Examination of Nonmetrical Characters of the Form of Innominate Bones from Pleistocene in Japan

Part I Description*

Banri ENDO¹⁾ and Hisao BABA²⁾

- 1) *Department of Anthropology, Faculty of Science, and Department of Anthropology and Prehistory, The University Museum, The University of Tokyo*
- 2) *Department of Anatomy, Dokkyo University School of Medicine*

Abstract The nonmetrical characters of the principal items defined in this study are observed and described on five innominates discovered from the Pleistocene deposits in Japan. They are compared with various fossil innominate casts and recent Japanese innominates. The character of each item is expressed by the successive categories also defined in this study to enable objective comparisons and nonparametric statistics, which will be shown in Part II. The general features of the Japanese fossil innominates, except for the Akashi, suggest that they belong to the Pleistocene Sapiens stage. Their characteristics are as follows: the concavity of the iliac anterior interspinous border is variable but tends to be more or less deep; the elevation of the vertical iliac buttress is moderate or traceable; its root comes around the middle portion of the upper part of the acetabular brim; the supracetabular fossa and the iliac sulcus are moderately developed; the angle between the inner iliac and ischial surfaces is also moderate. It is tentatively concluded that the Akashi innominate is in the Holocene Sapiens stage and probably modern.

Keywords Pleistocene, Innominate, Japan, Morphology, Nonmetrical-character

Introduction

Previously, the authors published a paper dealing with a general view of the morphology of innominate bones from Pleistocene in Japan (ENDO and BABA, 1982). In the above paper, the ilia of most of these innom-

inates as well as of the various well-known fossil innominates were restored in order to facilitate various measurements for comparisons, including especially comparisons by means of multivariate statistical analyses. Recently, such kinds of analyses are frequently carried out in the field of bone

morphology.

However, fossil specimens which are undamaged or restorable with tolerably objective bases are limited in number, as is well known. Therefore, the fossil specimens used for comparison in the previous report were not many, and some inaccurate estimations could not be avoided.

Almost all the fossil innominate bones were more or less damaged either in the deposits or at the time of uncovering. Consequently, these specimens have, in general, few mark points for the measurements standardized for osteometry, and there is only a small possibility of estimating accurately such points by means of restoration. Therefore, it seems that the reports on the fossil innominates give, in general, a small number of metrical data and subsequently indicate more or less poor results and vague conclusions.

On the other hand, most fossil innominates exhibit many nonmetrical characters on their surfaces that are hardly measurable by means of the usual measurement methods. Therefore, large amounts of description of these nonmetrical characters can be generally seen in those reports.

However, the method for obtaining a conclusion using such nonmetrical characters has mostly been only the speculation of the studying researcher. Therefore, the subjectivity of the researcher in this case cannot be eliminated. This situation often seems to cause confusion or leads to meaningless discussions.

This report aims to examine in more detail the nonmetrical characters of the innominates from Pleistocene in Japan by comparing them with various more or less damaged fossil innominates as well as with recent Japanese innominates of both sexes.

It also aims to clarify the general characteristics of Pleistocene innominates in Japan. No restorations are carried out in this study. Only small partial restorations for the necessary reconstruction carried out by the original researchers can be seen in the fossil specimens. These restorations and their influences are avoided as much as possible in observation.

The principal items of nonmetrical characters of the anterior part of the ilium, which is fairly well preserved in almost all the innominates in Japan, are selected for the purpose of enabling objective comparisons of all the specimens by common criteria. Though the examinations lay stress on these principal characters, other nonmetrical characters are also observed.

In the first part, descriptions concerned with those nonmetrical characters are shown on each specimen from Pleistocene in Japan and descriptive comparisons with other specimens are briefly made. Then non-parametric statistical analyses follow in the second part, based on the above descriptions for clarifying the positions of those innominates in human evolution.

In order to obtain objective results and conclusions as much as possible and to make these statistical analyses possible, the principal nonmetrical characters of each specimen are classified into successive categories which are defined by comparing these characters in all the fossil and recent specimens.

Preparation of Materials

In observing the surface character of the specimens, the differences in colour of the specimens seem to disturb the comparison of the pure form. Therefore, yellow gypsum casts were newly made in the case of the fossil specimens found in Japan as well as

the cast specimens of Pleistocene hominids for the purpose of avoiding this disturbance. Furthermore, the colour of the yellow gypsum is roughly similar to the colour of recent macerated bone. This makes it easy to compare the cast with recent macerated specimens. Photographs shown in the Plates of this paper are all of these casts.

Materials of Japanese Pleistocene Innominates

Specimens of the innominates from the Pleistocene in Japan available for this examination are as follows:

[Minatogawa I, II, III] These innominates were discovered together with the other parts of skeletons in the Upper Pleistocene deposit in a fissure of a limestone quarry at Minatogawa on Okinawa Island, South Japan. Innominates of four individuals were discovered in total, but IV was so severely damaged that it could not be used in this study. I is male; II and III are females. Though these individuals have the innominates of both sides, the better preserved side of each individual was selected for this study, that is, the left of I and the right of II and III. These specimens were reported together with the other postcranial skeletons by BABA and ENDO (1982). See Plate 3.

[Mikkabi] Discovered from the Upper Pleistocene deposit in a fissure of the limestone in a quarry at Mikkabi, Central Japan. The remaining part is only the anterior portion of the right ilium from the anterior part of the crest to the upper part of the acetabulum and to the greater sciatic notch. This specimen is regarded as male. This bone was reported by SUZUKI (1962), together with other bone fragments. See Plate 4.

[Akashi] Often called also by the name

of "Nishiyagi". An isolated left innominate found in a clod apparently dropped from the wall surface of the cliff in front of the beach at Nishiyagi near Akashi, West Japan. Some Pleistocene layers could be seen on the wall at the time of discovery. The discoverer maintained that the clod consisted of the soil of one of the above layers. The morphological observation of this innominate was written by HASEBE (1948). He concluded that this innominate was comparable to that of the *Homo erectus*. However, the authors have already indicated that this innominate belonged neither to the Erectus, nor to the Neanderthal, nor to the Pleistocene Sapiens (ENDO and BABA, loc. cit.). But this examination is again applied to this specimen in order to verify the previous conclusion of the authors. See Plate 4.

