Chapter 2
The Expulsion of Eve

It has been said that though God cannot alter the past,
historians can; it is perhaps because they can be useful to Him
in this respect that He tolerates their existence
(Samuel Butler)

Reviewing the Corpus in Question

This is the incredible story of how a couple of decades ago an entire academic discipline fell under the spell of an inherently improbable hypothesis, the advocates of which succeeded in neutralizing almost all academic dissent; and how it eventually, against considerable odds, began to unravel. The conditions required to sustain the African Eve hypothesis are quite obvious and precise:

1. Because Graciles and Robusts are purported to be different species, they need to be sharply separated in the paleoanthropological record by distinguishing morphological features.
2. For the same reason the genetic signatures immediately before and after the claimed replacement need to be sufficiently different to indicate separate species.
3. As the claimed victory of the Graciles over the Robusts is attributed to the formers' superior technological capabilities, there needs to be clear evidence of different technologies before and after the "replacement."
4. Another factor supposedly separating the Robusts from the Graciles replacing them is the "big bang" introduction of paleoart, i.e., apparently symbolic productions reminiscent of "art." Therefore, such evidence should only occur with the Graciles.
5. Since the Graciles are claimed to have come from sub-Saharan Africa, and traveled via the Levant and southeastern Europe, it would be expected that evidence of their presence can be found first in their homeland and later progressively along such a route, in the form of the arrival of a dramatically different technology as well as paleoart.

In testing these reasonable and crucial propositions against the evidence I begin with the first. When I noted that we lack any skeletal evidence of the people of the Early Aurignacian (Bednarik 1995a), African Eve supporter Randy White chastised me:

> [T]he idea that there is no skeletal evidence to suggest that the Aurignacian was the work of anatomically humans is overdrawn. . . . Bednarik seems to have forgotten the modern human crania from Aurignacian sites like Vogelherd, Cro-Magnon, and Mladeč (White 1995).

An examination of this reaction would serve as a heuristic device to determine why such fads as the Eve model (and many others) can gain currency in Pleistocene archeology so easily. The three sets of human fossils White cites are among those most often listed by the replacement advocates as demonstrating the full anatomical modernity of the "Aurignacians." However, all three sets are in fact not of an age to place them in this technological pigeonhole, and at least in the case of the four Stetten specimens from Vogelherd (in the Swabian Jura, southwestern Germany) it had always been perfectly transparent that they were much younger, deriving from intrusive Neolithic interments (Czarnetzki 1983: 231; Gieseler 1974). That attribution has since been squarely confirmed by Conard et al. (2004): direct carbon isotope determinations, of samples taken from the mandible of Stetten 1, the cranium of Stetten 2 (Fig. 2.1), a humerus of Stetten 3 and a vertebra of Stetten 4, all agree, falling between 3980 ± 35 BP and 4995 ± 35 BP. Why all the Eve advocates (e.g., Protsch 1975; Bräuer 1981, 1984a, b, 1989: 136; Stringer 1984a, b, 1985, 1989; Stringer and Andrews 1988; Mellars and Stringer 1989; Wainscoat et al. 1986; Wainscoat 1987; Cann et al. 1987), and even others, such as Churchill and Smith (2000a, b), were unaware of these serious doubts is a mystery.

The Cro-Magnon sample White cites, derived from four adults and three or four juveniles, had been subjected to so much pseudoscientific spin that separating it

Fig. 2.1 The Stetten 2 skull from Vogelherd, Germany, attributed to the Aurignacian; the Stetten human remains are in fact all of the late Neolithic

from credible accounts is not readily possible. It had somehow become the type fossil of all "anatomically modern humans" (see Tobias 1995 for a most pertinent critique of this vacuous and blatantly anthropocentric term), making all contemporary people "Cro-Magnons." The group is in reality quite robust, and especially the very pronounced supraorbital torus, projecting occipital bone and other features of cranium 3 are Neanderthaloid rather than gracile. Sonneville-Bordes (1959) placed the sample from the Cro-Magnon shelter, just outside Les Eyzies, in the late Aurignacian; Movius (1969) suggested an age of about 30 ka BP and preferred an attribution to the Aurignacian 2. Both opinions, and numerous others, including White's, are refuted by the direct dating to about 27,760 carbon years BP (Henry-Gambier 2002); it places the Cro-Magnon individuals in the Gravettian rather than the Aurignacian technocomplex.

   White's third example, that of the Mladeč specimens, is even more tenuous. There is no clear evidence that Pleistocene humans ever entered this cave, partly excavated about 130 years ago. Most of the macro-faunal remains in it apparently fell through the large shaft in the cave's roof, and Smyčka (1922: 118–119) proposed that the human remains had also dropped through this chimney, which is probably the case. The first group of documented archeological materials originates from J. Szombathy's second digging season, in 1882. The center of the Dóm mrtvých (Dome of the Dead) yielded in the upper part of the sediments twenty-two perforated animal teeth (probably of a single necklace), a long bone point, several fragments of points or awls, a utilized lower jaw of *Ursus spelaeus*, and two flint artifacts (Szombathy 1925: 8). In the subsequent decades the cave became a quarry for phosphate loam, and Knies (1906) reports that there were scattered and trampled bones along the road leading to the top of the Třesín Hill. In 1904 a small quarry was opened 20 m west of the entrance to the main cave and the sediments of the small horizontal passage were quarried (Knies 1906; Smyčka 1907). It is impossible to determine the find spots of the five bone points from Jan Knies' collection as there is no mention of them in his records (Szombathy 1925: 9). Little is known of the clearing operations of the Museum Society in Litovel from 1911 to 1922, or of the subsequent excavations by J. Fürst, E. Smékal, H. Rohm, and others (Fürst 1922, 1923–1924; Smyčka 1922, 1925). It is impossible to locate the sites where the human remains were found, except for a mark made by Rohm on a cave plan (in Weiser 1928: 281, Point 3). Most archeological finds have been lost (e.g., lithics and all bones published by Szombathy 1925: figure 9; and the fragments of "bone awls" from the old exposition near the cave, cf. Skutil 1938: Note 76). Skutil (1938: 32, figure 60) found two "Aurignacian" stone tools in the loess of the cave entrance and mentioned that J. Novotný discovered a blade core below the chimney (1938: Note 77). The excavations by the Moravian Museum from 1958 to 1961 located no evidence of any Upper Paleolithic occupation within the cave, and the view developed that the cave entrance had become sealed prior to the Würm Glacial (Jelínek 1987; Svoboda et al. 2002). It was guided by a comparison with Koněpruské jeskyně (Zlatý Kůň) in the Bohemian karst, where similar circumstances pertain (which, however, is now thought to be "Magdalenian"). The paucity of stone implements in the interior of Mladeč Cave, compared with the vast quantities of faunal remains,

is conspicuous, and it needs to be emphasized that there is no sound evidence linking the apparently Aurignacian artifacts with any of the human remains. Nor does the assumption that "Aurignacians" occupied the cave derive any support from the hypothesis that the red pigment marks in its interior (Oliva 1989) are Paleolithic rock art. Of the sixteen red marks, four are definitely of the nineteenth century and the rest almost certainly so too (Bednarik 2006). Finally, the dating obtained from the reprecipitated calcite on the wall 7 m west of point "a" (of about 34 ka BP) is much older than the dates later obtained directly from bones and has been questioned (Svoboda et al. 2002).

In view of the lack of credible stratigraphic evidence from the site, the recent attempt to provide direct dates from some of the human remains is of greater relevance (Wild et al. 2005). A series of dates derived from specimens Mladeč 1, 2, 8, 9a, and 25c range from about 26,330 BP (the ulna of 25c) to 31,500 BP. It is, therefore, at best, partly of the very final phase of the Aurignacian period with its duration of about 15,000 years. More likely, most or all of the series is of the Gravettian technocomplex. Moreover, there is considerable evidence that the Mladeč specimens were far from "fully modern" (Smith 1982, 1985; Frayer 1986; Trinkaus and Le May 1982; and especially Jelínek et al. 2005). Notably, there appears to be pronounced sexual dimorphism, with male crania characterized by thick projecting supraorbital tori, Neanderthaloid posterior flattening, low brain cases, and very thick cranial vaults—all typical robust features. As in "Neanderthals," cranial capacities exceed those of Graciles (1650 ml for Mladeč 5), but there is a reduction in the difference between male and female brain size relative to Neanderthal data. The dimorphism is also expressed in the more inclined forehead in the males, their more angled occipital areas with lambdoidal flattening, broad superior nuchal planes, and more prominent inion. The female specimens show similarities with, as well as differences from, accepted Neanderthal females, such as larger cranial vaults, greater prognathism, lack of maxillary notch, a very narrow nose, and distinct canine fossa. However, the females are more gracile than the males, while still being more robust than males of later periods. The Mladeč population thus seems to occupy an intermediate position between late Neanderthaloid *Homo sapiens*, and *H. sapiens sapiens*, a position it shares with numerous human remains from other Czech sites.

This is an important issue we will return to later in this book. Suffice it to note here that the material from Pavlov Hill, an important Czech site, is among the most robust available from the European Upper Paleolithic, sharing its approximate age of between 26 and 27 ka with yet another Moravian site of the Gravettian, Předmostí. The more gracile finds from Dolní Vestonice are around 25 ka old and still feature some archaic characteristics (particularly the Neanderthaloid specimen DV16). Another find that has been considered as very early European "Modern" is the calotte from Podbaba, near Prague, variously described as sapienoid and Neanderthaloid, but undated; it probably belongs to the Mladeč-Předmostí-Pavlov-Dolní Vestonice spectrum. Morphologically similar specimens also come from Cioclovina (Romania), Bacho Kiro levels 6/7 (Bulgaria), and Miesslingtal (Austria), so this is unlikely to be a local phenomenon. Indeed, it needs to be seen in the greater Eurasian context.

Randy White's hasty comment can also be placed in a greater context, by reviewing the generic issue of the ethnicity of other European specimens of the period linking the decline of Mode 3 technologies (called "Middle Paleolithic," cf. Foley and Lahr 1997) with the final phase of the Late Pleistocene (called "Late Upper Paleolithic"). Turning next to adjacent western-central Europe, the extraordinary recent developments in German paleoanthropology are of considerable relevance here. Not only is there the correction to the age of the "robust" Neolithic human remains from Vogelherd, which the mitochondrial Eve advocates had been all too keen to place at 32 ka; nearly all of the German fossils claimed to be of the Upper Paleolithic are now thought to be of the Holocene. Of particular interest is the Hahnöfersand calvarium, described as so robust that it was judged to show typical Neanderthal features (Bräuer 1980) and hailed as the northernmost Neanderthal found. It was initially dated to the earliest "Upper Paleolithic" (Fra-24: 36,300 ± 600 BP; UCLA-2363: 35,000 ± 2000 BP, or 33,200 ± 2990 BP; Bräuer 1980), which conflicts sharply with results secured by Terberger and Street (2003): P-11493: 7470 ± 100 BP; OxA-10306: 7500 ± 55 BP. The re-dating of the skull fragment from Paderborn-Sande yielded even more dramatic differences. Originally dated at 27,400 ± 600 BP (Fra-15; Henke and Protsch 1978), Terberger and Street (2003) report an age of only 238 ± 39 BP (OxA-9879). In fact the skull was so fresh that it emitted a putrid smell when Terberger and Street drilled it for sampling. Then there is the cranial fragment of Binshof near Speyer, dated by R. Protsch in the 1970s as Fra-40 to 21,300 ± 320 BP. According to Terberger and Street it is only 3090 ± 45 carbon years old (OxA-9880). These authors also analyzed two individuals from the Urdhöhle near Döbritz, which had been attributed to the Upper Paleolithic, and found them both to be about 8400 years old. Indeed, of all the German "Upper Paleolithic" human remains, only one remains safely dated to earlier than 13,000 BP: the interred specimen from Mittlere Klause in Bavaria. A carbon isotope date of 18,200 ± 200 BP (UCLA-1869) from a tibia fragment (Protsch and Glowatzki 1974) has been confirmed by Terberger and Street's date from a vertebra, of 18,590 ± 260 BP (OxA-9856). It has, therefore, become clear that there are currently no "modern" remains from the first half, if not the first two-thirds of the west-central European "Upper Paleolithic." Nearly all the dates for German humans from the radiocarbon laboratory of the University of Frankfurt am Main appear to be substantially false, as do some of those from the University of California, Los Angeles. In addition, another German key specimen, the skull from Kelsterbach, has mysteriously disappeared from the safe of the Frankfurt institution. It had been dated to 31,200 ± 1600 BP (Fra-5) (Protsch und Semmel 1978; Henke und Rothe 1994), but is also believed to be of the Holocene, perhaps the Metal Ages (Terberger and Street 2003).

Then there are the robust but "modern" hominin remains of the EUP ("early Upper Paleolithic") at Velika Pećina, Croatia, close to the Neanderthal site Vindija. This specimen, too, has been a principal support for the replacement advocates, but it has also joined the long list of European humans whose age was grossly overestimated. It is now considered to be only 5045 ± 40 radiocarbon years old (OxA-8294; Smith et al. 1999).

