All of the genetic studies have their critics, many of whom emphasize the difficulty of determining the genetic "clocks" or mutation rates, which are critical in estimating the timing of evolutionary divergence. Many of the rates used actually have large ranges, and the derived dates have large margins of error. Moreover, rates of mutation may have varied through time, and other factors, such as recombination, may have affected the DNA segments studied. It has also been suggested that variations in past regional population sizes may have influenced the degree of modern genetic diversity, quite independently of rates of evolutionary change.

For the most part, the various genetic studies do generally support the idea that Neanderthals were not directly ancestral to modern humans, and therefore contrast with the skeletal evidence discussed above. There is a third class of evidence – the archaeological record – that can be examined, but unfortunately, this only increases the ambiguity and uncertainty about the transition to the Upper Paleolithic in Europe.

## *The Archaeological Evidence*

A variety of different archaeological "cultures" or industries have been identified in the Upper Paleolithic record of Europe (Fig. 5.2). Here the focus is on the earliest of these, found during the time period of the transition, roughly 45,000–30,000 years ago.

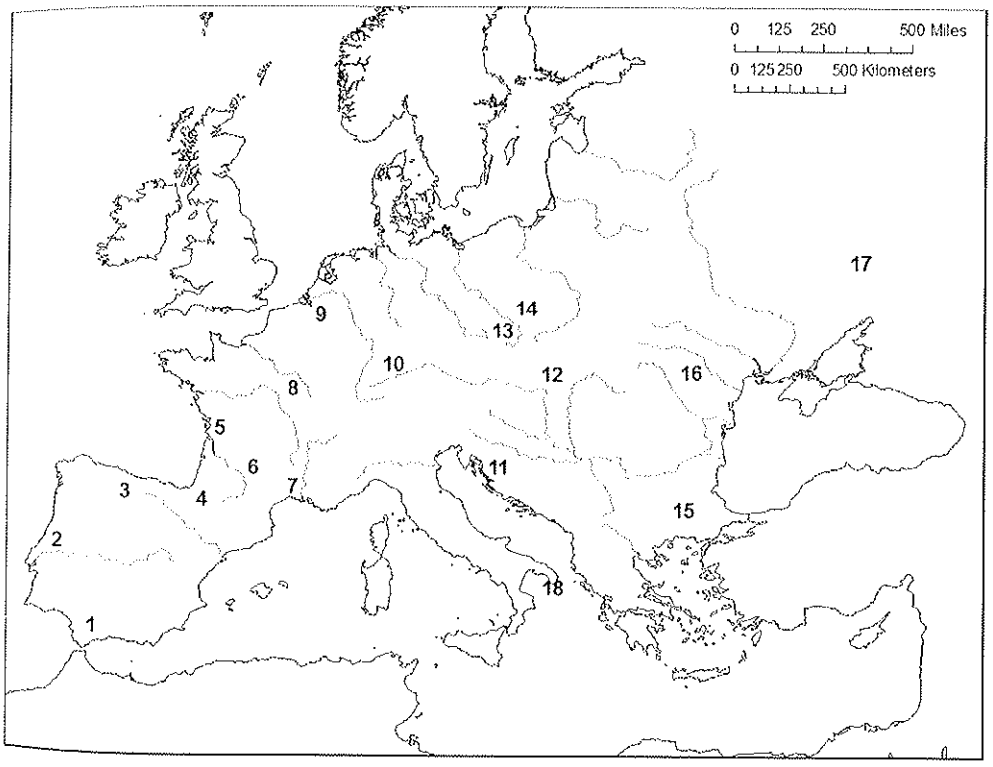


Fig. 5.2 Early upper Paleolithic sites mentioned in the text: *1* Zafarraya; *2* Lagar Velho; *3* El Castillo; *4* Brassampouy; *5* Saint-Césaire; *6* Castanet, Blanchard, Les Rois, Cro-Magnon; *7* Chauvet; *8* Arcy-sur-Cure; *9* Couvin; *10* Vogelherd, Geissenklösterle, Hohlenstein-Stadel; *11* Vindija; *12* Bohunice, Stránská Skála, Vedrovice; *13* Mladeč; *14* Dzierżysław; *15* Bacho Kiro; *16* Molodova; *17* Kostenki; *18* Grotta del Cavallo

## The Aurignacian

The earliest true Upper Paleolithic industry with a widespread distribution across much of the continent is the *Aurignacian*, named after a site in France. Found across much of Europe from Bulgaria to Iberia, Aurignacian assemblages are quite different from Mousterian ones in many ways. First, they contain a considerable number of stone blades, which contrast with flakes in being long and narrow, often with parallel sides (Fig. 5.3). Blades are manufactured in various ways, some of which, like the Levallois technique, were seen in the preceding Middle Paleolithic, and others, like prismatic core technology, are new. This latter technique entails the preparation of a nodule to form a flat striking platform, and then the removal of blades around the periphery, using either a natural edge in the material or creating by retouch an artificial ridge along the side, to guide the force down the length of the nodule. The resulting core, with numerous blade removals, resembles a prism with its straight, parallel facets. Flakes still comprise a substantial amount of the stone assemblage, varying in proportion significantly from site to site.

Many of the retouched tools were made from blades, often using a flat, invasive retouch (Fig. 5.3). The tools include a number of types that were either rare or absent in the Mousterian. End scrapers, made on the end of blades or thick flakes, are more common than side scrapers. Tools with a chisel-like end, called burins, are common. Specific forms of these general categories are characteristic of the Aurignacian, such as steep, thick, carinate scrapers, nosed scrapers, and beaked burins. Heavily retouched blades, often narrower in the middle than at either end, are also typical.

Aurignacian assemblages display considerable variability, both spatial and temporal. In France the Aurignacian has been subdivided into a number of chronological stages that differ in terms of the relative proportions of different tool categories (scrapers versus burins, for example) as well as the presence or absence of various specific tool types.

Recent appraisals suggest that what has been called "Aurignacian" is, in fact, so variable that it should not be considered a unitary phenomenon (Clark and Riel-Salvatore 2005/2006, Kozłowski

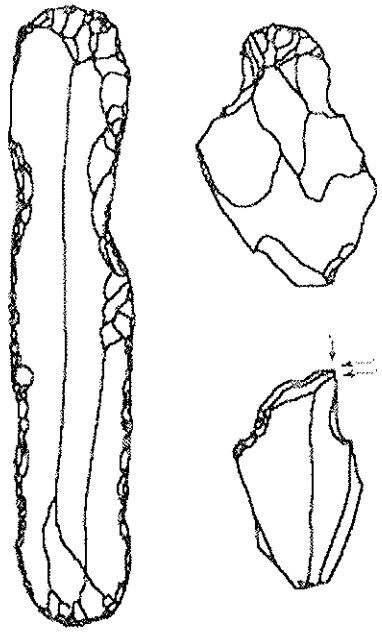

**Fig. 5.3** Some Aurignacian tools (from *left*: end scraper on waisted blade; nosed end scraper; burin)

and Otte 2000). In Italy and other parts of southern Europe, for example, some "Aurignacian" assemblages are dominated by small retouched bladelets, which have not normally been considered to be characteristic (Kuhn and Steiner 1998).

Tools made from bone and antler are regular components of Aurignacian assemblages. These differ considerably from the few examples known for the Lower and Middle Paleolithic. They are well made, often by carving and polishing rather than chipping, and show a variety of repetitive, standardized forms. Common types include finely pointed bone awls, perforated antler batons, bone and antler rods incised with regular lines, and different forms of antler points, some with split bases, others with forked or beveled bases.

One of the most remarkable aspects of the Aurignacian is the abundance of objects of ornamentation. Thousands of beads and pendants have been discovered, fashioned from a variety of materials in various shapes. Ivory beads, made from segments of cylindrical rods taken from mammoth tusks, are particularly common in France, Belgium, and Spain. These were made in different, standardized shapes: "basket-shaped" with one perforation in France, elongated forms in Belgium, and double-perforated types in Germany. Experiments suggest that the French forms each took about an hour to manufacture (White 1993). Some sites, such as Castanet and Abri Blanchard in southern France, contained hundreds of these beads. Pendants and beads were also made from animal teeth (fox, red deer, beaver, moose, bovids), shells, fossils, limestone, steatite, hematite, bone, antler, and other materials. The distribution of jewelry is as widespread as the Aurignacian itself, from Spain through France, Belgium, Germany, and Moravia over to Bulgaria. Studies of the distribution of different types of beads suggest the existence of different cultural regions within the area of the Aurignacian (Vanhaeren and d'Errico 2006). The production of what we consider as "art" also proliferated during the Aurignacian period. Most notable is a group of three-dimensional ivory carvings found in three south German caves, Vogelherd, Geissenklösterle, and Hohlenstein-Stadel, all located on tributaries of the upper Danube River (Hahn 1983). Twelve animal figurines, ranging in length from 5 to 9 centimeters, include representations of mammoth (5), felines (4), rhinoceros (1), bison (1), and horse (1). They are carved in fine detail, including eyes, ears, and hair, and a number bear other marks, such as cross-hatches or dots. Some of these figures, such as the horse, are highly polished suggesting long use, and perhaps were suspended as pendants. In addition, three other figurines have been interpreted as human or anthropomorphic. One is a small (6.9 centimeters) ivory cylinder with a spherical portion on one end, interpreted as a head. The entire figure is covered with rows of dot-like depressions. Another is actually a rectangular plaque, measuring only 3.8 centimeters in length, which has carved onto one face the schematic figure of a human with outstretched arms and legs. On the opposite face are rows of incised marks. The third figure is much larger (28.1 centimeters) and perhaps more remarkable: the upright human body has the face of a cave lion. Such detailed carvings are unique in the archaeological record of this period, but one ivory carving of a woman's head, with details of hair and face intricately carved, was found at the French site of Brassempouy and may date to the Aurignacian (Bahn and Vertut 1988:85).

Various other types of Aurignacian art are known, particularly from France. A number of stone blocks have been found with engravings of triangular, schematized vulvas, indicating that female imagery was an important artistic theme. Some engravings of animals and geometric shapes, as well as traces of painting, on the walls of caves are also thought to be of Aurignacian age (Delluc and Delluc 1991). Very early evidence of possible cave painting has been found at Fumane Cave in northern Italy, where painted slabs, possibly fallen from the cave roof or walls, have been dated to 35,500–32,000 years ago.

Without a doubt, however, the most impressive recent find of Aurignacian art is the painted cave of Chauvet. This site, located in southeastern France along a tributary of the Rhône River, was discovered in 1994, and has revolutionized our knowledge of Paleolithic art. Over 300 individual animal figures are painted or engraved on the walls of this deep cave, together with motifs of hands, dots, and other

geometric forms. The paintings are done in black (charcoal) or red (hematite), and include details of hair, ears, and shading. The predominant animals depicted are rhinoceros, lion, mammoth, and horse, which in a preliminary count together made up 67% of the animal figures (Clottes 1995:96–97). Three samples of charcoal figures on the walls were dated directly by the accelerator radiocarbon technique and produced dates between 32,000 and 30,000 years ago, that is, of Aurignacian age. This early date for such sophisticated and abundant cave art has posed a real challenge to traditional schemes of stylistic evolution of the art, which would have placed this cave at a much more recent date. Arguments for a significant cognitive discontinuity between Neanderthals and early moderns have been considerably strengthened by this find, which seems to have no earlier counterparts or preliminary stages. Further confirmation of the precocity of cave art is provided by the recent discovery of painted slabs found buried within sediments in the north Italian cave of Fumane (Balter 2000). The sediments have been dated to between 32,000 and 36,500 BP. These slabs, which apparently fell from the cave ceiling, bear images painted in red ochre, one identified as an animal and another as a human with an animal head, echoing the theme from the German carving of a lion-headed man.

One of the earliest dates for an Aurignacian assemblage is greater than 43,000 BP from Bacho Kiro Cave in Bulgaria, but as mentioned above, this date has been considered uncertain. However, it is now supported by several dates in the range of 44,000–46,000 BP from two other sites in Bulgaria and Hungary (Mellars 1992). Dates of approximately 40,000 years ago have been obtained for Aurignacian materials in southern Germany at the site of Geissenklösterle (Richter et al. 2000) and northern Spain at the sites of El Castillo and L'Arbreda (Bischoff et al. 1989, Cabrera and Bischoff 1989). No human remains have been found associated with these earliest Aurignacian assemblages. The vast majority of Aurignacian sites in France and central Europe have however been dated to the period of about 34,000–27,000 years ago and are associated with remains of modern humans at such sites as Vogelherd in Germany and Le Rois and Cro-Magnon in France (Mellars 1992).

The abundance of sites varies considerably across the continent. In France alone, 211 Aurignacian sites have been discovered, primarily concentrated in the south (Demars 1996). Spain and Portugal together contain 43 known or probable sites of this period (Straus et al. 2000). Belgium has at least 17 (Otte 1985) and Moravia at least 37 Aurignacian sites (Svoboda et al. 1996), while Hahn (1971) estimates approximately 100 in Germany, Austria, Hungary, and Bulgaria. This distribution does not appear to be static, however. Earlier Aurignacian sites in Spain are confined to the northernmost portions of the country, spreading to the south only around 30,000 years ago (Straus et al. 2000). In France, early Aurignacian sites are found largely in the southeast and gradually spread to the west and north (Harrold 1989). Mussi (1990) points out that the earliest Aurignacian in Italy appears to be concentrated in the north and expands southward by 31,000 BP. A general overview of the Aurignacian across the entire continent suggests an initial appearance in southeastern Europe, followed by a relatively rapid expansion in a contiguous area to the north and west, as well as occupation of separate areas in southern France and northern Spain (Bocquet-Appel and Demars 2000). These areas expand as well, so that by 30,000 BP, the entire continent except for the southwestern portion of the Iberian Peninsula is occupied by the Aurignacian, and by 27,500 BP, even this last refuge disappears.

Supporting this pattern is the late date of 28,000 BP for a Middle Paleolithic assemblage in the southern Spanish site of Zafarraya (Smith 2000). Whereas in much of Europe the typical Middle Paleolithic appears to end by around 40,000–35,000 BP, it appears that southern Iberia, to the south of the Ebro River, retained a Middle Paleolithic character for another 10,000 years or so. It is significant that Neanderthal remains from the same site have been determined to be similarly late, dating to around 30,000 BP.

The archaeological record of the Aurignacian and Middle Paleolithic, consequently, displays a number of features that support the idea of an immigration of modern humans into Europe and

the gradual displacement of Neanderthal populations. Beginning in the southeast, the Aurignacian, identified at least in its later stages with modern humans, spread north and westward, while typical Middle Paleolithic industries and classic Neanderthals show a shrinking distribution, ultimately concentrating in the southwestern part of the Iberian cul-de-sac. From the outset, the Aurignacian shows a number of novel characteristics: a much greater importance of prismatic blade technology, new stone tool forms, a much greater and more standardized use of bone, antler, and ivory to manufacture tools, a proliferation of beads and pendants, and the production of sophisticated portable and cave art.