Materials of the Fossil Hominid for Comparison

For the purpose of comparison with the Japanese specimens from Pleistocene, the following casts of the innominates of the fossil hominids were selected.

Australopithecus stage

[Sts 14] Right innominate. Discovered at Sterkfontein in South Africa. This bone has been described by many researchers. The cast was made by the Wenner-Grenn Foundation. The anterior superior spine is broken off, but already restored by referring the remaining left spine. In general, the surfaces are to some degree cracked and compressed in the deposit. See Plate 1.

[Sk 50] Right innominate. Discovered at Swartkrans in South Africa. Reported by BROOM and ROBINSON (1950). The cast was made by the Philadelphia University Museum. The crestal part of the ilium and

Plate 1. Gypsum casts of the innominates used in this study in the *Australopithecus* and the *Erectus* stages.

Plate 2. Gypsum casts of the innominates used in this study in the Neanderthal and the Pleistocene Sapiens stages.

Plate 3. Gypsum casts of the innominates used in this study in Pleistocene Sapiens stage.

Plate 4. Gypsum casts of the innominates used in this study in the Pleistocene Sapiens stage and the Holocene Sapiens stage. RJ143 is a recent Japanese male and RJ2054 is a recent Japanese female.

the pubis are missing. Many cracks due to compression in the deposit can be seen. See Plate 1.

Erectus stage

[OH 28] Left innominate. Discovered with a femur at Olduvai Gorge in Tanzania, East Africa. The upper part of the ilium, the pubic part and the rami are missing. Cracks can be seen on its surfaces. Its morphology was reported by DAY (1971). The cast was made by the National Museum of Kenya. See Plate 1.

[Arago] Male left innominate. Discovered together with the other parts of a skeleton in a cave at Arago, Tautavel in France. The discovery was reported by DE LUMLEY (1979). Its cast was given by Professor DE LUMLEY. The specimen is severely cracked, but very little deformation can be seen. The pubic part and the rami are missing. See Plate 1.

Neanderthal stage

[Düsseldorf] Properly called "Neandertal". But it is called here by this name in order to avoid confusion by applying the same name to the specimen and to the evolutionary stage. Male left innominate. Discovered with the other parts of a skeleton. The middle to posterior part of the iliac crest is broken off. Also the pubic part and the rami are missing. Morphologically, it was reported by many researchers, above all, by KLAATSCH (1901) and McCOWN and KEITH (1939). See Plate 2.

[Amud] Male left innominate. Discovered together with all the principal parts of a skeleton in a cave called Amud in Israel, Western Asia. The upper part of the ilium, the pubic part and the rami are broken off. The surface are severely cracked. Its

morphology was written by ENDO and KIMURA (1970). See Plate 2.

[Skhul IV] Male. Both sides of the innominates remain, but the left side is used in this study. Discovered with other parts of a skeleton in a rock shelter called Skhul in Israel. The specimen was reconstructed and slightly restored by McCOWN and KEITH. The morphological report was written by them (1939). They concluded that this specimen was similar to the Sapiens rather than to the Neanderthal. See Plate 2.

Pleistocene Sapiens stage

[Oberkassel Male] Discovered from an Upper Pleistocene deposit in a quarry at Oberkassel near Bonn, Germany. Its morphology was reported by BONNET (1919). White gypsum casts of the left innominate and some other bones were brought to The University of Tokyo by someone before the Second World War. No documents were attached. During and after the war, these casts were slightly damaged. The left innominate is used in this study. The recent appearance of this cast, shown in Plate 2, is somewhat worse than that of the photographs reported by BONNET. The superior anterior part of the ilium is broken off and its anterior margin is damaged. Also the pubic part and the rami are broken into small pieces.

[Oberkassel Female] Discovered and reported together with the male. The present cast is left innominate, which was apparently brought and kept together with the male specimen. The anterior superior part of the ilium is broken. The anterior border was later slightly damaged and the rami remain in the form of small pieces. See Plate 3.

Material of Recent Japanese for Comparison

Because the majority of the fossil specimens are from the left side, also left innominates of recent Japanese were used for this study. Most of the specimens were extracted from the collection of the recent Japanese skeletons preserved in the Medical Department of The University Museum, The University of Tokyo. Three male specimens are from the collection of the Department of Anatomy of Dokkyo University School of Medicine.

The number of specimens is 21 in male and female cases respectively. Specimens used are all adult and are not senile. No other selection criteria were used in preparing the specimens. In other words, the specimens roughly constitute random samples of males and females respectively. The identification numbers of the male specimens from Dokkyo University are 54, 129 and 143. The identification numbers of the male specimens from the University Museum are 234, 236, 241, 242, 243, 255, 258, 267, 272, 276, 2138, 2156, 2159, 2177, 2390, 2394, 2547 and 2593. The identification numbers of the females are 239, 281, 282, 283, 284, 285, 290, 291, 292, 293, 300, 2054, 2057, 2058, 2062, 2063, 2065, 2068, 2070, 2072 and 2076.

The male and female specimens, shown in Plate 4, are their yellow gypsum casts for the purpose of comparison with other fossil specimens.

Principal Items of Nonmetrical Character

The pubis and the ischium in most of the fossil specimens are missing or damaged. Therefore, observation must be restricted to the ilium. However, even their ilia are

not complete. As the posterior part of the ilium of the Mikkabi and the Akashi is more or less broken and the same part of the other fossil specimens for comparison is also more or less missing, the items for the observation of nonmetrical characters must be limited to the anterior part of the ilium. Consequently, the possible observation items that can be regarded as important ones remain not many. Six items, which define the principal features of the anterior part of the ilium and the characters of which change markedly from the Neanderthal stage to the Recent Sapiens stage, are selected in this study. Subsequently, these items are not very useful for distinguishing between the Australopithecus and the Erectus or between the Erectus and the Neanderthal, though they are used for the criteria of the categorization of items. The reason for such a selection of items is that none of the Japanese fossil specimens seem to be earlier than the Neanderthal stage.