The currently earliest, liminal "intermediate" finds in Europe, the Peştera cu Oase mandible and face from southwestern Romania (Trinkaus et al. 2003; Rougier et al. 2007), are perhaps about 35,000 radiocarbon years old, but they are without an archeological context. Although in some aspects "modern," the "derived Neanderthal features" of the mandible include cross-sectional symphyseal orientation, exceptionally wide ramus, exceptionally large third molars, and unilateral mandibular foramen lingular bridging. The partially preserved facial remains found in a different part of the extensive cave system and apparently from another individual, also combine robust and gracile features. More recently, Soficaru et al. (2006) have reported six human bones from another Romanian cave, Peştera Muierii, also clearly intermediate between robust and gracile Europeans. Found in 1952, they have now been dated to about 30,000 carbon years, which might correspond to around 35,000 sidereal years, and combine a partly modern, partly archaic brain case with a suite of other intermediate features.

The loss of the only relevant Spanish remains, from El Castillo and apparently of the very early Aurignacian technocomplex, renders it impossible to determine their anatomy. French contenders for EUP age present a mosaic of unreliable provenience or uncertain age, and direct dating is mostly not available. Like the Vogelherd and other specimens, those from Roche-Courbon (Geay 1957) and Combe-Capelle (originally attributed to the Châtelperronian levels; Klaatsch and Hauser 1910) are now thought to be of Holocene burials (Perpère 1971; Asmus 1964), and the former is now apparently lost. Similar considerations apply to the partial skeleton from Les Cottés, whose stratigraphical position could not be ascertained (Perpère 1973). Finds from La Quina, La Chaise de Vouthon, and Les Roches are too fragmentary to provide diagnostic details. The *os frontale* and fragmentary right maxilla with four teeth from La Crouzade, the mandible fragment from Isturitz, and the two juvenile mandibles from Les Rois, about 28–30 ka old (Ramirez Rozzi et al. 2009), range from robust to intermediate (e.g., Trinkaus 2007). Just as the Cro-Magnon human remains now appear to be of the Gravettian rather than the Aurignacian, so do those from La Rochette. The Fontéchevade parietal bone does lack prominent tori (as do many other intermediate specimens) but the site's juvenile mandibular fragment is robust.

This pattern of features intermediate between what paleoanthropologists regard as Neanderthals and Moderns is found in literally hundreds of specimens apparently in the order of 45–25 ka old (including the large Czech collection lost in the Mikulov Castle fire at the end of World War II). They occur in much of Europe, and intermediate forms between archaic *Homo sapiens* and *Homo sapiens sapiens* existed also in Asia and Australia. They include examples from right across the breadth of Eurasia, such as those from Largo Velho, Crete, Starosel'e, Rozhok, Akhshtyr', Romankovo, Samara, Sungir', Podkumok, Khvalynsk, Skhodnya, as well as Chinese remains such as those from Jinniushan and Tianyuan Cave (Shang et al. 2007). Similarly, the African evidence does not, as is often claimed, present "anatomically modern humans" at 150 ka or almost 200 ka. The skulls from Omo Kibish offer some relatively modern features as well as substantially archaic ones;

especially Omo 2 is very robust indeed (McDougall et al. 2005). Their dating, also, is not secure at all, and Omo 2 is a surface find. The much more complete and better dated Herto skull, BOU-VP-16/1, is outside the range of all recent humans in several cranial measurements (White et al. 2003) and is clearly just as archaic as other specimens of the late Middle Pleistocene, in Africa or elsewhere. The lack of "anatomically modern" humans from sub-Saharan Africa prior to the supposed Exodus is glaring: the Border Cave specimens have no stratigraphic context and are thought to be only around 80 ka old; Omo and Dar es Soltan are obviously not sub-Saharan (and the latter is undated), which leaves only the lower jaws of Klasies River Mouth, lacking cranial and postcranial remains. On the other hand, current Australians average a cranial capacity of only 1264 cc (males 1347 cc, females 1181 cc, i.e., well within the range of *Homo erectus*), while their molars average the size of those of Europeans several hundred millennia ago. And yet they are still considerably smaller than those of fossil Australians, such as the large Kow Swamp sample. So while diminution of molars did occur in Australia, supposedly also settled by Eve's progeny, it lags greatly behind that of the rest of the world.

With the lack of African fossils of the African Eve "species," the Eve apostles turned to the Levant for help, and recruited the Mount Carmel finds from Qafzeh Cave and Skhul Shelter as supposed "Moderns." Yet all of these skulls present prominent tori and receding chins, even Qafzeh 9, claimed to be of the most modern appearance. The distinct prognathism of Skhul 9 matches to that of "classic Neanderthals," and the series of teeth from that cave has consistently larger dimensions than typical "Neanderthal" teeth. Even Stringer concedes that this material is "transitional" or intermediate. Besides, supposedly much later "Neanderthal" burials in nearby Tabun Cave as well as the Qafzeh and Skhul material are all associated with the same Mousterian tools, and the datings of all Mount Carmel sites are far from soundly established, with their many discrepancies. The TL dates from Qafzeh, for instance, clash severely with the amino racemization dates (ranging from 33 to 45 ka), and are in any case plagued by inversion: the lower layer (XXII) averages 87.7 ka, the middle layer (XIX) 90.5, while the uppermost (XVII) averages 95.5. Therefore, the claims of 90-ka-old "modern" humans from Mount Carmel, a cornerstone in the Eve notion, are in every respect unsound, and this population is best seen as transitional between robust and gracile forms, from a time when gracilization had commenced elsewhere as well.

This presents an overall picture that is very different from that which the replacement protagonists subscribe to. Their model cannot tolerate such intermediate forms, nor can it allow hybrids, yet in Europe there is a clear continuation of some Neanderthaloid features right up to and into the Holocene. This is demonstrated not only by the Hahnöfersand specimen, but also by others, such as the equally robust "Mesolithic" skull fragment from Drigge, also from northern Germany, which is about 6250 years old (Terberger 1998), and numerous other late specimens previously thought to be of the EUP. They range in age from the "Magdalenian" through the "Neolithic," and even younger. One distinctive "Neanderthal" feature is the shape of the mandibular nerve canal, surrounded by a bony ridge in 53%

of specimens included in this designation. Its occurrence diminishes during the transition period to 44%, but it is still present in today's Europeans, at 6% (Lewin 2005: 196). This feature alone demands the presence of "Neanderthal" genes in Europeans. The process of gracilization has indeed generally continued to the present time: early Mesolithic material is about 10% more robust than modern Europeans. Indeed, Hawks (1997) has estimated that at least 25% of the ancestors of later Upper Paleolithic people would need to be Neanderthals to account for the preservation of Neanderthal autapomorphies observed (see also Frayer 1993, 1998; Frayer et al. 1994).

The second issue emerging from this brief review is that there are now almost no supposedly modern specimens left as possible contenders for attribution to EUP or Aurignacoid industries. The maxilla from Kent's Cavern, United Kingdom (~31 ^{14}C ka BP), and the Romanian remains from Pestera Cioclovina (~29 ^{14}C ka BP) lack secure and diagnostic archeological association. There are, however, numerous "Neanderthal" remains to fill this void. Of particular interest are the most recent, those from Saint Césaire (~36 ka), Arcy-sur-Cure (~34 ka), Zafarraya Cave (~33.4 ka), Máriaremete Upper Cave (~38 ka), Sungir' (~25 ka), Trou de l'Abîme (~33 ka), and Vindija Cave (~28 and ~29 ka).

At the first of these sites, the Neanderthal remains of a burial occur together with clear Châtelperronian artifacts, which until 1979 had been generally assumed to be the work of anatomically modern humans. Arcy-sur-Cure, also in France, yielded numerous ornaments and portable art objects, again from a Châtelperronian. This prompted various convoluted explanations of how these elaborate pendants could have possibly found their way into a "Neanderthal" assemblage (e.g., White 1993; Hublin et al. 1996; a similar argument was used by Karavanic and Smith [1998] in explaining the bone points of Neanderthals in Vindija layer G1). It was contended that the primitive Neanderthals must have scavenged these objects from the camps of "Moderns," as if people lacking the ability to use symbols would have any use for symbolic artifacts. On the other hand, Zafarraya Cave, near Malaga, provides late Mousterian tools (Hublin et al. 1995). The Jankovichian or Trans-Danubian Szeletian (Allsworth-Jones 1986) has yielded three mandibular "Neanderthal" teeth from Máriaremete Upper Cave (Gábori-Csánk 1993). The Streletsian of Sungir' in Russia produced an isolated Neanderthaloid tibia from a triple grave of "Moderns," and the adult male exhibits pronounced supraorbital tori (Bader 1978). Trou de l'Abîme near Couvin in southern Belgium furnished "Neanderthal" remains together with a typical Aurignacian industry, and there can be no question that the Vindija late Neanderthals used EUP tools and technology. Not only has that site supplied some of the most recent "Neanderthals" found so far—and from a site in south-central Europe at that—these are more gracile than Neanderthals of much earlier periods, and they are considered to be transitional by some (Smith and Ranyard 1980; Wolpoff et al. 1981; Frayer et al. 1993; Wolpoff 1999; Smith et al. 2005). Vindija Vi-207 is a mandible of 29,080 ± 400 carbon years BP (OxA-8296), Vindija Vi-208 is a parietal of 28,020 ± 360 carbon years BP (OxA-8295) (Smith et al. 1999). These "late Neanderthals" (or very robust Graciles) exhibit significant reduction in "Neanderthaloid" features such as

mid-facial prognathism and supraorbital tori. The related tool assemblage includes even apparent bone fabricators (Ahern et al. 2004).

Ignoring these many significant contradictions to their ideas, the replacement proponents have responded to the recent developments in Germany by contending that the new data bolster their model, because the "Neanderthaloid" Hahnöfersand specimen had been suggested to be a hybrid (Bräuer 1980). In this futile argument they are grasping at straws, instead of admitting the plainly obvious: they have been the victims of the greatest scam in the history of paleoanthropology since the Piltdown affair early in the twentieth century. By hailing each of the very late dates for Neanderthal remains as they appeared in recent years as a confirmation of their prediction that the evidence "effectively precludes any hypothesis of a gradual evolution from Neanderthal to anatomically modern populations within Western Europe itself" (Mellars and Stringer 1989: 8) they have literally argued themselves into a corner. They had strongly contended that "a whole spectrum of radical cultural innovations" (op. cit.) appeared with the beginning of the Aurignacian. But what are the many innovations at 45–40 ka they claim were introduced from Africa? According to them, the people of the Aurignacian are "indistinguishable" from us in terms of cognition, behavior, and cultural potential. Perhaps this is so, but what the evidence now shows is that the period from 45 ka to 28 ka BP has produced dozens of "Neanderthal" specimens, but no securely dated, unambiguously fully modern human remains. This point is reinforced by the occurrence of Neanderthal finds together with EUP lithic traditions at six sites at least, while no "Moderns" have so far been found in clear association with Aurignacian or any other EUP artifacts (Churchill and Smith 2000b). Therefore, one would have thought that the proposition to test is not whether the replacement advocates were correct, but the proposition that the Aurignacian and other Aurignacoid or EUP industries are traditions of "Neanderthals," or of their descendants. Unless that proposition is refuted, we are left with the dictum coined by the African Eve advocates themselves: *that the EUP people, i.e. late 'Neanderthals', from about 45 ka BP on, were of "entirely modern behavior"* (cf. d'Errico 1995).

The "short-range" advocates have apparently failed to grasp the effects of the new data on their embattled hypothesis (e.g., Mellars 2005). There are only three realistic alternatives to account for the "EUP" tool, rock art, and portable art traditions: that they are the work of "Neanderthals"; or of the descendents of "Neanderthals"; or of invading, perhaps genocidal "Moderns." Since there is currently no evidence for the third possibility, and the two others are entirely unacceptable to the mitochondrial Eve advocates because they would refute their hypothesis, one would have thought that they might reconsider. Certainly, the onus is presently on these scholars to present evidence that there were anatomically fully modern humans, free of any "Neanderthaloid" features, in Europe during the first half of their "Upper Paleolithic," i.e., since 45 ka BP. They also need to demonstrate evolutionary continuity in southern Africa, but its complete absence everywhere else. Until they do this, their contentions about human evolution over this period, especially in the European theatre, are contradicted by all available skeletal evidence, and in fact stand refuted.

The African Exodus

Although the notion of replacement arose initially from skeletal evidence (and its misdating) it soon sought support in genetic data. For African Eve advocates, genetic changes in populations represent mass movements of people. Therefore, to render this notion credible, the second phenomenon that would need to be substantiated by hard evidence would be to demonstrate unambiguously that the genetic signatures immediately before and after the claimed replacement are sufficiently different to indicate separate species. Let us be quite clear upfront: no such evidence has been presented. Fragmentary sequences from contaminated remains of robust individuals significantly predating the "replacement" (such as the original August 1856 finds from the Kleine Feldhofer Cave in the Neander valley) show limited differences from present-day populations, which is to be expected. But we have no indication of the genetic distance between Robusts and Graciles of similar ages, say, 30 ka. That, however, is required to show that this distance, and not the distance between specimens of greatly different antiquities, would be great enough to prevent the production of fertile offspring. We already know that individuals living at very different times produced no offspring—they could not breed if they lived in different eras.