## Other European Archaeological Evidence

Both the archaeological data just discussed and the genetic studies offer strong support for the replacement model of the transition to modern humans in Europe. As discussed earlier, however, the skeletal evidence is more ambiguous, at least to some physical anthropologists. A number of forms that display a mixture of both modern and Neanderthal characteristics are difficult to explain in a strict replacement scenario. There is also another body of archaeological data that is at odds with this scenario and that has fostered considerable debate. These data consist of a number of archaeological "cultures" or industries that appear intermediate between the Middle and Upper Paleolithic. Like some of the fossil skeletal material, they are "mixed," and have been interpreted as evidence of either local development of Upper Paleolithic characteristics or of interaction between modern and Neanderthal populations.

In southern Russia and the Ukraine there is no true Aurignacian, although some Aurignacian tool forms do appear sporadically in various assemblages, particularly in the west (Hoffecker 1988, Soffer 1990). Perhaps the most notable feature of the early Upper Paleolithic assemblages is their variability within and among regions. Two areas of site concentrations exist: the middle Dnestr drainage in the west and the middle Don Basin farther east. Although relatively few absolute dates are available, both areas appear to have a number of sites dating to a period before 30,000 BP. Assemblages in the west, at sites like Molodova V, have a mixture of characteristics: Middle Paleolithic side scrapers, discoidal cores, and Mousterian points, together with some irregular prismatic cores, a few blades, end scrapers, and burins. In the east, two different groups of assemblages have been identified. The *Streletskaya Culture*, found at such sites as Kostenki VI and XII, 3 is characterized by a predominance of Middle Paleolithic tools, together with rare prismatic cores, blades, and end scrapers, as well as some small bifacial points. By contrast, the *Spitsynskaya Culture*, occurring in nearby sites or even other levels of the same sites (Kostenki XVII and XII, 2), shows a predominance of prismatic blade cores, burins, end scrapers, and retouched blades, together with bone awls and points. No art or ornaments are known from either the western sites or the Streletskaya sites, but the Spitsynskaya site of Kostenki XVII has produced a number of perforated teeth, fossils, and stone pendants. These Russian and Ukrainian sites, therefore, display a varying mixture of Middle and Upper Paleolithic traits, and there seems to be a correlation between the more Upper Paleolithic stone technology and other Upper Paleolithic features such as bone tools and ornaments.

In east-central Europe, two "transitional" or "mixed" industries have been recognized (Allsworth-Jones 1986, Oliva 1991, Svoboda et al. 1996). They are similar in possessing "well-determined Upper Paleolithic tool equipment, while the technologies, as if they were more 'retarded,' retained and modified various Middle Paleolithic traditions" (Svoboda et al. 1996:107). The *Bohunician*, which has dates of around 42,000–38,000 BP, is found at relatively few sites in Moravia, including Bohunice and Stránská Skála. Core preparation is by a modified version of the Levallois technique and the tools include blade end scrapers and burins, together with Mousterian side scrapers and points. The

*Szeletian*, dating back to roughly 40,000–35,000 years, is more abundant and widespread, extending into southern Poland and Slovakia. Important sites include Dzierżysław in Poland and Vedrovice V in Moravia. This industry has more blades than the Middle Paleolithic, but fewer than the Bohunician. Leaf-shaped points with bifacial retouch, similar to those from the preceding central European Middle Paleolithic, are common, as are side scrapers. End scrapers and pointed retouched blades, on the other hand, are also common elements of assemblages.

Another industry with a mixture of traits has been found across much of the north European Plain, from England through Belgium and Germany to Poland (Otte 1990). At the Belgian site of Couvin it has been dated to approximately 45,000 BP. It is characterized by the regular production of both blades and thick flakes. Bifacial leaf-points, similar to those of the late Middle Paleolithic, are the most common tool form.

In the central and southern portions of Italy is an industry called the *Uluzzian*, dating to a period of at least 32,000–36,000 BP and probably earlier. At every major site where it occurs, such as Grotta del Cavallo, it is followed by an Aurignacian level, suggesting that it precedes this culture, rather than being its contemporary (Mussi 2001). The Uluzzian is largely a flake industry with very few blades. Side scrapers and notched and denticulated pieces are common, as are so-called scaled pieces, which may have been wedge-like tools or exhausted cores.

Upper Paleolithic forms include end scrapers and backed points, with occasional burins. Only a few bone points and perforated marine shells have been found in Uluzzian contexts, contrasting significantly with the Aurignacian assemblages, particularly in terms of the evidence of bone-working.

France and northern Spain contain the best known of these "transitional" or "mixed" assemblages, designated as the *Chatelperronian* (de Sonneville-Bordes 1960). The admixture of traits shown by this industry is underlined by the fact that in traditional French chronological frameworks, the Chatelperronian was once considered to be a developmental stage from the Mousterian of Acheulean Tradition to later Upper Paleolithic industries called the Upper Perigordian or Gravettian. It does, in fact, share a number of characteristics with both of these and was used as evidence for a local evolution of the Upper Paleolithic. It contains a number of Mousterian flake tools (side scrapers, points, denticulated flakes) along with blade tools (end scrapers, burins, borers) and, most characteristic, several types of steeply retouched, curved back points or knives (Fig. 5.4).

**Fig. 5.4** Chatelperron point, characteristic of the Chatelperronian

These sites also contain a number of well-made bone tools and other objects. The most prolific site is Arcy-sur-Cure, Grotte du Renne in north-central France. Chatelperronian levels at this site contained a total of 142 worked pieces of bone, including projectile points, awls, pins, and polishers, as well as a variety of rods, carved rings, and tubular sections of bird bone (d'Errico and Zilhão 1998). This same site contained 36 ornaments in the form of grooved and perforated animal teeth, ivory beads, and grooved and perforated bones and fossils.

Dates for the Chatelperronian have been much debated. Most determinations place these sites in the time period of roughly 37,000–33,000 BP, although some dates as early as 45,000 BP have been obtained. Thus, the question has been posed whether the Chatelperronian is solely contemporary with the Aurignacian in this part of Europe, or whether it actually first appeared before the Aurignacian. The importance of this question derives from the fact that this is the only one of the "mixed" industries for which we have identifiable skeletal remains. At two sites, Arcy-sur-Cure, Grotte du Renne and Saint-Cesaire, skeletal remains of Neanderthals have been found in direct association with Chatelperronian assemblages. It appears indisputable that Neanderthals were responsible for the manufacture of these assemblages. Whether this is true for the other "mixed" industries is still unknown. As more research is done, the number of these "transitional" industries is proliferating and it is clear that archaeological changes occurred at different rates and in different ways across the continent during this period.

In France and northern Spain, therefore, evidence suggests that Neanderthals were behaving in a quite "modern" manner, manufacturing Upper Paleolithic stone tools (along with those characteristic of the Middle Paleolithic), fashioning an array of bone implements, and creating a variety of personal ornaments. The significance of this has been interpreted in various ways:

1. Neanderthals gathered tools and ornaments that had been abandoned by modern humans
2. Neanderthals obtained these objects through exchange with modern humans
3. Neanderthals made the objects in imitation of their modern neighbors
4. Neanderthals developed this technology on their own, independent of and before the arrival of modern populations
5. Neanderthals developed the technology on their own, in the course of a local biological and cultural development into what we recognize as modern humans and Upper Paleolithic culture.

Evidence against the first two interpretations is the presence of much bone and ivory waste material at Grotte du Renne, interpreted as the by-products of manufacturing and therefore as indications that the Neanderthals, indeed, made the objects themselves. If the fourth interpretation were true, then the very early dates for the Chatelperronian would have to be demonstrated as valid, indicating that it precedes the Aurignacian. It is true that whenever both the Chatelperronian and Aurignacian occur at the same sites, the former usually underlies the latter, but there are also a number of cases where the two are interstratified, suggesting contemporaneity (Mellars 1992). Furthermore, it seems unlikely to many archaeologists that Neanderthals would independently develop many of the behaviors that happen to be associated with immigrating populations, just before their arrival, after so many thousands of years of European occupation.

Arguments against the fifth interpretation have much ammunition. The growing body of genetic evidence increasingly suggests an immigration of modern humans from outside of Europe. The African skeletal evidence supports the position that modern humans evolved on that continent long before they appeared in Europe. There is a growing body of chronological evidence for an east-to-west expansion of the Aurignacian within Europe. Arguments for a purely local evolution of biology and culture within Europe are increasingly difficult to maintain.

### *Summary of the Transition to the Upper Paleolithic*

The third interpretation for the features at Grotte du Renne is currently the most accepted, which suggests the following processes for the transition to the Upper Paleolithic in Europe:

- There was an immigration of biologically modern humans into Europe, ultimately from Africa via the Near East, perhaps around 45,000 years ago.
- These populations brought with them many of the features considered to be "Upper Paleolithic," in the form of an emphasis on prismatic blade technology, bone, antler, and ivory manufacture, and the creation of ornaments and artwork.
- They were contemporary with Neanderthals for a considerable period of time.
- The Neanderthals, exposed to these new behaviors, began to imitate some of them, creating many of the "mixed" industries.
- More controversially, the Neanderthals and the modern humans interbred to some extent, creating some of the skeletal material with mixed traits.
- Biologically and culturally unaffected Neanderthals persisted longer in some areas such as the southern portion of Iberia.
- By approximately 28,000 years ago, the entire continent was populated by groups practicing much the same behaviors, making similar tools, and looking more uniformly modern.

## Early Upper Paleolithic Subsistence

If modern humans immigrated into Europe and were ultimately more successful than resident Neanderthal populations, there should be evidence of more effective or adaptive behavior during the early Upper Paleolithic. Although the early Upper Paleolithic witnessed a number of dramatic changes in technology, ornamentation, and art, it does not appear to show major alterations in the subsistence economy (Chase 1989). The admittedly biased archaeological record continues to document an emphasis on big game, with little contribution to the diet of plants, fish, or birds. Hockett and Haws (2005), however, suggest that early modern populations had greater dietary diversity than Neanderthals. This is based in part on studies of bone chemistry, but unfortunately the data for modern populations come from skeletons that postdate the Aurignacian.

This period witnessed a number of climatic fluctuations that doubtless had a major impact on local economies (Van Andel and Tzedakis 1996), but our chronological resolution is generally not precise enough to detect patterns. Mellars (1973), focusing primarily on southern France, has argued that the Upper Paleolithic shows a greater specialization on fewer herbivore prey than the Middle Paleolithic, but while this is the case for later Upper Paleolithic groups, it is not so clearly true for the Aurignacian. Freeman (1973) points out that Aurignacian groups in northern Spain hunted a variety of species from different habitats – forest, grassland, and mountains – including red and roe deer, boar, horse, bovids, ibex, and chamois. Straus (1988) adds that these Spanish sites usually contain the remains of only a few animals, suggesting individual hunting, rather than any communal techniques. The mountain species, although not numerically abundant as prey, do represent a new addition to the diet, having been largely ignored during the Middle Paleolithic. In Germany, the major Aurignacian preys were reindeer, horse, mammoth, and rhinoceros, but there is no evidence of a specialization on a single species (Hahn 1987). Single individuals of horse or mammoth are the most common faunal remains in Moravian Aurignacian sites (Svoboda et al. 1996:127). On the other hand, Soffer (1990) documents a narrowing of the diet in sites in the Ukraine, from a total of 12 large herbivores exploited during the

Middle Paleolithic to only six during the Early Upper Paleolithic in the Dnestr Valley. She interprets this change as indicative of less opportunism and greater planning and targeting of prey during the early Upper Paleolithic. The major changes in the subsistence economy throughout much of Europe, however, appear to lie in the equipment used. In addition to stone points, a variety of bone and antler points are now documented. Unfortunately, the extent to which they may have contributed to greater hunting effectiveness is unknown.

## Early Upper Paleolithic Settlement and Exchange

Settlement patterns similarly show a varied pattern across the continent, with some evidence of differences from the Middle Paleolithic. In France and Spain, much the same regions and often the same sites are occupied in both periods (Straus 1988). In Russia and the Ukraine, on the other hand, while the middle Dnestr Valley is occupied in both periods, the middle Don is newly colonized during the early Upper Paleolithic. In Italy, Aurignacian sites appear at higher elevations than those of the Middle Paleolithic and also constitute the first occupation of the island of Sicily (Mussi 2001). Svoboda documents an "out-of-the-caves" movement for the Aurignacian of Moravia: the cave-rich limestone hills that were the focus of Middle Paleolithic settlement were replaced by topographically more open locations at lower elevations during the early Upper Paleolithic (Svoboda et al. 1996:118–119). In both Italy and Moravia, these changes in settlement have been interpreted as a reflection of changes in the organization of land use to include higher mobility and more frequent establishment of special-purpose camps in distant areas to hunt or collect stone raw material.

Although the Aurignacian persisted for thousands of years and is found at numerous sites, knowledge of many other aspects of behavior for this period is quite limited. Many sites have suffered severe erosion and displacement of materials. Cave assemblages are often mixed by geologic processes and other animals. Hahn (1987) discusses major geomorphological changes that occurred throughout central Europe toward the end of the Aurignacian, characterized by severe erosion and a general flattening of relief. Hilltops were eroded away and valleys were filled with up to 5 meters of deposits. As a result, it has proven difficult to reconstruct internal site patterns, site functions, and regional organization of settlement for the Aurignacian.

Both a higher degree of mobility and a greater importance of exchange among groups are suggested by the distribution of stone and other materials in some areas. Although many sites contain mostly materials available quite nearby, some long-distance transport is evident. The majority of tools of all Spitsynkaya sites on the middle Don in Russia are made of flint from sources 150–300 kilometers away (Soffer 1990:732), and the site of Kostenki I contains shells from even farther away, perhaps 600 kilometers (Hahn 1971). The middle Dnestr sites also have small amounts of exotic stone. Sites in Lower Austria, such as Krems-Hundsteig, contain shells from either the Mediterranean, about 300 kilometers away today, or the Black Sea, approximately 600 kilometers away (Hahn 1971). Small amounts of stone or fossils in Aurignacian sites of Moravia, southern Germany and the Rhineland can be traced to sources from 50 to over 200 kilometers away (Hahn 1987, Svoboda et al. 1996). French Aurignacian sites frequently contain stones from the Pyrenees and shells from the Atlantic or Mediterranean, with transport distances of 200–300 kilometers or more (White 1993). In a few cases, such as the Moravian sites, the amount of exotic material is large enough to suggest that the occupants procured it themselves, during the course of their seasonal movements. In most cases, however, only small amounts are present and have been interpreted as exchange items in wide-ranging social networks. The greater amount of evidence for such exchange may reflect a more structured and important set of regional social relationships during the Aurignacian as compared to the previous period. These networks, which could have facilitated movement into other areas during times of environmental stress, may have been an important adaptive innovation of modern humans.

## The Developed Early Upper Paleolithic: The Gravettian

The Aurignacian disappeared from the archaeological record in many regions by around 29,000–27,000 years ago. In some areas, however, assemblages with many Aurignacian characteristics have been dated to a considerably later time. In southwestern France, for example, the sites of Abri Pataud and Le Flageolet I both have late Aurignacian levels dated to approximately 24,000 BP (Mellars 1987), and southeastern France similarly appears to show a late persistence of Aurignacian-like assemblages (Rigaud and Simek 1990). In addition, three sites in lower Austria have Aurignacian assemblages dating to the period of 25,000–20,000 years ago (Svoboda et al. 1996:137).

