Chapter 10
Neanderthal Geographical and Chronological Variation

Bernard Vandermeersch and María Dolores Garralda

Abstract There is now a reasonable sample of human fossils from the European Middle and beginning Upper Pleistocene. However, our ability to fully understand their evolutionary relationships and the part they played in the ancestry of the Neanderthals remains uncertain. Part of the reason for this is the fragmentary nature of many of the finds, with fossils preserving different anatomical features, making detailed anatomical comparisons difficult or impossible. An equally important obstacle to our knowledge of this part of human biological history are the often difficult to interpret and conflicting dates that have been obtained for many of these finds. Nevertheless, a number of fossils, including the sizable sample from the Sima de los Huesos, testify to the European ancestry of the Neanderthals, although the possible presence and gen-flow from groups of Asian or maybe African origins cannot be excluded.

At present, our knowledge on the Neanderthals must consider the huge geographic area where they have been identified, the chronological span throughout more than 140 ky, and the very diverse environments to which they adapted. The second part of this chapter is the summary of the main points about the Neanderthal variability and biodynamics.

Keywords Neanderthal variability • Middle Pleistocene hominins • Human evolution • Europe • Western Asia • Dating

Introduction

Neanderthal variability can be studied from two points of view, chronological and geographical. The first one consists not only of reconstructing the origin and evolution of the Neanderthal morphology, but also in determining if prior to their evolution there were several species coexisting in Europe, or only one. Further, considering the latter possibility there are two current interpretations: either the Neanderthals have a long history as an evolutionary species, *Homo neanderthalensis*, or they derived from *Homo heidelbergensis*.

Geographical variability can only be analyzed at the end of the Neanderthal lineage, during OIS 4, when the maximum territorial expansion of this group seems to be documented, and the human remains are more numerous.

We will deal shortly with these two questions. Our aim is not to provide answers, but to focus on some current problems in the study of Neanderthal evolutionary biology.

Chronological Variability

To analyze this problem it is necessary to examine the chronology of some European fossils, in relation to their morphology, in order to consider the possibility of the presence of one or two species in Europe at the beginning of the Middle Palaeolithic (~at about 250 ky). An additional aspect of this question is the identification of *Homo heidelbergensis* in Europe.

Mauer

The Mauer fossil presents two important and unsolved problems: its unknown stratigraphical position (thus, its age is uncertain) and the fact that it is an isolated mandible (Fig. 10.1). Both uncertainties make it very difficult to interpret this specimen from a phylogenetic perspective.

Accidentally discovered in 1907, at the bottom of a loess quarry, the exact level from where the fossil originated is

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Fig. 10.1 Mandible of Mauer (Germany), *right lateral view* (Photo courtesy of A. Mounier)

unknown, and the quarry has since been altered. Consequently, it is impossible to replace it in its correct chronostratigraphical position. However, Wagner and Beinhauer (1997) have produced a remarkable work combining the analysis of ancient documents with a new study of the site furnishing more precise information about this discovery. According to their data, the mandible comes from the inferior sands of Mauer (Fundschicht) and can be assigned to isotopic stages 13–15. Thus, age estimation for this fossil is between 474 and 621 ky (Wagner and Beinhauer 1997).

In the monograph published in 1908, Schoetensack focused on characteristics which he called "primitive," creating the species *Homo heildelbergensis*. But at that time, the age of the fossil was totally unknown and the interpretations later proposed depended on the antiquity attributed to the fossil. For Piveteau, for instance, the mandible dated from the "Final Villafranchian"; however, in the "Traité de Paléontologie" (1957), he examined it together with the Neanderthals, but in a separate chapter. During the symposium celebrating the centenary of the Neanderthal discovery, von Koenigswald (1958) included Mauer in a list of German Neanderthals, but without comment because of the fossil's primitive morphology. More recently, the title of the book commemorating the 85th anniversary of the Mauer discovery is: "Schichten – 85 Jahre *Homo erectus heidelbergensis*" (Beinhauer and Wagner 1992), and still more recently, another publication reattributed to the fossil the name of the species created by Schoetensack (Wagner and Beinhauer 1997). These remarks illustrate the difficulties in the interpretation of this mandible. It possesses unquestionable archaic characteristics, but resembles neither Asiatic or African *Homo erectus*, nor the Neanderthals. It does not present typical Neanderthal features such as the backward position of the mental foramen, the retromolar space, the relation of the extremity of the sigmoid notch and the condyle, or the development of the anterior teeth (Condemi and Koenigswald 1997).

For some researchers, Mauer and some other European fossils, such as Arago and Petralona, represent one European species, *Homo heidelbergensis*, which could be a "grade" on the Neanderthal lineage (Rosas and Bermúdez de Castro 1998).

Arago

The "Caune de l'Arago" (Tautavel, France) is one of the major sites of the ancient Palaeolithic of southern France. The excavations, directed by H. de Lumley, uncovered numerous human remains, including the anterior part of a skull and two mandibles (H. de Lumley and M.-A. de Lumley 1971; de Lumley 1982). Most of them, especially the skull Nº 21, come from layer III, with an age of around 450 ky on the basis of the associated mammals (Iacumin et al. 1996). Direct dating of cranium Arago 21 by uranium series and gamma spectrometry gave a similar result, but with a high degree of uncertainty (Yokoyama and Nguyen 1981).