However, when we examine the genetic justification of the Eve model (e.g., Cann et al. 1987) we find that it is just as flawed as its skeletal rationalizations (see preliminary notes in Chapter 1). Different research teams have produced different genetic distances in nuclear DNA, i.e., the distances created by allele frequencies that differ between populations (e.g., Vigilant et al. 1991; Barinaga 1992; Ayala 1996; Brookfield 1997). For instance, when the haplotype tree offered by the Vigilant team in 1991 was reanalyzed, its basal branches included non-African origins of human mitochondria. Some geneticists concede that the model rests on untested assumptions; others even oppose it (e.g., Barinaga 1992; Hedges et al. 1992; Maddison et al. 1992; Templeton 1992, 1993, 1996; Brookfield 1997). The various genetic hypotheses about the origins of "Moderns" that have appeared over the past few decades placed the hypothetical split between these and other humans at times ranging from 17 to 889 ka BP. They all depend upon preferred models of human demography, for which no sound data at all are available. This applies to the contentions concerning mitochondrial DNA (African Eve) as much as to those citing Y-chromosomes ("African Adam"; Hammer 1995). The divergence times projected from the diversity found in nuclear DNA, mtDNA, and DNA on the nonrecombining part of the Y-chromosome differ so much that a time regression of any type is extremely problematic. Contamination of mtDNA with paternal DNA has been demonstrated in extant species (Gyllensten et al. 1991; Awadalla et al. 1999; Morris and Lightowlers 2000; Williams 2002), in one recorded case amounting to 90% (Schwartz and Vissing 2002). Not only was the assumption by Cann et al. (1987) about exclusive maternal transference of mitochondria without basis, the constancy of mutation rates affecting mtDNA was also a myth (Rodriguez-Trelles et al. 2001, 2002), because

molecular time estimates suffer from a methodological handicap, namely, that they are asymmetrically bounded random variables, constrained by a nonelastic boundary at the lower end, but not at the higher end of the distribution. This introduces a bias toward an overestimation of time since divergence, which becomes greater as the length of the molecular sequence and the rate of evolution decrease … Despite the booming amount of sequence information, molecular timing of evolutionary events has continued to yield conspicuously deeper dates than indicated by the stratigraphic data. Increasingly, the discrepancies between molecular and paleontological estimates are ascribed to deficiencies of the fossil record, while sequence-based time tables gain credit. Yet, we have identified a fundamental flaw of molecular dating methods, which leads to dates that are systematically biased towards substantial overestimation of evolutionary times (Rodriguez-Trelles et al. 2002).

Kidd et al. (1996) have shown that, outside Africa, the elements of which haplotypes are composed largely remain linked in a limited set. Gibbons (1998) observed that by using the new putative "genetic clock," Eve would not be 200 ka old, but only 6000 years. By then the issue had become farcical: the thesis by Cann et al. had not only been based on botched computer modeling, its haplotype trees were fantasies that could not be provided with time depth even if they were real. To render these issues even more complex, the transfer of genetic information is not, as many seem to assume, limited to DNA. For instance, ribonucleic acids associated with the brain's thrombospondin (THBS4 and THBS2) can carry such information (Christopherson et al. 2005; Cáceres et al. 2007), and epigenetic, behavioral, and symbolic inheritance systems need to be considered as well (Jablonka and Lamb 2005), as we shall study in Chapter 5.

The genetic picture in Africa as well as elsewhere has been found to be far more complicated than the Eve proponents ever envisaged. The much-promoted claims that "Neanderthals" were genetically different from modern Europeans, based on very fragmentary DNA sequences, were erroneous, Gutierrez et al. (2002) have shown. Their analysis suggests that the pairwise genetic distance distributions of the two human groups overlap more than claimed, if the high substitution rate variation observed in the mitochondrial D-loop region (Walberg and Clayton 1981; Torroni et al. 1994; Zischler et al. 1995) and lack of an estimation of the parameters of the nucleotide substitution model are taken into account. Moreover, the results presented from museum specimens, especially "Neanderthal" remains, are probably irrelevant. Pruvost et al. (2007) have recently shown that DNA deteriorates rapidly after excavation, up to fifty times as fast as in buried specimens. The various reported "fragmentary DNA sequences" from "Neanderthal" remains stored for up to 150 years need to be considered in that light. A large part, on average 85%, of the genetic material preserved in fossils is lost as a result of treatment by archeologists and storage in museums; therefore, the results disseminated from these specimens and their interpretations may be questioned. More reliable are genetic studies of living populations, which have shown that both Europeans and Africans have retained significant alleles from multiple populations of Robusts (Hardy et al. 2005; Garrigan et al. 2005; cf. Templeton 2005). In fact, the Neanderthal genome seems to include an excess of "human"-derived single nucleotide polymorphisms (Green et al. 2006).

Recent genetic analyses confirm not only that "Neanderthal" genes persist in recent Europeans, Asians, and even Papuans (Green et al. 2010), but also that "it seems Neandertals interbred with the ancestors of Europeans and Asians, but not with the ancestors of Africans" (Gibbons 2010; cf. Krings et al. 1997). In the words of Green et al. "[g]iven that the OOA alleles occur at a frequency of much less than 50% in non-Africans (average of 13%, and all less than 30%), the fact that the candidate regions match the Neandertals in 10 of 12 cases ($P = 0.019$) suggests that they largely derive from Neandertals". Thus, the African Eve model has become an absurdity: it is precisely Africans who had the least contact with Europeans.

Relethford (2002) has detected drastic spatiotemporal changes in the genetic profiles of three recent Chinese populations, negating the idea of regional genetic homogeneity. He found that the Linzi population of 2500 years BP is genetically more similar to present-day Europeans than to present-day eastern Asians. This refutes the idea that regional comparisons of DNA can establish affinity or its absence. Assumptions about a neutral mutation rate and a constant effective population size are completely unwarranted, and yet these variables determine the outcomes of all the genetic calculations. For instance, if the same divergence rate as one such model assumes (2–4% base substitutions per million years) is applied to the human–chimpanzee genetic distance, it yields a divergence point of 2.1–2.7 million years, which can be considered unambiguously false. Nei (1987) suggests a much slower rate, 0.71% per million years (now abandoned by him), according to which the human–chimpanzee separation would have occurred 6.6 million years ago, which is close to the estimate from nuclear DNA hybridization data of 6.3 million years. It also appears to be close to what the fossil record seems to indicate. However, this would produce a divergence of "Moderns" at 850 ka BP, over four times as long ago as the favored models, and eight times as long ago as the earliest fossils of *purported* Moderns ever found (though both their dating and modernity are controversial, as noted above). To explain away the perplexingly late split of the "Moderns", some of the short-range geneticists have even resorted to suggesting mtDNA transfer between "proto-humans" (e.g., australopithecines) and proto-chimpanzees (i.e., species presumably separated by millions of years of evolution), while at the same time excluding such a possibility for recent robust and gracile populations that are of the same species (Hasegawa et al. 1985).

Molecular archeology, the analysis and interpretation of paleogenetic, ancient DNA (Pääbo 1989), remains an experimental method and those who overinterpret its results tend to overlook its limitations. Initial results were obtained from a quagga (Higuchi et al. 1984), an Egyptian mummy (Pääbo 1985), a moa (Cooper et al. 1992), and a cave bear (Noonan et al. 2005), before the genome of *Homo sapiens neanderthalensis* was tackled (Green et al. 2006). But paleogenetics poses challenges that differ significantly from in vivo studies, because DNA suffers both mechanical and chemical degradation through time and there are high sequencing error and template damage rates (Pääbo et al. 2004; Pruvost et al. 2005, 2007; Orlando and Hänni 2008). It is certainly easier to template modern DNA than ancient DNA. Results of the polymerase chain reaction (PCR) amplifications, performed by clonage, need to be repeated and three negative controls have to be

added to safely detect contamination. Then there is the potential, particularly in moist conditions, of hydrolytic cleavage of phosphodiester bonds between phosphate and sugar (Jolivet and Henry 1994: 180). Similarly, sugars and amino groups in proteins and nucleic acids, caused by condensation, can react and lead to errors during PCR. Deamination of cytosine in xanthine, guanine, and uracil, or adenine in hypoxanthene can occur, involving the incorporation of nucleotide in the process of PCR amplification. The issues of base substitution (Lindhal and Nyberg 1972) and fragmentation of DNA (Golenberg et al. 1996) have long been known, and the point is demonstrated, for instance, by the erroneous results obtained from the DNA of insects embedded in amber (Gutierrez and Marin 1998). Other problems with interpreting or conducting analyses of paleogenetic materials are alterations or distortions through the adsorption of DNA by a mineral matrix, its chemical rearrangement, microbial or lysosomal enzymes degradation, and lesions by free radicals and oxidation (Geigl 2002; Carlier et al. 2007, 2008). These scientific qualifications are generally unheeded in the archeological folklore established around the "authoritative" DNA data, in much the same way as archeologists usually fail to heed the reservations of scientists concerning datings of rock art (Bednarik 1996, 2002; Watchman 1999), or most other archeometric data furnished by scientists. Such results are always grossly simplified, misinterpreted, and overinterpreted, and then embedded in the mythology of mainstream archeology. In the case of paleogenetic data, they have been eagerly seized by one or another school of thought to support its case or discredit that of the opponents. Yet archeologists make little concerted effort to appreciate the reservations scientists have.

For instance, there are considerable complexities concerning the accumulation of base substitutions, or mutations, that are not even relevant to natural selection. The mechanisms governing DNA mutation rates, which are so central to the archeological claims involving genetics, are not at all well understood. Those mutations that have no selection consequences, "neutral" mutations, are also reflected in DNA mutation rates, which can be estimated by comparing neutrally evolving sequences in species that share a common ancestor. Sequences that are high in pairs of the bases C and G (CpGs) have been positively correlated with mutation rate. However, the chemical modification of CpGs makes them prone to mutation themselves, and with time they are eliminated from neutrally evolving sequences. Walser and Furano (2010) have taken advantage of this property to investigate the role of CpGs on the mutation rate of non-CpG DNA by comparing "old" and "young" sequences. They found that CpGs are not only promoting mutations, but also influencing how the non-CpG sequences around them are being mutated. In determining the neutral non-CpG mutation rate as a function of CpG content they compared sequence divergence of thousands of pairs of neutrally evolving chimpanzee and human orthologs that differ primarily in CpG content. Both mutation rate and mutational processes are contingent on the local CpG content.

Protagonists of the replacement or short-range hypothesis often cite possible genetic bottlenecks to contrive explanations for inherent weaknesses of their model. But in combining the model of a population bottleneck with that of an endemic population we also need to remember that genetic bottlenecks tend to reduce fitness

in the population (Bryant et al. 1986; Berger et al. 2008), rather than bring about the population's supremacy (cf. Hawks et al. 2000), as proposed for Eve's progeny. Another genetic model (Pennisi 1999) has modern humans evolving from two discrete populations, one resulting in modern Africans, the other in non-Africans. Templeton (2002) has contradicted the replacement hypothesis genetically. Using ten different haplotype trees (MtDNA, Y-chromosomal DNA, two X-linked regions and six autosomal regions), he suggested that following an initial exodus from Africa at about 1.7 million years ago, there were at least two subsequent major expansions out of Africa. One occurred at 840–420 ka ago, the second at 150–80 ka ago. The genetic data also show ubiquity of genetic interchange or interbreeding between human populations *throughout the 1.7 million years*, as had been predicted by the multiregional hypothesis since Weidenreich (1946). In response to Templeton's comprehensive refutation of the Eve model, Cann (2002) made no attempt to argue against his proposals of long-term, multiregional evolution.

It is also of concern that the first colonization dates assumed by the geneticists supporting the Eve model are mostly false (see e.g., Cann et al. 1987), and these researchers admitted from the beginning of their involvement that their base-pair substitution rates were based on the (almost certainly false) assumption of single colonization events. It has long been known that there were probably multiple settlement events in most colonizations, which in the case of Australia is indisputable (Bednarik and Kuckenburg 1999). The dingo, introduced in the mid-Holocene, could not have arrived unassisted. The lineage of the earliest known "anatomically modern" remains in Australia, Lake Mungo 3, has been shown to have probably diverged before the most recent common ancestor of contemporary human mitochondrial genomes (Adcock et al. 2001). In the absence of any reliability of the proposed rates of nucleotide changes and the many variables to be accounted for effectively, the contentions by the replacement advocates are essentially unsupported, and nucleotide recombination renders their views fully redundant (Strauss 1999).

When the same "genetic clock" used in all this is applied to dogs and suggests that the split between wolves and dogs occurred 135 ka ago, archeologists reject it on the basis that there is no paleontological evidence for dogs prior to about 15 ka BP (Napierala and Uerpmann 2010; but see Germonpré et al. 2009 for a claim of c. 31 ka). In other words, the weak theory that effectively provides the only remaining basis for the replacement scenario is rejected when applied to another species. The scenario of genetic isolation, long enough to render Eve's progeny unable to interbreed with any other humans, is another unsupportable short-range notion. Interfertility yielding viably breeding offspring occurs between many species (e.g., in wolf, coyote, and dog; in several species of deer; in mallards and ducks) and can even yield viable subspecies.