The subsequent archaeological culture is known generally as the *Gravettian* or *Upper Perigordian* in France, Spain, and Belgium and as the *Gravettian* or the *Eastern Gravettian* in central, southern, and eastern Europe (Fig. 5.5). Despite many regional differences, sites of this period show a number of strong similarities across the continent, and are referred to here simply as *Gravettian.* The Gravettian appears between approximately 30,000 and 27,000 years ago in different parts of Europe.

The overlap in dates between the Aurignacian and Gravettian raises important questions about the meaning of differences between the two. In many ways, the questions are similar to those posed about differences in Middle Paleolithic assemblages discussed in the previous chapter. In this case, however, the differences are of another sort entirely. Rather than involving primarily (although not exclusively) differing proportions of the same tools, as was the case in the Middle Paleolithic, the Aurignacian and Gravettian are distinct in a variety of ways (de Sonneville-Bordes 1963):

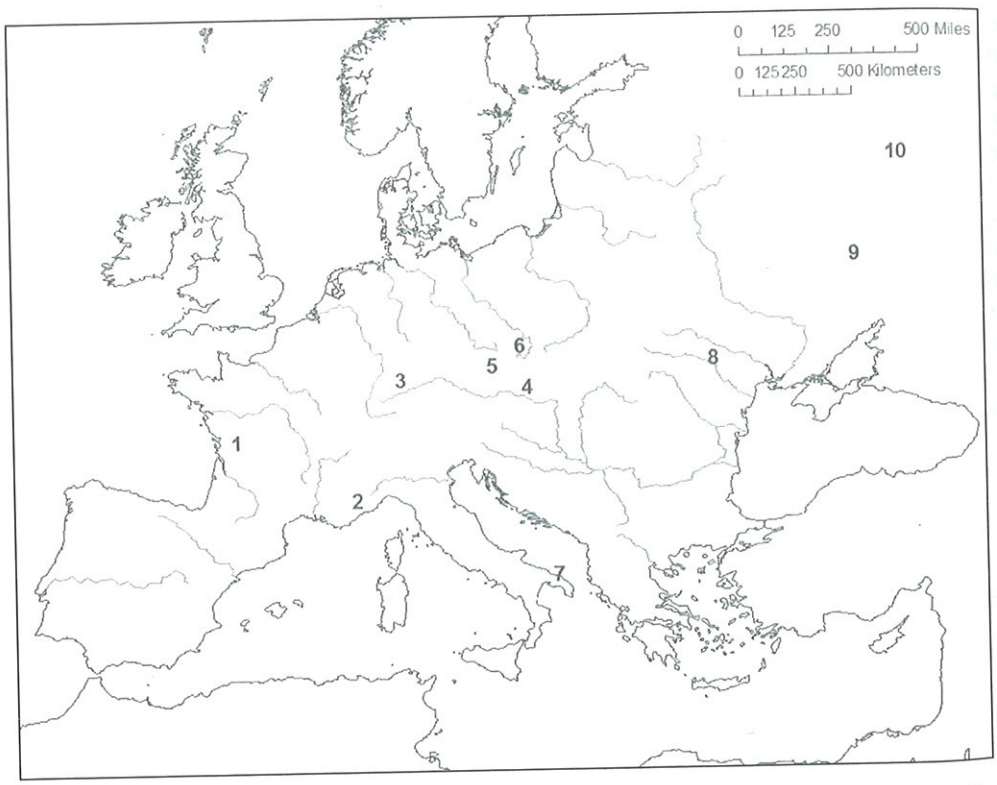


**Fig. 5.5** Gravettian sites mentioned in the text: *1* Corbiac, Solvieux; *2* Balzi Rossi, Barma Grande, Arene Candide; *3* Brillenhöhle; *4* Stillfried; *5* Pavlov, Dolni Věstonice, Předmosti, Brno; *6* Petrkovice; *7* S. Maria di Agnano; *8* Molodova; *9* Kostenki; *10* Sungir

- The technology of blade manufacture, with Gravettian blades much more finely made;
- The dominant type of retouch, which is steeper and more abrupt in the Gravettian;
- The presence of particular stone tool types, differing in their distribution, such as straight-backed points with abrupt retouch along the back, backed bladelets and other small tools, or microliths, tanged and shouldered points, and small multiple burins in the Gravettian;
- The proportion of general tool classes, with burins more abundant in the Gravettian;
- The lack of particular stone tools, such as the absence of steep and nosed scrapers in the Gravettian;
- The lack of certain characteristic bone and antler artifacts, as exemplified by the absence of typically Aurignacian split- and bevel-based points in the Gravettian; and
- The presence of new forms of artwork, including female figurines in the Gravettian.

The magnitude and variety of these differences suggests to many archaeologists that they truly represent two different cultural traditions, and perhaps even two different biological populations. Recent DNA studies have given some support to this interpretation. For example, the research on mitochondrial DNA discussed earlier suggests several later migrations into Europe after the earliest identified between 45,000 and 55,000 BP (Richards et al. 2000). One of these occurred in the period of approximately 30,000–38,000 BP, the other between 20,000 and 33,000 BP. Either or both of these might reflect the influx of "Gravettians," perhaps from central Asia into an Aurignacian Europe. Studies of the DNA on Y chromosomes similarly indicate a second immigration into Europe some time around 25,000 BP (Semino et al. 2000).

Taken together, the archaeological differences and the genetic studies strongly support the view that the prolonged transition between the Aurignacian and Gravettian involved different cultural traditions. On the one hand, many archaeologists are loath to attributing ethnic or cultural significance to Paleolithic material culture (Clark 1994). There are many good reasons for this. Stone tools may be particularly inappropriate for the active and recognized expression of ethnicity, in part because they are so strongly influenced and limited by characteristics of the raw material and the needs for particular functional designs. Moreover, ethnicity is more likely to be actively expressed by material culture in situations of reasonably high population density, which would encourage intensive within-group interaction and promote competitive relations with others. In such situations, highlighting distinctions between groups may foster group cohesion and persistence. In Paleolithic Europe, however, population densities were surely low.

On the other hand, differences in material culture need not derive solely from patterns of interaction within and between groups. They may also arise from different histories and reflect simply different, learned traditions of doing things. If two groups from different areas and histories happen to come together in the same region, their material culture can be expected, at least initially, to differ. What happens subsequently, whether these traditions remain distinct, or blend, or one disappears, depends on the nature of the interactions between the two groups. In light of the growing genetic evidence for periodic immigrations into Europe of biologically different groups, this type of scenario should be evaluated in attempts to explain the archaeological record.

## *Spotlight on a Gravettian Site: Pavlov I*

The site of Pavlov I is part of an important cluster of sites lying within 2.5 kilometers of each other in the foothills of southern Moravia (Svoboda 1994). These sites are situated just south of the Moravian Gate, a series of passes and river corridors linking the middle Danube Valley with southern Poland. The site was discovered through accidental finds of mammoth bones in a vineyard and systematically excavated from 1952 to 1972. Over the course of this work, the methods of excavation changed;

the plotting of artifact location, first by grid square and later by precise, three-dimensional coordinates, and the water-screening of sediments were introduced only after the first season. Altogether, approximately one million stone artifacts were recovered, together with bones and other materials. The analysis of finds is still in progress; only those from the first two seasons have been published to date and form the focus of discussion here.

The cultural level, 50 centimeters in thickness and in places recognizable as two separate layers, probably represents a number of episodes of occupation, which radiocarbon measurements place between 24,500 and 27,000 BP. Studies of pollen and charcoal from this and nearby sites suggest that the environment at the time was a cool forest-steppe, with considerable open vegetation, but with significant amounts of pine, spruce, larch, fir, juniper, elm, and yew. Rather small growth rings visible in the wood charcoal suggest fairly rigorous conditions limiting tree growth.

The central feature of the excavated area was originally interpreted as a hut (Klima 1994), but may have been more like a lean-to, open to the south. This consists of an irregular oval depression, measuring about 3.4 × 7.5 meters. The depression is most pronounced along the north side, and is further delineated by a rough outline of large bones, primarily of mammoth. Four ashy hearths lie inside the shelter, with another seven nearby. Both bones and stone artifacts are abundant in this area, but the shelter contains relatively fewer artifacts than the outside spaces. Over 1800 pieces of chipped stone are concentrated within 7 square meters adjacent to two hearths north of the shelter and are associated with the bones of reindeer, rabbit, and polar fox (Tomášková 1994). Microwear analysis indicates that tools in this area were used on both soft (meat, hides) and hard (bone, wood) materials. Within the shelter itself, artifacts are clustered around two of the hearths and extend to the south, suggesting a doorway or open side. The bones in this concentration consist mainly of wolf and fox, and the tools show wear traces from both soft and hard materials. The primary outside activity area is located to one side of the hut. Here, a large amount of both stones and bones is concentrated in semicircular patterns around five hearths. The bones include reindeer, wolf, horse, fox, rabbit, and mammoth. Several pits in this area have been interpreted as boiling pits for cooking. It is clear that the hearths were the focus of activities, which appear to have included a variety of different tasks. Subsequent excavations revealed a number of other structures and hearths.

Over 52,000 stone artifacts were recovered during the first two seasons. The raw materials – flint, radiolarite, chert, quartz – come primarily from distances of over 100 kilometers away to the northeast and southeast. Very little local raw material was used. Blades are very numerous and approximately 16% are retouched as tools. The tools include burins (about 33%), end scrapers (10%), backed microblades and points (29%), other microliths (14%), and various other implements (14%).

A large variety of different species, including many carnivores, was found among the bones at the site (Musil 1994). These include (together with the percentage of bones represented by each) the following:

| | |
|---|---|
| 18.5% | Hare |
| 16.9% | Polar fox |
| 12.5% | Wolf |
| 10.7% | Red fox |
| 10.1% | Reindeer |
| 8.3% | Birds |
| 7.5% | Mammoth |
| 4.6% | Horse |
| 4.4% | Badger |
| 0.7% | Brown bear |
| 0.5% | Panther |
| 0.5% | Wildcat |

0.2% Cave bear
0.2% Aurochs or bison
0.2% Red deer
0.2% Lynx
2.7% Other or indeterminate species

It is likely that many of the carnivores were hunted primarily for their furs and that most meat came from the various herbivores such as hare, reindeer, mammoth, and horse. A number of bones, or portions of bones, from specific body parts are missing from the assemblage, suggesting their use in the manufacture of tools.

Over 250 pieces of bone, antler, and ivory that were partially worked or made into finished tools were uncovered at this site (Klima 1994). These include a large variety of different forms such as points, knives, and awls, shovels, spoons, clubs, and axes. Many of these are decorated with engraved, parallel lines along the side. In addition, more than 300 objects of art and jewelry were also recovered, again in great variety. Bracelets, rings, and decorated hair-clasps were fashioned out of mammoth ivory. Bone, ivory, animal teeth, and shells were shaped and perforated to create pendants and beads. A few carvings and engravings of animal and human figures and over 1000 fragments of red ochre pigment were also found.

Among the most remarkable of the finds are over 4000 pieces of clay, a number of which were fired to temperatures of up to 800 degrees Centigrade (Soffer and Vandiver 1994, 1997). Most of these finds are concentrated within one of the hut-like structures. The vast majority of these are simply small lumps less than 1 centimeter in diameter, but most of these do show definite signs of purposeful smoothing. A few are clearly portions of figurines, including the body of a bear, the head of a rhinoceros, and a human leg. Details were fashioned through the use of tools or fingernails. Many

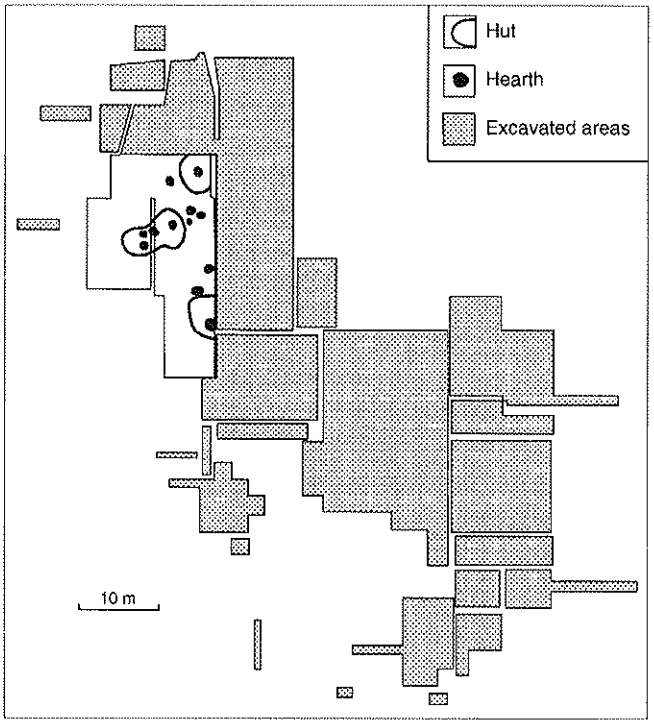


Fig. 5.6 Pavlov I site plan (after Svoboda 1994)

of these figurine parts show evidence of thermal shock, that is, abrupt shatter caused by exposure to fire when still wet. Clay may also have been used in other ways as well. The original excavator reported that a number of mammoth bones were coated in clay to create a windbreak around one of the hearths. Furthermore, several of the clay fragments had traces of the impressions of textiles or basketry, manufactured from interwoven twine made of plant fibers (Adovasio et al. 1996).

This site of Pavlov I was apparently occupied a number of times as a complex, residential camp in the forest-steppe of southern Moravia (Fig. 5.6). The occupants devoted considerable labor to the construction of huts or shelters and hearths, perhaps with clay-lined windbreaks. They carried out a diverse array of activities, including the hunting of large and small game for both meat and pelts, and subsequent butchering and hide-working around the hearths. Stone, brought in from a considerable distance, as well as bone, ivory, and antler, was used to manufacture a variety of different tools and even twine was made and interwoven to fashion various objects. An impressive amount of material documents a rich aesthetic sense and perhaps ritual life. Figurines were created from clay and fired, perhaps sometimes with the intent that they shatter. Numerous objects of art and adornment suggest that personal identities were brightly displayed.

