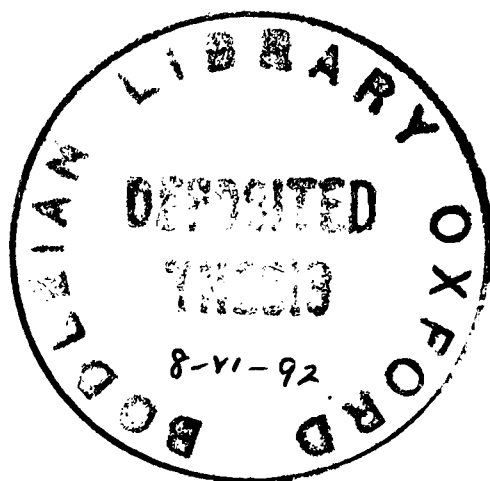


ASPECTS OF LITHIC ASSEMBLAGE VARIABILITY IN THE LATE PALAEOLITHIC
OF SOUTH-EAST ITALY

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Abstract

This thesis concerns late Palaeolithic settlement in the region of Puglia, south-east Italy, at the close of the Pleistocene. Puglia comprises three sub-regions which contain sites of this period: the Salento peninsula, the Murge, and the Gargano promontory. The late Palaeolithic occupation must be considered in relation to the former existence of an extensive coastal plain, and to the sea-level rise which submerged it. The late Palaeolithic assemblages of the region have been studied previously by Italian archaeologists from a rigid typological stance, with various schemes put forward suggesting evolution of the assemblages through different stages of an Epigravettian tradition. In this thesis, attribute analysis is used to re-examine the principal assemblages, using published data where adequate and supplemented by samples studied by the author in Italy. The results are analyzed to seek the social and economic factors which shaped the various industries, as well as diachronic change wherever it can be demonstrated. Factors such as difficulty in obtaining raw material were clearly crucial to assemblage composition. The existing typological schemes are shown to lack real bases and to mask rather than reveal sociocultural information. Chapter 1 states the aims of the thesis and critically discusses previous theoretical approaches to the late Palaeolithic of the region. Chapters 2 and 3 describe relevant aspects of the regional palaeoenvironment. The author's own methodological approach is explained in Chapter 4, and then used for a detailed study of the assemblages from Grotta delle Cipolliane in Chapter 5. This is followed in Chapter 6 by a broader study of the late Palaeolithic assemblages in Puglia, with discussions of their possible diachronic and synchronic relationships. Chapter 7 develops this latter theme into an attempt to understand the social and economic features of the late Palaeolithic settlement of Puglia, and suggestions are made concerning future work that might improve the quality of the archaeological evidence. Chapter 8 summarizes the main conclusions of the thesis.

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CHAPTER 1

INTRODUCTION

1:1 INTRODUCTION

The purpose of this chapter is to provide the historical background of previous research into the south-east Italian late Palaeolithic, and to assess the state of current theoretical approaches in Italian Palaeolithic studies. A critical review of this provides a context within which the aims and theoretical methodology of this thesis will be introduced.

The region of Puglia lies in the extreme south-east of the Italian peninsula, confined between the parallels 41°56'6" N at Peschici and 39°47'8" N at Punta Ristola, and the meridians 14°57'00" at Ansa del Fortore and 18°31'26" at Capo d'Otranto, the most easterly point of Italy. The position and shape of the region have earned Puglia the agnomen 'the heel of Italy', and the protruding Gargano promontory is euphemistically called 'the spur'. The region is divided into five administrative provinces: Foggia, Bari, Taranto, Brindisi, and Lecce; and four natural divisions according to the topography: the Gargano promontory, the Tavoliere, the Murge, and the Salento peninsula.

The aim of this thesis is to explore the traditional interpretations of the south-east Italian late Palaeolithic assemblages, especially with regard to diachronic and synchronic assemblage variability, by means of an alternative theoretical and methodological approach. The late Palaeolithic is here defined as spanning the late glacial period, 18-9,000 BP. The assemblages will be considered within a broader behavioural perspective than is typical in Italian Palaeolithic studies, by looking at the potential influence of such factors as the environment, economy, and ethnicity on lithic technology and typology.

1:2 A HISTORY OF RESEARCH

Antonio Jatta, in his volume *La Puglia Preistorica* (1914), remarked that the Palaeolithic of Puglia was "uncertain and not very widespread". Prior to the publication of this book, research into the Palaeolithic of the region had consisted largely of the haphazard work of local collectors, such as Angelucci (Angelucci 1872, 1876). The first scientific excavation to take place at a late Palaeolithic site in the region was that of Stasi and Regalia (1904; Regalia and Stasi 1905) at Grotta Romanelli, in the province of Lecce. At that time, there was a firm belief that there was no culture in Italy between the Mousterian and the Neolithic (Pigorini 1886), and therefore the findings from Grotta Romanelli were assigned to the Neolithic. This opinion, which was accepted by many eminent paleontologists, and figured in Peet's *The Stone and Bronze Ages in Italy and Sicily* (1909), continued to be held until Mochi's ideas to the contrary (1911) became accepted.

With the formation in the 1920s of the *Comitato per la Ricerche di Paleontologia Umana in Italia*, under the direction of A.Mochi and G.A.Blanc, a more serious interest was taken in the Palaeolithic of Italy. In Puglia, Blanc re-excavated Grotta Romanelli (G.A.Blanc 1920, 1928a, 1928b), and local research groups were set up, such as the *Missione Preistorica del Gargano* of 1929-1934, led by Rellini and Battaglia. Interest in the Palaeolithic was continued into the 1940s and '50s by Blanc's son, A.C.Blanc, and by Luigi Cardini, who excavated and surveyed much of the provinces of Lecce and Bari, though the premature death of A.C.Blanc meant that most of this research has remained unpublished.

However, it was not until the 1960s and early '70s that a general scientific interest began to be taken in Italian prehistory. This resulted in the creation of various bureaucratic machines, such as the *Istituto Italiano di Paleontologia Umana (IIPU)* in Rome, and the *Istituto Italiano di Preistoria e Protostoria (IIPP)* in Florence. In Puglia, this period was marked by a florescence of research into the late Palaeolithic of the region, with a multitude of excavations, funded principally by the *IIPP*, and carried

out by various northern universities and museums, namely Siena, Verona, Florence, Pisa and Milan.

The province of Lecce was the most extensively researched, with excavations at Ugento in 1961 (Cardini 1965); Grotta delle Cipolliane in 1962 and 1964 (Palma di Cesnola 1962; Gambassini 1970); Grotta del Cavallo in 1963-66 (Palma di Cesnola 1963, 1964, 1965a, 1965b, 1966a, 1966b); Grotta di Uluzzo in 1963-64 (Borzatti von Löwenstern 1963, 1964b); Taurisano in 1964 (Bietti 1979); Grotta delle Prazziche in 1964-66 (Borzatti von Löwenstern 1965a, 1965c, 1966, 1969); Grotta Carlo Cosma (Uluzzo C) in 1964-68 (Borzatti von Löwenstern 1965b; Borzatti von Löwenstern and Magaldi 1969); and Grotta delle Venere, Parabita, in 1966-7 (Radmilli 1966, 1969). Surveys in the southern part of the province revealed the presence of various surface scatters of late Palaeolithic material representing open site occupation (Piccinno and Piccinno 1974, 1978).

In the province of Bari, there were excavations at Grotta delle Mura in 1952-53 (Anelli 1953, 1957) and in 1960-63 (Borzatti von Löwenstern 1964a; Cornaggia Castiglione and Palma di Cesnola 1964, 1967; Cornaggia Castiglione and Menghi 1963); and at Grotta Santa Croce (Cardini 1956, 1961b). In the province of Foggia, the excavations at Grotta Paglicci, started in 1961-63 by Zorzi, were resumed after his death in 1970 (Mezzena and Palma di Cesnola 1967, 1972a, 1972b; Mezzena 1975; Palma di Cesnola 1974c, 1975a). The remaining two provinces, Taranto and Brindisi, have received virtually no attention from the point of view of Palaeolithic research, except for the survey and brief excavation at Torre Testa, near Brindisi (Punzi 1967, 1968; Cremonesi 1967, 1978).

The past decade has seen a decline in local interest in the late Palaeolithic of the region. Apart from the re-excavations of the late Palaeolithic levels at Grotta delle Mura (Calattini 1986) and Porto Badisco (Guerri 1984, 1986), elsewhere the focus has shifted towards the Middle Palaeolithic levels at sites such as Grotta Paglicci and Grotta del Cavallo. My own fieldwork around the Alimini lakes in the Salento peninsula was oriented towards gaining a better understanding of the nature of open

site settlement in the region (Milliken and Skeates 1990). All the sites mentioned in these three paragraphs feature in the later chapters of this thesis.

The Italian Upper Palaeolithic industries are traditionally divided into four chronological groups: the Uluzzian, contemporary with the French lower Perigordian or Châtelperronian; the Aurignacian; the Gravettian, contemporary with the French middle and upper Perigordian; and the Epigravettian. The last group covers a time interval conventionally fixed between 20,000 BP and 10,000 BP. The distribution of the principal Epigravettian sites in Italy is shown in Figure 1:1, and those sites outside of the region of Puglia that are discussed in the text are indicated. The uneven distribution of sites is partly a factor of topography and post-Pleistocene geomorphological processes, and partly a factor of the regional bias in research.

The first detailed study and classification of the Italian Epigravettian assemblages was published by G.Laplace in *Les Subdivisions du Leptolithique Italien* (1964b), in which the Epigravettian was subdivided into three phases: Ancient, Evolved and Final. These were designed to correspond neatly with the French Upper Palaeolithic cultural divisions of Solutrean, Magdalenian and Azilian. The Laplace chronostratigraphic scheme is a classic example of the culture historic method, based exclusively on the typological classification of tools without reference either to absolute dates or to environmental or ecological parameters. This approach is not concerned with the study of cultures in the standard anthropological sense, but with 'archaeological cultures' identified from a strict morphological and stylistic point of view, using tool types or groups of tools which are deemed to provide diagnostic criteria for the establishment of chronological sequences and cultural facies.

In *Les Subdivisions du Leptolithique Italien* (Laplace 1964b), the Ancient Tardigravettian (Epigravettian) was divided into three subphases which corresponded with the classic partition of the French Solutrean: a phase with unifacial points (*pointes à face plane*); a phase with foliate points (*pointes à pièce foliacée*); and a phase with shouldered points (*pointes à cran*). The latter phase was divided into two subphases

based on the relative percentages of shouldered points. The region of Puglia itself was divided into two cultural facies which retain their identities through the Tardigravettian: the 'Garganian facies' in the north, and the 'Salentine facies' in the centre and south. In the Ancient Tardigravettian the Garganian facies is characterized by the presence of trapezes in the first subphase and small circular endscrapers in the second, while the Salentine facies is characterized first by rhomboids and later by truncations (Table 1:1).

The Evolved Tardigravettian was divided into eight regional facies which were identified on the basis of the relative percentages of truncated tools, tanged points and denticulates: Liguria; Veneto; Toscana; Lazio; Abruzzo; northern Puglia; the Salento peninsula; and Sicily. The distinction between the Garganian facies and the Salentine facies was made on the basis of the presence of truncated backed bladelets in the assemblages of the latter. The Salentine facies was divided into two phases based on fluctuations in the burin and endscraper indices (Table 1:2).

The Final Tardigravettian was divided into six regional facies: Liguria; Toscana; Veneto; Lazio; northern Puglia; and the Salento peninsula. The Garganian facies was divided into three phases on the basis of fluctuations in the burin and endscraper indices and the relative percentages of truncated backed bladelets, geometrics and denticulates. The Salentine facies was divided into only two phases: a phase of truncations and truncated backed bladelets; and a phase of circular endscrapers and truncated backed bladelets. The latter phase was subdivided into three subphases characterized by fluctuations in the burin and endscraper indices and the presence/absence of certain geometric types. Central Puglia, which in the Ancient Tardigravettian was considered as belonging to the Salentine facies, was now included in the Garganian facies (Tables 1:3-1:4).

Bartolomei *et al.*'s publication *Chronostratigraphie et Ecologie de l'Epigravettien en Italie* (1979) renamed the Tardigravettian the 'Epigravettian', and took into account the new sites that had been excavated in the intervening two decades

since the publication of the Laplace scheme. Absolute dates were by then available, and Bartolomei *et al.* placed the Early Epigravettian between 20-16,000 BP, the Evolved Epigravettian between 16-14,000 BP, and the Final Epigravettian between 14-10,000 BP. Some sites, such as Grotta Romanelli, which were radiocarbon dated to the early Holocene, were still regarded as Final Epigravettian on the basis of the typology of the industry. The classification approach used by Bartolomei *et al.*, based on 'diagnostic' indices and tool types, stemmed directly from that of Laplace, and the tripartite division into 'Ancient', 'Evolved' and 'Final' phases was retained.

The Ancient Epigravettian was considered to be culturally homogeneous throughout Italy, and was divided into three phases: an initial phase; a phase with foliate points; and a phase with shouldered points. The latter phase was subdivided into three subphases on the basis of fluctuations in the burin and endscraper indices and the relative percentages of shouldered points. No distinctions were made between the industries from northern and southern Puglia (Table 1:5).

The Evolved Epigravettian was also considered to be culturally homogeneous throughout Italy and throughout Puglia, and was divided into two chronological phases based on fluctuations in the burin and endscraper indices, the relative percentages of truncated backed bladelets, and the presence of geometrics (Table 1:6).

The Final Epigravettian was divided into four regional facies: northern Tyrrhenian (Liguria and Toscana); middle and southern Tyrrhenian (Lazio, Campania and Calabria); northern and middle Adriatic (Veneto, Marche, Abruzzo, and northern Puglia); and southern Adriatic and Ionian (the Salento peninsula). The northern Puglian facies was divided into two phases on the basis of the relative percentages of circular endscrapers, truncated backed bladelets and geometrics. The central and southern Puglian facies was also divided into two chronological phases: before 12,000 BP, characterized by a marked development of truncated backed bladelets, and after 12,000 BP, characterized by a marked increase of circular endscrapers and the presence of geometrics (Table 1:7).

A revised classification of the Italian Epigravettian was proposed at the 1983 Siena conference '*La position taxonomique et chronologique des industries à pointes à dos autour de la Méditerranée européenne*'. Again the supposedly 'diagnostic' indices and tool types provided the basis for the classificatory scheme. The Ancient Epigravettian was divided into three phases: an initial phase characterized by a 'large format' industry; a phase with foliate points; and a phase with shouldered points (Palma di Cesnola and Bietti 1983). The latter phase was subdivided into three subphases on the basis of fluctuations in the burin and endscraper indices and the relative percentages of shouldered points. No distinction was made between the industries from northern and southern Puglia (Table 1:8).

Both the Evolved and Final Epigravettian were divided into five regional facies: upper and middle Adriatic (Veneto-Trento-Friuli, Marche and Abruzzo (Bisi *et al.* 1983); upper Tyrrhenian (Liguria and northern Toscana) (Palma di Cesnola 1983); middle and lower Tyrrhenian (Lazio, Campania and Calabria) (Bietti *et al.* 1983); Sicily (Segre and Vigliardi 1983); and Puglia (Palma di Cesnola *et al.* 1983). Puglia itself was again divided into two sub-regions on the basis of the relative percentages of certain tool types. The Final Epigravettian of central and northern Puglia, was divided into four subphases on the basis of fluctuations in the burin and endscraper indices and the relative percentages of circular endscrapers, truncated backed bladelets and geometrics. The Evolved Epigravettian of the Salento peninsula was divided into two subphases and the Final Epigravettian into three; again, these divisions were based on fluctuations in the burin and endscraper indices and the relative percentages of circular endscrapers, truncated backed bladelets and geometrics (Tables 1:9-1:10).

Alternative approaches have made use of quantitative methods for the statistical verification of the suggested cultural facies and temporal trends. Ammerman (1971, 1972), Ammerman and Hodson (1972) and Pollnac and Ammerman (1973) all failed to find evidence in support of Laplace's division of the Italian Final Epigravettian into regional facies. Coverini *et al.* (1982), on the other hand, demonstrated quantitative

confirmation of Laplace's intuitive perception of an evolutive dynamism operating through the three stages of the Epigravettian. According to their interpretation of their results, the Ancient Epigravettian is characterized by a general uniformity in its elementary structure, while the Evolved Epigravettian shows more evidence for distinct chronological horizons, which culminates in the Final Epigravettian with a phase of rich structural variability characterized by marked individuality of the assemblages, suggesting regional facies distinct in different phases of local evolution. These workers all relied on an uncritical use of tool types and indices derived from Laplace's *Typologie Analytique* (1964a, 1968) as a measure of similarity, thereby making the unfounded assumption that the Laplace type-list provides a reasonably detailed description of the full range of variability. Bietti and Burani (1985) also attempted a quantitative validation of the traditional Laplace classification, and achieved a very different set of results and conclusions to those of Coverini *et al.* Their analysis found no justification for the majority of the features that are considered to be regionally diagnostic according to Laplace's qualitative approach, although the assemblages from the northern Tyrrhenian region (Liguria) showed a strong degree of association with those from the southern Adriatic region (Puglia). As an alternative to the Laplace typology, Bietti has used the French Upper Palaeolithic type-list combined with various environmental and ecological attributes, in a series of cluster analyses of late Palaeolithic assemblages (Bietti 1980b, 1981, *et al.* 1978). He concluded that the intra-regional clusters, such as Grotta delle Mura-Grotta delle Cipolliane in Puglia, represent distinct culture groups, each with their own Epigravettian tradition, while the inter-regional clusters, such as those between sites in Puglia and Liguria, represent similar activities performed in similar environmental conditions by different culture groups.

Research oriented towards behavioural interpretations of the late Palaeolithic assemblages of south-east Italy is rare, and the only direct functional analysis of artifacts from a late Palaeolithic site in the region is Donahue's microwear study of

material from Grotta Paglicci (Donahue 1985, 1986, 1988). Ammerman (1972) was the first to integrate lithic and faunal data, but again he relied heavily on an uncritical use of the Laplace typology. His proposal for a 'Salentine Culture' in replacement of the 'Romanellian', defined on the basis of material culture and environmental adaptations and exploitation patterns, has never been adopted. The 'Romanellian', whose name derived from the type site of Grotta Romanelli, was introduced by A.C.Blanc (1939a, 1939b) to distinguish the later stages of the Final Epigravettian in Puglia, and was defined as a microlithic industry characterized by small circular and subcircular endscrapers, truncated and pointed backed bladelets, polyhedral and nucleiform burins, geometrics (semilunates and triangles), and microburins. The term 'romanellianization' is frequently used to refer to the process of late Palaeolithic diminution in the size of tools and in particular to the development of small circular endscrapers. The 'Romanellian' was later expanded in its geographical distribution to incorporate typologically similar industries from other regions in Italy: Grotta La Porta (Positano) in Campania; Grotta Jolanda (Sezze Romano), Palidoro and Grotta Polesini in Lazio; Tane di Parrano in Umbria; and Grotta delle Campane (Val di Lima) in Toscana (Radmilli 1978) (see Figure 1:1). The geographical expansion of the 'Romanellian' did not stop at the Italian frontiers, but spread into south-east France where the Mesolithic industries were called 'Romanello-Azilienne' to demonstrate their 'cultural affinities' with both the Romanellian and the Azilian cultures (Sauter 1948; Escalon de Fonton 1966). Typological similarities between the lithic industries from Puglia and Liguria even led to hypotheses of a 'cultural convergence phenomenon' occurring between the two regions (Palma di Cesnola 1974b).

In summary, the traditional approach to the late Palaeolithic in south-east Italy has focused on the description and classification of assemblages within a chronostratigraphic framework, and the seriation of typological sequences of artifacts to establish inter-site cultural correlations. The process of periodization using abstract typological indices as temporal markers and ethnic identifiers was grounded on the

assumption that the stone tool record conformed to what was essentially an organic model of diachronic change, with time and culture as parallel causal variables. Although time is continuously connected, the tendency to divide and classify has resulted in a synchronic view of time as a sequence of homogeneous periods, rather than a diachronic view of time as continuous change. The naming of these periods on binomial principles, such as the Early, Evolved, and Final Epigravettian, affords the illusion of classed order, but the traditional chronostratigraphic schemes neither adequately describe the range of assemblage variability, nor do they serve to explain that variability. The potential role of intra-site and inter-site spatial differentiation in functional activities as a potential causal factor of lithic assemblage variability has been completely ignored, and there has been no attempt to explore the dynamic interaction between lithic technology and environmental or sociocultural phenomena.

1:3 ORIENTATION OF THIS THESIS

The aim of this thesis is to identify diachronic change and synchronic variability in the Epigravettian assemblages of south-east Italy, and to seek explanation for that variability in terms of social and economic strategies. The thesis will critically examine the validity of the traditional interpretations outlined above, according to which two separate industrial facies coexisted in the region, distinct in different phases of local evolution through the various stages of an Epigravettian tradition. The thesis does not reject *a priori* the validity of the previously established chronostratigraphic phases, but rather seeks to examine whether they exist as technologically and typologically distinct entities, and to refine their definition through the more contextual approach of the concept of lithic production systems.

The cybernetic character of lithic technology can be explored by using the concept of the *chaîne opératoire*, which was derived from ethnographic studies (Mauss 1947; Maget 1953) and introduced into prehistoric studies by Leroi-Gourhan (1964).

The *chaîne opératoire* is defined as the chain of mental operations and technical actions which are performed to accomplish a particular objective, and while certain stages in the chain are imposed by the mechanical and technical constraints of the raw material and by the nature of the objective, others are optional. The postulate that the *chaîne opératoire* responds to an objective, and is therefore in part determined by that objective, does not negate the significance of cultural variation in lithic industries. If there exist many satisfactory solutions to the resolution of a technical problem or the satisfactory accomplishment of an objective, then the choice between different possible *chaînes opératoires* is made as a function of the technical tradition of a group, which is one element of the cultural tradition of a group. Therefore the identification of these alternative solutions practised in response to analogous objectives permits a cultural diagnosis of the technical tradition of a tool-making group (Pelegriin 1985; Pelegriin *et al.* 1988).

Technical tradition may therefore be reflected in the choice of raw materials, the knapping techniques of core reduction and blank production, and alternative types of retouch. It may also be reflected in the distinctive ways in which tools were used and rejuvenated before being discarded, or in the extent and manner in which 'expedient' or *ad hoc* tools were employed. The assemblage of decisions that take place along the *chaîne opératoire* can be described in terms of technological 'strategies': collective strategies, which emanate from the group itself, and which concern the general concept of the lithic industry and its place in the economic and technical system; and individual strategies, the practice of this or that *chaîne opératoire* when faced with a given problem (Perlès 1987a). If it is the *chaîne opératoire* which forms the basis of the analytical approach to the study of lithic material, then it is the concept of 'strategy' which allows one to describe in a synthetic way the assemblage of decisions practised in a given context. In other words, the notion of strategies gives us the domain for the interpretation of observed phenomena.

The *chaîne opératoire* offers a sequentially ordered context for the study of technical operations: the choice of raw materials; the techniques and products of

debitage; the selection of blanks for retouched tools; the techniques of blank transformation; tool maintenance; and eventual discard (Figure 1:2). The concept of the 'economy' of a lithic industry provides a context within which to examine the differential management of resources and products. The 'economy' of a lithic industry has three constituent parts, which though complementary and interrelated, occur in temporal succession: the economy of the raw material, where the strategies identified are interpreted as a function of differential acquisition, quality and intended use; the economy of tool production, which determines differential utilization of products at each technical stage of the *chaîne opératoire*; and the economy of the toolkit, which demonstrates differential management of tools in terms of cycles of utilization, transformation, and rejection (Perlès 1987a).

According to the traditional Italian chronostratigraphic approach, variation within a group of similar objects is seen to reflect variation in the ideas which produced them and is therefore interpreted as a function of cultural tradition. Current theoretical developments in the interpretation of lithic assemblage variability are moving away from the view that a stone tool is a static creation that reflects an equally static design notion nurtured in the mind of the prehistoric artisan. Instead, a stone tool should be regarded in dynamic terms as representing only one state in a complex series of changes that constitutes the reduction sequence through which tools proceed during the course of their manufacture and use. As tools are discarded at various points along this continuum of reduction, certain morphological features could reflect stages in reduction and use, rather than different functions or styles. The implication of this is that there may be no straightforward relationship between either form and function or form and cultural tradition (Dibble 1984, 1987a, 1987b, 1988).

Typologies such as that of Laplace (1964a, 1968) allow no room for this morphological variation in the life of a tool. By focusing on the similarities between objects, the typological approach undoubtedly leads to the suppression of vast amounts of information by summarizing the variability among artifacts, and reduces

the number of dimensions of variability that can be taken into account. In this thesis, attribute analysis is used as an approach which is considered to be better suited to an attempt to understand the dynamics that lie behind the observed variability. Attributes are the basic, observable characteristics which make up a specific tool, and describe its size and shape as well as the retouch. Attributes can be equated with decisions, whether conscious or unconscious, that were made by the artisan during the manufacturing process. Given that each attribute is recorded as one of a set of mutually exclusive possibilities, different attributes can be seen as a set of alternative choices from which the prehistoric artisans made their selection at each decision making stage. The choice between different possible *chaînes opératoires* will therefore be manifested in the variability within a mutually exclusive set of attributes, and in covariations of different sets of attributes which occur on the same tool. Thus the identification of these alternative solutions through the observation of the variability in the attributes should permit a cultural diagnosis of the technical tradition of a tool-making group.

The discussion of the lithic assemblages presented in this thesis is based on a combination of published data and first-hand analysis. To resolve questions of inter-assemblage variability, it is first necessary to clarify the processes that lead to variability within a single assemblage. If factors such as reduction sequences and relative intensity of raw material utilization are shown to affect variability *within* one assemblage, these factors can therefore be expected to affect variability *between* assemblages. The assemblage from Grotta delle Cipolliane was chosen as the site which offered the most fine-grained assemblage for the study of temporal variability, and explanations for that variability are examined that might be accounted for by functional or stylistic factors, or in terms of changing strategies of raw material economy. This is followed by a comparative review of the south-east Italian late Palaeolithic assemblages, which considers the spatial organization of lithic technology and how it varies temporally.

The interpretation of lithic assemblage variability should involve questions about *how* such patterning of formal variability comes into being, and what meaning should be attached to it. Rather than treat tools and assemblages as abstract concepts, this thesis explores the role of stone tool assemblages within behavioural systems, by considering technological strategies as an integral part of social and economic strategies. Technological strategies can be viewed as problem-solving processes that were responsive to conditions created by the interplay between humans and their physical and social environment, and the discussion will focus on such questions as the influence of raw material availability on lithic technology and typology, and how strategies of raw material procurement may have been incorporated in subsistence economies; how subsistence economies were affected by late glacial environmental change, and how technology was adapted in response to these changes; the nature of the occupations at each site, and their role within a larger socio-economic system; the effects on assemblage composition of ecological shifts which altered those roles in terms of the seasonal round in relationship to local resources, and in particular to the former existence of an extensive coastal plain and the sea-level rise which submerged it; how the need to maintain a network of social relations may have affected land use and settlement strategies, and how these in turn may have influenced stone tools and tool production strategies.

The aim of this thesis is therefore to identify temporal change and spatial variability in the late Palaeolithic assemblages of south-east Italy, and to explain this variability in terms of a number of interrelated causal vectors which will expand our understanding of prehistoric human adaptations in this region during the late glacial period. The thesis does not presume that the results of this particular study will be universally applicable, as each region differs in its environment, topography, geology and subsistence base. However, it is hoped that the alternative theoretical and methodological approach used here will stimulate others to break free from their rigid typological stance.

A brief precis of the chapters which follow provides a summary of the orientation and structure of this thesis:

Chapter 2 presents a reconstruction of the regional palaeoenvironment and examines the nature of the late glacial environmental changes. Certain features of the environment are considered to be potentially influential on hunter-gatherer settlement and resource exploitation strategies, and therefore the identification of these key environmental variables is an important preliminary to reaching an understanding of regional lithic assemblage variability. The late glacial environmental changes are considered in some detail in order to provide a context against which the observed technological, economic and social changes can later be viewed.

Chapter 3 introduces the sites in south-east Italy with lithic assemblages that have been attributed to the Epigravettian period, and describes their location, their stratigraphies, and their relative and absolute chronologies. The microenvironment of each site is reconstructed using the nature of the sediments as an indicator of the climate that prevailed during their deposition, and an attempt is then made to correlate the sites with one another according to the stratigraphic correlation of their sediments.

Chapter 4 presents a detailed and critical review of the Laplace analytical typology, and then describes the methodology and terminology used in this thesis for the analysis of the lithic assemblages.

Chapter 5 presents a reanalysis of the lithic industry from Grotta delle Cipolliane. The reanalysis identifies temporal variability within the assemblage sequence, and then interprets that variability in terms of functional and stylistic factors and changing strategies of raw material economy.

Chapter 6 presents a review of the Epigravettian assemblages in south-east Italy, and considers the spatial organization of lithic technology in the south-east Italian late Palaeolithic as a whole and how it varies temporally.

Chapter 7 considers various social and economic strategies that might account for the observed synchronic and diachronic assemblage variability, and focuses on a discussion of raw material economies, subsistence economies, and settlement patterns and social relations. Suggestions are made for future research that might improve the quality of the archaeological evidence.

Chapter 8 presents a brief summary of the results of the thesis.

CHAPTER 2

THE REGIONAL PALAEOENVIRONMENT

2:1 INTRODUCTION

The prehistoric organization of lithic technology can be considered primarily as a strategy that was designed for the extraction of energy from the physical environment. A reconstruction of the temporal and spatial environmental variability therefore provides a framework within which the lithic assemblages can be examined. Certain features of the environment are considered to be particularly influential on hunter-gatherer economic and social strategies, such as the location of raw material sources, the location of water, and the temporal and spatial distribution of food resources in relation to changing littoral and terrestrial habitats. Therefore, the identification of these key environmental variables is one of the most important preliminaries in reaching an understanding of regional lithic assemblage variability, and in this chapter I shall consider such factors for south-east Italy.

The late glacial period was characterized by significant climatic change. Humans experience climate directly in the form of 'weather', such as the particular effects of precipitation or temperature (Harding 1982), and indirectly climate is experienced through its effect on certain aspects of the biosphere, such as vegetation and fauna. Palaeoclimatic reconstruction builds on studies of climate dependency in modern plants and animals, which incorporate into their structure and behaviour a measure of this dependency, and therefore provide a proxy record of climate. This approach relies on the principal of uniformitarianism, which assumes that the physical principles and rules which apply today also apply to the past (Bradley 1985).

Vegetational changes in response to climatic change occur at both the microscale and the macroscale. At the microscale, or local scale, climate affects the

water and nutrient availability of the soil, factors which are important for the establishment and succession of species populations. At the macroscale, or regional scale, biotic responses to climatic change include migration, extinction and speciation of plant taxa, and changes in the composition, structure, areal extent and distribution of an ecosystem (Delcourt *et al.* 1983). These changes in turn influence the species composition and distribution of fauna.

The response of a particular species, whether plant or animal, does not occur at the inception of climatic change, but is delayed until a certain threshold is reached. The response to a climatic change favouring the expansion of the range of a plant species may be substantially delayed by the nature of the dispersal method of propagation, and this lag-effect may even be extended for centuries (Wright 1984). Each species behaves independently of others, because its response to climatic or other environmental factors is determined by its own unique genetic inheritance. There is also great regional variation in the intensity of the response of vegetation to the late glacial climatic events in Europe (Watts 1980). In northern Europe, the climatic deterioration of the Younger Dryas event (11-10,000 BP) led to major changes in species composition, whereas in southern Europe, the changes were quantitative rather than qualitative.

Unless otherwise stated, the main references concerning the geology, topography and hydrology of Puglia are taken from the Naval Intelligence Handbook (1944), Baldacci (1972), and Guerricchio and Zezza (1982).

2:2 GEOLOGY AND TOPOGRAPHY

The region of Puglia is composed almost exclusively of exogeneous rocks, of which karstic limestone is the dominant type. However, there is great variation in altitude, structure and hardness, and according to this variation the region can be neatly divided into four distinct geographic areas (Figures 2:1 and 2:2):

THE SALENTO PENINSULA

The Salento peninsula has a low relief (maximum height 200 metres) and a varied surface geology. The rocks, which are mainly calcareous, consist of four principal types: compact Cretaceous limestones (*Calcareniti del Salento*) which form the substratum of the whole peninsula and outcrops in the hilly areas; Miocene marly limestone (*Pietra leccese*) in scattered lowland areas to the east; a wide distribution of Pliocene calcareous tufa (*facies astiana*); and unconsolidated Pliocene sands occurring in beds resting on the tufa in the south. In addition to these four major rock types, deposits of Pleistocene *terra rossa* (red earth) cover parts of the troughs between the *serre*, asymmetrical ridges which were originally caused by fracturing associated with folding of the limestone, but have since been deepened by erosion. The red sticky clay of the *terra rossa* forms deposits of up to five metres in depth.

THE MURGE

The Murge are tablelands consisting of homogeneous blocks of gently folded stratified limestone of Cretaceous age. The land rises in a series of broad steps with north-east facing scarps, from a narrow coastal plain to an undulating stony zone with a maximum height at Torre Disperata of 686 metres.

THE TAVOLIERE

The Tavoliere is composed of nearly horizontal beds of comparatively soft Pliocene sands and Pleistocene clays over a Mesozoic carbonate substrate. These beds are covered by a calcareous soil (calcrete), over which lie thick deposits of Holocene alluvium of both marine and continental origin (Ciaranfi 1983). The highest point of the Tavoliere is 400 metres above sea-level, where the tablelands meet the Capitanata Apennines in the west.

THE GARGANO PROMONTORY

The Gargano promontory, which rises steeply from the Tavoliere lowland up to a broad plateau with heights of more than 900 metres, is composed of secondary

limestones with dolomitic outcrops in the centre. On the north-western and southern flanks there are small areas of Pliocene deposits. The Gargano promontory is the only source of cryptocrystalline rocks in the region. Chert is found in the form of both nodules and tablets in Upper Cretaceous limestone and marly limestone formations (*Scaglia rossa*), and in Cretaceous/Upper Jurassic micritic limestones and clayey micrites (*Rodi Garganico facies*). The other sources of chert in south-east Italy are the Jurassic limestones and cherty marls and Upper Triassic cherty limestones in the region of Basilicata (Figure 2:3).

The coasts of Puglia are for the most part rocky, though there are some exceptions as a result of locally differential movements of submergence and emergence which have determined the alternating morphology of the coastline (Zunica 1976). The northern coast of the Gargano promontory, the coast of the Tavoliere, and small areas around Brindisi and Taranto are alluvial with low sandy beaches. The predominantly rocky coasts of the Murge, the Salento peninsula and the south-eastern Gargano are irregular cliffs with caves formed by limestone solution. At Santa Maria di Leuca, the southernmost tip of the Salento peninsula, the cliffs rise over 60 metres above sea-level.

Caves are a characteristic feature of karstic environments. In south-east Italy, the majority of the caves are located along the coast. Inland, they occur along fault lines, where tectonic activity provided the initial throughways for water solution. Solution acts as freely both laterally and vertically, and produces caves where roofs as well as walls are subject to fall. Changes in cave shape as a result of solution, corrosion and transport of cave deposits can upset a previously established equilibrium of forces, so that breakdown occurs to restore a fresh temporary equilibrium (Jennings 1985). In south-east Italy there is evidence which suggests a period of 'karstic sinking' between 13-12,000 BP, that was probably related to climatic change and local disruption of karst by faulting. Periglacial conditions promoted slope instability and mass movement, and a combination of isostatic uplift and eustatic rise in sea-level

resulted in positive movements of base level. As a result, some caves were blocked by the action of vault sinking, while others which had been previously been blocked by landslides were reopened.

2:3 HYDROLOGY

Horace coined the name "*Siticulosa Apulia*" ¹ in reference to the extreme aridity of the region. This aridity is the result of the combined effects of a low annual rainfall and the karstic geomorphology. Karstic regions are characterized by subterranean drainage as a result of the solubility of the limestone in natural waters, which results in a marked permeability of the rock. Therefore surface drainage tends to become intermittent, widely spaced, or absent. In karst, springs are usually larger and more permanent than in other kinds of terrain because of greater infiltration of rainfall, and can be either perennial or seasonal. Various factors condition the presence or absence of springs; underlying impervious rocks cause springs at the base of the karst rock, and fault contacts of karst and impervious rocks are also likely spring locations. Sea-level is another important factor; many springs emerge at sea-level, and there are also subaqueous springs where karst rocks descend below sea-level. Outflows that have become submarine, as a result of either tectonic subsidence or rising sea-levels, continue to function afterwards in a submarine condition. Oscillations of sea-level can also cause corresponding upwards and downwards movements of inland water tables (Jennings 1985). A rise in sea-level causes a rise in the levels of the surface aquifers in coastal zones, and the development of an underground drainage system (Renault 1976).

The main features of the hydrology of Puglia are shown in Figure 2:4. The majority of the springs in the Salento peninsula are located along the coast, where the phreatic layer is at a shallow depth (5-10 metres) under the surface, and inland there

¹ *Siticulosa* - very parched, dry

are no springs at altitudes of more than 10 metres above sea-level. There are no surface rivers. The Murge lacks surface water; inland, the impervious rocks are at such a depth that there are no springs, and only where superficial Pliocene deposits hold a little ground water are reliable supplies naturally available. In the Tavoliere, rivers rising in the Apennine mountains of the neighbouring region of Basilicata flow across the thick deposits of alluvium which seal the permeable bedrock. Of the rivers, all except the Fortore drain with a gentle gradient towards the Gulf of Manfredonia, and all except the Ofanto are dry during the summer. Finally, the Gargano promontory can be divided into three hydrographic zones: the springs are restricted to the coastal plateau margins; inland, where the mountains drop steeply down to the Tavoliere plain, there are erratic seasonal torrents; and in the interior montane zone there is virtually no water, in spite of the relatively high rainfall.

A characteristic feature of Puglian karst is the presence of small spring-fed seasonal lakes along the coast, which form at the bottom of depressions lined with impermeable clay deposits. Since the early nineteenth century, extensive drainage and land reclamation programmes, such as the *Bonifica di San Cataldo*, have considerably altered the original hydrology of the coastal lake zones, in an attempt to eradicate malaria which was making these areas uninhabitable. Cartographic documentation such as Gastaldo's *La descriptione de la Puglia* (1567), Botero's *Relazioni universali* (1595), Ortelius's *Theatrum orbis terrarum* (1595), and Marzolla's *Descrizione del Regno delle Due Sicilie per Provincie* (1854) show the extensive distribution of coastal lagoons prior to the last century. Three main areas have been affected (see Figure 2:4): a large area of flat low lying land bordering the Golfo di Manfredonia containing the Lago di Siponto and Lago di Salpi was reclaimed in 1811 as alluvium and salt deposits, and the Lago di Salso was partially drained (Delano Smith 1976, 1978, 1979); in 1965, the *Bonifica di San Cataldo* reclaimed a forty kilometre stretch of lakes along the Adriatic coastline of the Salento peninsula east of Lecce; and finally, the lagoons along the Ionian coast between Taranto and Porto Cesareo were reclaimed.

The only remaining extensive areas of surface water in the region are the Laghi Alimini on the Adriatic coast of the Salento peninsula, and the Lago di Varano and Lago di Lesina on the northern shore of the Gargano promontory (see Figure 2:4). Lago di Lesina and Lago di Varano were originally open coastal bays. During the Holocene, rivers flowing out into the Adriatic deposited sediments which were carried eastwards by the current, thus cutting off the bays and creating two large shallow-water lakes with a mixture of sea water and karstic freshwater. The Laghi Alimini, called Alimini Grande and Alimini Piccolo (or Fontanelle), cover an area of 100 hectares and lie at present day sea-level in two interclusal valleys which cut into the Pleistocene terrigenous skeletal limestones. Alimini Piccolo, to the south, was originally a closed basin with an impermeable bottom, fed by freshwater springs. In the early twentieth century, two canals were constructed, one joining the two lakes and the other running from Alimini Grande to the sea, thus altering their original hydrology by making them both saline (Congedo 1964).

2:4 THE LATE GLACIAL: 18-9,000 BP

The Quaternary succession of the Italian Alps is still essentially based on the quadriglacial model established by Penck and Brückner (1909). Recently, new data have been collected from studies in the French and Italian piedmonts which refine the regional chronology of the late glacial period (Billard and Orombelli 1987). Radiocarbon dated ice-contact lacustrine sediments from Pontida in the Italian piedmont place the culmination of the maximum ice advance of the last glacial here at just earlier than $17,700 \pm 360$ BP (Orombelli 1974; Alessio *et al.* 1979). An estimation of 15-14,000 BP for the start of the deglaciation is suggested by larch stumps found in a position of growth at Revine, Treviso, well inside the Piave Würm moraine system. These are radiocarbon dated to $14,765 \pm 135$ BP and $14,370 \pm 115$ BP (Casadoro *et al.* 1976). There is also evidence to suggest that the deglaciation process was interrupted by at least two major glacial readvances, for which dating has not yet been obtained

(Porter and Orombelli 1982). Finally, a date of $10,000 \pm 75$ BP from peat at Villa Dora in the Susa valley indicates that by 10,000 BP, the major valleys were free of ice (Charnier and Peretti 1975).

It is now fairly well established that the ice sheet disintegration occurred in two major steps which accompanied a stepwise temperature trend. Two different models of stepped deglaciation have been proposed: the 'French two-step' model, where the maximum melting rates (at 14-12,000 BP and 10-7,000 BP) are separated by a mid-deglacial pause with little or no loss of ice volume (Duplessy *et al.* 1981; Mix and Ruddiman 1985); and the 'Younger Dryas' model, with a mid-deglacial reversal (11-10,000 BP) characterized by significant ice re-growth (Broecker *et al.* 1985, 1988). The exact timing of the onset of the first phase of deglaciation is also open to question, depending on the location of the area where the core samples are taken. Duplessy *et al.* (1981) place it between 16,000 BP and 13,000 BP; Kennett and Shackleton (1975) before 15,000 BP; Jones and Keigwin (1988) at 15,000 BP; Bard *et al.* (1987) at 14,500 BP; Berger (1985) and Berger *et al.* (1985a, 1985b) between 14,000 BP and 13,000 BP; and Mix and Ruddiman (1984) between 13,000 BP and 11,000 BP. The second step is commonly thought to have begun at about 10,000 BP.

