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Eudald Carbonell i Roura *Editor*

High Resolution Archaeology and Neanderthal Behavior

Time and Space in Level J of Abric Romaní (Capellades, Spain)

Springer

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Cover illustration: Photographs (from top to bottom) of worked bone, red deer mandible, lithic refitting, *Iberomys cabrerae* molar, and SEM image of butchery use wear, superimposed on a view of level J occupation surface. Photos IPHES.

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Preface

The behavioral strategies of Neanderthals are currently one of the key questions in archeological and paleoanthropological research. There are different reasons for this interest in Neanderthal behavior, related both to the development of empirical studies and the introduction of new theoretical paradigms that have changed the understanding of the material record of prehistoric groups. First, accessing behavior is the only way to approach one of the classic problems of archeological research: the variability of Middle Paleolithic archeological assemblages. The multifactor nature of this variability, closely linked to economic strategies and daily activities, necessarily implies examining the complexity of human behavior as an approach to explaining changes in the characteristics of archeological assemblages. Second, Neanderthal behavior has taken on special importance in the framework of the debate on the nature of the cultural transformations defining the transition from the Middle to the Upper Paleolithic. The behavioral capacities of Neanderthals are a key component in clarifying the scope of differences between this human species and anatomically modern humans, an essential question concerning the evolutionary role of Neanderthals and the way in which we understand their culture.

At the site of Abric Romaní, we have never found skeletal remains attributed to *Homo neanderthalensis*. However, the lithic assemblages from all the archeological levels (except level A, corresponding to the Upper Paleolithic) exhibit methods of flake production and tool manufacture consistent with the technological characteristics traditionally associated with this human species. In addition, the chronology of these layers fits perfectly into the temporal range of the last Neanderthals. Therefore, we have always worked with the hypothesis that the archeological evidence found at this site was abandoned by hominids belonging to this European human species.

The scientific and popular debates about *Homo neanderthalensis* began from the very moment the first Neanderthal remains were discovered in Feldhofer Cave in 1856. Soon after that discovery, the remains were studied and interpreted by renowned members of the scientific community. Some of them suggested that the remains from Feldhofer Cave actually corresponded to a *Homo sapiens* affected by a serious pathology. In the mid nineteenth century creationism was still a common explanation for the appearance of living beings and the existence of human species different from *Homo sapiens* was difficult to accept.

One of the more passionate debates that arose as the number of fossils increased concerned the interaction or hybridization between Neanderthals and modern humans. This debate particularly intensified when new radiometric data began to suggest that the two species coexisted in certain European regions for at least 8 ka. And the controversy was further fuelled by evidence suggesting that previously, about 90 ka ago, Neanderthals and modern humans coexisted in the Near East, coinciding with the first

Homo sapiens migration out of Africa. This is still a crucial scientific debate. In spite of numerous excavations undertaken in Europe, fossils of these two species have never been found together in the same archeological layer. However, the genetic analysis recently published by Svante Pääbo and the Max Planck Institute in Leipzig, in coordination with an extensive team of researchers, found that direct contact did indeed occur between the two species during the Upper Pleistocene. These studies show that non-African *Homo sapiens* share between 1 and 4% of their gene pool with the extinct species.

Another topic traditionally treated in scientific works on Neanderthals concerns the factors involved in their extinction. This debate started at the beginning of the twentieth century and is still alive at the beginning of the twenty-first, and probably constitutes one of the most controversial questions in the paleoanthropological and archeological research about our genus.

Some of the arguments used in these debates throughout the past century emerged from the erroneous interpretation of some of the first Neanderthal fossils, like that found at La Chapelle-aux-Saints. Boule's incorrect reconstruction of this fossil contributed to the distorted view of Neanderthals that was dominant in the scientific and mass-culture arenas during most of the twentieth century. The anatomical characteristics of Neanderthals and the lack of symbolic expressions in the archeological assemblages produced by these hominids were arguments used to suggest that their cognitive and organizational patterns were less complex than those exhibited by modern humans.

However, there is evidence to dispute these inferences. It is true that the skull of *Homo neanderthalensis* was different from that of modern humans, but it had a large cranial volume—larger than that of *Homo sapiens*—which seems at odds with the purported inability of Neanderthals to develop symbolic expression. In the same way, it has also been argued that Neanderthals had some impediments to speech, or at least were incapable of the same level of communication that modern humans are capable of. However, the discovery of several ear bones in the Sima de los Huesos of Atapuerca, dated to 500 ka, has allowed the structure of the auditory area of *Homo heidelbergensis* to be reconstructed. This area is similar to that exhibited by *Homo sapiens*, which indicates that human species older than modern humans were probably capable of speech. Although funerary practices are also controversial, intentional burials have been well documented among European and Near Eastern hominids and provide sound evidence supporting the behavioral complexity of Neanderthals.

We believe that the social complexity of *Homo neanderthalensis* is beyond question considering the growing amount of data derived from archeological inquiry. Well verified information is essential to solving the debates described above. This is the only valid method in scientific endeavor: fieldwork should be done after a consistent hypothesis about behavioral complexity has been posed. Only then can we avoid the speculative loop that has often characterized the scientific inquiry into the social and evolutionary complexity of Neanderthals.

The aim of this monograph is to share the scientific information gained from the large-surface excavations carried out in level J, one of the archeological levels forming the Abric Romaní sequence. We wish to present new information about the behavioral patterns of Neanderthals living in northeastern Iberia 50 ka ago. We would like to contribute to the debate on the degree of complexity and organization characterizing these hominids from the multidisciplinary study of this archeological level. In addition, we think that the data yielded by this level are relevant to some of the big issues related to the emergence, evolution and extinction of *Homo neanderthalensis*. Level J is one of the richest of the sequence, both in the quantity of archeological remains and in its occupation structures.

It has been almost thirty years since our team started the excavations at this site on the banks of the Anoia River. In Spanish archeology, it was already a classic site when

our work began, having been discovered in 1909 and excavated at different times during the twentieth century. Abric Romaní is a rockshelter formed in a 50 m thick tufaceous formation. Sediments accumulated in this rockshelter throughout the Upper Pleistocene until it was totally filled in during MIS 2. At the beginning of the 1980s, we planned an excavation over a surface large enough to yield a paleoethnographic picture of the spatial strategies of Neanderthals. Since then, this large-surface strategy has been a fundamental component of our data recovery process. We are convinced that spatially oriented studies can lend a great deal towards understanding the level of behavioral complexity achieved by Neanderthals during Marine Isotope Stage 3.

The goal of our research is to discover the behaviors of these European hominids at a specific time and in a specific place in order to establish their social and organizational complexity. This is the first step towards a basis for comparison with the complexity and organization of modern humans arriving in Europe 40 ka ago. When fieldwork began we were convinced that through the recovery of reliable data we would be able to determine whether Neanderthals had a complex social structure.

An important characteristic of this study on level J is that most of the contributing researchers have been excavating the Abric Romaní for some time, some of them for over 20 years. This means that their experience is based on praxis and this close empirical knowledge is very useful for a reliable interpretation of the archeological record. They have been a part of the logical sequence made up of the starting hypothesis, excavation, data recovery, study, discussion and, finally, publication of the results.

More than ten archeological levels have been excavated over a surface equivalent to 90% of the total extension of the site. The excavation strategy followed since 1983 has been directed explicitly towards the reconstruction of the behavioral strategies of Neanderthal groups through the excavation of a large surface area, which includes most of the surface occupied originally. This has led to the excavation of an area measuring nearly 300 m^2, undertaken with careful attention to the spatial distribution of the archeological remains and the identification of structures. This has yielded a diachronic perspective on spatial patterns spanning over more than 10 ka, conditioned by the rapid sedimentation rate characterizing the tufa deposits, which increases the temporal resolution of the occupation layers. Thick sterile layers separate these levels, which considerably diminishes the temporal depth of the palimpsests. This is the case of level J, where the excavated surface is approximately 240 m^2.

In addition to tufa formation, other sedimentary processes have played an important role at Abric Romaní. The cyclic events of roof collapse conditioned the occupation of the site by Neanderthals, as the accumulation of blocks in some areas restricted the habitability of the rockshelter as a whole. As we will see in this book, level J is a good example of this.