## *Gravettian Technology*

As discussed earlier, Gravettian stone technology throughout the continent is characterized by a preponderance of fine blades and of steep retouch used both to shape tools and to create blunt backed edges on points and knives (Fig. 5.7). Local distinctions, however, are evident in the manufacture of particular tools. In France and adjacent parts of Spain and Italy, for example, specific types of points and burins appear to be characteristic of particular phases and have been used to establish a multistage chronology of the Gravettian. In central and eastern Europe, other forms of points and

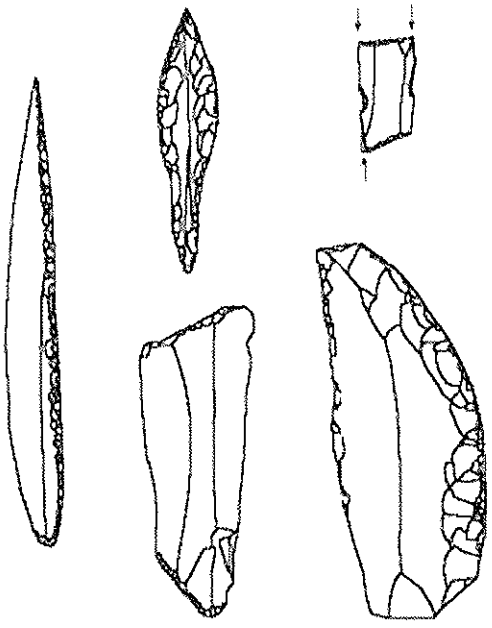

**Fig. 5.7** Some Gravettian tools (from *left*: gravette point; font-robert point; noailles burin; bitruncated blade; side scraper)

knives show changing distributions in space and time, suggesting patterns of interaction, movement, and chronological development.

Ground stone technology is also an important feature of some Gravettian sites, particularly in eastern Europe. Upper and lower grinding stones made of sandstone and quartzite appear in significant numbers, for example, at Molodova V in the Ukraine and at Kostienki IV in Russia (Kozłowski 1986). In France, a few sandstone labs with artificial depressions have been found, apparently representing lamps that burned animal fat as fuel and used lichen or bark as wicks (De Beaune and White 1993).

The manufacture of objects of bone, antler, and ivory is considerably more evident than in earlier times. As indicated by the finds at Pavlov I, a large variety of tools and ornaments was fashioned from these materials. One notable innovation for which we have evidence is the first eyed needles, which suggests that sewing, perhaps even of tailored clothing, was now practiced (De Baume 1993). Slotted bone handles for stone tools are another new development, including one find of a grooved antler with a retouched bladelet still in place at the site of Stillfried in Austria (Kozłowski 1986). Certainly, one of the richest areas for such finds is Moravia, which contains not only the site of Pavlov I, but other extremely impressive sites as well, such as Dolni Vestonice I and II, Predmosti, and Petrkovice. Sites rich in such artifacts are also found in Austria (Willendorf), the Ukraine (Molodova V), and south Russia (Kostienki sites). Again, some regional differences are evident. The east European sites, for example, contain some tools not seen in the Moravian sites, such as mattocks, needle cases, and pins with triangular heads (Grigor'ev 1993). In contrast to central and eastern Europe, sites in France, Spain, and Italy contain far fewer objects of these materials and fewer different artifact types (de Sonneville-Bordes 1963).

Entirely new in the Gravettian are industries based on the use of fired clay and cordage. This technology – the oldest in the world – was not designed to make pottery vessels, however. Rather, as the finds at Pavlov I suggest, the primary use was the manufacture of figurines, largely of animals, as well, perhaps, as the use as daubing to create barriers to the flow of air as windbreaks or of liquid, in the form of basketry containers. Gravettian fired clay objects have been found, not only at Pavlov I, but at other Moravian sites (Pavlov II, Dolni Vestonice I and II, Predmosti, and Petrkovice) and at Kostienki in Russia. By far the most productive site in this respect is Dolni Vestonice I, located less than 1 kilometer from Pavlov. This site which, like Pavlov, has evidence of multiple occupations and numerous hearths produced over 6000 pieces of clay, many of which were worked and fired. More than 3700 of these are broken fragments of figurines. Analysis of these materials indicates that the figurines were built out of separate pieces of clay: torsos were modeled, then legs and heads attached and given some detail by smoothing and etching. Only a few can be identified, including a bear, a horse's head, and a probable mammoth leg (Vandiver et al. 1989). The most famous figurine from this site, however, is clearly that of a woman, the so-called Venus of Dolni Vestonice, which differs significantly from the others in its fine quality and detail. Made out of baked clay and measuring about 11 centimeters in height, the figure displays large, pendulous breasts and pronounced hips and buttocks, with small, stylized arms and tapered legs. The head has no facial features indicated save for two slanting grooves that may represent eyes. Just below the large navel, a groove encircles the figure, suggesting a belt or sash.

Two kilns have been found at this site. One, which contained over 2300 ceramic fragments mixed with ashy deposits, was found in a circular hut about 80 meters from the main concentration of the site. The kiln was a depression measuring 140 × 40 centimeters and 40 centimeters deep. Along the north edge it had a clay wall forming a partially domed enclosure. The other kiln, some 40 meters away, also contained a mix of ashes and figurine fragments, and was walled in clay around much of its perimeter. Virtually all the figurines are broken, with many, including the Venus, showing physical signs consistent with thermal fracture. Experiments with the local clay suggest that such thermal fracturing does not occur often by accident, leading to the conclusion that the high incidence may be intentional (Vandiver et al. 1989). In essence, the ceramic industry may have focused on the production

and explosion of figurines, perhaps as part of a ritual performance of hunting magic or divination. The concentration of these activities inside structures and often away from the main habitation area may underscore their special, ritual nature.

Another major technological innovation at this time was the development of cordage and basketry (Adovasio et al. 1997, Pringle 1998). Preserved from this early period solely as impressions in clay, the evidence for a highly developed industry is nevertheless clear and compelling. Analysis of impressions from Dolni Vestonice and Pavlov indicates that the variety of produced materials was great. Some fine-mesh, woven textiles resemble linen; others have a wider weave and appear similar to basketry. Intriguingly, some of the impressions show evidence for knotting, similar to patterns seen in nets. Such finds revolutionize our ideas of Gravettian people, outfitting them now perhaps with woven clothing in addition to hides and furs, providing them with basketry mats and containers, and possibly even equipping them with nets for hunting small game. The abundance of hares at sites like Pavlov I, in fact, may reflect the importance of this hunting technique.

## *Gravettian Subsistence*

There is considerable variability in the nature of Gravettian subsistence economies across Europe. In Spain and Italy, for example, faunal assemblages are generally small and contain varying amounts of herbivores and carnivores. Because virtually all of these assemblages derive from caves and rockshelters, the possibility must be considered that many of the carnivores and smaller herbivores represent simply accumulations of natural predators and their prey. Among the larger game, red and roe deer, ibex, horse, and bovids are most common, reflecting environments of mixed forest and steppe. French Gravettian sites, although much more numerous, are largely caves and rockshelters as well. Examination of 21 occupation levels from 6 sites indicates that a total of 16 large herbivores are represented in the often large faunal collections, suggesting a highly diverse food base. The bones of these big-game species account for 70–99% of the bones in each collection, which may mean that these caves were rarely used by non-human predators. In 16 of these collections, reindeer are the dominant prey, accounting for 85–98% of the big-game bones. Other species of importance include red deer, ibex, horse, and bovids. One or two bones of mammoth occur only in five of the levels. In addition to the big-game animals, smaller prey includes hare, various fur-bearing carnivores, birds, and occasionally a few fish. In southern Germany, faunal assemblages, which are generally quite small, also derive from caves and include a high proportion (50–70%) of small carnivores, hare, birds, and fish. Among the bigger game are reindeer, bear, horse, and some mammoth. Again, the role of natural accumulations of bones in these shelters is unknown, but may be significant.

In central and eastern Europe, Kozłowski (1986) has documented a variety of different patterns in faunal assemblages. Many of these assemblages are quite large and derive almost exclusively from open-air sites. The most northern sites, in southern Poland and the upper Dnepr and Desna basins of Russia, contain assemblages dominated by mammoth (around 80% of the assemblages), with a few remains of a variety of other species such as reindeer, polar fox, and grouse. These areas were characterized by largely treeless tundra in which mammoth would have been the major game animal. Farther south, sites along the middle Dnepr and Desna have fewer mammoths and greater amounts of hare and fox. Sites in Moravia constitute a third group, in which the numbers of mammoth are further reduced (less than 20% of the assemblages) and other species, both large (reindeer, horse, rhinoceros, bear, and bison) and small (hare, fox, wolf, wolverine, and lynx) are numerous. In Ukrainian sites, reindeer often dominate together with horse and mammoth, and farther east in the drier steppes north of the Black Sea, bison and horse are the most common prey.

The role of mammoths in the eastern Gravettian economies has been much debated. Some sites in Moravia, Russia, and the Ukraine contain huge amounts of mammoth bones. Often these form

discrete areas adjacent to the habitation areas and are relatively free of remains of other species. At Dolni Vestonice I, these bones lie in water-laid sediments in a ravine alongside the site itself, and they have been variously interpreted as dump areas for food remains and as locations of natural mammoth deaths. Soffer (1993) has argued for the latter, suggesting that Gravettians were drawn to these natural bone beds because they provided sources of raw material for the construction of huts and the manufacture of implements. In support of this interpretation, she notes that often the bones in these beds show different degrees of weathering and deterioration, as though they were deposited gradually over a long period of time. She also suggests that mammoth would have been extremely difficult to hunt and that it is unlikely for mammoth bones to have been discarded in an area separate from all other food waste. On the other hand, Grigor'ev (1993) and others argue for at least some active role for hunting of mammoth, noting evidence of butchery marks, the lack of bone beds at some sites, and the overwhelming preponderance of mammoth at some of the northern sites.

Big-game hunting, including at least some mammoths, was apparently carried out largely with spears equipped with stone or ivory points. If nets were indeed manufactured, and used for hunting, then communal drives of hare and other small game may have been practiced. Birds might also have been caught with nets or snares. Fish and shellfish clearly appear to have played a very small role in subsistence.

Plant foods, however, have also become the topic of some debate. As is typical for Paleolithic archaeology in general, direct remains of plant foods are virtually nonexistent. Recently, however, a sample of charred material from a hearth at Dolni Vestonice I was examined for carbonized plant material. It was shown to contain several plants of the daisy and aster family that have edible roots, as well as what appeared to be a pulverized mush of plant material (Mason et al. 1994). This at least raises the possibility that plant foods could have been gathered in the steppe-tundra environments. Furthermore, the often numerous grinding stones at some sites may have been used to process plant foods, although they may also have been used to grind mineral pigments. Any conclusions about the role of plant foods in Gravettian diets clearly remain speculative.

## *Gravettian Settlement*

One of the most impressive features of the archaeological record of this period is the abundant evidence of huts or other forms of shelters. The vast majority of this evidence comes from central and eastern Europe, where open-air sites are most frequent. A typology of the structures found in this region based upon building materials and shape reflects their considerable variability (Kozłowski 1986). Most are semi-subterranean, consisting of round or oval depressions measuring 2–6 meters in diameter. The framework for the structure is either wood, as indicated by rings of postholes, or mammoth tusks. Frequently, large rocks or bones encircle the structure, apparently having served as weights to hold down the hides used as a tent. Hearths and pits are common features both inside and outside of the huts. As many of the pits contain bones, they have been interpreted as cooking pits. In a few sites, much larger structures have been found, so large that it is unlikely that they were roofed. Rather, they may represent windbreaks or some other form of partially sheltered living space. At one of the Kostenki sites in Russia, for example, an area with three hearths and measuring roughly 30 × 5 meters has been interpreted in this way.

Evidence of structures in western Europe is much scarcer. The open-air site of Corbiac in southwestern France contained evidence of two oval huts outlined by postholes; one measured 3 × 1.4 meters, the other 2 × 1 meters (Bordes 1968). Neither contained hearths, but three were found in the space between the two huts. The larger hut had a large flat stone placed at its center. Another open-air site in the region, Solvieux, had some linear and circular concentrations of stone, but no clear evidence of a structure (Sackett 1988). Structures were also built inside of caves, presumably to provide

shelter in addition to the cave itself against the cold and wind. In southern Germany, for example, an arrangement of large stones against the back wall of Brillenhöhle Cave outlined an oval measuring roughly 9 × 3.5 meters and probably formed supports for a wooden framework of a hide tent (Rieck 1973).

The patterns of settlement are poorly known for this period. In central and eastern Europe, large sites, particularly those with several substantial huts, are usually interpreted as residential camps for sizeable groups, but it is difficult to establish the contemporaneity of the different huts. It may be the case that such sites were simply occupied many times by small groups of people. In a number of cases, some of the larger sites contain faunal evidence of kills in all seasons of the years, suggesting the possibility of year-round residence (Kozłowski 1986). Again, however, several occupations in different seasons could create the same pattern. It does seem clear that functional differences among sites exist. Pavlov I, Dolni Vestonice I, Molodova V, and some of the Kostenki sites, for example, are large sites that were reoccupied repeatedly. These are often the sites with the most diverse tool and bone assemblages, the location of most of the evidence for specialized activities, such as ceramic production, and the source of the majority of finds of art and ornamentation. These sites must represent major residential camps where occupants stayed at least several months, where the greatest variety of activities was carried out, and where most ceremonial activity took place. Other sites, often with one hut, appear to be seasonal residential camps that were occupied briefly, perhaps by only a family or two, and less often reoccupied. Finally, there appears to be a category of more specialized sites, such as short-term hunting camps in some of the Moravian caves or workshops near outcrops of stone raw material. The settlement pattern, therefore, may have entailed seasonal movement of residence, perhaps with changes in group size and periodic gatherings of larger groups, who exploited the surrounding countryside from small, satellite camps (Kozłowski 1986).

In western Europe, a similar interpretation of settlement patterns has been made, but the evidence is often poorer. Most of the sites known are caves and rockshelters, which may reflect only a portion of the settlement record, and which may represent hunting camps more often than residential bases. There are differences among these sites, however, differences in size, assemblage diversity, and quantity of artwork that may reflect differences in site function (David 1973). Analysis of some faunal collections from sites in the narrow valleys of southwestern France indicates reindeer kills largely in fall and winter, suggesting both seasonal movements and the targeting of the animals during their annual migrations (Spiess 1979).

The range over which people moved annually appears in many cases to have been larger than was true in earlier times. Studies of stone raw material distributions document in many areas the regular transport of substantial amounts of material over distances of more than 100 kilometers. Although sites in some areas, such as the Dnestr basin in the Ukraine, which is rich in high-quality stone, show little import of exotic material, sites in eastern Russia along the Don River brought in stone from sources 150 kilometers to the west (Kozłowski 1986). Moravian sites such as Pavlov I obtained over 90% of their material from sources 150 kilometers to the north, as well as some from areas 80–100 kilometers southeast (Svoboda 1994). These materials were brought in as raw nodules or partially worked cores and further processed at the sites. While much of the material used in south German sites was locally available, some seem to be derived from more distant sources, up to 150 kilometers along the Danube corridor (Hahn 1987). Rigaud and Simek (1990) emphasize the large stone source areas for sites in southwestern France as well, although here, too, local materials are most abundant in the assemblages. Some of these transported materials may reflect exchange activities, but in many cases the amount of material is sufficient to suggest that it was gathered during the course of annual movements. Gravettian groups in many regions were apparently quite mobile, at least seasonally, and covered large areas in the course of their annual movements.