Recently a study has been made of the oxygen and carbon isotope records from a North Atlantic core (V23-81) from the Feni Drift, Ireland (Jansen and Veum 1990). The benthic and planktonic $\delta^{18}\text{O}$ composition of core V23-81 suggests that the major deglacial $\delta^{18}\text{O}$ increase started after 15,200 BP, and proceeded in two steps: isotope stage Termination 1A from 15,200 BP to 11,500 BP, and isotope stage Termination 1B from 10,400 BP. The two steps are separated by the Younger Dryas (Dryas III) oscillation, when the temperature increase was interrupted by a sharp return to almost full glacial conditions between 11,500-10,400 BP.

Whatever the precise dates, the rates of environmental change during the two main intervals of deglaciation would have been extremely rapid, and sea-level rises, changes in precipitation, rising temperatures, the migration of vegetation zones and the concomitant redistribution of fauna must all have been obvious on a human time scale

(Van Andel 1990b). Though of comparatively short duration, the return to glacial conditions in the Younger Dryas would also have induced noticeable environmental changes.

2:5 SEA-LEVELS

The glacio-eustatic mechanism for postglacial sea-level rise has been well established for over a century, but the amplitude and chronology of the changes remain uncertain. Estimates of the volume of ice stored on the continents in the form of glaciers during the last glacial maximum indicate that a global layer of water 150 to 165 metres thick had been removed from the oceans (N.J.Shackleton 1987). Correction for isostatic compensation places the global sea-level for 18,000 BP at -120 to -130 metres (Chappell and Shackleton 1986; Nakada and Lambeck 1988).

Various different rates have been proposed for the global sea-level rise (eg., Curray 1965; Milliman and Emery 1968; Delibras 1974; Dillon and Oldale 1978). More recent curves have taken into account the idea of a two-stepped deglaciation. Johnson and Andrews' (1986) estimation of ice volume reductions based on isotope ratio variations from various locations, suggests that the first pulse (16,000-13,000 BP) of the sea-level rise was 55 metres, giving a mean rate of 18 m/kyr. More recently Chappell and Polach's (1991) study of the coral record from the Huon Peninsula, Papua New Guinea, suggests a rise of 50 metres between 11,000 BP to 7,000 BP, giving a mean rate of 10m/kyr. The rate of rise was found to be greatest between 10,000 BP and 9,000 BP, at 13m/kyr. Between 9,000 BP and 8,000 BP the sea-level rise slowed markedly because the continental ice-caps had shrunk to approximately their present sizes. The sea at 8,000 BP is estimated at 25 metres below its present level (Van Andel and Lianos 1983).

Radiocarbon dated samples from a series of sixteen cores drilled into submerged coral reefs on the Barbados shelf have recently provided the first almost continuous record of sea-level rise during the last deglaciation (Fairbanks 1989). The

Caribbean reef-crest coral (*Acropora palmata*) only grows within about five metres of the sea surface, and therefore acts as an accurate sea-level indicator. The nearly continuous sequence of *Acropora palmata* from the Barbados shelf spans the period 17,100 BP to 7,800 BP, and shows that the sea-level rise was characterized by two periods of rapid rise. During the last glacial maximum at 17,000 BP, the depth of the shore was at -120 ± 5 metres. Beginning at 12,500 BP, a slow rise of about 20 metres was followed by a major acceleration to a rate of 24 metres in less than 1000 years. This phase is termed 'melt-water pulse 1A', and corresponds to the later part of isotope stage Termination 1A. The rate of ice melting subsequently slowed down, reaching a minimum during the first half of the Younger Dryas chronozone (11,000-10,500 BP). There then followed another rapid rise in the second half of the Younger Dryas (10,500-10,000 BP), culminating in 'melt-water pulse 1B' during which the sea-level rose by 28 metres. This pulse, which is centred at 9,500 BP, corresponds with isotope stage Termination 1B.

The Fairbanks sea-level curve renders obsolete all earlier proposed eustatic sea-level curves (Van Andel 1990a). However, uranium-thorium ($^{230}\text{Th}/^{234}\text{U}$) dates of the same Barbados corals, obtained by mass-spectrometry, have raised doubts over the exact chronology of the curve (Bard *et al.* 1990). It is now well documented that radiocarbon dating is not an accurate chronometer, because the atmospheric $^{14}\text{C}/\text{C}$ ratio changes with time. Before 10,000 BP, the ^{14}C timescale cannot be accurately calibrated because of the lack of suitable fossil trees for dendrochronological dating, and ^{14}C dates from this period are consistently younger than true ages. The Th dates from the Barbados corals are consistently older than the ^{14}C dates from the same corals, and comparisons between them suggest that the late glacial ^{14}C timescale is significantly compressed. The adjusted ^{14}C timescale shifts the last glacial maximum back from 18,000 BP to 21-22,000 BP (Stuiver 1990).

However, it is necessary to question the relevance of the global eustatic sea-level curve in an archaeological context. Firstly, it is a fallacy to believe that since all

oceans are connected, then change in sea-level would follow a universal pattern (Kidson 1982). Eustasy is a regional phenomenon, and therefore, for local applications, a global eustatic curve such as that of Fairbanks needs to be adjusted to allow for the gravitational attraction of ice sheets, hydro-isostasy (isostatic compensation) and local tectonics (Van Andel 1990a). Secondly, human behaviour does not relate to such an abstract concept as global sea-level, but to local sea-level and its impact on resource availability (Van Andel 1989). Therefore, we should be concerned with the reconstruction of regional palaeoshorelines and local shore environments, and their changing character over time, rather than with a model of universal application.

The Adriatic Sea can be divided into two basins: a shallow (-150 m) transgressional basin north of the Pomo trench (Pesaro) and, to the south, a deep (-1,200 m) basin of subsidence which links up with the Ionian sea at Otranto (Zunica 1976). At the last glacial maximum, the northern Adriatic basin was occupied by a vast coastal plain traversed by meltwater rivers coming from the Alps and northern Apennines (D'Ambrosi 1969; Bortolami *et al.* 1977). The coast of the southern part of the Adriatic was also fringed by a coastal plain, varying between 10 and 60 metres wide (Figure 2:5).

There is a lack of detailed studies of palaeoshorelines in the Adriatic region. The best available to date is Van Andel and Lianos' (1984) average sea-level rise curve, compiled from data in Bloom (1977). The sea-level between 18,000 BP and 15,000 BP is estimated at -118 metres (64 fathoms). A period of rapid rise between 15,000 BP and 11,000 BP brought the sea-level up to -54 metres (39 fathoms), giving a rate of rise of 16m/kyr. There then followed a halt between 11,000 BP and 10,000 BP (the Younger Dryas event), and then a second period of rapid rise of 17m/kyr between 10,000-9,000 BP, bringing the sea-level at 9,000 BP up to -37 metres (20 fathoms). By 9,000 BP the coastal plains had largely disappeared, and between 9,000 BP and 8,000 BP the rate of rise slowed to 10m/kyr bringing the 8,000 BP sea-level

to -27 metres (Van Andel and Lianos 1983, 1984; J.C.Shackleton *et al.* 1984). These calculations take into account the isostatic rebound posterior to the melting of the Würmian ice load on the Alps, which is estimated to have been about 20 metres (Bortolami *et al.* 1977). The changing position of the late glacial shoreline in relation to each archaeological site will be presented in Chapter 3.

Finally, a brief mention should be made of late glacial Mediterranean sea temperatures and salinity, which would have affected the species composition and distribution of marine fauna. The modern Mediterranean sea is an evaporitic basin with a lagoonal-type circulation, in which light water from the Atlantic flows in at the surface in exchange for deep outflow of denser water through the Straits of Gibraltar. The minimum sea temperature at 17,200 BP is estimated to have been similar to that now prevailing in Newfoundland (Emiliani 1955). Temperature reconstructions by Thunell (1979), on the basis of cores taken from the eastern part of the basin, maintain a late glacial seasonality as marked as that seen in the modern Mediterranean, which contrasts with the reconstructions made by Thiede (1978) derived from transfer functions based on North Atlantic data.

Cores recently taken from the southern part of the Ionian Basin have been found to contain a late glacial sequence of sapropel formation (Troelstra *et al.* 1991). Sapropel form during periods of low salinity, and the onset of sapropel formation at 16,000 BP has been attributed to a complex interplay of various parameters. The melting of the ice caps in the Northern Hemisphere resulted in the introduction of glacial meltwater into the Mediterranean, initially by means of rivers such as the Po, and subsequently by the introduction of isotopically lighter Atlantic water into the Mediterranean at 14,000 BP (Buckley and Johnson 1988). A further establishment of low salinity followed the Younger Dryas event centred at 10,500 BP, and this was added to at 9,000 BP by high runoff from rivers such as the Nile and the Po, caused by increased precipitation (Rossignol-Strick *et al.* 1982). A gradual return to normal Mediterranean salinities did not start until 7,000 BP (Troelstra *et al.* 1991).

2:6 CLIMATE AND VEGETATION

The modern Mediterranean climate is characterized by fluctuations in moisture, especially rainfall rhythm, rather than temperature. This rhythm of marked seasonality, with summer drought and mild winters, was established in the late Pliocene, and the periodicity and amplitude of successively dry and humid fluctuations has increased up to the present (Suc 1984). The establishment of the Mediterranean altitudinal zonation of vegetation occurred at the Plio-Pleistocene boundary, and the following vegetational belts can be distinguished: a coastal 'Mediterranean belt', with thermophilous evergreen forest and/or *macchia* (*Olea-Ceratonia* association with *Pistacia*, *Erica*, *Phillyrea* and *Myrtus*); a 'submediterranean belt', of both evergreen (*Quercus ilex*) and deciduous (*Carpinus orientalis*, *Quercus pubescens*) woodland and/or shrubs (*Rhamnus*); a 'submontane belt', of broad-leaved deciduous trees (*Fraxinus ornus*, *Quercus* sp., *Carpinus betulus*, *Carpinus orientalis*, and *Castanea sativa*); and a 'mountain belt', with *Pinus*, *Abies*, *Fagus*, *Picea* and *Tsuga* (Bertoldi *et al.* 1989).

Pollen data suggest that during the last glacial maximum the mean annual temperature in the Mediterranean region was 6° below the present value (Peterson *et al.* 1979), and that the climate was dry (Van Zeist and Bottema 1982). In central Italy, the snow-level during the last glacial maximum was at 1700 metres (Malatesta 1985). The data on the principal plant species that occur in the late glacial pollen record of southern Europe is taken from Huntley and Birks (1983):

Artemisia sp. is a herb or small shrub that is found in a variety of open, often unstable, treeless habitats. The majority of the European species are associated with xeric habitats, especially steppes, in southern Europe. A vegetation with abundant *Artemisia* indicates a dry, continental climate with warm summers, which result in well-drained, xeric soils. Therefore, the widespread occurrence of *Artemisia* in late glacial southern Europe contradicts the assumption (by Zeuner 1959) of a wet (pluvial) climate in the Mediterranean during the late glacial.

Chenopodiaceae are herbs or shrubs, commonly associated with arid and/or saline open, treeless habitats, often with unstable soils. Most of the European species today are restricted to the Mediterranean and south-east Europe. As with *Artemisia*, the extensive distribution of Chenopodiaceae in southern Europe during the late glacial implies an arid steppe environment.

The continued abundance of *Artemisia* and Chenopodiaceae in southern Europe at the beginning of the Holocene contrasts with their rapid decline in northern Europe at end of the late glacial. This suggests that, in southern Europe, aridity probably declined more slowly than temperatures rose, though by 9,500 BP, southern Europe was no more arid than today .

Ephedra sp. is a procumbent shrub, characteristic of Mediterranean *macchia* or arid scrub in steppe areas. Like *Artemisia* and Chenopodiaceae, *Ephedra* was widespread in southern Europe during the late glacial, and was still present in significant quantities in the Mediterranean region after 9,000 BP.

Gramineae (grasses) is a diverse taxon including the majority of wild grasses native to Europe, which occur in almost every habitat from woodland to steppe.

Cyperaceae (sedges) are tufted plants which also occur in a wide range of habitats, but are especially associated with treeless vegetation in moist, cool environments.

Juniperus sp. (Juniper) is primarily associated with scrub or open woodland, avoiding waterlogged soils. Widespread in southern Europe during the late glacial, by 10,000 BP *Juniperus* communities had been displaced by expanding broad-leaved forests.

Quercus sp. (Oak) includes both deciduous (eg. *Q.pubescens*) and evergreen (eg. *Q.ilex*) forms, which vary from low shrubs to tall forest trees. *Quercus* is taxonomically and ecologically a diverse species, and in the Mediterranean region a

wide range of oak-dominated vegetation is found, ranging from scrub to steppe-woodland to forest. The species was widespread in the Mediterranean during the late glacial, when it was probably dominant in the plant community, and values increase in the Holocene. Evergreen oaks have a wider soil tolerance than the deciduous form, and occurred at relatively high latitudes during the late glacial.

Pinus sp. is a comparatively abundant element in late glacial pollen diagrams from the Mediterranean area, with values ranging between 30-60% of total land pollen. However, all the species are very prolific pollen producers, and produce pollen which is exceptionally well dispersed. Therefore, the sparsity of other tree pollen and the abundance of *Artemisia* and *Chenopodiaceae* pollen suggests that the high pine values may result from long-distance transport into a treeless environment.

The Mediterranean area provided a number of glacial refugia for mixed deciduous woodland species such as *Ostrya carpinifolia*, *Carpinus orientalis*, *Carpinus betulus*, *Fraxinus ornus*, *Alnus* sp. and *Corylus* sp.. These species were present in low values in late glacial southern Europe, and their increase in abundance and expansion in range at the opening of the Holocene at 10,000 BP was triggered by the climatic amelioration at that time.

Fluctuations in the late glacial eustatic curve are mirrored by comparable fluctuations in the pollen record. A recent analysis of a well dated core (KET 8003) from the Tyrrhenian sea off the north coast of Sicily (Figure 2:6), has demonstrated that oak pollen abundance and the isotopic composition of the sea water co-vary in phase with each other, with peaks in oak pollen preceding $\delta^{18}\text{O}$ depletion signifying a phase of climatic amelioration (Rossignol-Strick and Planchais 1989). The chronology of the core is based on six interbedded ash layers which have been correlated with radiocarbon dated lava flows from southern Italy on the basis of their chemical composition. The section of the core from 240-190 cm represents the last glacial maximum (end of isotope stage 2), with a low average abundance of oak pollen and a

dominance of Poaceae. At 190 cm, the isotope signal indicates the start of the decrease in ice volume (15,000 BP), which precedes the expansion of oak pollen abundance accompanied by high levels of *Populus*, starting at 14,000 BP. As the oak pollen abundance rises, the dominance of Poaceae is replaced by that of the classic steppe combination of *Artemisia*, Chenopodiaceae and *Ephedra*. This section of the core represents isotope stage Termination 1A. The next section is correlated with the Bölling-Alleröd, with an oak pollen peak at 122 cm and a decline of the three steppic taxa. At 112 cm, the $\delta^{18}\text{O}$ reversal which represents the Younger Dryas oscillation is radiocarbon dated to $12,970 \pm 180$ BP. This point marks the oak pollen minimum (a decline of 33%), accompanied by a general decline in arboreal pollen. Isotope stage Termination 1B (10,000 BP) sees a synchronous resumption of the deglaciation process and oak pollen abundance increase. Modern analogues for this pollen spectrum are found in south-east Europe and middle Asia. The dominant oak species, *Quercus robur pubescens*, today lives in temperate cool forests of sub-humid and humid altitudinal zones with 600-1,200 mm of rainfall.

The Italian terrestrial pollen record is extremely impoverished and poorly dated. At present there are only thirteen published cores from the mainland which represent the late glacial and early postglacial pollen spectrum: the cores from Bondone and Saltarino Sotto (Grüger 1968), Lago di Ledro (Beug 1964), Lago di Biandronno, Lago Viverone and Torbiera d'Alice Superiore (Schneider 1978) in the southern Alps; Lago di Monterosi (Bonatti 1970), Lago di Vico (Frank 1969), Lago di Martignano (Kelly and Huntley in press), Valle di Castiglione (Follieri *et al.* 1988) and Mezzaluna (Agro Pontino) (Eisner *et al.* 1986) in central Italy; and Laghi di Monticchio (Watts 1985) and Canolo Nuovo (Grüger 1977) in southern Italy (Figure 2:6).

The 775 cm core from Lago di Vico has eight pollen zones covering the period from the early Würm to the late Holocene, showing fluctuations between steppe and more closed vegetation. As the core has no ^{14}C dates, the age of the pollen zones was estimated by correlation with other diagrams. In pollen zone DIII (the Oldest

Dryas/Dryas I), the combination of steppe elements Gramineae, *Artemisia* and *Juniperus* reflect the aridity of the climate. In zone E (the Bölling-Alleröd), the association of *Corylus* and *Quercus* with high values for Gramineae and Cyperaceae suggests that the climate was both more humid and warmer, with the effect of increased precipitation being partly cancelled by higher temperatures. In zone F (the Younger Dryas), the climate becomes considerably drier again, as indicated by the dominance of Gramineae, Chenopodiaceae and *Artemisia*, but the humidity was high enough to enable the growth of *Quercus*, *Alnus* and *Ostrya*. The early postglacial saw the development of a broad-leaved forest of *Quercus*, *Corylus*, *Fagus*, *Carpinus*, and *Alnus* (Frank 1969).

The 248 cm core from Lago di Monterosi spans the period $24,260 \pm 1,300$ BP to 984 ± 72 BP. An *Artemisia*-steppe period extends from the base of the core to about 15,000 BP, after which a dominance of Gramineae pollen suggests the evolution of a less arid grassland. Subsequently, at about $10,920 \pm 210$ BP, *Corylus* appears, followed by the development of a mixed deciduous woodland composed of *Quercus*, *Abies*, *Salix*, *Alnus*, *Carpinus*, *Ulmus*, *Fagus* and *Tilia* (Bonatti 1970).

The core from Lago di Martignano provides an 11,000-year record of vegetation. The earliest pollen spectra are dominated by *Artemisia* and Gramineae, while broad-leaved forests were established by circa 11,000 BP, with *Quercus* sp. initially dominating the canopy (Kelly and Huntley, in press).

The 2550 cm core from Laghi di Monticchio, at 520 metres above sea-level in the Basilicata Apennines, is geographically the nearest core to the region of Puglia. The late glacial section of the core is characterized by an abundance of grasses, *Artemisia*, juniper and pine. Grasses and herbs, which are still abundant during the initial Holocene birch-oak expansion, decline when the forest becomes more diversified. The radiocarbon dates, which place the Pleistocene/Holocene boundary between $18,290 \pm 280$ BP and $21,200 \pm 500$ BP, seem dubious, though the possibility must be entertained that the dates are in fact correct, in which case a forest development took place remarkably early in southern Italy (Watts 1985).

In the core from a peat bog near Canolo Nuovo (at 900 metres above sea-level) in southern Calabria, Zone B represents part of the Older Dryas period. The pollen spectrum is dominated by *Artemisia*, Gramineae and Chenopodiaceae, though small quantities of *Fagus*, *Picea*, *Quercus*, *Alnus* and *Pinus* suggest that trees might have existed in the belt below 900 m. There is a ^{14}C date at the top of zone B of $12,385 \pm 125$ BP. A hiatus between zones B and C covers the period of early postglacial reforestation (Grüger 1977).

As would be expected, the six cores from the southern Alps all have high values of non-arboreal pollen such as *Artemisia*, Chenopodiaceae and Gramineae. Until the postglacial, aridity was probably the main factor restricting tree growth to the lower altitudes, where thermophilous species such as *Quercus* was present. The early postglacial reforestation was preceded by a long shrub phase characterized by *Juniperus* and *Alnus*. Three of the cores have ^{14}C dates: Torbiera d'Alice Superiore dates from $14,200 \pm 150$ BP to $9,850 \pm 120$ BP; Lago di Biandronno from $14,290 \pm 100$ BP to $9,200 \pm 100$ BP; and Bondone has one date of $9,580 \pm 135$ BP.

The only core from a lowland site is that from Mezzaluna in the Agro Pontino. The transition from Pleistocene to Holocene is very gradual, with a steady decline in herbs and grasses and an increase of regional arboreal pollen starting at $15,850 \pm 500$ BP, and with local arboreal pollen appearing after $9,860 \pm 130$ BP (Eisner *et al.* 1986).

Comparable climatic data is available from pollen cores from elsewhere in the Mediterranean region (Figure 2:6). Recently, a well dated core from the peat bog at Padul (Granada), in Spain, has provided a detailed pollen sequence that spans the late pleniglacial to the early postglacial (Pons and Reille 1988). At $15,200 \pm 80$ BP, the Padul 3 core shows a decline in *Pinus* values and an expansion of steppe cover with Poaceae and *Juniperus*, which marks the beginning of the Oldest Dryas. A climatic amelioration at 13,000 BP is characterized by a predominance of *Quercus* at low and mid altitudes, with *Juniperus* at higher elevations. The next zone represents the Younger Dryas, with much reduced values for *Quercus ilex*, and an increase in

Artemisia, *Chenopodiaceae* and *Ephedra*. The presence of these steppic elements, accompanied by only minor changes in the altitudinal distribution of other species, suggests that the main climatic characteristic of the Younger Dryas oscillation was aridity rather than low temperatures. The onset of the postglacial climatic amelioration, at $9,930 \pm 110$ BP, is marked by a sudden recurrence of high values of thermophilous vegetation, such as *Quercus ilex* and *Pistacia*.

At the other end of the Mediterranean, there are three cores from Greece which cover the late glacial and early postglacial period. The core from Xinias, at 500 metres above sea-level, is characterized by a very low presence of trees and a uniformity of the diagram from 25,000 BP to 10,000 years BP, while the oak expansion at the beginning of the Holocene is dated to $10,580 \pm 90$ BP (Bottema 1979). In the core from Ioannina in north-west Greece, at 470 metres above sea-level, trees including oak, fir, pine and birch, were present in significant quantities before 15,000 BP, and there is a less sharp transition from Pleistocene to Holocene, which suggests that some trees may have survived the Pleistocene in this area (Van Zeist and Bottema 1982). Finally, in the core from Tenaghi Phillipon the beginning of the Holocene is marked by a steep rise in *Quercus*, followed by the subsequent arrival of *Corylus*, *Carpinus*, *Ostrya*-type and finally *Abies* (Wijmstra 1969; Wijmstra and Smit 1976).

The combined picture for the late glacial in central and southern Italy is one of alternating phases of aridity and humidity. From 15-13,000 BP (Oldest Dryas), an open, treeless vegetation of steppic type indicates an arid climate; the period from 13-11,000 BP (Bölling-Alleröd) was characterized by higher temperatures and higher precipitation rates, as indicated by the increase in arboreal pollen values; 11-10,000 BP (Younger Dryas) saw a return to more arid conditions, though the combination of steppe vegetation with some trees suggests that conditions were less extreme than during the Oldest Dryas; and at 10,000 BP, the postglacial climatic amelioration triggered an increase and expansion of thermophilous vegetation.

2:7 FAUNA

There are three factors which are likely agents in delimiting an animal species' distribution: topographical barriers, climate, and flora. Some animals may respond directly to climatic change, by their intolerance of winter cold or summer heat, but most mammals, being warm blooded, only respond to indirect climatic influences, such as the altitude of the snow line, the availability of water, and the availability of appropriate food (Wright 1984).

Animal species have well defined habitats, and the species composition of ungulate faunal remains from archaeological sites is often used as a means of refining palaeoclimatic and vegetational reconstructions. However, there is the question of to what extent the presence/absence and relative abundance of ungulate remains in an archaeological deposit are a true reflection of the local habitat, rather than a reflection of human and carnivore hunting strategies, and to what extent the bone assemblages have been distorted by taphonomic processes. Human predation strategies are very selective, involving such unquantifiable factors as preference and choice, and are also determined by the effectiveness of the available technology and the ease of capture of different species. Archaeological bone assemblages of ungulate species could therefore be a reflection of human technology, mobility patterns and subsistence modes, rather than a true reflection of the local biotic community. An experiment was conducted in the Amboseli Park (Kenya) in order to see how accurately a recent bone assemblage reflected a census of the species diversity of the area, and to evaluate the taphonomic effects of geologic and biologic processes on the assemblage. The results showed that although the habitat distributions of all the major herbivore species were reflected in the assemblage, species representation was a function of body size, and that predepositional taphonomic processes tended to destroy the smaller bones, thus leading to an over-representation of the larger ungulate species (Behrensmeyer and Dechant Boaz 1980).

Faunal assemblages from non-archaeological deposits are rare, and in Puglia the only natural faunal assemblages to date are those from S.Isidoro (Maglie) and Cardamone (Novoli), where an Upper Pleistocene-type fauna was found in vertical karstic fissures (*ventarole*), filled with red earth deposits covered by a series of brown earth deposits (A.C.Blanc and Cardini 1957; Cardini and Cassoli 1961; De Lorentiis 1961; Lacorte 1990). However, there are no absolute dates available, and no quantification was made of the species composition. It is not possible to use archaeological faunal data *both* for palaeoenvironmental reconstruction *and* as a means of investigating the element of selection in hunter-gatherer subsistence strategies, without creating a circular argument. By modelling which species would have been available according to the environment, and by comparing this with the relative abundance of species actually found in the archaeological sites, it should be possible to observe processes of human subsistence choice and selectivity, once the potential role of carnivores has been factored out. Therefore, as hunting selection is of considerable interest from the point of view of contributing to an understanding of lithic technology, it was decided to exclude fauna as a means for regional palaeoenvironmental reconstruction. In Chapter 3 I shall record the faunal remains recovered from the archaeological sites, and in Chapter 7 I shall return to consider their significance from the point of view of hunter-gatherer subsistence strategies. Here I will state briefly the salient ecological and behavioural characteristics of the ungulate species that occur in these deposits. Unless otherwise stated, the following data are derived from Corbet (1966) and Nowak and Paradiso (1983).

Red deer (*Cervus elaphus*) tend to be associated with deciduous woodland habitats in montane areas. However, Flerov (1960) argues that the present day distribution of the species is a result of displacement caused by human pressure, and that the red deer was originally a creature of steppe or open forest. Darling (1937), in his classic study of red deer behaviour, pointed out that, unlike roe deer (*Capreolus capreolus*), red deer are not true woodland creatures; for while roe deer move by

bounding, a method useful in undergrowth, red deer trot. Worldwide the species is notably adaptable to a wide range of climatic, topographic and vegetational conditions (Straus 1981). Red deer are both browsers and grazers. In woodland habitats they feed on leaves, berries, and fungi, and in open country, grasses, herbs, and lichens. They are a highly gregarious species, though the size of the herd varies, depending on the habitat. Females and juveniles form large herds, which may number twenty in woodland habitats and one hundred in open country, and have well defined home ranges (Clutton-Brock and Albon 1989). These herds are fairly compact, though they may break into smaller herds in the summer when, in mountainous country, they migrate to higher ground. Mature stags form independent herds, and in woodland habitats they are often solitary. During the rutting period in October, the stag herds break up, and the stags enter female herd territories.

Roe deer (*Capreolus capreolus*) are small deer, primarily of deciduous and Mediterranean woodland zones, where they are mainly confined to the wooded valleys and lower slopes of mountains under 2,400 metres. They are predominantly browsers, eating the leaves of trees and shrubs, but they also graze on grass, berries, fungi and, in the autumn, acorns and beech mast. Roe deer are the most solitary of the indigenous deer in Europe, living alone or in small groups, and are nocturnal or crepuscular in their habits. Males are territorial before and after the rut, which takes place in July and August. Roe deer are more tolerant than red deer of areas where there is no surface water (Prior 1968).

Chamois (*Rupicapra rupicapra*) is a south European alpine species, a subspecies of which (*Rupicapra rupicapra ornata*) still lives in the Apennines. Chamois live in alpine forest around the level of the treeline, ranging up to the snow line in summer, and moving down to the forests in winter, though some populations live permanently in the forest. Accordingly, they are both grazers and browsers, eating a variety of grasses and other herbaceous plants on the high alpine pastures, and browsing on both deciduous and coniferous trees in the forest. Primarily a diurnal

species, chamois make regular movements between feeding and resting areas. The females and young live in groups of between fifteen and thirty individuals, which unite into herds of up to several hundred during the rutting season, from mid October to December. The males are solitary, joining the herd only for the rut.

Ibex (*Capra ibex*) is a wild goat species which lives at much higher altitudes than the chamois, on rocky crags and high alpine meadows, and descends only as far as the forest fringe. Both a browser and a grazer, ibex feed predominantly on shrubs, including heather, grasses, sedges and lichens. Population densities are variable; in the Alps the density is 9/km². Male ibex live apart from the groups of females and young, occupying higher ground and forming their own groups of between twenty and thirty individuals. Both groups rest on high ground during the day, descending to feed on the lower pastures at night. Herds of up to a hundred form for the rut, which takes place in mid-winter (December and January). Some populations have definite seasonal migrations, moving up into the high mountain pastures in spring in search of new feeding areas, and down to lower levels in the autumn and winter to avoid deep snow.

The wild ass (*Equus asinus hydruntinus*) is mostly found on desert or steppic plains, where it grazes on low sparse shrubs. The wild ass can go for longer periods without water than other equids, and can survive with a minimum amount of food. Today it is restricted in its distribution to small areas of Ethiopia and Somalia, as a result of excessive hunting and habitat deterioration. It is a solitary, territorial species, forming transient groups of variable composition.

The wild horse (*Equus caballus*) is an animal of steppes and deserts. The diet of the wild horse is exclusively restricted to grasses. It is a gregarious species, though not territorial, and the animals tend to live in bands, each with one or more stallions and their 'harems' of females and young.

Wild boar (*Sus scrofa*) live in the deciduous and Mediterranean woodland zones, avoiding dry steppe and favouring habitats with a dense vegetation cover. They

are a solitary omnivorous species, feeding principally at night and spending the day in a lair. After the rut (November to February) when herds form of between twenty and one hundred individuals, the males return to their solitary existence.

The aurochs (*Bos primigenius*) lived in open forest and meadows, feeding on grasses, leaves and acorns, in small herds composed of one bull, several females, and their young. The last aurochs died in the Jaktorow Forest near Warsaw in 1627 (Kurtén 1968).

The modern habitats of the principal species of marine mollusc which occur in the south-east Italian late Palaeolithic sites is presented in Table 2:1. The sources for this table are Riedl (1963) and Fiedler (1967). Combined with the reconstruction of the late glacial shorelines, these data will provide a basis for establishing in Chapter 7 the relationship between what was *potentially available* for human exploitation at each site and what was *actually* exploited, and therefore human selection processes can be monitored accordingly.

2:8 DISCUSSION

The reconstruction of the late glacial and early postglacial palaeoenvironment of Puglia is summarized in Table 2:2. The end of the last glacial maximum, between 18,000 BP and 15,000 BP, was a cold arid phase with an open steppe vegetation composed of *Artemisia*, *Chenopodiaceae* and *Ephedra*. The sea-level was at a low point of -118 metres and a plain varying between 60 and 10 kilometres in width fringed the Puglian coast.

15,000 BP marks the beginning of the deglaciation, and the sea-level rose rapidly at a rate of 16m/kyr to a level of -54 metres at 11,000 BP. The coastal plain would therefore have been reduced by at least 50%, and in some places totally submerged. During this period, a progressive decline of the steppe vegetation and the

appearance of mixed deciduous woodland elements such as oak and poplar suggests an increasingly mild and humid climate.

The Younger Dryas event, between 11,000 BP and 10,000 BP, saw a halt in the sea-level rise. The return of a steppe vegetation suggests that the climate was cold and arid, though the presence of some trees indicates that the climate was less severe than during the last glacial maximum.

10,000 BP saw the return of mild and humid conditions. A rapid rise of sea-level at a rate of 17m/kyr brought the sea-level up to -37 metres, and the coastal plain would have been more or less submerged throughout the region. The vegetation was characterized by a mixed deciduous woodland of oak, beech, and hazel.

This palaeoenvironmental reconstruction has been at a very basic and synthetic level, primarily because more refined data for the region are lacking. The aim of this chapter was to demonstrate the broad temporal and spatial variability of potentially 'limiting factors' from the point of view of hunter-gatherer behaviour, such as the distribution of cryptocrystalline rocks suitable for stone tool manufacture, subsistence resources and fresh water sources. Undoubtedly there were minor oscillations within the major climatic phases identified here which would have been noticeable on a human time-scale, and these oscillations are reflected in the sediments of the archaeological stratigraphies and will be discussed in detail in Chapter 3.

The effects of rising sea-levels would certainly have been noticeable on a human time-scale. Firstly, rising sea-levels would have caused a corresponding upward movement of the inland water table, which would have affected the distribution of fresh-water springs. This might have been particularly important in the Salento peninsula and the Murge, which lack surface water in the form of rivers. Secondly, the rising sea-levels would have influenced the spatial and temporal availability of subsistence resources. The Adriatic coastal plain before 15,000 BP may have been sufficiently productive to support semi-sedentary hunting bands throughout the year, without necessitating summer forays into high country as is often assumed (eg., Higgs and Vita Finzi 1972; Barker 1981). Between 15,000 BP and 9,000 BP,

the rising sea-levels would have resulted in the progressive segmentation of these once continuous plains into smaller fragments that would have been no longer capable of supporting large migratory herds. One could also postulate that a much closer seashore would have allowed a more substantial marine contribution to the diet. Accordingly, one would expect to see a proportional change in the subsistence base, and a change in the technology adapted to the exploitation of these new resources. One might also expect to see a reduction in the intensity of the occupation of the coastal sites as a result of the changing subsistence base, though on the other hand, the amelioration of the climate may have enhanced the natural resources to the point where a smaller territory could support the same or a larger population, which may have therefore prompted an intensification of site occupation. These and other questions will be considered in more detail in Chapters 3 and 7. Up to this point, the question of sea-level rise and resulting land loss has been discussed in general regional terms. The actual amount of land loss depends on the local off-shore bathymetry, which is highly variable around the region. In Chapter 3 I will suggest reconstructions of the relationship of each site to the changing shorelines during the period studied, linking this to descriptions of the local environment of each site and details of their stratigraphies.

CHAPTER 3

SITES AND STRATIGRAPHIES

3:1 INTRODUCTION

The aim of this chapter is to introduce the sites in south-east Italy with lithic assemblages that have been attributed to the late Palaeolithic, and to describe their location, environment, and stratigraphies. While Chapter 2 was concerned with the environment at the macroscale, the region, this chapter considers the environment at the microscale, the site. The microenvironment of a site is defined in terms of the local physical and biotic parameters that would have influenced the original site selection, that were effective during the use of the site, and that were responsible for its subsequent preservation (Butzer 1982). A retrospective analysis of the sediments from the archaeological sites should allow the broad regional climatic framework presented in Chapter 2 to be refined. The principal sources of information for this chapter are the excavators' reports, which are of variable quality, and I have added my own interpretation wherever possible. It is the first time that this information has been gathered together for the region as a whole.

Previous environmental and climatic interpretations of the south-east Italian sites have been based on inferences made from the ungulate remains contained in the archaeological deposits. Ungulates can be broadly categorised into either woodland types or open grassland types, depending on their diet. Woodland type fauna and flora are generally associated with temperate humid climatic phases, while open grassland type fauna and flora tend to be associated with cold arid climatic phases. The general picture obtained from the late glacial large vertebrate faunal remains from south-east Italy is one of a cycle of species types, fluctuating between grassland types (eg., *Equus caballus*, *Equus asinus hydruntinus*, *Capra ibex*, *Rupicapra rupicapra*) in the continental arid phases of Dryas I, Dryas II and Dryas III, and forest/woodland types

(eg., *Bos primigenius*, *Sus scrofa*, *Cervus elaphus*, *Capreolus capreolus*) in the temperate humid phases of the Bölling and Alleröd interstadials.

The reasons against using the presence/absence or relative percentages of ungulate species as stratigraphic markers or *leitfossils* were briefly discussed in Chapter 2. Carnivores and microfauna, on the other hand, are more suitable palaeoenvironmental indicators, as they tend to represent natural death assemblages rather than man-made assemblages, and are therefore a less biased and more complete reflection of a living community. Carnivores are present in most of the south-east Italian sites. The red fox (*Vulpes vulpes*) mainly lives in woodland but can also be found on open moorland. The wolf (*Canis lupus*) has a wide distribution and is very adaptable to different climates and vegetation. Therefore it can be found in woodland, tundra, and dense forest. Wolves are still found today in the mountains of the Abruzzo region. The wild cat (*Felis sylvestris*) lives in deciduous woodland and scrub. The lynx (*Felis lynx*) is found in lowland scrub, while the pine marten (*Martes martes*), mainly favours coniferous and mixed woodland, but is also found in deciduous woodland and sometimes on open rocky ground and cliffs. The badger (*Meles meles*) is found in deciduous woodland and also in open pastures or steppe, being most abundant where there is a mixture of the two. The weasel (*Mustela nivalis*) inhabits all terrestrial habitats, requiring little cover (Corbet 1966).

The brown hare (*Lepus europaeus*) and the rabbit (*Oryctolagus cuniculus*) are species adapted to open habitats. The European hedgehog (*Erinaceus europaeus*) is found in a wide range of habitats, including temperate deciduous woodland, Mediterranean steppe, and arid environments. The reptiles *Testudo hermanni*, *Testudo graeca* (tortoise) and *Emys orbicularis* (terrapin) all favour temperate, humid environments (Corbet 1966).

Most rodents which are identified only to genus level cannot be associated with a particular habitat, and while some species are habitat-specific, others tolerate a wide range of habitats and are consequently not very diagnostic. The water voles (*Arvicola* sp.) live in a variety of habitats where there is fresh water, including tundra, boreal

forest, deciduous forest, Mediterranean steppe, and forest steppe. Although they are usually associated with water, in some areas they live in normal dry habitats. Of the grass voles (genus *Microtus*), the field vole (*Microtus agrestis*) is found in all grassland habitats provided that the grass is long enough to provide cover, such as in open woodland and Mediterranean steppe; the snow vole (*Microtus nivalis*) mainly lives on open mountain slopes above the tree line, but is also found on low hills with dry woodland; and the common vole (*Microtus arvalis*) favours all grassland including short grass. Today, *Microtus* sp. is not found in Italy south of the river Po. The pine voles (*Pitymys* sp.) live in grassland and open woodland. Despite their name, wood mice (*Apodemus* sp.) inhabit both woodland and grassland habitats. The wood mouse (*Apodemus sylvaticus*) and the hazel doormouse (*Muscardinus avellanarius*) both live in deciduous woodland which have a dense undergrowth of shrubs. The garden doormouse (*Eliomys quercinus*) is less strictly arboreal than other doormice and is often found in scrub and rocky areas, though its main habitat is woodland (Corbet 1966).

The use of ecological information obtained from modern day representatives of an animal species as proxy data for establishing their ecological characteristics in the late glacial involves the assumption that the modern ecological relationships observed today have operated unchanged throughout history. However, the extent to which human hunting pressures and habitat deterioration are responsible for determining the modern habitat characteristics of any species is unknown. An alternative approach to microscale palaeoenvironmental reconstruction, which has hitherto been largely neglected by researchers in southern Italy, is to use the nature of the sediments of stratified cave deposits to reconstruct the climate that prevailed during their deposition. The sedimentary deposits of archaeological sites provide a potential source of important information for the sequencing of artifact industries, and also provide a detailed record of climate history: the changes in temperature and humidity that were directly responsible for the variety of textures, colours and alterations of the

sediments, and for the morphology of the individual grains. Sediments tend to be the result of a continuous event rather than an intermittent phenomenon, and therefore the climatic record of a cave site's sediments is much more complete than is the cultural or faunal record of its archaeological horizons (Laville *et al.* 1980). An analysis of cave and rockshelter deposits can thus provide us with a detailed scheme of climate history, each phase of which is defined in terms of a characteristic form and succession of sediments which in principal recur from one site to the next throughout a region. With the aid of such a scheme, cave and rockshelter sites can be then correlated with one another, according to the stratigraphic correlation of their sediments. This process of intersite correlation is based on analogy rather than identity; the sediments representing any given climatic oscillation are never precisely the same from one site to the next, as each site has its own peculiar parent rock, its own topographic position and its own occupational history (Laville *et al.* 1980).

The major processes which contribute towards the formation of limestone cave and rockshelter sediments can be broadly divided into either mechanical weathering or chemical weathering. Mechanical weathering, which involves the breakage and abrasion of rocks, occurs during cold periods. Frost weathering is the process by which rock fragments are spalled from the walls and ceiling of a cave as the water they contain expands as it freezes. This freeze-thaw fragmentation results in the deposition of *éboulis*, or limestone rock fragments, in the sediments. The degree of frost weathering to be attributed to a sediment is measurable in terms of its texture, in other words the average size of the limestone fragments, and the extent to which they dominate the sediment volumetrically. Severe cold conditions will result in freezing of considerable amplitude of the water deep in the cracks and fissures of the bedrock, and relatively infrequent periods of thawing. This results in the formation of **large** *éboulis*. Smaller *éboulis* occurs when conditions are less severe but still rigorous, and when the freeze-thaw cycles are more frequent but of a lesser amplitude, and therefore only result in a superficial disintegration of the ceiling and walls. The morphology of the *éboulis* is also diagnostic of the severity of the conditions under which it formed,

and **angular éboulis** indicates a particularly rigorous climate. A certain amount of fine-grained **aeolian sand** is also transported into caves and rockshelters during colder and drier climatic episodes, as the surface of the ground would have been less stabilized by vegetation and therefore more susceptible to wind erosion.

Chemical weathering, which entails phenomena in which rock is modified by chemical interaction with water under atmospheric conditions, occurs under warmer and wetter climates which prevail during temperate phases. Chemical weathering involves the dissolution of calcium carbonate from the limestone parent rock, which is deposited in the form of calcareous **concretions**.