If the age of 450 ky is correct, this fossil is possibly contemporaneous with, or slightly older than those from the Sima de los Huesos at Atapuerca (Spain), which is in accordance with the morphological data. The Arago skull presents archaic characteristics, such as a very receding frontal, the morphology of the *torus supra-orbitalis,* and the shape of the palate. It also possesses Neanderthal features such as the development of the facial region and the obliquely backward malar bone. These characteristics are more developed on Neanderthal skulls, but there is no doubt that Arago is on the lineage which evolved to the later Neanderthals.

However, the mandibles Arago 13 and Arago 2 do not present derived Neanderthal characteristics and they are very different from each other. Their dimensions and robustness are different, but both have some similarities with the Mauer mandible, demonstrating the difficulty of interpreting an isolated jaw. Considering that the Arago mandibles lack real Neanderthal characteristics, while the upper face displays some of them, it is possible that Mauer, a little more ancient, could correspond to a human group displaying similar "mosaic" morphology.

Boxgrove

An incomplete tibia and two isolated teeth were uncovered at the Boxgrove site (Sussex, England), and dated from the OIS 13, around 500 ky, confirmed by geological, macro- and microfaunal data (Stringer et al. 1998; Stringer 2006). Thus, these remains are penecontemporaneous with the Mauer mandible. Associated with Acheulean artifacts, the tibia is exceptionally robust. The study of diaphyseal sections shows proportions comparable with those of the Neanderthals and seem to reflect cold adaptation (Trinkaus et al.1999).

However, because it is an adaptation known in various species of homeotherm vertebrates and appears independently in various human populations, it remains uncertain if this resemblance to the Neanderthals has any phylogenetic significance. Nevertheless, this fossil may represent, with Mauer, Arago, and Swanscombe, "early members of a western European lineage that culminated in the last glacial Neanderthals" (Trinkaus et al. 1999). It has been attributed to *Homo* cf. *heidelbergensis* by its discoverers who, however, remarked that the morphological characteristics of the tibia largely overlap various populations, making it difficult to propose a precise taxonomic status for Boxgrove.

Atapuerca – Sima de los Huesos

At least 27 individuals, represented by skulls, mandibles, and postcranial elements, have been recovered from the site of La Sima de los Huesos at Atapuerca Hill (Burgos, Spain). Although there are important chronological problems, the site has become the most important European Middle Pleistocene site (Arsuaga et al. 1997).

Combined U-series and ESR, dating of both speleothem and human bones, appeared to provide a minimum age of about 200 ky and suggestive evidence of possible entry prior to 320 ky (Bischoff et al. 2003). More recently, however, reanalysis of the speleothem produced dates of around 530/600 ky (Bischoff et al. 2007). The presence of *Panthera leo* suggests a maximum age of 600 ky because this is the lower limit of its presence at the Iltalian site of Isernia. The rodent *Mimomis savini* is absent in the Sima de los Huesos, while it is present in layer TD8 of the Gran Dolina, dated to about 596/615 ky (ESR and U-series on mammal teeth, Falguères et al. 1999). Thus, the Sima de los Huesos sample is probably less than 600 ky, with a reasonable estimate of their age between 350 and 450 ky.

Morphologically, the Sima de los Huesos fossils appears younger than Mauer and Boxgrove, and possibly also Arago, but they are much more complete, with remarkably preserved skulls.

In their study of the crania, Arsuaga et al. (1997) emphasized the presence of archaic characteristics which are absent on the Neanderthals (the sagittal keel, for instance), but they also documented the presence of derived features, such as a protruding middle face. But the Neanderthal features do not have the same development as on the typical Neanderthals, and the authors cited above considered that the skulls of Saccopastore (Italy; Fig. 10.2) were more similar to the Sima de los Huesos specimens than the typical Neanderthals, some of them of very recent chronology.

There is no doubt that the Sima de los Huesos series represents a stage in the process of "Neanderthalization," which took place in Europe throughout the Middle Pleistocene and the beginning of the Upper Pleistocene. These series were on the Neanderthal lineage, even if all the apomorphies are not yet present. Skull Nº 5, for instance, presents a face with many of the traits associated with Neanderthal midfacial prognatism, but the shape and morphology of the vault are quite different from those of the Neanderthals.

Vérteszöllös

The site of Vérteszöllös is situated on a terrace of the Atalér river, 50 km to the west of Budapest. It was a quarry where, in 1965, an occipital and a deciduous molar were found associated with fauna and a Clactonian industry (Vértes 1965). Four layers were identified at the site, the human remains coming from the lowest.