Instead of unambiguously showing that "anatomically modern humans" (whatever that ethnocentric term is intended to mean) originate in one region, sub-Saharan Africa, all the available genetic data suggest that gene flow occurred in Old World hominins throughout much of recent human evolution (Templeton 1996, 2002), which is also strongly suggested by all available empirical evidence, both

paleoanthropological and archeological. For instance, the evidence that *Homo sapiens neanderthalensis* managed to live and subsist at the Arctic Circle, in temperatures that would at times have been below –40°C (Schulz 2002; Schulz et al. 2002; see also Pavlov et al. 2001), easily dispatches the notion that there were great expanses of habitable land in Europe that remained unoccupied by humans. The Finnish evidence, dating back 135 ka BP, suggests that these innovative people coped with extreme climatic conditions by the advent of the Late Pleistocene, and that the demographic modeling of Pleistocene archeologists (e.g., Gamble 1999) must be largely false. If human groups on the margins were forced into regions of truly appalling living conditions we can safely assume the presence of largely continuous populations in much of the Old World, and by 50 ka even in Australia.

That implies that *Homo sapiens sapiens* must have evolved as a single extended breeding unit across much or most of the region once occupied by robust *sapiens* hominins, from southern Africa to eastern Asia and Australia. Genetic drift, introgressive hybridization (Anderson 1949), and episodic genetic isolation during climatically unfavorable events (e.g., the Campagnian Ignimbrite event, or the Heinrich Event 4; Barberi et al. 1978; Fedele et al. 2002, 2003; Fedele and Giaccio 2007) rather than mass migration probably account for the mosaic of hominin forms we can observe through time. Reticular introgression tends to increase at times of ecological stress. Previously deleterious variants, be they mutation- or introgression-derived, may become adaptive. Episodic sharp reductions in gene pool size are the most effective factor in the acceleration of phylogenetic change in a population, particularly if they are combined with genetic drift or introgression across contiguous populations subjected to demographic adjustments.

It is then unnecessary to resort to an explanation via mass migration and complete replacement by an intrusive population. The many archaic or robust *sapiens* populations of the Old World existed in various climatic and ecological environments, therefore would have had a much higher number of adaptive mutations, and would have genetically overwhelmed a numerically smaller intrusive population bringing with it a much smaller number of adaptive alleles. Moreover, since the technology of any contemporary robust and gracile populations were always evenly matched (as we shall see below), the notion that some African super-humans overwhelmed an extremely well adapted and acclimatized resident population in Europe and everywhere else is demographically most unlikely. Such replacement could have been through introduced diseases, it has been argued; but that contention, surely, cuts both ways. Since we need to assume, as a credible null-hypothesis, that all habitable parts of Europe were occupied by robust tribes 40 ka ago, we would have a scenario of cold-adapted, physically much stronger Robusts being attacked at the periphery by numerically inferior, naked people from the tropics with their thin skulls, wielding the same kinds of Mode 3 weapons. One does not need to be a military strategist to see who would have overwhelmed whom, both physically and genetically. Moreover, in any massive invasion, much of the mitochondrial DNA of the ensuing population turns out to be that of the vanquished, whose females the victors absorb.

   Ultimately, demographic genetics, that is, allele drift based on generational mating site distance, easily accounts for archeologically observed population changes (Harpending et al. 1998). A distance of merely 50 km per generation is most reasonable for such highly mobile populations, and suffices to explain the travel of genes over 10,000 km in as few as 200 generations. In reality, generational mating site distances of some hundreds of kilometers seem to be perfectly reasonable. Yet the enormous time scale available for the development of "Moderns" amounts to perhaps 2000 generations. The notion of invading Africans is as likely to be valid as the account of Noah's Ark: the more one thinks about the logistics and demography, the more absurd it tends to appear—except for the believers.

Tools and Cultures

We have seen that the Eve model derives to some extent from a series of false dates of fossil hominin remains and that Graciles emerged not suddenly, but gradually over many millennia. Next we considered the claims of genetic support, and we found none: invented coefficients of all crucial variables, false assumptions, and computer bungles characterize this aspect. Already the replacement hypothesis looks invalidated, yet we have not even reviewed some of the most debilitating factors. In Chapter 1 we considered the epistemology of taxonomies of Pleistocene archeology and it seemed that the cultures and their sequence are based on invented stone tool categories, rather than on authentic cultural variables. So to trust them invites circular reasoning, such as: these purported cultures must have some validity, even if they are only based on tool types, because similar combinations do occur repeatedly and seem to have discrete geographical distributions. But the tool types were derived from their occurrence in certain combinations, and they as well as the cultures are invented constructs. The process of validation is always one of confirmation, because whenever it seems to fail, we confirm it by contrasting the failed occurrences and naming them other tool types, other combinations of tool types, other cultures. This is an unscientific procedure, in the sense that it implicitly rejects testing by simply finding excuses for refuting evidence.

   Despite these concerns about the taxonomies, and for the sake of the argument, we will now pretend that these entities do have real existence in the period we are concerned with, roughly from 45 to 25 ka ago. We will determine whether the empirical pronouncements based on these taxonomies, as considered below, will fail when tested against the predictions and claims of the replacement model.

   The EUP industries of Eurasia first appear fairly simultaneously between 45 ka and 40 ka BP, or even earlier, at widely dispersed locations from Spain to Siberia (e.g., Makarovo 4/6, Kara Bom). Senftenberg, a clearly Upper Paleolithic (Mode 4) blade industry in the middle of Europe (Gravette point, keeled Aurignacian scraper) has even been dated to 48,300 ± 2000 (GRO-1217) or, if we are to consider a still earlier date, >54,000 years BP (GRO-1771) (Felgenhauer 1959: 60). The Aurignacian of El Castillo level 18, in Spain, seems to commence well before 40 ka

ago (Cabrera Valdés and Bischoff 1989; carbon dates of 40,000 ± 2100, 38,500 ± 1800, 37,700 ± 1800 BP). At Abric Romani, the lowest AMS dates from the Aurignacian average 37 ka BP, but the probably more relevant uranium-series dates point to a sidereal age of 43 ka BP (Bischoff et al. 1994). At El Pendo, the Lower Périgordian (i.e., Châtelperronian) industry, attributed to "Neanderthals" in France, overlies two Early Aurignacian levels (González Echegaray et al. 1980), a stratigraphic pattern also observed in France, for example, at Roc de Combe (Bordes and Labrot 1967) and La Piage (Champagne and Espitalié 1981). The Châtelperronian at Morín Cave has been dated to about 36,950 carbon-years BP, an antiquity similar to that of the same tradition at French sites (generally 37–33 ka BP). The most recent Middle Paleolithic (Mode 3) occupation known in Spain, however, is at Abric Agut. According to both radiocarbon and U-series dating, it occurred only 13–8 ka BP, i.e., straddling the Pleistocene–Holocene interface (Vaquero et al. 2002). Like many other finds, it shows how illusory the separation of the Middle and Upper Paleolithic cultures is (Bednarik 1995b).

The Iberian pattern of a mosaic and gradually decreasing component of Mode 3 technology in regional EUP lithic industries applies through much of Europe. In southern Italy, variants such as the Uluzzian (Palma di Cesnola 1976, 1989), the Uluzzo-Aurignacian, and the Proto-Aurignacian (43–33 ka BP) have been reported (Kuhn and Bietti 2000; Kuhn and Stiner 2001). The Olschewian of the Alpine region, another Aurignacoid tradition (42–35 ka BP), developed from the final Mousterian (Abel 1931; Andrist et al. 1964; Bächler 1940; Bayer 1924, 1928, 1929a, b, 1930; Bednarik 1993, 2007; Bégouën and Breuil 1958; Brodar 1957; Cramer 1941; Ehrenberg 1951, 1953a, b, 1954, 1956, 1957, 1958, 1959, 1962, 1970; Kurtén 1968: 127; Kyrle 1931; Malez 1956, 1959, 1965; Mottl 1950; Rabeder et al. 2000; Rakovec 1967; Stehlin and Dubois 1916; Trimmel 1950; Tschumi 1949; Vértes 1951, 1955, 1959, 1965; Zotz 1939, 1944, 1951). Further east this mosaic includes the Bachokirian of the Pontic region (>43 ka BP), the Bohunician of east-central Europe (Svoboda 1990, 1993: 44–38 ka BP), and various traditions of the Russian Plains. The latter comprise major concentrations of sites in the Prut-Dniester basin and on the middle Don. Some of these industries, such as the Streletsian, Gorodtsovian, and Bryynzenian derived clearly from Mousteroid technologies, whereas the Spitzinian or Telmanian are free of Mode 3 bifaces (Anikovich 2005). In parts of Russia, such as regions of the Don River, the Crimea, and northern Caucasus, Mode 3 technologies (Mousterian and Eastern Micoquian) continue alongside intermediate and Mode 4 ones and the gradual development from one into the other can be observed at many individual sites. The coexistence of seven accepted tool traditions between 36 ka and 28 ka BP has been reported from the region: the Mousterian, Micoquian, Spitzinian, Streletsian, Gorodtsovian, Eastern Szeletian, and Aurignacian (Krems-Dufour variant). The rich mosaic of "EUP cultures" began before 40 ka BP on the Russian Plain and ended only 24–23 ka BP. In the Crimea, the Middle Paleolithic is thought to have ended only between 20 and 18 ka BP. Elsewhere in the region, the introduction of a first fully developed Upper Paleolithic tradition (the Kostenkian) appears about 24 ka at the Kostenki-Borshevo site complex.

A succession of traditions connecting Middle Paleolithic biface technocomplexes, including the late Eastern Micoquian, with typical late Paleolithic ones, continue through the Szeletian of eastern Europe (Allsworth-Jones 1986; 43–35 ka BP), the Jankovician of Hungary; and the Altmühlian (c. 38 ka BP), Lincombian (38 ka BP), and Jerzmanovician (38–6 ka BP) further north. Similarly, the gradual development from the Middle Paleolithic at 48 ka BP (with "Neanderthal" footprints of small children) to the Upper Paleolithic is clearly documented in Theopetra Cave, Greece (Kyparissi-Apostolika 2000; Facorellis et al. 2001). These and other cases of "intermediate" industries or gradual changes all demonstrate the continuity between Mode 3 and Mode 4 technocomplexes in many parts of Europe, but most especially in the east and southeast, the logical entry point of the presumed African invaders. A degree of regionalization precedes this period even in the late Mousterian (Kozłowski 1990; Stiner 1994; Kuhn 1995; Gamble 1999; Riel-Salvatore and Clark 2001), marked by both miniaturization and increasing use of blades, by improved hafting and the use of backed or blunted-back retouch, apparently heralding subsequent developments. German Mode 3 sites have produced backed microliths and evidence of the use of birch resin, and replication experiments suggest that the technology involved in preparing this resin is exceedingly complex. The artificial dichotomy between Middle and Upper Paleolithic materials has thus only served to overemphasize gradual changes in technology (Fedele et al. 2003), at the expense of veracity.

The specious separation of Mode 3 and Mode 4 technologies has even less currency in Africa (e.g., the Howieson's Poort tradition with its microliths, or the Amudian), India (Bednarik 1994; Bednarik et al. 2005) or China (Gao and Norton 2002). In Australia the Mode 3 traditions continue until well into the Holocene, and in Tasmania until the arrival of the British, just over two centuries ago. Indeed, at Tasmania a society with a Mode 3 technology was ethnographically observed.

Instead of a sudden change of technology in Europe at any time during the period from 45 to 25 ka ago, what we do observe is a complex mosaic of regional traditions which, in general, exhibit a gradual change of several variables, such as tool size, knapping method, retouch, and reuse. This suggests in all cases *in-situ* evolution of cultures, rather than the effects of an intrusive tradition. It mirrors precisely the patterns already documented above, in the development in human morphology. Moreover, not one of the more than twenty perceived EUP stone tool traditions of Europe derives from Africa or the Levant. On the contrary, Aurignacoid or similar traditions arrived in the Levant long after they first arose elsewhere in Eurasia, so they were clearly not introduced through this presumed corridor. If these technologies had been imported from sub-Saharan Africa, one would expect a trail of their traces through northern Africa. Yet right across the north of that continent, the Middle Stone Age continued up to 20 ka ago, i.e., at least for 20,000 years after the introduction of Mode 4 technologies across Eurasia. The advocates of the Eve model have steadfastly ignored this glaring inconsistency. Nor have they ever explained where the African or Levantine precedents of the Upper Paleolithic art traditions are to be found, if these African invaders were their carriers as claimed. There is no trace of such evidence, in fact there is almost no proven Pleistocene

rock art currently known from Africa, the exception being very early petroglyphs from the Kalahari (Beaumont and Bednarik 2010). Similarly, the only demonstrated mobiliary art from Africa, found in Namibia, is merely 26 ka or so old (and is not of the MSA, as often claimed, but of the middle LSA). The state of available information from the Levant or Arabia indicates much the same along the route the Africans are supposed to have taken to Europe.