Unfortunately, there are many factors which complicate this rather simplistic correlation between the type of weathering process, mechanical or chemical, and the type of climate that prevailed, cold and dry or warm and humid. Firstly, the distinction between the two is not always clear cut. For example, sands and silts that fall into the same size range as aeolian sand may have in fact derived from the disintegration of the limestone parent rock through chemical weathering rather than mechanical weathering. Secondly, the data used here for the sediment correlation scheme are derived from the publications of the site-reports, and the majority of the sites were excavated at a time when there was no standardized scheme for the description of sediments. The sediments from different sites were studied by different people and, as with artifact classification, different people have different ideas about colour, texture, size, angularity etc.. Finally, in addition to processes of chemical and mechanical weathering, the occupation of caves and rockshelters by humans also constitutes an agent of deposition and alteration of considerable importance. Humans may have modified their living space by activities such as importing slabs of limestone for the construction of fireplaces, or clearing away rock debris. In addition, acids produced by the accumulation of animal and vegetable matter may have promoted chemical weathering of the occupation surface and of the sediments immediately underneath it (Laville *et al.* 1980: 59-61).

Despite these problems, a retrospective reconstruction of the regional sediment correlation sequence would still appear to be a profitable exercise. Once the scheme of a stratigraphy's climatic history has been identified, this information can later be compared with the faunal remains contained within the sediments, in order to evaluate whether the species present are indeed representative of the local environment, or whether they reflect differential human predation strategies. Another advantage of the sediment correlation approach is that it frees us from the circular argument that arises from a dependence on the seriation of typological sequences of artifacts to establish intersite chronological correlations, which was discussed in Chapter 1.

Figure 3:1 shows the distribution of the late Palaeolithic sites discussed in this chapter. The sites are grouped here according to the geographical areas defined in Chapter 2: the Salento peninsula; the Murge; the Tavoliere; and the Gargano promontory. The stratigraphies are described from the lower levels upwards, and the laboratory reference number of each ^{14}C date is cited in brackets after the date. All radiocarbon dates are left uncalibrated, and 'BP' is used to signify radiocarbon years before 1950 AD. The majority of the published stratigraphic sections are diagrammatic, and therefore only the more complex stratigraphies are reproduced here, when it is considered that they serve to clarify the description given in the text.

3:2 THE SALENTO PENINSULA

To date there are eleven cave and rockshelter sites and nine surface localities with lithic assemblages that have been attributed to the late Palaeolithic. The sites are all located within an area of approximately 1500 square kilometres in the southern part of the peninsula, and all but seven of them are situated along the present day coastline (Figure 3:2).

GROTTA DELLE CIPOLLIANE

Grotta delle Cipolliane (or Grotta delle Presepe) lies on the Adriatic coast at 30 metres above sea-level, cut into a rocky coastal cliff of Plio-Pleistocene tufaceous limestone (*Calcareniti del Salento*), 2 kilometres south of Marina di Novaglie (39°51'20"N 18°23'19"E). It is the largest of a group of caves which face eastwards over the sea, and measures between twelve and fifteen metres in depth and nineteen metres across the mouth. The floor area is roughly 100 m², and the surface slopes gently in a north-south direction. Above the cliff the land rises steeply up to a plateau at 120 metres above sea-level, and then rises more gradually up to a plateau at 190 metres. The cave is located between two gorges which today carry seasonal torrents. At 15,000 BP there would have been a 10 kilometre wide coastal plain in front of the cave, watered by springs emerging at the foot of the cliff. By 11,000 BP, rising sea-levels would have reduced this plain to 0.5 kilometres, and by 9,000 BP it was completely submerged. Grotta delle Cipolliane was excavated by Palma di Cesnola in 1962 (Palma di Cesnola 1962) and by Gambassini in 1964 (Gambassini 1970). The stratigraphy is as follows (Figure 3:3):

Level 4: Brown (7.5 YR 5/4) calcareous sand of 80 centimetres thickness, resulting from the degradation of the base of the rockshelter, with lines of hearths towards the top along the northern wall (4A). Below this, and limited to the eastern part of the cave, is a browner soil with sparse carbon remains (4B) resting on lighter coloured sand (4C). The western part of the cave is filled by a natural rock pavement. The fauna is composed exclusively of *Equus caballus* and *Equus asinus hydruntinus*, and the lithic industry was attributed initially to the Gravettian (Palma di Cesnola 1962), and later to the Ancient Epigravettian phase with shouldered backed bladelets (Gambassini 1970). There are no ¹⁴C dates.

Level 3: Sandy clay intercalated with small lenses of very plastic red clay, with many hearths containing carbonised material including burnt bone. The upper part of

level 3 is a dark greyish brown colour (10 YR 3.5/2), while the lower part is dark grey (10 YR 3.5/1). The lithic industry was initially attributed to the typical Epigravettian (Palma di Cesnola 1962), and later to the Evolved Epigravettian (Laplace 1964b, 1966b; Gambassini 1970). The total thickness of the level is 40-60 centimetres, which was subdivided into three horizons: 3A, 3B, and 3C. Faunal remains are abundant, consisting of *Bos primigenius*, *Equus caballus*, *Equus asinus hydruntinus*, and *Cervus elaphus*. A series of three ^{14}C dates was obtained from charred bones: 15,000 $\pm$ 100 BP (R-353) from spits I-II; 15,270 $\pm$ 300 BP (R-355) from spit III; and 15,200 $\pm$ 100 BP (R-356) from spits VI-VII (Alessio *et al.* 1976).

Level 2: Calcareous coarse sand, originating from the local weathering of fossiliferous tufa. The lithic industry was attributed by Laplace (1964b, 1966b) and Gambassini (1970) to the Evolved Epigravettian, and by Palma di Cesnola (1962; *et al.* 1983) to the early Final Epigravettian. The matrix of the sediments is very similar to that of level 4. The upper part of the level is 40-50 centimetres thick, and is a pink colour (7.5 YR 8/4) with loose white horizons intercalated with hearths (2S). In the lower part of level 2, which is between 50 and 70 centimetres in thickness and light brown in colour (10 YR 6/3), black horizontal lines of hearths (2A) alternate with lenses of white, yellow or grey sand and some thin traces of hearths (2B and 2C). At the base of level 2, large boulders of rock-fall mark a clear boundary with the underlying level 3. Faunal remains are few, consisting of *Equus caballus*, *Equus asinus hydruntinus*, *Bos primigenius* and *Cervus elaphus*. Level 2B, which was culturally sterile, contained a notable abundance of micromammal remains, which were probably brought into the cave by raptors. The micromammals consist primarily of *Pitymys* sp. and *Microtus arvalis*, accompanied by *Arvicola* sp., *Apodemus* sp., *Eliomys* sp., and *Muscardinus* sp.. There are no ^{14}C dates.

The predominance of *Microtus arvalis* indicates an open grassland habitat, though the presence of *Muscardinus* sp. suggests the presence of some deciduous

woodland in the vicinity. As the other rodents are only identified to genus level, they could be associated with either grassland or woodland habitats.

Level 1: Dark greyish brown (10 YR 4/2) humic sandy clay of between 30-90 centimetres in depth. Towards the bottom, a lens of calcareous sand (1S) contained concentrations of organic material, carbon, an abundant lithic industry attributed to the late Romanellian phase of the Final Epigravettian (Palma di Cesnola 1962; Laplace 1964b, 1966b; Gambassini 1970), and a few intrusive fragments of Neolithic pottery brought in by animal burrowing. The faunal remains consist of *Equus caballus*, *Equus asinus hydruntinus*, *Bos primigenius*, *Cervus elaphus*, *Capreolus capreolus*, *Sus scrofa*, *Meles meles*, *Vulpes vulpes*, *Erinaceus europaeus*, *Lepus europaeus*, *Testudo graeca*, and *Microtus* sp.. Marine molluscs are also present, and consist of *Monodonta turbinata*, *Patella* sp., and *Glycimeris* sp.. There are no ¹⁴C dates.

A detailed study of the granulometry of the sediments was made by Gambassini (1970). Levels 2 and 4 are composed of much larger grains than levels 1 and 3. These are calcareous grains, larger than 250μ, which originated from local weathering of the cave walls. By contrast, granules smaller than 250μ predominate in levels 1 and 3. These sediments are composed of a combination of smaller calcareous granules and a sandy fraction, the latter containing a diversity of mineralogical components: quartz, feldspar, muscovite, granite, pyroxene and magnetite. These minerals are not of local origin, and indeed the calcareous nature of the whole region of Puglia means that the origin of such minerals is some distance away. It is most likely that some are derived from sedimentary rocks, while others came from the volcanic rocks of Monte Vulture in the region of Basilicata, 250 kilometres north-west of Grotta delle Cipolliane. As a result of the erosion of sedimentary rocks, lava and other pyroclastics, the minerals were probably transported by the river Ofanto to the sea in a much reduced and sandy form, and then carried southwards by marine currents. The sediments would eventually have been borne into the cave by aeolian processes. This suggests that during levels 1 and 3 a sandy beach was exposed below

the cliffs at Grotta delle Cipolliane (Gambassini 1970). According to the reconstruction of the palaeoshorelines, this would mean that the sediments of level 1 were deposited before 10,000 BP.

The granulometry of the sediments suggests a cycle of two modes of sediment deposition, fluctuating between local weathering in level 4, aeolian deposition in level 3, another phase of local weathering in level 2, and a return to aeolian deposition in level 1. Though the differences between the granulometry of the levels are clear enough to make these distinctions, there is no evidence to suggest that the changes between them were abrupt. On the contrary, the lower part of level 3 and the lower part of level 2 both show intermediate characteristics. There is however the suggestion of a hiatus between levels 2 and 1.

The results of this sediment study can be used to make inferences about the climate that prevailed during their deposition. In level 4, an arid continental climate prevailed, which accentuated the process of erosion of the cave walls. In level 3 the climate became more humid, suggesting a temperate oceanic oscillation, with less internal erosion of the cave and therefore a relatively lower calcareous element in the sediment. In level 2, the sediments suggest conditions analogous to level 4, with an increase in aridity towards the top. The sediments of level 1 are similar to those of level 3, but suggest that the climate was considerably more humid.

On the basis of the ungulate faunal remains and the ^{14}C dates, Palma di Cesnola *et al.* (1983) assigned the temperate humid phase of level 3 to the Angles interstadial, and the following continental arid phase of level 2 to Dryas I. Between level 2-2S and level 1, a phase of erosion suggests a hiatus, and level 1 was therefore assigned to the Preboreal. However, my reconstruction of the palaeoshorelines suggests that level 1 predates the Preboreal, and therefore here it is tentatively reassigned to the Bölling or Alleröd.

TAURISANO

The village of Taurisano lies inland at 110 metres above sea-level, 5 kilometres north-west of Ugento and roughly equidistant between the Ionian and Adriatic coasts (11 and 16 kilometres respectively). At Pietra L'Aia, 0.5 kilometres to the north-west of Taurisano (39°57'34"N 18°12'31"E), a collapsed rockshelter was found in a ridge of tufaceous Plio-Pleistocene limestone (*Calcareniti del Salento*) at 111 metres above sea-level. The surrounding terrain is flat, rising gently to a maximum of 150 metres above sea-level. The site was discovered only after it had been partially destroyed during the building of a house, and a rapid rescue excavation was carried out in 1964 by Cassoli (unpublished). The surface area of the excavation covered 9m², and a trench was dug to a depth of 4.5 metres, revealing the following stratigraphy (Figure 3:4):

Level C: 40 centimetres of deposit consisting of large limestone blocks (*éboulis?*) with a small amount of red earth. The level was excavated in four spits (spits 27-24), and contained a fauna of Equids and *Bos primigenius*, and a lithic industry attributed to the final Gravettian or "initial" Epigravettian (Bietti 1979).

Level B: Brown earth deposit with limestone pebbles. The deposit has a thickness of 2.4 metres, which was excavated in 23 spits of roughly 10 centimetres each:

Spits 23-6: The lithic industry was attributed to the shouldered backed bladelet phase of the Ancient Epigravettian (Laplace 1964b, 1966b; Bietti 1979). The faunal remains are comprised solely of large mammal species: *Bos primigenius*, *Equus caballus*, *Cervus elaphus*, *Equus asinus hydruntinus*, *Sus scrofa*, and *Canis lupus*. Three ¹⁴C dates were obtained from charred animal bone: 16,000±150 BP (R-1064) from spits 18-22; 15,600±120 BP (R-1063) from spits 10-12; and 16,050±160 BP (R-1062) from spits 6-9 (Alessio *et al.* 1978).

Spits 5-1: The lithic industry was attributed by Laplace (1964b, 1966b) to the phase of truncations and truncated backed bladelets of the Final Epigravettian, and by Bietti (1979) to a phase of transition between the Ancient and Evolved Epigravettian. The same faunal species are present as in spits 23-6. A ^{14}C date of $15,500 \pm 150$ BP (R-1061) was obtained from charred animal bones from spits 4-5 (Alessio *et al.* 1978).

Level A: Red earth, 60 centimetres in thickness and culturally sterile.

The ^{14}C dates place spits 23-6 in Dryas Ia, and spits 5-1 in Dryas Ia/Angles. Palma di Cesnola regards these dates with some reserve, on the basis that they give more or less the same date for a series of 2.4 metres thickness, and suggests that the date for spits 22-18 is too young while that for spits 5-1 is too old. Ignoring the dates, and on the basis of the ungulate remains and lithic typology, Palma di Cesnola and Bietti (1983) place level C in the Laugerie interstadial. After a hiatus between levels C and B, spits 23-6 of level B are assigned to the Lascaux/Dryas Ia. After another hiatus, between spits 6 and 5, the decrease of *Equus asinus hydruntinus* and *Equus caballus* and the increase of *Bos primigenius* in spits 5-1 is interpreted by Palma di Cesnola *et al.* (1983) as indicating a passage from a continental arid phase to a more temperate humid one, and on the basis of this spits 5-1 were assigned to Dryas Ib/Prebölling.

UGENTO

The locality of Fondo Focone lies on the Ionian coast eight kilometres west of Ugento and three kilometres north of Torre S.Giovanni ($39^{\circ}54'10''\text{N}$ $18^{\circ}5'28''\text{E}$). Today, the site is 350 metres from the sea, at 10 metres above sea-level. Two karstic cavities (dolines) in the Cretaceous limestone (*Calcari di Melissano*) were found to contain the remains of an Epigravettian type lithic industry and faunal remains. The cavities (Pozzo Zecca and Bocca Cesira) are roughly 20 metres in diameter, oriented north-south, and separated by a rock partition. The terrain slopes gently towards the sea in a south-westerly direction. At 15,000 BP the site would have been located on

the edge of a 10 kilometre wide coastal plain. By 11,000 BP, rising sea-levels would have reduced this plain to 5 kilometres, and by 9,000 BP it would have been further reduced to 3 kilometres. The site was discovered during the construction of a well in the middle of the lower basin, Pozzo Zecca, and was excavated by Cardini in 1961 (Cardini 1965). The stratigraphy of Pozzo Zecca is as follows:

Level 3: 0.5 metres of clayey red earth, culturally sterile.

Level 2: Brown earth with traces of hearths in the central part, surrounded by fragments of bones and lithics. The level is 1.5 metres in thickness. The lithic industry was attributed by Laplace (1964b, 1966b) to the phase of truncations and truncated backed bladelets of the Final Epigravettian, and by Cardini (1965) to the Romanellian phase of the Final Epigravettian. There are two ^{14}C dates from Pozzo Zecca, both obtained from burnt bone: $14,170 \pm 170$ BP (R-271) from spits I-II; and $13,870 \pm 110$ BP (R-272) from spits III-IV (Alessio *et al.* 1967).

Level 1: Three metres of rock-fall sealing the brown earth deposits, and culturally sterile.

Details of the stratigraphy of Bocca Cesira, which is one metre in depth, have not been published, and its exact stratigraphic relation to Pozzo Zecca is unclear. According to Cardini, the industry from Bocca Cesira appeared to be typologically less developed than that from Pozzo Zecca, on the basis of which it was attributed to the Pre-Romanellian phase of the Final Epigravettian (Cardini 1965). Laplace (1964b, 1966b) however makes no distinction between the two.

The faunal remains from Ugento consist of *Equus caballus*, *Bos primigenius*, *Equus asinus hydruntinus*, *Cervus elaphus*, *Sus scrofa*, *Vulpes vulpes*, *Canis lupus*, *Oryctolagus cuniculus*, *Lepus europaeus*, *Aves* (species undetermined), *Testudo graeca*, *Erinaceus europaeus* and *Emys orbicularis*. Marine molluscs were also present, consisting of *Patella* sp., *Monodonta* sp., *Venus gallina*, *Pecten jacobaeus*, *Cyclope neritea*, *Arca noae* and *Columbella rustica*. Unfortunately this list constitutes

the fauna from both cavities, and no distinction was made in the publication between the different levels. The ^{14}C dates from Pozzo Zecca place it during the Prebölling/Dryas Ic, and the presence of *Testudo graeca* and *Emys orbicularis* suggests a temperate, humid climate.

GROTTA ROMANELLI

Grotta Romanelli is located in a small cove on the Adriatic coast, 1.5 kilometres north of Castro Marina and 16 kilometres south of Otranto (40°00'55"N 18°25'59"E). The cave is cut into a vertical cliff face of Paleocene/Oligocene bioclastic limestone (*Calcari di Castro*), 7 metres above sea-level. The cave is 25 metres long and 15 metres wide, giving a floor area of roughly 375m², and the ceiling is 8 metres high. Above the cliff, the land rises steeply up to 128 metres above sea-level, and then slopes gently down to a wide plateau at between 80 and 90 metres above sea-level. There is a steep gorge 1.5 kilometres to the south of the cave with a seasonal torrent. At 15,000 BP there would have been a 25 kilometre wide coastal plain in front of the cave, watered by springs emerging at the foot of the cliff. By 11,000 BP, rising sea-levels would have significantly reduced this plain to only 2 kilometres in width, and by 9,000 BP it would have been reduced to less than 1 kilometre. Grotta Romanelli was first excavated by Stasi and Regalia (1904; Regalia and Stasi 1905), and was later re-excavated by G.A.Blanc (G.A.Blanc 1920, 1928a, 1928b, 1953; G.A.Blanc and Cortesi 1941). It is the only late glacial site in south-east Italy where plant remains have been recovered from the sediments (Follieri 1968; Follieri and Riello 1970). The plant remains were recovered in the form of 79 partially carbonized fragments of wood found in hearths. Amongst the species present, it was often difficult to distinguish between *Pinus sylvestris* and *Pinus montana*, and Follieri therefore groups them together as *Pinus sylvestris/montana* (see below). The stratigraphy of the late glacial levels is 3 metres in depth (Figure 3.5):

Level F: Stalagmitic concretion or breccia of 0-5 centimetres in thickness, which separates the red earth deposits (levels L-G, containing a warm-type fauna and

Middle Palaeolithic artifacts) from the overlying brown earth deposits containing an Epigravettian-type lithic industry and cold-type fauna. The presence of massive boulders in the breccia suggests that during this hiatus the entrance to the cave was blocked by a rock-fall, possibly caused by a period of karstic sinking. The nature of the sediments of level F, characterized by processes of chemical weathering, suggests a warm wet climate.

Level E: Brown sandy earth with few stones, 60 centimetres in depth. The matrix of the sediment is made up of very fine particles of sand, probably of aeolian origin, with some traces of hearths and a lithic industry attributed to the Romanellian phase of the Final Epigravettian (Palma di Cesnola *et al.* 1983). Of the avifauna, xerothermic marsh and lagoon species predominate over arctic types. The mammalian fauna is composed of *Equus asinus hydruntinus*, *Bos primigenius*, *Cervus elaphus*, *Capra ibex*, *Vulpes vulpes*, and *Lepus europaeus*. Marine molluscs were also present, consisting of *Patella* sp.. The flora is composed of *Fraxinus ornus*, *Populus* sp., *Quercus* sp., and *Pinus sylvestris/montana*.

Level D: Brown sandy earth, with abundant large angular stones, of 90 centimetres depth. There are various hearths, and some burnt rounded beach pebbles which could be hearth stones. The lithic industry has been attributed to the Romanellian phase of the Final Epigravettian (Palma di Cesnola *et al.* 1983). Aeolian sand is still present in the soil matrix, but the presence of intercalating lenses of angular *éboulis* indicates a clear climatic change between levels E and D to much colder, arid conditions. The mammalian fauna is composed of *Equus asinus hydruntinus*, *Cervus elaphus*, *Bos primigenius*, *Capreolus capreolus*, *Sus scrofa*, *Lepus europaeus*, *Vulpes vulpes*, *Felis sylvestris*, *Canis lupus*, *Meles meles* and *Lutra lutra*. Marine molluscs were also present, consisting of *Cyclope neritea*. The avifauna is composed of arctic types such as *Alca impennis*, *Gallina prataiola*, and *Otarda maggiore*. The flora is composed of *Pinus sylvestris/montana* and *Juniperus* sp..

There is one ^{14}C date from the Gröningen Laboratory of $10,640 \pm 100$ BP (GrN-2055), obtained from a charcoal sample (Vogel and Waterbolk 1963).

Level C: Brown sandy earth, very stony, of 70 centimetres depth. The sediments of level C are similar to those of level D, with alternating lenses of aeolian sand and angular *éboulis*, though the blocks of *éboulis* tend to be larger than in the level below. The lithic industry has been attributed to the Romanellian phase of the Final Epigravettian (Palma di Cesnola *et al.* 1983). The fauna consists of *Equus asinus hydruntinus*, *Bos primigenius*, *Cervus elaphus*, *Capra ibex*, *Capreolus capreolus*, *Sus scrofa*, *Vulpes vulpes*, *Canis lupus*, *Lynx lynx*, *Felis sylvestris*, *Lepus europaeus*, *Martes martes* and *Erinaceus europaeus*. Marine molluscs were also present, consisting of *Glycimeris* sp.. The avifauna is again composed of arctic types such as *Alca impennis* and arctic marsh and lagoon birds, and there are few xerothermic species. The presence of *Eliomys quercinus* suggests the presence of woodland. The flora is composed of *Pinus sylvestris/montana* accompanied by *Quercus* sp., *Populus* sp., *Fraxinus ornus*, *Fraxinus excelsior*, *Juniperus* sp., *Pinus pinea*, and *Ephedra* sp.. There are three ^{14}C dates available for level C. A Rome Laboratory date of $11,930 \pm 520$ BP (R-56) was obtained from a sample of humic acid (Bella *et al.* 1961). The two Gröningen Laboratory dates obtained from charcoal samples suggest a younger date for level C (Vogel and Waterbolk 1963): level C1: $10,390 \pm 80$ BP (GrN-2153); and level C2: $9,790 \pm 80$ BP (GrN-2154).

Level B: Brown sandy earth, stony, of 60 centimetres thickness. The percentage of angular *éboulis* among the matrix is significantly lower than in level C. The lithic industry has been attributed to the Romanellian phase of the Final Epigravettian (Palma di Cesnola *et al.* 1983). The mammalian fauna is composed of *Equus asinus hydruntinus*, *Bos primigenius*, *Cervus elaphus*, *Sus scrofa*, *Vulpes vulpes*, *Felis sylvestris*, *Canis lupus*, *Lepus europaeus*, *Meles meles*, and *Erinaceus europaeus*. Plant remains are absent, but the presence of *Microtus arvalis* suggests an open grassland habitat. There are no ^{14}C dates from level B.

Level A: Brown sandy earth with very few stones, 80 centimetres in depth. The lithic industry has been attributed to the Romanellian phase of the Final Epigravettian (Palma di Cesnola *et al.* 1983). The fauna is composed of *Equus asinus hydruntinus*, *Bos primigenius*, *Cervus elaphus*, *Vulpes vulpes*, *Meles meles*, *Lepus europaeus* and *Phoca monaca*. The presence of *Microtus arvalis* suggests the presence of an open grassland habitat in the vicinity. A xerothermic avifauna dominates over arctic types, and the flora is composed of *Fraxinus ornus* and *Populus* sp., with rare *Pinus sylvestris/montana* and *Quercus* sp.. There are four ^{14}C dates for this level. The first Rome Laboratory date of $11,800 \pm 600$ BP (R-58) was obtained from charcoal (Alessio *et al.* 1964), while the second date of $9,050 \pm 100$ BP (R-54) was obtained from humic acid (Alessio *et al.* 1965). Both of the Gröningen Laboratory dates were obtained from charcoal samples: level A3: $10,320 \pm 130$ BP (GrN-2305); and level A2: $9,880 \pm 100$ BP (GrN-2056) (Vogel and Waterbolk 1963).

On the basis of the sediments at Grotta Romanelli, the stratigraphy of the late glacial deposits can be divided into three phases. The first phase constitutes level E, where the dominance of aeolian sand in the matrix suggests a temperate climate. The second phase comprises levels D, C and B, which together represent a zone of cryoclastic *éboulis* derived from frost-weathering of the cave walls, indicating a change to colder and more arid conditions. The *éboulis* is relatively voluminous in levels D and B, while in level C the large size of the *éboulis* blocks suggests a cold peak. The third phase constitutes level A, which is made up of only small cryoclastic elements in a sandy matrix, suggesting a more temperate climate. On the basis of the faunal and floral remains, Cassoli *et al.* (1979) attribute the temperate forest phase of level E to the end of the Alleröd interstadial, the cold arid steppe phase of levels D to B to Dryas III, and the temperate forest phase of level A to the end of Dryas III/beginning of the Preboreal.

The presence of aeolian sand in the sediments of all the levels suggests that throughout the late glacial occupation of Grotta Romanelli a sandy beach lay at the foot

of the cliff, exposed by the late glacial marine transgression, and this is in accordance with the reconstruction of the palaeoshorelines. However, Cassoli *et al.* (1979) have attempted an elaborate reconstruction of the shoreline during Dryas III (Younger Dryas) when, according to Van Andel and Lianos (1984), there was a halt in the sea-level rise. According to the reconstruction of Cassoli *et al.*, during the first phase of Dryas III (level D) the sea-level was at -75 to -60 metres; the sandy plain was penetrated by arms of sea, and sand dunes began to build up next to the rocks exposed at the foot of the cliff. This was followed by a phase characterized by lagoons (level C), which formed when the arms were cut off by cordons of sand. Scrub and forest vegetation grew at the foot of the cliffs and in the valleys, while the plateau above was characterized by a cold steppic vegetation of *Ephedra*. The sea-level during this phase is estimated at -55 metres. Finally, in level B, the sea-level rose to -50 metres, partially submerging the outer littoral cordons. The salinity of the remaining lagoons was reduced by water input from freshwater springs rising at the foot of the cliff, and there was a new phase of sand dune formation (Cassoli *et al.* 1979). Such a detailed reconstruction as this can only be achieved using sidescan sonar data, seismic reflection records and bottom samples, while in fact the reconstruction was based exclusively on the pollen and bird remains found at the site. For this reason I am very sceptical of its validity.

There is a lack of concordance between the ^{14}C dates from Grotta Romanelli. The Rome laboratory dates were made on humic acids (Bella *et al.* 1961; G.A.Blanc and Blanc 1961b), which are believed to have derived from processes of humification that took place during the deposition of the sediments (G.A.Blanc and Cortesi 1941). Of this series, date R-54 from level A ($9,050 \pm 100$ BP) was considered to be too recent compared with the ages obtained for R-56 and R-58, and surface contamination of the palaeosol humus by small mammals was suggested as an explanation (Alessio *et al.* 1965). Dates R-56 and R-58 would place levels C to A at the beginning of the Alleröd. The ages from the Gröningen laboratory, which were obtained from charcoal samples, are all younger than those from the Rome laboratory (except for R-54). While three of

the dates (GrN-2055, 2153 and 2056) place levels D to A in the Younger Dryas, the other two dates (GrN-2056 and 2154) would place levels C to A in the Preboreal.

GROTTA DELLE VENERI

Grotta delle Veneri is located 2 kilometres north of Parabita (40°04'10"N 18°06'50"E), and ten kilometres from the Ionian coast. The cave, which is cut into a ridge of Cretaceous limestone (*Calcari di Melissano*), consists of two parts: the cave itself, and an external rockshelter. The stratigraphies of the two parts do not correlate with each other. At 175 metres above sea-level, it is the highest altitude site in the Salento peninsula. Above the cave the land rises to a limestone plateau at 193 metres, and below it falls quite steeply down to 75 metres. The mouth of the rockshelter opens to the south. Grotta delle Veneri was excavated in 1966-67 (Radmilli 1966, 1969), and the lithic assemblages remain essentially unpublished. The main cave contained lithics attributed to the Gravettian and Ancient Epigravettian periods:

Level B: Brownish grey concreted earth with a fauna of equids and an assemblage attributed to the Gravettian phase with truncated backed bladelets (Palma di Cesnola and Bietti 1983).

Level A1: Red concreted earth. The fauna consists of *Equus caballus*, *Equus asinus hydruntinus*, *Sus scrofa*, *Bos primigenius* and *Cervus elaphus*. A sparse lithic industry has been attributed to the "initial" phase of the Ancient Epigravettian (Palma di Cesnola and Bietti 1983).

Level A: Red-brown concreted earth. The fauna is dominated by equids, and the lithic industry has been attributed to the Ancient Epigravettian phase with leaf-shaped points (Palma di Cesnola and Bietti 1983).

The temperate phase corresponding to level A1, framed by two more continental episodes (levels B and A), has been placed in the Laugerie interstadial

(Palma di Cesnola and Bietti 1983). Level A would therefore date to Dryas I. The stratigraphy of the late glacial deposits of the external rockshelter is as follows:

Level C: Yellow-white loamy soil with lenses of grey earth concreted at the walls, 20-60 centimetres thick and culturally sterile, overlying an Uluzzian level (D).

Level B: Red sandy earth with small stones, 30-70 centimetres thick, incorporating large blocks of rock-fall. The lithic industry has been attributed to the late Romanellian phase of the Final Epigravettian period (Palma di Cesnola *et al.* 1983). The faunal remains consist of *Bos primigenius*, *Cervus elaphus*, *Sus scrofa*, *Equus asinus hydruntinus*, *Meles meles* and *Vulpes vulpes*.

Level A: Black humic earth with Neolithic pottery.

The lack of ^{14}C dates makes the chronology of these two stratigraphies difficult to resolve. The sediments in themselves are not particularly diagnostic, though the blocks of rock-fall in level B of the external rockshelter may well have resulted from the same period of karstic sinking in the Bölling as that which blocked the caves at Taurisano and Ugento and reopened Grotta Romanelli.

GROTTA DEL CAVALLO

Grotta del Cavallo (or Grotta delle Giumente) is one of a group of three caves with late glacial deposits situated on the Ionian coast in the arc of the Baia di Uluzzo, three kilometres north of Santa Caterina al Bagno (40°09'12"N 17°57'39"E). The cave is cut into a sloping cliff face of compact Cretaceous limestone (*Calcari di Melissano*) at 15 metres above sea-level. The top of the cliff is at 35 metres above sea-level, and from there the terrain rises gently to a plateau at about 50 metres above sea-level. At 15,000 BP, a 16 kilometre wide coastal plain would have stretched along the foot of the cliffs below the cave. By 11,000 BP the width of the plain would have been reduced by half to 8 kilometres, and by 9,000 BP it would have been 6 kilometres wide. The mouth of the cave, which faces north-west, is three metres high

and five metres wide. The plan of the cave floor is roughly circular, with an average diameter of nine metres giving an estimated floor area of 75m². The roof is three metres above the present day level of the cave floor. The first season of a large scale excavation took place in 1963, under the joint direction of Palma di Cesnola and Borzatti von Löwenstern, with the aim of finding elements that were analogous to those found in the late glacial levels at Grotta delle Cipolliane. This was followed by a further three seasons of excavation from 1964-1966 (Palma di Cesnola 1963, 1964, 1965a, 1965b, 1966a, 1966b). The stratigraphy of the late glacial levels is as follows:

Level C: Sterile layer of aeolian volcanic sand making a hiatus which separates the Middle Palaeolithic and Uluzzian levels (M-D) from the Final Epigravettian levels.

Level BII: Dark brown sandy earth, lighter in colour towards the top. The sediment contains very few stones and is 70 centimetres in thickness. The lithic industry has been attributed to the Epiromanellian phase of the Final Epigravettian (Palma di Cesnola *et al.* 1983). The level was subdivided into two parts: BIIb and BIIa. The fauna of BIIb is dominated by *Equus caballus*, accompanied by *Equus asinus hydruntinus*, *Bos primigenius*, *Sus scrofa*, *Cervus elaphus* and *Vulpes vulpes*. In level BIIa, the same faunal species are present, though *Bos primigenius* is predominant. Marine molluscs are present in both levels, consisting of *Patella* sp., *Monodonta* sp., *Columbella rustica*, *Cerithium* sp., *Cyclope neritea*, *Glycimeris glycimeris*, *Cardium* sp., and *Venus* sp. The terrestrial mollusc *Helix* sp. is also present.

Level BI: The level is 35 centimetres in thickness, and was subdivided into two parts: BIb, a brown sandy earth (10 cm) with blocks of *éboulis* forming a marked horizon; and BIa, a reddish-brown sand (25 cm) in part cemented by calcareous concretions. The lithic industry from level BI has been attributed to the Epiromanellian phase of the Final Epigravettian (Palma di Cesnola *et al.* 1983). The mammalian fauna is composed of *Equus caballus*, *Equus asinus hydruntinus*, *Bos primigenius*, *Cervus*

elaphus, *Sus scrofa* and *Vulpes vulpes*. Marine molluscs were also present, consisting of *Monodonta* sp., *Patella* sp., *Columbella rustica*, *Murex* sp., *Cardium* sp., *Nassa* sp., *Natica* sp., *Dentalium* sp., and *Glycimeris glycimeris*. The terrestrial mollusc *Helix* sp. is again present.

Level A: An undated hearth (AII) separates level BI from the overlying Neolithic level.

A granulometric study of the sediment matrix (Palma di Cesnola 1963) showed a gradual decrease in the sand component (from 93% to 64%) and an increase in the silt and clay component (from 7% to 36%) from levels CII to AII. The sandy and relatively stone-free nature of the sediments of level BII suggests a temperate humid phase. This was followed by a cold oscillation (BIb) characterized by frost weathering. The calcareous concretions in level BIa suggest a very humid and temperate climate. Palma di Cesnola *et al.* (1983) have tentatively assigned levels BII-I to the Preboreal. Unfortunately, there are no ¹⁴C dates and no micromammals to confirm this.

GROTTA DI ULUZZO

The Grotta di Uluzzo lies at 15 metres above sea-level, cut into a cliff face of compact Cretaceous limestone (*Calcari di Melissano*) on a small promontory at Torre di Uluzzo, three kilometres north of Santa Caterina and 500 metres north of Grotta del Cavallo (40°09'30"N 17°57'24"E). The late glacial and early postglacial shorelines would have been the same as at Grotta del Cavallo. The mouth of the cave is oriented towards the south-east. The cave is ten metres long and 2 metres wide, giving an estimated floor area of 20m² which slopes towards the outside. The height of the ceiling goes from 4 metres at the mouth to 6 metres in the internal part. In recent times the cave had been used as a stable. The cave was excavated from 1963-64 by Borzatti von Löwenstern (Borzatti von Löwenstern 1963, 1964b), and the stratigraphy of late glacial deposits is as follows:

Level L: Sediments derived from the disintegration of volcanic sands from the underlying level of pumice (M), mixed with aeolian sands and culturally sterile. Level L separates the Middle Palaeolithic and Uluzzian levels (P-M) from the Final Epigravettian levels.

Level I: Reddish-brown sandy clay becoming lighter in colour towards the top, with some large stones with earth concretions. The lithic industry was attributed to the Epiromanellian phase of the Final Epigravettian (Borzatti von Löwenstern 1963, 1964b). The faunal remains consist of *Equus caballus*, *Bos primigenius*, *Equus asinus hydruntinus*, *Cervus elaphus*, *Lepus europaeus* and *Vulpes vulpes*. The avifauna consists of *Turdus merula*, *Corvus monedula*, *Falco tinnunculus* and *Columba palumbus*. Marine molluscs were also present, consisting of *Patella* sp., *Mytilus* sp., and *Monodonta* sp.. The terrestrial mollusc *Helix* sp. is also present.

Level H: Grey-blue sandy earth in the form of thick lenses towards the mouth of the cave and thinner lenses inside. The fine matrix is of aeolian origin and composed of volcanic minerals. The deposit is locally reddened, with concretions towards the upper part. The lithic industry was attributed to the Epiromanellian phase of the Final Epigravettian (Borzatti von Löwenstern 1963, 1964b), and there are a few faunal remains of *Bos primigenius*. Marine and terrestrial molluscs are absent.

Level G: Dark red sandy clay with few stones. Towards the bottom, concretions of volcanic sand from level H indicate that the surface of level H was already hard before the deposition of level G. This suggests that the sediments of level H had been exposed for some time to the humid marine air, and therefore one can identify a stratigraphic hiatus, in the sense of a pause in the deposition of unknown duration. The lithic industry was attributed to the Epiromanellian phase of the Final Epigravettian (Borzatti von Löwenstern 1963, 1964b). The faunal remains consist of *Equus caballus*, *Bos primigenius*, *Equus asinus hydruntinus*, *Sus scrofa*, *Cervus elaphus*, *Vulpes vulpes*, *Meles meles* and *Erinaceus europaeus*. The avifauna consists

of *Corvus monedula*, *Cinclus cinclus* and *Columba livia*. Marine molluscs were also present, consisting of *Patella* sp., *Monodonta* sp., *Cardium* sp., *Dentalium vulgare*, *Columbella rustica*, and *Cyclope neritea*. The terrestrial mollusc *Helix* sp. is also present.

Level F: Dark grey sandy clay, with more clay than level G and very stony. Towards the top there is the remains of a hearth. The lithic industry was attributed to the Epiromanellian phase of the Final Epigravettian (Borzatti von Löwenstern 1963, 1964b). The faunal remains consist of *Equus caballus*, *Equus asinus hydruntinus*, *Bos primigenius*, *Sus scrofa*, *Cervus elaphus*, *Lepus europaeus*, *Erinaceus europaeus*, *Felis sylvestris* and *Vulpes vulpes*, and the avifauna of *Athene noctua* and *Turdus merula*. Marine molluscs were also present, consisting of *Monodonta* sp., *Patella* sp., *Murex* sp., *Mytilus* sp., *Cardium* sp., *Cyclope neritea*, *Columbella rustica*, *Dentalium vulgare* and *Glycimeris* sp.. The terrestrial mollusc *Helix* sp. is also present.

Level E: Red sandy clay with abundant stones. Around the walls inside the cave there are concretions. The lithic industry was attributed to the Epiromanellian phase of the Final Epigravettian (Borzatti von Löwenstern 1963, 1964b), and the faunal remains consist of *Equus caballus*, *Equus asinus hydruntinus*, *Bos primigenius*, *Cervus elaphus*, *Sus scrofa*, *Vulpes vulpes*, *Lepus europaeus* and *Testudo graeca*. Marine molluscs were also present, consisting of *Monodonta* sp., *Patella* sp., *Murex* sp., *Cyclope neritea*, *Columbella rustica* and *Glycimeris* sp.. The terrestrial mollusc *Helix* sp. is also present.

Level D: A hearth containing a lithic industry attributed to the Epiromanellian phase of the Final Epigravettian (Borzatti von Löwenstern 1963, 1964b). Faunal remains are absent.

Level C: Red sandy clay with abundant stones. Towards the walls the earth is concreted to a greater degree than in level E, again probably as a result of humid seasonal rain. The lithic industry was attributed to the Epiromanellian phase of the

Final Epigravettian (Borzatti von Löwenstern 1963, 1964b), and there are sparse faunal remains of *Bos primigenius*. Marine molluscs were also present, consisting of *Monodonta* sp., *Patella* sp., and *Murex* sp.. The terrestrial mollusc *Helix* sp. is also present.

Levels B and A: Two metres of disturbed deposits.

On the basis of the sediments from Grotta di Uluzzo, the stratigraphy of the late glacial deposits can be divided into five phases. A first phase consists solely of level I, where the concretions and the volumetric importance of clay in the matrix suggest a humid and temperate climate. A second phase is clearly represented by level H, where the aeolian sand, composed of volcanic minerals, suggests a less humid but still temperate phase. This is followed by a hiatus, during which the surface of level H was exposed to humid marine air. In the third phase, the volumetric importance of clay in the matrix of level G suggests a return to more humid conditions. A fourth phase is represented by level F, with a sandy matrix and an abundance of stones, suggesting a short cold arid oscillation, and the final phase, comprising levels E and C, sees a return to more humid conditions. The concretions in levels E and C probably originated as stalagmitic or travertine-like deposits of recrystallized carbonates that form on the walls and roof of a cave during mild and humid climatic phases. There are no ¹⁴C dates.

GROTTA CARLO COSMA

Grotta Carlo Cosma (or Grotta Uluzzo C) lies in the concave part of the Baia di Uluzzo, 350 metres north of Grotta del Cavallo and 150 metres south of Grotta di Uluzzo (40°09'21"N 17°57'31"E). Like the other two caves in the bay, Grotta Carlo Cosma lies at 15 metres above sea-level in a cliff face of compact Cretaceous limestone (*Calcari di Melissano*). The late glacial and early postglacial shorelines would therefore have been the same as at these two sites. Grotta Carlo Cosma was excavated from 1964-68 by Borzatti von Löwenstern (Borzatti von Löwenstern 1965b; Borzatti von

Löwenstern and Magaldi 1969). There is no published information concerning the size of the cave. The stratigraphy of the late glacial deposits is as follows:

Level B: Volcanic sand mixed with quartzitic sand reddened by iron oxidation, 45 centimetres thick, containing lenses of light grey volcanic sand (β). Culturally sterile, level B separates the Uluzzian levels below from the Epiromanellian level above.