The following are the principal items selected and the definition of successive categories in each item in this study (cf. Fig. 1 and 2 and Plate 5).

1. *Concavity of the anterior interspinous border*

KLAATSCH (1901) pointed out the deep notch of the anterior interspinous border in the Neanderthal stage unlike the shallow notch in the Recent Sapiens stage.

In fact, this border is strongly concave in the Australopithecus and still markedly concave in the Neanderthal, but this concavity is usually weak in the recent Japanese. The grade of this concavity is classified into three successive categories; pronounced=3, moderate=2 and slight=1. Sts 14 is selected for the standard of

Fig. 1. Areas for showing the principal items of the nonmetrical character (from No. 1 to No. 5) of the innominate in Plates 5 and 6. Left is the inner view and right, the outer view. 1 CAIB is the area showing the concavity of the anterior interspinous border (Item No. 1); 2 PVIBR, the area showing the position of the vertical iliac buttress root (Item No. 2); 3 EVIBR; the area showing the elevation of the vertical iliac buttress ridge (Item No. 3); 4 DSF, the area showing the development of the supraacetabular fossa (Item No. 4); 5 DIS, the area showing the development of the iliac sulcus (Item No. 5).

category 3 and No. 54 of the recent Japanese, for the standard of category 1.

2. *Position of the vertical iliac buttress root*

Since COBAU (1929a, b) and MEDNICK (1955), the long thickened structure connecting the iliac crest and the acetabulum has

been regarded as a mechanically important structure of the ilium. This structure is named in various ways, i. e., pillar, thickening, bar and buttress. The term buttress is used in this study because it is most suitable in terms of architecture.

Many researchers have pointed out that

Plate 5. Standards of the highest and the lowest of the successive categories of the five principal items of nonmetrical characters defined in this study. **a** is Sts 14 defined as category 3; **b**, RJ54 defined as category 1; **c**, Sts 14 defined as category 3; **d**, RJ129 defined as category 0; **e**, OH 28 defined as category 3; **f**, RJ143 defined as category 0; **g**, Arago defined as category 3; **h**, RJ129 defined as category 0; **i**, Düsseldorf defined as category 3; **j**, RJ143 defined as category 1. RJ means recent Japanese.

Plate 6. Nonmetrical characters of the same items shown in Plate 5 in the cases of three representative innominates from Pleistocene in Japan examined in this study.

Character	Pronounced (3) Case	Absent (0) or Slight (1) Case
1. CAIB Concavity of Anterior Interspinous Border
2. PVIBR Position of Vertical Iliac Buttress Root
3. EVIBR Elevation of Vertical Iliac Buttress Ridge
4. DSF Development of Supraacetabular Fossa
5. DIS Development of Iliac Sulcus

Minato I

Mikkabi

Akashi

Fig. 2. Cross-sectional line of the inner surfaces of the ilium (IL) and the ischium (IS) for showing the angulation between them (Item No. 6) around the arcuate line (ARL). Arago is the standard of category 3; RJ143 (recent Japanese), the standard of category 1.

this buttress is located extremely anterior in the *Australopithecus* stage and still anterior in the Neanderthal stage, but it is comparatively posterior in the Recent Sapiens stage. This tendency is marked in the case of the observation of the restored ilium, as shown in the previous paper in the moiré isohypsigram, and more exactly in Fig. 3 for reference for this report. In this figure, it is redrawn to make a percentile interval contour-line map when the distance from the deepest point of the greater sciatic notch to the iliac crest through the cristal tubercle is taken as 100%. The thick lines show each vertical iliac buttress. However, the restoration includes speculations and can not be accurate. Therefore, as this report is based on the intact form of the specimen, i.e., unrestored form, this character is excluded from the items of this study.

The item here is the position of the root of the vertical iliac buttress in relation to the position of the acetabulum. It is fairly distinctly observable among various ilia that the root of the buttress is located contrary

to its upper and middle part; the former is shifted posteriorly in relation to the acetabulum in the case that the latter is located anteriorly, and the former is shifted anteriorly in the case that the latter is located posteriorly. This tendency is caused by the difference in inclination of the longitudinal axis of this buttress (cf. Fig. 4 in ENDO and BABA, 1982). Therefore, it is also important to observe the location of the vertical iliac buttress root in relation to the acetabulum for examination concerned with the evolution of the human innominate.

In the case of *Australopithecus*, this root passes behind the posterior brim of the acetabulum. This character is defined here as category 3 and its standard is also Sts 14. Generally in the cases of *Erectus* and Neanderthal, this root reaches to the comparatively posterior part of the upper portion of the acetabular brim. This character is referred to as category 2. When the root reaches to around the middle portion of the upper brim of the acetabulum, the category is defined as 1, and when it comes to the

anterior portion, the category is defined as 0. The recent Japanese No. 129 is selected as the standard of category 0.

3. *Elevation of the vertical iliac buttress ridge*

In the case of the well-developed vertical iliac buttress, it is markedly elevated to form a distinct ridge. The typical elevated ridge can be seen in the Erectus. This ridge is almost untraceable in many recent specimens.

The extreme elevation is seen in the case of the OH 28, which is defined as the standard of the pronounced type, that is, category 3. The development of this ridge is moderate in the Düsseldorf, which is referred to as the standard of category 2. The untraceable case is often observable among the recent Japanese specimens. No. 143 among them is selected as the standard of category 0. The cases intermediate between category 2 and 0 are defined as category 1.