Gravettian populations were not evenly distributed across Europe, nor did their distribution remain stable. France stands out as one area of concentrated settlement, with 175 sites identified, mostly

concentrated in the southwest (Demars 1996). Iberia has 59 recorded sites clustered in three areas: northern Spain, southeastern Spain, and west-central Portugal (Straus et al. 2000). Other centers of occupation occur in the Meuse Valley of Belgium, the middle Rhine and upper Danube portions of Germany, central Moravia, the middle Danube of lower Austria, the Dnestr basin in the Ukraine, and the upper Dnepr and Don Valleys of Russia. South and southeast Europe have relatively few known sites, with certain areas, such as northeastern Italy and the Balkans virtually empty (Mussi 2001). Some of the patterns in this distribution may reflect the differential effects of environmental conditions favoring site preservation and of varying research intensity, but it seems clear, after so many years of archaeological research, that particular portions of the continent were population centers. Environmental factors may have played an important role in these patterns, since certain unfavored areas such as northeastern Italy were extremely dry and relatively poor in resources (Mussi 2001). It is likely that the paucity of sites in northern Europe is similarly due to the more rigorous climatic conditions at higher latitudes.

Some regions, such as southern France, appear to have been centers of occupation throughout the entire period of the Gravettian. Other areas, however, were inhabited for shorter periods. Italy, for example, shows no Gravettian occupations until around 25,000 years ago (Mussi 2001). In fact, this peninsula appears to have been largely abandoned around 30,000 years ago and was virtually empty until the Gravettian appeared, probably deriving from southeastern France. Part of the reason for this abandonment may have been a series of large volcanic eruptions centered in the area around Naples, some of which dateback 40,000, 36,000, 33,000, and 29,000 years. This period of great volcanic activity must have had periodically devastating effects on vegetation and wildlife, particularly as one of the eruptions seems to have deposited materials, in some locations up to 60 meters in thickness, over an area of at least 14,000,000 square kilometers.

Moravia is another area that was not continuously occupied. Most of the Gravettian sites in this region date to the period between 28,000 and 24,000 years ago, after which time occupation becomes scarce and finally disappears by around 22,000 BP. In this case the precipitating factor seems to be the gradually deteriorating climate with the onset of the last full glacial episode. Similarities between the stone tools and artwork of Moravian sites and those of later sites in the Dnepr, Dnestr, and Don River valleys suggest that as people gradually abandoned Moravia, they moved eastward into the Russian Plain, which became a new population center in the later Gravettian (Grigor'ev 1993, Soffer 1993). Southern Germany is another region that, like Moravia, had a larger Gravettian presence early in the sequence, with the later Gravettian characterized by fewer, smaller sites with thinner occupation levels (Hahn 1987).

## *Gravettian Exchange*

The most probable evidence of exchange among Gravettian groups is the presence of shells and fossils in sites far removed from their sources. In some areas of Europe, such materials were transported over very large distances, suggesting far-flung networks of exchange linking groups together. A number of sites in Russia contain shells brought from the Black Sea over distances of 800–1000 kilometers, as well as fossils from central European sources over 1000 kilometers away (Kozłowski 1986). Mediterranean shells appear in sites in the middle Rhine Valley, at least 800 kilometers away from the sources (Hahn 1987). Similar materials appear in Italian and French sites, but the distances involved are not as great. One motivation for this exchange was simply the desire for objects of adornment, which generally proliferated during this period. In addition, however, and perhaps more importantly, such networks would have provided a social and economic safety net, one in which the relationships created by exchange were more important than the goods themselves. In a variable and often harsh environment, resource failure must have been a major threat, one that could have been dealt with partly

by moving into new areas. The social ties forged by exchange would have made such moves easier; exchange partners would have been more likely to accept immigrants than total strangers would have been. Moreover, the populations were scattered and their density low; the need to find mates would also have encouraged maintaining social ties with neighbors. Exchange may have been primarily a cultural solution to economic and demographic problems.

## *Gravettian Art and Ornament*

Widespread communication and interaction seems also to have fostered broad similarities in both stone tools and artwork across the continent, as well in the expansion of *Homo sapiens* in the New World (Whallon 1989). The manufacture of what we see as works of art flourished in Europe during the Gravettian. As suggested by the finds discussed at Pavlov I, art objects were both abundant and extremely varied. Beads and pendants of shell, fossils, bone, ivory, and other materials are numerous. Objects of ivory, often heavily decorated with incised geometric designs, are especially common in eastern Europe. Although they are, for the most part, poorly dated, it is clear that some of the painted and engraved cave walls of France and Spain were produced during this time as well (de Sonneville-Bordes 1963).

Two recent discoveries are among the best dated and most impressive decorated caves. Cussac, in southwestern France, contains engravings of horse, bison, mammoth, rhinoceros, birds, and even humans. These are located deep within the cave and are associated with the skeletal remains of five humans, one of whom was placed in a depression created by bears. One skeleton has been firmly dated to the Gravettian. The cave of Les Garennes, also in southwestern France, contained some paintings, including a hand stencil, together with the partial remains of a man. These are also dated to the Gravettian.

Among the most impressive finds, however, are the numerous female figurines called "Venuses." These figurines, which were made from a variety of materials, including fired clay, bone, ivory, sandstone, steatite, and marl, are extremely diverse, but share a number of general characteristics (Gamble 1982). Most are nude, or have only hints of clothing, such as grooves representing belts or engraved marks that may be hair or headdresses. Generally, faces contain little detail, except for occasional incisions that may be eyes. Similarly, feet and hands receive little attention and are usually absent. On the other hand, breasts, stomachs, hips, and buttocks are accentuated and are generally the most striking features of the figures. The figurines have a broad distribution, occurring in sites in France, Italy, Austria, Moravia, the Ukraine, and Russia. Female images are also found in the form of stone engravings and low reliefs at a number of French sites of this period (de Sonneville-Bordes 1963).

Many different interpretations have been devised to explain these figurines. They have been seen as reflections of a goddess or a fertility cult, examples of prehistoric pornography, instructional aids for pregnant women, and icons of widespread social alliances. It is unlikely that any of these interpretations is correct. Their location within sites shows no patterning to suggest that the figurines were sacred objects of veneration. Their extreme diversity in proportions, position, and emphasized features argues against their serving as "badges" of membership in social alliances (Soffer 1987). This diversity is particularly marked among the numerous Italian finds, 15 of which come from the Balzi Rossi cave (or two adjacent caves) in the northwestern portion of the country (Mussi 2001). Several of these figurines, as well as a few from other parts of Europe, display a pairing of the female image with that of another – a male human, a female human, or an animal. This principal of duality, which was seen in the Aurignacian lion-man from southern Germany, appears in later Paleolithic art as well. The meaning of these diverse figurines is not at all clear, and may simply lie beyond our modern understanding.

## *Gravettian Burials*

Burials are reasonably numerous for this period, but are not uniformly distributed across the continent. France, for example, which has a rich Gravettian archaeological record, has no recorded burials (Quechon 1976). By contrast, burials are abundant in Moravia and Italy. Rich burials have been discovered at a variety of Moravian sites, including Dolni Věstonice I and II, Pavlov I, Brno II, and Předmosti (Svoboda 1994). Many are single burials, with the individuals flexed or on their side, and frequently covered with red ochre and accompanied by ivory pendants, perforated teeth, or other grave goods. One burial at Brno II was particularly rich, containing over 600 perforated fossil shells, two perforated, incised stone disks, an ivory figurine of a man, and other goods. In most cases, these burials occur within the site boundaries, often covered with the debris of later occupations, and men, women, and children are all represented. Large mammoth shoulder blades and stones often lie around or on top of the skeletons and seem to be coverings for the graves. A child's grave was discovered at Dolni Věstonice I in which the skeleton showed signs of having been partially burned. Clearly, some ritual activities accompanied the burying of the dead. Multiple graves are also known. At Dolni Věstonice II, for example, a triple burial of a man and two women was recently found. Most spectacularly, a large burial pit at the site of Predmosti, which was excavated in the nineteenth century, was found to contain the remains of at least 20 individuals, most side-by-side, but some lying above others, suggesting reuse of this location as a burial site. An analysis of a number of the skeletons revealed evidence of healed wounds to the skull, suggesting violence or perhaps ritual fighting.

Italy has also produced numerous Gravettian burials, with the remains of 21 individuals found in 16 graves (Mussi 2001). Most are single burials, but some contain more than one body, as, for example, a grave of a woman and a newborn child at the site of S. Maria di Agnano and the triple grave of a young man and two young women at Barma Grande. The skeletal sample is quite biased, dominated by adolescents and adults, and by males, with pronounced underrepresentation of children and females. Most are buried in an extended position close to the back wall of caves and a number have stones placed near the head. Men, women, and adolescents are all accompanied by goods, primarily beads of shells or stone. The young man at Barma Grande had a necklace made of several strands of fish vertebrae, perforated shells, and deer canines. A young man buried in the cave of Arene Candide must have worn a cap that had been decorated with hundreds of shells and teeth that were found about his head and shoulders. Here, as in Moravia, there is evidence that considerable preparation and ritual accompanied the burial, but the Italian sample is more biased. Adult men were given preferential treatment, but apparently only some of them, in particular, the taller men. A study of a number of the skeletons indicated that the average male height was between 180 and 190 centimeters (roughly 5 feet10 inches–6 feet 2 inches), a remarkable and unusual height surely indicating some differential treatment.

One of the richest sets of graves was found at the Russian site of Sungir, approximately 150 kilometers east of Moscow (Pettitt and Bader 2000). This large site, which covers more than 1500 square meters, dates to approximately 28,000–27,000 BP, but the burials found here within the occupation area are later, dating to 24,000–23,000 BP. Two graves were found, one containing the skeleton of an adult man, the other the remains of two adolescents, possibly one male and one female, lying head-to-head. All three bodies had been covered with red ochre and all were accompanied by a wealth of grave goods. These include over 13,000 beads made of mammoth ivory, stone tools, ivory spears, daggers, and bracelets, antler rods, animal carvings, perforated fox teeth, bone pins, and disk-shaped pendants. These grave goods represent a tremendous investment of time and energy. The beads alone took at least 9000 hours to manufacture, with the adolescents receiving the greater part, perhaps indicative of inherited status differences within this society (White 1993).

## Europe During the Last Glacial Maximum

Beginning around 25,000 BP, a period of climatic deterioration began that culminated in the glacial maximum between 20,000 and 18,000 BP, by which time ocean surface temperatures reached their minimum and continental ice sheets attained their greatest extent (CLIMAP 1976, COHMAP 1988). (Figure 5.8) Various areas of Europe were affected differently by this climatic cooling. Northern and central Europe were most seriously affected, northern Europe because of its high latitude and proximity to the Scandinavian ice sheet, and central Europe because it was situated between the Scandinavian and Alpine glaciers. Both areas experienced low average temperatures, long winters, permafrost formation, and high winds. As human habitats, they were increasingly harsh places, characterized by a decreasing abundance and diversity of plants and animals. Duplessy et al. (1976) characterize northwestern Europe as a polar desert between 25,000 and 14,000 BP. Montet-White (1984) describes the entire plains of northern Europe as an arctic desert after 22,000 BP. On the basis of detailed studies of pollen records for southern Germany, Frenzel (1983) suggests that in this area, vegetational productivity and large herbivore biomass decreased between 90 and 95% from the early glacial to the glacial maximum.

Southern Europe was much less adversely affected by these climatic changes. Biological studies suggest that many species of plants and animals retreated into or persisted in glacial refuges in southern France and Spain, Italy, and southeastern Europe (Willis and Whitaker 2000). For example, although southwestern France during the glacial maximum was generally characterized by tundra

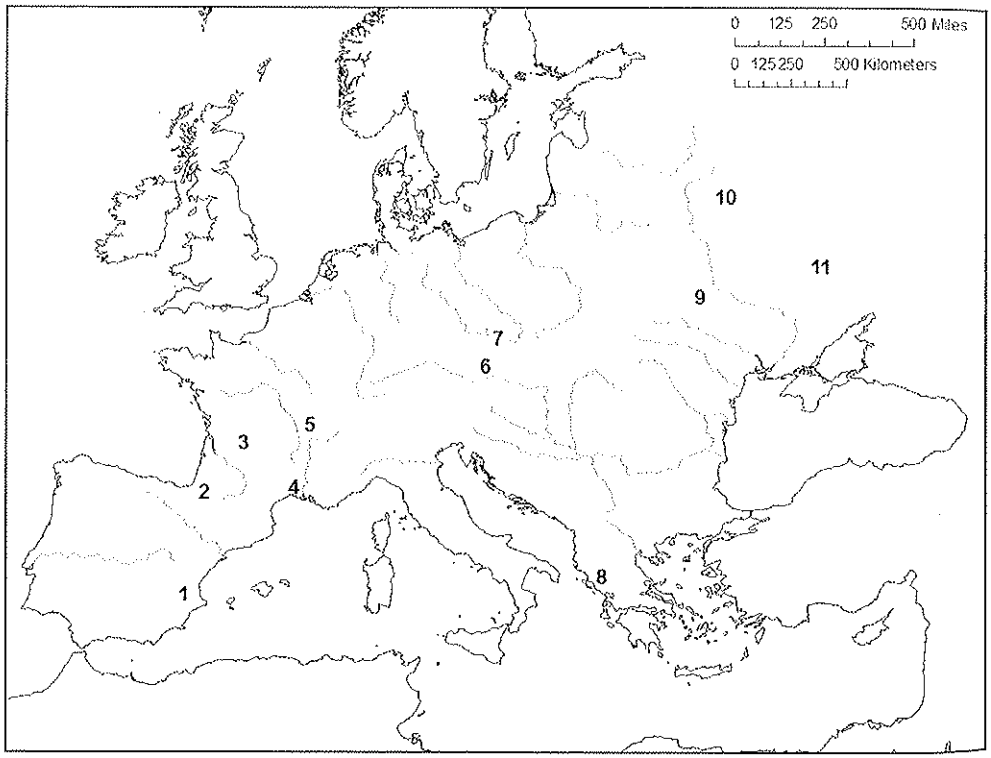


**Fig. 5.8** Sites of the glacial maximum mentioned in the text: *1* Parpallo; *2* Montaut; *3* Le Placard, Roc de Sers, Fourneau du Diable, Cougnac; *4* Tète du Lion; *5* Solutré; *6* Grubgraben; *7* Stránská Skála; *8* Kastritsa; *9* Kirillovskaya, Radmyshl'; *10* Pushkari; *11* Kostenki

vegetation, it was low in latitude, high-insolation tundra with some trees present, at times including warmth-loving species like elm, oak, and beech (Paquereau 1976). An indication of the relative hospitality of this region is provided by an examination of estimated average summer and winter temperatures. For the occupation period of the site of Abri Pataud in southwestern France, roughly 34,000–22,000 BP, Wilson (1975) estimates average summer temperatures to have been 12–15 degrees Centigrade and average winter temperatures to have been 0 degrees. By contrast, for approximately the same period, Frenzel (1983) estimates that in southern Germany average summer temperatures were 14–19 degrees and average winter temperatures –10 to –18 degrees. In this period before the glacial maximum, southern Germany was much more continental in climate and had much harsher winters. Additional confirmation of the contrast between the two areas is provided by an examination of the number of large herbivores available as prey. During the Gravettian, French hunters chose from among 16 species of large game, whereas those in Germany had access to only 9 species (Delpech 1975, Boessneck and von den Driesch 1973, Hahn et al. 1973). Even in the period before the glacial maximum, therefore, central European habitats were less diverse and probably less productive. With the climatic deterioration of the glacial maximum, southern Europe would have retained and increased its productive advantage and would have been attractive as northern and central Europe became increasingly inhospitable.