This raises yet another matter consistently avoided by the proponents of replacement. Wherever robust and more gracile forms of humans apparently coexisted locally (as was often the case for tens of millennia), be it in the Levant, in Australia or in any part of Europe, they are always thought to have shared quite similar if not identical cultures, technologies, even ornaments. The simplistic notion that one can trace ethnic differences through tool assemblages is, therefore, unlikely to be helpful in understanding the cultural dynamics of this period; it is yet another fundamental fallacy of archeology. Not only does this observation render the idea of technological or cognitive superiority of the Graciles without support, it reminds us of the tendency of the Eve advocates to explain away any evidence contradicting their version of events. For instance, when sophisticated items of decoration are found together with robust human remains, "they must have been scavenged" from their much more developed gracile betters, or they must "indicate a running ahead of time". When the genetic sophistries propping up the Eve notion contradict the archeological view of the dog's ancestry the finding is rejected. Accommodative modes of thinking of this kind can of course explain away any evidence, but they are complete anathema to scientific practice. The question then becomes whether we are engaged in a search for truth, or whether the purpose of our efforts is to confirm what we already believe to be the case. This is where science, as defined in Chapter 1, truly has to part ways with orthodox archeology, and where the operation of the latter as a belief system becomes apparent.

Until 1979, the Châtelperronian had been considered to be the work of "Moderns," and after its "Neanderthal" makers were recognized, it became essential to explain the presence of a suite of extraordinarily developed decorative objects (Fig. 2.2). The notion of the Châtelperronian being a tool tradition of gracile people can be traced back to Dorothy Garrod, the controversial archeologist who tried to salt the Glozel site on 8 November 1927 in order to discredit its discoverer, the nonarcheologist Émile Fradin. She believed that the "Upper Paleolithic cultures" were the result of a series of invasions into Europe. Since 1979 it has been conceded that the Châtelperronian refers to a technocomplex of robust people. This chapter has shown that history will need to repeat itself, and this time there will be no explaining away of the empirical evidence. Last time around Eve's apostles were able to attribute the incriminating proof to someone else: those smart Aurignacians, who were so very much like ourselves, and so very utterly different from those brutish Neanderthals (how did they ever manage to make Châtelperronian stone tools?). This time checkmate is looming, because it now appears that those smart Aurignacians were also "Neanderthals." In fact a most ignominious defeat now stares the replacement archeologists in the face. Not only the Aurignacian tools, but also those of all other EUP industries are in all probability the work of Robusts:

Fig. 2.2 Two ivory ring
fragments, two perforated
animal canines, and a fossil
shell with an artificial groove
for attachment.
Châtelperronian, Grotte du
Renne, Arcy-sur-Cure,
France. These objects were
used, and almost certainly
made, by "Neanderthals"

3 cm
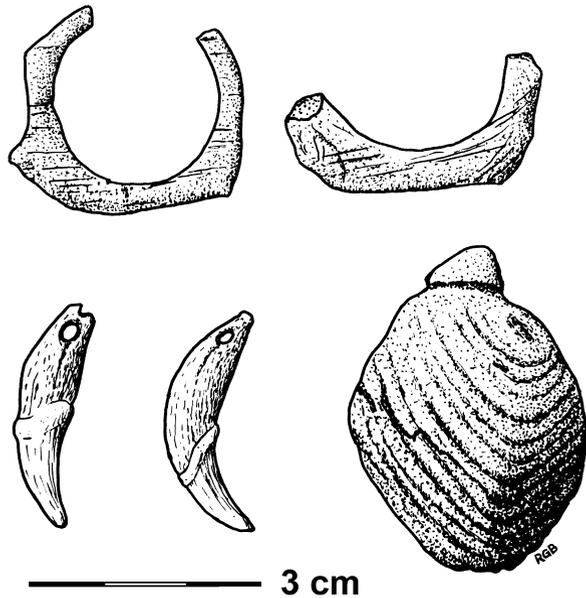
Neanderthals or their direct descendants. Worse still, modern Europeans themselves,
the crown of creation, God's redeeming gift to this world, seem to descend from
these Neanderthals. The humiliation is not just about descending from these brutes,
but about having to concede that, for some decades, the Eve supporters have led the
study of hominin origins on a monumental wild-goose chase.

They will no doubt argue that every possible avenue needed to be explored, and
that research will inherently and unavoidably lead to some dead ends as well as
viable solutions. However, this particular impasse was not necessary. If we check
through the data and rationalizations of this chapter, it becomes clear that most of
this information was available before 1987, the time of the rise of the replacement
hypothesis to dogma. Of the five conditions listed at the beginning of this chapter
as providing the support needed by this hypothesis, four have now been decisively
shown not to have been satisfied, and a rational review would have yielded the same
conclusion more than 20 years ago. It is clear that the paleoanthropological record of
Europe has not produced evidence of a sharp separation between robust and gracile
specimens, but instead points to a complex mosaic suggesting some process of spe-
ciation. It is equally clear that no evidence has been presented that, at any time in
the final third of the Late Pleistocene, contemporary populations exhibited genetic
signatures that might indicate the presence of separate species. Nor was there a sud-
den appearance of pronounced gracility at any point in time. Europeans about 10 ka
ago were on average 10% more robust than today (large molars, more robust cra-
nia and skeletons). That trend of the average continues further back until we arrive
at typical "Neanderthals." We have also found that the same gradual development
applies to the technologies. In fact the development of technology from about 30 to

10 ka is clearly greater than that from 50 to 30 ka ago, and all of it is comparatively gradual. Finally, there is no archeological evidence along the presumed route taken by the mythical African invaders, of an intrusive technology or culture that could have arisen in sub-Saharan Africa. Thus, four crucial tests applied to the Eve model have led to its sound rebuttal, and the fifth should not even be required. The "big bang of consciousness," the "creative explosion" marking the arrival of the intrusive population and technology that we cannot find any evidence for on the genetic, skeletal or technological record still remains to be considered. It is very central to the subject of this book, so we will consider it more exhaustively. Suffice it to say, this perspective will best illuminate the follies of the replacement ideas.

Before we move on to examine these more important factors in how and why we became human, we need to consider one more epistemological aspect of the replacement hypothesis: the question of timing. If the Robusts of Europe were overwhelmed by an intrusive population of a different species, that invasion must have begun at a specific point in time. That time would be marked by the first occurrence of the superior technological manifestations that rendered the invasion successful, and by the first evidence of the purported symbolic revolution driving the invasion. But whatever time slot we choose for the event, it is squarely contradicted by most of the empirical data. The "Upper Paleolithic" technology first appears by at least 45 ka ago, but there is no sign of even remotely gracile humans. If we take the advent of Franco-Cantabrian rock art and mobiliary art as the first proof of Moderns, 33 and 40 ka respectively might be realistic estimates, but it is contradicted by technology, and by the presumed identity of the artists as Neanderthaloid. Alternatively, we could set the date by the first anatomically modern skeletal remains, but there is no agreement on their identification, and there is in any case a gradual introduction. Timing it by the end of the fossils we choose to include with the "Neanderthals," or the stone tools we call Middle Paleolithic, would be another option, but the first end 28 ka ago, while the second marker could be set anywhere from 40 to 10 ka ago in Europe, and even much later elsewhere. Not surprisingly, there is no consensus on the timing of the invasion, or even on how it ought to be identified. But without pinpointing this event, by whatever evidence, how can the replacement model have any credibility whatsoever? Unless we have evidence that the first Graciles were genetically so different from the Robusts of their time that they could not produce fertile offspring with them, we have in fact a hypothesis that should never have gained any currency.

Let us now see how this unfounded hypothesis that fails every simple test fares when we examine the relevant evidence that relates to *culture* rather than some other variable.

References

Abel, O. 1931. Das Lebensbild der eiszeitlichen Tierwelt der Drachenhöhle bei Mixnitz. In O. Abel and G. Kyrle (eds), *Die Drachenhöhle bei Mixnitz*, pp. 885–920. Speläologische Monographien, Vols. 7–9, Vienna.

Adcock, G. J., E. S. Dennis, S. Easteal, G. A. Huttley, L. S. Jermiin, W. J. Peacock and A. Thorne 2001. Mitochondrial DNA sequences in ancient Australians: implications for modern human origins. *Proceedings of the National Academy of Sciences of the United States of America* 98(2): 537–542.

Ahern, J. C. M., I. Karavanic, M. Paunović, I. Janković and F. H. Smith 2004. New discoveries and interpretations of fossil hominids and artifacts from Vindija Cave, Croatia. *Journal of Human Evolution* 46: 25–65.

Allsworth-Jones, P. L. 1986. The Szeletian: main trends, recent results, and problems for resolution. In M. Day, R. Foley and W. Rukang (eds), *The Pleistocene perspective*, pp. 1–25. World Archaeological Congress, Southampton 1986. Allen and Unwin, London.

Anderson, E. 1949. *Introgressive hybridization*. Wiley, New York, NY.

Andrist, D., W. Flähiger and A. Andrist 1964. Das Simmental zur Steinzeit. *Acta Bernensia* 3: 1–46.

Anikovich, M. 2005. Early upper paleolithic cultures of Eastern Europe. *Journal of World Prehistory* 6(2): 205–245.

Asmus, G. 1964. Kritische Bemerkungen und neue Gesichtspunkte zur jungpaläolithischen Bestattung von Combe-Capelle, Périgord. *Eiszeitalter und Gegenwart* 15: 181–186.

Awadalla, P., A. Eyre-Walker and J. Maynard Smith 1999. Linkage disequilibrium and recombination in hominid mitochondrial DNA. *Science* 286: 2524–2525.

Ayala, F. J. 1996. Response to Templeton. *Science* 272: 1363–1364.

Bächler, E. 1940. *Das alpine Paläolithikum der Schweiz*. Monographien zur Ur- und Frühgeschichte der Schweiz, Vol. 2, Basle.

Bader, O. N. 1978. *Sungir: Verkhnepaleoliticheskaya stoyanka*. Izdatel'stvo 'Nauka', Moscow.

Barberi, F., F. Innocenti, L. Lirer, R. Munno, T. S. Pescatore and R. Santacroce 1978. The Campanian Ignimbrite: a major prehistoric eruption in the Neapolitan area (Italy). *Bulletin of Volcanology* 41: 10–22.

Barinaga, M. 1992. 'African Eve' backers beat a retreat. *Science* 255: 686–687.

Bayer, J. 1924. Die geologische und archäologische Stellung des Hochgebirgspaläolithikums der Schweiz. *Die Eiszeit* 1: 59–65.

Bayer, J. 1928. Das zeitliche und kulturelle Verhältnis zwischen den Kulturen des Schmalklingenkulturkreises während des Diluviums in Europa. *Die Eiszeit* 5: 9–23.

Bayer, J. 1929a. Die Olschewakultur. *Eiszeit und Urgeschichte* 6: 83–100.

Bayer, J. 1929b. Wildkirchlikultur. *Eiszeit und Urgeschichte* 6: 142.

Bayer, J. 1930. Hat das Hochgebirgspaläolithikum der Schweiz Knochenwerkzeuge geliefert? *Eiszeit und Urgeschichte* 7: 139–140.

Beaumont, P. and R. G. Bednarik 2010. Pleistocene rock art from Africa. Paper presented to IFRAO Congress 2010, Foix.

Bednarik, R. G. 1993. Wall markings of the cave bear. *Studies in Speleology* 9: 51–70.

Bednarik, R. G. 1994. The Pleistocene art of Asia. *Journal of World Prehistory* 8(4): 351–375.

Bednarik, R. G. 1995a. Concept-mediated marking in the Lower Palaeolithic. *Current Anthropology* 36(4): 605–634.

Bednarik, R. G. 1995b. Traces of cultural continuity in Middle and Upper Palaeolithic material evidence. *Origini* 18: 47–67.

Bednarik, R. G. 1996. Only time will tell: a review of the methodology of direct rock art dating. *Archaeometry* 38(1): 1–13.

Bednarik, R. G. 2002. The dating of rock art: a critique. *Journal of Archaeological Science* 29(11): 1213–1233.

Bednarik, R. G. 2006. The cave art of Mladeč Cave, Czech Republic. *Rock Art Research* 23: 207–216.

Bednarik, R. G. 2007. Antiquity and authorship of the Chauvet rock art. *Rock Art Research* 24: 21–34.

Bednarik, R. G. and M. Kuckenburg 1999. *Nale Tasih: eine Floßfahrt in die Steinzeit*. Jan Thorbecke, Stuttgart.

Bednarik, R. G., G. Kumar, A. Watchman and R. G. Roberts 2005. Preliminary results of the EIP Project. *Rock Art Research* 22: 147–197.

Bégouën, H. and H. Breuil 1958. *Les cavernes du Volp, Trois-Frères, Tuc d'Audoubert*. Arts et métiers graphiques, Paris.

Berger, L. R., S. E. Churchill, B. De Klerk and R. L. Quinn 2008. Small-bodied humans from Palau, Micronesia. *PLoS One* 3(3): e1780. DOI: 10.1371/journal.pone.0001780.