4. *Development of the supraacetabular fossa*

The importance of the form of the supraacetabular fossa in human evolution has been pointed out by many researchers, especially by McCOWN and KEITH (1939).

The specimens from the Erectus stage have a deep and long fossa above the acetabulum around the end of its slope. Such a fossa can often be also seen in the Neanderthal stage. However, this fossa is usually absent in the recent Japanese. The highly developed (or pronounced) fossa of the Arago is defined as the standard of category 3, and the absent case of this fossa in No. 129 of the recent Japanese is defined as the standard of category 0. The moderately developed fossa of the Düsseldorf can be referred to as category 2 and

the slightly developed fossa of the Oberkassel Male as category 1.

5. *Development of the iliac sulcus*

There is a groove on the inner surface of the ilium just below the anterior inferior spine. This groove is called the iliac sulcus. Its size and shape have often been considered as an important character in studying the fossil innominate since KLAATSCH (1901).

In the case of the Düsseldorf, a deep and relatively long sulcus ranged by the wall-like elevations of the inner surfaces of the twisted anterior inferior spine and of the arcuate line can be observed. The development of such a sulcus is rather slight in the Australopithecus and also in the recent Japanese. In the latter case, this sulcus is rather short and shallow and sometimes like a half-cut shallow funnel in shape. This shape is quite different from the shape in the Düsseldorf. The pronounced long and deep sulcus in the Düsseldorf is defined as the standard of category 3 and the small and shallow sulcus in the case of No. 143 of the recent Japanese is defined as the standard of category 1. The intermediate development of this sulcus as seen in the Oberkassel Male can be referred to as category 2.

6. *Angulation between the inner surfaces of the ilium and the ischium*

The horizontal buttress connects the sacroiliac joint and the acetabulum and further extends toward the pubic symphysis as the superior ramus of the pubis. Thus, both sides of this buttress and the pubic ramus as its extension form a ring together with the sacrum. This ring plays an important role in terms of structure strength as PAUWELS (1948) stated. This buttress is,

in general, strongly thickened in the robust innominate. The thickened buttress forms an inward elevation which is either edged or blunt. The top of this elevation is commonly called the arcuate line.

The inner surfaces of the ilium and the ischium meet at this line at an obtuse angle. When the buttress is strongly thickened and elevated inward, the inner surfaces around this line is largely flexed. The strong flexion, i.e., the angulation, is generally seen in the Erectus and Neanderthal stages.

It seems at a glance that this item is measurable. However, it is hard to determine and fix the principal direction of inclination of the inner surface of the ilium. This surface is not a uniform plane, and the junction with the ischial surface does not often form a sharp ridge. Therefore, it is easier to treat this item as a non-metrical character.

This angulation is most pronounced in the case of the Arago, which is defined as the standard of category 3, and the weak angulation between the surfaces observed in the case of No. 143 from the recent Japanese is defined as the standard of category 1 (cf. Fig. 2). The moderate angulation as seen in the Oberkassel Male can be referred to as category 2.

As seen in the above explanations, the highest numbers of each successive category are defined in the cases of the archaic specimens, whereas the lowest numbers are defined in the cases of the rather gracile specimens of the recent Japanese for showing modern characters. The reason for such definitions is to make it easy to recognize how archaic the Japanese fossil specimens are

Characters of the Japanese Innominates from Pleistocene

The nonmetrical characters of the fossil innominates in Japan are observed principally according to the items described above. The following are the results of the observations of each specimens (cf. Table 1 and Plate 6).

Minatogawa I

The iliac anterior interspinous border is moderately concave (category 2).

The position of the root of the vertical iliac buttress is about the middle of the upper part of the acetabular brim (category 1).

The vertical iliac buttress is distinctly elevated, but it is neither high nor edged (category 2).

There is a distinct acetabulospinous buttress in this specimen, which is very rare among the ilia of the hominid. Because of the presence of this buttress, there is a distinctly depressed surface between these two buttresses.

The supraacetabular fossa is located slightly anterior to the center of the root of the vertical iliac buttress. It is small but traceable (category 1). It continues anteriorly to the groove between the acetabulospinous buttress and the outwards bulging lip of the anterior inferior spine. This spine is not large but thick and moderately twisted.

These facts partially cause the moderately developed iliac sulcus (category 2), which is not so elongated as in the case of the Neanderthal.

The inner surface of the ilium is fairly concave and the arcuate line forms a relatively sharp edge. The ischial surface

under this ridge is marked but moderately flexed from the iliac surface (category 2).

The thickness of the anterior superior spine is moderate. The development of the cristal tubercle is also moderate.

The outer surface of the ischial body forming the posterior wall of the acetabulum is fairly swollen.

There is a distinct depression of the outer surface of the ilium in the area between the vertical iliac buttress and the horizontal buttress, a thickened long structure connecting between the acetabulum and the iliosacral joint.

For other descriptions, see BABA and ENDO (1982).

Minatogawa II

The iliac anterior interspinous border seems slightly concave, though the part of the superior spine is missing (category 1). This feature is partially due to the only slightly protruded inferior spine. The twist of this spine is also slight.

The root of the vertical iliac buttress comes to the fairly posterior part of the upper portion of the acetabular brim (category 2).

A concave surface is observable between the vertical iliac buttress and the outer lip of the iliac crest around the anterior superior spine. This causes a distinct elevation of the vertical iliac buttress, which, however, is neither high nor edged (category 1). The cristal tubercle at the top of the buttress is moderately developed.

The supraacetabular fossa begins with a triangular depression at the slope of the superior posterior wall of the acetabulum, continues forward as a shallow groove and reaches to a round and markedly deep depression (category 1). This depression is

quite similar to that of the Oberkassel Female (cf. BONNET, 1919).

On the inner surface of the ilium, an internally elevated long ridge of the anterior inferior spine forms the upper wall of the iliac sulcus, which is moderately deep but relatively long (category 2).

The arcuate line is not sharp but round and blunt. However, the inner iliac surface is markedly flexed from the ischial surface (category 2).