Another goal of this work has been to place this far-reaching archeological record in a well-defined environmental context. Level J formed during MIS 3, a period characterized by a high climatic instability, during which cold phases alternated with wet and temperate interstadials. Some colleagues have suggested that these climatic conditions played an important role in the population dynamics of Neanderthals and even determined their extinction.

But the natural environment is not the only driving force that should be taken into account. The historical environment is also an essential key to interpreting the archeological record. This historical context is represented by the patterns defining the Middle Paleolithic as a developmental stage in material culture and social organization. Manufacturing of lithic and wood artifacts, provisioning of raw materials, food and fuel, processing and consumption of faunal and plant resources, and spatial organization are behavioral domains partly conditioned by long-term processes that appeared during Middle Pleistocene times.

Animal hunting and processing behaviors provide insight into the complexity of foraging strategies. Classic questions in faunal studies, like the opposition between specialization and diversification, can be clarified through the analysis of bone assemblages. The formation dynamics defined by the alternating occupations of humans and carnivores is another topic of interest that will be considered in the faunal analysis, although Abric Romaní is characterized by the dominant role of humans in the generation of the archeological record.

Among these behavioral patterns, microspatial interactions are particularly important. The role of hearths should be emphasized, as they are highly abundant in all the archeological levels excavated so far, and have allowed us to designate the formation of hearth-related activity areas as one of the essential features of Neanderthal spatial behavior. These areas can be interpreted as household spaces similar to those identified among contemporary hunter-gatherer groups, a comparison that makes it possible to approach the social dynamics of prehistoric groups. From this point of view, hearths were the basic points of reference in the formation of the archeological record. The dimensional and morphological variability of combustion structures shows the complexity of their functional patterns. These structures determined the spatial distribution of the archeological remains and were particularly important as evidence of social relations. From this perspective, the production and use of fire played a primary role in reinforcing human sociability. Level J can therefore be of great value in testing hypotheses concerning the social structure of Neanderthal groups.

The Abric Romaní rockshelter was a point of reference in the landscape that was visited repeatedly, possibly following a cyclical pattern. This temporal dimension is also an essential part of interpreting the archeological record. The central role of human behavior in the interpretation of the archeological record has been linked to a generalization of ethnoarcheological models as an essential referent in the reconstruction of the formation dynamics of assemblages. However, the use of these models to identify behavioral strategies gives rise to various problems, some of which are not always explicitly approached by researchers. One of the more pronounced of these problems is related to the different time scales that define archeological assemblages and ethnoarcheological contexts. Most archeological assemblages are palimpsests of one type or another, whose formation can span periods of hundreds or even thousands of years and to which many natural and cultural processes of very diverse character can have contributed. From this point of view, then, one must question the extent to which ethnographic models, defined by very different time scales, can provide suitable explanations for these assemblages, and whether misconceptions might occur in assemblage interpretations due to differences concerning formation time.

To approach these essential questions in current archeological research, it is necessary to study assemblages whose time scale is as close as possible to the ethnographic time scale, that is to say, to increase to the maximum the temporal resolution of our assemblages. Achieving this goal is not always easy, since the possibility of accessing increasingly higher temporal levels depends partly on the natural formation processes of the deposits and their stratigraphic resolution. Middle Paleolithic assemblages are often difficult to interpret in temporal terms. Most of them are deep palimpsests formed by the accumulation of archeological remains over long periods. Due to these formation processes, identifying spatial patterns is particularly challenging in many Pleistocene sites featuring low sedimentation rates. For this reason, deposits characterized by high-resolution geological formation processes are especially attractive, as they provide stratigraphic levels covering time periods that are considerably shorter compared to other contexts. These types of deposits are especially suitable for a behavioral reading of the archeological record, and the Abric Romaní is one of these deposits.

In spite of the high temporal resolution favored by geological formation dynamics, some data indicate that the level J assemblage corresponds to a palimpsest formed by an

indeterminate number of occupation episodes. The study of level J will be directed to the temporal dissection of this palimpsest, identifying higher resolution assemblages of remains from which it will be possible to access behavioral patterns with a considerable degree of certainty. In this context, the spatial data will be fundamental, since they reveal the dynamics of mobility and artifact transport from which the formation sequence of the archaeological assemblage can be established. The temporal and spatial interpretations will therefore be closely linked.

This spatio-temporal interpretation will be achieved through the information yielded by a wide range of analytic fields that constitute the different chapters of the monograph, including aspects related both to natural formation dynamics (stratigraphy, palaeoenvironment, biostratigraphy, taphonomy, etc.) and human activities (lithic technology, faunal processing, habitat structures, spatial distribution, wood implements, etc.). The last section will discuss whether the spatio-temporal perspective that we propose opens up a new view of Neanderthal behavior, different from that derived from works that do not address the importance of time resolution in the formation of archeological assemblages.

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Tarragona, November 2010 Eudald Carbonell

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Chapter 1
Introduction: Neanderthal Behavior and Temporal Resolution of Archeological Assemblages

Manuel Vaquero

Abstract Neanderthal behavior is currently one of the main topics in paleoanthropological and archeological research. This interest is largely related to the debate about the emergence of modern humans and the extinction of Neanderthals. In this context, some researchers have considered Neanderthal behavior as archaic and essentially different to the "modern behavior" characteristic of *Homo sapiens*. We present in this chapter a general outline of this debate in different domains of the archeological research, from technology and subsistence to spatial patterns. Moreover, we point out that these behavioral issues should be approached by taking into account the temporal nature of the archeological assemblages, since temporal resolution may be a primary factor in interassemblage variability. Due to these time-dependent formation processes, Abric Romaní appears as a site particularly suitable to yield information on Neanderthal behavior.

Keywords Neanderthal behavior • Abric Romaní • Time scales • Settlement patterns

Neanderthal Behavioral Strategies and Middle Paleolithic Variability

The behavioral patterns of ancient hominids are among the main concerns of Paleolithic archeology. Although chronocultural issues also play an important role in research, especially in periods such as the Upper Paleolithic, there seems to be general agreement about the significance of behavioral strategies in the variability of archeological assemblages. Understanding behavior is one of the principal goals of Paleolithic archeologists, but at the same time, behavior has become a key factor in explaining the variability of the archeological record. This interest in behavioral patterns also has clear evolutionary implications, especially if we take into account two related issues. On the one hand, behavior is a basic form of adaptation to natural and social environments, and the Darwinian struggle for survival often takes place in the behavioral realm (Cronk 1991; Krebs and Davies 1991; Smith and Winterhalder 1992; Cronk et al. 2000). On the other hand, behavior is subject to evolutionary forces and the behavioral patterns of current human populations may be understood as the outcome of a long process during which these patterns progressively developed. Paleolithic archeology provides the essential database for insight into this second issue as it is the best means by which to approach the behavioral strategies of hominid populations prior to modern humans.

Among ancient hominids, Neanderthals play a central role in the ongoing debate on the evolution of behavioral capabilities. The behavioral strategies of Neanderthals are currently one of the key questions in paleoanthropological research. Neanderthals were the last of the ancient hominids prior to the worldwide expansion of modern humans, with whom they coexisted during several millennia. This interest in Neanderthal behavior has developed for different reasons related both to the publication of empirical works and to the introduction of new theoretical paradigms that have changed the understanding of the material record of prehistoric groups. First, it is clear that accessing behavior is the only surefire way of approaching one of the classic problems in archeological research: the variability of Middle Paleolithic archeological assemblages. The multifactorial character of this variability, closely tied to economic strategies and daily activities, necessarily implies an approach to the complexity of human behavior as a way of explaining the changes in the characteristics of archeological assemblages. In fact, recent

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explanations of Mousterian variability have emphasized behavioral factors as opposed to classical preconceptions based on a normative sense of culture and the definition of chronocultural entities. Second, Neanderthal behavior has taken on special importance in the framework of the debate on the nature of the cultural transformations that define the passage from the Middle Paleolithic to the Upper Paleolithic. In this context, the behavioral capacities of Neanderthals are a key issue in clarifying the scope of the differences between them and anatomically modern humans, an essential question concerning the evolutionary role of Neanderthals and the manner in which we understand their culture.