The fauna is abundant and has been attributed to an interstadial of the Mindel glaciation (Kretzoi and Vértes 1965). Initial results by the U-series technique gave an age

Fig. 10.2 Skull of Saccopastore 1 skull (Italy), *right lateral view* (Photo courtesy of A. Mounier)

of between ~250 and 475 ky (Cherdyntsev et al. 1965); later determinations were between ~250 and 350 ky (Cherdyntsev 1971). More recently, other samples indicated ~185/210 ky (Schwarcz and Lathan 1990). These radiochronological dates are very imprecise, but the abundant macro- and microfauna indicate a Mindel interstadial, and an age of ~350 ky. Vérteszöllös could be more or less contemporaneous with la Sima de los Huesos, or slightly younger, but in order to know the chronological position of the Vérteszollos remains, it would be necessary to obtain more precise dates.

The occipital, described by Thoma (1966), does not possess the general morphology of the Neanderthal occipital in the *torus*, or the suprainiac fossa, but it has a *torus* directed upwards toward the sagittal region, which resembles that of ancestral populations, although it has a tubercle at the end of the right side. Hublin (1988) suggested the possibility that this morphology could have evolved to the Neanderthalian supra-iniac fossa if the area progressively became more and more concave, simultaneously decreasing in height and developing the tubercles at both extremities.

But, strictly speaking, Vérteszöllös occipital lacks Neanderthal apomorphies, and it must be remembered that the fossil corresponds to a period when the human remains reflect a wide diversity. We ignore the morphology of other regions of the Vérteszöllös skull.

Bilzingsleben

Bilzingsleben is an open air site, in the Wipper Valley (Thuringia, Germany), 35 km north of Erfurt. The archaeological deposits are in the lowest part of a travertine sequence, and excavations directed by D. Mania discovered numerous human fragments representing at least three individuals. Two adult skulls have been partially reconstructed.

The industry is a variety of micro-Clactonian and the associated fauna is abundant (Mania et al. 1980). Paleontological and paleobotanical data indicate a moist climate which could correspond to the Holstein interglacial,

~280–300 ky (Mania and Thomae 2006). But U-series analysis gave an older age, around 350 ky (Schwarcz et al. 1988).

Cranial vaults are thick. The frontal fragments possess projecting *torus* and very receding squamas. There are numerous occipital fragments, angulated and with a very robust *torus*. Those fossils lack Neanderthal traits, and with such a morphology it is difficult to integrate them into the Neanderthal lineage. Vlcěk (1989) and Mania et al. (1994) assigned them *Homo erectus*.

In conclusion, the Bilzingsleben human remains appear to be different from the Pre-Neanderthals. They also seem more recent than Arago, and penecontemporaneous to Vérteszöllös and La Sima de los Huesos. This interpretation means that *two lineages* were present in Europe during the Middle Pleistocene, but several cautions must be observed. The first is that the Neandertal lineage probably evolved by accretion and fragmentary fossils such as those of Bilzingsleben may not present apomorphies that are present, at the same time, on others. Additionally, the inaccuracy of many dates and, consequently, that the chronological position of the European fossils is still unclear.

Swanscombe

The site of Swanscombe (Kent, England) is a stratified deposit of gravels and clays. At the lowest part of the deposits were found, in 1935, 1936, and 1955, the two parietals and the occipital from the same skull, with a rich fauna and an Acheulean industry.

The fossil is assigned to the Holstein interglacial on the basis of the fauna, and could be ~300 ky old, although geomorphological investigations of the terrace estimate an age of about 400 ka (Stringer and Hublin 1999). The incomplete skull is very different from the Bilzingsleben human remains, because the occipital is rounded, without a centrally strong *torus*. On the contrary, the weak occipital *torus* displays a bilateral projection and is surmounted by a central suprainiac fossa and the occipital plane is strongly convex.

Steinheim

The skull of Steinheim (Germany) was discovered in 1933, in a river deposit of gravels and clays with a diversified fauna assigned to the OIS 7, ~225 ky (Adam 1954a, b, 1985). There was no lithic industry.

The skull is crushed and deformed but many characteristics can be observed. Hublin (1988) showed clearly that the occipital area can be integrated into the Neanderthal evolutionary line. The face is short with a concave area below the orbits and an angulated malar bone. This aspect could be accentuated by the *post mortem* distortion, but the face was not typically Neanderthal, and the fossil can represent another example of the mosaic evolution.

Petralona

The Petralona skull (Greece) was found accidentally (in 1959), in a cave 37 km from Thessaloniki. Because the sediments were covered by a stalagmitic floor that partially covered the skull, the stratigraphical position of the fossil is unknown. Liritzis (1980) identified two layers, one brown-red and another paler. The same brown-red layer was identified at the top of the stalagmitic deposit of the cave. Unfortunately, the U-series dates are very inaccurate, ranging from 150 ky to more than 350 ky. ESR determinations show a similar range, from 127±37 to 340 ky. More recently, Grün (1996) reanalyzed the ESR dates and concluded that the age was ~150–250 ky, which is in accordance with most of U-series results.

Morphologically, the skull (Figs. 10.3 and 10.4) presents, like Arago 21, a Neanderthal-like protruding mid-face, associated with some archaic features, such as a prominent and angular *torus occipitalis*.

Biache-Saint-Vaast

Two partial skulls were exhumed from Biache-Saint-Vaast (France) in a terrace of the river Scarpe. Biache-Saint-Vaast 1 was found in place in 1976, while Biache-Saint-Vaast 2 was found later, fragmented and mixed with faunal remains.