The concavity of the inner surface of the ilium is weak. A markedly developed pre-auricular sulcus is observable, showing a female characteristic.

On the outer surface of the iliac wing, a large triangular depression is observable surrounded by a well-developed horizontal buttress, the highly elevated outer lip of the iliac crest and the vertical iliac buttress. Such a depression can be seen in all the Minatogawa specimens, but it is very remarkable in this specimen.

The angle of the greater sciatic notch is slightly less than a right angle.

Minatogawa III

The anterior superior spine is well preserved and strongly protruded. The inferior spine is also markedly protruded. Thus, the interspinous border is remarkably concave (category 3).

The root of the vertical iliac buttress meets the upper part of the acetabular brim at its middle portion (category 1). A branch of this buttress, i.e., the acetabulospinous buttress, runs obliquely forward as a straight ridge. Thus, two depressions between this buttress and the vertical buttress and between this buttress and the acetabular wall are distinctly observable.

The elevation of the vertical iliac buttress

is moderate (category 2). The cristal tubercle at its top is markedly developed and protruded outwards.

The supraacetabular fossa is a rather shallow groove in shape (category 1).

The anterior inferior spine is markedly twisted and its upper part is strongly protruded inwards, forming the upper wall of the iliac sulcus. Thus, this sulcus becomes relatively deep and long (category 2).

The arcuate line is rather blunt but fairly elevated. Thus, the inner surfaces of the ilium and the ischium meet at a moderate angle (category 2).

The angle of the greater sciatic notch is about a right angle. A marked preauricular sulcus is observable showing a female characteristic.

The area of the outer surface surrounded by the well elevated horizontal buttress, the likewise elevated outer lip of the iliac crest and the vertical iliac buttress is also remarkably depressed.

Mikkabi

The anterior interspinous border of the ilium in this specimen is moderately concave (category 2).

The root of the vertical iliac buttress comes directly to the supraacetabular fossa which is located just above the middle of the upper acetabular brim (category 1).

The elevation of this buttress is not remarkable, but distinctly traceable (category 1). Because of the elevations of this buttress and the horizontal buttress, the outer surface between them is apparently concave.

The supraacetabular fossa is small but not very shallow (category 1). It continues to a shallow groove at the root of the anterior inferior spine, which is moderately twisted.

Partially because of this twist, the iliac

sulcus is marked (category 2), though it is not so long and deep as in the case of the Neanderthal.

The arcuate line is not sharp but so prominent that the iliac surface is moderately flexed from the ischial surface (category 2).

The angle of the greater sciatic notch is relatively acute.

The outer surface of the ischial body at around the level of the acetabulum is moderately swollen.

The anterior superior spine is thin mainly due to abrasion in the deposit. It is as thin as that of the Akashi.

Akashi

The development of the anterior inferior spine is slight and almost not twisted, as often observable in the recent gracile Japanese specimens. The protrusion of the anterior superior spine is also weak. This spine is thin, partially due to abrasion in the deposit but mainly due to the gracility of this specimen. It is as thin as the same spine of the Mikkabi described before. Thus, the concavity of the interspinous border is slight (category 1), but such a slight concavity is sometimes observable among the recent Japanese specimens.

The root of the vertical iliac buttress is located in the slightly anterior portion of the upper part of the acetabular brim (category 0). This location can also be observed in the recent Japanese.

The area of the outer surface along the vertical iliac buttress is gently convex and the area anterior to this part is oriented markedly inward. But the distinct elevation of the proper vertical buttress is not observable, i.e., the buttress is only traceable (category 1).

Above the upper part of the acetabular brim, the margin of which is partially broken off, the surface forms a relatively gentle slope. Thus, the supraacetabular fossa is not observable (category 0), as in most cases in the recent Japanese.

Because of the absence of twisting of the anterior inferior spine, the iliac sulcus is short. It is also shallow, as is often observable among the recent Japanese (category 1).

The arcuate line is rather obscure and not markedly elevated. Hence, the inner surfaces of the both sides of this line are jointed at a rather large angle (category 1).

The inner surface of the iliac wing is remarkably concavely curved like a shovel between the anterior and posterior borders. This character is rare but exists among the recent Japanese specimens.

The anterior superior spine is located at a fairly low position. This feature is also rare but observable among the recent Japanese specimens, but never observable among fossil innominates.

The cristal tubercle is well developed as is often seen among the recent Japanese.

The area of the outer surface between the vertical iliac buttress and the horizontal buttress is very slightly concave unlike the other Pleistocene specimens in Japan.

The above-mentioned characters, which are rather gracile ones, imply that this individual may be female.

On the other hand, the angle of the greater sciatic notch is somewhat less than a right angle. The preauricular sulcus is absent. The distance between the anterior edge of the auricular surface and the center of the acetabulum is short. The acetabulum is somewhat larger than that of the female Minatogawa specimens.

These facts imply that this individual is probably male. In conclusion, it is hard to determine whether this individual is male or female.

Characters of Specimens for Comparison

The characters of the principal items of the specimens used for comparison are shown in Table 1 as the numbers of the successive categories. The table also shows the specimens from Pleistocene in Japan which are described above.

Generally, the specimens from the early stages of human evolution have higher numbers in each category. However, the slight development of the iliac sulcus, though LOVEJOY *et al.*, (1973) stressed its existence, and the moderate development of the supraacetabular fossa are the characteristics of the *Australopithecus* that differ from the *Erectus* and the *Neanderthal*. The extremely posterior position of the root of the vertical iliac buttress in the *Australopithecus* seems to be a feature earlier than that of the *Erectus*.

The Sapiens-like specimen of the Skhül IV, according to McCOWN and KEITH (1939), seems to be intermediate between the typical *Neanderthal* and the Pleistocene Sapiens such as the Oberkassel Male.