Level A: Sandy clay, containing lenses of blue volcanic sand (α) and few stones, 17 centimetres thick. The lithic industry has been attributed to the Epiromanellian phase of the Final Epigravettian (Palma di Cesnola *et al.* 1983). The faunal remains consist of *Bos primigenius*, *Equus caballus*, *Equus asinus hydruntinus*, *Sus scrofa*, *Cervus elaphus*, *Lepus europaeus*, *Vulpes vulpes* and *Canis Lupus*. Marine molluscs were also present, consisting of *Patella* sp. and *Monodonta* sp..

Such a short stratigraphy for the late glacial deposits and the lack of ^{14}C dates makes a climatic interpretation of the sediments difficult.

GROTTA DELLE PRAZZICHE

Grotta delle Prazziche cuts into a spur 20 metres above sea-level, looking over a deep gully (Il Ciolo) at Le Fogge (Gagliano del Capo) (39°50'40"N 18°22'59"E). The cave lies only one kilometre to the south of Grotta delle Cipolliane, in the same Paleocene/Oligocene bioclastic limestone formation (*Calcari di Castro*). As at Cipolliane, the coast is steep and rocky; the gully is dry for almost all the year. The cave is south-facing, 42 metres long and 5-6 metres wide, giving an estimated floor area of 230m². Until recently, the cave was used as a stable for cows; there is some evidence that the deposits have been disturbed as a result of clandestine excavations, and soil was removed from part of the cave by farmers, in order to create terraces for cultivation. Below a depth of 0.5 metres, the remaining deposit appears to be intact and undisturbed. The changing morphology and position of the late glacial shorelines

would have been the same as for Grotta delle Cipolliane, with a 10 kilometre wide coastal plain at 15,000 BP, reduced to 0.5 kilometres by 11,000 BP, and totally submerged by 9,000 BP. Grotta delle Prazziche was excavated by Borzatti von Löwenstern from 1964-66 (Borzatti von Löwenstern 1965a, 1965c, 1966, 1969), and the late glacial stratigraphy is as follows:

Level D: Red sandy soil, concreted in the upper part, containing faunal remains of *Equus caballus*, *Cervus elaphus* and *Bos primigenius*, and culturally sterile.

Level C: Dark brown sandy earth with an industry attributed to the Romanellian phase of the Final Epigravettian (Palma di Cesnola *et al.* 1983). The faunal remains consist of *Equus asinus hydruntinus*, *Bos primigenius*, *Sus scrofa*, *Cervus elaphus*, *Capreolus capreolus*, *Vulpes vulpes*, *Meles meles*, *Lepus europaeus*, *Canis lupus* and *Testudo hermanni*. Marine molluscs, consisting of *Monodonta* sp. and *Patella* sp., and fish (unidentified) were also present.

Level B: Dark stony earth, sealed at the top by a thin layer of concreted soil. A Romanellian-type industry was associated with a Neolithic blade industry, obsidian bladelets, and impressed and incised coarse-ware pottery. The fauna is composed of a combination of wild animals (*Equus asinus hydruntinus*, *Bos primigenius*, *Sus scrofa*, *Cervus elaphus* and *Capreolus capreolus*), and domesticated animals (*Ovis aries*, *Capra hircus* and *Canis familiaris*).

Level A: Dark earth, homogeneous, containing late Neolithic pottery.

There are no ¹⁴C dates from Grotta delle Prazziche. The nature of the sediments are not diagnostic enough to allow a climatic interpretation, although the presence of *Testudo hermanni* in level C suggests a temperate, humid climate.

Two other cave sites in the Salento peninsula have produced lithics which have been attributed to the Epigravettian period. GROTTA ZINZULUSA is located at the head of a small bay, 0.5 kilometres south along the coast from Grotta Romanelli. The

cave, which opens towards the south, extends 150 metres into the cliff and is composed of various internal caverns. In the 'vestibule', a small assemblage of lithics was found in a level (D) of reddish brown earth associated with a fauna of *Equus asinus hydruntinus*, *Equus caballus*, *Bos primigenius* and *Cervus elaphus*, which is separated from the overlying Neolithic level by a thin layer of stalagmite (A.C.Blanc 1961). The industry has been attributed to the Evolved Epigravettian by Laplace (1964b, 1966b), and to the Final Epigravettian by Palma di Cesnola *et al.* (1983). In a chamber (B) adjacent to the vestibule, a 'hypermicrolithic' assemblage associated with a fauna of *Equus asinus hydruntinus* and *Bos primigenius* has been attributed to the Epipalaeolithic (Cardini 1961a). At PORTO BADISCO, 8 kilometres along the coast north of Grotta Romanelli, recent excavations in cavities D and A have uncovered late glacial brown earth deposits with a Final Epigravettian lithic industry associated with a fauna composed of *Equus caballus*, *Equus asinus hydruntinus*, *Bos primigenius* and *Cervus elaphus* (Guerri 1984, 1986). The assemblages from both Grotta Zinzulusa and Porto Badisco are unpublished.

In addition to the cave and rockshelter sites, a number of surface scatters of lithic material have been found in the Salento peninsula, which have been attributed to the Epigravettian period on the basis of their typological characteristics. At SOLETO, 18 kilometres south of Lecce, a surface scatter of lithics was found containing types which were thought to be comparable with those from the brown earth series at Grotta Romanelli (Cardini 1946). Between TORRE DELL'ALTO and the Uluzzo bay, a small collection of Epigravettian-type lithics, mixed with Mousterian and Uluzzian lithics made from limestone, were found eroding out from below a sandy red earth deposit (Borzatti von Löwenstern 1964c). At SAN FOCA, which lies on the Adriatic coast 20 kilometres south-east of Lecce, a surface scatter of lithic material was found a few hundred metres from the sea, covering an area of 100m². The site is situated on the edge of a Plio-Pleistocene lake basin now filled by Holocene sands and sandy clays. A survey and small scale excavation revealed hollows in the bedrock filled with red sandy soil of up to 1.4 metres in depth, containing carbon and a lithic industry

(Ingravallo 1980). At TORRE TESTA, 7 kilometres north along the coast from Brindisi a surface lithic scatter was found on a terrace of red earth 10 metres above sea-level by the mouth of the Giancola canal. An analysis of the red earth deposit revealed the presence of rounded quartzite granules, suggesting an aeolian origin for the sediment. The assemblage consists of a microlithic Epiromanellian-type industry mixed with Middle Palaeolithic and patinated large format Upper Palaeolithic (evolved Aurignacian?) assemblages (Punzi 1967; 1968; Cremonesi 1967; 1978). Finally, small surface assemblages from MONTI RUSSI, near Salve, PUNTA MACALONE, near Ugento, TORRE VADO, and SUPERSANO, have all been attributed to the late Palaeolithic (Piccinno and Piccinno 1974).

My own fieldwork recovered an abundance of surface material from the ALIMINI LAKES north of Otranto, following on from previous surveys by Piccinno and Piccinno (1978). The Alimini area contains the greatest concentration of surface and ground water in the Salento peninsula, and the sites are located on Pleistocene terraces around the two lakes, between 1 and 2 kilometres from the Adriatic sea. Some of these assemblages have been tentatively assigned to the Epigravettian period (Milliken and Skeates 1990), although the lack of typological and technological change in the late glacial and early postglacial industries of the region and the absence of stratigraphic resolution makes it difficult to be confident about the date of surface assemblages, and I will return to this point in Chapter 6. Finally, an assemblage attributed to the Epigravettian period was found during excavations by Cremonesi (unpublished) at the small rockshelter of GROTTA MARISA, which is situated on the western side of the canal joining the two lakes at Alimini. The rockshelter has a semicircular plan with a maximum diameter of 8 metres, and the deposits range in depth from 0.6 to 1.0 metres. The faunal remains are still under study at the University of Pisa, but a preliminary examination revealed the presence of fish, birds and marine molluscs, plus cervids and bovids (Piccinno pers. comm.).

3:3 THE MURGE

To date there are only five sites in the Murge with assemblages that have been attributed to the late Palaeolithic. The sites are spread over an area of 2500 square kilometres; three of the sites lie along the coastal zone, while the other two are located inland (Figure 3:6).

GROTTA DELLE MURA

Grotta delle Mura is cut into a low cliff of Pleistocene terrigenous-skeletal limestones (*Tufi delle Murge*) in a rocky bay at Lido Bianco, 500 metres south-east of Monopoli (40°56'40"N 17°18'17"E). The cave lies at 2 metres above sea-level, and 25 metres from the present shoreline. At 15,000 BP there would have been a 13 kilometre wide coastal plain in front of the cave, which would have been reduced to 4 kilometres at 11,000 BP, and further reduced to 2 kilometres at 9,000 BP. Grotta delle Mura was originally excavated by Anelli from 1952-53 (Anelli 1953, 1957), and reexcavated from 1960-63 (Borzatti von Löwenstern 1964a; Cornaggia Castiglione and Palma di Cesnola 1964, 1967; Cornaggia Castiglione and Menghi 1963). The stratigraphy of the late glacial deposits is as follows:

Level G: Reddish-yellow earth of 80 centimetres thickness, with medium sized stones. The lithic industry was attributed to the Ancient Epigravettian phase with shouldered backed bladelets (Cornaggia Castiglione and Palma di Cesnola 1964), and the fauna consists of *Bos primigenius*, *Equus caballus*, *Cervus elaphus*, *Sus scrofa* and *Vulpes vulpes*.

Level F: Lens of grey-green volcanic tufa, 8 centimetres thick and culturally sterile.

Level G/1: Lens of yellow-red earth with medium sized stones similar to that of level G, 12 centimetres thick and restricted to the eastern part of the cave. The faunal remains consist of *Bos primigenius*, *Equus caballus*, *Cervus elaphus* and *Lepus*

europaeus, and the lithic industry was attributed to the Epigravettian *sensu lato* (Cornaggia Castiglione and Palma di Cesnola 1964).

Level E: Brown clayey earth with medium sized stones, 50 centimetres thick. The faunal remains consist of *Bos primigenius*, *Equus caballus*, *Cervus elaphus*, *Capreolus capreolus* and *Vulpes vulpes*. The lithic industry was attributed to the Final Epigravettian (Cornaggia Castiglione and Palma di Cesnola 1964).

Level D: Yellow very clayey earth with small and medium sized stones, 28 centimetres thick. The fauna consists of *Bos primigenius* and *Equus caballus*, and the lithic industry was attributed to the Pre-Romanellian phase of the Final Epigravettian (Cornaggia Castiglione and Palma di Cesnola 1964).

Level C: Brown slightly clayey soil, with abundant small stones, 95 centimetres in thickness and subdivided into three spits. The upper spit contained fragments of Neolithic impressed pottery and a few snapped blades and trapezes, associated with a Romanellian-type industry. The lower two spits, which were of a lighter colour, contained an exclusively Romanellian-type industry (Cornaggia Castiglione and Palma di Cesnola 1964), some charcoal fragments, and faunal remains of *Bos primigenius*, *Equus caballus*, *Equus asinus hydruntinus*, *Cervus elaphus*, *Sus scrofa*, *Vulpes vulpes*, *Lepus europaeus* and *Meles meles*. Marine molluscs are also present, consisting of *Patella* sp., *Monodonta* sp., and *Glycimeris glycimeris*.

Level B: Black humic earth with Neolithic coarse impressed-ware pottery, and a Romanellian-type lithic industry associated with a blade industry. The fauna includes wild animals such as *Bos primigenius* and *Equus caballus*, and domesticates such as sheep/goat and dog.

There are no ¹⁴C dates from Grotta delle Mura. The presence of *Pitymys* sp. and *Microtus agrestis* in levels D and E suggests a local grassland habitat.

GROTTA SANTA CROCE

Grotta Santa Croce is located 7 kilometres south of the Adriatic coastal town of Bisceglie (41°10'30"N 16°28'14"E). The cave is situated on the eastern side of a small ravine of the same name, 100 metres above sea-level and 12 metres above the bottom of the ravine. A seasonal torrent runs through the ravine. To the south of the cave, the land rises steeply to an undulating plateau at 170 metres above sea-level. The north-facing cave, which is cut into Lower Cretaceous limestone (*Calcare di Bari, livello Corato*), extends into the hillside for more than 100 metres and has an extensive talus outside. Grotta Santa Croce was excavated by Cardini in 1954, 1956 and 1958 (Cardini 1956, 1958, 1961b). The stratigraphy of the late glacial deposits inside the cave is as follows (Segre and Cassoli 1987):

Level D2: Eroded deposit overlying the Middle Palaeolithic levels (4-6), culturally sterile.

Level 8: Concreted deposit, thin and discontinuous, with remains of an avifauna of *Pyrrhocorax graculus*, *Columba livia*, *Perdix perdix*, *Alecteris graeca*, *Athene noctua* and *Anser erythropus*, and culturally sterile.

Level 10: Stalagmite, culturally sterile.

Level 12: Red clay with carbon fragments, culturally sterile.

Level D3: An eroded deposit, culturally sterile, which separates the late glacial deposits from the Holocene levels above containing Neolithic pottery.

In the talus outside the cave, two levels (7 and 9) interposed between the erosional phases of levels D2 and D3 contained a lithic industry attributed to the Romanellian phase of the Final Epigravettian (Palma di Cesnola *et al.* 1983) and a fauna dominated by *Equus asinus hydruntinus*. Levels 7 and 9 are therefore considered to be contemporary with the culturally sterile levels 8, 10 and 12. The

presence of *Pyrrhocorax graculus* (alpine chough) and *Anser erythropus* (lesser white-fronted goose) in level 8 suggests a cold climate, while the nature of the sediments of levels 10 and 12 suggests an increasingly humid temperate climate. On the basis of the lithic typology, the Final Epigravettian assemblages from levels 7 and 9 were assigned to the Dryas II/Alleröd transition (Palma di Cesnola *et al.* 1983). There are no ^{14}C dates to confirm this.

A surface scatter of lithics which has been attributed to the Romanellian facies of the Final Epigravettian was found at MONTICELLO, located above the Valle d'Itria, 4.5 kilometres south-east of Martina Franca in the south-eastern part of the Murge (Gambassini 1969). The site is situated at 400 metres above sea-level, on the edge of a scarp slope which runs northwest-southeast. The lithics were found eroding out of a dark red sand composed of minerals of volcanic origin: sanidine, amphibole and pyroxene. As these minerals are not of local origin, the sediment was probably deposited by aeolian action.

Finally, the assemblages from the cave sites of GROTTA SIMONE (also known as GROTTA MACCHIONE) near Conversano, and GROTTA DI CORTO MARTINO near Acquaviva delle Fonti, have both been attributed to the late Palaeolithic (Palma di Cesnola 1987), but no details of their stratigraphies have been published.

3:4 THE TAVOLIERE

To date, no late glacial sites have been found on the Tavoliere. For the most part the area is covered by Holocene sediments: alluvial deposits which accumulate on the valley floors of the principal watercourses; detrital cones of rock debris which accumulate along the southern edge of the Gargano promontory; and calcareous *crosta*, a soil enriched with carbonates which formed under arid and semi-arid climatic conditions (Ciaranfi 1983). It is likely that the Tavoliere would in fact have supported dense populations of herbivores and humans during the late glacial period. Under the

Holocene sediments lies a 2000 metre deep layer of clays and silts that was deposited during a Pliocene invasion of the sea. The area would have been watered by rivers and springs running off both the Gargano promontory to the east and the Capitanata Apennines to the west, and at least 20,000 hectares of resource-rich lagoons fringed the coast (Delano Smith 1976). The Tavoliere would therefore have been very attractive to herbivores and hunter-gatherers alike, but considering the depth and extent of the Holocene deposits, it is unlikely that any vestiges of late Palaeolithic occupation will ever be found.

3:5 THE GARGANO PROMONTORY

To date there are only three cave sites and two surface localities in the Gargano promontory with assemblages that have been attributed to the late Palaeolithic. The sites are located within an area of approximately 1000 square kilometres; two of them lie within the coastal zone, while the other three are located some distance inland (Figure 3:7).

GROTTA PAGLICCI

Grotta Paglicci is situated on the north side of the Valle Settepenne, on the southern side of the Gargano promontory near Rignano Garganico, and 15 kilometres east of San Severo (41°39'6"N 15°36'52"E). The cave, which is cut into Jurassic limestone (*Calcari di S. Giovanni Rotondo*) lies at 150 metres above sea-level and faces southwest, overlooking the valley floor and the Tavoliere plain. Grotta Paglicci is therefore located at the interface of two distinct environments: the barren, rugged mountains of the Gargano promontory which rise up to 1000 metres; and the low, flat Tavoliere plain, which probably hosted either prairie or steppe vegetation communities during the late glacial, depending on the temperature and humidity (Sala 1983a, 1983b). The cave consists of an atrium and a large internal space of 120m². The excavations, which were started by Zorzi in 1961-63, were resumed after his death in 1970 by Palma di Cesnola and Mezzena (Mezzena and Palma di Cesnola 1967, 1972a,

1972b; Mezzena 1975; Palma di Cesnola 1974c, 1975a). Grotta Paglicci has an impressive stratigraphy, with 22 levels of Gravettian and Epigravettian deposits, while the Middle Palaeolithic deposits below are still being excavated. The last Final Gravettian level (18b) has a ^{14}C date of $20,200 \pm 305$ BP (F-44) (Azzi *et al.* 1974). The stratigraphy of the Epigravettian levels is as follows (Figure 3:8):

Level 18a: Dark brown clayey earth, 30 centimetres thick, with a lithic industry attributed to the "initial" phase of the Ancient Epigravettian (Palma di Cesnola and Bietti 1983). The fauna consists of *Equus caballus*, *Equus asinus hydruntinus*, *Sus scrofa*, *Bos primigenius*, *Capra ibex* and *Cervus elaphus*.

Level 17: Reddish-brown earth, 50-60 centimetres in thickness, containing a series of blocks of *éboulis*. The lithic industry has been attributed to the foliate phase of the Ancient Epigravettian (Palma di Cesnola and Bietti 1983). The fauna consists of *Equus caballus*, *Equus asinus hydruntinus*, *Sus scrofa*, *Bos primigenius*, *Capra ibex* and *Cervus elaphus*.

Level 16-15: Reddish-brown stony earth, 35 centimetres thick. The lithic assemblage has been attributed to the Ancient Epigravettian phase with shouldered backed bladelets (Palma di Cesnola and Bietti 1983). The fauna consists of *Equus caballus*, *Equus asinus hydruntinus*, *Sus scrofa*, *Bos primigenius*, *Capra ibex*, *Cervus elaphus*, *Rupicapra rupicapra* and *Capreolus capreolus*.

Level 14-12: Brown, red, and reddish-brown soils, totalling 120 centimetres, and containing many blocks of *éboulis*. The lithic industry has been attributed to the Ancient Epigravettian phase with shouldered backed bladelets (Palma di Cesnola and Bietti 1983). The fauna consists of *Equus caballus*, *Equus asinus hydruntinus*, *Sus scrofa*, *Bos primigenius*, *Capra ibex* and *Cervus elaphus*.

Level 11-10: Reddish-yellow stony earth, totalling 50-60 centimetres. The lithic industry has been attributed to the terminal subphase of the Ancient Epigravettian

phase with shouldered backed bladelets (Palma di Cesnola and Bietti 1983). A ^{14}C date of $15,320 \pm 250$ BP (F-68) was obtained from charcoal from level 10 (Azzi *et al.* 1977). The fauna, which is present only in level 10, consists of *Equus caballus*, *Equus asinus hydruntinus*, *Sus scrofa*, *Bos primigenius*, *Capra ibex* and *Cervus elaphus*.

Level 9: Brown silty earth with few stones, 40 centimetres in depth. Traces of many hearths were found towards the back of the cave. The level was subdivided into four spits (9d-9a) and contained a lithic industry attributed to the Evolved Epigravettian (Palma di Cesnola *et al.* 1983). A ^{14}C date of $15,270 \pm 220$ BP (F-67) was obtained from a charcoal sample from level 9 (Azzi *et al.* 1977). The fauna consists of *Equus caballus*, *Equus asinus hydruntinus*, *Sus scrofa*, *Bos primigenius*, *Capra ibex*, *Cervus elaphus* and *Rupicapra rupicapra*.

Level 8: Grey-brown silty earth with few stones, 20-30 centimetres in depth, with various artificial *sols d'habitat*. The level was subdivided into four spits (8d-8a). The lithic industry has been attributed to the Evolved Epigravettian (Palma di Cesnola *et al.* 1983), and a ^{14}C date of $15,460 \pm 220$ BP (F-66) was obtained from a charcoal sample from level 8 (Azzi *et al.* 1977). The fauna consists of *Equus caballus*, *Equus asinus hydruntinus*, *Sus scrofa*, *Bos primigenius*, *Capra ibex* and *Cervus elaphus*.

Level 7: Grey-brown silty earth similar to level 8, with a few large blocks of *éboulis*, various artificial *sols d'habitat* and a lithic industry attributed to the Final Epigravettian (Palma di Cesnola *et al.* 1983). The level is 20-25 centimetres in depth and was subdivided into three spits (7c-7a). A ^{14}C date of $14,820 \pm 210$ BP (F-65) was obtained from a charcoal sample from level 7 (Azzi *et al.* 1977), while a date of $13,720 \pm 870$ BP (Ly-1628) was obtained from bone in spit 7c (Evin *et al.* 1979). The fauna consists of *Equus caballus*, *Equus asinus hydruntinus*, *Sus scrofa*, *Bos primigenius*, *Capra ibex* and *Cervus elaphus*.

Level 6: Grey-brown silty earth with very few stones, 15-20 centimetres in depth, with lenses of yellow ash and various artificial *sols d'habitat* intercalated in the deposit. The level was subdivided into four spits (6d-6a) and the lithic industry has been attributed to the Final Epigravettian (Palma di Cesnola *et al.* 1983). A ^{14}C date of $14,270 \pm 230$ BP (F-64) was obtained from a charcoal sample from level 6 (Azzi *et al.* 1977). The fauna consists of *Equus caballus*, *Equus asinus hydruntinus*, *Sus scrofa*, *Bos primigenius*, *Capra ibex*, *Cervus elaphus*, *Rupicapra rupicapra* and *Capreolus capreolus*.

Level 5: Light brown silty earth, relatively stony, 20-30 centimetres in depth. The level was subdivided into three spits (5c-5a) and the lithic industry has been attributed to the Final Epigravettian (Palma di Cesnola *et al.* 1983). One ^{14}C date of $13,590 \pm 200$ BP (F-96) was obtained from a charcoal sample from spits 5b-c (Azzi *et al.* 1977). The fauna consists of *Equus caballus*, *Equus asinus hydruntinus*, *Sus scrofa*, *Bos primigenius*, *Capra ibex*, *Cervus elaphus*, *Rupicapra rupicapra* and *Capreolus capreolus*.

Level 4: Brown and light brown silty earth, relatively stony, 20-30 centimetres in depth. Several large hearths with thick lenses of ash were found. The level was subdivided into three spits (4c-4a) and the lithic industry has been attributed to the Final Epigravettian (Palma di Cesnola *et al.* 1983). One ^{14}C date of $11,950 \pm 190$ BP (F-95) was obtained from a charcoal sample from level 4 (Azzi *et al.* 1977). The fauna consists of *Equus asinus hydruntinus*, *Sus scrofa*, *Bos primigenius*, *Capra ibex*, *Cervus elaphus*, *Rupicapra rupicapra* and *Capreolus capreolus*.

Level 3: Brown silty earth with few stones, 20-35 centimetres thick, with alternating intercalations of hearths and lenses of sand, and a lithic industry attributed to the Final Epigravettian (Palma di Cesnola *et al.* 1983). One ^{14}C date of $11,440 \pm 180$ BP (F-94) was obtained from a charcoal sample from spit 3a (Azzi *et al.* 1977). The

fauna consists of *Equus asinus hydruntinus*, *Sus scrofa*, *Bos primigenius*, *Cervus elaphus* and *Capreolus capreolus*.

Level 2: Brown silty earth with abundant stones, of a variable thickness of between 10-60 centimetres. The level is intercalated with lenses of sand, and contained an industry that has been attributed to the Final Epigravettian (Palma di Cesnola *et al.* 1983). There are no ^{14}C dates from level 2, and no faunal remains were recovered.

Level 1: Dark brown earth, incoherent and in part reworked, of a variable thickness of between 10-40 centimetres. The level is very stony, with some large elements, and contained an industry that has been attributed to the Final Epigravettian (Palma di Cesnola *et al.* 1983). There are no ^{14}C dates from level 1, and no faunal remains were recovered.

A climatic interpretation of the late glacial levels was made by Sala (1983a, 1983b), on the basis of the faunal remains. Level 18a was assigned to a temperate phase (Laugerie), while the predominance of ibex over equids in levels 17-15 was interpreted as suggesting a rigorous cold phase, with the cold maximum occurring in level 16. In the temperate phase of levels 14-12 (Lascaux), equids predominate over ibex, and level 11, which lacks fauna, was ascribed to a more continental phase. The faunal remains from levels 10 to 8b are characterized by open country types, with a predominance of equids (especially *Equus caballus*) over bovids (*Bos primigenius*) and caprids (*Capra ibex*). Sala interprets this as indicating a cold period, which peaks in level 9, followed by a relatively temperate phase with an increase in *Cervus elaphus* (levels 8d-8b). There then followed an uninterrupted cold phase (levels 8a-6c), associated with a marked change in the fauna which is characterized by a predominance of *Capra ibex* and *Equus caballus*. From level 6c onwards, forest types become more frequent (*Cervus elaphus*, *Capreolus capreolus* and *Sus scrofa*), *Capra ibex* declines to very low percentages, and *Equus caballus* disappears. This is interpreted by Sala as evidence for a progressively more temperate climate, interrupted

by a relatively cold phase in level 4a when there is a marked increase of *Rupicapra rupicapra*. Level 3 sees the complete disappearance of the caprids (*Capra ibex* and *Rupicapra rupicapra*) and a relative predominance of *Cervus elaphus* over other species (Sala 1983a, 1983b).

The micromammalian fauna from levels 7 to 4 seem to agree with the identification of a temperate climatic phase, with the rarification and eventual disappearance of *Microtus agrestis* and *Microtus nivalis*, and the increase of *Apodemus sylvaticus* and *Arvicola* sp.. The latter attain their maximum frequency in level 3.

The nature of the sediments also appears to corroborate this climatic interpretation of the late glacial levels. The temperate phase of levels 9d to 8b and the cold period preceding it have been attributed by Sala to the last part of the Angles interstadial, while the cold phase which follows is attributed to the second episode of Dryas I. The presence of a probable stratigraphic lacuna has been suggested between levels 5a and 4c on the basis on the typology of the artifacts (Palma di Cesnola *et al.* 1983), thereby subdividing the temperate period of levels 6c-4b into two phases. These are tentatively assigned to the Prebölling and part of the Bölling, thus placing the hiatus in the last episode of Dryas I. The cold phase of level 4a probably relates to Dryas II, whereas levels 3-2 are assigned to the Alleröd interstadial (Sala 1983a, 1983b).

The ^{14}C dates accord with Sala's interpretation, except for the date for level 4 ($11,950 \pm 190$ BP) which places it at the beginning of the Alleröd. The apparent typological hiatus would therefore span the Bölling/Dryas II.

An assemblage of lithics was found in a light brown sandy-clay deposit in a karstic doline near the Casa Forestale in the FORESTA UMBRA, which has been attributed to the Ancient Epigravettian (Galiberti 1974). Typologically similar lithics were found scattered on the surface around the doline, on the basis of which Galiberti concludes that those in the section are not *in situ*. A surface assemblage from

MACELLI near Vico del Gargano has also been attributed to the Ancient Epigravettian, while the assemblage from MACCHIONE near Vieste has been attributed to the Final Epigravettian (Palma di Cesnola 1984). Finally, assemblages from GROTTA SCALORIA near Manfredonia have been attributed to the Final Epigravettian (Palma di Cesnola 1984). The assemblages come from levels which have radiocarbon dates from charcoal samples of $11,040 \pm 190$ BP (LJ-4979), $10,790 \pm 210$ BP (LJ-4978), $9,030 \pm 120$ BP (LJ-5098) and $9,560 \pm 140$ BP (LJ-4982) (Linick 1984). The site is as yet unpublished, and consequently there are no data concerning the nature of the fauna or the sediments.

3:6 DISCUSSION

The reconstruction of the regional sediment correlation sequence (Table 3:1) presented more problems than were expected. Even within a relatively small geographical area with a uniform regional climate such as this, each cave and rockshelter is a unique entity, and this complicates the correlation of sedimentary features among them. Sedimentary ensembles within nearby caves and rockshelters may vary because of variability in any number of factors, including the nature of the parent rock, exposure, local relief, size, shape, and the intensity of human occupation (Farrand 1985).

A major problem when trying to correlate the sites retrospectively, on the basis of the available published data, is that of determining the major factors that influenced the deposition of a sediment, especially in coastal areas. For example, what is described in a publication as 'a wind blown sediment' may either be the result of a dry and arid climatic phase, or of sand blowing in from the exposed coastal shelf during a generally humid climatic phase.

In the absence of a sufficient number of absolute dates, one might be tempted to consider the thickness of the sediments as indices of the relative duration of climatic phases. However, the inferred relative duration of each phase appears to be different in

different sites. For example, the inferred duration of the Angles interstadial would appear to be *longer* in Grotta Paglicci levels 10-8b (c.85 cm) than in Grotta delle Cipolliane level 3 (c.50 cm), while the Dryas I cold phase would appear to be *shorter* in Grotta Paglicci levels 8a-6d (c.35 cm) than in Grotta delle Cipolliane level 1 (c.105 cm). The idiosyncratic nature of cave and rockshelter sites, combined with a variable human presence, modulates both the intensity and the duration of the palaeoclimatic signal. Given this variability between and within sites, it is therefore unsure whether, for example, the apparently short cold phase represented by the sediments of Grotta del Cavallo level BIb (10 cm), is a short-term cold oscillation *within* a warm and humid phase represented by levels BII and BIa, or is a major cold phase *between* two distinct warm and humid phases. As a consequence, it is difficult confidently to correlate particular sedimentary levels at a site with the regional palaeoclimatic scheme presented in Chapter 2.

This leads to the problem of assessing the duration of the stratigraphic hiatuses at undated sites, such as that between Grotta delle Cipolliane levels 2 and 1. Though in the case of Grotta delle Cipolliane the proposed reconstruction of the late glacial palaeoshorelines suggests that the hiatus is in fact shorter than was originally suggested by Gambassini (1970), it is not possible to ascertain whether level 1 dates to the Bölling or to the Alleröd.

In the preceding pages I have recorded the radiocarbon dates available for each site and used them as confirmatory evidence or otherwise when levels are attributed to a specific stage in the late glacial sequence. Although it is tempting to accept radiocarbon dates as statements of truth, they are in fact only statements of probability. We have also to bear in mind that 'plateaux' are clearly present in the radiocarbon record for the period in question (Becker and Kromer 1986). Though the date series from individual sites might therefore not provide reliable absolute dates, they may sometimes at least give an indication of the relative age of different levels. The ^{14}C dates from the late Palaeolithic sites in south-east Italy are presented in Table 3:2, in descending order of age from the oldest to the youngest. As the table demonstrates,

there is a lack of concordance between the ^{14}C dates from each of the individual sites, and therefore even the relative ages are open to question. To confound matters, there are hazards involved with trying to correlate sites that were dated at different laboratories, using different techniques, on different materials, obtained by different sampling procedures. Problems are known to arise with the dating of materials containing carbonates, such as bone, which are particularly susceptible to contamination by exchange reactions with modern carbon, and therefore the dates may turn out to be 'too young' (Bradley 1985:55).

The majority of the problems outlined above are insoluble on the basis of the published data. Of necessity, the available radiocarbon dates have to be taken in good faith, but for those sites lacking absolute dates the stratigraphies remain suspended in uncertainty. An exception to this may be the undated Baia di Uluzzo sites: Grotta del Cavallo, Grotta di Uluzzo and Grotta Carlo Cosma. At each of the three sites, a layer of volcanic sand fills a long cultural hiatus between levels containing Uluzzian assemblages (c.30,000 BP) and levels containing assemblages that have been ascribed to the Epiromanellian phase of the Final Epigravettian (c.10,000 BP). It is proposed here that these volcanic sediments can be tentatively correlated with dated volcanic eruptions. Tephrochronology (ash-layer dating) uses dated ash layers as chronostratigraphic marker horizons to provide limiting dates on the sediments with which they are associated. A tephra layer of known age provides a *minimum* date on the material over which it lies, and a *maximum* date on material superimposed on the tephra (Bradley 1985).

Borzatti von Löwenstern (1963:88) suggests that the volcanic material at the Baia di Uluzzo sites derived from the disintegration of pumice that was washed along the coast by marine currents, after an eruption of Monte Vulture or of one of the volcanoes in the Aegean. The main evolution of Monte Vulture took place during the early and middle Pleistocene, and though Hieke Merlin (1967) has suggested that eruptions took place during the last glaciation, this has not been confirmed with

radiocarbon dates. A more probable source for the volcanic sediments at the Baia di Uluzzo sites would be the volcanoes in the Naples area, where a series of well dated late Pleistocene eruptions have been identified. Ash from the *First Phlegrean Period*, called Campanian Ignimbrite (C-9 and C-10 ash layers), has been dated in marine sediments to 31 ± 150 , 33.4 ± 1.6 and 37.5 ± 2 kyr BP (Paterne *et al.* 1986). Terrestrial dates for the same volcanic event range between 26-38 kyr BP (Alessio *et al.* 1971). It is not known whether the apparent long duration of the First Phlegrean Period is really the result of a long period of volcanic activity, or whether it is the result of poor resolution of the dates. A single eruption created the C-4 ash layer, which has been dated at 17.5 ± 0.3 kyr BP (Paterne *et al.* 1986). The C-2 ash layer, or Neapolitan Yellow Tuff, derives from the *Second Phlegrean Period*, and is dated at 12.6 ± 0.5 kyr BP in marine sediments (Paterne *et al.* 1986), and between $12,680\pm100$ and $10,740\pm90$ BP in terrestrial sediments (Alessio *et al.* 1971). Neapolitan Yellow Tuff is of a distinctive trachytic composition, containing minerals such as quartz, sanidine, albite, biotite, hornblende, augite, aegirine, and riebeckite.

There is abundant evidence for long-distance aeolian transportation of volcanic ash from eruptions in the Naples area. Campanian Ignimbrite from the First Phlegrean Period has been found in sediments around the Fucino lake basin in the region of Abruzzo (Giraudi 1989). The Y-5 ash layer in the eastern Mediterranean has also been attributed to Campanian Ignimbrite by Thunell *et al.* (1979), although Paterne *et al.* (1986) suggest that it may in fact derive from the Citara eruption at 40 ± 2 ka BP. Stratum Q at Franchthi cave, in the Greek Peloponnese, is a pale grey layer of tephra, 5-6 centimetres thick, and chemical and mineralogical analyses have indicated that this is Campanian volcanic ash from the First Phlegrean Period, c.30-38,000 BP, which was wind-transported 880 kilometres from the Naples area (Vitaliano *et al.* 1981). In historic times, ash from eruptions in the Naples area has been recorded as far afield as Constantinople (Naval Intelligence Handbook 1944). Finally, ten airborne tephra layers have been identified in deep-sea core RC 9-191 from the Ionian sea, and of these, seven layers originate from the Roman-Campanian region (First and Second

Phlegrean Periods), two from the Hellenic Arc (which are older than 40,000 BP), and one from Pantelleria, which is dated to c.45,000 BP (Keller 1981). Therefore, it is not unreasonable to suggest that volcanic ash from the First and Second Phlegrean Periods in the Naples area may have been deposited on the late glacial beach and carried by wind into the caves at the Baia di Uluzzo. The ^{14}C date of $10,740 \pm 90$ BP (the youngest radiocarbon date for the Second Phlegrean Period) would therefore provide a *maximum age* for the end of the stratigraphic hiatus at the three sites.

At Grotta delle Mura, which faces eastwards over the Adriatic coast, a distinctive green layer of volcanic tufa (level F) was deposited between levels containing industries ascribed to the Ancient Epigravettian and the Epigravettian *sensu stricto*, and this may be tentatively correlated with a dated volcanic eruption in the Hellenic Arc. A series of cores from the Adriatic sea, in the triangle formed by Bari, Brindisi and Dubrovnik, were found to contain ash layers composed of volcanic glass, feldspar, sanidine, pyroxene and biotite (Van Straaten 1967). This mineralogy suggests that the provenance of the ash was the volcano of Santorini in the Hellenic Arc; it is composed of very different minerals to that from the Naples area (Keller *et al.* 1978). The Y-4 ash layer pertains to the Lower Santorini eruption, which occurred at 18,000 BP or less, while the Y-2 ash layer pertains to the Middle Santorini eruption, which occurred at the Pleistocene/Holocene transition at c.10,000 BP. The Upper Santorini eruption occurred in historic times (Van Straaten 1967). Considering its position in the stratigraphy, level F could therefore be correlated with the Y-4 ash of the Lower Santorini eruption, dated at c.18,000 BP.

It must be stated that there is no *a priori* reason to associate distant proxy records with specific volcanic eruptions, and geochemical analyses of the ash layers would be needed to confirm these correlations. This is something which lay ^soutside _L my resources of time and funding in completing this thesis. Nevertheless, it seems to me that much more might be done with tephrochronology in the dating of archaeological sites of the later Pleistocene age in southern Italy and indeed elsewhere in the central Mediterranean.

The review of the sites provided by this chapter highlights the regional bias that has existed thus far amongst researchers towards caves and rockshelters as opposed to open sites. In south-east Italy there has been no comprehensive regional survey, and the intensity of research has tended to be localised in certain areas, such as the Salento peninsula, and in particular has favoured the excavation of caves. As a result, it is difficult to assess what percentage of the settlement system these sites represent, and how representative they are from the point of view of site function. It is likely that both the Tavoliere and the now submerged late glacial coastal plain would have supported dense populations of herbivores and humans, and these areas may indeed have provided the loci for residential sites. This point will be returned to in Chapter 7.

This chapter has also highlighted the relative merits of each site, from the point of view of the integrity of their archaeological deposits, and therefore from the point of view of their potential for resolving the problems to be explored in this thesis. Lithic assemblages from sites such as Grotta Romanelli and Grotta delle Mura, which were excavated according to thick sedimentary levels of up to 95 centimetres in depth, must surely be regarded as palimpsests and consequently the information they contain can only be useful at the broadest comparative level. Sites such as Grotta delle Cipolliane, Taurisano and Grotta Paglicci, on the other hand, were excavated by the removal of thin spits, and therefore they offer a greater potential for tracing technological and typological developments across sedimentary units. In the time available to me, I had to select one of these as a source of lithic material for detailed study. As the industry from Grotta Paglicci is currently under study, and that from Taurisano has recently been reanalysed by Bietti (1979), I chose Grotta delle Cipolliane as the site which offered the most fine-grained assemblage for the study of temporal variability, and the results of the reanalysis of the assemblage are presented in Chapter 5. This is followed in Chapter 6 by a comparative review of the late Palaeolithic assemblages from the other sites in the study area. Beforehand, it is necessary to describe in Chapter 4 the

methodological approach used in this thesis for the study of lithic assemblage variability.

CHAPTER 4

ANALYSIS OF THE LITHIC ASSEMBLAGES: METHODOLOGY AND TERMINOLOGY

4:1 INTRODUCTION

This chapter presents the methodology and terminology used in the analysis of the lithic assemblages (Chapters 5 and 6). To recapitulate briefly, the aim of this thesis is to identify diachronic change and synchronic variability in the Epigravettian assemblages of south-east Italy, and to explain this variability in terms of social and economic strategies. Therefore the analysis of the lithic assemblages was oriented towards the identification of temporal and spatial variability that might be accounted for by functional or stylistic factors, or in terms of different strategies of raw material economy. The analysis of the lithic assemblages is based on a combination of published data and of data resulting from my own analysis of material stored at the Istituto Italiano di Paleontologia Umana in Rome, and the Museo Comunale di Paleontologia in Maglie.

The methodological approach used for the analysis of the lithic assemblages had to be adapted to the variable quality of the data and to the constraints of time and funding available for this thesis, as well as to the specific problems to be investigated. At the time when the majority of the sites were excavated, there was an overwhelming preoccupation with the identification of cultures and their chronological arrangement. The excavations, analyses and publications were therefore inevitably oriented towards those artifacts which were believed to have the greatest diagnostic value in space-time systematics, the retouched tools. Unretouched flakes, chipping debris, cores and rejuvenation flakes were rarely systematically collected or quantified in the publications. Consequently, and regrettably, the analysis of the lithic assemblages

presented in Chapters 5 and 6 is largely confined to the retouched tools, though where data are available for thedebitage they have been incorporated in the discussion.

The presentation of the methodology and terminology used for the analyses of the retouched tools is preceded by a critical review of Laplace's *Typologie Analytique*. This typology, and the analytical method that goes with it, was used by the original excavators or by Laplace himself for the classification and publication of the majority of the assemblages discussed in this thesis, and it is still almost universally used in Italy today. Therefore it is important to outline the relative strengths and the weaknesses of this particular typology, not only because some of the data that will be discussed in Chapter 6 are derived directly from Laplace type-lists, but also because the widespread and normally uncritical use of it has been, and still is, largely responsible for shaping the current state of knowledge about the Italian Palaeolithic.

4:2 LAPLACE'S *TYPOLOGIE ANALYTIQUE*

Laplace's concept of the *Typologie Analytique* originated from a study of the North African Capsian industries (1957), and was later developed and adapted to the study of the Italian Gravettian and Epigravettian industries in the publication of *Essai de Typologie Systématique* (1964a). The scheme was revised in *Recherches de Typologie Analytique* (1968), and subsequent changes appeared in the 1970s (Laplace 1974). However, it is the 1964 and 1968 versions of the *Typologie* that have been adopted by the majority of Italian researchers, and it is therefore these that will be discussed here.

The basic concept behind the *Typologie Analytique* is the notion of the hierarchical *structure* of a lithic assemblage. Laplace employed four levels of nomenclature: the primary type; the tool class; the tool group; and the tool family (Table 4:1). *Primary types* are defined, described and identified by their distinctive attributes, such that a 'type' is an entity distinguished from other entities by a diagnostic set of morpho-technical attributes. For example, burins are divided into nine

primary types on the basis of the morphology and preparation of the burin bit. The primary types from the 1964 *Typologie* are presented in Figures 4:1-4:14.