Biache 1 was just above the layer IIA. The pollen, the microfaune, and the molluscs correspond to a temperate climate event in the Saale glaciation (Tuffreau et al. 1978). The layer is dated by thermoluminescence at ~175 ky (Huxtable and Aitken 1988). The industry is an abundant Mousterian of La Ferrassie type (Tuffreau 1988).

On Biache 1, only the half posterior part of the skull is preserved, exhibiting characteristic Neanderthal morphology, with suprainiac fossa, small mastoid apophysis, and protruding occipitomastoid crest. The general pattern of the vault is also typical, with a transverse profile "*en bombe*" and an occipital curvature very similar to those of La Chapelle-aux-Saints or La Ferrassie (Rougier 2003).

The problems of estimating populational morphology by taking into account only one individual are well demonstrated with the Biache sample: the unpublished and fragmentary male adult Biache 2 corresponds to a very robust individual with a thick and protruding *torus supraorbitalis*, unexpected when considering Biache 1. The differences in what parts of each fossil are preserved make attemps at morphological comparisons extremely difficult (Biache 2,

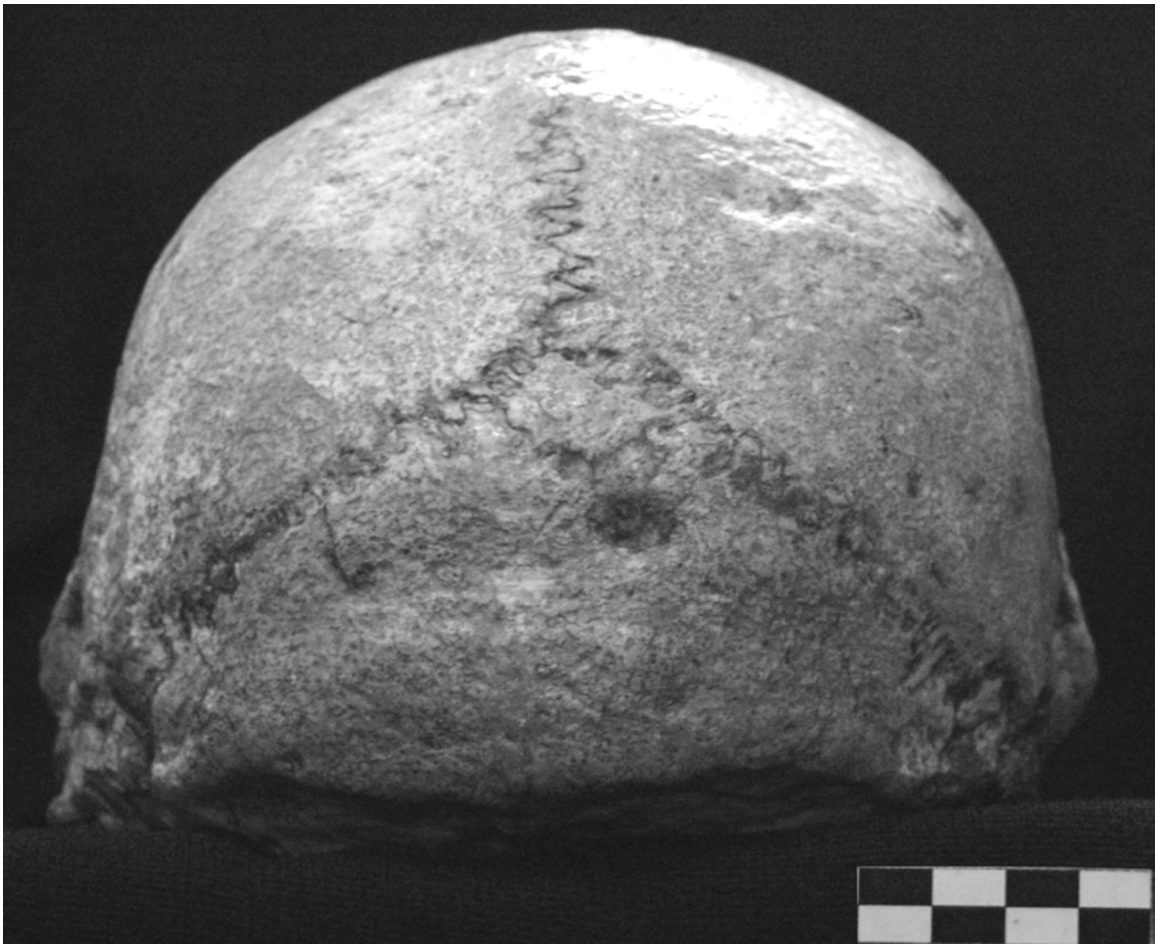

Fig. 10.3 Skull of Petralona skull (Greece), *occipital view* (Photo courtesy of A. Mounier)

for example, lacks the posterior portion of the vault present in the presumed young female, Biache 1).

After the time of the Biache-Saint-Vaast fossils, ~175 ky (OIS 6), all European human remains can be assigned to the Neanderthal group.