The specimens of the recent Japanese generally have low category numbers in most of the items, but they vary considerably. Some of them have relatively high categories in some items, but have also relatively low categories in the other items. Almost none of them have relatively high categories in many of the items. This feature is different from the feature of the specimens in the earlier stages. Only one specimen has many relatively high or

moderate categories and it seems like a specimen from the Pleistocene Sapiens Stage.

General Features of Japanese Fossil Innominates

There have been few papers dealing with the innominates from the Pleistocene Sapiens stage, especially those concerned with the nonmetrical characters. Moreover, the nonmetrical characters in this study are classified into the successive categories defined here by the authors. Consequently, the data or descriptions shown in the other papers, for example, BONNET (1919), GORJANOVIĆ-KRAMBERGER (1906) and MATIEGKA (1938), are hardly comparable. Therefore, the comparative examination or discussion must be limited to the specimens used in this study.

As seen in Table 1, the Akashi innominate has no high (archaic) categories in all the principal items defined in this study. Its categories are, in general, rather low (modern) even in the samples of the recent Japanese. Even if the individual having this innominate is a recent Japanese, this innominate is rather gracile one. Therefore, there is only a slight or almost non-existent possibility that this specimen belongs to the Pleistocene Sapiens. Rather, it should be considered that this specimen belongs to the Holocene Sapiens and that it is gracile and modern in shape even among innominates of the Holocene Sapiens. It rather seems that this specimen is modern one. Thus, the authors consider that the Akashi innominate should be excluded from the Pleistocene innominates in Japan.

The other four innominates from Pleistocene in Japan naturally vary according to the individual. But they tend to have many moderate categories and few low ones. This

tendency is different from such a tendency of the recent Japanese specimens, both male and female, in which the categories are mostly low.

On the other hand, the Japanese Pleistocene specimens are also different from the specimens of the Neanderthal stage, which have many high (or pronounced) categories. In particular, if the Skhül IV of the so-called Sapiens-like type is excluded from the Neanderthal Stage, the other two specimens are very similar to each other in the combination of the categories. It may be better to note that the innominate of the Krapina from the Neanderthal stage is also very similar in shape to the Düsseldorf according to GORJANOVIĆ-KRAMBERGER (1906). In conclusion, all the Japanese Pleistocene innominates examined in this study must belong to a later stage than the Neanderthal stage.

The male specimens and also the female specimen of the Minatogawa III are rather similar to the innominate of the Oberkassel Male in the combination pattern of categories, though its anterior border is missing.

Judging from the facts or tendencies described above, it may be concluded that all the fossil innominates in Japan, except for the Akashi innominate, belong to the Pleistocene Sapiens stage, as already classified in Table 1. However, this conclusion is obtained only from careful consideration. A more objective conclusion derived from nonparametric statistics will be given in Part II.

As the general features of the Japanese innominate in the Pleistocene Sapiens stage, the characteristics described below are observable.

The concavity of the iliac anterior interspinous border is variable, but it tends to be deeper in most cases than that of the

Table 1. Successive categories of characters of the principal nonmetrical items defined in this study in all the innominates used for examination (RJD are from the collection of the Dokkyo Univ.; RJT, from the Tokyo Univ.. * is questionable).

Specimen	Item	1. Concavity of Anterior Interspinous Border	2. Position of Vertical Iliac Buttress Root	3. Elevation of Vertical Iliac Buttress Ridge	4. Development of Supracetabular Fossa	5. Development of Iliac Sulcus	6. Angulation between Inner Surfaces of Ilium and Ischium
[Australopithecus]							
Sts 14		3	3	2	2	1	3
Sk 50		3	3	3	2	1	3
[Erectus]							
OH 28		3	2	3	3	2	2
Arago		3	2	3	3	3	3
[Neanderthal]							
Düsseldorf		3	1	2	2	3	3
Amud		3	2	3	2	3	3
Skhül		2	2	3	1	2	3
[Pleistocene Sapiens]							
Oberkassel Male		—	2	2	1	2	2
Oberkassel Female		—	1	1	1	1	2
Minatogawa I (male)		2	1	2	1	2	2
Minatogawa II (female)		1	2	1	1	2	2
Minatogawa III (female)		3	1	2	1	2	2
Mikkabi		2	1	1	1	2	2
Akashi*		1	0	1	0	1	1
[Recent Japanese male]							
RJD54		1	0	1	0	2	2
RJD129		2	1	1	1	2	1
RJD143		1	1	1	0	1	1
RJT234		3	1	1	1	2	2
RJT236		1	0	2	0	2	2
RJT241		1	0	1	0	2	2
RJT242		1	0	0	0	1	2
RJT243		2	0	0	0	1	2
RJT255		1	1	1	1	2	2

(continued on the next page)

RJT258	2	1	1	0	1	1
RJT267	1	1	2	0	2	2
RJT272	1	1	1	0	1	1
RJT276	2	0	1	0	1	1
RJT2138	2	1	1	0	1	1
RJT2156	2	1	2	0	1	1
RJT2159	2	0	1	0	1	2
RJT2177	1	1	2	0	1	1
RJT2390	1	0	1	0	1	3
RJT2394	2	1	1	0	2	2
RJT2547	2	0	1	0	1	1
RJT2593	2	1	1	0	2	1
[Recent Japanese female						
RJT239	1	2	1	1	1	1
RJT281	1	1	0	0	1	2
RJT282	1	1	1	0	1	1
RJT283	1	1	1	0	1	2
RJT284	1	1	1	0	1	1
RJT285	1	0	1	0	1	2
RJT290	1	1	1	0	1	2
RJT291	2	1	0	0	1	1
RJT292	2	0	1	0	1	2
RJT293	1	1	1	0	1	2
RJT300	1	0	1	0	1	1
RJT2054	1	1	0	1	1	2
RJT2057	1	1	1	0	2	2
RJT2058	1	0	1	0	1	1
RJT2062	1	1	1	0	2	2
RJT2063	1	1	1	0	1	1
RJT2065	1	1	1	1	1	1
RJT2068	1	0	1	0	1	1
RJT2070	2	1	0	0	1	1
RJT2072	1	1	1	1	1	2
RJT2076	1	0	1	0	2	2

recent Japanese. The position of the root of the vertical iliac buttress is, in general, located at the middle part of the upper portion of the acetabular brim. The elevation of this buttress is either moderate or traceable. The supraacetabular fossa is small and shallow, but distinctly exists in all the specimens. The development of the iliac sulcus is consistently moderate. The angulation between the inner surfaces of the ilium and the ischium is also consistently moderate.