These environmental changes were accompanied by demographic changes as well. Beginning around 25,000 BP there appears to have been a progressive decrease in population of parts of Europe in conjunction with the process of climatic deterioration. Britain and Belgium were apparently unoccupied between 25,000 and 14,000 BP (de Sonneville-Bordes 1974, Evans 1975, Mellars 1974, Otte 1976). Much of northern and eastern France has few sites dating to the period of 20,000–15,000 BP (de Lumley 1976). Germany was sparsely inhabited between 23,000 and 15,000 BP (Hahn 1976) (Fig. 5.8). Settlement in Poland is rare during the height of the last glaciation (Kozłowski 1983) and Moravia shows only a few traces of occupation from about 21,500 to 14,000 BP (Valoch 1980, West 1997). The site of Grubgraben was occupied during the glacial maximum, but otherwise, Austria has very few sites dating to this period (Montet-White 1988, West 1997). Similarly, northern areas of the Ukraine and the Russian Plain show significant decreases in the number of sites around the glacial maximum (Soffer 1987). It appears that huge portions of the continent were largely abandoned during the height of the last ice age, and that, like other animals, human populations sought refuge in southern areas of Europe (Jochim 1983, 1987). These glacial refuges – Spain, southern France, Italy, the Balkans, and south Russia – show evidence of continuous occupation throughout the glacial maximum.

## Western Europe: The Solutrean

Roughly coinciding with the peak of the last glaciation, there appeared in Spain and France a new archaeological culture, the *Solutrean*. Dating between approximately 21,000 and 17,000 BP, this culture is characterized, above all, by a number of well-made stone points (de Sonneville-Bordes 1963, Smith 1965). These implements, which are frequently considered the most impressive examples of Paleolithic stone-working, were shaped by fine pressure-flaking, on either one face or both, to create a variety of forms, called laurel leaf, notched, and willow leaf points (Fig. 5.9). The different types form a temporal sequence, allowing for the establishment of a stylistic chronology of Solutrean development. Among accompanying tools, end scrapers are common, burins are rare, and surprisingly, a number of Mousterian-like side scrapers and points appear.

The function of these special points has been much debated. Most commonly, they are considered to have been used as spear points and perhaps knives. One variety, with concave bases, has been found almost always as fragments, suggesting that they broke during use and the remnants discarded

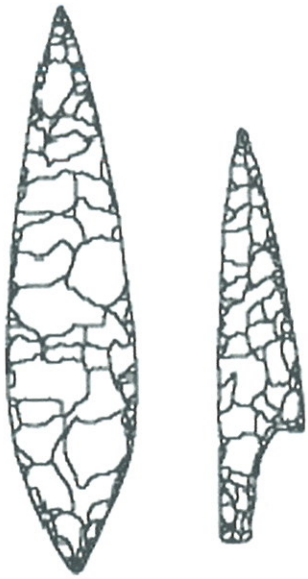

**Fig. 5.9** Solutrean points (from *left*: laurel-leaf point; shouldered point)

(Straus 1977). Other evidence, however, suggests a more specialized and perhaps even ceremonial use for at least some of the points.

- Their raw material is usually of particularly high quality and often banded in several colors, indicating a careful selection of stone.
- The amount of work invested in the manufacture of the points exceeds that of other tools by a considerable margin.
- A number of the points are so thin and delicate that they would surely have shattered upon use.
- Some specimens are so large (with lengths exceeding 28 centimeters) that it seems unlikely that they could have been effectively hafted as spear points.
- Some sites have exceptional amounts of the points; the site of Le Placard in southwestern France, for example, has more than 5000.
- At the site of Volgu in southern France, an isolated cache of 17 large points was found, not associated with an occupation site.

Consequently, it may well be that at least some of the points, made of selected stone, carefully worked, and concentrated in special locations, were important nonutilitarian goods, used perhaps in ceremonies or exchange.

## *Spotlight on a Solutrean Site: Solutré*

Most Solutrean sites are caves or rockshelters. Because of the variety of natural disturbance processes operating in such sites (rockfalls, water erosion, activity of other animals), they provide little information on the organization of prehistoric behavior. The site of Solutre, however, which gave its name to this culture, is exceptional. It is a large, open-air site covering an area of over a hectare, located in east-central France. Situated near the base of a cliff in blind canyon, the site appears to have been used for mass animal drives sporadically over a period of at least 20,000 years (Olsen 1989).

Its 9 meters of cultural deposits contain materials from the Middle Paleolithic and all periods of the Upper Paleolithic. A variety of excavations have been carried out over the past 100 years, but most of the site remains untouched.

Stone artifacts are relatively scarce at the site, but the Solutrean levels include a number of points that are characteristic of the middle and later phases of this culture. Bones, on the other hand, are extremely abundant in all levels. In all periods of the Upper Paleolithic, horse was the dominant species represented, making up 94% of the identified remains. Based on the small sample excavated, it has been estimated that the entire site may contain the remains of over 32,000 horses. In the Solutrean levels, both reindeer and a bovid, either bison or aurochs, were also present, with the following estimated minimum number of individuals of each:

5 Horse
5 Reindeer
1 Bovid

Analysis of the entire sample collection of bones suggests some patterns in the economic activities carried out. Most horses appear to have been hunted during the summer, perhaps during migrations. Reindeer, on the other hand, were killed largely in winter and spring. The horses are mostly prime-age adults, with an underrepresentation of very young or very old animals. It appears likely that the animals were driven into the box canyon and killed. The fact that the horse carcasses often show some articulation of body parts and relatively few butchering marks suggests that successful drives produced an overabundance of meat and that much was wasted. Because storage of meat during the warm summer months would have been difficult, only portions of the kills were used. The reindeer, by contrast, show much more evidence of butchery. During winter, the animals may have been rather solitary and been killed individually. The lesser amount of meat from these kills, together with the potential for meat storage by freezing, may have led to the more complete butchery of these animals. Solutré is consequently a kill site where animal drives and butchery were practiced on a recurring basis. The topographic situation channeled game through the valley and allowed hunters to trap their prey in the blind canyon. Meat was sufficiently plentiful, at least during summer, so that much appears to have been wasted. Like many other specialized kill sites, Solutre lacks abundant stone tools or features such as huts. It was one component in the settlement system, a component that retained its role for thousands of years.

## *Solutrean Subsistence*

Despite the evidence for the importance of horses at Solutre, these animals appear to have played a rather small role in Solutrean economies. Instead, the reindeer was the primary prey in France at this time, and faunal assemblages are more specialized than at any previous time (Delpech 1975, Rigaud and Simek 1990). Although this region was richer in resources than central and northern Europe, it nevertheless was significantly affected by the climate of the glacial maximum. In comparison to their Gravettian counterparts, Solutrean hunters in southwestern France had fewer big-game species available as prey (Jochim 1987). Moreover, the reindeer of this period are smaller in body size than previously, suggesting greater environmental stress (Delpech 1988). During the Solutrean, big-game hunting appears to have intensified and focused in particular on the most abundant species, reindeer. Along with this greater emphasis on the hunting of a few large game species there appears an important technological development: the spear-thrower. This device, usually made of carved antler and sometimes decorated, increased the distance and accuracy of thrown spears and must have led to much greater hunting efficiency.

In northern Spain, subsistence practices also changed in relation to earlier periods, but in a different way. Big-game hunting was certainly the mainstay of the economy, but it became more diversified. Alongside red deer, bovids, and horse, ibex now became an important focus of hunting, necessitating specialized exploitation of mountainous habitats (Straus 1987). In addition, birds, fish, shellfish, and even seals were included as regular parts of the diet (Straus 1985). The full glacial climatic changes, although not as severe here as farther north, apparently forced people into economic diversification to cope with declining environmental productivity.

## *Solutrean Regional Interaction*

If there was an influx of population into southern France during the glacial maximum, the number of known sites does not indicate this clearly, either in the southwest (Rigaud and Simek 1990) or the Pyrenees (Bahn 1983). Approximately 121 Solutrean sites have been found in France, compared to 175 for the somewhat longer Gravettian (Demars 1996). In Spain and Portugal, on the other hand, site numbers show a dramatic increase: 164 Solutrean sites compared to only 59 Gravettian sites (Straus et al. 2000). The Solutrean sites are concentrated in the northern, southeastern, southern, and western portions of the peninsula, with the southern area of Andalucia showing the largest relative increase. As Straus et al. (2000:561) conclude, "Andalucia may have been a most favored refuge within a refugium," due to its location far to the south.

Sites tend to be distributed in discrete concentrations, for example in the Perigord region of southwestern France, the lower Rhone Valley, coastal valleys in northern Spain, the Gulf of Valencia, and west-central Portugal. Many of these clusters seem to have had specific local styles of points. The area of western Santander and eastern Asturias in northern Spain, for example, is characterized by unique concave-based points, while other styles predominate in the Rhone Valley, the central Pyrenees, and the western Pyrenees (Straus 1977). Nevertheless, studies of stone raw material distributions in southwestern France (Rigaud and Simek 1990) and of stylistic similarities in stonework and art in France and Iberia (Bahn 1982, Straus et al. 2000) suggest that Solutrean groups maintained wide areas of communication and interaction. Seashells from both the Atlantic and the Mediterranean appear in Solutrean sites in France and apparently represent exchange networks. Some degree of specialization for exchange is suggested by the existence of possible workshop sites. The site of Montaut in the Pyrenees was also a workshop for local flint that supplied nearby residential camps with tools. The large number of virtually identical Solutrean points found at this site has been interpreted as the output of specialists, whose products have been found distributed throughout the Pyrenees and into northern Spain (Bahn 1982). Similarly, the site of Le Placard in southwestern France, which contained over 5000 stone points, may have been a workshop and distribution center for these artifacts.

## *Solutrean Art, Ornaments, and Ritual*

Like earlier phases of the Upper Paleolithic, the Solutrean contains evidence for the production of personal decoration. Pendants, beads, and bracelets were made of bone and ivory, and notched bone pins may have been used for clothing or hair arrangements. A number of sites contain pieces of mineral pigments – red and yellow ochre, black manganese – that could have been used for face or body painting. Portable art objects such as engravings are also known, but are not particularly common. One notable feature of the Solutrean is the appearance of deeply carved bas-reliefs of animal figures on large blocks adjacent to the occupation areas of caves (de Sonneville-Bordes 1963, White 1986). Two of the best-known examples come from southwestern France. In the cave of Roc de Sers, a series

of carved blocks, which lined the back of the cave, contained figures of horses, bison, reindeer, ibex, and humans. Two decorated blocks were found in the cave of Fourneau du Diable, one of which bears the carved figures of two aurochs, one in front of the other.

Despite the difficulties of dating cave art, it is clear that some caves were decorated during Solutrean times as well. The caves of Tete du Lion in the Rhone drainage and Cougnac in southwestern France, as well as a number of sites in southern Spain and central and northern Portugal all have wall paintings or engravings that have been reasonably well dated to Solutrean times (Lorblanchet 1993, Straus et al. 2000, White 1986). In addition, the eastern Spanish cave of Parpallo contains thousands of painted stone slabs within its Solutrean levels (Straus et al. 2000).

Evidence of burials from the Solutrean is completely lacking. Whether this is simply an accident of discovery, or truly reflects a fundamental change from the Gravettian, is unknown. Direct evidence of other ritual activity is also absent. It may well be, however, that the increased production of wall art, the placement of engraved blocks at some sites, the accumulation of painted slabs at Parpallo, and even the abundance of elaborate worked stone points at a number of sites all reflect some type of ceremonial or ritual activities. A number of archaeologists have argued that the rigors of full glacial climate and the compression of populations into circumscribed glacial refuges necessitated a number of economic and social changes (Clark et al. 1996, Gamble 1991, Jochim 1983, 1987, Mellars 1985). During the Solutrean, big-game hunting, particularly of reindeer, was intensified in France, whereas in Spain, the economy changed to include a greater diversity of terrestrial and marine resources as regular components of the diet. Socially, there is some indication that small, regional groupings emerged, each characterized by stylistic variants of both stone tools and artwork. Such local groups may have developed in part as a response to increasing competition for diminished resources. In the absence of leaders (for which there is no evidence), mediation of relations within and between groups may have increasingly relied upon ceremonial or ritual events and the emergence of special locations for their occurrence.

## Southern and Southeastern Europe: The Epigravettian

Other parts of southern Europe that were occupied during the last glacial maximum showed industries that were essentially a continuation of the Gravettian into the so-called *Epigravettian*, characterized by much variation in types of points and other tools. In part because much less archaeological research has been done in most of these areas, however, the record is sparse in comparison with that of France and Spain. In Italy, for example, Mussi (1990) discusses 13 sites that date to approximately the glacial maximum, many of them characterized by particular leaf-shaped points. The adjacent Balkans have little evidence for occupation during this period; one of the few known sites, Kastritsa in Greece, has only traces of occupation dating to around 20,000 BP, interpreted as reflecting brief visits (Bailey and Gamble 1990). As mentioned earlier, Moravia and Austria were largely abandoned during this time, but the Moravian site of Stranska Skala, with dates around 18,000 BP, was probably used seasonally and episodically as a specialized horse hunting camp (Svoboda 1990) and the contemporary site of Grubgraben in Austria was used in the specialized hunting of reindeer and horses (Montet-White 1988, West 1997). Western Slovakia actually contains a number of sites from this period, largely clustered in an area of hot springs that may have created a favorable microclimate (Kozłowski 1990). The Carpathian Basin in Hungary has three known sites of this time, all large sites with several levels of occupation and a stone tool industry called the Sagvarian (Dobosi 1998–1999). One of these sites has the remains of at least four dwelling platforms about 5–6 meters in diameter.

Farther to the east, in the Ukraine and Russia, the record is somewhat more impressive. In comparison to earlier times, the southern Dnestr Basin shows an increase in the number of sites dating to around the glacial maximum (Kozłowski 1990). Although the Dnepr and Desna Basins of the central

Russian Plain have only five known sites from this period, these represent a similar increase in occupation intensity. On the other hand, the Don Valley has only one known site, reflecting a decline in site numbers from earlier times (Soffer 1990). Three of the sites in the central Russian Plain – Kirillovskaya, Pushkari I, and Radomyshl' – have been interpreted as winter residential camps with impressive remains of mammoth bone dwellings, hearths, and work areas. Their economy was based on the hunting of bison, horses, reindeer, hares, and probably some mammoth. The most significant features at these sites are numerous storage pits dug into the permafrost. Their appearance suggests a fundamental change in the economy, one geared to intensive hunting in autumn and the amassing of food stores for the winter. Farther east, the one known site in the Don Valley, Kostenki 19, also had a number of features, including two dwelling structures, pits for roasting food, and complex hearths with channels to guide air flow (Soffer 1990).

If there were glacial refugia in south and southeastern Europe, only the Ukraine and the central Russian Plain contain evidence of this role. Both show an increase in relative numbers of sites and the Russian Plain, at least, has evidence of important economic changes. As Soffer (1985) has argued, the development of storage technologies coupled with big-game hunting allowed larger groups (perhaps over 50 individuals) to remain more sedentary than previously, staying perhaps as long as 9 months in their residential camps.