It is worth emphasizing, however, that this evolutionary scenario implies some negative consequences for Neanderthals due to the inevitable intertwining of biological and cultural issues. It seems that it is the Neanderthals' fate to be systematically compared with modern humans, or more precisely, with Upper Paleolithic modern humans. In this framework it is not surprising that Neanderthal behavior appears less complex or developed, although we should wonder if such an appraisal is at least partly the result of comparing two successive historical periods. In this respect, it would be an instructive exercise to consider what differences in behavioral capabilities could be inferred by comparing, for instance, Upper Paleolithic and Neolithic material cultures. The archeological differences between these two periods are in some respects more impressive than those found between the Middle and Upper Paleolithic. However, nobody has proposed an explanation in terms of behavioral capabilities for the Neolithic Revolution, surely due to the fact that both Upper Paleolithic and Neolithic populations look anatomically like us.

So, the Neanderthals versus modern humans debate has given rise to two opposing perspectives on Neanderthal behavior. According to some authors, Neanderthals did not have the capabilities required to develop fully modern behavior. This inability would have been related to Neanderthal biological and cognitive patterns, which determined that their mental and linguistic capacities were significantly different from those of modern humans (Klein 1995, 2000; Mellars 1996a, b; Mithen 1994, 1996a, b; Tattersall 1999; Wynn and Coolidge 2004). For example, Mithen argued that the Middle-Upper Paleolithic transition represented the emergence of modern human intelligence, based on the connectivity between different cognitive domains. In general, this conclusion emerges from the comparison between Middle and Upper Paleolithic archeological records and the alleged clear-cut differences that can be observed between them. The adaptive advantages provided by these new behavioral patterns would explain the replacement of Neanderthals by modern humans. Meanwhile, other researchers argue that the behavior inferred from Middle Paleolithic sites exhibits the basic features that characterize modern behavior. They point out that the differences between the Middle and Upper Paleolithic can be attributed to various social, economic and historical causes, but they do not imply any biologically determined behavioral inability of Neanderthals (Hayden 1993; Soffer 1994; d'Errico et al. 1998).

It is important to recognize, however, that from the very start this debate entails a problem that is difficult to resolve: to what extent can we define "modern human behavior"? The human population, both historic and of today, exhibits considerable behavioral variability; variability that makes discovering the features that can be accepted as common to all past and present modern humans no easy task. From an archeological point of view, an operational definition of behavioral modernity should avoid any essentialist concept about human nature and focus on what humans do. As a matter of fact, we are what we do. This is especially important in evaluating arguments based on intellectual or mental capabilities. These capabilities are useful in defining behavioral modernity only if they are expressed in how material activities are performed.

There are different versions of the Neanderthal inability hypothesis, depending on the behavioral domain, although this argument is normally associated with the idea that the emergence of the Upper Paleolithic represented a behavioral revolution—the *human revolution* (Mellars and Stringer 1989). It is considered the great breakthrough in the evolution of humankind, the beginning of culture as we understand it today (Binford 1985) or "the conquest of nature by the spirit" (Otte 1996). Bearing this complete set of behavioral innovations, modern human populations would have had decisive adaptive advantages over local Neanderthal populations, which would ultimately be doomed to extinction due to their inability to successfully compete with the newcomers. Although many Upper Paleolithic features were not exclusively associated with modern humans, as shown by some Chatelperronian assemblages, this has not changed the general terms of this assumption on the behavioral disadvantages of Neanderthal ways of life. Most of these theories are based more or less explicitly on the alleged inability of Neanderthals to develop symbolic behavior. Symbolic expression represented a huge step forward in human evolution and the capacity to use symbols in everyday life would have radical consequences on all human activities, especially on those associated with the production of material culture. The appearance of clear evidence of mobile and parietal art coinciding with the beginning of the Upper Paleolithic is the most conclusive manifestation of this symbolic revolution. As Henshilwood and Marean (2003) pointed out, modern human behavior is defined by the use of symbolism to organize behavior. Several works provide a full account of

this approach (Klein 1995, 2000; Mellars 1996a; Noble and Davidson 1996), which we will only briefly summarize here.

In the first place, if Neanderthals lacked the ability for symbolic behavior, this would be evident in the technological realm; however it is clear that some knapping methods widely represented in Middle Paleolithic assemblages, such as Levallois technology, exhibit high levels of technical complexity, similar to those inferred from Upper Paleolithic technologies. In addition, blade reduction methods, once considered exclusive to Upper Paleolithic technologies, have been well documented in Middle Paleolithic assemblages. However, some clear-cut differences still remain in tool manufacture, and these differences are the main argument of those advocating the Neanderthal cognitive drawback perspective. For instance, it has been pointed out that the Middle Paleolithic toolkit is not standardized and shows little diversity, which some say points to a lack of competence in adapting tool morphology to the function at hand. Middle Paleolithic tools were versatile and therefore less efficient than the specialized artifacts typical of the Upper Paleolithic, which were designed for specific functions. This is especially clear in the manufacture of tools interpreted as comprising part of the hunting gear, such as the wide array of projectile points that appear from the start of the Upper Paleolithic. Among such tools, it is worth highlighting those made from raw materials other than stone, like bone and antler, which contrasts with the scant use of these materials during the Middle Paleolithic. This evidence suggests that hafting technology and the use of composite tools were more developed during the Upper Paleolithic, which may be related to the increased use of hunting techniques based on throwing weapons. Although the use of hafting and throwing spears was probably not unknown in the Middle Paleolithic, it seems clear that it was less systematic and widespread than in the Upper Paleolithic (Shea 2006).

Upper Paleolithic technology shows a higher level of complexity and capacity for innovation (Hoffecker 2005). This would explain the trend of temporal change exhibited by the Upper Paleolithic chronocultural sequence, as well as the clearer pattern of geographical variability in lithic assemblages as opposed to the comparatively diachronous monotony of Middle Paleolithic assemblages. The ultimate explanation for this difference rests on the inability of Neanderthals to give to their tools an imposed form according to well-defined mental templates (Chase 1991). Another consequence of such a cognitive feature would be the lack of symbolic significance in artifact shape and therefore the inability to transmit social and ethnic information through material culture. This temporal and spatial patterning in tool morphology has been interpreted as the first clear evidence of stylistic variability in technology. Stylistic expression in material culture would have been a method of marking social and ethnic boundaries.

Food-procurement strategies also show this specific characteristic of Neanderthal behavior. Two issues have focused the debate on this subject: the role of scavenging in the exploitation of animal resources and the degree of specialization in subsistence patterns. The former issue was put forward by Binford (1985), who suggested that Middle Paleolithic peoples were incapable of hunting large animals due to their low degree of long-range planning and cooperation. The remains of the large animals found at archeological sites would therefore correspond to resources obtained through scavenging. However, Binford's hypothesis has received little support, and many studies of Middle Paleolithic faunal assemblages indicate that hunting was the primary strategy for obtaining large animal carcasses (Chase 1988; Auguste et al. 1998; Marean 1998; Patou-Mathis 2006). In spite of this evidence, it has been suggested that Neanderthal hunting practices would have been less systematic and intensive, exhibiting a lower level of logistical organization (Mellars 1989), related to Neanderthals' inability to make long-term plans. In addition, their communicative flaws would have been a handicap in developing cooperative hunting techniques.

As for the degree of specialization in subsistence patterns, most Middle Paleolithic sites do not exhibit clear evidence of economic specialization, defined as the deliberate selection of a particular species from the animal resources available in the environment, although apparent examples of specialization are not unheard of (Gaudzinski and Roebroeks 2000). This pattern is more common in Upper Paleolithic faunal assemblages (Mellars 1973; Orquera 1984), although such specialization has basically been documented in Late Upper Paleolithic fauna (Chase 1989) and some studies have pointed out that Middle and Early Upper Paleolithic subsistence strategies were not significantly different (Grayson and Delpech 2002, 2003; Adler 2006). As a matter of fact, the faunal changes observed in some regions at the beginning of the Upper Paleolithic show a higher diversification of subsistence strategies, which were particularly characterized by the increasing exploitation of small resources (Aura et al. 2002). In addition, some authors (Kuhn and Stiner 2006; O'Connell 2006) have suggested that diversified patterns enabled more efficient exploitation of the environment, which would have been a key factor in the more successful adaptation of modern humans.