Appendix

After the publication of the previous paper (ENDO and BABA, 1982), NAORA (1983) maintained, based on the moiré isohypsogram (contourogram) of this paper, that the Akashi innominate resembles the innominates of the Sts 14, the Arago and the Düsseldorf in the pattern of the contour-line distribution of the outer surface of the ilium. He also suggested that the Akashi specimen belonged to the Erectus stage, because the Akashi specimen was near to the specimens in the Erectus stage and distant from the Recent Sapiens specimens in the "average" inward inclination angle of the outer surface of the anterior part of the iliac wing.

However, as can be seen in Fig. 3, which is redrawn to make the percentile isohypsograms when the distance between the tops of the arrow are defined as 100%, the pattern of the contour-lines distribution is quite different between the Akashi and the other fossil specimens such as the Sts 14, the Arago and the Düsseldorf.

In the case of the Akashi innominate, the contour-lines show a smooth and nearly uniform inclination all over the anterior area. On the other hand, in the Sts 14, the Arago or Düsseldorf, the pattern of the

contour-line distribution is locally quite different. There are the strongly curved contour-lines showing the existence of a valley-like groove above the acetabulum, and a rather gentle slope near the anterior superior spine. Moreover, the absolute distance between the deepest point of the anterior interspinous border and the vertical iliac buttress ridge of the Akashi is absolutely larger than that of the Arago or the Düsseldorf, though the overall size of these is apparently larger than that of the Akashi.

As concerned with the average angle of the inward inclination of the outer surface, his calculation may be true. However, the average angle in the Sts 14, the Arago and the Düsseldorf mainly indicates a degree of elevation of the vertical iliac buttress ridge, because the inner surface of this region is almost flat in these cases (cf. Fig. 2 in ENDO and BABA, 1982). On the contrary, the average angle in the innominates of the Recent Sapiens and the Akashi principally reflects an inward flexion of the iliac wing itself at the vertical iliac buttress. Consequently, the actual meaning of the average angle is different between the above fossil innominates and the Akashi innominate.

The authors consider that the average angle has scarcely no morphological significance in this case and that the difference in the pattern of the contour-line distribution is more important for distinguishing the three-dimensional forms of the ilia. Thus, the Akashi innominate is quite different from the innominates in the Australopithecus, Erectus and Neanderthal stages.

Fig. 3. Percentile isohypsograms of the restored ilia when the distance from the deepest point of the greater sciatic notch (lower arrow) to the iliac crest through the cristalline tubercle (upper arrow) is defined as 100%. Thick lines show each ridge of the vertical iliac buttress. The thick broken line of the Sts 14 is the buttress obtained from direct observation. The innominate is so oriented that the top of the anterior inferior spine and the top of the posterior inferior spine are at approximately the same level (0) as well as the highest point of the cristalline tubercle and the highest point of the acetabular brim also are at approximately the same level.

This figure has been redrawn based on the moiré isohypsogram (contourogram) of Plate 6 of the previous paper (ENDO and BABA, 1982) and is used for the appendix.

References

- BABA, H. and B. ENDO, 1982: Chapt. 4. Postcranial skeleton of the Minatogawa Man. In: The Minatogawa man. The Upper Pleistocene man from the Island of Okinawa (eds. H. SUZUKI and K. HANIHARA). Bull. Univ. Mus. Univ. Tokyo, 19: 61-195.
- BONNET, R., 1919: III Die Skelete. In: Der diluviale Menschenfund von Obercassel bei Bonn (eds. M. VERWORN, R. BONNET und G. STEINMANN). Bergman, Wiesbaden, 11-185.
- BROOM, R. and J. ROBINSON, 1950: Notes on the pelvis of the fossil ape-man. Am. J. Phys. Anthropol., N.S., 8: 489-494.
- COBAU, A., 1929a: Sur la structure de l'os iliaque. Une nouvelle ligne de force. Ann. Anat., 6: 1133-1137.
- COBAU, A., 1929b: La role de la structure de l'os iliaque dans la statique du corps humain. Ann. Anat., 6: 1137-1138.
- DAY, M., 1971: Postcranial remains of Homo erectus from Bed IV, Olduvai Gorge, Tanzania. Nature, 232: 383-387.
- ENDO, B. and H. BABA, 1982: Morphological investigation of innominate bones from Pleistocene in Japan with special reference to the Akashi man. J. Anthrop. Soc. Nippon, 90 (Suppl.): 27-54.
- ENDO, B. and T. KIMURA, 1970: Postcranial skeleton of the Amud man. In: Amud man and his cave site (eds. H. SUZUKI and F. TAKAI). Univ. Tokyo/Keigaku, Tokyo, 231-406.
- GORJANOVIĆ-KRAMBERGER, K., 1906: Der diluviale Mensch von Krapina in Kroatien. Ein Beitrag zur Paläoanthropologie. In: Studien über die Entwicklungsmechanik des Primatenskelettes mit besonderer Berücksichtigung der Antropologie und Descendenzlehre (ed. O. WALKHOFF). Kreidels, Wiesbaden, 204-269.
- HASEBE, K., 1948: A human coxal bone from the Lower Pleistocene deposit at Nishiyagi, Akashi. J. Anthro. Soc. Nippon, 60: 32-36 (in Japanese).
- [長谷部言人, 1948: 明石市附近西八木最新世前期堆積出土人類腰骨(石膏型)の原始性について. 人類誌, 60: 32-36.]
- KLAATSCH, H., 1901: Das Gliedmassskelet des Neanderthalmenschen. Anat. Anz., 19 (Erghft.): 121-154.
- LOVEJOY, C., K. HEIPLE and A. BURSTEIN, 1973: The gait of Australopithecus. Am. J. Phys. Anthropol., 38: 757-780.
- DE LUMLEY, H., 1979: L'homme de Tautavel. Dossiers de l'Archéol., 36: 54-59.
- MCCOWN, T. and A. KEITH 1939: The stone age of Mount Carmel. Vol. 2. The fossil human remains from the Levallois-Mousterian. Clarendon, Oxford.
- MATIEGKA, J., 1938: Homo předměstensis. II. Ostatní části kostrové. Nákladen české Akademie Věd o Umění, Praha.
- MEDNICK, L., 1955: The evolution of the human ilium. Am. J. Phys. Anthropol., 13: 203-216.
- NAORA, H., 1983: A critical view of the argument against the human innominate bone of Nipponanthropus akashiensis. J. Anthrop. Soc. Nippon, 91: 489-496 (in Japanese with English summary).
- PAUWELS, F., 1948: Beitrag zur Klärung der Beanspruchung des Beckens, insbesondere der Beckenfugen. Z. Anat. Entwckl. Gesch., 114: 167-180.
- SUZUKI, H., 1962: 1. Skeletal remains of Mikkabi man. In: Mikkabi man and the fossil bearing deposits from Tadaki limestone quarry at Mikkabi, Central Japan. J. Anthrop. Soc. Nippon, 76: 1-20, 46-48 (in Japanese with English summary).