Primary types are subsequently grouped into *typological classes*. The classes can consist of either single primary types or of more than one primary type which have 'important' characteristics in common. For example, the burin group is divided into three typological classes on the basis of the preparation of the burin bit: 'simple', 'on break' and 'retouched/truncated'.

Typological classes are then combined into *typological groups* according to their "morphological themes and general techniques" (1966a:201): burins, endscrapers, backed blades etc.. Finally, typological groups are grouped into five *typological families*: a burin family; an endscraper family; a family characterized by abrupt retouch (truncation group, perforator group, backed point group, backed blade group, backed truncations group, and geometrics); a family characterized by foliate retouch; and the *substrate*, which is comprised of points, blade-scrappers, flake-scrappers, abruptly retouched flakes and denticulates.

According to Laplace's analytical method, assemblages can be compared using the concept of 'diagnostic' indices and 'diagnostic' tool classes and types, and it is these features that are still used to characterize the different evolutive stages of the Epigravettian, as was outlined in Chapter 1. The diagnostic indices are derived from those of de Sonneville Bordes and Perrot (1953). There are four typological indices: the *index of primary types* (the percentage value of a primary type relative to the total number of the primary types); the *restricted index of primary types* (the percentage value of a primary type relative to the total of the primary types of the typological group to which it belongs); the *index of typological groups or typological families* (the percentage value of primary types in a typological group or family relative to the total number of primary types); and the *index of composite tools* (the percentage value of composite tools relative to the total number of tools). In addition there are two technical indices: the *laminar index of primary types* (the percentage value of primary

types made on blades or bladelets relative to the total number of primary types); and the *index of microlithism* (the percentage value of microlithic primary types relative to the total number of primary types). The other diagnostic indices most commonly used in the characterization of Italian Epigravettian industries, which are expressed as either less than, equal to, or more than a value of one, are those of the ratios of burins to endscrapers (B/G index), of retouched to simple burins (Br/Bs index), and of long to short endscrapers (Gfl/Gfc). The presence/absence or relative abundance of certain tool groups, such as geometrics, or of primary types, such as circular endscrapers, shouldered bladelets or unifacial points, were also considered to be culturally significant.

According to Laplace, the 'structure' of an assemblage could be described at three distinct levels: the *developed structure*, which consists of the ratios of the primary types; the *elementary structure*, which consists of the ratios of the tool groups and the tool classes; and the *essential structure*, which consists of the ratios of the tool families. This hierarchical scheme was subsequently modified in the publication of *Recherches de Typologie Analytique* (1968) to incorporate just two levels: the *elementary structure* (consisting of the ratios of the primary types, the tool classes and the tool groups) and the *fundamental structure* (consisting of the ratios of the tool families or *modal orders*). Graphic representation in the form of block-histograms of each structural level served as the means for comparing different assemblages.

The *Typologie Analytique* and the analytical method have been adopted uncritically by most researchers of the Italian Epigravettian, with the exception of Bietti (1978), despite the fact that they have received strong criticism outside Italy (eg., Bordes 1965; de Sonneville Bordes 1967; Delporte 1967; Minzoni-Déroche 1985). The *Typologie* most widely used is still the 1964 version; few researchers use the modifications of 1968 which rejected various primary types (eg., PD3 and P3) and even less the typological revisions and discussions of the successive years (eg.,

Laplace 1974). For the majority, an analysis of the diagnostic indices and of the different structural levels represents the most refined level of analysis and publication.

In my analysis of the south-east Italian assemblages I found that the hierarchical ranking of attributes according to their supposed diagnostic relevance, which Laplace uses as the basis for distinguishing one primary type from another, made it difficult to use the *Typologie* in a judicious manner. This can be illustrated by an example taken from the 1964 version of the *Typologie*. The flake-scrapers are classified initially on the basis of their cross-section: flat (R1-R4) or carinated (R5). The flat flake-scrapers are then classified according to whether the retouch is marginal (R1) or invasive (R2-R4), and those with invasive retouch are subsequently divided according to the location of the retouch: lateral (R2), transversal (R3), or latero-transversal (R4) (Figure 4:12). Therefore a carinated flake-scrapers with transversal retouch would be classified as R5, while a flat flake-scrapers with transversal retouch would be classified as R3. The supposedly diagnostic attributes do not retain consistent hierarchical values throughout the tool groups, such that an attribute that is discriminant in the case of some groups becomes secondary for others. Morphology is considered to be a diagnostic attribute for endscrapers, while for others such as backed bladelets it is not, and curved and straight backed bladelets are classified as one primary type. Using the Laplace typology therefore meant that tools had to be forced into the existing primary types, as the typology leaves no room for variability. This was considered to be unsuitable for the aims of this thesis, and consequently it was necessary to find an alternative approach.

4:3 AN ALTERNATIVE APPROACH

I considered various methodological approaches as alternatives to a strict adherence to the Laplace typology. The options of adopting an alternative and less rigid typology, such as that of Tixier (1963), or of creating my own specialized type list were rejected as unsuitable, for the following reasons. Firstly, the use of a

different typology would have created problems for making comparisons with the published data on which much of this thesis is based, as constraints of time and funding precluded the possibility of restudying all the assemblages from the region. Comparisons between assemblages that have been classified according to different typologies is bound to create its own source of inter-assemblage variability, and therefore a standardized framework for comparison is an essential prerequisite. Secondly, there are methodological problems inherent in a strict adherence to the typological approach. By focusing on the similarities between objects, the typological approach undoubtedly leads to the suppression of vast amounts of information by summarizing the variability among artifacts, and reduces the number of dimensions of variability that can be taken into account. Attribute analysis, on the other hand, places the emphasis on trying to understand the dynamics that lie behind the observed variability in stone tools, rather than on ordering the variability in terms of artifact classification. Attributes are the basic, observable components which together make up a specific artifact. Therefore some attributes describe the morphology of a tool, such as its size and shape, while others describe the characteristics of the retouch.

Detailed attribute data are available for only some of the assemblages discussed in this thesis. Tool-by-tool descriptions have been published of the assemblages from the 1964 excavation at Grotta delle Cipolliane and the 1972-73 excavation of the Final Epigravettian levels at Grotta Paglicci. In addition, there is detailed information resulting from my own analysis of samples of the assemblages from Taurisano, Ugento, Grotta Romanelli, and Grotta di Uluzzo, and of survey material from the Alimini lakes, where I carried out fieldwork in the course of this research. Data on the remainder of the assemblages are confined to the publication of Laplace type-lists and/or vague descriptive accounts. The Laplace type-lists themselves contain a certain amount of rather disparate information on the attributes. For example, the two types of perforator are defined on the basis of the position of the point in relation to the axis of the blank, but otherwise there is no record of any other attribute, such as whether the

tool is made on a flake or a bladelet, or of the type of retouch. The three types of truncation are defined on the basis of the angle of the truncation and the amplitude of the truncation retouch (marginal or invasive), but again all other attributes are left unrecorded. Therefore the main emphasis in the analysis of the lithic assemblages is placed on those samples for which data on the attributes are available, and the other assemblages are used for comparative purposes as far as the data allow. The rest of this chapter describes the methodology and terminology of the attribute analysis.

The identification of lithic assemblage variability using the attribute approach proceeds from the *analysis* of attributes rather than from simple description, and involves the examination of covariations of pairs of attributes as well as the presence/absence and relative frequencies of individual attributes. In order to investigate diachronic change in the assemblages from Grotta delle Cipolliane, Grotta Paglicci and Taurisano, attribute tables for each tool class from each site were constructed according to a standardized format, with the stratigraphic divisions running down the vertical axis and the coded attributes along the horizontal axis. The quantity of the different attributes in each level were then recorded. Temporal variability could be observed on the basis of the presence/absence and relative proportions of the different attributes, and of covariations of morphological and retouch attributes that appear on the same tool. The potential number of covariations within each tool class is enormous, especially within the larger tool classes and those which are described by most attributes. It would have been too laborious and possibly unfruitful to examine all the covariations, and therefore it was necessary to choose attributes which were expected to be pertinent to the questions being asked: in other words, those which were likely to be meaningful with regard to explaining variability in terms of function, style or raw material economy. Some attributes and attribute covariations that are stratigraphically discontinuous cannot necessarily be considered as chronologically diagnostic. If attribute distributions are discontinuous but recurrent, the discontinuities could be the result of hazard, while fluctuations in the relative

proportions of attributes could result from differences in sample size. I decided against the use of standard statistical tests for two reasons. Firstly the majority of the sample sizes from each level are too small for the results to be statistically significant. Secondly, it has always seemed to me that the relationship between statistical significance and archaeological significance is a tenuous one. Too often, statistical significance leads to inferences of causal relation, or is confused with strength of association. Alternatively, a strict adherence to the 0.05 level of statistical significance, which is that most commonly used in archaeological research, may result in the rejection of something that is archaeologically significant. Therefore the question of whether the observed variability was likely to result from the sample size-effect or from hazard, and of whether the attribute covariations held any significance, was resolved intuitively. It is worth adding that the data I have recorded could readily be used in the future to check other covariations or to carry out statistical tests.

Attributes can be equated with decisions, whether conscious or unconscious, that were made by the artisan during the manufacturing process (Rouse 1960:314; Clarke 1968:138). Given that each attribute is recorded as one of a set of mutually exclusive possibilities, different attributes can be seen as a set of alternative choices from which the prehistoric artisans made their selection at each decision making stage. An attribute analysis is therefore an essential part of the reconstruction of the *chaîne opératoire*. If there existed a range of satisfactory solutions to a particular technical problem or the satisfactory accomplishment of an objective, the choice between different possible *chaînes opératoires* will be manifested in the variability in a mutually exclusive set of attributes. For example, when choices are not dictated by the mechanical and technical constraints of the raw material or by the nature of the objective, the decision to make a certain tool on a flake as opposed to a bladelet, or to use alternate retouch rather than direct retouch, is made as a function of the technical tradition of a group. Therefore the identification of these alternative solutions through the observation of the variability in the attributes permits a cultural diagnosis of the

technical tradition of a tool-making group. Once the factor of diachronic variability has been controlled for, the attribute analyses therefore provide an opportunity for examining whether the assemblages from the Salento peninsula and the Gargano promontory represent two distinct cultural traditions, according to the theories of Laplace and others that were outlined in Chapter 1.

The potential number of attributes that can be recorded on any one tool is theoretically infinite. The attributes which are used in this thesis are those defined by Laplace (1968), although I am making a very different use of them; the reason for this is to provide a standardized format for comparisons between published attribute data from Grotta delle Cipolliane and Grotta Paglicci and the attribute data resulting from my own analysis of samples from Taurisano, Ugento, Grotta di Uluzzo and Grotta Romanelli. The terminology used to describe the attributes is defined at the end of this chapter. The attributes are all essentially qualitative or descriptive, which has the advantage of permitting the inclusion of fragments in the analyses. Some attributes are inherently qualitative, such as sinister and dexter, direct and inverse. Other attributes, such as the size of the blank, involve the conversion of measurements from the numeric scale on which they were measured to a nominal scale. The nominal scale is a set of mutually exclusive categories, and the act of scaling consists of assigning each entity to be scaled to its proper category where it is treated as identical to the other entities in that category. For example, according to the attributes defined by Laplace, a blank is described as 'small' when the maximum dimension is less than 2.5 centimetres, as 'medium' when the maximum dimension is 2.5 cm or larger but less than 5 centimetres, and as 'large' when the maximum dimension is larger than 5 centimetres. Thus a blank with a maximum dimension of 1.8 centimetres is treated as being identical to a blank with a maximum dimension of 2.4 centimetres. The use of qualitative variables is often criticised for forcing continuous variation into static classes which represent intuitively defined modes or norms (see for example Hoffman 1985). Spaulding's (1982) justification of the use of the nominal scale is that many of

our observations, such as large and small, are inescapably made in the nominal mode rather than in terms of absolute measures, and therefore it is likely that the makers and users of archaeological artifacts also operated in the nominal mode. While this is undoubtedly so, to take this stance involves making implicit inferences about the perceptions of the artifact makers. For example, advocates of the Laplace typology observe that there are long and short endscrapers, and in so doing they infer that the artisans also conceived of length as two categories. They may then proceed to search for non-random relationships between the attributes 'long' and 'short' and other variables, and finish by inferring that the long-short categories are culturally or functionally imposed. The conversion of metrical attributes into the nominal scale is tactically necessary, in order to produce a standardized format to facilitate comparisons; however, it must always be borne in mind that this may be creating variability where there is none, or alternatively it may be masking real metrical distinctions recognized by the prehistoric artisans.

The last part of this chapter defines the terminology used here for the description of attributes.

THE ATTRIBUTES OF THE BLANK (Figure 4:15)

The **blank** is defined as the unit of stone on which the tool has been made. For present purposes, a **tool** is defined as a blank which shows intentional retouch.

The **type** of blank: a **flake** is a blank whose length is less than twice its width; a **blade** is a blank with essentially parallel lateral edges, a length that is equal to or greater than twice the width, and a length greater than 5 centimetres; and a **bladelet** is a blank with essentially parallel lateral edges, a length equal to or more than twice the width, and a length of up to 5 centimetres.

The **size** of the blank: a blank is described as **small** when the maximum dimension is less than 2.5 centimetres, as **medium** when the maximum dimension is

2.5 cm or larger but less than 5 centimetres, and as **large** when the maximum dimension is larger than 5 centimetres (Figure 4:15a).

The **cross-section** of the blank: a blank is described as **flat** when the thickness of the blank is less than half the width, and as **carinated** when the thickness of the blank is equal to or greater than half the width (Figure 4:15b).

THE ATTRIBUTES OF THE RETOUCH (Figure 4:16)

The **angle** of the retouch describes the angle formed by the retouch and the flaking surface: the retouch is described as **simple** when the angle is less than 45°; as **abrupt** when the angle is 45° or more; as **flat** when the retouch spreads inwards from the edge of the blank forming an angle of much less than 45°; and as **elevated** when large retouch scars on a thick blank form an angle of more than 45° (Figure 4:16a).

The **amplitude** of the retouch describes the extent to which the retouch modifies the original surface of the blank: retouch is described as **marginal** when it is restricted to the very margins of the blank and therefore does not substantially modify the original surface of the blank; and as **invasive** when it extends much deeper onto the blank and consequently modifies the original surface of the blank (Figure 4:16a).

The **direction** of the retouch describes the direction from which the percussion or pressure was applied on the blank: retouch is described as **direct** when the percussion or pressure is applied exclusively from the ventral face of the blank; as **inverse** when the percussion or pressure is applied exclusively from the dorsal face of the blank; as **alternate** when the percussion or pressure is applied directly and inversely in discrete areas on the ventral and the dorsal faces; and as **bifacial** when the percussion or pressure is applied from both the dorsal and the ventral faces at the same point on the edge of the blank. When the angle of bifacial retouch is abrupt, the retouch scars may have the appearance of being 'crushed'. This type of retouch has been shown to be the result of the **bipolar** or **anvil technique**, when the blank is

rested on an anvil or other support and subsequently struck to retouch it (Figure 4:16b).

The **lateralization** of the retouch is described as either **sinister lateral**, **dexter lateral**, **bilateral** or **transversal**. Sinister and dexter describe the lateralization in relation to the dorsal surface of the blank, and mean 'on the left side' and 'on the right side' respectively when the blank is placed dorsal face up with the striking platform nearest to the observer. The term **lateral** is defined as an edge perpendicular to the striking platform, while the term **transversal** is defined as the edge opposite the striking platform, or the edge where the striking platform is located (Figure 4:16c).

The **extent** of the retouch describes whether the retouch continues along the entire length of an edge, in which case it is described as **continuous**, or whether the retouch is restricted to a limited section of the edge, in which case it is described as **partial**.

If the extent of the retouch is partial, its **location** is described as being either **partial proximal**, **partial medial** or **partial distal**. The **proximal** part of a blank is that part closest to the bulb of percussion, the **distal** part of a blank is that part furthest from the bulb of percussion, while the **medial** part is the central part of a blank (Figure 4:16c).

Secondary retouch is defined as retouch that can be considered to be optional, in that it is secondary to the primary retouch modifications that define a class. For example, a backed bladelet is defined as a bladelet with abrupt lateral retouch, and any other retouch occurring on the tool is described as secondary.

The retouched tools have been grouped into ten tool classes which are morphologically discrete and therefore mutually exclusive. This serves as a framework for the initial sorting of the retouched tools.

BACKED BLADELETS

Backed bladelets are laminar blanks which have abrupt retouch on one or both of the lateral edges. Occasionally the blank is technically a blade rather than a bladelet (i.e, its length is 5 cm or more), but these occur so rarely that it was decided to refer to the whole class as backed bladelets. The class combines three of Laplace's (1964a) tool groups which were distinguished on the basis of the morphology of the tip: backed points, backed blades, and backed truncations. It was decided here to regroup the backed bladelets into one class, in order that the temporal variability in the morphology of the tip could be examined alongside the other attributes which cross-cut the three Laplace groups.

The backed bladelets are described by sixteen attributes: the size of the blank; the condition of the blank; the lateralization of the backed edge(s); the morphology of the backed edge(s); the direction of the backing retouch; the amplitude of the backing retouch; the morphology of the distal end; the morphology of the proximal end; the direction of the truncation retouch; the amplitude of the proximal ventral retouch; the amplitude of the distal ventral retouch; the extent of the backing retouch; the extent and location of the secondary lateral retouch; the angle of the secondary lateral retouch; the amplitude of the secondary lateral retouch; and the direction of the secondary lateral retouch.

The **condition of the blank** describes whether the piece is whole or broken and, if broken, whether the fragment is of the proximal, medial or distal part of the bladelet.

The **morphology of the backed edge(s)** is described as either **rectilinear**, **curved** or **shouldered** (Figure 4:17a).

The **morphology of the end** is described as either **pointed**, **obtuse** (rounded) or **truncated**. Truncated ends are described as **right-angle** when the truncation lies at approximately 90° to the axis of the blank, and **oblique** when the truncation lies at an angle to the axis of the blank. The truncation is described as

piquant trièdre when it incorporates the characteristic trihedral point which results from a truncation made by use of the microburin technique (Figure 4:17b).

There are two types of secondary retouch. The distinction is made between **secondary lateral retouch**, which occurs on the lateral margins of the tool, and **proximal/distal ventral retouch**, which is flat retouch, normally with long and parallel or subparallel flake scars, which occurs at the proximal and/or distal ends of the bladelet, on its ventral surface.

LINEAR RETOUCED TOOLS

The linear retouched tool class combines Laplace's flake-scraper, blade-scraper and abrupt groups. It was decided here to group them together because the three groups are not sufficiently morphologically distinct to qualify for separate classes. At the same time it is a rather amorphous class, in that its members are retouched blanks which lack any other distinguishing feature that would allow them to be classified into another class. The class includes flakes with either simple or abrupt retouch, and blades or bladelets with simple retouch. The retouch is described as 'linear' in order to distinguish it from denticulated or notched retouch.

The linear retouched tools are described by sixteen attributes: the type of blank; the size of the blank; the lateralization of the retouch; the cross-section of the blank; the morphology of the sinister edge; the angle of the sinister lateral retouch; the amplitude of the sinister lateral retouch; the direction of the sinister lateral retouch; the morphology of the dexter edge; the angle of the dexter lateral retouch; the amplitude of the dexter lateral retouch; the direction of the dexter lateral retouch; the morphology of the transversal edge; the angle of the transversal retouch; the amplitude of the transversal retouch; and the direction of the transversal retouch.

BURINS

Burins are tools which have a chisel-shaped **bit** formed by the intersection of two ~~surfaces~~, at least one of which is a **facet** constituting the scar left by the removal of a laminar spall. The burins are described by fifteen attributes: the type of blank; the size

of the blank; the location of the burin bit(s); the direction of the distal facet(s); the direction of the proximal facet(s); the primary modification of the distal end; the morphology of the distal burin profile; the morphology of the distal facet convergence line; the primary modification of the proximal end; the morphology of the proximal burin profile; the morphology of the proximal facet convergence line; the lateralization of the secondary retouch; the angle of the secondary retouch; the amplitude of the secondary retouch; and the direction of the secondary retouch.

The **direction of the facet(s)** describes the direction of the spall removal(s) in relation to the axis of the blank. The direction is therefore described as **lateral** when the facets run parallel to the axis of the blank, as **transversal** when the facets run perpendicular to the axis of the blank, and as **latero-transversal** when both lateral and transversal facets originate from the same end of the blank (Figure 4:18a).

The **primary modification** describes the modification (if any) of the blank before the removal of the burin spall(s). The angle of the **truncation** is described as either **right-angle**, when it lies at approximately 90° to the axis of the blank, and as **oblique** when it lies at an angle to the axis of the blank. The morphology of the truncation is described as either **straight**, when it is rectilinear or slightly convex, or **concave** (Figure 4:18b).

The term **profile** is used to describe the plan-form of the artifact, after Sackett (1989). The **morphology of the burin profile** describes the position of the burin bit in relation to the axis of the blank. When the burin bit lies central to the axis it is described as **axial**, and when it is oblique to the axis it is described as **angle** (Figure 4:18c).

The **morphology of the facet convergence line** describes the line of intersection on the burin bit between two or more converging facets, or between a single facet and the blank. The morphology is described as **rectilinear** where there is one single facet or two convergent single facets, forming a continuous rectilinear or subrectilinear line; as **sigmoid** when multiple convergent facets form a sinuous line;

and as **polygonal** where there are multiple facets, or one single facet and multiple convergent facets, forming a convex line (Figure 4:18d).

ENDSCRAPERS

The scraping edge characteristically forms an acute angle with the ventral face of the blank of around 60°. The endscrapers are described by eleven attributes: the type of blank; the size of the blank; the cross-section of the blank; the morphology of the blank; the location of the scraping edge; the morphology of the distal scraping edge; the morphology of the proximal scraping edge; the lateralization of the secondary retouch; the angle of the secondary retouch; the amplitude of the secondary retouch; and the direction of the secondary retouch.

The **morphology of the blank** is described as **long** when the length of the blank is equal to or greater than twice the width; as **short** when the length of the blank is less than twice the width; and as **circular** when the length of the blank is roughly equal to the width, and the scraping edge is continuous (Figure 4:19a).

The **morphology of the scraping edge** is described as **convex** when the scraping edge contour is regularly arched, and as **nosed** when the scraping edge contour is sinuous (Figure 4:19b).

NOTCHES

A notched tool is defined as a blank with an intentionally made notch, and no more than one notch on each edge. Blanks with more than one notch on each edge are classified as denticulates. According to the Laplace classification, notches are regarded as two primary types in the denticulate group (D1 and D5). Here, notches are considered to be sufficiently morphologically distinct from denticulates to be considered as a separate class.

The notches are described by ten attributes: the type of blank; the size of the blank; the lateralization of the notch(es); the angle of the notch retouch; the amplitude of the notch retouch; the direction of the notch retouch; the lateralization of the

secondary retouch; the angle of the secondary retouch; the amplitude of the secondary retouch; and the direction of the secondary retouch.

DENTICULATES

Denticulates are characterized by a line of indented retouch, created either by a series of small notches or by more continuous serrated retouch. The denticulates are described by ten attributes: the type of blank; the size of the blank; the lateralization of the denticulate retouch; the angle of the denticulate retouch; the amplitude of the denticulate retouch; the direction of the denticulate retouch; the lateralization of the secondary retouch; the angle of the secondary retouch; the amplitude of the secondary retouch; and the direction of the secondary retouch.

POINTS

This class includes all flakes or blades which have been retouched to form a point, but excluding pointed backed bladelets, and perforators. Laplace's *pointes foliacées* are also included in this class.

The points are described by seven attributes: the type of blank; the size of the blank; the cross-section of the blank; the lateralization of the retouch; the angle of the retouch; the amplitude of the retouch; and the direction of the retouch.

TRUNCATIONS

This class includes all tools with a truncation except for truncated burins, truncated backed bladelets, perforators and geometrics. The truncations are described by eleven attributes: the type of blank; the size of the blank; the angle of the truncation; the morphology of the truncation; the angle of the truncation retouch; the amplitude of the truncation retouch; the direction of the truncation retouch; the lateralization of the secondary retouch; the angle of the secondary retouch; the amplitude of the secondary retouch; and the direction of the secondary retouch.

The angle of the **truncation** is described as either **right-angle**, when it lies at 90° to the axis of the blank, or **oblique** (Figure 4:20a).

The morphology of the truncation is described as either **straight**, when it is rectilinear or slightly convex, **concave**, or **chevron** (Figure 4:20b).

PERFORATORS

Perforators are tools with a small and robust point which projects slightly from the rest of the blank. The perforators are described by fourteen attributes: the type of blank; the size of the blank; the location of the perforator; the position of the perforator; the technique of manufacture; the angle of the truncation; the morphology of the truncation; the angle of the retouch; the amplitude of the retouch; the direction of the retouch; the lateralization of the secondary retouch; the angle of the secondary retouch; the amplitude of the secondary retouch; and the direction of the secondary retouch.

The **position** of the perforator is described as **axial** when it lies central to the axis of the blank, and as **angle** when it lies oblique to the axis of the blank.

The **technique of manufacture** describes whether the perforator point was formed by means of retouch, truncations, or notches.

COMPOSITE TOOLS

Composite tools are those where two *different* tool classes, such as a burin and an endscraper, are found on the same blank, usually on opposite ends but sometimes on contiguous edges. The composite tools are described by only three attributes: the type of blank; the size of the blank; and the tool class combinations.

GEOMETRICS

Geometrics are microlithic tools which have a geometric morphology created by abrupt retouch. The geometrics are described by nine attributes: the type of blank; the size of the blank; the morphology of the tool; the amplitude of the primary retouch; the direction of the primary retouch; the extent of the secondary retouch; the angle of the secondary retouch; the amplitude of the secondary retouch; and the direction of the secondary retouch.

The morphology of the tool is described as either **semilunate; trapezoidal segment; scalene triangle; isosceles triangle; scalene trapeze; isosceles trapeze; rectangle trapeze; or rhomboid** (see Figure 4:8)

This concludes the account of the methodology of the attribute analysis approach that is used in this thesis. In order to resolve questions of inter-assembly variability on a regional scale, it is first necessary to clarify the processes that lead to variability within a single assembly; for example, if factors such as raw material constraints are shown to affect variability within one assembly, these factors can also be expected to affect variability between assemblies. The next Chapter presents a detailed attribute analysis of the assemblies from Grotta delle Cipolliane.

CHAPTER 5

ANALYSIS OF THE LITHIC ASSEMBLAGES: GROTTA DELLE CIPOLLIANE

5:1 INTRODUCTION

This chapter presents a reanalysis of the retouched tools from the 1964 excavation at Grotta delle Cipolliane. The sequence from this site is believed to span the Ancient, Evolved and Final Epigravettian, with a possible hiatus between the earlier and later stages of the Final Epigravettian. The publication of the 1964 excavation (Gambassini 1970) consists of a detailed tool-by-tool description of the assemblage which I considered to be worthy of reanalysis, as it offers considerable potential for expanding on the existing interpretations of cultural succession. The thesis does not reject *a priori* the validity of the previously established chronostratigraphic phases, but rather seeks to examine whether they exist as technologically and typologically distinct entities, and to refine their definition through the more contextual approach of the concept of lithic production systems. The reanalysis of the assemblage was therefore aimed at identifying temporal variability within and between the chronostratigraphic phases that might be accounted for by functional or stylistic factors, or in terms of changing strategies of raw material economy. The majority of the data are presented in the form of tables and figures, and these are analysed and discussed in the text.

Grotta delle Cipolliane was excavated in two separate seasons: in 1962 by Palma di Cesnola and Borzatti von Löwenstern (Palma di Cesnola 1962); and in 1964 by Gambassini (1970). The 1964 excavation opened a trench directly adjacent to that excavated in 1962 (Figure 5:1). Both excavations were conducted according to a system of rectangular excavation units of varying sizes (quadrats). As a background, a brief summary of the original chronological attributions of the industries is presented.

As one would expect, the 'chronology' depends heavily on somewhat myopic attention to the minutiae of lithic typology.

Level 4: in 1962 level 4 was explored only in quadrats A1, A2 and B3. On the basis of the size of the lithics recovered, Palma di Cesnola identified two distinct horizons within level 4: a lower horizon, with a small and medium sized industry; and an upper horizon, with a 'microlithic' industry. The lithics from both horizons were considered to demonstrate a 'typical Final Gravettian physiognomy', on the basis of the high percentage of backed bladelets (57%), and a burin/endscraper index of >1.

In 1964, level 4 was excavated partially in quadrats C1-4 and C5 east, in B3 where the 1962 excavation had been incomplete, and in C3 west where 19 spits (4I-XIX) were excavated. In quadrats B3 and C3 west the excavation reached bedrock. Gambassini correlated the typological characteristics of the assemblages from Cipolliane with those from Grotta Paglicci, which he considered to be an 'Upper Palaeolithic regional pillar' (Gambassini 1970:173), despite the fact that there were supposed to be 'cultural' differences between the two sites and consequently different assemblage characteristics. On the basis of the presence of shouldered backed bladelets and a burin/endscraper index of >1, Gambassini classified the lithic industry as belonging to Laplace's attenuated subphase of the Ancient Epigravettian phase with shouldered points.

Level 3: in 1962 level 3 was excavated in three spits in quadrats A1, A2 and B3, and partially in A3 and A4. A single industry was present, considered to be similar to that from the upper part of level 4, on the basis of its microlithic morphology and the typology of the endscrapers, and it was therefore attributed to the typical Epigravettian.

In 1964, level 3 was excavated in seven spits (3I-VII) in quadrats C1-4 and C5 west. Spits 3VI and 3VII were also excavated in quadrats A3 and A4, where the excavation in 1962 had been incomplete. In some areas of the site it was necessary to remove two further spits (3VIII-IX) to reach the surface of the underlying level 4. In

C5 east the level was excavated down to and including spit 3V. Gambassini identified three distinct phases within level 3, on the basis of the essential structure of the industry: a first phase in spits 3IX-VI, characterized by relatively high values for the substrate; a second phase in spits 3V-IV, characterized by an abundance of burins and endscrapers and low values of the substrate; and a third phase in spits 3III-I, characterized by a maximum development of proto geometrics (bitruncated backed bladelets), a decrease in the burins and endscrapers, and an increase in the substrate. These phases were considered to belong to two aspects of the Evolved Epigravettian, divided on the basis of the burin/endscraper ratio: the phase with truncated backed bladelets (spits 3IX-IV), with a B/G ratio of >1 ; and the phase of transition from Evolved to Final Epigravettian (spits 3III-I) with a B/G ratio of <1 . The 1964 excavation also produced the only radiocarbon dates from the site: $15,000 \pm 100$ BP (spits 3I-II), $15,270 \pm 300$ BP (spit 3III) and $15,200 \pm 100$ BP (spits 3VI-VII) (Alessio *et al.* 1976). As these dates were obtained when radiocarbon dating was still in its early stages of development, they should be treated with caution.

Level 2: in 1962, level 2 was excavated in four spits (2C, 2B, 2A and 2S). The single industry present was attributed by Palma di Cesnola to the Protoromanellian phase of the Final Epigravettian.

In 1964, level 2 was excavated in eight spits (2I-VIII) in quadrats C1-C4 and in C5 west and east. The sparse industry was attributed by Gambassini to the phase of transition between the Evolved and Final Epigravettian, therefore suggesting a direct continuation with the upper part of level 3.

Level 1: the industry from the 1962 excavation was classified by Palma di Cesnola as belonging to the late Romanellian phase of the Final Epigravettian, on the basis of the presence of small circular endscrapers, and a burin/endscraper index of <1 . The absence of geometrics and the abundance of denticulates suggested a later date than the typical Romanellian, and therefore indicated a hiatus between levels 2 and 1.

In 1964, level 1 was excavated without spits in quadrats C1-C4 and in C5 west and east. The burin/endscraper ratio was again <1 , and Palma di Cesnola's attribution of the industry to the late Romanellian phase of the Final Epigravettian was retained.

The stratigraphy at Grotta delle Cipolliane therefore presents a fairly continuous Epigravettian sequence with only two hiatuses: a hiatus within level 4 (spits 4VIII-VII); and a hiatus between levels 2 and 1. That between levels 2 and 1 was originally suggested by Palma di Cesnola on the basis of the typology, and was confirmed in the 1964 excavation by the presence of two culturally sterile spits (2II-I) at the top of level 2, and sedimentary evidence for a phase of erosion prior to the deposition of level 1. Because of the erosion, it is difficult to estimate the length of the hiatus on the basis of the sediments. On typological grounds, Gambassini (1970) suggested a duration of between the earliest and the latest stages of the Final Epigravettian (4.5 kyr). However, as was discussed in Chapter 3, the presence of aeolian sandy sediments in level 1 suggests that during their deposition a beach was exposed below the cliffs. According to the reconstruction of the paleoshorelines, this would mean that the sediments of level 1 were deposited before the Preboreal, and therefore the sediments of level 1 have been reassigned to the Bölling or the Alleröd. According to this new interpretation the length of the hiatus between levels 2 and 1 is reduced to 1.5-2.5 kyr. The stratigraphic hiatus in level 4, on the other hand, is comparatively short, and although it is not possible to estimate its duration on the basis of the rate of sediment deposition, neither Palma di Cesnola nor Gambassini found any suggestion of a hiatus on the basis of the lithic typology.

The tools from the 1962 excavation were later restudied by Laplace and published in the form of a type-list, without comment (Laplace 1966b). A comparison of the tool class lists which resulted from Palma di Cesnola's and Laplace's analysis of the same data reveals quite significant differences (Tables 5:1-5:2), and provides a cautionary tale concerning the inherent subjectivity of archaeological classification. Firstly, apart from the fact that there are discrepancies between Palma di Cesnola and

Laplace concerning the total numbers of tools coming from each level, more significantly the number and relative sizes of tool classes also differ considerably. When either of these class lists is compared with that of Gambassini (Table 5:3), which resulted from an exploration of an area directly adjacent to that excavated in 1962, again the number and size of tool classes for each level differ. A graphic representation of the relative percentages of tool classes for each level indicates where some of these discrepancies lie (Figures 5:2-5:5). This comparative exercise highlights the dangers not only of making simplistic characterizations of site function or assemblage diversity based on the relative percentages of tool classes but also of interpretations made on the partial excavation of a site.

The attribute study which forms the basis of this chapter was made on 849 of the 902 tools recovered during Gambassini's 1964 excavation. Those tools which came from uncertain contexts were excluded from the analysis (n.53, 6% of the total), and this explains the slight discrepancies between Gambassini's tool class totals and my own. There is great variability in the number of retouched tools from each spit, ranging from one in level 4VI, to 159 in level 1 (Tables 5:4-5:5). Though the mean quantity is 34, the median is only 19. The problem of small sample size is especially acute for level 2 and the lower spits of level 4. The small sample from spits 3VIII-IX results from the fact that these spits were only found in part of the excavated area. The implications of the sample size-effect on assemblage variability have been comprehensively discussed by Thomas (1983). The relationship between sample size and sample diversity is linear, such that the larger the sample size the greater the diversity, and vice versa, and these problems have to be borne in mind when interpreting the observed variability.

The tools at Grotta delle Cipolliane are all made from chert. An exhaustive survey of geology maps, and research at the Department of Geology at the University of Bari, revealed that the only sources of chert in south-east Italy are the *Scaglia rossa* and *Rodi Garganico facies* in the Gargano promontory, and the Jurassic and Upper

Triassic limestones in Basilicata (see Figure 2:3). The exploitation of sources in the Gargano promontory would have meant that all lithic raw material used at Grotta delle Cipolliane had to be imported from a distance of approximately 300 kilometres, while the transportation of raw material from Basilicata would have involved a distance of around 250 kilometres. One way of minimizing the costs incurred by inconvenient procurement trips would have been to cache raw material at regularly used campsites, but this alone would not be an entirely satisfactory solution as the caches would have to be constantly replenished. Therefore hunter-gatherers at Grotta delle Cipolliane can be expected to have employed economizing strategies in lithic procurement, tool production and use. The influence of raw material economy on tool design may include standardization in artifact form or reduction in tool size, and in addition it is likely that the tools will have been strongly modified during the course of their use-life, by breakage and by subsequent rejuvenation. As a result of these factors, some type-categories may actually only represent relatively minor permutations on the generic class, reflecting more often than not either successive stages in the progressive modification of a single design-type, or minor alterations arising from variations in blank morphology, rather than clearly defined 'mental templates'. However, the hypothesis that raw material economy will have influenced tool design does not negate the potential influence of functional and stylistic factors, and it is expected that multiple factors acting differentially within each tool class are responsible for creating the observed variability.

The first part of the chapter is therefore oriented towards identifying the structure of the variability within each tool class, and exploring these causal factors. The expected archaeological consequences of each factor are discussed, and the data are then examined to see whether they conform to these expectations. Since the actual functions of the artifacts are not known and are therefore only inferred from microwear and ethnographic studies, the functional hypothesis cannot be tested directly. However, as some attributes seem likely to have been of functional significance, for example the morphology of the tip of a backed bladelet, the functional hypothesis can

therefore be tested by examining the degree to which these attributes covary with other attributes whose variability is to be explained. The degree of covariation should be directly proportional to the functional relevance of the latter.

An important part of analysing the individual tool classes will be to examine the stratigraphic behaviour of the traditional diagnostic indices and type fossils. The fact that the 1964 excavation was carried out by the removal of thin spits means that the stratigraphic resolution at Grotta delle Cipolliane is good, and therefore if these type fossils are shown not to be temporally diagnostic in this stratigraphy, then they cannot be expected to be chronologically diagnostic in other assemblages where the stratigraphic resolution is less refined. As an alternative, the identification of those attributes and attribute covariations within each tool class which are diagnostic in this respect should provide a chronological framework within which to reconsider the assemblages from the other late Palaeolithic sites in the region (Chapter 6).

The discussion which concludes this chapter considers the evidence for the influence of raw material economy on strategies of tool production and use.

5:2 BACKED BLADELETS (Tables 5:6-5:10)

Backed bladelets (whole and fragments) constitute the largest tool class (n.324, 38%) (Table 5:4). They are present in virtually every tool-bearing spit, with significantly high values in spits 4III-I, 3VII-VI, 3III-I, and level 1. Fragments account for 47% (n.152) of the backed bladelet class, and therefore it was necessary to calculate the minimum number of backed bladelets for each spit, in order to avoid overrepresentation of the backed bladelet class with respect to the other tool classes. This was done according to an adaptation of the method used by Cauvin and Coqueugniot (1989:70-73), by matching proximal, medial and distal fragments according to the morphology of the backed edge (rectilinear, curved, shouldered), the type of backing retouch (angle, amplitude and direction), the lateralization of the backing retouch (sinister, dexter or bilateral), and the type of secondary retouch

(angle, amplitude, and direction). This method, which must still count as only approximate, was thought to be the most suitable in the absence of data on the widths and thicknesses of the backed bladelets. The corrected values only slightly reduce the global percentage of backed bladelets with regard to other tool classes (n.290, 36%), and the class retains consistently high values within each spit of between 20% and 100% (Table 5:5).

Breakage may have occurred during manufacture, either as a result of technical error or intentionally. Unintentional breakage during on-site manufacture which rendered the tool useless should result in equal representation of proximal and distal fragments. Alternatively, breakage may have occurred during use, and the relative frequencies of fragment types will accordingly depend on the kinds of functions for which the backed bladelets were used, and where they were used. For example, if the bladelets broke during use at the cave, then the different fragment types should be equally represented, while on-site retooling of longitudinally hafted backed bladelets that broke during use away from the cave should result only in the deposition of either proximal or distal fragments, depending on which end of the bladelet was hafted. Finally, proximal, medial or distal fragments of bladelets used as projectile elements may have been removed from carcasses that were returned to the site for butchery. For all these reasons, the interpretation of fragment type abundance is far from straightforward. Turning to the data (Table 5:7), there is no coherent temporal variation in breakage through the spits, either in terms of whether the fragments are proximal, medial or distal, or in terms of the quantity of fragments in relation to unbroken bladelets, though level 1 has a considerably higher percentage of fragments (67%) than any of the other spits. Considering the fragments together, they are for the most part proximal (47%), with medial and distal parts more or less equally represented (25% and 28%), but within the individual spits there is much variation in the order of abundance.

Donahue (1985, 1986, 1988) found that the size of the backed bladelets in the Final Epigravettian level 4a at Grotta Paglicci was related to function. While the backed bladelets smaller than 2.2 cm showed microwear evidence suggesting their use as hafted projectile elements, the bladelets larger than 2.8 cm appear to have been used as meat cutting knives. Therefore, if size was related to function at Grotta delle Cipolliane, one might expect to find different patterns of breakage related to size. Table 5:11 shows the length of the fragments, grouped into the two broad size categories of less and more than 2.5 centimetres. The smaller size group (80% of all fragments) shows a predominance of proximal types (48%), with medial and distal fragments present in roughly equal proportions (27% and 25%). Within the individual spits, there is no marked difference in the relative abundance of the fragment types, except for a clear predominance of proximal fragments in level 1 (60%). In the larger size group (20% of all fragments), proximal and distal types are present in roughly equal quantities (42% and 39%), while medial fragments are few (19%). There is an absence of larger size fragments in all spits of level 2, spit 3I and spits 4IV-IX, and medial fragments are absent from level 1. Therefore there appears to be a contrasting pattern of breakage between the two size groups which may indeed be related to functional differences.

The morphology of a backed bladelet tip can be described as either pointed, obtuse (rounded) or truncated. Those modified by retouch (pointed and truncated) may be either proximal, distal or double (retouched at both ends). Moving upwards through the stratigraphy (Table 5:12), a distal location predominates in spits 4II-3II, and from spit 3I through level 2 a proximal location seems to be favoured, though the small sample size of the level 2 spits has to be taken into account. In level 1, proximally and distally modified tips are present in roughly equal quantities. Pointed backed bladelets have a predominantly distal location (69%), while of the truncated backed bladelets proximal tips are slightly more abundant than distal tips (50% and 42% respectively).