Bischoff, J. L., K. R. Ludwig, J. F. Garcia, E. Carbonell, M. Vaquero, T. W. Stafford and A. J. T. Jull 1994. Dating of the basal Aurignacian sandwich at Abric Romani (Catalunya, Spain) by radiocarbon and uranium series. *Journal of Archaeological Science* 21: 541–551.

Bordes, F. and J. Labrot 1967. La stratigraphie du gisement de Roc de Combe (Lot) et ses implications. *Bulletin de la Société Préhistorique Française* 64: 15–28.

Bräuer, G. 1980. Die morphologischen Affinitäten des jungpleistozänen Strinbeins aus dem Elbmündungsgebiet bei Hahnöfersand. *Zeitschrift für Morphologie und Anthropologie* 71: 1–42.

Bräuer, G. 1981. New evidence of the transitional period between Neanderthal and modern man. *Journal of Human Evolution* 10: 467–474.

Bräuer, G. 1984a. A craniological approach to the origin of anatomically modern *Homo sapiens* in Africa and implications for the appearance of modern Europeans. In F. H. Smith and F. Spencer (eds), *The origins of modern humans: a world survey of the fossil evidence*, pp. 327–410. Alan R. Liss, New York, NY.

Bräuer, G. 1984b. Präsapiens-Hypothese oder Afro-europäische Sapiens-Hypothese? *Zeitschrift für Morphologie und Anthropologie* 75: 1–25.

Bräuer, G. 1989. The evolution of modern humans: a comparison of the African and non-African evidence. In P. Mellars and C. Stringer (eds), *The human revolution: behavioural and biological perspectives on the origins of modern humans*, pp. 123–154. Edinburgh University Press, Edinburgh.

Brodar, S. 1957. Zur Frage der Höhlenbärenjagd und des Höhlenbärenkults in den paläolithischen Fundstellen Jugoslawiens. *Quartär* 9: 147–159.

Brookfield, J. F. Y. 1997. Importance of ancestral DNA ages. *Nature* 388: 134.

Bryant, E. H., S. A. McComas and L. M. Combs 1986. The effect of an experimental bottleneck on quantitative genetic variation in the housefly. *Genetics* 114: 1191–1211.

Cabrera Valdés, V. and J. Bischoff 1989. Accelerator ^{14}C dates for early Upper Palaeolithic (Basal Aurignacian) at El Castillo Cave (Spain). *Journal of Archaeological Science* 16: 577–584.

Cáceres, M., C. Suwyn, M. Maddox, J. W. Thomas and T. M. Preuss 2007. Increased cortical expression of two synaptogenic thrombospondins in human brain evolution. *Cerebral Cortex* 17: 2312–2321.

Cann, R. L. 2002. Tangled genetic routes. *Nature* 416: 32–33.

Cann, R. L., M. Stoneking and A. C. Wilson 1987. Mitochondrial DNA and human evolution. *Nature* 325: 31–36.

Carlier, L. 2008. Caractérisation de la région 51-160 de la protéine KIN17 humaine par RMN et modélisation moléculaire, les dommages de l'ADN, 2000–2008.

Carlier, L., J. Couprie, A. le Maire, L. Guilhaudis, I. Milazzo, M. Gondry, D. Davoust, B. Gilquin and S. Zinn-Justin 2007. Solution structure of the region 51-160 of human KIN17 reveals an atypical winged helix domain. *Protein Science* 16: 2750–2755.

Champagne, F. and R. Espitalié 1981. *La Piage, site préhistorique sur Lot*. Mémoires de la Société Préhistorique Française, No. 15.

Christopherson, K., E. Ullian, C. Stokes, C. Mullowney, J. Hill, A. Agah, J. Lawler, D. Mosher, P. Brownstein and B. Barres 2005. Thrombospondins are astrocyte-secreted proteins that promote CNS synaptogenesis. *Cell* 120: 421–433.

Churchill, S. E. and F. H. Smith 2000a. A modern human humerus from the early Aurignacian of Vogelherdhöhle (Stetten, Germany). *American Journal of Physical Anthropology* 112: 251–273.

Churchill, S. E. and F. H. Smith 2000b. Makers of the early Aurignacian of Europe. *American Journal of Physical Anthropology* 113: 61–115.

Conard, N. J., P. M. Grootes and F. H. Smith 2004. Unexpectedly recent dates for human remains from Vogelherd. *Nature* 430: 198–201.

Cooper, A., C. Mourer-Chauvirp, G. K. Chambers, A. Von Haeseler, A. C. Wilson and S. Pääbo 1992. Independent origins of New Zealand moas and kiwis. *Proceedings of the National Academy of Sciences of the United States of America* 89: 8741–8744.

Cramer, H. 1941. Der Lebensraum des eiszeitlichen Höhlenbären und die 'Höhlen-bärenjagdkultur'. *Zeitschrift der Deutschen Geologischen Gesellschaft* 93: 181–196.

Czarnetzki, A. 1983. Zur Entwicklung des Menschen in Südwestdeutschland. In H. Müller Beck (ed), *Urgeschichte in Baden-Württemberg*, pp. 217–240. Konrad Theiss, Stuttgart.

d'Errico, F. 1995. Comment on R. G. Bednarik, 'Concept-mediated markings of the Lower Palaeolithic'. *Current Anthropology* 36: 618–620.

Ehrenberg, K. 1951. 30 Jahre paläobiologischer Forschung in österreichischen Höhlen. *Quartär* 5: 93–108.

Ehrenberg, K. 1953a. Die paläontologische, prähistorische und paläoethnologische Bedeutung der Salzofenhöhle im Lichte der letzten Forschungen. *Quartär* 5: 35–40.

Ehrenberg, K. 1953b. Berichte über Ausgrabungen in der Salzofenhöhle im Toten Gebirge. VII. Beobachtungen und Funde der Salzofen-Expedition 1953. *Sitzungsberichte der Österreichischen Akademie der Wissenschaften, mathematisch-naturwissenschaftlicher Klasse* 162: 51–56.

Ehrenberg, K. 1954. Die paläontologische, prähistorische and paläo-ethnologische Bedeutung der Salzofenhöhle im Lichte der letzten Forschungen. *Quartär* 6: 19–58.

Ehrenberg, K. 1956. Berichte über Ausgrabungen in der Salzofenhöhle im Toten Gebirge. IX. Die Grabungen 1956 und ihre einstweiligen Ergebnisse. *Sitzungsberichte der Österreichischen Akademie der Wissenschaften, mathematisch-naturwissenschaftlicher Klasse* 165: 15–19.

Ehrenberg, K. 1957. Berichte über Ausgrabungen in der Salzofenhöhle im Toten Gebirge. VIII. Bemerkungen zu den Untersuchungen der Sedimente durch Elisabeth Schmid. *Sitzungsberichte der Österreichischen Akademie der Wissenschaften, mathematisch-naturwissenschaftlicher Klasse* 166: 57–63.

Ehrenberg, K. 1958. Vom dermaligen Forschungsstand in der Höhle am Salzofen. *Quartär* 10: 237–251.

Ehrenberg, K. 1959. Die urzeitlichen Fundstellen und Funde in der Salzofenhöhle, Steiermark. *Archaeologia Austriaca* 25: 8–24.

Ehrenberg, K. 1962. Über Lebensweise und Lebensraum des Höhlenbären. *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien* 101: 18–31.

Ehrenberg, K. 1970. Vigaun, Salzburg. *Fundberichte aus Österreich* 9: 247.

Facorellis, Y., N. Kyparissi-Apostolika and Y. Maniatis 2001. The cave of Theopetra, Kalambaka: radiocarbon evidence for 50,000 years of human presence. *Radiocarbon* 43(2B): 1029–1048.

Fedele, F. G. and B. Giaccio 2007. Paleolithic cultural change in western Eurasia across the 40,000 BP timeline: continuities and environmental forcing. In P. Chenna Reddy (ed), *Exploring the mind of ancient man. Festschrift to Robert G. Bednarik*, pp. 292–316. Research India Press, New Delhi.

Fedele, F. G., B. Giaccio, R. Isaia and G. Orsi 2002. Ecosystem impact of the Campanian Ignimbrite eruption in Late Pleistocene Europe. *Quaternary Research* 57: 420–424.

Fedele, F. G., B. Giaccio, R. Isaia and G. Orsi 2003. The Campanian Ignimbrite Eruption, Heinrich Event 4, and Palaeolithic change in Europe: a high-resolution investigation. In *Volcanism and the earth's atmosphere*, pp. 301–325. Geophysical Monograph 139, American Geophysical Union, Washington, DC.

Felgenhauer, F. 1959. Das Paläolithikum von Willendorf in der Wachau, Niederösterreich. Vorbericht über die monographische Bearbeitung. *Forschungen und Fortschritte* 33(3): 152–155.

Foley, R. and M. M. Lahr 1997. Mode 3 technologies and the evolution of modern humans. *Cambridge Archaeological Journal* 7: 3–36.

Frayer, D. W. 1986. Cranial variation at Mladeč and the relationship between Mousterian and Upper Palaeolithic hominids. *Anthropos* (Brno) 23: 243–256.

Frayer, D. W. 1993. Evolution at the European edge: Neanderthal and Upper Paleolithic relationships. *Préhistoire Européenne* 2: 9–69.

Frayer, D. W. 1998. Perspectives on Neandertals as ancestors. In G. A. Clark and C. M. Willermet (eds), *Conceptual issues in modern human origins research*, pp. 220–234. Aldine de Gruyter, New York, NY.

Frayer, D. W., M. H. Wolpoff, F. H. Smith, A. G. Thorne and G. G. Pope 1993. The fossil evidence for modern human origins. *American Anthropology* 95: 14–50.

Frayer, D. W., M. H. Wolpoff, A. G. Thorne, F. H. Smith and G. G. Pope 1994. Getting it straight. *American Anthropology* 96: 424–438.

Fürst, J. 1922. Nové nálezy v Mladečých jeskyních. *Litovelské novinsky* 26 August.

Fürst, J. 1923-1924. Nálezy v jeskyních Mladečých. *Vlastivdný sborník střední a severní Moravy* 2: 6–7.

Gábori-Csánk, V. 1993. *Le Jankovichien: une civilisation paléolithiques en Hongrie*. ERAUL 53, Liège.

Gamble, C. 1999. *The Palaeolithic societies of Europe*. Cambridge University Press, Cambridge.

Gao, X. and C. J. Norton 2002. A critique of the Chinese 'Middle Palaeolithic'. *Antiquity* 76: 397–412.

Garrigan, D., Z. Mobasher, T. Severson, J. A. Wilder and M. F. Hammer 2005. Evidence for archaic Asian ancestry on the human X chromosome. *Molecular Biological Evolution* 22: 189–192.

Geay, P. 1957. Sur la découverte d'un squelette aurignacien en Charente-Maritime. *Bulletin de la Société Préhistoroque Française* 54: 193–197.

Geigl, E.-M. 2002. Why ancient DNA research needs taphonomy. Paper presented to Conférence ICAZ, 'Bioshere to Lithosphere', Durham.

Germonpré, M., M. V. Sablin, R. E. Stevens, R. E. M. Hedges, M. Hofreiter, M. Stiller and V. R. Després 2009. Fossil dogs and wolves from Palaeolithic sites in Belgium, the Ukraine and Russia: osteometry, ancient DNA and stable isotopes. *Journal of Archaeological Science* 36(2): 473–490.

Gibbons, A. 1998. Calibrating the mitochondrial clock. *Science* 279: 28–29.

Gibbons, A. 2010. Close encounters of the prehistoric kind. *Science* 328: 680–684.

Gieseler, W. 1974. *Die Fossilgeschichte des Menschen*. Konrad Theiss, Stuttgart.

Golenberg, E. M., A. Bickel and P. Weihs 1996. Effect of highly fragmented DNA on PCR. *Nucleic Acids Research* 24: 5026–5033.

González Echegaray, J., L. G. Freeman, I. Barandiaran, J. M. Apellaniz, K. Butzer, C. Fuentes Vidarte, B. Madariaga, J. A. Gonzalez Morales and A. Leroi-Gourhan 1980. *La Cueva de El Pendo*. Bibliotheca Praehistorica Hispana, Madrid.

Green, R. E., J. Krause, S. E. Ptak, A. W. Briggs, M. T. Ronan, J. F. Simons, L. Du, M. Egholm, J. M. Rothberg, M. Paunovic and S. Pääbo 2006. Analysis of one million base pairs of Neanderthal DNA. *Nature* 444: 330–336.

Green, R. E. et al. 2010. A draft sequence of the Neandertal genome. *Science* 328: 710–722.

Gutierrez, G. and A. Marin 1998. The most ancient DNA recovered from amber-preserved specimen may not be as ancient as it seems. *Molecular Biological Evolution* 15: 926–929.

Gutierrez, G., D. Sanchez and A. Marin 2002. A reanalysis of the ancient mitochondrial DNA sequences recovered from Neandertal bones. *Molecular Biological Evolution* 19: 1359–1366.