Conclusions

There are some other European fossils between 500 and 150 ky, such as Fontana Ranuccio or Castel di Guido (Italia) which are possibly older than 400 ky, and those from Apidima (Grecia), Reilingen (Germany), and Montmaurin (France), but all of them are difficult to place chronologically. Although they were not discussed in the present paper, they do not alter our conclusions.

Taking into account their morphological characteristics, the Bilzingsleben fossils – probably a little more recent than those from Arago and La Sima de los Huesos – diverge from the Preneanderthals from the two latter sites. This observation may perhaps indicate that until about 350 ky ago, or a little earlier, two evolutionary lineages existed in Europe, one of late *Homo erectus*, another of Preneanderthals. Nevertheless, caution must be exercised, not only because of the difficulties associated with comparisons of fragmentary fossil specimens, often preserving different parts of their anatomy, but also due to the tentative nature of the chronological placement of many of them. Thus, the presence in Europe of two populations throughout the Middle Pleistocene can be only a hypothesis.

This raises several questions about the concept of *Homo heidelbergensis.* As usually presented for Europe, it is possible to distinguish two periods in the Neanderthal lineage, two chronospecies, *Homo heidelbergensis* (Preneanderthals) and *Homo neanderthalensis.* However, this results in the lumping together into the same taxon, *H. heidelbergensis,* isolated or fragmentary bones, such as the Mauer mandible or the Boxgrove tibia, too incomplete to be rigorously interpreted, with other more complete fossils, such as Arago, Swanscombe, Petralona, or La Sima de los Huesos, which present a mixture of archaic and modern features. The problem

Fig. 10.4 Skull of Petralona skull (Greece), *right lateral view* (Photo courtesy of A. Mounier)

is that several of these modern features are generally considered as Neanderthal apomorphies. In any event, if the taxon *H. heidelbergensis* is to be preserved, it will be necessary to establish a functional diagnosis, which, in our opinion, does not exist, and this would inevitably entail a revision of the apomorphies of the species *H. neanderthalensis.*

Faunal studies (Koenigswald, present volume) demonstrate that during most of the Middle Pleistocene, humans are predominantly documented in Central Europe during interglacial periods and seem to have migrated with elements from the Mediterranean and Southeast regions. So, very probably, human fossils document not a "genetic continuity" but multiple migrations from different origins and in small groups.

Consequently, the biological history of Europe between ~500 and ~300 ky was probably more complex than usually considered. The possibility that gene flow existed, among the diverse groups moving throughout Eurasia, cannot be excluded, although, if such was the case, it was necessarily moderated because of the scant number of individuals. This complexity is also probably reflected in much older fossils such as Ceprano or Gran Dolina, especially the ATD6-96 mandible (Carbonell et al. 2005).

The Diversity of the Neanderthals

Known Neanderthal remains extend over a huge geographic area across all European regions not covered by ice, and a great part of Asia, from the north of the Black Sea, Turkey, Near and Middle East (Syria, Israel, Iraq, Iran) to Central Asia, where, in Uzbekistan, was found the Teshik Tash site. At present, the eastern and northernmost fossils are the isolated teeth from Denisova and Okladnikov in the Altai Mountains, in the south central region of Siberia.

Such a vast geographical area, covering more than 11,000,000 km^2, deserves consideration of the very diverse environments, many of them periglacial, where these Neanderthal populations lived and to which they adapted. Accordingly, living conditions, the flora and the fauna varied during the warm and cold periods, depending also on the different latitude or altitude of each region. These different paleoenvironments must have had important consequences on the biodynamics of the human groups, but are difficult to appreciate because of the fragmentation and dispersal of the human remains.

Chronologically, Neanderthal remains have been identified between 170/160 ky and perhaps 30 ky. There is thus a partially documented evolutionary history of more of ~130 ky, more than 5,200 generations. This is important to take into consideration because throughout this period, numerous macro- and microevolution factors must have acted with different intensity, according to the circumstances of each population. Geochronological studies indicate that the oldest typical Neanderthal remains appear during a warm and humid period, the Riss-Würm (or Eemien) interglacial, which corresponds to OIS 5. Nevertheless, most of the fossils are attributed to the two cold periods of the Early Würm (OIS 4), whereas the most recent findings corresponded to the Hengelo interstadial (OIS 3) with mild climatic conditions.

There are ~400 Neanderthal individuals discovered throughout this vast territory, although most of them are isolated bones and teeth, frequently fragmentary and incomplete. To estimate the biological diversity of these human groups, and therefore to identify regional populations (representing clinal groups), it would be necessary to have skeletal series, or at least several complete individuals, which is not the case. In reality, the whole sample is poor and incomplete, and the example of the Spy crania (Figs. 10.5 and 10.6) shows that individual variation can be significant. Genetics demonstrate that intrapopulational variation is much more important than that existing between two different populations.

In the Spy case, the two craniums (Figs. 10.5 and 10.6) present relatively significant differences. Spy II is shorter, with higher forehead and less prominent *torus*; its sagittal profile shows higher cranial vault and the occipital less extended towards the rear. It also has been shown that Spy I is slightly careened, while Spy II is not.