Finally, the lack of symbolic expression among Neanderthals would have also had critical consequences in the social realm (Pettitt 2000). Several different authors (Soffer 1994; Pettitt 2000; Kuhn and Stiner 2006) propose that Neanderthal society would have differed from modern patterns of social organization—as defined, for example,

by Rodseth et al. (1992)—on several different levels, from gender relationships and the division of economic activities between the sexes to group structure and the formation of regional networks. Based on the spatial distribution of the remains at Combe Grenal, Binford suggested that Neanderthal social structure was characterized by a separation between males and females, who formed separate foraging units and got together only during mating periods (cited in Mellars 1992, pp. 357–359). This pattern would be radically different from that characteristic of present-day human groups, which is based on household units formed by the permanent relationship between pairs of males and females. Other researchers (Soffer 1994; Kuhn and Stiner 2006) have also pointed out a gender-related difference between Neanderthals and modern humans, but in the opposite direction. They argue that the Middle Paleolithic record does not show the sexual division of labor characterizing modern hunter-gatherer societies. Male and female roles would have been similar in Neanderthal groups and their economy would therefore be less efficient, since the division of activities according to sex allows the subsistence pattern to be more diversified and, as a consequence, less fragile in periods of resource stress.

Regardless of their cognitive significance, the virtual absence of personal ornaments and grave offerings associated with human burials during the Middle Paleolithic indicates that Neanderthal communities were characterized by scant social differentiation in terms of gender, age or status. According to Zilhao (2002), Middle Paleolithic burials do not show a differential treatment of individuals by age classes, which suggests that developmental stages did not have social significance in Neanderthal society, or at least such significance was not expressed in material cultural and funerary practices. One of the most extreme statements about the non-modern character of Neanderthal society can be found again in the work of Pettitt (2000), who points out that age thresholds were simply determined by the physical achievements of individuals, in the context of a lifecycle defined as "nasty, brutish and short". Under this assumption, biology would have been more important than culture in the constitution of Neanderthal society.

Large-scale social interactions and the formation of large social or ethnic units would have been another change caused by the enhanced communicative abilities of modern people. The density of Neanderthal populations would have been low and they would have organized themselves into small social units, both at local and regional levels. The lack of an extended network of information exchange would have had particularly negative effects during periods of environmental decline characterized by an increase in resource stress. According to Finlayson (2004), the fragmentation of Neanderthal populations in the context of the climatic instability of MIS 3 was the ultimate cause of their extinction. The appearance of symbolically mediated forms of communication would have allowed the formation of alliances and kinship relationships over large territories. This would have permitted a more effective adaptation to high-risk environments defined by an unpredictable and unreliable distribution of resources. Neanderthal bands would have been unable to establish social bonds and, as a consequence, band size would be smaller.

However, in order to discuss these questions related to social structure we first need an approach to spatial behavior. In this book we pay special attention to behavioral strategies related to settlement and spatial organization. Spatial behavior, both at the regional and the intrasite levels, is closely linked to social structure and is a good approach to understanding aspects like group size, occupation type, site function, specialization of activity areas, mobility patterns, social relationships, etc. Furthermore, these issues are central to any understanding of archeological assemblage variability. There is no doubt that Neanderthals regularly used caves and rockshelters as occupation or activity sites, although open-air settlements are certainly underrepresented in the Middle Paleolithic record due to the traditional focus of research on cave and rockshelter sites. Nevertheless, some data indicate that the use of these locations was somewhat different to that inferred from the Upper Paleolithic record. The alternating use of cave and rockshelters by humans and carnivores was common during the Middle Paleolithic. Mixed assemblages derived from this alternation form a well-documented archeological context (Brugal and Jaubert 1991). It seems that this scenario changed with the appearance of the Upper Paleolithic, in which human impact was clearly dominant, and carnivore activity—especially that associated with large carnivores—showed a significant decline. This change could be attributed to more intense or longer occupations during the Upper Paleolithic, which may indicate that caves and rockshelters were more commonly used for residential purposes. As mentioned earlier, it has also been argued that modern humans had an enhanced capacity to settle in harsh environments at high latitudes and high-mountain areas that were scarcely visited by Neanderthals (Mellars 1989; Gamble 1994). This would have also been related to the use of symbolism to construct social and regional networks for sharing information and resources, which would be essential to successful adaptation in such high-risk environments. In any case, settlement patterns are fundamental in reconstructing the cultural processes responsible for the formation of the archeological assemblage and many studies have recently suggested that these patterns are a primary factor in Middle Paleolithic interassemblage variability (Henry 1992; Kuhn 1995; Marks and Chabai 2001; Richter 2001; Bolus 2004; Depaepe 2004; Soressi 2004; Burke 2006; Wallace and Shea 2006).

When we talk about settlement patterns we are basically dealing with two interrelated issues: mobility patterns and types of sites. As for the former, it seems clear that mobility plays an essential role in the hunter-gatherer way of life and we can presume that it conditioned many aspects of Neanderthal behavior. In general, mobility patterns can be characterized by means of various distinct features, such as the distance traveled in each movement, the total distance covered during an annual cycle, the number of moves, and the character of the movement—residential or logistical (Kelly 1983). With regard to the latter, site variability can be analyzed on two levels: site type or function, and occupation type, that is, length of occupation and group size. Site function basically means differentiating between residential and non-residential sites. This is a particularly important issue, especially if we take into account the social relevance of concepts such as the residential campsite, because such campsites can be interpreted as social spaces based on interpersonal communication and food-sharing. The functional variability of sites is therefore a key issue to understanding the spatial behavior of Neanderthals, and the archeological criteria that might provide insight into that variability are particularly significant.

Residential sites have been defined as "…the locus out of which foraging parties originate and where most processing, manufacturing and maintenance activities take place" (Binford 1980, p. 9). They are where the family units that make up the band live and where resources gathered in the foraging territory are brought back to. The home base is the basic type of site in hunter-gatherer settlement patterns. Nevertheless, finding residential sites in archeological contexts poses serious challenges derived from the temporal dimension of archeological assemblages. Many of the criteria used to identify such sites are also employed to infer occupation length, which will be discussed in further detail later on in this work. However, now is a good time to emphasize one such criterion. In ethnographic contexts, residential sites are always characterized by the role played by hearths as the focal points of their spatial organization. Hearths are an essential characteristic of the household areas that define residential campsites, and most activities are carried out around them. From this point of view, identifying combustion structures in archeological sites seems to be a strong basis for characterizing them as residential campsites. The fact that hearths are commonly found in Middle Paleolithic sites suggests that residential locations were an important component of Neanderthal settlement patterns.

In addition to these residential sites, special activity sites complete the range of functional variability in settlement strategies. As we have seen, the specialization concept has frequently come up in discussions about the emergence of modern human behaviors. The manufacture of functionally specialized tools and subsistence strategies specializing in certain resources have been considered indicators of modern behavioral competences. The search for specialized sites is a common theme in research on settlement patterns. Among these sites, those devoted to lithic raw material provisioning (stone quarry sites) and the first processing of animal resources (kill sites or hunting camps) are the most commonly identified in the Middle Paleolithic record. The former were places in which lithic resources were extracted and initially worked. They are defined by the almost exclusive presence of lithic remains corresponding to the first stages of the reduction sequence and are normally located close to raw material outcrops (Geneste 1985; Turq 1992). In the latter, bone remains are overwhelmingly dominant and lithic remains are mainly represented by selected tools used in butchering activities (Chase 1989; Farizy and David 1992; Costamagno et al. 2006). When carcasses were obtained through hunting, the bones remaining at the kill site correspond mainly to the less useful parts of the animal, since the richest anatomical portions would have been brought back to the residential camp.

Beyond the functional differences between residential sites and special-purpose sites, a second level of variability concerns the differences than can be found between residential occupations. This topic is particularly difficult to approach, as the two features that define this variability—occupation length and group size—are especially elusive to archeological inquiry. In recent years, several Middle Paleolithic assemblages have been attributed to short-term occupations characterized by a limited number of activities (Roebroeks 1986; Geneste 1988; Deloze et al. 1994; Defleur and Cregut-Bonnoure 1995; Conard and Adler 1997; Martínez Moreno et al. 2004; Vallverdú et al. 2005). In some cases, intrasite spatial information indicates that occupation events took place in restricted and very limited areas, with no evidence of links between different activity areas. Based on these data, some authors (Mellars 1996a, b; Kolen 1999) argue that Neanderthal settlements as a whole are characterized by the ephemeral occupations of small groups, unlike modern humans who exhibit higher settlement variability, including long-term residential camps. However, we should wonder if this proliferation of short-term occupations is an artifact of the resolution problems affecting archeological interpretation. Small assemblages corresponding to short events are easier to interpret in settlement terms than the huge accumulations derived from long-term occupations, which are difficult to differentiate from occupational palimpsests. We will come back to this subject in the next section.