Gyllensten, U., D. Wharton, A. Josefsson and A. C. Wilson 1991. Paternal inheritance of mitochondrial DNA in mice. *Nature* 352: 255–257.

Hammer, M. F. 1995. A recent common ancestry for human Y chromosomes. *Nature* 378: 376–378.

Hardy, J., A. Pittman, A. Myers, K. Gwinn-Hardy, H. C. Fung, R. de Silva, M. Hutton and J. Duckworth 2005. Evidence suggesting that *Homo neanderthalensis* contributed the H2 *MAPT* haplotype to *Homo sapiens*. *Biochemical Society Transactions* 33: 582–585.

Harpending, H. C., M. A. Batzer, M. Gurven, L. B. Jorde, A. R. Rogers and S. T. Sherry 1998. Genetic traces of ancient demography. *Proceedings of the National Academy of Sciences of the United States of America* 95: 1961–1967.

Hasegawa, M., H. Kishino and T. Yano 1985. Dating of the human-ape splitting by a molecular clock of mitochondrial DNA. *Journal of Molecular Evolution* 22: 160–174.

Hawks, J. 1997. Have Neanderthals left us their genes? In L. Cavalli-Sforza (ed), *Human evolution: abstracts of papers presented at the 1997 Cold Spring Harbor Symposium on Human Evolution arranged by L. L. Cavalli-Sforza and J. D. Watson*, p. 81. Cold Spring Harbor Laboratory, Cold Spring Harbor, New York, NY.

Hawks, J., S.-H. Lee, K. Hunley and M. Wolpoff 2000. Population bottlenecks and Pleistocene human evolution. *Molecular Biological Evolution* 17: 2–22.

Hedges, S. B., S. Kumar, K. Tamura and M. Stoneking 1992. Human origins and analysis of mitochondrial DNA sequences. *Science* 255: 737–739.

Henke, W. and R. Protsch 1978. Die Paderborner Calvaria—ein diluvialer *Homo sapiens*. *Anthropologischer Anzeiger* 36: 85–108.

Henke, W. and H. Rothe 1994. *Paläoanthropologie*. Wiley-VCH Verlag GmbH, Berlin.

Henry-Gambier, D. 2002. Les fossiles de Cro-Magnon (Les-Eyzies-de-Tayac, Dordogne): Nouvelles données sur leur position chronologique et leur attribution culturelle. *Bulletin et Mémoires de la Société d'Anthropologie de Paris* 14(1–2): 89–112.

Higuchi, R., B. Bowman, M. Freiberger, O. A. Ryder and A. C. Wilson 1984. DNA sequences from the quagga, and extinct member of the horse family. *Nature* 312: 282–284.

Hublin, J.-J., C. B. Ruiz, P. M. Lara, M. Fontugne and J.-L. Reyss 1995. The Mousterian site of Zafarraya (Andalusia, Spain): dating and implications on the Palaeolithic peopling processes of western Europe. *Comptes Rendus de l'Academie des Sciences de Paris*, Series 2a 321(10): 931–937.

Hublin, J.-J., F. Spoor, M. Braun, F. Zonneveld and S. Condemi 1996. A late Neanderthal associated with Upper Palaeolithic artefacts. *Nature* 381: 224–226.

Jablonka, E. and M. Lamb 2005. *Evolution in four dimensions: genetic, epigenetic, behavioral, and symbolic variation in the history of life*. MIT Press, Cambridge, MA.

Jelínek, J. 1987. Historie, identifikace a význam mladečských antropologických nálezů z počátku mladého paleolitu. *Anthropos* 25: 51–69.

Jelínek, J., M. H. Wolpoff and D. W. Frayer 2005. Evolutionary significance of the Quarry Cave specimens from Mladeč. *Anthropologie* 43: 215–228.

Jolivet, J. P. and M. Henry 1994. *De la solution à l'oxyde, condensation des cations en solution aqueuse, chimie de surface des oxides*. InterEditions CNRS, Paris.

Karavanic, I. and H. Smith 1998. The Middle/Upper Palaeolithic interface and the relationship of Neanderthals and early modern humans in the Hrvatsko Zagorje, Croatia. *Journal of Human Evolution* 34: 223–248.

Kidd, K. K., J. R. Kidd, S. A. Pakstis, C. M. Tishkoff, C. M. Castiglione and G. Strugo 1996. Use of linkage disequilibrium to infer population histories. *American Journal of Physical Anthropology* Supplement 22: 138.

Klaatsch, H. and O. Hauser 1910. *Homo Aurignaciensis Hauseri*. *Prähistorische Zeitschrift* 1: 273–338.

Knies, J. 1906. Nový nález diluviálního človka u Mladče na Morav. *Vstník klubu přírodovdného v Prostjov* 7: 1–19.

Kozłowski, J. K. 1990. A multiaspectual approach to the origins of the Upper Palaeolithic in Europe. In P. Mellars (ed), *The emergence of modern humans. An archaeological perspective*, pp. 419–438. Edinburgh University Press, Edinburgh.

Krings, M., A. Stone, R. W. Schmitz, H. Krainitzki, M. Stoneking and S. Pääbo 1997. Neandertal DNA sequences and the origin of modern humans. *Cell* 90: 19–30.

Kuhn, S. L. 1995. *Mousterian lithic technology. An ecological perspective*. Princeton University Press, Princeton, NJ.

Kuhn, S. L. and A. Bietti 2000. The late Middle and early Upper Paleolithic in Italy. In O. Bar-Yosef and D. Pilbeam (eds), *The geography of Neandertals and modern humans in Europe and the Greater Mediterranean*, pp. 49–76. Peabody Museum of Archaeology and Ethnology, Cambridge, MA.

Kuhn, S. L. and M. C. Stiner 2001. The antiquity of hunter-gatherers. In C. Panter-Brick, R. H. Layton and P. Rowley-Conwy (eds), *Hunter-gatherers: an interdisciplinary perspective*, pp. 99–142. Cambridge University Press, Cambridge.

Kurtén, B. 1968. *Pleistocene mammals of Europe*. Weidenfeld and Nicolson, London.

Kyparissi-Apostolika, N. (ed) 2000. *Theopetra Cave. Twelve years of excavation and research 1987–1998*. Institute for Aegean Prehistory, Athens.

Kyrle, G. 1931. Die Höhlenbärenjägerstation. In O. Abel and G. Kyrle (eds), *Die Drachenhöhle bei Mixnitz*, pp. 804–962. Speläologische Monographien, Band 7–9, Vienna.

Lewin, R. 2005. *Human evolution: An illustrated introduction*. Blackwell, Oxford.

Lindhal, T. and B. Nyberg 1972. Rate depurination of native deoxyribonucleic acid. *Bio-chemistry* 11: 3610–3618.

Maddison, D. R., M. Ruvolo and D. L. Swofford 1992. Geographic origins of human mitochondrial DNA: phylogenetic evidence from control region sequences. *Systematic Biology* 41: 111–124.

Malez, M. 1956. Geoloska i paleontolska istrazivanja u pecini Veternici. *Acta Geologica Zagreb* 1: 83–88.

Malez, M. 1959. Das Paläolithikum der Veternicahöhle und der Bärenkult. *Quartär* 11: 171–188.

Malez, M. 1965. Novi opci varijacioni raspon vrste Ursus spelaeus Rosnm. et Heinroth. *Geoloski Vjesnik* 18: 133–139.

McDougall, I., F. H. Brown and J. G. Fleagle 2005. Stratigraphic placement and age of modern humans from Kibish, Ethiopia. *Nature* 433: 733–736.

Mellars, P. 2005. The impossible coincidence. A single-species model for the origins of modern human behavior in Europe. *Evolutionary Anthropology* 14: 12–27.

Mellars, P. and C. Stringer 1989. Introduction. In P. Mellars and C. Stringer (eds), *The human revolution: behavioural and biological perspectives on the origins of modern humans*, pp. 1–14. Edinburgh University Press, Edinburgh.

Morris, A. A. M. and R. N. Lightowlers 2000. Can paternal mtDNA be inherited? *The Lancet* 355: 1290–1291.

Mottl, M. 1950. Die paläolithischen Funde aus der Salzofenhöhle im Toten Gebirge. *Archaeologia Austriaca* 5: 24–34.

Movius, H. L. 1969. The Abri of Cro-Magnon, Les Eyzies (Dordogne) and the probable age of the contained burials on the basis of the nearby Abri Pataud. *Anuario de Estudio Atlanticos* 15: 323–344.

Napierala, H. and H.-P. Uerpmann 2010. A 'new' Palaeolithic dog from central Europe. *International Journal of Osteoarchaeology*. DOI: 10.1002/oa.1182

Nei, M. 1987. *Molecular evolutionary genetics*. Columbia University Press, New York, NY.

Noonan, J. P., M. Hofreiter, D. Smith, J. R. Priest, N. Rohland, G. Rabeder, J. Krause, J. C. Detter, S. Pääbo and E. M. Rubin 2005. Genomic sequencing of Pleistocene cave bears. *Science* 309: 597–599.

Oliva, M. 1989. Mladopaleolitické nálezy z Mladečských jeskyní. *Acta Musei Moraviae* 74: 35–54.

Orlando, L. and C. Hänni 2008. Du nouveau pour l'AND ancien. *Médicine Sciences* 8–9: I–XVI.

Pääbo, S. 1985. Molecular cloning and ancient Egyptian mummy DNA. *Nature* 314: 644–645.

Pääbo, S. 1989. Extraction, characterization, molecular cloning, and enzymatic amplification. *Proceedings of the National Academy of Sciences of the United States of America* 86: 1939–1943.

Pääbo, S., H. Poinar, D. Serra, V. Jaenicke-Després, J. Hebler, N. Rohland, M. Kuch, J. Krause, L. Vigilant and M. Hofreiter 2004. Genetic analyses from ancient DNA. *Annual Review on Genetics* 38: 645–679.

Palma di Cesnola, A. 1976. Le leptolithique archaïque en Italie. In B. Klíma (ed), *Périgordien et Gravettien en Europe*, pp. 66–99. Congrès IX, Colloque XV, UISPP, Nice.

Palma di Cesnola, A. 1989. L'Uluzzien: faciès italien du Leptolithique archaïque. *L'Anthropologie* 93: 783–811.

Pavlov, P., J. I. Svendsen and S. Indrelid 2001. Human presence in the European Arctic nearly 40,000 years ago. *Nature* 413: 64–67.

Pennisi, E. 1999. Genetic study shakes up out of Africa theory. *Science* 283: 1828.

Perpère, M. 1971. L'aurignacien en Poitou-Charentes (étude des collections d'industries lithiques). Doctoral thesis, University of Paris.

Perpère, M. 1973. Les grands gisements aurignaciens du Poitou. *L'Anthropologie* 77: 683–716.

Protsch, R. 1975. The absolute dating of Upper Pleistocene sub-Saharan fossil hominids and their place in human evolution. *Journal of Human Evolution* 4: 297–322.

Protsch, R. and H. Glowatzki 1974. Das absolute Alter des paläolithischen Skeletts aus der Mittleren Klause bei Neuessing, Kreis Kelheim, Bayern. *Anthropologischer Anzeiger* 34: 140–144.

Protsch, R. and A. Semmel 1978. Zur Chronologie des Kelsterbach-Hominiden. *Eiszeitalter und Gegenwart* 28: 200–210.

Pruvost, M., T. Grange and E.-M. Geigl 2005. Minimizing DNA contamination by using UNG-coupled quantitative real time PCR on degraded DNA samples: application to DNA studies. *Bio Techniques* 38(4): 569–575.

Pruvost, M., R. Schwarz, V. Bessa Correia, S. Champlot, S. Braguier, N. Morel, Y. Fernandez-Jalvo, T. Grange and E.-M. Geigl 2007. Freshly excavated fossil bones are best for amplification of ancient DNA. *Proceedings of the National Academy of Sciences of the United States of America* 104(3): 739–744.

Rabeder, G., D. Nagel and M. Pacher 2000. *Der Höhlenbär*. Species 4, Jan Thorbecke Verlag, Stuttgart.

Rakovec, I. 1967. Jamski medved iz Mokriske Jame v Savinjskih Alpah. *Razprave* 10: 123–203.

Ramirez Rozzi, F. V., F. d'Errico, M. Vanhaeren, P. M. Grootes, B. Kerautret and V. Dujardin 2009. Cutmarked human remains bearing Neandertal features and modern human remains associated with the Aurignacian at Les Rois. *Journal of Anthropological Sciences* 87: 153–185.

Relethford, J. H. 2002. Absence of regional affinities of Neandertal DNA with living humans does not reject multiregional evolution. *American Journal of Physical Anthropology* 115(1): 95–98.

Riel-Salvatore, J. and G. A. Clark 2001. Grave markers. Middle and Early Upper Paleolithic burials and the use of chronotypology in contemporary Paleolithic research. *Current Anthropology* 42: 449–479.

Rodriguez-Trelles, F., R. Tarrio and F. J. Ayala 2001. Erratic overdispersion of three molecular clocks: GPDH, SOD, and XDH. *Proceedings of the National Academy of Sciences of the United States of America* 98: 11405–11410.