Double-tipped backed bladelets are restricted in their distribution to level 3 (Figure 5:6, 1-2).

Considering the assemblage as a whole, obtuse backed bladelets are the most abundant type (54%), followed by pointed (25%) and truncated (21%) types (Table 5:13). Within the individual spits, there is a consistent predominance of obtuse ended bladelets throughout the stratigraphy, followed by pointed types and then truncated, except in spits 3I-III where truncated types are more abundant than pointed types. The truncations are predominantly right-angle and direct (Figure 5:6, 3). Apart from one isolated occurrence in level 1, oblique truncations (Figure 5:6, 4) are restricted in their stratigraphic distribution to level 3. Inverse truncations are rare, except in level 4 where they are more numerous than right-angle truncations. According to the chronostratigraphic schemes outlined in Chapter 1, truncated backed bladelets are considered to be a diagnostic feature of the Salentine facies of the Evolved and Final Epigravettian. The presence of one truncated backed bladelet in spit 4XI cannot be considered strong enough reason to revise either the utility of the type as a chronological marker or, alternatively, to doubt the chronology (Ancient Epigravettian) of this level. However the presence of four truncated backed bladelets in spit 4I does suggest that, if these types are temporally diagnostic, the transition between the Ancient and Evolved Epigravettian does not coincide exactly with the sedimentary transition between levels 4 and 3 but precedes it.

An analysis of the covariation between the size of the unbroken backed bladelets and tip morphology (Table 5:14), shows that while the smaller backed bladelets are predominantly obtuse (63%), the larger backed bladelets are predominantly pointed (50%). Within the morphological groups each is dominated by smaller bladelets: 90% of obtuse types, 85% of truncated types and 69% of pointed types are smaller than 2.5 centimetres (Figure 5:6, 5-7).

The morphology of the backed edge may be either rectilinear, curved or shouldered. Table 5:7 shows the predominance of rectilinear backed edges (87%), and

the low occurrences of curved (8%) and shouldered (5%) backs. An analysis of the covariation between the morphology of the backed edge and the morphology of the tip (Table 5:15) shows that rectilinear backed points (Figure 5:6, 8-9) are slightly more abundant than curved backed points (Figure 5:6, 10), accounting for 53% and 39% respectively of the pointed backed bladelets, though rectilinear backed points are absent from level 2. Truncated backed bladelets are exclusively rectilinear backed, except for just one with a curved back in spit 3III. Obtuse backed bladelets are predominantly rectilinear backed (92%), with one curved back in spit 4IV and two in spit 4II. An interesting feature is the continual presence, albeit low, of shouldered obtuse backed bladelets (Figure 5:6, 11-12), and the occasional occurrence of shouldered pointed types (Figure 5:6, 13-14). According to all three of the chronostratigraphic schemes outlined in Chapter 1, shouldered backed bladelets are supposed only to occur in the Ancient Epigravettian and in the early phase of the Evolved Epigravettian. Therefore their presence in level 1 suggests either that shouldered backed bladelets are not as temporally diagnostic as has previously been thought, or else that the chronological attribution of level 1 (late Final Epigravettian) is incorrect. The latter hypothesis would need to be corroborated by evidence from the other tool classes.

According to the 1964 version of the Laplace typology, pointed, obtuse and truncated backed bladelets constitute three separate tool groups. Within those groups, a total of 21 types were devised on the basis of whether the backing retouch is marginal or invasive, partial or total, and, in the case of the shouldered types, distinctions were made on the basis of whether the shoulder is adjacent to or opposite the backed edge (see Figures 4:5-4:7). The notion of *transmutation* between tool types was originally seen as a conceptual process with regard to the classification of designs (Hassan 1988). However, transmutation can just as usefully be envisaged as a technological process which may have taken place within a strategy of raw material economy. Where supplies of lithic raw material were scarce or locally absent, as in the case of the

Salento peninsula, broken or blunted backed bladelets may habitually have been reworked to restore their effectiveness as tools, which would have been more economical in terms of time and resources than fabricating a replacement from scratch. To give two examples of many, an obtuse backed bladelet with an adjacent shoulder (type LD4) which breaks at the distal end could be retouched into a pointed backed bladelet with an adjacent shoulder (type PD5). A pointed backed bladelet (type PD4) which breaks at the proximal end could be retouched into a pointed backed bladelet either with a normally (right-angle) truncated base (type DT7) or with an obliquely truncated base (type DT8), and so on. A selection of possible transmutations is presented in Figure 5:7. Consequently, according to this concept of transmutation, the tool classes devised by Laplace (pointed, obtuse and truncated) are not necessarily mutually exclusive and therefore may not be culturally or even functionally diagnostic.

Using experimental and microwear evidence, or that provided by preserved hafts, various authors have suggested that pointed or obtuse backed bladelets were used as barbs hafted laterally or obliquely on the *side* of a projectile point (Keeley 1981; Moss and Newcomer 1981). At the Magdalenian site of Pincevent, two backed bladelets were found hafted laterally in a piece of reindeer antler (Leroi-Gourhan 1983). Other examples of laterally hafted backed bladelets have been found in late Palaeolithic and early Mesolithic sites in eastern Europe. At Talickij a series of three backed bladelets, the distal one pointed, were hafted along one side of a projectile shaft, while at Nizhnee Veret'e I, Olenij Ostrov and Rajgorodok the laterally hafted backed bladelets were truncated types (Nuzhnyj 1989). Alternatively, it has been suggested that pointed backed bladelets were hafted longitudinally on the *end* of the shaft of a projectile point (Bordes 1952; Keeley 1981; Moss and Newcomer 1981). Bietti (1980a, 1981) believes that the shouldered backed points in the south-east Italian Epigravettian can be regarded as arrowheads, due to their small dimensions. Other functional interpretations suggest their use as knives (Bordes 1952; Keeley 1981; Moss and Newcomer 1981). As has been mentioned previously, Donahue's

microwear analysis of tools from the Final Epigravettian level 4a Grotta Paglicci, in the Gargano promontory, revealed that the smaller backed bladelets were hafted either laterally as barbs or longitudinally as projectile points, while the larger ones were meat knives (Donahue 1985, 1986, 1988).

If backed bladelets were hafted longitudinally as armatures for projectile points, their primary function would have been to inflict an instantly fatal wound. Friis-Hansen (1990) has investigated the optimum functional design of the hunting arrow based on ethnographic and modern designs. When hunting large game such as deer, the modern and recent bow-hunter uses arrows with a broad, sharp, cutting head. The function of the head is to open a hole in the hide with as little friction as possible, and to cut the arteries and blood veins in the lungs. The design of projectiles in fact involves contradictory elements. While a broader and thicker head may cut a wider wound, a projectile penetrates better if it has a narrow front angle (tip). A front angle that is too narrow makes a long and weak point which cannot withstand hitting bone, and therefore breaks. The wider the angle, and the less sharp the tip, the greater the chance of the point bouncing off the hide during the elastic fall-back, if it hits diagonally. If maximum hide penetration and bone splitting capability are needed, the front angle should be no more than 20°. According to Friis-Hansen, width is the single most important dimension of a projectile. When not hitting bone, resistance to a projectile's penetration into the prey arises from drag on the head and on the embedded part of the shaft, and a slender head produces least drag. Deepest penetration occurs when the projectile has cut a sufficiently wide wound to allow the shaft to pass without causing drag. Therefore the opening should be cut by the head with a perimeter larger than the circumference of the shaft. The bigger the head, the greater the chance of hitting the ribs, but the larger the surface area of the wound, the higher the probability that an artery or vital organs are cut. The resulting haemorrhage is faster, and the kill will have been more efficient. Therefore the design of a projectile point is a compromise, with no single optimal construction (Friis-Hansen 1990).

According to these criteria for the optimal design of a projectile, longitudinally hafted pointed and truncated backed bladelets would be more efficient than obtuse ended types. However, as Table 5:13 shows, obtuse backed bladelets are the predominant morphological type throughout the stratigraphy at Grotta delle Cipolliane. If different types of projectiles were used according to whether the prey were small or large, the lack of temporal change in backed bladelet tip morphology might suggest no change in the size of game. According to Bleed's (1986) concept of 'maintainable' and 'reliable' technologies, reliable technologies would be characterized by a specialized hunting technology, with different projectile types for different species, each designed according to the optimum design for the most efficient kill of that particular species. In contrast, a maintainable technology would be characterized by a generalized hunting technology, with one projectile type for all species (Bleed 1986). The stratigraphic review presented in Chapter 3 in fact showed that there is progressive expansion of the subsistence base through the stratigraphy, characterized by the addition of new large mammalian species rather than by a process of replacement, and with the addition of marine molluscs in level 1. Therefore, in the case of these backed bladelets, typological continuity appears to transcend economic change. This point will be returned to in Chapter 7 when the subsistence economy at Grotta delle Cipolliane will be discussed in more detail.

As backed bladelets are symmetrical about their long axis, there is no apparent functional reason why one side should be backed rather than the other, and therefore one would expect the ratio of sinister to dexter backed bladelets to be approximately 1:1 (Close 1977). Table 5:7 shows the fluctuation through the stratigraphy between a relative predominance of either sinister and dexter backing, and the rare occurrence of bilateral backing. One way to examine whether lateralization of the backed edge may be of functional significance is to examine covariation between lateralization and a probable functional attribute, such as the morphology of the tip (pointed, obtuse or truncated), the morphology of the backed edge (rectilinear, shouldered, curved), and

size (small or medium). Firstly, the analysis of the covariation between edge lateralization and tip morphology (Table 5:16) is based on all pointed and truncated backed bladelets (whole and fragments), and whole and distal fragments only of obtuse ended types, giving a total sample size of 234. Considering the assemblage as a whole, sinister and dexter backed bladelets are present in equal proportions (48% each). Bilateral backed bladelets are rare (4%), and are either pointed or truncated. There are more points and truncates with sinister backing than dexter, and more obtuse backed bladelets with dexter backing than sinister. There appear to be no significant temporal reversals in edge lateralization within the three morphological groups. Secondly, the analysis of the covariation between edge lateralization and morphology of the backed edge (Table 5:17) is based on the minimum number of backed bladelets, which provides a total sample size of 290. The assemblage as a whole shows roughly equal quantities of dexter and sinister backing for the rectilinear and shouldered types, and a slight predominance of sinister backing in the curved type. Again, lateralization appears to fluctuate randomly through the stratigraphy within each morphological group, though the small sample size of the shouldered and curved types inhibits meaningful comparisons. Finally, the analysis of the covariation between edge lateralization and size (Table 5:18) is based on the unbroken backed bladelets, giving a total sample size of 172. The assemblage as a whole shows very similar numbers of sinister and dexter backed edges for each size group. In the smaller size group (<2.5 cm), sinister and dexter edges are equally abundant in level 4. In level 3, a predominance of dexter over sinister backing in spits 3VIII-III is followed by a reversal in spits 3II-I to a predominance of sinister edges. Level 1 sees a return to equal proportions of sinister and dexter backed edges. No temporal reversals are apparent in the larger size group (>2.5 cm).

In summary, apart from a slight tendency towards sinister backing of curved backed points, there are no strong correlations between backed edge lateralization and morphological types. Close (1977) suggested that the tendency to back bladelets on one side rather than the other may be a stylistic feature, and that temporal variability in

this attribute may be expected to cast some light on socio-cultural change. However, it would be simplistic to expect that variation in the sinister:dexter ratios of backed bladelets would have been affected by the operation of only a single factor, either functional or stylistic, and the cause of variability probably lies in a combination of these and maybe other factors. With regard to temporal variability, apart from weak temporal reversals in the backed edge lateralization of small backed bladelets, the backed bladelet class at Grotta delle Cipolliane is characterized by apparently random oscillations which cannot be attributed to either functional or stylistic factors.

Attributes of the type of backing retouch are presented in Table 5:8. The retouch is predominantly direct (86%), with bipolar backing as the second most common type (11%). Inverse and alternate retouch are rare (2% and 1% respectively), and both are stratigraphically restricted to level 3. The amplitude of the retouch is predominantly invasive (88%), and the extent of the retouch (Table 5:9) is predominantly continuous. Partial backing is restricted stratigraphically to spits 4III-3II. As with backed edge lateralization, the preferred type of backing may have been determined by a number of factors. Functional considerations may have involved the difference between the size and shape of the blank and the desired tool form, and therefore the degree of modification necessary to achieve the desired form. Traditional preferences, or stylistic factors, may also have been influential. The greatest amount of modification of the blank will be required when the blank is wider or thicker than the desired form (Close 1977). The amplitude of the backing retouch can be considered in terms of *intensity*, according to the degree to which the shape of the blank is modified. Therefore, invasive backing retouch can be said to be more intense than marginal backing retouch. If the blanks removed from the cores for the production of backed bladelets were rectilinear edged with obtuse ends, then one might expect certain morphological types, such as curved, shouldered and pointed types, to be characterized by intense backing retouch, while the rectilinear and obtuse types should be characterized by less intense backing retouch. The analysis of the covariation

between the intensity of the backing retouch and the three probable functional attributes follows the same procedure as the analysis of edge lateralization. Firstly, the covariation between retouch amplitude and the morphology of the tip (Table 5:19) reveals that all except one of the pointed backed bladelets have invasive backing retouch (98%), the exception being a bilateral double-tipped point in spit 3VI. Marginally backed obtuse bladelets are rare (13%) and sporadic, while marginally backed truncates (17%) are all clustered in spits 3III-2VIII with the exception of a single example in spit 4XI. Covariation between backing retouch amplitude and edge morphology (Table 5:20) shows the absence of marginally backed shouldered forms, and the single marginally backed curved example is that same bilateral double-tipped point from spit 3VI. Marginally backed rectilinear bladelets (14%) are more or less continuously present in low numbers, with absences in the lower part of level 2 (spits 2VIII-IV) and spit 3IX, both of which could be attributed to the small sample size. Of more interest are the absences in spits 3IV and 3VI, where the sample size-effect is a less likely explanation. Finally, covariation between backing retouch amplitude and size (Table 5:21) reveals that only one of the larger (>2.5 cm) backed bladelets has marginal retouch, while marginal backing of the smaller (<2.5 cm) types is rare (10%).

In summary, the analysis confirms that those morphological types which would require the greatest amount of modification of the blank to achieve the desired shape, that is the shouldered, curved and pointed types, have exclusively invasive backing, with the single exception of the curved bilateral double-tipped point from level 3VI. However, the consistent predominance of invasive backing retouch on those morphological types which would require less modification of the blank to achieve the desired shape, in other words the obtuse and rectilinear types, contradicts the assumption. This might suggest that the laminar blanks used for the production of backed bladelets were irregular and unstandardized. There are no data concerning unretouched laminar blanks from the 1964 excavation, but the data from the 1962 excavation show that they tend to be irregular, without parallel edges and naturally

pointed (Palma di Cesnola 1962). Although this appears to support the suggestion of unstandardized laminar blank production, we cannot know whether the unretouched laminar blanks are typical of the laminar blanks as a whole, or whether they were not retouched as tools precisely because of their irregular morphology. Though stylistic or traditional preferences may also have been a factor in determining the type of retouch, this would not explain why there is a more or less continuous presence, albeit low, of marginally backed obtuse and rectilinear types.

The attributes of the secondary retouch are presented in Tables 5:9-5:10. The secondary lateral retouch is predominantly direct (76%) or inverse (20%), with alternate (2%) and bifacial (2%) restricted to level 3. The amplitude of the retouch is predominantly marginal (64%), except in level 1. Backed bladelets with secondary lateral retouch are present in all spits except 4XI, 4IX, 2VII and 2III. All these absences can be attributed to the small sample sizes. In all other spits, there are more backed bladelets without secondary lateral retouch than with, except in spits 2VI and 3IV, and therefore the question arises as to whether the presence or absence may be of functional and/or stylistic significance. For example, the retouch may have been applied to modify slightly the shape of the blank to achieve the desired form, and therefore once again we might expect to find more secondary lateral retouch on pointed, shouldered and curved types than on rectilinear and obtuse types. Alternatively, the retouch may have been applied to sharpen a blunted edge. The analysis of the covariation between the presence or absence of secondary retouch and the three probable functional attributes follows the same procedure as before. Table 5:22 shows the covariation between the presence/absence of secondary lateral retouch and the morphology of the tip. Considering the assemblage as a whole, there are more pointed backed bladelets with secondary lateral retouch (59%) than without, and more obtuse and truncated backed bladelets without secondary lateral retouch (76% and 75%) than with it. Within the pointed group, the predominance of presence or absence fluctuates through the stratigraphy, and there are no clear temporal trends apparent for

either of the other two morphological groups. The covariation between the presence/absence of secondary lateral retouch and the morphology of the backed edge (Table 5:23) shows that in all three morphological groups the retouch is predominantly absent. The difference is less marked for the shouldered group, and the shouldered types with secondary lateral retouch (41%) are all clustered in the lower part of the stratigraphy, between spits 4V and 3IV. For the rectilinear and curved types (32% and 33%), there are no temporal trends. Finally, the covariation between the presence/absence of secondary lateral retouch and the size of the whole backed bladelets (Table 5:24) shows a slight predominance of retouch in the larger (>2.5 cm) group (57%), compared with less secondary retouch among the smaller (<2.5 cm) backed bladelets (35%). In this size group, there are more bladelets with secondary lateral retouch in level 1 (64%) than without it, in contrast to the lower part of the stratigraphy, but the sample size is small and this may not be significant. In summary, there are no strong correlations between the presence or absence of secondary lateral retouch and backed bladelet morphology, apart from the covariation with pointed types. This would appear to confirm the postulate that secondary lateral retouch may have served to modify the shape of the blank rather than as a resharpening process. Within the pointed group, the location of this retouch is predominantly distal in levels 4 and 3, and thereafter distal retouch is absent (Table 5:25). The obtuse backed bladelets are characterized by a predominance of continuous retouch (53%), followed by more proximal than distal (33% and 13%). The truncated group shows a slight predominance of continuous retouch (50%), and equal proportions of distal and proximal (25% each). Within the obtuse and truncated types there are no significant temporal patterns.

The other type of secondary retouch that is occasionally found on the backed bladelets is proximal or distal ventral retouch (Table 5:9) (Figure 5:6, 1, 8, 13-16). Owen (1987) has suggested that this type of retouch may have been applied to backed bladelets to facilitate hafting. Alternatively, it may have been applied to the functional end of a projectile in order to reduce the thickness of the tip. Of the whole backed

bladelets with ventral retouch, all are small (<2.5 cm) except for one point in spit 3VII and one obtuse bladelet in spit 2VIII. An analysis of the covariation between ventral retouch location and tip morphology (Table 5:26) shows a predominance of proximal ventral retouch for all three morphological groups. Considering the assemblage as a whole, 29% of points, 9% of obtuse-ended and 6% of truncated backed bladelets have either proximal or distal ventral retouch. However, there is no backed bladelet which has both. Finally, an analysis of the covariation between the amplitude of this ventral retouch and tip morphology (Table 5:27) shows that the retouch on obtuse backed bladelets is predominantly invasive (67%), and that on truncated backed bladelets is exclusively invasive (100%), while marginal and invasive retouch are present in roughly equal quantities among the pointed backed bladelets (53% and 47% respectively). The small sample size inhibits the detection of any temporal trends.

Particular techniques are part of the technical tradition of a group, and can therefore sometimes be used effectively as stylistic or chronological markers. One technique which has often been assigned chronological and/or cultural significance in the late Palaeolithic industries of the Mediterranean region is the microburin technique, which produces controlled truncations of microlithic tools in the manufacture of either backed bladelets with a trihedral point (*piquant trièdre*) and/or geometric microliths. The truncation is achieved either through a single blow delivered onto a notched or abruptly retouched edge (Tixier 1963:40; Tixier *et al.* 1980:62-64), or by the application of pressure (Albarello 1987). Microburins, which are the by-products of this technique, are generally classified as either ordinary (simple) or Krukowski (Tixier 1963:40). Although it was sometimes formerly thought that the microburins themselves are tools rather than by-products (Radmilli 1974:57), it is generally accepted that the other part of the blank with the *piquant trièdre* was the intended product. According to Fischer (1989), the microburin technique makes it possible to produce a tip which is sharper than a retouched tip. There were numerous apparently independent developments of the microburin technique in the late Palaeolithic in

Europe, the Near East and North Africa. At Franchthi cave in the Greek Peloponnese, the levels which date to the thirteenth millenium BP (Franchthi phase IV) are characterized by very high quantities of *piquant trièdre* truncated backed bladelets, totalling no less than 13% of the retouched assemblage from this phase (Perlès 1983; 1987b). La Mouillah points, which were manufactured by the same technique, are characteristic of the Iberomaurusian in the Maghreb (Tixier 1963), and of the Mushabian in Israel (Phillips and Mintz 1977), both of which are roughly contemporary with Franchthi phase IV. At Grotta delle Cipolliane, the 1964 excavation recovered only one *piquant trièdre* truncated backed bladelet, from spit 3VI (Table 5:9; Figure 5:6, 17), and in the 1962 excavation one *piquant trièdre* truncated backed bladelet and one simple microburin were found in level 2. There is no record of whether microburins were found in the 1964 excavation. It is quite possible that some *piquant trièdre* facets have been obscured by retouch, and that the microburin technique was more common than the available data suggest. However, it is equally possible that the microburin and the two *piquant trièdre* truncated backed bladelets were produced accidentally. Bordes demonstrated by means of experimentation that any lithic assemblage which contains high frequencies of backed bladelets will be likely to exhibit a number of accidentally produced microburins, and therefore, by inference, of *piquant trièdre* facets, resulting from a manufacturing error during the application of backing retouch (Bordes 1957:582). Thus, on the basis of the available data, the intentional use of microburin technique at Grotta delle Cipolliane cannot be established with confidence, and consequently the presence of a single *piquant trièdre* backed bladelet in spit 3VI cannot be assigned any chronological significance.

In summary, the backed bladelets at Grotta delle Cipolliane are characterized by a strong technological and typological continuity throughout the 23 spits in which they are present. Small rectilinear backed, obtuse ended bladelets with direct invasive backing retouch are predominant throughout the stratigraphy, and there are no significant temporal reversals in the relative abundance of the various attributes. While

there is no evidence for either technological or typological discontinuity between levels 4 and 3, there is however some typological change apparent between levels 3 and 1 but, due to the small sample size in level 2, it is difficult to know at which stage the change occurred. In absolute terms, these changes involve the absence of various attributes in level 1. Inverse and alternate backing retouch, distal oblique truncations, partial backing, flat secondary lateral retouch, and alternate and bifacial secondary lateral retouch are all absent, and as no new attributes are introduced to replace these, the backed bladelets of level 1 can therefore be said to be characterized by a typological impoverishment, or a higher degree of standardization, compared with the backed bladelets of levels 4 and 3. In addition, two relative changes of some interest occur in level 1: a higher percentage of fragments, and a slight increase in the size of both the unbroken bladelets and the fragments. The size increase could be interpreted as indicating a change in the raw material economy, while the increase in breakage may suggest a change in the nature of the occupation of the site, with more on-site manufacture and/or repair of backed bladelets than in the earlier period.

5:3 LINEAR RETOUCED TOOLS (Tables 5:28-5:32)

Linear retouched tools constitute the second largest tool class (n.146, 17%), and they are present from the bottom of the tool bearing spits to the top with only three brief absences: spits 3V-IV, 2VII and 2V-IV (Table 5:4). Considering the size of the assemblage in each spit, only the absence from spits 3V-IV is significant. Relative values range between 1% and 75%, with significantly high values in spits 4IV, 4II-I and level 1 (Table 5:5).

Starting with the morphological attributes (Table 5:29), it is clear that there are no temporal reversals in the type of blanks used for the manufacture of linear retouched tools. While blades are rare and sporadic, flakes and bladelets are present in roughly equal quantities (50% and 46% respectively), with no significant temporal fluctuations in the relative proportions of each type. The occasional absence of either

flakes or bladelets in some of the spits can be accounted for by the small sample size. With regard to the size of the tools, there is only a slight predominance of medium sized blanks over small (54% and 41% respectively), while large blanks are rare and sporadic. The cross-sections of the blanks are predominantly flat throughout the stratigraphy, with carinated examples present only in spits 4III-I, 3II and level 1. The tools are for the most part unilaterally retouched, except in spit 3VIII where there are more bilateral types. The relative proportion of sinister and dexter retouch fluctuates through the stratigraphy with no significant temporal trends. Bilateral types are absent until spit 4IV, and present in most spits thereafter. Retouch on the transversal edge is rare except in level 1 (15%), and is only found on flakes. The morphology of the retouched edges is predominantly rectilinear (83%). Concave edges occur only in spits 4IV and level 1, while convex edges are restricted to spits 4V-I and level 1. The absence of concave and convex edges in levels 2, 3 and the lower spits of level 4 can probably be attributed to the small sample size in these spits.

Abruptly retouched flakes are rare and sporadic, and flat retouch is absent. The proportions of marginal and invasive retouch are roughly equal throughout the stratigraphy except in level 1, where invasive retouch is predominant (70%). Considering the assemblage as a whole, the retouch is for the most part direct (90%), with inverse retouch present in spits 4IV, 4I, 3II, 2III and level 1. Alternate retouch is restricted to spits 4I, 3II and level 1, and bifacial retouch is absent. 52% of all linear retouched tools from Grotta delle Cipolliane are broken. Comparisons between the levels are hampered by the small sample sizes, but there seems to be a significantly higher rate of breakage in spits 4IV-III (73%) than in spits 4II-I (35%). In level 1 the rate of breakage is 53%.

Despite the fact that the linear retouched tools are abundant at Grotta delle Cipolliane, they are a very homogeneous class compared with the backed bladelets and consequently the information they yield is limited. There appears to be strong

continuity throughout the stratigraphy, with no significant temporal changes either in the morphological or the retouch attributes.

5:4 BURINS (Tables 5:33-5:37)

Burins are the third largest tool class (n.123, 15%). First present in spit 4V, burins are absent from level 2 except for a single occurrence in spit 2VI. Relative frequencies, which range between 7% and 33%, rise to a peak in spits 3VII-IV, and then fall again. The morphological attributes are presented in Table 5:34. Throughout the stratigraphy the burins are predominantly made on flakes (76%). The majority of the bladelet burin forms are clustered in spits 3VII-II (86%), with only one example in level 4 (spit 4IV) and three in level 1. Blade burins are entirely absent. Blank size is predominantly smaller than 2.5 cm (78%), and no burins are larger than 5 cm in length. There is only one fragment, in spit 3V. Considering the assemblage as a whole, the location of the burin bit is predominantly distal (56%), then proximal (11%). Double burins, where spalls have been removed from both the proximal and the distal ends of the blank, account for the remaining 33%. The only variation from this norm is spit 3VII, where there are more double burins (56%) than distal (38%) and proximal (6%).

The burins from Grotta delle Cipolliane can be divided into four manufactural types, according to the primary modification of the blank. Burins made on unmodified blanks account for 34% of all burins at Grotta delle Cipolliane. A second type of burin is made on a transversally broken blank ('burin on break'), and these account for 17% of the burin assemblage. The question of whether these breaks were intentional or unintentional at Grotta delle Cipolliane is unresolved. A third type of burin is made on a retouched blank, and these account for 16% of the burins. The fourth type of burin is made on a truncated blank, and these make up the remaining 33%. The relative proportion of each of the four manufactural types fluctuates through the stratigraphy. The two major types, unmodified and truncated, are present in fairly equal proportions

throughout the stratigraphy, except in spit 3VI where there is a predominance of unmodified over truncated types (38% and 27% respectively), and spit 3V where the relative proportions are reversed and truncated types predominate over unmodified (50% and 29% respectively).

Some of the types of retouch and truncation are restricted in their stratigraphic distribution. Right-angle concave truncations (Figure 5:8, 1) are only present in level 4; simple marginal retouch occurs only in spit 3VII; abrupt marginal retouch is restricted to spits 3VI and 3IV-III; and abrupt invasive retouch only occurs in spits 4I and 3II. Some of the types of retouch and truncation are also restricted in their location: oblique concave truncations and elevated retouch only occur on the distal end. While the truncations are predominantly proximal (55%), only 32% of the retouched, 23% of the breaks and 18% of the unmodified burins are proximal.

The direction of the facets may be either lateral, when they run approximately parallel to the axis of the blank (Figure 5:8, 2-3), or transversal, when they run across the axis of the blank. Burins with both lateral and transversal facets emanating from the same end of the blank are described as latero-transversal (Figure 5:8, 4). Considering the burins as a whole (Table 5:34), the direction of the facets is predominantly lateral (75%), then latero-transversal (17%) and transversal (8%). Transversal facets are stratigraphically restricted to spits 4III-3I.

The morphology of the burin profile describes the position of the burin bit in relation to the axis of the blank. It is described as axial when its position is central to the axis (Figure 5:8, 5), and as angle when its position is oblique to the axis (Figure 5:8, 6-7). Axial profiles are rare at Grotta delle Cipolliane (12%), and of these the majority (75%) are distal in location.

The facet convergence lines (see Figure 4:18c) are predominantly rectilinear (61%), then polygonal (31%) and finally sigmoid (8%). There is no temporal deviation from this norm, apart from the equal proportions of rectilinear and polygonal types in level 1.

Classifications of burins tend to be based on the position and shape of the burin bit(s), along with the method of preparing the surfaces from which the burin spall(s) are struck (eg., Pradel 1966, Pradel 1971; Movius *et al.* 1968). In the Laplace typology (1964a), the burin group is divided into three classes: simple (unretouched), on break and retouched. The simple class is then divided into types according to the number of burin facets (single or multiple), the position of the burin bit in relation to the axis of the blank, and the direction of the facets. The retouched class is also divided into types on the basis of the position of the burin bit in relation to the axis of the blank and the direction of the facets (see Figure 4:1).

In Italy, as in France, the relative proportion of retouched/truncated and unretouched (simple) burins (the Br/Bs index) is used as a chronological and cultural marker. The burins on break are included in the simple group. The index fluctuates through the Epigravettian, and there are slight discrepancies between the different chronostratigraphic schemes. According to the most recent scheme, the Ancient Epigravettian is characterized by a shift from a predominance of simple burins to a predominance of retouched types (Palma di Cesnola and Bietti 1983). The predominance of retouched types is retained through the Evolved and Final Epigravettian (Palma di Cesnola *et al.* 1983). At Grotta delle Cipolliane, considering the burin assemblage as a whole, there is a marginal predominance of simple burins (51%) over retouched burins (49%). In level 4 (Ancient Epigravettian), the first three burin-bearing spits have an equal abundance of both types, followed by a slight predominance of simple burins in spit 4II and then a slight predominance of retouched burins in spit 4I. In level 3 (Evolved Epigravettian), the relative abundances fluctuate between a predominance of simple burins in spits 3IX-VI, a marked predominance of retouched burins in spit 3V (67%), a marginal predominance of simple burins in spit 3IV and of retouched burins in spits 3III-II, and equal proportions in spit 3I. The single burin from level 2 is simple, and there is a marginal predominance of simple burins in level 1 (Final Epigravettian). The differences in the absolute frequencies are

all of the order of one or two, except for the aforementioned predominance of retouched burins in spit 3V (16 compared with 8), and the predominance of simple burins in spit 3VII (15 compared with 10). Therefore it is clear that the burins from Grotta delle Cipolliane do not conform to the chronostratigraphic schemes, and the utility of the Br/Bs index as a chronological marker is questionable.

According to Tixier *et al.* (1980:65), the retouch is applied as a form of preparation for the removal of the burin spall. As the relative abundance of simple and unretouched burins has no chronological significance at Grotta delle Cipolliane, it is necessary to seek some other factor to account for the observed variability. At the Evolved Epigravettian site of Palidoro (Lazio), Bietti found a significant correlation between the type of burin and the type of blank on which it was made. The majority of the simple burins were made on flake blanks, while most of the retouched burins were made on blades (Bietti 1977). This would seem to suggest that the presence or absence of retouch may be related to different technological features of flake and blade forms. However, an analysis of the covariation between burin type and blank type at Grotta delle Cipolliane (Table 5:38) shows that while 81% (n.67) of the simple burins are made on flakes and only 19% (n.16) on bladelets, 70% (n.56) of the retouched/truncated burins are also made on flakes and only 30% (n.24) on bladelets, and there is no temporal variation in this relationship. Looking at it another way, of the burins made on bladelets there is a slight predominance of retouched types (60%), while of the burins made on flakes there is only a marginal predominance of simple types (54%). There is some temporal variation from these norms. Among the bladelet types, there is a slight predominance of simple burins in spits 3III and 3I, while among the flake types there is a slight predominance of retouched burins in spits 4I, 3V and 3III-I, but none of these variations is large enough in absolute terms to be considered significant. Therefore at Grotta delle Cipolliane there appears to be no strong correlation between whether the burins are simple or retouched and the type of blank on which they were made.

It is necessary to test the postulate that variations in blank morphology may be partly responsible for the alternative profile types and the variability in the direction of the facets on the burins from Grotta delle Cipolliane. In the Early Magdalenian levels at Solvieux, in south-west France, both the simple and the truncated burins showed a clear tendency for axial types to be made on narrow blanks, while angle types were made on wider blanks. Transversal facets showed a strong correlation with flake blanks (Sackett 1988b; 1989). According to Sackett, this relationship between burin profile, facet direction and blank morphology is a linkage that is grounded in mechanical and economic contingencies, although this does not negate the cultural significance of variations in burin type. Accordingly, four covariation analyses were performed on the burins from Grotta delle Cipolliane to examine the relationship between blank morphology and burin type. Firstly, an analysis of the covariation between burin profile and blank type (Table 5:39) found no consistent dichotomy. Both axial and angle type burins are predominantly made on flake blanks (85% and 74% respectively), and there are no significant stratigraphic variations from this norm. Secondly, an analysis of the covariation between burin profile and blank size (Table 5:40) shows a predominance of both axial and angle burins on smaller blanks (65% and 83% respectively), again with no temporal variations. The analysis of the covariation between the direction of the facets and blank type (Table 5:41) shows that all three directions predominantly occur on flakes (71% of lateral, 92% of transversal, and 89% of latero-transversal types). Finally, the analysis of the covariation between the direction of the facets and the size of the blank (Table 5:42) shows that all three directions predominantly occur on smaller blanks (78% of lateral, 77% of transversal, and 93% of latero-transversal types). Therefore, at Grotta delle Cipolliane there is no exclusive correlation between blank morphology and burin type, though there is a tendency for transversal and latero-transversal types to be made on small flake blanks.

If there is no strong correlation between blank morphology and burin type, the predominance of angle profiles and lateral facets and the stratigraphic restriction of

transversal types in spits 4III-3I may be a stylistic characteristic of the burins at Grotta delle Cipolliane. Alternatively, the observed variability may be of functional significance. The Laplace classification is based on the assumption that the burin bit served as the active functional part of the tool, and indeed some microwear analyses have confirmed the use of the bit for a diverse array of activities, including engraving and grooving bone and antler (Semenov 1964; Bordes 1967; Keeley 1980; Moss 1983); scraping, piercing and cutting hide (Moss 1983); and boring wood (Keeley 1978; Symens 1986) and shell (Keeley 1981). At Grotta Paglicci level 4a, the burin bits revealed wear from graving wood and bone (Donahue 1985, 1986, 1988). While at some sites the burins appear only to have had one function (eg., Cahen *et al.* 1979), at other sites it has been shown that the burins had diverse functions (eg., Plisson 1987b). In her analysis of the burins from the Magdalenian levels at Solvieux, Seitzer (1978) was unable to establish any correlation between the various traditional burin types and the different types of wear observed. Other microwear studies have found that the majority of the burin facets analysed exhibited no traces of wear at all, which suggests that variations in the morphology of the burin bit may not have a directly functional significance. Thus, in an assemblage studied by Vaughan (1985), the burin-blow technique and intentional retouch were found to have operated as functionally equivalent techniques for modifying used blanks, by removing parts of a tool's edge in order to rejuvenate blunted portions. Therefore the burin-blow technique was simply a form of rejuvenation of other tool forms. Alternatively, some authors have suggested that the absence of wear traces on the burin bit may result from the fact that the burin bit served as a part for hafting or prehension (Semenov 1964; Moss 1986). This argument is based on the fact that the symmetry created by the burin bit, and that of axial dihedral burins in particular, would facilitate hafting. In addition, when use wear is absent from the burin bit, the opposite end of the tool and/or most of the lateral edge often shows intense use wear (Vaughan 1985). Plisson (1987b) argues that where standardization of the burin type is absent, hafting probably did not take place, and this would apply at Grotta delle Cipolliane. Therefore, in the absence of

microwear studies of the burins from Grotta delle Cipolliane, the relationship between the observed morphological variability and a possible functional explanation is too complex to be explored.

A factor which further complicates an interpretation of the observed variability among the burins at Grotta delle Cipolliane is the possibility of transmutation between burin profiles. Gambassini observed many burin spalls amongst the debitage that are longer than the facets on the burins, and in some cases are longer than the burins themselves (Gambassini 1970:163). This suggests that burins were being rejuvenated to a considerable extent, though unfortunately there are no data on the ratio of burin spalls to burins. As the distinction between bladelets and flakes is based on the value of the length:width ratio, the constant rejuvenation of burins by the removal of more spalls might therefore account for the observed predominance of flake forms. If so, the relative abundance of bladelet forms in spits 3IV-II might suggest less intense rejuvenation compared with the other spits. Returning to the significance of retouched and simple burins, if the retouch is indeed a form of preparation for the removal of a burin spall, then axial and angle simple burins could result by means of a burin blow on truncated or retouched axial and angle burins, and the detachment of the spall would remove the retouch (Figure 5:9a). The repeated removal of spalls from a lateral axial burin could eventually create a transversal angle burin (Figure 5:9b). In the light of the abundance of feasible transmutations (Figure 5:9c), Laplace's burin types may simply represent modal points on a continuous range of variation of one generic type.

The observation was made at the beginning of this section that the majority (78%) of the burins are smaller than 2.5 cm, and that there is no temporal variation from this norm. Gambassini provides length, width, and thickness measurements for the burins, and concludes that there is no significant variation between levels 1, 2, 3 and 4 on the basis of the mean length (Gambassini 1970:163). The burins from levels 3 and 4 are ungrouped here and placed into their respective spits, in order to see if some temporal variation is apparent within these levels (Table 5:43-5:45). The first

column of each table indicates the total number of burins in each spit. The larger the sample size, the more significant will be the calculations made on that sample. The *range* is the difference between the maximum and minimum measurements, and therefore provides an absolute measure of 'dispersion'. *Mean* and *median* provide two alternative measures of the 'central tendency' of the burin measurements for each spit. There are as many observed values greater than the median as there are less, and when the number of observed values is even, the median is quoted as the value half-way between the two middle values. The median is more reliable in distributions where the presence of an extreme high or low value ('outlier') has the effect of distorting the mean, pulling it too far away from the centre of the distribution. The *standard deviation* (SD) provides an alternative measure of dispersion to range, by indicating the 'average' amount by which all the values deviate from the mean. The larger the standard deviation, the more dispersed is the distribution around the mean. Finally, *mode* is the value in a distribution which is observed with the greatest frequency and, if burin size is a function of design rather than rejuvenation, the mode could be considered as representing the size most favoured by the tool maker. If no values are observed more than once, no value is given for the mode. If two or more different values are observed with the greatest frequency, each of these is considered a modal value. If burin size is standardized, one would expect small values of dispersion (range and standard deviation), though this will to a certain extent be dependent on sample size.

None of the metrical attributes show any linear trend of either a decrease or an increase in value. Instead the values rise and fall through the stratigraphy. The greatest diversity in length occurs in spit 4II and level 1, in width in spits 4III-II, and in thickness in spits 4III and level 1. The burins of level 3 are more homogeneous. Scatter-plots of the length/width, length/thickness and width/thickness relationships are presented in Figures 5:10-5:12. It is difficult to make comparisons between the levels because of the differences in sample size. Both the length/thickness and the width/thickness ratios in level 1 are very dispersed compared with levels 3 and 4. On

the whole the burins in level 3 appear to be more standardized than those in levels 4 and 1.

Secondary retouch is predominantly absent, except in spits 4V-IV. Of those burins with secondary retouch (38%), sinister and dexter lateralizations are present in roughly equal proportions (45% and 49% respectively), while bilateral retouch is rare (6%) and restricted to spits 4III, 3VI and 3III. The retouch is for the most part simple (72%). Abrupt and elevated retouch (13% each), and flat (2%) retouch are rare and sporadic. The amplitude of the retouch is predominantly invasive (77%), the only variations from this norm being relatively minor ones in level 4. Finally, the direction of the retouch is for the most part direct (94%), with inverse retouch present in spits 4I and 3VII, and bifacial in spit 3V.

There is no apparent correlation between the presence of secondary retouch and profile type (Table 5:46). On both axial and angle types, secondary retouch is predominantly absent (60% and 61% respectively). There is however a weak correlation between the presence of secondary retouch and blank type (Table 5:47). Secondary retouch is present on the majority of bladelet forms (63%), and absent from the majority of flake forms (65%). Only in spit 3III are there more bladelet forms without secondary retouch than with it. Therefore the presence of secondary retouch may be of functional significance. Some microwear studies have revealed the use of the lateral margins of burins for functions such as woodworking and butchery (eg., Moss 1983), while at Grotta Paglicci level 4a, Donahue found evidence which suggested that the lateral edges, whether retouched or unretouched, had been used for hideworking and meat processing prior to the use of the burin bit for graving wood or bone (Donahue 1985, 1986, 1988).

In summary, while many of the attributes span the hiatus of level 2, others are restricted to the lower spits: burins on abrupt retouch (spits 4II-3IV), burins on elevated retouch (spits 4III-3VI), burins on flat retouch (spits 3IX and 3I), and burins on right-angle concave truncation (spits 4V and 4I). Bifacial secondary retouch is also

restricted to the lower part of the stratigraphy (spits 4IV-3I), along with abrupt (spits 4I-3V), inverse (spits 3VII) and bifacial (spit 3V) secondary retouch. There is a progressive decrease in the diversity of the variants of manufactural types through the stratigraphy, with a maximum of eight in spit 4I, seven in spits 3VII-VI, six in spits 3V-III, five in spits 3II-I, and six in level 1. Diversity appears to be independent of sample size. The analysis of the metrical attributes showed that the burins of level 3 are more standardized than those in levels 4 and 1, but this may be more apparent than real, and fairly dependent on sample size. The only significant typological distinction between the burins of levels 3 and 1 is the absence of transversal types in the latter.

