* mandible. *Publikasi Teknik Seri Paleontologi* 2:1-51. Bandung.
- Tobias, P.V. and Koenigswald, G.H.R. von. 1964. A comparison between the Olduvai hominines and those of Java and some implications for hominid phylogeny. *Nature* 204:515-518.
- Tobias, P.V. 1966. A re-examination of the Kedung Brubus mandible. *Zoologische Mededelingen* 41, nr. 22:307-321.
- Weidenreich, F. 1945. Giant early man from Java and South China. *Anthropological Papers of the American Museum of Natural History* 40:1-134.
- Wood, B.A. and Noten, F. van. 1986. Preliminary observations on the BK 8518 mandible from Baringo, Kenya. *American Journal of Physical Anthropology* 69:117-129.