Those differences attracted the attention of several researchers, for example, in 1930 Hrdlička approximated Spy II to modern morphology. Later, Thoma (1975) rejected

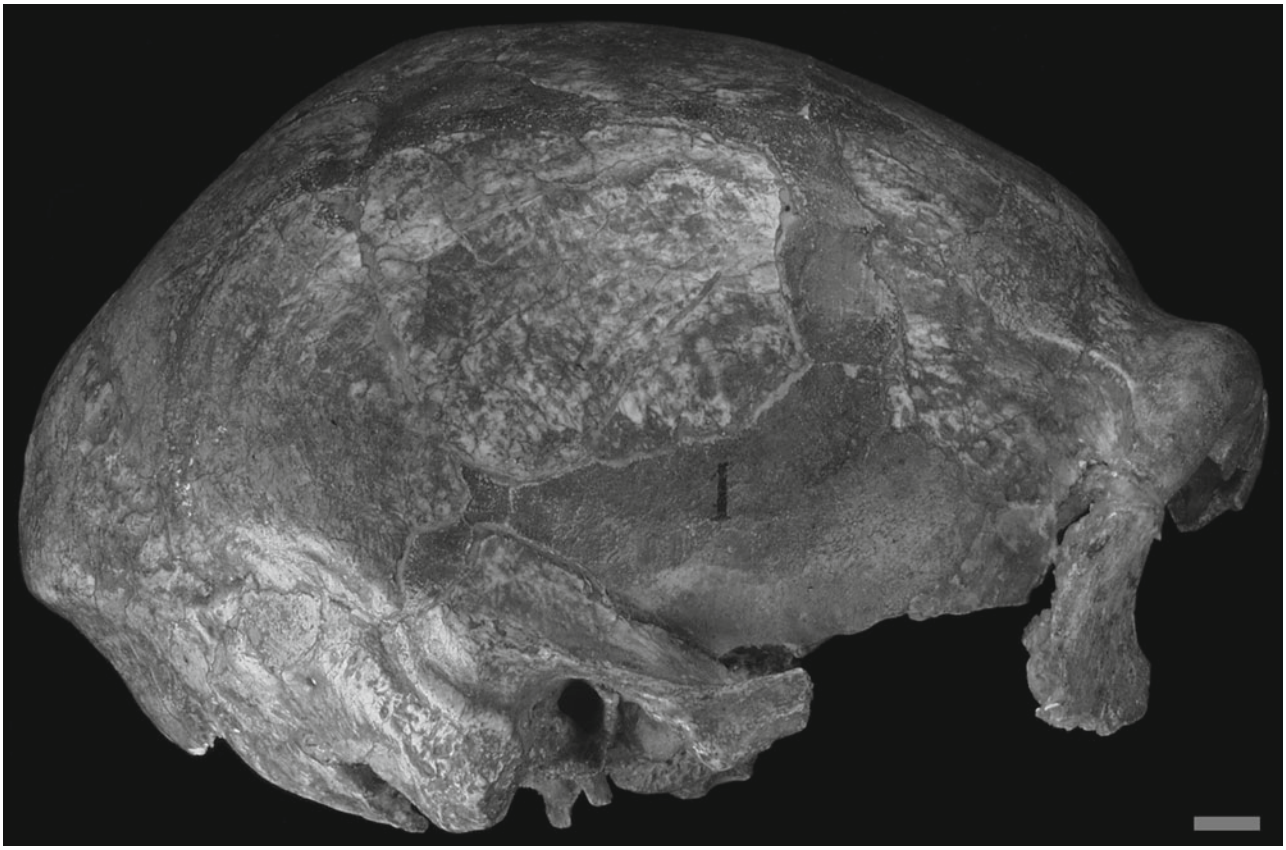

Fig. 10.5 Skull of Spy 1 (Belgium), *right lateral view* (Photo courtesy of the Institut Royal des Sciences Naturelles de Belgique, Bruxelles)