5:5 ENDSCRAPERS (Tables 5:48-5:50)

Endscrapers constitute the fourth largest tool class at Grotta delle Cipolliane (n.105, 13%). They first appear in spit 4IV and, like the burins, are absent from level 2 except from a single occurrence in spit 2VI (Table 5:4). Relative values range between 2% to 29%, with a significantly high value in spit 3V (27%) (Table 5:5). The relative proportion of flake and bladelet forms fluctuates through the stratigraphy, and considering the assemblage as a whole there is only a marginal dominance of flake types (51%). The blanks are predominantly smaller than 2.5 cm (87%), accompanied by sporadic occurrences of medium sized types (2.5-5 cm); none is larger than 5 cm in length. Long endscrapers, whose length is greater than twice their width, are present in small quantities from spits 4II-2VI, but do not reappear in level 1 after the hiatus. The majority of the blanks are flat (90%), that is their thickness is less than half their width, with carinated types present in spits 4I-3III and again in level 1. A distal location of the scraping edge predominates throughout the stratigraphy (80%), with proximal endscrapers (11%) present in low quantities and in a sporadic fashion. Double endscrapers account for 5% of the total, with one in spit 3VII (8%), one in spit 3II (8%), and three in level 1 (14%). In addition, one endscraper has a continuous scraping edge, while three have lateral scraping edges. Though a 'lateral endscraper'

may sound like a misnomer, according to the definition used here (see Chapter 4:3) the distinguishing factor is the acute angle formed by the intersection of the scraping edge with the ventral face, and the morphology of the scraping edge, rather than its location in relation to the axis of the blank. Both the continuous and lateral varieties are restricted to level 1. Finally, the morphology of the scraping edge is predominantly convex (96%). Nosed forms are rare, occurring in spits 4I, 3IV (n.2), 3II and level 1, and are exclusively distal in location.

According to the Laplace typology (1964a), there are nine endscraper types (see Figure 4:2). His differentiation between the primary types is based initially on whether the endscrapers are convex-fronted, nosed or carinated. The convex-fronted types are further subdivided according to firstly whether they are long or short, and secondly whether secondary retouch is present or absent. Circular types by definition have a continuous scraping edge. The nosed forms are divided into two types on the basis of whether the nose is more or less acute. Finally, the carinated endscrapers are divided into two types according to whether the scraping front is nosed or convex.

According to the chronostratigraphic schemes outlined in Chapter 1, certain characteristics of the endscraper class are considered to be temporally diagnostic. To recapitulate briefly, the Salentine facies of both the Evolved and the Final Epigravettian is characterized by a long/short endscraper index (Gfl/Gfc index) of less than one, and the Final Epigravettian sees the appearance and subsequent relative increase of circular endscrapers (Laplace 1964b; Bartolomei *et al.* 1979; Palma di Cesnola *et al.* 1983). In addition, carinated endscrapers are thought to be a characteristic type of the Ancient Epigravettian (Palma di Cesnola and Bietti 1983). At Grotta delle Cipolliane, the endscraper assemblage conforms to the Gfl/Gfc index of less than one. According to both Palma di Cesnola (1962) and Gambassini (1970), level 1 dates typologically to the Final Epigravettian, and therefore the presence of only one circular endscraper from this level (Figure 5:13, 1) is surprising. However, the 1962 excavation retrieved 22 circular endscrapers from level 1 (Laplace 1966b), accounting for 18% of the

endscrapers in that level, which suggests that the paucity of this type from the 1964 excavation is misleading. According to Bietti and Burani (1985:23), circular endscrapers represent a typical example of the influence of raw material scarcity on lithic typology. Repeated resharpening of endscrapers made on small flakes may have resulted in the creation of a circular endscraper, with a continuous retouched edge. With regard to the carinated endscrapers, they are not stratigraphically restricted to the Ancient Epigravettian (level 4), and indeed there are proportionately more in level 1 than in any other level. Carinated endscrapers are also likely to result from repeated resharpening of the tool, which shortens its length in relation to its width and increases the steepness of the scraper edge angle (Wilmsen 1968), and this is supported by the fact that all five of the carinated endscrapers in level 1 are smaller than 1.2 centimetres, while those in levels 3 and 4 all fall in the range of 1.2 to 2.5 centimetres, with the exception of one in spit 3VII which is made on a cortical bladelet and is larger than 2.5 centimetres (Figure 5:13, 2).

According to the Laplace typology (1964a), long endscrapers are those whose length is twice their width, though they may be made on either flake or laminar blanks. As there is no change in the type of blanks used for the manufacture of endscrapers in level 1 compared with the lower levels, the absence of long endscraper types in level 1 may be related to a strategy of raw material economy. However, diminution in the size of endscrapers and the appearance of short circular and subcircular 'thumb-nail' forms is not a phenomenon restricted to the late Palaeolithic assemblages of south-east Italy. On the contrary, it is characteristic of many of the European late Palaeolithic and early Mesolithic industries, such as the Final Magdalenian and Azilian in France and Spain (Rozoy 1980; Demars and Laurent 1989). At Grotta delle Cipolliane, eight of the endscrapers from level 1 are smaller than 1.2 centimetres (Figure 5:13, 3-5), and it is hard to imagine that these could have been used in any way other than by being hafted. There are numerous ethnographic accounts of scraper hafting, and at Grotta Paglicci level 4a Donahue found microwear traces on endscrapers which suggested hafting

(Donahue 1985, 1986, 1988), but to date no examples have been found in the archaeological record. Plisson (1987a) has suggested that the development of hafting techniques may have enabled a reduction in the size of late Palaeolithic endscrapers, but one could alternatively argue that a reduction in the size of endscrapers necessitated the development of hafting techniques. However, Broadbent and Knutsson (1975) found in their experimental study that hafted endscrapers are more effective. Therefore the diminution in the size of endscrapers and the disappearance of long types at Grotta delle Cipolliane cannot be exclusively attributed to a strategy of raw material economy.

In relation to the late Palaeolithic of south-west France, Sackett (1988a:419) has proposed that nosed scrapers may in fact have originally been designed as convex forms, and only subsequently assumed a nosed contour as a result of heavy use or breakage and resharpening. It is suggested here that if nosed endscrapers are indeed a distinct type, then there should be a range of forms exhibiting a gradual decrease in size and a concomitant increase in edge angle. If, on the other hand, nosed forms result from edge resharpening of convex forms, then all nosed forms should be smaller and have more obtuse edge angles than the convex forms. Unfortunately the sample of nosed forms from Grotta delle Cipolliane (n.4) is too small to test this hypothesis. All four are smaller than 2.5 centimetres in length. Those from spits 4I and 3IV are carinated with steep retouch, while those from spit 3II and level 1 are flat. The endscraper from level 1 (a fragment) is made on a bladelet, while the others are made on flakes (Figure 5:13, 6).

Fragments of endscrapers at Grotta delle Cipolliane are rare. Only nine (5%) are broken, five of which come from level 1 (24% of the endscrapers in level 1), the others from spits 3I (n.1, 11%), 3V (n.1, 8%) and 3VII (n.2, 15%). Thus there would appear to be a higher rate of breakage in level 1 than in level 3, which might suggest that the endscrapers were being used and resharpened more intensively before being discarded, and therefore that a strategy of raw material economy was in operation. This is supported by the relatively high proportion of carinated endscrapers

in level 1. As with the other tool classes, the question arises as to whether a broken tool has resulted from breakage during manufacture, use, or resharpening, or whether it was initially made on a broken blank. Rigaud's (1977) experimental study of endscraper breakage found that 93% of breaks occurred during resharpening, and that of the breaks that occurred during use, 90% of these produced an endscraper fragment of less than 3.5 cm in length. Therefore he set 3.5 cm as the critical length above which endscrapers can be classified as having been made on broken blanks (Rigaud 1977:22). However, the size of the fragments which result from breakage during use may depend on any number of factors, such as the original size of the endscraper when complete, whether it was made on a flake or a bladelet, and the use(s) to which the endscrapers were put, as different actions will create stresses on different parts of the blank. The most common functional interpretation of endscrapers is as hide scrapers (Keeley 1981; Juel Jensen 1982; Gendel 1982). At Grotta Paglicci level 4a, all the endscrapers showed wear from hide-working on the scraping edge, and the lateral edges, whether long or short and whether retouched or unretouched, often showed evidence of having been used for scraping hides or for cutting meat prior to the manufacture of the scraping front (Donahue 1985, 1986, 1988). Microwear analyses have also demonstrated the use of endscrapers for working harder materials, such as wood, bone and antler (Dumont 1983; Siegel 1984). Therefore a functional change in the use of the endscrapers at Grotta delle Cipolliane, from working softer materials to working harder materials, might account for the increase in breakage, but without evidence from microwear this cannot be substantiated. Alternatively, broken endscrapers may have been reworked into other, smaller endscrapers rather than abandoned (eg., Bordes 1973), and this could explain the marked absence of endscraper fragments in most spits which cannot be attributed to the sample-size effect. Therefore the evidence provided by endscraper breakage with regard to raw material economy is ambiguous.

Secondary retouch is present on 57% of the endscrapers, and in all spits except 3VI-V and level 1 there are more endscrapers with secondary retouch (Figure 5:13, 7-11) than without it (Figure 5:13, 12-13). An analysis of the covariation between the presence/absence of secondary retouch and blank size (Table 5:51) shows only a marginal predominance of secondary retouch on small blanks (55%), and a more marked predominance of medium sized blanks with secondary retouch (71%). Among the smaller size group, the relative proportion of retouched and unretouched endscrapers fluctuates through the stratigraphy. An analysis of the covariation between the presence/absence of secondary retouch and blank type (Table 5:52) shows a marginal predominance of flake blanks without secondary retouch (54%), compared with a larger predominance of bladelet blanks with secondary retouch (69%). This distinction is particularly marked in level 1

The location of the secondary retouch is predominantly dexter (35%), then sinister (33%), and bilateral (30%). There is one example of bitransversal secondary retouch on a lateral endscraper in level 1. Variation in predominant lateralization of secondary retouch (sinister:dexter) fluctuates through the stratigraphy, with a predominance of sinister in spit 3VII, dexter in spits 3VI-IV, sinister in spits 3III-I, and dexter in level I, but the sample sizes are too small to enable us to attribute any significance to this pattern. The angle of secondary retouch is for the most part simple (97%), with flat retouch present in spits 3I and 3IV, and elevated retouch only in level 1. The amplitude of the retouch is predominantly invasive (89%), with marginal retouch restricted stratigraphically to spits 3VII-V, 3III, and 2VI. The direction of the retouch is predominantly direct (98%), with one inverse example in spit 3V and another in level 1.

In summary, the endscraper class is characterized by stratigraphic continuity in the morphological attributes, apart from the absence of long endscrapers in level 1 and the introduction of circular and lateral types. With regard to the retouch attributes, level

1 sees the appearance of bitransversal and elevated secondary retouch, and the absence of flat and marginal secondary retouch.

5:6 NOTCHES (Tables 5:53-5:55)

Notches (n.51, 6%) first appear in spit 4II, are present through level 3, are absent during spits 2VII-2I, and reappear in level 1 (Tables 5:4-5:5). They are predominantly made on flakes (73%), and the majority are made on blanks smaller than 2.5 cm (73%). Nine (18%) are broken. The majority of the notches are unilateral, predominantly sinister and then predominanty dexter after spit 3III, though in view of the small sample size it is not sure if this is significant. Bilateral notches occur only in spit 3I and level 1. Apart from two in spits 3VI-V, all notches are made by simple retouch. The amplitude of the notch retouch fluctuates, between being predominantly marginal in level 4, invasive in level 3, and marginal in level 1. The direction of the notches is for the most part direct (82%), while inverse notches are rare. Abrupt, as opposed to simple, notches are present only in spits 3IV-III. Secondary retouch is present on 20% of the tools, and is absent from level 1. It is for the most part unilateral (80%), simple, marginal and direct.

These data on the notches do not amount to anything significant or consistent in the way of variation through the stratigraphic succession. Further discussion of them is incorporated with the denticulates, which are described next.

5:7 DENTICULATES (Tables 5:56-5:58)

The denticulates (tools with more than one notch on the same edge) are relatively few in number (n.30, 4%). Of these, nine (30%) are broken. Denticulates are present more or less consistently through the lower part of the stratigraphy in relatively low frequencies (fluctuating between 1% and 10%), and are conspicuously absent from spits 3III-II (Tables 5:4-5:5). The denticulates are predominantly made on

flakes (70%), and in contrast to the notches the majority are larger than 2.5 cm (73%). Apart from three tools with bilateral denticulate retouch (all in spit 3VI) and a rare occurrence of transversal retouch (spits 4XI, 4V and level 1), the retouch is located either on the sinister or dexter lateral edge. There appears to be a shift in edge lateralization, from being predominantly dexter in level 4, to being predominantly sinister from spit 3V onwards. The angle of the retouch is predominantly simple (93%), with abrupt retouch occurring in spit 3V and level 1. The amplitude of the retouch is mostly invasive (70%), the direction direct (73%). Only one example has alternate retouch (in spit 3V), and inverse retouch is sporadic. Secondary retouch occurs on only two of the pieces, in spit 4I and level 1.

According to the Laplace typology (1964a), notches and denticulates belong to the same tool class. At the Evolved Epigravettian site of Palidoro, in Lazio, Bietti found a strong correlation between the manufacture of notches on flake blanks, and the manufacture of denticulates on laminar blanks (Bietti 1977). At Grotta delle Cipolliane, both types are predominantly made on flakes, but there is a difference in size. While the notches tend to be made on small blanks (73%), the majority of the denticulates are made on medium sized blanks (73%). This distinction may be related to function. Except in spits 4VI-III and 3VI-V, notches are more abundant than denticulates. At Grotta Paglicci, Donahue found that the majority of both the notched and denticulated tools were unused, while a few showed traces of having been used on meat or bone (Donahue 1985, 1986, 1988). Bietti's computer-generated correlation analysis (Bietti 1980b, 1981) of tool types and faunal remains from Italian Mesolithic sites found a strong correlation between notched and denticulated tools and the presence of the rock dwelling marine molluscs *Trochus (Monodonta)* and *Patella*, and he concluded that at coastal sites the function of these tools was for prising the molluscs off the rocks. The reconstruction of the local palaeoshoreline presented in Chapter 3 showed that the sea moved progressively nearer to Grotta delle Cipolliane throughout the period of its occupation, from a distance of 10 kilometres at 15,000 BP to 0.5 kilometres at 11,000

BP, though marine molluscs, including the species *Trochus (Monodonta)* and *Patella*, have only been found in level 1. However, there is no increase in the actual or relative abundance of notched and denticulated tools through the stratigraphy, and no typological change which might indicate a functional change when the microenvironment of the site changed from inland to coastal.

5:8 POINTS (Tables 5:59-5:61)

The points are a small class (n.21, 3%). Absolute frequencies range from 1 to 7, and the relative frequencies are insignificant (Tables 5:4-5:5). They are made predominantly on bladelets (62%), and the majority are larger than 2.5 cm (71%). Four (19%) are broken, in spits 4II, 4I, 2VI and level 1. Carinated forms are rare (19%), and stratigraphically dispersed. The retouch is predominantly bilateral (62%), and either simple and invasive or flat and total, with one marginally retouched point in spit 4I. Inverse retouch is restricted to spits 4III-II, 3II and 2VI. Contrary to the chronostratigraphic schemes outlined in Chapter 1, according to which 'foliate points' (those with flat retouch which covers most or all of the dorsal face) are temporally restricted to the Ancient Epigravettian, at Grotta delle Cipolliane they occur sporadically throughout the stratigraphy from level 4 to level 1. Therefore their utility as chronological markers is doubtful. At Grotta Paglicci level 4a, both the foliate and non-foliate points all showed microwear from meat cutting (Donahue 1985, 1986, 1988).

The points at Grotta delle Cipolliane appear to be a homogeneous class, though this may result from a combination of the small sample size described by comparatively few attributes. There are no temporal trends in either the morphological or the retouch attributes.

5:9 TRUNCATIONS (Tables 5:62-5:64)

Truncations are the smallest tool class (n.15, 2%), occurring sporadically through the stratigraphy from spit 4II onwards. Absolute frequencies range between 1 and 3, and their relative frequencies are insignificant (Tables 5:4-5:5). The blanks are predominantly bladelets (60%), with one blade in spit 4II, and flakes present from spit 3IV onwards. The size of the blanks is either small or medium, with large blanks present only in spits 4II and 3IV. For the most part the truncations are straight (80%), with concave examples in spits 4I and 3II, and one chevron in level 1. Right-angle and oblique truncations are present in equal quantities, and the relative proportion of the two types fluctuates through the stratigraphy. All the truncations are made by abrupt direct retouch, and the amplitude of the retouch is predominantly invasive (73%). Secondary retouch is present only in spits 4I (n.1, dexter) and 3IV (n.2, bilateral and sinister), and in all three examples the retouch is simple, marginal and direct. Five (33%) of the truncations are distal fragments, and these occur in spits 4I, 3IV, 3III and 3II (n.2).

The three truncation types in the Laplace typology (1964a) are devised on the basis of the amplitude of the truncation retouch (marginal or invasive) and the angle of the truncation (straight or oblique) (see Figure 4:3). It is not certain that truncations represent a functionally specific tool class. At Grotta Paglicci level 4a, the truncations themselves showed no traces of use, while the unretouched or retouched lateral edges revealed use-wear from cutting meat, defleshing hide, and working bone (Donahue 1985, 1986, 1988). Therefore the truncation would have served to reduce the length of the blank to conform to the functional requirements of the tool, and the angle and morphology of the truncation, and the amplitude of the truncation retouch, would have had no functional significance. Alternatively, it has been suggested that truncations are simply prepared blanks for the manufacture of burins (Movius *et al.* 1968:18), but this is difficult to prove. In either case, the truncation itself has no functional significance, and therefore the variability in its morphology and angle may be a stylistic feature. On

the other hand, as a technical attribute, truncations may vary in the amplitude of their retouch, and in their morphology and angle, in relation to manufactural contingencies dictated by the type and size of the blank to be truncated.

The truncations are all made on the distal end of the blank. Though this may have some stylistic significance, it can also be explained in terms of ease of manufacture. As the proximal ends of blanks tend to be thicker than the distal ends, and the dorsal surface more markedly convex in cross-section, the manufacture of a truncation at the proximal end would require the removal of a thicker part of the blank than it would at the distal end. Consequently, less time and effort would be required if truncations are made at the distal end.

An analysis of the covariation between the type of blank and the angle of the truncation (Table 5:65) shows a marked predominance of oblique truncations made on bladelets (86%), and equal proportions of right-angle truncations made on laminar and non-laminar blanks. However, the covariation between the size of the blank and the angle of the truncation (Table 5:66) shows no significant correlations. Though the correlation between oblique truncations and bladelets suggests that the angle of the truncation may have some technological significance, the question arises as to whether the makers of the truncations were passively affected by technological contingencies, or whether they systematically took advantage of them to achieve some desired effect, in which case the observed variability may be of stylistic significance. In other words, do the obliquely truncated bladelets result from having to accommodate truncations to bladelet blanks, or were bladelet blanks intentionally made with the aim of producing oblique truncations? The fact that right-angle truncated bladelets do occur, since it suggests that the technological contingencies were not restrictive, supports the general validity of the latter hypothesis.

Straight truncations are made on both laminar and non-laminar blanks, whether small, medium or large. While the concave truncation in spit 4I is made on a small bladelet, that in spit 3II is made on a medium sized flake. The chevron truncation in

level 1 is made on a medium sized bladelet. Therefore the morphology of the truncations appears to be independent of the type and size of the blank. As both the concave and the chevron truncations are stratigraphically restricted in their distributions, this might suggest that they are indeed a stylistic feature, though the small sample size has to be borne in mind.

The amplitude of the truncation retouch is predominantly invasive except for four right-angle truncations, in spits 4II, 3IV, 2V and level 1. However, these four show no correlation with either the type or the size of the blank. Those in levels 4 and 3 are made on laminar blanks, while those in levels 2 and 1 are made on flakes. With regard to size, that from level 4 is large, those from levels 3 and 2 are medium sized, while that from level 1 is small. Therefore the rare occurrence of marginal retouch may derive from idiosyncratic knapping behaviour.

In summary, the location, angle and morphology of the truncations may all be stylistic features, but because of the small sample size this can only be tentative.

5:10 PERFORATORS (Tables 5:67-5:70)

Perforators are a small class (n.17, 2%), which first appear in spit 4II, and are present sporadically through the stratigraphy. Only one perforator comes from level 2 (spit 2VIII). Absolute frequencies range between 1 and 4, and their relative frequencies are insignificant when the sample size is taken into account (Tables 5:4-5:5). The blanks are predominantly flakes (71%) and there are marginally more medium sized (53%) than small (41%), with one large perforator in spit 2VIII. Only in spits 3III-II are the perforators predominantly small. The location of the perforator is normally distal (88%), with proximal types occurring in spits 3III and 2VIII only. The position of the perforator, which describes the position of the point in relation to the axis of the blank, is predominantly angle (59%), and there is no variation from this norm except in level 1 where the majority (75%) are axial.

There are five different techniques of manufacture at Grotta delle Cipolliane, which show some temporal patterning: truncations opposite retouch, the most common type (41%), are restricted to levels 4 and 3; bilateral truncations (12%) are found only in spits 3 and 2VIII; both bilateral retouch (23%) and bilateral notches (18%) are restricted to levels 3 and 1; and a truncation opposite a notch (6%) occurs in level 1 only. The angle and morphology of the truncations show no significant temporal variability; the absence of straight and concave truncations from level 1 may result from the small sample size. There is no apparent correlation between blank morphology (type and size) and technique of manufacture.

The retouch is predominantly abrupt (76%), invasive (81%) and direct (76%). Secondary retouch is restricted to spits 3IX, 3VI, 3II and level 1. The retouch is exclusively simple and marginal, and predominantly direct, with one inverse example in spit 3VI. Four (24%) of the perforators are distal fragments, occurring in spits 3VII, 3III, 3II and level 1.

5:11 COMPOSITE TOOLS (Tables 5:71-5:72)

Composite tools (n.17, 2%) are restricted in their stratigraphic distribution to level 3 and the lower part of level 2 (Tables 5:4-5:5). None of the composite tools are broken. The class is composed of combinations of burins, endscrapers, denticulates, truncations, notches and perforators. The composite tools are predominantly small (76%) and are made on either bladelets or flakes in equal proportions. Those made on flakes are restricted to a tight stratigraphic cluster from spits 3VI-II. Burin-endscrapers are the most common combination (41%). The composite tools are described individually, with the distal end first:

Spit 3IX: a burin on break/convex endscraper.

Spit 3VI: a burin on right-angle straight truncation/perforator (right-angle straight truncation and abrupt retouch).

A convex endscraper/right-angle concave truncation.

A burin on break/denticulate (elevated, invasive, flat retouch).

A transversally retouched burin/convex endscraper.

Spit 3V: a convex endscraper/burin on right-angle straight truncation.

An angle dihedral burin/denticulate (abrupt, invasive, direct retouch).

Spit 3IV: A burin on break/convex endscraper.

An angle retouched burin/perforator (right-angle straight truncation and abrupt, marginal, direct retouch).

A right-angle straight truncation/burin on break.

A burin on break/convex endscraper, with bilateral secondary retouch (simple, invasive, direct retouch).

Spit 3III: an angle retouched burin/nosed endscraper.

Spit 3II: an angle dihedral burin/convex endscraper.

A convex endscraper/lateral perforator (notched).

Spit 3I: a right-angle straight truncation/convex endscraper.

Spit 2VIII: a convex endscraper/oblique concave truncation, with bilateral secondary retouch (simple, invasive, direct retouch).

Spit 2V: an nosed endscraper/oblique concave truncation, with continuous bilateral secondary retouch (simple, invasive, direct retouch).

Moss (1983) has suggested that in the case of burin composite tools, the burin might sometimes have served as a hafting device. However, at Grotta delle Cipolliane none of the burin parts is symmetrical (ie., axial burins), and therefore this seems unlikely. Composite tools may have been designed as multipurpose tools, like penknives, or alternatively they may represent successive stages in the transformation

of a tool blank. There is no apparent correlation between blank morphology (type and size) and the tool combinations.

5:12 DISCUSSION

The analysis of the individual tool classes revealed that, though some temporal variability is apparent, the retouched tool sequence from Grotta delle Cipolliane is characterized by strong continuity in both the morphological and the retouch attributes. The analysis identified very few attributes or covariations of attributes which are temporally diagnostic, either in terms of being stratigraphically restricted in their distribution, or in terms of proportional shifts. The majority of the traditional type fossils, such as foliate points, shouldered backed bladelets, and carinated endscrapers, are also not as temporally diagnostic as is normally assumed. Some of the tool classes are more homogeneous than others, and with the exception of the linear retouched tools this probably results from the combination of a small number of tools described by comparatively few attributes. Though change is seen to occur in some of the tool classes, such as the backed bladelets, burins and endscrapers, it is staggered through the stratigraphy, occurring in different tool classes at different times. This may result in part from the fact that the spits are arbitrary excavation units, rather than individual *sols d'habitat* or occupation residues that are separated by continuous sterile layers, and therefore it is likely that the lack of stratigraphic division will have resulted in the mixing of discrete episodes and the creation of a behavioural palimpsest.

It is difficult to assess the degree of continuity or change between the lower and the upper spits of level 4, which are separated by a culturally sterile stratigraphic hiatus, because of the small sample size of the lower spits. There is typological continuity between levels 4 and 3, with the only significant change being the first appearance of composite tools in level 3. The transition between spits 3VI and 3V sees a significant shift from a predominance of unmodified burins to a predominance of retouched and truncated burins, and in spits 3V and IV burins are more abundant than

backed bladelets, while linear retouched tools are significantly absent. There is a comparatively low proportion of burins made on flakes in spits 3IV-I. Double-tipped pointed backed bladelets are restricted to spits 3VII-VI, while bitruncated backed bladelets occur only in spits 3VII and 3III-I. There is also a shift to a predominance of truncated backed bladelets over pointed types in spits 3III-I. Therefore there appears to be a marked change between spits 3IV and 3III in the backed bladelets, which may have been induced by changes in hafting technology. Denticulates are significantly absent from spits 3III-II. Continuity between levels 3 and 2 is suggested by the continued presence of composite tools until spit 2V, but otherwise the sample size from level 2 is too small to assess the degree of continuity with either level 3 or level 1. After the stratigraphic hiatus between levels 2 and 1, there are some marked changes in the retouched tools. Long endscrapers, transversal burins and various retouch attributes are absent. The backed bladelets are more standardized than in level 3, while the burins are more diverse in their metrical attributes, neither of which can be accounted for by the sample size-effect. Level 1 sees the appearance of new designs among the endscrapers (lateral and circular forms), and a relative abundance of small carinated endscrapers. There is also a significantly higher rate of breakage among the endscrapers and backed bladelets in level 1 compared with the lower levels.

Although the reanalysis has revealed certain characteristics of the assemblage which are temporally diagnostic, less than 15% of the area inside the cave was excavated in 1964 and therefore it would be unrealistic to assume that the sample obtained is in any way typical of the site as a whole. Indeed, comparisons with the Laplace type-list from the 1962 excavation which explored an area adjacent to that opened in 1964 reveals some marked differences. Within the backed bladelets there is a fluctuation between a predominance of pointed types in level 4, obtuse in level 3, pointed in level 2 and obtuse in level 1, in contrast with a consistent predominance of obtuse types in 1964. There is no information concerning the presence of double-pointed backed bladelets, while bitruncated backed bladelets were found in all levels

except level 2. Circular endscrapers are significantly more abundant in level 1 than the 1964 excavation would suggest, and in addition there is one from level 2 and another from level 3. Long endscrapers and composite tools are present in level 1, and transversal burins are restricted to level 4. As the assemblages from both excavations were classified according to the Laplace typology, it is unlikely that these discrepancies result from idiosyncrasy in classification. It is also important to consider differential intra-site patterning of refuse disposal variability, as it has been shown that people occupying caves, on either a short-term or a long-term basis, will tend to toss large objects towards the entrance rather than towards the rear walls, while smaller objects tend to be dropped within the cave (Binford 1983:153), and this will result in a size-sorting effect and spatial variation of artifact types. However, this phenomenon does not explain the differences between the two excavation areas at Grotta delle Cipolliane.

Even with the total excavation of a site, the degree to which an assemblage is a representative 'sample' of what was originally present at the site can never be known. It is likely that the differential influence of variable tool use-lives, curation, caching, periodic episodes of site cleaning, and post-depositional processes will have all contributed towards obscuring the substantive significance of the assemblages at Grotta delle Cipolliane. Although this has to be borne in mind in the course of interpreting the data, it should not be allowed to negate the validity of exploiting that data to the fullest extent.

The main body of this chapter has so far concentrated on the individual tool classes, and has shown that their morphological and retouch attributes appear to have been affected by the absence of local sources of lithic raw material. Further information with regard to raw material economy can be gained by examining the technological attributes that cross-cut the individual tool classes, and by incorporating data from the cores and debitage. Therefore I will continue the discussion with a consideration of technological strategies of tool production and how these may have been influenced by raw material constraints.

The tools are predominantly laminar (61%), except in spits 3V and 2VI, though only in spit 3V is this significant (Table 5:73). Backed bladelets are the only tools which are exclusively, and indeed by definition, made on laminar blanks. When the backed bladelets are excluded from the calculation, the assemblage is for the most part made on flake blanks (60%) except in spits 4IV and 3VIII, though only in spit 3VIII is this significant (Table 5:74). The only tool classes which are predominantly laminar are the points (62%) and the truncations (60%). All the other tool classes have some laminar forms, ranging from 24% (burins) to 50% (linear retouched tools and composite tools). The majority (99%) of these laminar blanks are bladelets, with blades only occurring in spits 4II (n.2), 3VIII (n.1), 2VIII (n.1) and level 1 (n.3). The distinction used here between blades and bladelets is based on absolute size, and it is in a sense an arbitrary distinction, as blades are no more than the tail-end of a single, continuous size distribution. The dominance of bladelets among laminar blanks may result not so much from a positive intention to make bladelets as such, as from an inability to make blades because of raw material constraints, such as the size of the raw material blocks or their quality. The distinction between flakes and bladelets is based not upon size but on the value of the length:width ratio, and again is an arbitrary distinction. A greater proportion of flakes in an assemblage as opposed to bladelets may also result from raw material constraints rather than design.

Technological strategies can be envisaged as being determined by the need to maximize efficiency and economy as defined by their relative costs. The strategy of blank production for tool making may have been determined by a number of parameters. Firstly, certain functional tasks impose constraints on the morphology of the blank, such as cutting which requires tools with long, rectilinear edges. Blank production may also have been induced by morphological constraints that did not arise from the tool's function but rather from its mode of utilization. For example, in the case of grooved hafts into which interchangeable stone elements are inserted, the inserts must be standardized and morphometric norms respected. The morphology of

the tool blanks may also reflect a strategy of raw material economy. A dominance of laminar forms in an assemblage has been interpreted by some as an indication of a technological strategy to economize on raw material (Leroi-Gourhan 1964:190-197). A laminar technology requires the investment of more time and effort in core preparation than a flake technology, but there are certain advantages of blades and bladelets compared with flakes. The factor of length permits prehension or hafting, while the factor of being elongated permits segmentation of blanks and the fabrication of geometric microliths (Tixier 1984). In terms of raw material economy, laminar blanks have a longer cutting edge for a given volume of raw material than flakes. In distal type tools, such as endscrapers and burins, the length of the laminar blank does not directly play a functional role, but provides the possibility of rapid and efficient tool maintenance which may be a potentially determinant parameter. Laminar blanks permit more frequent rejuvenations than flake blanks, and they are also more flexible and can be transformed more easily into a wide variety of tools. Therefore the longer use-life of laminar tools compensates for the cost of the technical investment in their production. Standardized preforms such as bladelets can be removed from cores with less waste than random amorphous flakes (Johnson 1987). In addition, blade or bladelet cores maximize or conserve raw material because a large quantity of tool edge can be produced in relation to the amount of raw material used. Flake technologies require less investment of time and effort in core preparation than laminar technologies, but are less economic in terms of raw material consumption, except for the fact that flake tools are less subject to breakage during manufacture and use than bladelet tools (Bleed 1986). In the debitage recovered during the 1962 excavation the ratio of unretouched laminar blanks:flake blanks ranges between 1:6 and 1:19, with no linear temporal trend (Table 5:77).

At this point in the discussion it is necessary to address the question of whether blanks for retouched tools were produced as the focus of the core reduction process, or whether debitage was generated in quantity and then certain pieces were selected

and used as tool blanks because they exhibited a suitable morphology. Strategies of tool production are not necessarily determined by the needs related to each of the tool classes, but instead can be determined by a single predominant tool class which alone orients the core reduction strategy (Perlès 1987a). For example, a *single reduction strategy* may have been oriented towards the production of bladelets, and the by-products of this operational sequence, such as the blanks produced during the initial shaping of the core, preliminary blanks, blanks of inferior quality, and blanks broken during the flaking process, may then have been used to manufacture other tool classes. Alternatively, a *serial reduction strategy* entails the production of multiple interior products from the same core (Ferring 1988). For example, after the initial shaping and removal of preliminary blanks, the core may have produced large interior flake blanks and then bladelets. *Multiple reduction strategies* entail separate core reduction sequences for each specific product (Ferring 1988). Multiple reduction strategies would reflect divergent tool blank requirements that could not be met efficiently by a single or a serial reduction strategy.

In the absence of evidence from core refitting, the reconstruction of the core reduction strategies at Grotta delle Cipolliane can only be hypothetical, and serial reduction strategies cannot be identified as there are no data concerning which of the tools have cortex. A single reduction strategy is the most conservative in terms of raw material consumption, while a multiple reduction strategy would be the least conservative. At Grotta delle Cipolliane the data suggest the use of a single reduction strategy throughout the stratigraphy. The backed bladelets are made on blanks with a fairly specific morphology, while the other tool classes are made on blanks that vary markedly in form. Multiple reduction strategies are less likely, as blade tools are very rare. The relative percentages of the tool classes cannot be used as an indicator of reduction strategies, as the tools were not all necessarily produced on-site. Indeed, it is likely that some classes of tools, such as backed bladelets, would have been transported between sites as part of a hunter's personal toolkit, while maintenance tools such as burins and endscrapers may have been produced on-site as required from

transported cores. If tools were transported between sites in anticipation of future use, this will result in the temporal and spatial separation of tool manufacture, use and discard/loss.

The desired shape and size of a tool is not necessarily obtained through strategies of core reduction, but may be achieved by means of retouch. Either as a complement or as an alternative, retouch can make it possible to achieve the proper correspondence between the desired tool and the shape of the blank, and in some cases it may be easier to obtain the shape of the desired tool by retouch rather than directly by core reduction strategies. An extreme example of this can be seen at Franchthi cave in the Greek Peloponnese, where the majority of the backed bladelets in phases IV and V (13-12,000 BP) are actually fabricated on intensively retouched flakes, by means of a proximal truncation of the flake next to the distal edge, as the lithic raw material was not conducive to laminar flaking (Perlès 1987a). All the backed bladelets at Grotta delle Cipolliane are made on true bladelets, but the predominance of invasive backing suggests that the debitage blanks did not closely approximate the final morphology of the tool, and therefore that bladelet production was not standardized.

The factor of size has already been touched on to some extent, as blades are distinguished from bladelets on the basis of size. It would be logical to assume that the smaller the tools are, the more economical is the use of the raw material. Considering the assemblage as a whole, the majority (68%) of the tools at Grotta delle Cipolliane are smaller than 2.5 centimetres, except in spits 4VI, 3VIII and 2VII (Table 5:75). This may partly be due to the abundance of backed bladelet fragments. When backed bladelets are excluded from the calculation, the majority (59%) of the tools are still smaller than 2.5 cm, except in spits 4IX, 4VI, 4IV, 3VIII and 2VIII-VII, though only in spits 3VIII and 2VIII is this significant (Table 5:76). The small size of the industry at Grotta delle Cipolliane is in stark contrast with other contemporary sites in Italy, such as the Evolved Epigravettian site of San Corrado in Sicily, where the average

length of all tools is between 7 and 10 centimetres, with a maximum of 14 cm (Segre and Vigliardi 1983).

While the small size of the industry might be interpreted as evidence for a strategy of raw material economy in tool design, it is not known to what extent the size of tools when they are discarded reflects their original size, or whether it is the result of constant rejuvenation or resharpening. Rejuvenation and resharpening are two alternative maintenance strategies designed to prolong the use-life of tools and therefore to minimize the costs associated with lithic procurement. Resharpening involves the retouching of a blunted tool edge, while rejuvenation involves the removal of an edge to provide a new edge. Resharpening is therefore a more conservative strategy in terms of raw material than rejuvenation. It was suggested that continued resharpening of endscrapers may have resulted in the creation of carinated, circular and nosed forms, but the resharpening of other tool classes is more difficult to identify from the available data. Gambassini's note that many of the burin spalls are longer than the existing burins themselves (Gambassini 1970:163), suggests considerable reduction in the size of individual burins through rejuvenation. The data concerning rejuvenation flakes come from the 1962 excavation, where unfortunately no differentiation was made between core and tool rejuvenation flakes, except for level 3 where there are 150 tool rejuvenation flakes, 220 core rejuvenation flakes and 80 burin spalls (Palma di Cesnola 1962). The number of rejuvenation flakes expressed as a percentage of the total lithic assemblage ranges from 7% to 11%, with no linear temporal trend (Table 5:77).

Excessive resharpening or rejuvenation may also lead to the blade or flake origins of a blank being lost, which will have some bearing on the discussion of laminarity above. The amount of maintenance required for any one tool will result from the types and amounts of materials being processed. Even within a strategy of raw material economy, a concern for tool maintenance might only have applied to specific tools, such as those for working harder materials, as the processing of wood and bone reduces tools at a faster rate than processing meat or hides. Some functions,

such as cutting, generally require sharp, fresh edges, and therefore cutting tools are less likely to have been maintained.

The combined data on tool breakage is presented in Table 5:78. Considering the assemblage as a whole, 33% (n.283) of the tools are fragments. Spits 3VI-IV have a significantly lower rate of breakage than any other part of the stratigraphy, while level 1 has a higher rate of breakage than spits 3VII-I. This could be interpreted as indicating that the tools in level 1 were utilized more fully as part of a strategy of raw material economy, causing a greater potential for breakage, although breakage may occur either accidentally or intentionally during manufacture, as well as during use and maintenance, and on the basis of the available data it is not possible to identify the origin of the breaks. However, the postulate that the high rate of breakage in level 1 may indicate a relatively intense utilization of the toolkit is supported by the high proportion of carinated endscrapers which suggests heavy maintenance.

High rates of tool maintenance and breakage are features characteristic of a *curated technology*. Binford (1979) defined curated technologies as consisting of tools that are useful in a variety of tasks, manufactured in anticipation of use, maintained through a number of uses, transported between sites, and recycled into other functional modes. Therefore tools were designed to stay in the system as long as possible. An *expedient technology*, on the other hand, is characterized by the manufacture of tools as and when they are needed, and which are discarded after little use. The concepts of curation and expediency tend to be used in absolute terms, but ideally they should be seen as relative concepts which describe a continuous range of variation. Therefore a relative importance of retouched tools in an assemblage could be used as an indicator of the degree of curation, regardless of whether the retouch pertains to investment in design, as in the case of backed bladelets, or to maintenance. Data on the percentage of retouched tools are taken from the 1962 excavation, and are expressed here as the number of retouched tools in each level as a percentage of the total assemblage. The percentage ranges between 9% and 25%, with no linear

temporal trend (Table 5:77), and the study of other sites in Chapter 6 will show that this figure is relatively high.

Not all parts of the toolkit will have been curated to the same extent. As has already been mentioned, tools for functions such as cutting meat require sharp edges, and these tools can therefore be expected to have been used in a more expedient fashion than other components of the toolkit such as endscrapers. Consequently, the relative percentage of retouched tools may be more indicative of the types of economic activity carried out in each level, rather than of the overall degree of curation.

A relative importance of retouched tools could also indicate the enrichment of the toolkit by the import of prefabricated tools. Units of raw material can enter a site in various different stages of reduction: unmodified blocks, prepared cores, prepared blanks or finished tools. The import of unretouched blanks would have reduced the weight carried, but limited the spectrum of possible applications of the transported material. The import of prepared cores would have involved the transport of a greater weight, but the exact use to which they could be put would have been less circumscribed (Roebrooks *et al.* 1988). Given the possibility of breakage occurring during tool manufacture, the optimal strategy might have been to finish manufacturing the tool in the source area. Among the Alyawara of Australia, the decision to transport manufactured blanks versus cores was related to differential tool demand and the potential use-life of the intended tools. Blanks for curated tools, such as knives, were produced in quarries, while blanks for tools which dulled quickly and were otherwise used in a more expedient fashion, such as woodworking tools, were produced as needed from cores that had been transported to the living sites from the quarries (Binford and O'Connell 1984). Technology should therefore be seen as an internally differentiated strategy, where there may be one kind of procurement strategy appropriate to the supply of one class of tools, and another considered appropriate to providing or replacing other kinds of tools. Procurement and production strategies can be expected to have been organized with respect to differences in tool use-lives,

demand periodicities, and assemblage specializations, and strategies can therefore be expected to vary within a technological system, depending on its spatial patterning within a region (Binford 1982).