### *Responses to the Glacial Maximum*

As the above evidence indicates, human responses to the harsh climatic conditions of the glacial maximum were varied. Large areas of northern and central Europe were abandoned or used only sporadically by sparse populations on a seasonal basis. The portion of the continent to the south of the Alpine barrier continued to be occupied, but with little change from earlier times. On the other hand, two areas stand out as glacial refuges that probably witnessed some population influx from areas farther north: southwestern Europe (Iberia and southwestern France) and southeastern Europe (the Ukraine and central Russian Plain). In both areas, significant economic changes occurred. In southwestern France, economies intensified their focus on big-game hunting, particularly reindeer, and developed new technologies like the spear-thrower to increase their hunting efficiency. In Iberia, the economy remained focused on big game, but was diversified to include the regular use of additional species like ibex, as well as birds, fish, and shellfish. Economies in the Ukraine and Russia also continued to emphasize large mammals, but developed a storage technology to increase their economic security and to allow larger resident groups and greater sedentism. In both refuge zones there are also hints of changes in settlement patterns, social arrangements, and perhaps ritual. In terms of cultural development, the glacial maximum was truly a watershed in European prehistory.

## The Late Glacial Period

The climatic record after the glacial maximum is one of warmer and colder phases, alternating with increasing frequency until approximately 10,000 BP, when the glacial period finally came to an end. Vegetational communities responded to these changes. During the warmer intervals, the density and productivity of herbs and grasses in the tundras and steppes increased. Trees increased somewhat in density and expanded their distribution out of the glacial refuges, only to retreat again during colder periods. Some animal species thrived under these conditions until quite late in this period, especially reindeer, horse, bison, ibex, and, for a time, saiga antelope (Delpech 1988). Other species, however, suffered stress in the changing and gradually warming conditions, responding by gradually shifting their distributions and, ultimately, becoming extinct. The best documented case is that of mammoths,

which were numerous in eastern, central, and northwestern Europe before the height of the last glacial period (Soffer 1993). During the glacial maximum, these animals largely disappeared from central Europe but continued to thrive farther east in Russia. By 12,000 BP, however, they disappeared from this region as well, persisting to the east in northern Asia another few 1000 years. Studies of mammoth skeletons from several areas just before their local extinction document a number of signs of nutritional stress, including small body size, younger ages of death, and various pathological conditions. A similar pattern of a gradually shifting distribution and ultimate extinction, but with a different spatial pattern, has been observed for the giant deer, which disappeared from southeastern Europe during the Middle Paleolithic, but persisted in northwestern Europe until the beginning of the postglacial period. A number of other species also became extinct or abandoned Europe during the late glacial period, including wooly rhinoceros, muskox, fallow deer, cave bear, and cave lion. Toward the very end of the late glacial, when reforestation had occurred throughout much of the continent, other species retreated to the north (reindeer) or east (horse, bison, antelope), to be replaced by woodland communities of red and roe deer, aurochs, and wild boar.

Initially, humans remained confined within the glacial refugia, but beginning perhaps as early as 16,000 BP, or more certainly by 15,000 BP, groups began expanding to the north and repopulating central and northern Europe (Jochim et al. 1999, Otte 1990, Soffer 1985) (Fig. 5.10). As will become evident, the late glacial was a period not only of significant population movements, but also of remarkable cultural developments.

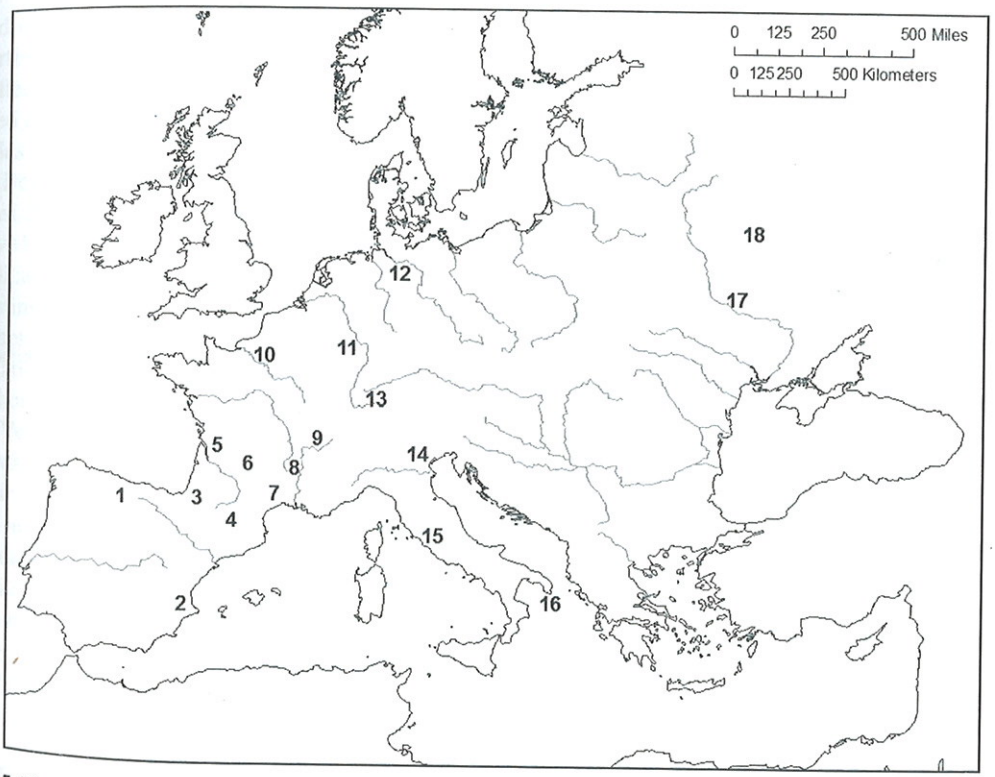


**Fig. 5.10** Late Paleolithic sites mentioned in the text: *1* El Juyo, La Riera, Altamira; *2* Parpallo; *3* Isturitz; *4* Mas d'Azil, La Vache, Enlène, Tuc d'Audoubert, Trois Frères, Montespan, Niaux; *5* Saint Germain La Rivière; *6* Guillasou, Le Cerisier, Plateau Parrain, Le Breuil, Lascaux, Le Placard; *7* Aldène; *8* La Marche; *9* Champréveyres, Montruz; *10* Verberie, Etiolles; *11* Gönnersdorf, Andernach; *12* Meiendorf, Poggenwisch, Borneck, Stellmoor; *13* Schussenquelle; *14* Riparo Tagliente; *15* Grotte Polesini; *16* Grotte Romanelli; *17* Mezhirich, Dobranichevka; *18* Mezin

## Western Europe: The Magdalenian

The archaeological record of western Europe during much of the late glacial is dominated by a culture called the *Magdalenian.* This is truly a spectacular culture, with abundant evidence of economic innovation, complex social interaction, and elaborate artistic and ritual activity. On the basis of stone and bone tool types, a stylistic chronology of the Magdalenian has been developed, but in recent years, some problems with this chronology have been identified. The very earliest is now considered sufficiently different from other stages that it has been renamed as the *Badegoulian.* This short-lived culture, found only in France, has abundant flakes, star-shaped borers, and an abruptly retouched "raclette" scraper. The true Magdalenian is characterized by abundant blades and bladelets, numerous burins, and particularly large numbers of backed bladelets that probably formed insets in composite tools (Fig. 5.11). Accompanying these stone tools are a series of bone points, initially smooth, but later carved to have one or two rows of barbs. These latter are considered to be harpoons, with points that would detach upon impact and remain in the wound.

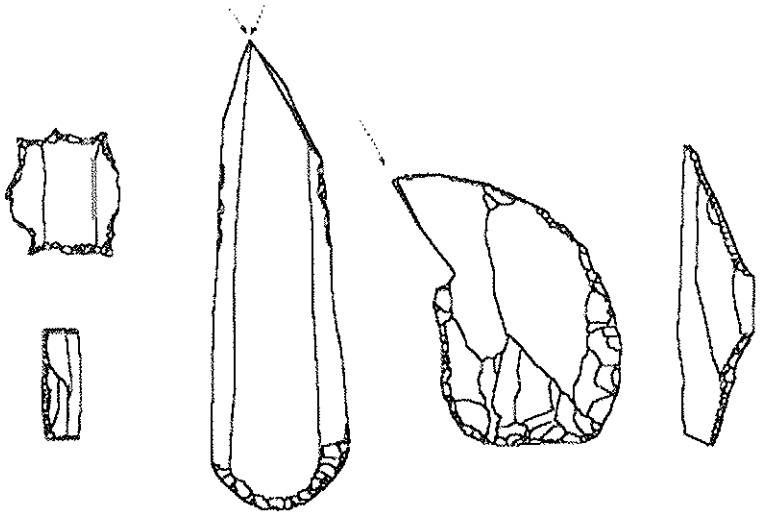

**Fig. 5.11** Some Magdalenian tools (from *upper left*: multiple star-borer; rectangular backed bladelet; combination burin-end scraper; parrot-beak burin; shouldered point)

### *Spotlight on a Magdalenian Site: Verberie*

The open-air site of Verberie is situated on a low terrace in the floodplain of the Oise River in the northern Paris Basin (Fig. 5.12) (Audouze 1987, Audouze and Enloe 1991, Enloe and David 1997). Unique depositional processes have preserved materials here with a remarkable degree of spatial integrity. Flooding by the river, which buried the site in alluvial loam, was so gentle that the artifacts were relatively undisturbed, leading to the preservation of the living floors intact. Radiocarbon dates of 12,900–12,450 $\pm$ 150 BP have been obtained, which would place the occupation during a warm period called the Bolling.

Three different concentrations of materials were identified, one of which (Locus 2) is the focus of discussion here. This area, excavated over more than 300 square meters, contains two hearths that appear to have been the focus of activities. Both are shallow basins lined and surrounded by rocks and slabs. Stones and bones are distributed around these hearths, forming clear concentrations. Over 6000 stone artifacts were found. Stone-working was aimed primarily at the production of blades, bladelets,

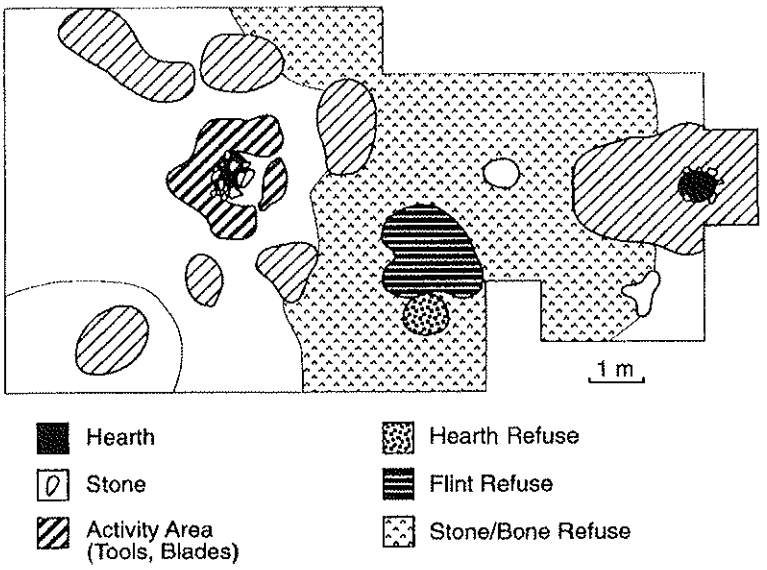


Fig. 5.12 Verberie site plan (after Audouze 1987)

and tools using locally available high-quality flint. The primary tools include burins, end scrapers, perforators, truncated blades, and backed bladelets. Many of the tools show evidence of having been hafted in bone handles (Keeley 1987). Microwear analysis indicates that the bladelets were primarily used not only in projectiles but also for cutting meat, and that scrapers were used in the working of hides.

Bones are numerous and well preserved. Over 99% of them come from reindeer and represent at least 24 different individual animals of all ages, including juveniles. The majority of them appear to have been killed during the early fall. Bones of all body parts are represented and are highly fractured, indicating intense butchering. A number of rib portions are still articulated with the vertebrae, suggesting that slabs of ribs may have been cut off from the vertebral column, perhaps for storage. The bones are distributed throughout the site, but some relatively empty areas have been interpreted as the locations of butchery, surrounded by discard zones for the refuse. In addition to reindeer, a few bones of horse, birds, and ground squirrel were found.

Verberie apparently was a small, short-term camp focused on the interception of migrating reindeer herds across the plains of northern France. During the fall migration, when the animals were fattest and their hides in best condition, the hunters stationed themselves along the route, killed, and processed the animals and may have stored some meat in anticipation of winter. The kills must have occurred close to the camp, as entire carcasses were brought back and butchered. During their stay, the hunters used the local flint to manufacture new tools, which they carried away with them. The fresh hides of the animals were processed and taken as well. They also did some bone- and antler-working, but left only two bone points and a needle behind. If they built tents or huts for shelter during their stay, they must have been simple structures that left no trace.

## *Magdalenian Subsistence Economies*

The earlier Magdalenian began during a period of still rigorous environmental conditions. Although a warming trend began episodically immediately after the glacial maximum, populations were still largely confined to the southwestern refugium. Badegoulian sites, coinciding with a warmer

interstadial period, do appear farther north in France, but subsequent site distributions show a retreat southward with the onset of colder conditions again (Schmider 1990). As a result, economic activities during the Magdalenian remain much the same as they were during the Solutrean. Hunting was emphasized, with big herbivores making up between 91 and 100% of the bones at many sites in southwestern France (Jochim 1987). Reindeer, still of small body size indicative of environmental stress, continued as the major prey, but horse increased in frequency and a number of other species regularly occur at many sites, suggesting a diversification of big-game hunting. Small mammals, fish, and birds played a small role in the subsistence during the earlier Magdalenian.

During the later Magdalenian, however, a number of changes occurred. Site economies became more variable and big game, although still dominant, apparently played a somewhat smaller role. Reindeer and horse continued as the major prey, but now were supplemented by fewer other large mammals. Instead, small mammals, birds such as ptarmigan and grouse, and fish all began to occupy a larger role in the diet (Le Gall 1992). Economies of this time appear to have diversified considerably.

Some major innovations of this period may have had a profound effect on hunting success. During the earlier Magdalenian, small backed bladelets became common and may indicate the development of bow and arrow technology. Although the earliest definite evidence of arrows is not found until the end of the late glacial period, these small stone artifacts were doubtless set into wood or bone shafts as part of composite projectiles. This innovation, if it indeed occurred at this time, would have given hunters a greater striking range and greater accuracy, and would have increased hunting efficiency immensely. A second innovation, again visible toward the end of the late glacial period, may have been the domestication of the dog. Although disputed (Soffer 1985:201–203), a number of skeletal finds, especially in Russia, have been interpreted as the remains of domesticated dog. Their presence during the succeeding early Mesolithic is widely accepted; if the process of domestication began in the late Paleolithic, it may have had important consequences for hunting practices. In modern hunting societies, the use of dogs to drive and chase game greatly increases hunting success and efficiency. If Magdalenian hunters were, indeed, armed with both bows and dogs, their hunting would have been much more effective than that of earlier groups.