Differences in occupation length and/or group size have frequently been used to explain the variability of archeological assemblages. In general, studies on Middle

Paleolithic settlement patterns have been more or less explicitly influenced by hunter-gatherer ethnoarcheology. In this respect, it is important to bear in mind the role played by the forager/collector distinction proposed by Binford (1980) and the different mobility patterns—residential and logistical—associated with these settlement strategies. Research on modern hunter-gatherers shows that some campsites are characterized by long stays and are occupied for several weeks or months, while others are used for considerably shorter occupations of only a few days or even hours. In the annual cycle, these differences were associated with the aggregation/segregation dynamics typical of hunter-gatherer bands, which ultimately depended on changes in the distribution and availability of resources. In this context, several authors have argued that some Middle Paleolithic assemblages would correspond to long-term occupations. For example, a radial settlement pattern based on seasonal or multi-seasonal base camps was proposed for the Middle Paleolithic of the Near East (Marks and Freidel 1977; Coinman et al. 1986; Lieberman 1993). By the same token, Henry (1992) pointed out that settlement in Southern Jordan included two different types of sites: transitory camps occupied by small groups and longer encampments. Lithic assemblages would be different at these site types, since ephemeral camps show an emphasis on tool manufacture and maintenance, while the full range of lithic processing activities were carried out at long-term sites.

This kind of settlement patterning has also been suggested for the European Middle Paleolithic. For example, Richter (2006) suggested that Middle Paleolithic settlement in Germany was characterized by a seasonal pattern based on a dichotomy between mountain areas and plains. The plain sites would correspond to autumn–winter camps and would have been occupied by larger human groups for extended periods. On the other hand, spring and summer campsites would be located in mountain areas and correspond to ephemeral occupations by small groups. For the Middle Paleolithic of Crimea, Marks and Chabai (2001) also proposed that variability in settlement strategies was defined by different types of sites largely characterized according to occupation length: ephemeral kill/butchery loci, ephemeral camps, short-term camps and base camps. In general, several settlement models have incorporated the coexistence of short-term and long-term campsites in the European Middle Paleolithic (Peresani 2001; Rolland 2001; Tillet 2001; Depaepe 2004; Moncel 2004). Meanwhile, other studies have stressed the absence of long-term residential sites in some regions (Conard 2001).

Settlement patterns have particularly been used to explain the variability of Middle Paleolithic lithic assemblages. Dibble and Rolland suggested that denticulate-rich assemblages would have resulted from the lower occupation intensities characteristic of milder conditions, while the assemblages dominated by highly reduced sidescrapers would correspond to longer residences more common in colder periods (Rolland and Dibble 1990; Dibble and Rolland 1992). Settlement dynamics might also explain the differences between types A and B of Mousterian of Acheulian Tradition (Soressi 2004) or between the Mousterian and the Micoquian in Central Europe (Richter 2001). Other authors have also pointed out the effects of mobility patterns on retouched tool inventories (Geneste 1988; Meignen 1988) and core reduction strategies (Kuhn 1995; Wallace and Shea 2006).

However, these approaches to archeological variability pose a far-reaching problem: how to identify different occupation types through the archeological record. Too often settlement dynamics are used to explain assemblage variability, but rarely have independent criteria for determining occupation type been proposed. It has been pointed out (Burke 2006) that trying to correlate ethnographically derived site typologies to archeological contexts is unrealistic and that a distinction should only be made between residential and non-residential locations. As we will discuss more thoroughly in the next section, these problems are derived from the temporal resolution of archeological assemblages and, as a consequence, the difficulties in differentiating between single occupations and palimpsests (Roebroeks 1988; Vermeersch 2001). For example, it seems clear that the quantity of remains, once used to infer occupation length, cannot actually be considered a valid criterion, especially for identifying long-term campsites. Small assemblages can be confidently attributed to short-term occupations, but the opposite cannot be assumed, since large assemblages may also be the product of multiple short events that took place over a long time span. Therefore, it is worth discussing other criteria that have been proposed both to identify residential locations and to measure occupation length. Among such criteria we emphasize the following:

- Origin of lithic raw materials. Raw materials coming from the vicinity of the site would be more intensively exploited as occupation length increased. On the other hand, short-term camps would correspond to contexts of higher mobility and would show higher percentages of exotic raw materials (Richter 2006).
- Proportion of certain artifact classes. Richter (2006) has suggested that denticulates were tools for daily use and their absolute number would reflect occupation time. However, this is at odds with the hypothesis that longer occupations are characterized by more intense use of lithic raw materials, therefore leading to the presence of higher percentages of heavily reduced artifacts, such as some types of sidescrapers.
- Diversity of activities. Residential locations are defined by the performance of a wide range of activities, including the processing and cooking of animal and plant

resources, and the manufacture and maintenance of tools. As occupation length increased, it would become more and more likely that new activities would be carried out at the site.

- Evidence of fire making. As previously discussed, residential locations are defined by the occurrence of household areas that are organized around hearths. The size and thickness of burnt deposits can be considered evidence of combustion intensity and, therefore, occupation length. For example, the thick ashy deposits associated with the combustion structures of Kebara would suggest that this site functioned as a home base during the Middle Paleolithic (Meignen et al. 1998).
- Site structure. Ethnoarcheological evidence indicates that the structure of a hunter-gatherer campsite is characterized by the coexistence of different household areas, each of them associated with at least one hearth-related accumulation of remains. In addition, some spatial features, like secondary refuse areas, tend to be better defined as occupation length increases. Identifying dumping sites is therefore a good indicator of long-term occupations.
- Transport of animal resources. Food sharing is a basic component of the definition of a residential campsite. Carrying animal carcasses back to the site—especially the nutritionally richer parts—is characteristic of residential sites, as opposed to the special-purpose sites from which these resources are removed.
- Contribution of carnivores to the faunal assemblage. Evidence of carnivore activity would be scarce in assemblages derived from long-term occupation sites, in which most faunal remains would correspond to human agency. Moreover, extended occupation can protect bones against carnivore scavenging, since there is more time for bones to lose their appeal (Yellen 1991, p. 186). The percentage of bones showing carnivore damage would therefore decrease as occupation length increased.

These criteria will be examined very closely in this book. We will analyze whether they are free from the effects derived from palimpsest formation and can be considered good approaches to determining occupation type or if they are inevitably flawed by the low temporal resolution of archeological assemblages. One of our goals is to establish whether, beyond the identification of residential sites, differences in occupation length or group size can be realistically ascertained.

As stated above, the discussion of settlement patterns is closely related to spatial analyses at the intrasite level. Some authors have argued that specificity of Neanderthal behavior would also be evident at the intrasite level, since the spatial layout of individual campsites would not show the traits that define a "modern use of space". According to Mellars (1996), the spatial patterns documented in some Middle Paleolithic sites are simply a pragmatic response to functional requirements such as the quest for greater comfort or the need for fire in resource processing, but they do not exhibit a deeper cognitive or conceptual structure in the organization of activities. Deliberate living structures are clearer in the Upper Paleolithic, showing a preconceived form that Middle Paleolithic spatial structures lack. It has also been argued that Neanderthal bands would have been smaller and their sites would have therefore been less extensive and complex, although it should be stressed that camp size is a feature that is particularly difficult to determine using archeological data. Similarly, Wadley (2001, 2004) claimed that behaviorally modern humans used space symbolically for social purposes, arranging themselves in social groupings based on kinship, gender, age, status or skill. The distribution of remains in Middle Paleolithic sites exhibits an unstructured pattern, while Upper Paleolithic settlements are characterized by recurring patterns of spatial organization, including the appearance of specific activity areas, the clustering of activities around hearths and the segregation of refuse middens. The most extreme version of this position was expressed by Pettitt (1997), who argued that Middle Paleolithic humans were characterized by the repetition of a single model, showing a simple organization similar to that observed among non-human carnivores. Under this hypothesis, the spatial distributions observed in some sites would be explained by site constraints and biomechanics.