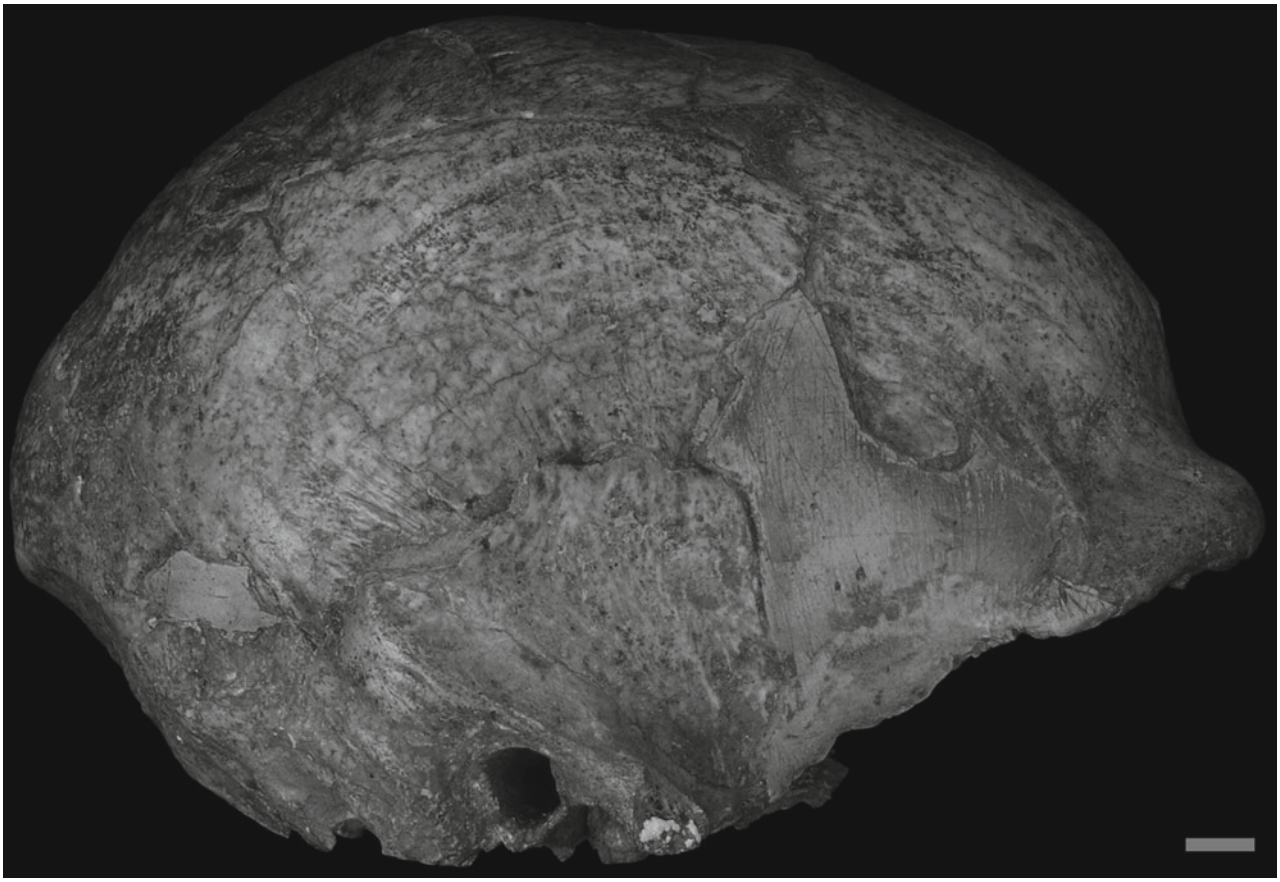

Fig. 10.6 Skull of Spy 2 (Belgium), *right lateral view* (Photo courtesy of the Institut Royal des Sciences Naturelles de Belgique, Bruxelles)

this interpretation and argued that both were Neanderthals, in spite of the evident individual differences. They were discovered very close together and at the same level, but could this variation be the reflection of their recent chronology, or of the presence of new genes in the population they represent?

At Krapina (Croatia), one of the earliest and more interesting Neanderthal samples, the presence of numerous individuals provides an estimate of sexual dimorphism as well as individual variability, well illustrated by the large collection of teeth, mandibles, postcranial skeletons, and incomplete crania. For example, the Krapina 5 skull, recently published by Caspari and Radovcic (2006), possesses great robusticity in contrast with other adult crania from the same site.

Unfortunately, the European fossil data set is so limited that it is not possible to use modern analytical criteria to examine problems of chrono-spacial, individual, sexual, intra- and interpopulational variability. Considering the available data, the morphology of the Mediterranean Neanderthals appears to be somewhat different from that of Neanderthals inhabiting higher latitudes. Biological differences also may have existed between groups living in Western and Central Europe, but, at present, this idea will remain tentative until new fossil finds fill the numerous gaps in the record. In any case, there is sufficient variability amongst the known Neanderthal sample to initiate a preliminary investigation of these differences.

The Saint-Césaire individual (Fig. 10.7) is a good example. The cranial gracility and the small dimensions of the teeth are remarkable compared to other Neanderthals. Taking into account its chronology and cultural context, the small size of the Saint-Césaire dentition might be related to the end of the Neanderthal lineage, individual variation, or to sexual dimorphism provided that the Charentian fossil is a female.

In the study of the L'Hortus human remains, de Lumley (1972, 1973) wrote that those coming from the upper levels were more slender, with smaller teeth, than the Neanderthals found in the lower layers, suggesting the existence of a "Mediterranean population" which differed from other groups. But, to date, there has been no additional data to confirm this hypothesis.

Undoubtedly, the biodynamics of different Neanderthal populations was influenced by many evolutionary factors including normal variation, natural selection for diverse environments, and small population size. However, because of the enormous area occupied by the Neanderthals and the time range of their existence, an understanding of the influence of each of these factors will be difficult to calculate.

Fig. 10.7 Skull of Saint-Césaire (France) (Photo B. Vandermeersch)

It is also noteworthy that the data coming from the analyses of the mtDNA of ~16 Neanderthal remains has revealed the existence of polymorphisms, especially between that of the earliest, Scladina, and samples from later-in time fossils. However, in our opinion the differences cannot be exclusively attributed to the influence of genetic drift or natural selection, since genetic processes usually have a more complex background.