In Spain, the Magdalenian also continued the pattern of economic changes that began earlier, increasing the effectiveness and diversity of the economy. Red deer and ibex were intensively hunted, along with bison, horse, chamois, and other large mammals. In some sites, such as El Juyo in northern Spain, the age and sex ratios of the red deer skeletal material suggest that mass hunting of herds was practiced, presumably by driving the animals into blind valleys (Klein et al. 1981). Birds, fish, and shellfish all increase in importance through time, indicating further diversification of the economy. In some sites, such as La Riera, shellfish decrease in size through time, a pattern interpreted as reflecting gradual overexploitation of this stationary resource (Straus and Clark 1986). Grinding stones found in a few sites may indicate the use of plant foods, although mineral pigments were certainly processed as well (Straus 1985). In both Spain and France, the late glacial period was characterized by continuing technological innovation as well as economic diversification and intensification.

## *Magdalenian Settlement and Migration*

With the beginning of the Magdalenian in France there is a large increase in the number of sites as well as shift in the type and location of sites. During the earlier Magdalenian (Badegoulian and early Middle Magdalenian according to typological schemes), 118 sites have been found (Demars 1996). For the first time, a considerable number of open-air sites are known: 53, or 45%. The vast majority of these sites are concentrated in the southwest, with occupation absent in the Pyrenees and sparse and episodic in areas farther north. During the later Magdalenian there is a veritable "explosion" of site numbers. For this period, 456 sites are known in France, of which 120, or 26%, are open-air

camps. These sites are distributed throughout most of France, including the north, the east, and the Pyrenees.

In Spain and Portugal, on the other hand, the number of Magdalenian sites is lower than that of the Solutrean (Straus et al. 2000). This decline in site numbers is due to a large decrease in eastern and southern Spain and in Portugal, particularly during the earlier Magdalenian. The number of earlier Magdalenian sites in northern Spain, on the other hand, remains essentially the same as that of the Solutrean at 59. During the later Magdalenian, the number of sites remains roughly constant (53) in northern Spain but increases again in the other three areas. In addition, there is evidence of increasing penetration into the center of the peninsula, a region lacking much evidence for occupation during most of the Upper Paleolithic.

A dramatic feature of Magdalenian settlement is its expansion to the north and east through time (Jochim et al. 1999, Otte 1988). With the climatic improvements after the last glacial maximum, conditions in north and central Europe gradually became more hospitable. Colonization out of the southwestern refugium carried the Magdalenian culture far into the heart of Europe. Traditionally, it was thought that this expansion coincided with a pronounced warm period called the Bolling, which dates to approximately 13,000 BP. More recently, however, it has become clear that the process started much earlier. A number of sites, possibly dating to before 15,000 BP, have been found outside of France. A number of these appear to be brief summer camps aimed especially at the seasonal hunting of reindeer or the procurement of raw materials like high-quality stone and reindeer antler. By the period of 13,000–11,000 BP, the Magdalenian was flourishing in northern France, Belgium, central and southern Germany, northwestern Switzerland, Moravia, and southern Poland, and occupation of these regions was year-round.

In both the heartland and the newly colonized areas, caves and rockshelters rather high above the valley floor continued to be the most common types of sites, but in addition, new locations were used especially in the later Magdalenian. Low-lying caves and shelters, barely above the valley bottom, were now frequently occupied, and in particular, sites close to natural river fords were sought (White 1985). These locations may have been chosen because they were crossing points for reindeer migrations or because they offered particularly rich fishing opportunities, or both. South-facing caves were preferred, presumably because they offered greater warmth from insolation. As mentioned above, open-air sites are now abundant and have been found in a variety of locations. A remarkable series of sites on the top of plateaux has been discovered in the Isle Valley of southwestern France (Sackett 1988). In the Paris Basin, a number of sites in addition to Verberie have been found on valley bottoms adjacent to the rivers (Audouze 1987). Later Magdalenian sites were also situated on the shores of large lakes, such as the Swiss sites of Champreveyres and Monruz on Lake Neuchatel (Affolter et al. 1994, Benkert et al. 1984), and next to springs, as exemplified by the south German site of Schussenquelle (Schuler 1994).

Huts or other structures are known for large number of sites. At the site of Etiolles in the Paris Basin, a ring 6 meters in diameter is formed of large stones surrounding a large hearth and a concentration of artifacts (Audouze 1987). Also in the Paris Basin, the site of Pincevent is well known for its numerous occupations and remains of over 100 huts within an excavated area of approximately 3500 square meters (Bahn 1983, Leroi-Gourhan and Brezillon 1972). Most of these structures were small circles or ovals of roughly 3 meters diameter, each with a central hearth. The German sites of Gonnersdorf and Andernach have several large structures measuring 6–8 meters in diameter characterized by postholes, pits, slate slabs, a central hearth, and numerous artifacts (Bosinski 1982, Veil 1982). In addition, Gönnersdorf has four smaller structures, each with a central hearth. In the Isle Valley of southwestern France, the sites of Guillassou, Le Cerisier, Plateau Parrain, and Le Breuil are all characterized by rich archaeological layers and rock "pavements" that appear to have been hut floors (Sackett 1988). The cobble pavements range in size from approximately 2 × 2 meters to 4 × 4 meters and presumably were built to create a dry surface above the soil surface. Interestingly, in some

cases artifact distributions are confined to the pavement surface, whereas in others the pavements are largely empty, a difference that may reflect seasonal differences in site occupation, with activities during the warmer seasons more likely to have occurred outside the huts.

Much speculation has been done about the seasonal pattern of settlement during the Magdalenian (Burke 1995). Ethnographic analogies with modern reindeer-hunting groups in Canada, in particular, have been used to infer seasonal migrations associated with the movements of the reindeer. There are several problems with such analogies. Although European glacial environments were largely tundra, they differed considerably from those of northern Canada. European tundras were situated at low latitudes and consequently received much greater solar energy. As a result, they were probably richer in a diversity of plant species than their Canadian counterparts. In addition, whereas Canadian hunters had a limited array of large mammal species available, European populations, even during the glacial maximum, had a much greater variety, including not only reindeer, but also horse, bison, saiga antelope, ibex, chamois, red deer, mammoth, wooly rhinoceros, and muskox. Finally, in the Canadian Barrenlands the topography is largely flat and reindeer undertake long-distance seasonal migrations of hundreds of kilometers in huge herds, whereas the more broken topography of much of Europe probably encouraged much shorter annual migrations and smaller groups. Uncertainty about prehistoric reindeer behavior has allowed for the construction of several different models. Sturdy (1975), for example, suggested that reindeer in central Europe moved over huge distances, from northern Europe along the Rhine corridor into the Alpine foothills and back again each year. Bahn (1977) suggested animal movements between southwestern France and perhaps the Alps or the Pyrenees. Gordon (1988) postulated regular north-south herd movements across the Aquitaine Basin of western France. Most scholars, however, have suggested shorter movements, for example from either the higher elevations of the Massif Central or the coastal plain in southern France in summer to the protected valleys of the Perigord region in winter, from the southern edges of the Paris Basin in winter to more northerly areas in summer, or from the Pyrenees in summer down to the adjacent lowlands in winter (Bouchud 1954, Spiess 1979, Straus 1983, White 1985).

Regardless of the specific migration patterns postulated for reindeer, it has often been assumed that reindeer was the single most important prey, that hunters intercepted the herds and made mass kills during the spring and fall migrations, that they stored meat for the winter, and that they aggregated in large groups for the migration hunts and dispersed into smaller groups for summer and perhaps winter. Growing archaeological evidence suggests that this interpretation is much too simplistic. Sites in the Paris Basin, such as Verberie, do indeed appear to have been situated so as to intercept migrating reindeer, but the sites are relatively small and briefly occupied, with no indication that they were inhabited by large aggregations of people. In a number of areas, such as Spain, southwestern France, central Germany, and Moravia, horse was an important part of the diet, sometimes more so than reindeer.

Moreover, studies of reindeer and horse teeth indicate complex patterns in the seasons of kills that do not easily fit the simple models of seasonal settlement shifts (Burke 1995, Boyle 1990). Reindeer were hunted in the narrow valleys of the Perigord largely in winter and spring, apparently using two different hunting techniques. During the spring migrations, some form of communal hunting was practiced, with kills of sufficient numbers of animals that only the meatiest parts show evidence of butchering. During winter, hunting must have been practiced by individuals on an encounter basis and the carcasses were more fully processed. Horses were hunted in this area during most of the year, both cold and warm seasons, and seem to have been seasonally complementary to reindeer in their availability and importance. Burke (1995) has argued that a clear seasonal round of settlement shifts is not evident in this area, at least for the early Magdalenian. Rather, many sites were occupied in several seasons, but the prey and hunting techniques may have shown seasonal changes within sites. This pattern makes sense if, in the mosaic environment of southwestern France, many different habitats and resources were accessible from each site.

By contrast, the evidence from southern Germany suggests rather clear seasonal contrasts in site occupations, with large sites occupied largely in fall and winter and focused on reindeer hunting, and smaller sites occupied in spring and summer and emphasizing horse and a variety of other resources (Weniger 1982). In this region, a clear seasonal round of shifting settlements and activities seems to have occurred. Most of the reindeer were killed in winter and occur in large numbers in several large sites. Germany at this time had a more highly seasonal climate and a more monotonous, open-tundra vegetation, which may have imposed a clearer pattern of seasonal migration on the reindeer herds.

## *Magdalenian Exchange*

The long-distance transport of materials is well documented for the Magdalenian (Fig. 5.13). Bahn (1982) has documented a number of imports into Pyrenean sites, including stone from the Perigord region and shells from both the Atlantic and the Mediterranean. Sites in the Perigord also contain both Atlantic and Mediterranean shells, as well as fossils from northern France, Belgium, and possibly the Isle of Man and Isle of Wight (Bahn 1977). The site of Monruz in western Switzerland contains fossils from southern Germany and the Paris Basin (Affolter et al. 1994). Shells from the Mediterranean and fossil shells from the Paris and Mainz Basins appear in sites in Switzerland, southern Germany, and the Rhine Valley. The south German sites also contain shells from the Atlantic. This pattern is also seen in other areas of Magdalenian expansion. Fossil shells from the Paris Basin occur in Belgian

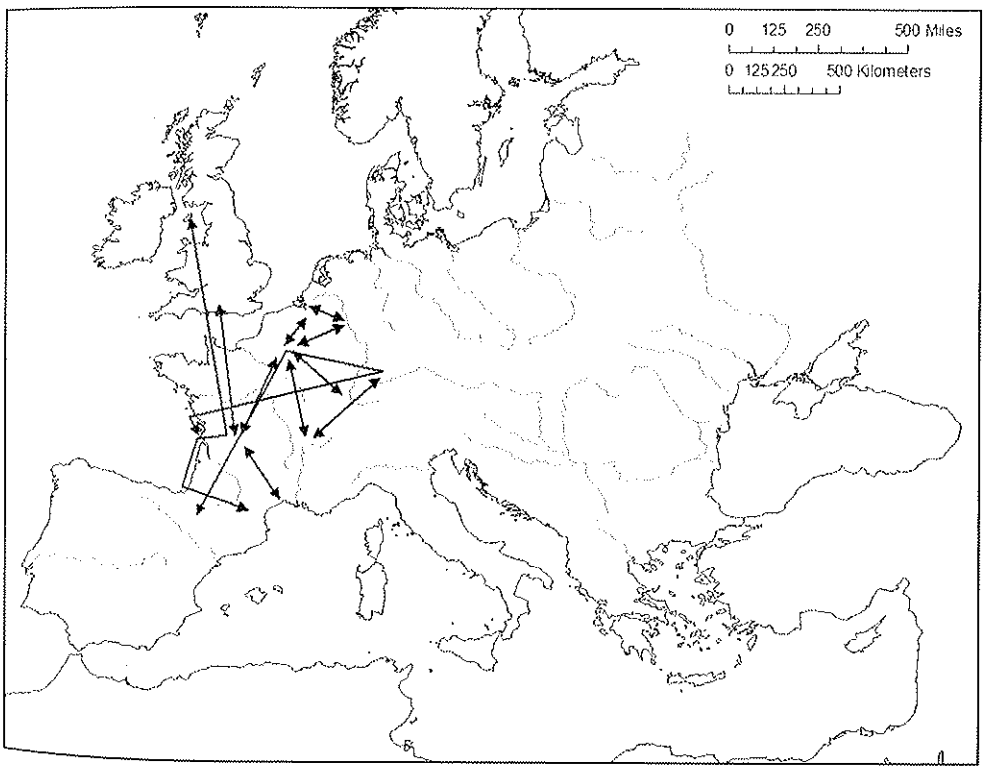


Fig. 5.13 Regional exchange connections of the Magdalenian

sites, and Belgian flint appears in sites in the Rhineland. These patterns suggest a complex web of interconnections across the entire region, linking dispersed groups in social and economic networks. For the Pyrenees, Bahn (1982) has suggested that two of the sites – Isturitz and Mas d'Azil – contain so many imports, as well as portable art objects, that they deserve the title of "supersites." Both sites are huge cave-complexes and river tunnels and both have wall art in addition to the rich archaeological assemblages. He suggests that both may have served as storehouses (for raw materials such as antler and for imports), as meeting places, and as centers for group aggregations and rituals. Other, smaller sites rich in art and imports may have also been scenes of aggregations, forming a chain spaced about every 50 kilometers along the length of the Pyrenees.

## *Magdalenian Portable Art*

Approximately 80% of all known portable art objects from western Europe has been found in Magdalenian sites. Although art was becoming increasingly common during the course of the Upper Paleolithic, the Magdalenian truly represents an explosion of artistic activity. Ornaments were manufactured in profusion, utilitarian tools were decorated with great care, and special art objects were created in abundance. The variety of materials and forms used is enormous. Using bone, animal teeth, imported shells and fossils, and the increasingly scarce mammoth ivory, beads and pendants were made for necklaces and ornaments on clothing. Among the decorated tools are spear throwers intricately carved with three-dimensional figures of animals, bone spatulas with carved designs, and sandstone lamps with engraved geometric decorations on their handles. Other, more enigmatic objects include elaborately carved perforated antler batons, incised antler rods, sculptures and figurines of ivory, clay, bones, and stone, engraved fragments of animal ribs and shoulder blades, intricately decorated and often perforated bone discs, and engraved stone plaquettes.

The two major classes of motifs used in the portable art are animals (including humans) and abstract or geometric designs. Although they are less common than geometrics, the animals are the most striking. Among the designs found on the carved spear throwers, for example, the following animal motifs have been identified:

- A leaping horse
- Two horses
- Horse heads (several examples in France and Switzerland)
- Two fighting ibexes (headless)
- An ibex or fawn defecating, accompanied by birds (10 examples in the Pyrenees)
- A reindeer
- An ibex
- A muskox
- A standing bison
- A galloping bison
- A bison licking its flank
- A mammoth
- A hyena
- Two birds
- Three birds
- Three fish
- A salmon
- Two salmon