Kolen (1999) proposed the term "centrifugal living structure" for the spatial structures left behind by Middle Paleolithic humans. Although in some ways these structures share features with nest building in primate societies, they are different from primate nests in other aspects, and they are different from modern human dwellings. Middle Paleolithic structures would describe fluid life histories characterized by continuous use, reuse and centrifugal cleaning—changing continuously and demonstrating an emphasis on process and flexibility. They were never "finished" in the sense of modern structures, which were defined by well-planned and goal-oriented trajectories and showed well-demarcated episodes of production, use and abandonment. In addition, these "centrifugal living structures" would correspond to small-scale occupations by individuals or small groups. This would indicate an ephemeral use of space that would be at odds with the characterization of Neanderthal sites as home bases defined by long periods of occupation. In short, Kolen pointed out that Neanderthals' use of space was "situational" in character, since they "… didn't bother a lot about places and environmental conditions when they were not actually there" (Kolen 1999, p. 161). This would be far from the symbolic and mythical links established between modern humans and places.

However, some traits used to define "modern spatial behavior" do not seem to be supported by available ethnoarcheological information. In fact, terms such as "pragmatic" or "situational" used to characterize Neanderthal spatial behavior seem particularly suitable for defining the spatial patterns of modern hunter-gatherers. If specific activity areas are considered a hallmark of spatial modernity, most ethnographically documented hunter-gatherer groups should be characterized as behaviorally archaic. According to the data provided by several authors (Yellen 1977; O'Connell 1987; O'Connell et al. 1991; Fisher and Strickland 1991; Jones 1993) about the spatial patterning in hunter-gatherer camps, most activities are carried out around hearths in household areas. Food processing and consumption and manufacturing activities take place in these multifunctional areas. Only certain activities that require a lot of space or are particularly messy tend to be located outside the household area, in special activity areas. For example, O'Connell (1987, pp. 83–84) distinguished between four types of such areas in Alyawara campsites: shady spots, roasting pits, auto repair stations and defecation areas. It therefore seems clear that the spatial segregation of activities is not a systematic feature in modern hunter-gatherer camps, especially in those with a forager settlement system. In addition, the activities carried out in the special activity areas tend to produce a limited amount of debris and the archeological visibility of these areas is therefore highly dependent on occupation length. Evidence of special activity areas would hardly be apparent in short-term camps.

In addition, clustering activities around household hearths tends to create the undifferentiated 'smudge' of food and manufacturing remains considered by Wadley as typical of non-modern spatial patterning. Remains from different activities lie together in these multifunctional areas, forming the main archeological accumulations in the campsite layout. This patterning is modified by refuse disposal strategies, which tend to segregate remains according to size. Small remains tend to remain in the activity area, while large remains are most commonly discarded outwards (Binford 1978; Hayden and Cannon 1983; O'Connell 1987). This occurs because large remains are more likely to hinder future activities, whereas small items are less disturbing and tend to be quickly buried. Moreover, size sorting is strengthened by post-depositional processes, both of natural and human origin, which also tend to separate remains by size. Because of these intentional and unintentional processes, spatial associations depend more on the size of the remains than on their use context. Remains generated during the same activity may be spatially segregated, while items of similar size from different activities may be found together in the archeological record. If we take into account the ethnoarcheological evidence, it seems that a "pragmatic" consideration such as the hindrance factor plays a more important role in the spatial distribution of remains than the symbolic or mythical significance of places. Human behavior is pragmatic and situational in nature, so these concepts can hardly be used to characterize Neanderthal spatial patterns as archaic.

However, ethnoarcheological research also indicates that occupation length is one of the principal factors affecting archeological spatial patterning. In the first place, some patterns tend to be more archeologically visible as occupation length increases and there is a spatial redundancy in the use of certain areas. This is not only the case of the abovementioned special activity areas, but also of secondary refuse areas. Secondly, increasing occupation periods may lead to changes in camp structure, especially in contexts of a marked reduction in mobility or sedentism. A reduction in residential mobility brings about an increase in the number of site types, and campsites tend to be more complex (Hitchcock 1987). Specific activity areas are more common than in mobile situations and, more importantly, some activities previously carried out in the multifunctional hearth-related area, like cooking, may be spatially segregated. Secondary dumping areas are particularly well defined and refuse disposal is also more complex, with the appearance of specialized or organized dumps in which different types of remains are located separately. In addition, spatial differentiation according to age, gender or social status is more common, which tends to strengthen the symbolic significance of the space. As we have seen, some of the characteristics derived from the increase in occupation length, like the proliferation of special activity areas or the differentiation of space according to symbolic and social categories, are among those used to define "modern spatial behavior". The relationship of these features with occupation length suggests that they have no cognitive implications.

As in settlement patterns, time is again an essential factor in behavioral variability. Spatial behavior, both at the regional and intrasite levels, largely depends on temporal dynamics. Therefore, attempting to understand such behavior without taking time into account is a near to impossible undertaking. However, we need to ask ourselves whether these temporal dynamics are accessible through archeological inquiry. When we ask about short-term or long-term occupations, we are posing these questions in terms of a fine-grained ethnographic time scale, but the evidence available to answer them—the archeological assemblages—is normally constructed from a coarse-grained geological time scale: that associated with the formation of archeological layers. In this book we will try to provide some insight into the consequences of this temporal discrepancy on the knowledge of ancient behavioral strategies.

Temporal Resolution of Assemblages and Ethnographic Interpretations

Today, any approach to Neanderthal behavior must take into account the methodological questions associated with the interpretation of the archeological record in behavioral terms. As mentioned above, the central role of human behavior in Paleolithic archeology has been linked to a generalization of ethnoarcheological models as an essential referent in the reconstruction of the formation dynamics of assemblages. Hunter-gatherer ethnoarcheological research has provided most of the middle-range theories needed to achieve the systemic reconstruction of prehistoric ways of life. The archeological literature of the last 40 years is replete with hunter-gatherer studies that have played a central role in archeological debates about practically all the behavioral domains cited in the previous paragraph. Ethnoarcheological studies devoted to the most systemic levels of behavior, like settlement strategies or intrasite spatial patterns, have been especially influential among the archeological audience.

Nevertheless, the use of these models in identifying behavioral strategies gives rise to several problems, some of which are not always explicitly approached by researchers. Among these problems, of particular interest are the different time scales defining archeological assemblages and ethnoarcheological contexts. This lack of temporal correspondence is the central argument in the "Pompeii premise" debate (Binford 1981, 1986; Schiffer 1985). According to Binford, archeological time represents a different order of reality from that of a living community, and reconstructing phenomena pertaining to ethnographic time would be an illusory endeavor. Moreover, the temporal pace of change shown by the archeological record is much slower than that perceived in an ethnographic context. Binford's archeological time is basically characterized by processes occurring over long intervals. However, it has been pointed out (Lucas 2005, p. 47) that Binford's characterization of ethnographic time is misleading, since ethnographic context is multitemporal and it is also enveloped in deep time scales. Regardless of the accuracy of this critique, it seems clear today that there is not simply one archeological time scale.

Archeology is particularly well-suited to approaching different temporal scales. Theoretical developments on this subject have recently been emphasized in connection with discussions about the validity in archeology of the time scale system proposed by the *Annales* school and the three scales distinguished by Braudel (1949) in historical time: the long term of environmentally determined dynamics, the medium term of social and economic structures, and the short term of events or individuals. According to the *Annales* theory, these time scales are characterized by different rates of change. Long-term processes have traditionally been a favorite subject of research due to the temporal depth of archeological evidence (Bailey 1983, 2007; Bintliff 1991; Knapp 1992; Smith 1992; Lucas 2005). The shortest temporal scale, that of the single action, is also easily accessible through archeological inquiry, since any artifact found in an assemblage can be interpreted as the outcome of a specific action or event. However, the temporal scale corresponding to "ethnographic time" is particularly difficult to isolate through the archeological method. Ethnoarcheological studies are normally carried out during short time spans made up of days, weeks or months. This "quick time" is especially evident in studies approaching spatial patterns, both at the regional and intrasite levels, which are based on the concept of "occupation", that is, the uninterrupted stay at the same site by a single human group. Although short-term events are visible in the archeological record, and long-term processes are also implicit in ethnographic contexts, there are differences between ethnographic and archeological time in terms of accessibility to the intermediate timescale or "occupation" time.