Rodriguez-Trelles, F., R. Tarrio and F. J. Ayala 2002. A methodological bias toward overestimation of molecular evolutionary time scales. *Proceedings of the National Academy of Sciences of the United States of America* 99: 8112–8115.

Rougier H., Ş. Milota, R. Rodrigo, M. Gherase, L. Sarcină, O. Moldovan, R. G. Constantin, C. Franciscus, P. E. Zollikofer, M. Ponce de León and E. Trinkaus 2007. Peştera cu Oase 2 and the cranial morphology of early modern Europeans. *Proceedings of the National Academy of Sciences of the United States of America* 104(4): 1165–1170.

Schulz, H.-P. 2002. The lithic industry from layers IV–V, Susiluola Cave, western Finland, dated to the Eemian interglacial. *Préhistoire Européenne* 16–17: 7–23.

Schulz, H.-P., B. Eriksson, H. Hirvas, P. Huhta, H. Jungner, P. Purhonen, P. Ukkonen and T. Rankama 2002. Excavations at Susiluola Cave. *Suomen Museo* 2002: 5–45.

Schwartz, M. and J. Vissing 2002. Paternal inheritance of mitochondrial DNA. *New England Journal of Medicine* 347: 576–580.

Shang, H., H. Tong, S. Zhang, F. Chen and E. Trinkaus 2007. An early modern human from Tianyuan Cave, Zhoukoudian, China. *Proceedings of the National Academy of Sciences of the United States of America* 104(16): 6573–6578.

Skutil, J. 1938. *Pravěké nálezy v Mladči u Litovle na Morav*. Krajinská musejni společnost, Litovel.

Smith, F. H. 1982. Upper Pleistocene hominid evolution in south-central Europe: a review of the evidence and analysis of trends. *Current Anthropology* 23: 667–686.

Smith, F. H. 1985. Continuity and change in the origin of modern *Homo sapiens*. *Zeitschrift für Morphologie und Anthropologie* 75: 197–222.

Smith, F. H., I. Janković and I. Karavanić 2005. The assimilation model, modern human origins in Europe, and the extinction of Neandertals. *Quaternary International* 137: 7–19.

Smith, F. H. and G. Ranyard 1980. Evolution of the supraorbital region in Upper Pleistocene fossil hominids from south-central Europe. *American Journal of Physical Anthropology* 53: 589–610.

Smith, F. H., E. Trinkaus, P. B. Pettitt, I. Karavanić and M. Paunović 1999. Direct radiocarbon dates for Vindija G_1 and Velika Pećina Late Pleistocene hominid remains. *Proceedings of the National Academy of Sciences of the United States of America* 96(22): 12281–12286.

Smyčka, J. 1907. Litovel a okolí za pravku. *Pravk* 3: 140–150.

Smyčka, J. 1922. Nálezy diluviálního člověka v Mladči u Litovle na Moravě. *Obzor prehistorický* 1: 111–120.

Smyčka, J. 1925. Kdy přišel první člověk do litovelského kraje. Vlastivědný sborník střední a severní Moravy III, příloha Olomoucko a Litovelsko 6–7.

Soficaru, A., A. Doboş and E. Trinkaus 2006. Early modern humans from the Peştera Muierii, Baia de Fier, Romania. *Proceedings of the National Academy of Sciences of the United States of America* 103(46): 17196–171201.

Sonneville-Bordes, D. de 1959. Position-stratigraphique et chronologique relative des restes humains du Palaéolithique supérieur entre Loire et Pyrénées. *Annales de Paléontologie* 45: 19–51.

Stehlin, H. G. and A. Dubois 1916. *Note préliminaire sur les fouilles entreprises dans la Grotte de Cotencher (canton Neuchâtel)*. Ecologae Geologica Helvetia 14, Lausanne.

Stiner, M. C. 1994. *Honor among thieves. A zooarchaeological study of Neandertal ecology*. Princeton University Press, Princeton, NJ.

Strauss, E. 1999. Can mitochondrial clocks keep time? *Science* 283: 1435–1438.

Stringer, C. B. 1984a. Human evolution and biological adaptation in the Pleistocene. In R. Foley (ed), *Hominid evolution and community ecology: prehistoric human adaptation in biological perspective*, pp. 55–83. Academic, London.

Stringer, C. B. 1984b. The fate of the Neanderthals. *Natural History* (December): 6–12.

Stringer, C. B. 1985. Middle Pleistocene hominid variability and the origin of Late Pleistocene humans. In E. Delson (ed), *Ancestors: the hard evidence*, pp. 289–295. Alan R. Liss, New York, NY.

Stringer, C. B. 1989. The origin of early modern humans: a comparison of the European and non-European evidence. In P. Mellars and C. Stringer (eds), *The human revolution: behavioural and biological perspectives on the origins of modern humans*, pp. 232–244. Edinburgh University Press, Edinburgh.

Stringer, C. B. and P. Andrews 1988. Genetic and fossil evidence for the origin of modern humans. *Science* 239: 1263–1268.

Svoboda, J. 1990. The Bohunician. In J. K. Kozłowski (ed), *La mutation*, pp. 169–192. ERAUL, Liège.

Svoboda, J. 1993. The complex origin of the Upper Paleolithic in the Czech and Slovak Republics. In H. Knecht, A. Pike-Tay and R. White (eds), *Before Lascaux: the complete record of the early Upper Paleolithic*, pp. 23–36. CRC Press, Boca Raton, FL.

Svoboda, J. A., J. van der Plicht and V. Kuzelka 2002. Upper Palaeolithic and Mesolithic human fossils from Moravia and Bohemia (Czech Republic): some new ^{14}C dates. *Antiquity* 76: 957–962.

Szombathy, J. 1925. Die diluvialen Menschenreste aus der Fürst-Johanns-Höhle bei Lautsch in Mähren. *Die Eiszeit* 2: 1–34, 73–95.

Templeton, A. R. 1992. Human origins and analysis of mitochondrial DNA sequences. *Science* 255: 737.

Templeton, A. R. 1993. The 'Eve' hypothesis: a genetic critique and re-analysis. *American Anthropologist* 95: 51–72.

Templeton, A. R. 1996. Gene lineages and human evolution. *Science* 272: 1363.

Templeton, A. 2002. Out of Africa again and again. *Nature* 416: 45–51.

Templeton, A. R. 2005. Haplotype trees and modern human origins. *Yearbook of Physical Anthropology* 48: 33–59.

Terberger, T. 1998. Endmesolithische Funde von Drigge, Lkr. Rügen—Kannibalen auf Rügen? *Jahrbuch für Bodendenkmalpflege Mecklenburg-Vorpommern* 46: 7–44.

Terberger, T. and M. Street 2003. Jungpaläolithische Menschenreste im westlichen Mitteleuropa und ihr Kontext. In J. M. Burdukiewicz, L. Fiedler, W.-D. Heinrich, A. Justus and E. Brühl (eds), *Erkenntnisjäger: Kultur und Umwelt des frühen Menschen*, pp. 579–591. Veröffentlichungen des Landesamtes für Archäologie Sachsen-Anhalt – Landesmuseum für Vorgeschichte, Vol. 57/2, Halle.

Tobias, P. V. 1995. The bearing of fossils and mitochondrial DNA on the evolution of modern humans, with a critique of the 'mitochondrial Eve' hypothesis. *South African Archaeological Bulletin* 50: 155–167.

Torroni, A., M. T. Lott, M. F. Cabell, Y.-S. Chen, L. Lavergne and D. C. Wallace 1994. MtDNA and the origin of Caucasians: identification of ancient Caucasian-specific haplogroups, one of which is prone to a recurrent somatic duplication in the D-loop region. *American Journal of Human Genetics* 55: 760–776.

Trimmel, H. 1950. Die Salzofenhöhle im Toten Gebirge. Ph.D. thesis, Philosophical Faculty, University of Vienna.

Trinkaus, E. 2007. European early modern humans and the fate of the Neandertals. *Proceedings of the National Academy of Sciences of the United States of America* 104: 7367–7372.

Trinkaus, E. and M. Le May 1982. Occipital bunning among Later Pleistocene hominids. *American Journal of Physical Anthropology* 57: 27–35.

Trinkaus, E., O. Moldovan, Ş. Milota, A. Bîlgar, L. Sarcina, S. Athreya, S. E. Bailey, R. Rodrigo, G. Mircea, T. Higham, C. Bronk Ramsey and J. van der Plicht 2003. An early modern human from the Peştera cu Oase, Romania. *Proceedings of the National Academy of Sciences of the United States of America* 100(20): 11231–11236.

Tschumi, O. 1949. Die steinzeitlichen Epochen. In O. Tschumi (ed), *Urgeschichte der Schweiz*, Vol. 1, pp. 407–727. Verlag Huber und Co., Frauenfeld.

Vaquero, M., M. Esteban, E. Allué, J. Vallverdú, E. Carbonell and J. L. Bischoff 2002. Middle Palaeolithic refugium, or archaeological misconception? A new U-series and radiocarbon chronology of Abric Agut (Capellades, Spain). *Journal of Archaeological Science* 29: 953–958.

Vértes, L. 1951. Novi'e raskopki v peschtschere na Istállóskö. *Acta Archaeologica* 1: 15–34.

Vértes, L. 1955. Neuere Ausgrabungen und paläolithische Funde in der Höhle von Istállóskö. *Acta Archaeologica* 5: 111–131.

Vértes, L. 1959. Die Rolle des Höhlenbären im ungarischen Paläolithikum. *Quartär* 11: 151–170.

Vértes, L. 1965. *Az Öskökor és az tmeneti kökor emlékei Magyarorsz gon*. Akadémiai Kiadó, Budapest.

Vigilant, L., M. Stoneking, H. Harpending, K. Hawkes and A. C. Wilson 1991. African populations and the evolution of human mitochondrial DNA. *Science* 253: 1503–1507.

Wainscoat, J. 1987. Out of the garden of Eden. *Nature* 325: 13.

Wainscoat, J. S., A. V. S. Hill, A. L. Boyce, J. Flint, M. Hernandez, S. L. Thein, J. M. Old, J. R. Lynch, A. G. Falusi, D. J. Weatherall and J. B. Vlegg 1986. Evolutionary relationships of human populations from an analysis of nuclear DNA polymorphisms. *Nature* 319: 491–493.

Walberg, M. W. and D. A. Clayton 1981. Sequence and properties of the human KB cell and mouse L cell D-loop regions of mitochondrial DNA. *Nucleic Acids Research* 9: 5411–5421.

Walser, J. and A. Furano 2010. The mutational spectrum of non-CpG DNA varies with CpG content. *Genome Research.* DOI: 10.1101/gr.103283.109

Watchman, A. 1999. A universal standard for reporting the ages of petroglyphs and rock paintings. In M. Strecker and P. Bahn (eds), *Dating and the earliest known rock art*, pp. 1–3. Oxbow Books, Oxford.

Weidenreich, F. 1946. *Apes, giants, and man*. University of Chicago Press, Chicago.

Weiser, E. 1928. *Reise und Wanderbuch*, 2nd volume. Ernst Feld, Freudenthal.

White, R. 1993. Technological and social dimensions of Aurignacian-age body ornaments across Europe. In H. Knecht, A. Pike-Tay and R. White (eds), *Before Lascaux: the complex record of the early Upper Palaeolithic*, pp. 277–299. CRC Press, Boca Raton, FL.

White, R. 1995. Comment on R. G. Bednarik, 'Concept-mediated markings in the Lower Palaeolithic'. *Current Anthropology* 36: 623–625.

White, T. D., B. Asfaw, D. DeGusta, H. Gilbert, G. D. Richards, G. Suwa and F. C. Howell 2003. Pleistocene *Homo sapiens* from Middle Awash, Ethiopia. *Nature* 425: 742–747.

Wild, E. M., M. Teschler-Nicola, W. Kutschera, P. Steier, E. Trinkaus and W. Wanek 2005. Direct dating of Early Upper Palaeolithic human remains from Mladeč. *Nature* 435: 332–335.

Williams, R. S. 2002. Another surprise from the mitochondrial genome. *New England Journal of Medicine* 347: 609–611.

Wolpoff, M. 1999. *Paleoanthropology*, 2nd edn. McGraw-Hill, New York, NY.

Wolpoff, M., F. H. Smith, M. Malez, J. Radovčić and D. Rukavina 1981. Upper Pleistocene hominid remains from Vindija Cave, Croatia, Yugoslavia. *American Journal of Physical Anthropology* 54: 499–545.

Zischler, H., H. Geisert, A. von Haeseler and S. Pääbo 1995. A nuclear 'fossil' of the mitochondrial D-loop and the origin of modern humans. *Nature* 378: 489–492.

Zotz, L. F. 1939. *Die Altsteinzeit in Niederschlesien*. Kabitsch Verlag, Leipzig.

Zotz, L. F. 1944. *Altsteinzeitkunde der Südostalpenländer*. Archiv für vaterländische Geschichte und Topographie 29, Weimar.

Zotz, L. F. 1951. *Altsteinzeitkunde Mitteleuropas*. F. Enke, Stuttgart.

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