From the morphological point of view, Neanderthal diversity appears more evident when the European fossils are compared with those of the Near East. In this comparison, two vast regions are separated by the Mediterranean, the Black Sea, and the foothills of the Caucasus. Demographic movements and contacts between human groups in South-Western Asia and Western Europe were probably infrequent at the beginning of the Upper Pleistocene, so the presence of variation between them is not surprising.

Indeed, grouping all the fossils from South Western Asia can underestimate the distance separating those sites (for example, Amud and Shanidar are about 1,000 km apart), as well as their different chronologies and environmental conditions.

A major problem is the uncertain antiquity of several of these fossils, especially the skeleton of the presumed female Tabun C1, considered amongst the oldest fossil specimens from the Levant. Tabun C1 was uncovered by Garrod in 1932 (Garrod and Bate 1937) in circumstances that make it impossible to establish if it was deposited during the formation of level C, or if it appeared in a *fossa* excavated from the most recent level B (Bar-Yosef and Callander 1999).

This uncertainty of its precise stratigraphic placement is crucial to the reconstruction of Neanderthal evolution in the Levant. Depending on the attribution of the fossil to level B or C, the earlier placement would document the presence of Near Eastern Neanderthals at about 170 ky (Jelinek1992), more or less comtemporary with the European Neanderthals, or, with a placement in level B, to a more recent time, around 90 ky. This situation is even more complicated when the isolated mandible (Tabun C2) from level C is considered. The morphology of this mandible has been variously interpreted as similar to that of other Levantine Neanderthals or as that of an "An atomically Modern Human."

The other sites have been dated to around 60 ky, for example Kebara (Valladas et al. 1998), and the somewhat younger Amud (Schwarcz and Rink 1998). From Iraqui Kurdistan, the Shanidar series seems to be between 60 and 46 ky (Trinkaus 1983). In comparison with the European Neanderthals (Fig. 10.8), those from the South West Asia have a more vertical forehead, a more elevated neurocranium, and less prominent occipitals. Because of the higher vault, the transversal contour is not "en bombe" as is common in the European fossils.

The central region of the face, although well developed, does not present the same backward and outward obliquity as the European Neanderthals. In the Shanidar sample, a small concavity corresponding to the *fossa canina* is present, and the malar is slightly angled below the infero-external angle of the orbit. The zygomatic arch is thicker than in the European Neanderthals, and its root is situated a bit higher in relation with the auditory meatus. The mastoid apophyses are more prominent.

Since these traits are more or less pronounced, depending on the specimen, it is reasonable to suggest that the most complete crania from Shanidar and the incomplete Amud 1 show peculiarities (autapomorphies?) specific to the South Western Asia Neanderthals. That leads to the question as to

Fig. 10.8 Skull of La Chapelle aux Saints (France), *left lateral view* (Photo courtesy of A. Mounier)

when the Asiatic populations diverged from the European, assuming that both had the same ancestral origin.

At the moment, there are no Near or Middle Eastern fossils with Neanderthal apomorphies as ancient as the European Pre-Neanderthals. It is possible that the Neanderthal lineage originated and evolved in the region of today's Europe, and that from there some groups moved, perhaps under environmental pressures, to warmer regions. If the date of around 170 ky for Tabun C1 is correct, it suggests the presence of the Neanderthals in Israel prior to OIS4. Condemi's (1991) study of the Saccopastore crania pointed out several traits in common with Tabun C1, Shanidar, and Amud 1, in comparison with the so-called "classic Neanderthals." If the general characteristics of the latter correspond to cold adaptations, as generally suggested, it is possible that these features had not developed in the groups already inhabiting less rigorous climates. Though a reasonable interpretation for the moment, it can only be considered a working hypothesis. The archaeological record, particularly well known in Israel, clearly demonstrates the presence of ancestral populations whose morphology is still unknown.

Moreover, what about the Neanderthals from Central Asia? Geographic continuity between Eastern Europe and Asia over a considerable time period has been well documented, probably resulting in significant biocultural interactions. The Teshik-Tash child's skeleton in Uzbekistan (dated between 50 and 30 ky) documents the presence of Neanderthals in that region; the cranial features, however, reveal a morphology somewhat different from that observed in European Neanderthal children, perhaps reflecting variability or gene flow. There are many Mousterian sites in Central Asia, but this vast region, with the exception of the few human fossils found in the Altai caves (Denisova end Okladnikov), is at present almost totally unknown.

Conclusions

The diverse data just summarized about the Neanderthals provide a complex, but still incomplete view of their morphological characteristics, as well as their long evolutionary history, which appears to be linked to the late Pre-Neanderthals and, through them, to still earlier Eurasian origins. Nevertheless, many problems remain unsolved.

There are many gaps in the study of human biological history and this is especially the case when the Neanderthals are considered. After 150 years of polemic, compelling anthropological, genetic, and cultural data has now been presented to reject the often cited image of the Neanderthals as a morphologically uniform population, the result of an almost linear evolution in Europe. The peopling of Europe was probably varied until the Holstein period and later the remains of the Neanderthals, through their long evolutionary history, and the vast geographic territory in which they appear, reflect chrono- and geographically diversified populations, which we have just begin to glimpse.

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