This difference between ethnographic and archeological time is even more conclusive if we consider the criteria normally used to create the archeological assemblages from which behavioral patterns are inferred. In general, assemblages are defined according to a geological time scale. All the remains found in the same stratigraphical unit are included in the same assemblage. The slow sedimentation rates dominant in most archeological deposits, together with the reduction of the sedimentary volumes caused by some post-depositional processes (Brochier 1999), make the recovery of occupation floors, especially in cave and rockshelter sites, extremely unlikely. It seems clear that practically all archeological assemblages are palimpsests of one type or another, the formation of which can span periods of hundreds or even thousands of years and to which many natural and cultural processes of a very diverse character may have contributed (Bailey 2007). The succession of different events has even been documented in archeological assemblages traditionally characterized by their high temporal resolution (Julien et al. 1992; Ketterer et al. 2004). Although the discovery of archeological horizons formed by a single occupation cannot be ruled out, it seems highly unlikely in most contexts, particularly at sites that were repeatedly occupied over time. From this perspective, one cannot help but wonder to what point the use of ethnographic models, defined by very different time scales, are suitable for explaining these assemblages and what misconceptions might be introduced in assemblage interpretation by differences concerning formation time. According to some authors (Smith 1992; Lake 1996; Murray 2002), the disjunction between ethnographic models and the low temporal resolution of many archeological assemblages can make ethnographically derived

interpretations problematic. According to Murray (1993), archeological theories must pay more attention to the nature of their own data, rather than relying on ethnographic information.

We should also ask ourselves which time scale provides the most suitable approach to understanding human behavior. There are reasons to believe that the shortest time scale—the event—is the best suited for making behavioral inferences (Brooks 1982). The deposition and characteristics of material remains depend on decisions made by individuals at specific times and places with the aim of solving specific needs. Stratigraphically defined archeological assemblages are simply the sum of an unknown number of such decisions. In fact, decision-making by individuals may be considered one of the main causes of human adaptation and, therefore, of cultural variability. An ideal explanation of an archeological assemblage would be one that accounts for each of the activity events that contributed to its formation.

Moreover, it seems clear that assemblage formation length can be an important factor in assemblage variability and it should therefore be considered in interassemblage comparisons. If an assemblage was formed over a long period, it would be more likely that different activities would be carried out at the site, including some relatively uncommon ones. The variability of an assemblage would therefore increase as the formation period of that assemblage increased. Interpreting archeological assemblages as the product of a sequence of different events raises other interesting implications. One of them concerns the search for internal coherence that characterizes many archeological explanations. Many times the whole assemblage is explained as the product of the same behavior, since it is assumed that the same constraints conditioned all the events represented in the assemblage. However, this is an unwarranted assumption as there may have been significant differences concerning the contexts, circumstances, needs, and constraints affecting those events. From this point of view, it seems unlikely that the entire assemblage could be explained by the same factors. In fact, it would be possible to find contradictory behaviors—for example, economizing and uneconomizing behaviors—represented in the same assemblage.

This problem becomes particularly evident if we analyze how the variability of an archeological assemblage can be interpreted. The behavioral variability attested to by an archeological assemblage can be considered as an expression of the different options available for humans during the period in which the assemblage was formed. In this sense, the variability of assemblages can be correlated to the variability of human behavior at a point in time. However, this same assemblage variability can be alternatively interpreted as the temporal succession of different behaviors during the assemblage formation period. In this case, there would be no correspondence between assemblage variability and behavioral variability, since the former would be the result of a pooling together of different behavioral moments. For example, we can imagine a faunal assemblage formed by different animal species. According to the synchronous interpretation, this diversity of taxa would show a wide range economy in which humans exploited the different resources available in the surroundings of the site. However, if each resource is associated with a specific temporal event, the behavioral interpretation might be completely different, since each one of these events would show a specialized behavior focused on a given resource. The sum of different specialized events can produce a diversified assemblage.

A palimpsest may be formed by the succession of natural and cultural events, sometimes creating particularly equivocal associations (c.f. Byers 2002). Recovery of faunal remains from carnivore activity or other natural processes together with evidence of human occupations is relatively common in Paleolithic sites. Taphonomic analysis can be particularly informative about the sequence of natural modifications that has affected an archeological assemblage (López González et al. 2006). However, in this book we will focus on cultural palimpsests. Some studies have pointed out that the interpretation of such palimpsests can be flawed by serious misconceptions derived from putting together events of a different character. These misconceptions can affect domains that are crucial to understanding the behavioral strategies of prehistoric hunter-gatherers, such as provisioning strategies, diet breadth or carcass transport. For example, Grayson and Delpech (1998) argued that diet breadths inferred from archeological assemblages reflect the addition of an uncontrolled number of collecting events distributed over an uncontrolled period of time, and they are therefore not comparable to diet breadths measured from ethnographic data. Certain variables, like the number of taxa, seem particularly sensitive to differences in the amount of time represented in the faunal assemblage. This disagreement between ethnographic and archeological data was also pointed out by Monahan (1998) in analyzing Hadza carcass transport. Variability in the patterns of carcass field processing and transport can be fully ascertained when each transport event is observed individually. On the other hand, this variability is masked when all the faunal remains from these events are aggregated in a single assemblage. It seems clear that time averaging could mask significant differences in resource exploitation patterns, as also shown by Lyman (2003), who argues that we should establish the temporal scale of archeological assemblages and ask questions relating to that scale.

The consequences of time averaging can also lead to serious misconceptions in the interpretation of lithic assemblages, since it tends to reduce the behavioral variability of the events responsible for their formation. If the

assemblage is considered as a whole, without discerning each specific technical event, it may be characterized by the events producing the highest number of remains, although these events may have been the least common and therefore the least significant from a behavioral point of view. In addition, grouping all the activity episodes together gives rise to a mixed assemblage that may not correspond to any of the events actually performed. For example, cores can be introduced into the sites at different stages of the reduction sequence. If we put together the artifacts coming from those different stages, we will get an assemblage suggesting that the reduction sequences were entirely carried out at the site, since all the products are present—cortical products, small and large flakes, and cores. In fact, the case may be that no entire sequence was represented and what are left are only different parts of sequences. The entire reduction sequence picture would be an illusion created by grouping together different segments of sequences.

Therefore, approaches to subsistence and technological behavior can be seriously conditioned by time averaging, but its consequences are especially apparent in spatial analyses, both at the regional and the intrasite level. As discussed in the previous paragraph, research on these domains has been highly influenced by the use of ethnoarcheological data and, as a consequence, it is particularly sensitive to the differences between ethnographic time and archeological time. Ethnoarcheological approaches to settlement patterns are highly dependent on temporal dynamics, since occupation length is a main factor in site typologies and spatial organization. However, inferences about this ethnographic time can be seriously flawed by a lack of correspondence with archeological time. As for subsistence strategies and technical activities, we should consider the extent to which occupation type and the intrasite spatial patterns inferred from palimpsests can be biased by time averaging. A spatial analysis should not be exclusively spatial, it should be also temporal. Temporal relationships between remains must be analyzed in order to test whether distribution patterns really correspond to the organization strategies of ancient humans, or if they are conditioned by the temporal dynamics of assemblage formation. This link between space and time is strengthened by the fact that spatial data are basic to obtaining information about temporal dynamics. As we will see in level J, the spatial distribution and directionality of refits and the differential scatter of remains produced in the same activity episode can provide information about the temporal ordering of different events. We will discuss this subject at length in the conclusions of this book.

In order to approach these key questions through current archeological research it is necessary to rely on assemblages whose time scale is as close as possible to the ethnographic time scale, in order to increase the temporal resolution of assemblages as much as possible. Achieving this goal is not always easy, since the possibility of accessing increasingly higher temporal levels depends on several factors, some of them not easily accessible through archeological research. It depends partly on the natural formation processes of the deposits and their stratigraphic resolution. The temporal resolution of stratigraphic units is highly conditioned by sedimentation rates. This makes deposits characterized by rapid sedimentary rates especially attractive because they provide stratigraphic levels with time spans that are markedly shorter than in other contexts. Moreover, the temporal resolution of assemblages is also conditioned by the occupation redundancy of human groups. As the frequency of occupation increases, it becomes more difficult to isolate assemblages of high temporal resolution. Therefore, in deposits characterized by rapid sedimentary rates, a low occupation redundancy would be especially suitable for attempting a behavioral reading of the archeological record.