抄 録

日本更新世人寛骨の非計量的特徴に関する研究

第1部 記載

遠藤萬里¹⁾・馬場悠男²⁾

1) 東京大学理学部人類学教室・総合研究資料館人類先史部門

2) 独協医科大学解剖学教室

以前に、日本更新世人の寛骨の形態について発表 (ENDO and BABA, 1982) したが、その際は、上記の寛骨と世界各地の諸進化段階の寛骨の形態を比較検討するために、腸骨を部分的に復原構成した寛骨の模型標本にもとづいて、各種の観察や計測を行い、計量的多変量統計解析により結論をえた。しかし、推定して復原できる化石寛骨は少なく、また推定には多少の誤差も含まれるため、結果にはある程度の限界があった。

今回はあまり標本の完全さを必要としない非計量的諸性質に関する観察を、同じく日本更新世人寛骨について行った。この第1部では観察結果の記載と単純比較について述べ第2部でそれらの結果にもとづくノンパラメトリック統計解析を行う。

対象とする標本は港川 I (男性)・II (女性)・III (女性)、三ヶ日 (男性)、明石 (男性?) である。比較標本には、アウストラロピテクス段階から Sts 14 と Sk 50, エレクトス段階から OH 28 と Arago, ネアンデルタール段階から Düsseldorf (Neandertal) と Amud および Skhul IV, 更新世サピエンス段階からは Oberkassel Male と Oberkassel Female の石膏模型標本を用いた。また、現代人の比較標本として、東京大学総合研究資料館医学部門および独協医科大学解剖学教室の収蔵する標本から、男性21個体、女性21個体の左寛骨を無作為的に選んで用いた。ただしこの場合、老人を除く成人に

限定した。

非計量的性質の観察は、化石の残存状態からみて、腸骨の前半部に限定せざるをえなかった。観察項目は腸骨前縁の棘間縁の凹みの程度、腸骨垂直扶壁 (垂直隆起) の基部の位置、同扶壁の稜形成の程度、寛骨臼上窩の発達程度、腸骨溝の延長および深さの程度、内面の弓状線付近における腸骨面と坐骨面との屈曲の程度である。ただし、対象標本については他の記載も行った。

上記の項目の性質は、観察により、0 から 3 ないし 1 から 3 の順次カテゴリーに分類して客観的に記録した。最高のカテゴリーの 3 については化石人類の寛骨から、最低のカテゴリーの 0 ないし 1 については現代人から選んだものを分類基準として設定した。各順次カテゴリーは全標本を見比べながら判定した。この順次カテゴリーを使用した理由は、観察の結果をできるだけ客観的にとらえることにもあるが、第2部に述べるノンパラメトリック統計解析に便利のためである。

この第1部における観察・記載の結果から、明石を除く更新世堆積出土の日本の寛骨はみな更新世サピエンス段階にあると考えられるに至った。それらの特徴を列記すると下記の通りである。棘間縁には変異が多いが、どちらかというと、大なり小なり深いものが多い。腸骨垂直扶壁の基部は寛骨臼のおおよそ直上に位置する。同扶壁の稜形成はやや強い中程度である。寛

骨臼上窩の発達は強くはないがすべてに存在する。腸骨溝はみな中程度の発達を示す。内側面において、弓状線を挟む領域における腸骨面と坐骨面の屈曲も、みな中程度である。要するに、一般的傾向として、日本更新人寛骨は、ネアンデルタール段階以前の高いカテゴリー値群と、現代日本人の低いカテゴリー値群との中間的でやや低めのカテゴリー値群を持つといえる。このようなカテゴリー値群を持つ現代日本人寛骨は、今回用いた42例中に1例しかない。また逆

に、ネアンデルタール段階以前の寛骨には、このような中間的カテゴリー値群を持つものは全くない。

なお、明石寛骨はこれらの項目のカテゴリー値がすべてにわたって低く、男性としても女性としても、完新世人のものとは考えられない。さらに、それらのカテゴリー値は現代日本人としても低い部類に属し、華奢であることを示している。

遠 藤 萬 里 東京大学理学部人類学教室
〒113 東京都文京区本郷7丁目3番1号

Banri ENDO Department of Anthropology, Faculty of Science, The University of Tokyo
Hongo 7-3-1, Bunkyo-ku, Tokyo 113, Japan