At first glance, Abric Romaní (Capellades, Spain) is one of these deposits. On the one hand, its stratigraphic sequence, dated between 70 and 40 ka, is characterized by the dominance of travertine formation dynamics. This is a particularly rapid formation process—the sedimentary rate has been calculated at 0.46 mm/yr (Bischoff et al. 1988), which has produced archeological levels of high temporal resolution. This can be seen, for example, in the paleoenvironmental sequence derived from pollen analysis (Burjachs and Julià 1994), which is more detailed than those obtained at most archeological sites. Because of the high sedimentary rate, the archeological levels took less time to form and include fewer occupation events than in other sedimentary contexts. Human occupations were notably discontinuous, since the rockshelter was not habitable during the travertine formation periods. Thick, sterile layers separate the levels, which considerably diminish the temporal depth of the palimpsests. As a matter of fact, the Abric Romaní sequence can be considered a natural sequence punctuated by short periods of human occupation. Archeological layers are vertically well delimited and the mixing of elements from different layers is unlikely.

On the other hand, some data suggest that the archeological levels are characterized by relatively limited occupation redundancy. Compared with the huge accumulations found at other sites, these levels have yielded a relatively low density of remains. For example, the density of lithic remains larger than 1 cm is less than 5 in most archeological levels: 1.3 artifacts/m^2 in level H. Even the levels with the highest densities—levels E and J—do not reach 25 artifacts/m^2. So, even if we take into account the irregular distribution of the remains (finds tend to be clustered in well-defined accumulations and are practically absent in other areas), this means that both the lithic and faunal assemblages are relatively small. The archeological

horizons are normally very thin, less than 10 cm in most layers, which suggests a limited overlapping of activities in the same areas. Moreover, Abric Romaní meets other conditions particularly suitable for behavioral inquiry. The sedimentary context was especially favorable for the conservation of some archeological evidence, like hearths and wood remains. Burnt areas are perfectly visible on the yellowish travertine surfaces, allowing the location and size of hearths to be documented even when their sedimentary deposits were affected by post-depositional processes. This explains why so many hearths have been recorded in Abric Romaní and facilitates understanding into the role played by these structures in the spatial organization of the site. Furthermore, Capellades travertine has proved an excellent material for U-series dating, which has resulted in a reliable chronological control for the entire sequence.

In addition, the excavation strategy followed since the interventions began in 1983 has been directed explicitly toward the reconstruction of the behavioral strategies of the Neanderthal groups that occupied the shelter. The research project started under the theoretical influence of processual archeology, and one of its main goals is to achieve an ethnographic interpretation of the archeological record. A central aspect of this strategy has been the excavation of a large surface, which includes most of the originally occupied surface. This has led to the excavation of an area of nearly 300 m^2, paying special attention to the spatial distribution of the archeological remains and the identification of structures. Among these structures the hearths should be emphasized, as they are very abundant in all the archeological levels so far excavated, and have allowed us to characterize the formation of hearth-related activity areas as one of the essential features of Neanderthal spatial behavior. These areas can be interpreted as household spaces similar to those identified among contemporary hunter-gatherer groups; a comparison that makes it possible to approach the social dynamics of prehistoric groups.

The aim of this monograph is to provide some insight into Neanderthal behavior through the multidisciplinary study of an archeological level of the Abric Romaní site: level J. This is the third study of this kind published to date on the Abric Romaní levels, after the monographs devoted to levels H (Carbonell 1992) and I (Carbonell 2002). The spatial dimension has been fundamental in all these works, in keeping with the archeological paradigm that has guided the excavation of this site since the current project began in 1983. However, the approach to spatial patterning has undergone some changes over the course of the years. The study of level H was strictly spatial and was clearly under the influence of the "occupation floor" concept. Although the possibility that the archeological assemblage was the result of different occupations was recognized, the interpretation had essentially a synchronous character and the possible consequences of the temporal dynamics were not developed. Temporal issues played a major role in the level I monograph. The starting assumption was still essentially spatial, but the final conclusion was largely based on identifying different occupation events in different areas of the rockshelter. Level I was characterized as a horizontal palimpsest formed by several hearth-related accumulations corresponding to different occupation events (Vallverdú et al. 2005). One of the primary goals of this monograph on level J is to integrate spatial and temporal data with the aim of testing whether this temporal perspective can provide new insight into Neanderthal behavior.

This level, dated at 50 ka, is one of the richest of the sequence, both in the quantity of archeological remains uncovered there and in the number of occupation structures it holds (more than 50 hearths have been identified). From this point of view, comparing level J with levels I and H can provide insight into the effects of time on the formation of archeological assemblages. Are the differences observed between levels J and H–I the result of behavioral changes in settlement strategies or are they simply the product of differences in formation length? In spite of the high temporal resolution favored by the dynamics of the geological formation, some data indicate that the level J assemblage corresponds to a palimpsest formed by an indeterminate number of occupation episodes. The study of level J is directed toward the temporal dissection of this palimpsest, identifying assemblages of remains of higher resolution from which it is possible to access behavioral patterns with a certain degree of confidence. In this context, spatial data are fundamental as they reveal the dynamics of mobility and artifact transport from which the formation sequence of the archeological assemblage can be established. The temporal and spatial interpretations are therefore very closely linked.

This spatial–temporal interpretation is achieved by means of the information yielded by researchers from a wide range of analytic fields whose contributions constitute the different chapters of this monograph, including aspects related both to natural formation dynamics (stratigraphy, paleoenvironment, biostratigraphy, taphonomy, etc.) and human activities (lithic technology, faunal processing, habitat structures, spatial distribution, wood implements, etc.). Chapter 2 deals with the geological and geomorphological characteristics of the Capellades area, as well as the chronostratigraphic sequence of Abric Romaní, paying especial attention to the stratigraphic set in which level J is located. We also present in this chapter the history of the archeological excavations carried out in this site, in which different theoretic and methodological paradigms followed one another during the twentieth-century. Chapter 3 focuses on the spatial distribution of archeological remains and

combustion structures, bringing a preliminary overview of the spatial patterns that will be further developed in the chapters devoted to lithic and bone remains. The natural and cultural processes that contributed to the formation of level J deposit are presented in Chap. 4 using the data provided by micromorphological analysis. This chapter emphasizes the paleoecological reconstruction, but also the anthropogenic processes, among which hearth construction played a primary role. Paleoecology is the central theme of Chap. 5, which summarizes the results from different domains: pollen and charcoal analysis, large and small vertebrate paleontology, microvertebrate taphonomy, and malacology. The natural processes affecting the archeological assemblages are also discussed in Chap. 6, in which the taphonomic study of bones and charcoals is presented.

The second section of this book, made up of Chaps. 7, 8 and 9, focuses on human activities by reviewing the provisioning and use of lithic, faunal and plant resources. The study of the lithic assemblage is presented in Chap. 7, in which two different analytical levels have been distinguished. The first one is based on the analysis of artifact attributes in order to identify the technical strategies used in the production of lithic implements. Raw material and usewear analyses are also included in this section. In the second level, we focus on spatial and refitting data for identifying single technical events and increasing the temporal resolution of the analysis. This temporal dimension is also a primary concern of Chap. 8, devoted to the zooarcheological study of the faunal assemblage. The anatomical representation of the different taxa and the traces of human activity on bones allow the primary agent of faunal assemblage formation to be identified. These data are also used for characterizing level J in terms of occupation length and site function. Chapter 9 focuses on the exploitation of plant resources, which will be examined using two kinds of evidence: charcoal remains derived from the use of wood as fuel and wood pseudomorphs that suggest the manufacture of wood artifacts. Finally, the last section of this monograph focuses on whether the spatial–temporal perspective that we propose gives rise to a new view of Neanderthal behavior, different from that derived from works that are unaware of the importance of time resolution in the formation of archeological assemblages.

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