The import of finished tools would result in the absence, or presence of only a small amount, of debitage. Debitage was found in all levels at Grotta delle Cipolliane, consisting of cores, unretouched flakes and bladelets and small chips, which indicates at least some on-site core reduction. The percentage of unretouched blanks ranges from 60% to 78%, with no linear temporal trend (Table 5:77). However, it cannot be taken for granted that the absence of retouch on a blank signifies knapping debris, and that it did not in fact form part of an imported toolkit. For example, at the Magdalenian site of Verberie the unretouched component of the lithic industry comprised a large part of the toolkit, where it was used for meat cutting and hide scraping activities (Symens 1986). This therefore brings us back to the discussion on the relative degrees of curation and expediency being related to the kinds of functional activities being performed at a site.

The percentage of cores from the 1962 excavation at Grotta delle Cipolliane ranges from 1% to 4%, with the highest percentage in level 2 (Table 5:77). A low proportion of cores in the assemblage might indicate either the import of ready-made blanks, or a very intensive reduction of the cores. In the process of blank production, as the core is reduced and transformed into blanks, there comes a time when blanks can no longer be removed easily. If lithic raw material were abundant, one might expect that at this point a larger nodule would be chosen for reduction, and that the spent or 'exhausted' core would be discarded and would remain recognizable as such in the archaeological record. If lithic raw material were being economized, one might expect the cores to have been reduced beyond their normal capacity for flake production by using bipolar flaking, which is a technique to facilitate the exploitation of small cores (Binford and Quimby 1963). A core is placed on the anvil so that the distal end, opposite to the point of percussion, rests on the anvil. When percussion is

applied, there is also a force rebound from the anvil which produces distinctive cores and flakes, with a fracture on the distal end as well as the primary fracture on the proximal end where the force is applied. The core would therefore be transformed into usable flakes and shatter, but the archaeological visibility of the core would be lost. Consequently, extensive reduction may lead to a relative scarcity of cores and the presence of bipolar flakes and cores in an assemblage. According to Gambassini (1970) all the cores from the 1964 excavation are bipolar, and as they grade morphologically into *pièces esquillées* (splintered flakes) he groups them together (Figure 5:14).

The core types from the 1962 excavation can be viewed along a trajectory of relative economy of raw material, with prismatic bladelet cores as the most economic, and discoidal flake cores as the least economic. In level 3, prismatic bladelet cores are the predominant type, with a maximum dimension of 3 centimetres. The second most common type are semiprismatic bladelet cores, while subdiscoidal flake cores are rare. Level 1 sees a reversal, with a predominance of discoidal flake cores, which have a maximum dimension of 2 centimetres, and then semiprismatic and rare prismatic bladelet types. However, the scars on a core are only an indication of the last blank removals, and in level 1 there are marginally more bladelet tools than in level 3 (44% compared with 41%), while amongst the debitage there are marginally fewer bladelets than in level 3 (5% compared with 9%). This suggests that there was no change in the strategy of blank production, but rather that the cores in level 1 were reduced more intensively by the continued removal of small flakes when it was no longer possible to remove bladelets, and this is supported by the smaller size of the residual cores.

In summary, the marked continuity in both the technological and the typological attributes of the retouched tools suggests that there was no change in technical tradition at Grotta delle Cipolliane. The combined data from the two excavations indicate an increase in raw material economy between levels 3 and 1, characterized by more intense core reduction and tool utilization, which suggests that

the costs of procurement were not simply a function of distance from the source. The increase in raw material economy may be related to a change in the nature of the occupation of the site and its role within a larger socio-economic system. The different occupations at Grotta delle Cipolliane probably represent only part of the annually mobile settlement system of a group, other parts of which should be represented at penecontemporaneous sites in the research area, and therefore before considering raw material procurement in relation to broader social and economic strategies, it is necessary briefly to review the other late Palaeolithic assemblages from the region. This will be done in the next chapter.

CHAPTER 6

ANALYSIS OF THE LITHIC ASSEMBLAGES: A REGIONAL REVIEW

6:1 INTRODUCTION

This chapter presents a review of the Epigravettian assemblages in south-east Italy, and considers the spatial organization of lithic technology in the south-east Italian late Palaeolithic as a whole and how it varies temporally. The discussion of the lithic assemblages is based on a combination of published data and of data resulting from my own analysis of material stored at the Istituto Italiano di Paleontologia Umana in Rome and the Museo Comunale di Paleontologia in Maglie.

The sites to be discussed in this chapter differ in the following ways: in their location; in the particular time-span they represent within the late Palaeolithic; in the quantities of archaeological material discovered and the qualitative information that can potentially be gained from them; in the condition and deposition of these assemblages; and in the quality of the excavation techniques employed at each site. The chief problem is that of establishing to what extent any of them can be regarded as contemporaneous, either broadly or precisely. Group mobility, seasonal occupations and variation in the intensity and frequency of different activities between sites all mean that a variety of different functional assemblage-types may be characteristic of any single social group, and doubtless several such groups were operating in the region. The precise chronological span of each assemblage is unknown, but possibly involves decades or, at some sites, centuries. This would allow any one site to be occupied by members of different social groups, thus involving more than one technical tradition in each assemblage. Consequently, the assemblages have to be regarded as behavioural palimpsests. In addition, the majority of the sites discussed in this chapter have only been partially excavated, and therefore the assumption cannot be made that the samples adequately represent the range of assemblage variation at the

sites from which they were drawn, and that they are unaffected by intra-site differences in artifact distribution as a function of the spatial segregation of certain activities. Although the potential influence of these factors has to be borne in mind in the course of interpreting the data, as was discussed in Chapter 5 even the total excavation of a site does not guarantee that the assemblages will be truly representative, and therefore the cautious use of data from partial excavations is justifiable.

This chapter is largely based on my treatment of published data, which are supplemented by my own analyses of samples of the assemblages from Taurisano, Grotta Romanelli, Ugento-Pozzo Zecca and Grotta di Uluzzo. The publications differ in the amount of qualitative and quantitative information they provide, and as the sites were excavated with a view to finding tools that could be used for typological dating, many of them lack data on the debitage. The data resulting from my own analyses are also not without their problems, as the material stored at the Maglie museum turned out to have no record of the stratigraphic levels from which it came. However, the analysis of this material has provided certain information which tends to be lacking from the publications, such as metrical attributes, which are still useful at a broad comparative level.

The sites are grouped according to sub-region: the Salento peninsula; the Murge; and the Gargano promontory. I will give a site-by-site description of the salient features of the assemblages in each of these sub-regions, followed by a short summary at the end of each group. In the subsequent discussion which completes this chapter, I will give a comparative assessment of the south-east Italian sites and their assemblages.

6:2 THE SALENTO PENINSULA

To date there are eleven cave and rockshelter sites, including Grotta delle Cipolliane, and nine surface localities with assemblages that have been attributed to the late Palaeolithic. The sites are all located within an area of approximately 1500 square kilometres in the southern part of the peninsula, and all but seven of them are situated along the present day coastline (see Figure 3:2). The nearest raw material sources are located in the Gargano promontory, 300 kilometres to the north-west, and in Basilicata, 250 kilometres to the west (see Figure 2:3).

TAURISANO

The industry from Cardini's unpublished excavation at Taurisano was first studied by Laplace (1966b), and later by Bietti using the French Upper Palaeolithic typology (1979). The small assemblage from spits 27-24 has been attributed to the Gravettian or the initial phase of the Ancient Epigravettian (Palma di Cesnola and Bietti 1983); the assemblage from spits 23-6 was assigned to the phase of shouldered backed bladelets of the Ancient Epigravettian (Palma di Cesnola and Bietti 1983); and the assemblage from spits 5-1 was initially assigned to the pre-Romanellian phase with truncations and truncated backed bladelets of the Final Epigravettian (Laplace 1964b), and the ^{14}C date of $15,500 \pm 150$ BP (Alessio *et al.* 1978) rejected as being too old. Spits 5-1 were later reassigned to a phase of transition between the Ancient and the Evolved Epigravettian (Bietti 1979), thereby conforming with the ^{14}C dates. However, the chronology of spits 5-1 is still debated (see Palma di Cesnola and Bietti 1983; Palma di Cesnola *et al.* 1983). The assemblages come from two sedimentary levels: level C (spits 27-24), and level B (spits 23-1). The assemblage from spits 27-24 contains only six retouched tools: two burins, three retouched blades and a retouched flake. The size of the tools and the debitage is large. Spits 23-1 produced a total of 490 retouched tools. Laplace divided the assemblage into three horizons: spits 23-13, spits 12-6 and spits 5-1. I will first summarize his classification and then discuss the results of my own analysis of a sample of the industry.

Spits 23-13: The retouched tools (n.111) are predominantly backed bladelets and linear retouched tools, which together account for more than half the assemblage (Table 6:1). Among the backed bladelets, pointed types are more abundant than obtuse ended types, and truncated backed bladelets are absent. The backing retouch is predominantly invasive on both pointed and obtuse ended types. The morphology of the backed edge is predominantly shouldered. 30% of the backed bladelets are fragments. There is one geometric microlith, which is a rhomboid. Of the burins, the majority are simple (unmodified). The endscrapers are predominantly made on long blanks, and circular types are absent. The linear retouched tools are for the most part made on laminar blanks with invasive retouch.

Spits 12-6: The retouched tools (n.212) are again predominantly backed bladelets and linear retouched tools, accounting for more than half of the assemblage (Table 6:1). Among the backed bladelets, obtuse ended types are more abundant than pointed types, while truncated types are rare. 32% of the backed bladelets are fragments. The backing retouch is predominantly invasive on both pointed and obtuse ended bladelets. Shouldered backed bladelets are still present, but geometric microliths are absent. Of the burins, the majority are retouched/truncated. The endscrapers are predominantly made on short blanks, and circular types are still absent while nosed endscrapers are present. The linear retouched tools are predominantly made on laminar blanks with invasive retouch. Composite tools include one burin-endscraper and one burin-perforator.

Spits 5-1: The retouched tools (n.167) are again dominated by backed bladelets and linear retouched tools, and again they account for more than half of the assemblage (Table 6:1). The backed bladelets are predominantly pointed, then truncated, and obtuse. The backing retouch is predominantly invasive on the pointed backed bladelets, and marginal on the obtuse ended types. Of the truncated types, there is one bitruncated example and one with a *piquant trièdre* facet, although no microburins were found at Taurisano. 41% of the backed bladelets are fragments. There is one shouldered backed bladelet, and geometric microliths are absent. The burins are

predominantly retouched/truncated, and the endscrapers are for the most part made on short blanks. Circular types are absent, and nosed types are present. The linear retouched tools are predominantly made on flake blanks, with invasive retouch. There is only one composite tool, an endscraper-truncation.

According to Laplace's grouping of the spits, the transitions between spits 13/12 and 6/5 are characterized by various reversals in the morphological and retouch attributes, although the assemblage composition in terms of tool classes sees little significant change apart from the marked increase of the endscrapers (Figure 6:1). The endscrapers and the linear retouched tools demonstrate a progressive decrease in laminarity, while the backed bladelets show a progressive increase in the rate of breakage. Bietti's reanalysis (1979) of the assemblage regrouped spits 23-6 into one assemblage. Of the laminar tools, bladelet blanks are more abundant than blades (between 85% and 97%), and the majority of the flake tools are smaller than 2.5 centimetres. The largest tools come from the lower spits. There is a relative abundance of rejuvenation flakes, and five times as many burin spalls as burins, which Bietti interprets as indicating that the samples are not sufficiently representative of the complex set of activities that were being carried out at the site (Bietti 1979).

My own analysis of a sample of the assemblage from Taurisano provides some additional information. The attributes of the backed bladelets (n.127) are presented in Tables 6:2-6:5. Fragments account for 46% (n.59) of the backed bladelets, and none of the fragments could be matched. Considering the fragments together, they are for the most part proximal (40%), then distal (31%), and medial (29%), though within the individual spits there is much variation in the order of abundance. The rate of breakage also varies considerably between the spits, but there is no linear temporal trend. Of the unbroken bladelets, the lengths range between 1.7 cm and 3.7 cm. The lateralization of the backing retouch is predominantly sinister (48%), then dexter (46%) and bilateral (6%). With the exception of two examples in spit 20, the bilateral backed bladelets are restricted to spits 8-1. The morphology of the backed edge is for the most part rectilinear (61%), then shouldered (22%) and curved (17%). All the shouldered

backed bladelets are pointed, and the shoulder is either adjacent to or opposite the backed edge. Shouldered backed bladelets are notably absent from spits 5-1, while curved backed bladelets are absent from spits 18-12. The direction of the backing retouch is predominantly direct (75%), then bipolar (16%), and alternate (9%). Inverse backing is absent. The amplitude of the retouch is predominantly invasive (70%), except in spits 8-7. Marginal backing is absent from spits 19-12, and partial backing (20%) is absent from spits 5-1. Pointed backed bladelets have a predominantly distal location (91%). The only proximal points are in fact on double pointed backed bladelets, in spits 16, 7 and 3. The morphology of the tip is for the most part obtuse (57%), then pointed (34%) and truncated (9%), and throughout the stratigraphy there is a consistent predominance of obtuse ended bladelets. Truncations are rare, and are predominantly distal in location (63%). Bitruncated backed bladelets are absent. The angles of the truncations are either right-angle or oblique, with no temporal patterning, and all are made by direct retouch. There are no *piquant trièdre* backed bladelets. Proximal and distal ventral retouch is sporadic, and secondary lateral retouch is predominantly absent (80%). The secondary retouch, which is mainly partial in extent, is predominantly simple (88%), marginal (65%), and direct (87%). Abrupt retouch occurs only in spits 7-6 and 1, inverse retouch is rare and sporadic, and alternate and bifacial secondary retouch are absent (Figure 6:2).

The presence of a truncated backed bladelet in spit 23 and another in spit 16 does not conform to Laplace's type-list, and neither does the total number of backed bladelets (n.127), which is 21 less than Laplace's total. The only temporal patterning that became apparent from this analysis of the backed bladelets is the absence of curved backs and marginal backing from spits 18-12, and the absence of shouldered backs and partial backing from spits 5-1. In all other respects there is marked technological and typological continuity, with no significant temporal reversals in the relative abundance of the various attributes. Compared with the backed bladelets from Grotta delle Cipolliane, those from Taurisano are very similar, with small, rectilinear backed, obtuse ended bladelets with direct invasive backing predominant throughout

the stratigraphy. According to the chronology favoured by Bietti (1979), spits 23-6 would date to an earlier phase of the Ancient Epigravettian than that present in level 4 at Grotta delle Cipolliane, while spits 5-1 would be contemporary with Cipolliane level 3 spits IX-IV. According to Laplace's chronology (1964b), the phase represented by spits 5-1 would fall within the hiatus between levels 2 and 1 at Grotta delle Cipolliane.

Debitage, comprising cores, unretouched flakes and bladelets, and rejuvenation flakes, is present in all of the spits. Because of the constraints of time and funding, it was only possible to study a sample of the assemblage, and therefore I selected spits 9-14 and spit 1. The total sample comprises 772 artifacts: 650 from spits 9-14 and 122 from spit 1. The percentage of retouched tools in spits 9-14 ranges between 0% and 18%, compared with 20% in spit 1. There is no significant difference between the spits in the size of the tools, which are all predominantly smaller than 2.5 centimetres with few exceptions. The percentage of unretouched blanks in spits 9-14 ranges between 68% and 86%, compared with 72% in spit 1. In spits 9-14 the ratio of unretouched bladelets to flakes ranges between 1:4 and 1:11, which is in stark contrast to the ratio of 1:43 in spit 1. The percentage of cortical blanks (tools and unretouched blanks) in spits 9-14 ranges between 3% and 13%, compared with 3% in spit 1. The percentage of rejuvenation flakes (including burin spalls) in spits 9-14 ranges between 10% and 13%, compared with 7% in spit 1. The burin spalls are predominantly secondary in spits 9-14, and primary in spit 1. The percentage of the combined cores and *pièces esquillées* in spits 9-14 ranges between 2% and 5%, compared with 1% in spit 1. *Pièces esquillées* are present in spits 9-14, but absent from spit 1. The cores in spits 9-14 are prismatic bladelet cores (n.2), bipolar cores (n.3), and a fragment of a bladelet core. The whole cores range between 2 and 3 centimetres in their largest dimension (Figure 6:3, 1-5). The core from spit 1 is a discoidal flake core, and measures 2 centimetres in its largest dimension (Figure 6:3, 6). In summary, the main differences between spits 9-14 and spit 1 are the higher percentage of retouched tools and the lower percentages of both rejuvenation flakes and cores in spit 1, and a contrast in the flake:bladelet ratio and core types.

UGENTO

The industry from the original excavation by Cardini was studied by Laplace, and published in the form of a type-list (Laplace 1966b), while the lithics from a second excavation by Segre and Biddittu remain unpublished and unavailable for study. It will be recalled that the industry was found in two adjacent karstic cavities, called Bocca Cesira and Pozzo Zecca, and that the stratigraphic relation between the two deposits has not been established (see Chapter 3). The assemblage from Bocca Cesira has been assigned to the pre-Romanellian phase of the Final Epigravettian (Cardini 1965; Palma di Cesnola *et al.* 1983). The assemblage from Pozzo Zecca is believed to pertain to a more advanced stage of the Final Epigravettian than Bocca Cesira (Cardini 1965; Palma di Cesnola *et al.* 1983), although Laplace (1964b) assigned both assemblages to the beginning of the Final Epigravettian, in accordance with the two ^{14}C dates of $14,170 \pm 170$ and $13,870 \pm 110$ BP from Pozzo Zecca (Alessio *et al.* 1967). Although both localities were excavated by the removal of spits, the Laplace type-list groups the tools into assemblages.

Bocca Cesira: The retouched tools (n.104) are dominated by backed bladelets and linear retouched tools, which account for more than half of the assemblage (Table 6:6). The backed bladelets are predominantly truncated, with pointed and obtuse ended types present in equal proportions. The truncations are for the most part distal, though proximal truncations and bitruncations are present. *Piquant trièdre* truncations and geometric microliths are both absent, but one microburin was found. The obtuse ended backed bladelets have predominantly marginal backing retouch, while that on the pointed backed bladelets is for the most part invasive. There is one pointed shouldered backed bladelet. 16% of the backed bladelets are fragments. The majority of the burins are simple (unmodified). There is a marginal predominance of endscrapers made on short blanks, and circular, nosed and carinated forms are all absent. The linear retouched tools are predominantly made on laminar blanks with marginal retouch. Composite tools include one burin-endscraper and one endscraper-truncation.

Pozzo Zecca: The retouched tools (n.341) are again dominated by backed bladelets and linear retouched tools, accounting for more than half of the assemblage (Table 6:6). Of the backed bladelets, truncated bladelets are again the predominant type, followed by obtuse and then pointed types. The truncations are again predominantly distal, accompanied by proximal and bitruncated types. Two of the backed bladelets have *piquant trièdre* truncations, although no microburins were found. Geometrics are again absent. Shouldered pointed backed bladelets are present, as are shouldered obtuse backed bladelets. The backing retouch is predominantly invasive on both the pointed and the obtuse backed bladelets. 43% of the backed bladelets are fragments. The majority of the endscrapers are made on short blanks, and there is one circular and one nosed form. The burins are for the most part retouched/truncated. Linear retouched tools are made predominantly on laminar blanks with marginal retouch. Composite tools include one burin-endscraper and one endscraper-point.

The two assemblages from Ugento are therefore similar in their assemblage composition, both in terms of tool classes (Figure 6:4), and in the morphological and retouch attributes, except for the greater diversity of endscraper types and the predominance of retouched/truncated burins at Pozzo Zecca. The predominance of invasive backing on obtuse ended backed bladelets compared with a predominance of marginal backing at Bocca Cesira could indicate a decrease in the standardization of blank production. The rate of backed bladelet breakage is significantly higher at Pozzo Zecca.

My analysis of a sample of 39 backed bladelets from Pozzo Zecca (41% of the number recorded by Laplace) provides attribute data which can be compared with that from Grotta delle Cipolliane and Taurisano, although there is no record of which spits in Pozzo Zecca the backed bladelets come from, and therefore they have to be studied together. Fragments account for 21% (n.8) of the backed bladelets, and none of the fragments could be matched. The fragments are either distal (75%), or medial (25%). Of the unbroken bladelets, the lengths range between 1.2 cm and 2.4 cm. The

lateralization of the backing retouch is predominantly sinister (51%), then dexter (49%), and none are bilateral. The morphology of the backed edge is for the most part rectilinear (62%), then curved (38%), and none are shouldered. The direction of the backing retouch is predominantly direct (95%), then bipolar (n.2, 5%), while inverse and alternate backing are both absent. The amplitude of the retouch is predominantly invasive (54%). The morphology of the tip is for the most part obtuse (36%), then pointed (32%) and truncated (32%). There is one bitruncated backed bladelet, and one *piquant trièdre* truncation. The truncations are predominantly distal (75%), and all are direct. Proximal and distal ventral retouch and secondary lateral retouch are absent from the backed bladelets (Figure 6:5).

The attribute analysis disagrees with the Laplace type list (1966b) in the relative predominance of tip morphology and in the absence of shouldered types in this sample, but this could result from the small size of the sample. The backed bladelets are similar to those from Grotta delle Cipolliane and Taurisano, in the predominance of obtuse ended rectilinear types with direct and invasive backing retouch. The absence of certain attributes in the sample from Ugento, such as secondary lateral and ventral retouch, and bilateral backing, may also arise from the small size of the sample. The unbroken backed bladelets are smaller at Ugento than at Taurisano, and the observation that the bladelets at Ugento as a whole are generally less than 4 centimetres in length while the backed bladelets have a maximum length of 3 centimetres (Cardini 1965), suggests a deliberate size selection in the manufacture of backed bladelets. According to Laplace's chronology (1964b), the assemblage from Pozzo Zecca would be contemporary with Taurisano spits 5-1, and would therefore fall within the hiatus between levels 2 and 1 at Grotta delle Cipolliane. According to the chronology favoured by Cardini (1965) and Palma di Cesnola *et al.* (1983), the assemblage from Pozzo Zecca would be contemporary with Taurisano 5-1 and also with Grotta delle Cipolliane level 2.

Data concerning the debitage are scarce. Burin spalls and rejuvenation flakes are reported as being numerous (Cardini 1965). The nine cores which I studied from

Pozzo Zecca are all prismatic bladelet cores, two of them with some cortex, and the sizes range from 1.9 centimetres to 3.8 cm (Figure 6:6). Again, there is no record of which spits they came from.

GROTTA ROMANELLI

The industry present at Grotta Romanelli, the type site of the Romanellian *facies*, is believed to have derived by direct local evolution from the Final Epigravettian at Ugento-Pozzo Zecca (Palma di Cesnola *et al.* 1983). There is however a lack of concordance between the radiocarbon dates (see Chapter 3). A qualitative description of the industry was published by Blanc (1928a), and the material from the same excavation was later restudied by Laplace (1966b) and published in the form of a type-list, where the assemblages from the five levels were grouped into three: levels E-D, level C and levels B-A.

Levels E-D: The retouched tools (n.397) are dominated by endscrapers, backed bladelets and linear retouched tools, which together account for more than half of the assemblage (Table 6:7). The backed bladelets are predominantly truncated, then pointed and obtuse. Two of the backed bladelets have *piquant trièdre* truncations, and there are two geometric microliths (both semilunates) and twelve microburins. The majority of the truncations are distal, though proximal and bitruncations are both present. The backing retouch is exclusively invasive on the pointed backed bladelets, and predominantly invasive on the obtuse ended types. Shouldered types are present but rare. 20% of the backed bladelets are fragments. The majority of the burins are made on retouch/truncation. The endscrapers are predominantly made on short blanks, and circular types are abundant. Nosed and carinated forms are also present. The linear retouched tools are for the most part made on laminar blanks, and as a whole there is more invasive retouch than marginal retouch, although those on flakes have predominantly marginal retouch. The composite tools consist of burin-endscrapers, endscraper-points, and endscraper-truncations.

Level C: The retouched tools (n.701) are again dominated by endscrapers, backed bladelets and linear retouched tools which together make up more than half of the assemblage (Table 6:7). The backed bladelets are predominantly truncated, then pointed, and obtuse. The truncations are predominantly distal, there is an increase in proto geometrics (bitruncations) compared with levels E-D, and proximal truncations are absent. *Piquant trièdre* truncations are abundant (n.27, 44% of the truncated types). There are seven geometric microliths (6 semilunates and 1 scalene triangle), 93 ordinary microburins and one Krukowski. The backing retouch is exclusively invasive on the pointed backed bladelets, and predominantly invasive on the obtuse ended types. Shouldered backed types are present but rare. 25% of the backed bladelets are fragments. The endscrapers are predominantly made on short blanks, but there is no increase in the relative percentage of circular types. Nosed and carinated forms are also present. The majority of the burins are made on retouch/truncation. The linear retouched tools are for the most part made on laminar blanks rather than on flakes, and as a whole the retouch is predominantly invasive, though those on flake blanks have predominantly marginal retouch. Composite tools consist of burin-endscrapers, endscraper-truncations, point-truncations and burin-truncations.

Levels B-A: The retouched tools (n.195) are dominated by endscrapers and backed bladelets, which account for more than half of the assemblage (Table 6:7). Among the backed bladelets there is a change in the relative predominance of tip morphology type, with the greater part being pointed, then truncated, and obtuse. Bitruncations and proximal truncations are absent, and six of the bladelets have *piquant trièdre* truncations. The single geometric microlith is a semilunate, and there are 18 microburins. The backing retouch is exclusively invasive on the pointed backed bladelets, and predominantly invasive on the obtuse ended types. Shouldered types are absent. 14% of the backed bladelets are fragments. The endscrapers are predominantly made on short blanks while long types are rare, and there is an increase in the percentage of circular endscrapers (from 14% to 30%). The majority of the burins are made on retouch/truncation. The linear retouched tools are predominantly made on

laminar blanks, and both laminar and flake types have more invasive than marginal retouch. Abruptly retouched flakes are absent. The composite tools consist of endscraper-burins and one endscraper-truncation.

The assemblage composition in terms of the tool classes is similar in each of the three levels, except for the decrease in linear retouched tools in levels B-A (Figure 6:7). In terms of the morphological and retouch attributes, the only significant changes are the shift to a predominance of pointed backed bladelets and the absence of shouldered types, and the marked increase in circular endscrapers in levels B-A. There is a progressive standardization in the truncated backed bladelets through the levels, which cannot be accounted for by the sample size-effect, and the abundance of *piquant trièdre* truncations in levels C and B-A is notable. The rate of backed bladelet breakage fluctuates from 20% to 25% to 16%. A characteristic feature of the industry from Grotta Romanelli is the abundance of points, which account for 15% of the assemblage in levels E-D, 11% in level C, and 7% in levels B-A (Table 6:7). These percentages are much higher than in the other assemblages that have been discussed so far: between 4% and 7% at Grotta delle Cipolliane (1962); 1% and 2% at Taurisano; and 2% and 3% at Ugento. The sample of twenty points which I studied from Grotta Romanelli have to be considered as a group, as there is no record of which levels they came from. Figure 6:8 shows the variety of morphological forms within this small sample. They are predominantly made on laminar blanks larger than 2.5 centimetres, and the largest is 4.8 centimetres in length. The retouch is for the most part bilateral and invasive, and two examples have foliate retouch. Carinated forms are few, and these are made on both flake and laminar blanks. These points from Grotta Romanelli are therefore similar to those that were described in Chapter 5 from Grotta delle Cipolliane. According to Laplace (1964b) and Palma di Cesnola *et al.* (1983), the phase represented at Grotta Romanelli levels E-A falls within the hiatus between levels 2 and 1 at Grotta delle Cipolliane, while according to Bartolomei *et al.* (1979) it would be contemporary with Grotta delle Cipolliane level 1.

It is interesting to note the size of some of the tools illustrated in G.A.Blanc's (1928a) publication of the industry from Grotta Romanelli. These include a burin of 6 centimetres alongside an endscraper of 1 centimetre in level E; a cortical retouched blade of more than 9 centimetres alongside backed bladelets of 2.5 centimetres in level D; various retouched blades of 8 centimetres alongside triangular geometrics of 1 centimetre in level C; a truncated blade of 7.5 centimetres alongside a semilunate of 1 centimetre in level B; and two blades of 5 centimetres in level A. On the basis of the available data it is not possible to say whether the blade tools were imported, or whether there was a multiple core reduction strategy. The nine cores which I studied at the Maglie museum, which unfortunately had no record as to their levels, are predominantly prismatic bladelet cores. Two of them have small areas of cortex, and the sizes range between 1.5 and 3.5 centimetres (Figure 6:9). Data on the presence of unretouched blanks and rejuvenation flakes are lacking. Of particular interest during my research at the Maglie museum was the discovery of a previously unrecorded truncated obsidian bladelet from level A. The late Palaeolithic occupation of level A is the last vestige of prehistoric activity in the cave, and therefore the bladelet would appear to be *in situ*. The nearest known source of obsidian is the island of Lipari off the north coast of Sicily, which is 340 kilometres south-west of the Salento peninsula.

GROTTA DELLE VENERE

The industries from the Grotta delle Veneri are still unpublished and unavailable for study, and there are no data concerning debitage. In the main cave, the assemblage from level A1 consists of around 30 retouched tools including numerous backed bladelets and an abundant 'substrate' in which retouched blades are predominant. This assemblage has been attributed to the "initial" Ancient Epigravettian (Palma di Cesnola and Bietti 1983). The assemblage from the overlying level A, which has been attributed to the Ancient Epigravettian phase with foliate points, consists of around 50 retouched tools, with endscrapers more numerous than burins, a predominance of long endscrapers over short types, and abundant backed bladelets.

The 'substrate' includes an 'exceptional' proportion of points, including some with foliate retouch (Palma di Cesnola and Bietti 1983).

A lithic industry from the external rockshelter has been attributed to the late Romanellian (Cremonesi 1984). The industry is characterized by an abundance of microlithic endscrapers, including circular and subcircular forms, and an absence of long endscrapers. Burins are rare. Pointed backed bladelets are abundant, and some have bilateral retouch. Truncated backed bladelets are less common, and include some microlithic forms. Geometrics are abundant, and include scalene triangles, some of them with all three edges retouched, semilunates, and isosceles trapezes. Linear retouched tools on flake blanks are more numerous than those on laminar blanks, and points and denticulates are present in low quantities (Cremonesi 1984).

According to the chronostratigraphic scheme of Palma di Cesnola and Bietti (1983), the phase of the Ancient Epigravettian represented in the two assemblages from the main cave at Grotta delle Venere is considerably earlier than that of Grotta delle Cipolliane level 4, while the Romanellian phase represented in the industry from the external rockshelter would fall within the hiatus between levels 2 and 1 at Grotta delle Cipolliane (Palma di Cesnola *et al.* 1983).

GROTTA DEL CAVALLO

The lithic industry from Grotta del Cavallo was initially studied by Palma di Cesnola (1963), who classified the industry as belonging to the 'Romanellian complex'. On the basis of some typological differences compared with the industry from Grotta Romanelli, such as a greater frequency of backed bladelets at Grotta del Cavallo, level BII was considered to be later than anything present at Romanelli itself, and was therefore assigned to the 'late Romanellian', while level BI was assigned to the 'Romanellian-Mesolithic'. The industry was later restudied by Laplace (1964b, 1966b), who assigned the assemblage from level BII to an evolved stage of the Final Epigravettian, while that from level BI was assigned to a terminal stage of the Final Epigravettian. Most recently, Palma di Cesnola *et al.* (1983) have reassigned the whole

complex to the 'Epiromanellian'. Unfortunately there are no radiocarbon dates to help to resolve this confusion. Level BII was excavated into two parts: BIIb and BIIa.

Level BIIb: The retouched tools (n.589) are predominantly backed bladelets and linear retouched tools, which together account for more than half of the assemblage from this level (Table 6:8). Of the backed bladelets, some of which are actually blades, pointed and obtuse ended types are present in equal proportions, followed by truncated types. The truncations are predominantly distal, accompanied by rare proximal and bitruncations. *Piquant trièdre* truncations are absent, and there are two geometric microliths (one semilunate and one scalene triangle) and 2 microburins. The majority of the obtuse ended backed bladelets have marginal backing retouch, while that on the pointed backed bladelets is predominantly invasive. Shouldered backed bladelets are present but rare. 45% of the backed bladelets are fragments. The majority of the burins are made on retouch/truncation, and the endscrapers are predominantly made on short blanks, between 2 and 3 centimetres in length. Circular and subcircular forms are rare, and are smaller than 2 centimetres in length. Nosed and carinated forms are also present. The linear retouched tools are predominantly made on laminar blanks with marginal retouch. The composite tools consist of one burin-point and one burin-endscraper.

Level BIIa: The retouched tools (n.270) are again predominantly backed bladelets and linear retouched tools, which together account for more than half of the assemblage (Table 6:8). Among the backed bladelets, there is a slight predominance of obtuse ended types, then truncated, and pointed. The majority of the obtuse ended backed bladelets have marginal backing retouch, while the majority of the pointed types have invasive backing. Shouldered backed bladelets are still present. The majority of the truncations are distal, while proximal and bitruncations are rare, and one backed bladelet has a *piquant trièdre* truncation. There are two geometric microliths (one semilunate and one trapeze), and 3 microburins. 48% of the backed bladelets are fragments. The burins are predominantly made on retouch/truncation. The vast majority of the endscrapers are made on short blanks, and circular endscrapers are

abundant. Nosed forms are present, while carinated forms are absent. The linear retouched tools are predominantly made on flake blanks, and both flake and laminar forms have predominantly marginal retouch. There is one composite tool, an endscraper-truncation.

Level BI: The retouched tools (n.188) are dominated by backed bladelets, linear retouched tools and endscrapers, which together account for more than half of the assemblage (Table 6:8). The backed bladelets are predominantly obtuse, while truncated and pointed types are present in equal numbers. The backing retouch on both the pointed and the obtuse ended types is predominantly invasive, and there is only one shouldered backed bladelet. The truncations are almost exclusively distal, with the exception of one bitruncated example. *Piquant trièdre* truncations are absent. The geometric microliths consist of one isosceles triangle, one trapeze and two semilunates, and there are two Krukowski microburins. 57% of the backed bladelets are fragments. The majority of the burins are made on retouch/truncation. The endscrapers are predominantly made on short blanks, and circular and subcircular endscrapers are abundant. Nosed and carinated forms are both abundant. The majority of the linear retouched tools are flakes with marginal retouch, and composite tools are absent.

With regard to the tool classes, there is little significant change in assemblage composition apart from the increase in endscrapers and denticulates in level BI (Figure 6:10). There is a progressive increase in the rate of breakage of the backed bladelets through the sequence, from 45% to 48% to 57%. With regard to the morphological and retouch attributes there is also little change. The linear retouched tools see a progressive decline of laminar blanks and an increase of flake blanks, while there is a steady increase in the abundance of circular endscrapers. Obtuse ended backed bladelets are predominant throughout the sequence, followed by pointed and then truncated types, except in level BIIa where there are more truncated than pointed types. The same pattern was observed at Grotta delle Cipolliane, where the reversal in the relative proportions of truncated and pointed types occurs in spits 3I-III. However,

according to the chronology of Laplace (1964b), the phase represented at Grotta del Cavallo in levels BIIb-BIIa falls within the hiatus separating levels 2 and 1 at Grotta delle Cipolliane, while the assemblage from level BI is broadly contemporary with that from Grotta delle Cipolliane level 1. Both Bartolomei *et al.* (1979) and Palma di Cesnola *et al.* (1983) place the entire sequence from Grotta del Cavallo in the post-12,000 BP/Epiromanellian phase of the Final Epigravettian, along with the assemblage from Grotta delle Cipolliane level 1.

There are no data concerning the debitage at Grotta del Cavallo. An interesting feature of the industry is the occasional use of silicified limestone for making large tools, alongside the use of chert (Palma di Cesnola 1963).

GROTTA DI ULUZZO

The industry from Grotta di Uluzzo has been assigned to the Romanellian by Borzatti von Löwenstern (1963, 1964b), and to the Epiromanellian by Palma di Cesnola *et al.* (1983). There are no radiocarbon dates. Assemblage composition in terms of the tool classes varies through the stratigraphy, with a predominance of notches/denticulates and linear retouched tools in level I; backed bladelets and linear retouched tools in level G; backed bladelets and endscrapers in lower level F; endscrapers and notches/denticulates in upper level F; and linear retouched tools and endscrapers in level E (Table 6:9; Figures 6:11-6:12). Retouched tools were absent from level H, and no absolute quantities are available for levels D and C. There is marked continuity through the levels in both the morphological and retouch attributes. The backed bladelets are predominantly pointed and truncated, and bilateral retouch, bipolar backing, partial secondary retouch and proximal ventral retouch are all characteristic. Semilunates and microburins are also present, but *piquant trièdre* truncations are absent. The burins are made on truncation/retouch, and the majority of the endscrapers are circular forms. Linear retouched tools are made on both flake and laminar blanks. According to the chronology favoured by Palma di Cesnola *et al.*

(1983), the industry from Grotta di Uluzzo is broadly contemporary with the assemblage from Grotta delle Cipolliane level 1.

Debitage, comprising cores and unretouched blanks, was also recovered. There is no mention of any rejuvenation flakes, and these may have been incorporated with the unretouched blanks. The percentage of retouched tools (in relation to the total assemblage from each level) ranges between 0% and 13%, compared with a range of between 9% and 25% at Grotta delle Cipolliane. The percentage of cores ranges between 0% and 3%, compared with a range of between 0% and 4% at Grotta delle Cipolliane. Four cores from the Maglie museum are all prismatic bladelet cores, which range between 2 and 2.5 centimetres in their maximum dimension (Figure 6:13), but there is no record of which levels they came from. The assemblage in level C is characterized by the presence of large retouched flake tools made from silicified limestone, one of them a burin, alongside a microlithic industry made from chert.

GROTTA CARLO COSMA (ULUZZO C)

The industry from Grotta Carlo Cosma was initially attributed to the Romanellian (Borzatti von Löwenstern 1965b), and later to the Epiromanellian complex (Palma di Cesnola *et al.* 1983). The retouched tools (n.60) belong to only five tool classes: denticulates, which are the predominant class, endscrapers, linear retouched tools, burins and backed bladelets (Table 6:10). Excluding the denticulate class where laminarity was not recorded, 58% of the tools are made on bladelets, 42% on flake, and blades are absent. The endscrapers are predominantly circular. In addition, there is one bladelet core and 327 unretouched blanks. According to the chronology favoured by Palma di Cesnola *et al.* (1983), the industry from Grotta Carlo Cosma is broadly contemporary with the assemblage from Grotta delle Cipolliane level 1.

GROTTA DELLE PRAZZICHE

The sparse lithic industry from level C has been attributed to the late Romanellian/Epiromanellian (Borzatti von Löwenstern 1969). The retouched tools

(n.58) are predominantly linear retouched tools (Table 6:11). The backed bladelets are truncated and pointed, with unilateral or bilateral backing. There is one bitruncated example, and one double-pointed. Bipolar backing is absent. There is one ordinary microburin, but no geometrics or *piquant trièdre* truncations. Of the endscrapers, only one is circular and the others are subcircular. The single burin, which forms part of a composite burin-endscraper, is made on a retouched/truncated blank. According to Borzatti von Löwenstern's chronology, the industry from Grotta delle Prazziche level C is broadly contemporary with Grotta delle Cipolliane level 1.

The debitage comprises 25 small, irregular flake cores and 310 unretouched flakes and bladelets. There is no mention of any rejuvenation flakes, and these may have been incorporated with the unretouched blanks. The industry is made predominantly on chert and occasionally on silicified limestone.

Finally, there are two further cave sites which deserve a brief mention, although the assemblages are essentially unpublished. In level D of the 'vestibule' at GROTTA ZINZULUSA, a small assemblage of 66 tools was found underlying a level containing Neolithic pottery (A.C.Blanc 1961). The assemblage, which contains backed bladelets, burins, endscrapers, a microburin and an isosceles trapeze, was attributed to the Evolved Epigravettian by Laplace (1964b), while Palma di Cesnola *et al.* (1983) suggest a Final Epigravettian date, on the basis of the presence of a geometric microlith. In a chamber (B) adjacent to the vestibule, a 'hypermicrolithic' assemblage containing geometrics has been attributed to the Epipalaeolithic (Cardini 1961a). Recent excavations at PORTO BADISCO have uncovered an industry which has been attributed to the Final Epigravettian, consisting of microlithic tools made from chert and macrolithic tools made from limestone (Guerri 1984, 1986).

In addition to the assemblages from the cave and rockshelter sites, a number of surface assemblages have been found in the Salento peninsula. A small assemblage from SOLETO was attributed to the Romanellian facies, on the basis of the abundance of numerous polyhedral burins (Cardini 1946). The other tool types present consist of

retouched blades, points, backed bladelets, discoidal and subdiscoidal endscrapers, and burin-endscrapers. One microburin was also found. At TORRE DEL'ALTO in the Uluzzo Bay, a small assemblage of twenty lithics contained backed bladelets, retouched bladelets with bilateral marginal retouch, and a point with marginal retouch. The assemblage has been attributed to the pre-Romanellian, on the basis of the lack of circular endscrapers (Borzatti von Löwenstern 1964c). In addition, small surface assemblages from MONTI RUSSI, near Salve, PUNTA MACALONE, near Ugento, TORRE VADO, and SUPERSANO, have all been attributed to the Epigravettian (Piccinno and Piccinno 1974), but details of their characteristics have not been published.

My own fieldwork recovered an abundance of surface material from the ALIMINI LAKES (Milliken and Skeates 1990). Although the assemblages contain many elements which are typical of the Final Epigravettian, such as carinated circular endscrapers, pointed backed bladelets, *piquant trièdre* backed bladelets and microburins, these elements are also characteristic of the so-called Mesolithic open sites of Torre Testa (Cremonesi 1967, 1978) and San Foca (Ingravallo 1980). In Italy, the distinction between the late Palaeolithic and the Mesolithic is a matter of definition. According to Taschini (1968, 1976), the Mesolithic begins at 11,000 BP, while the alternative view held by Radmilli (1960; *et al.* 1972) and Cremonesi *et al.* (1973) is that the Mesolithic is a period characterized by a shift in the subsistence economy towards the exploitation of small mammals, birds, and molluscs, with no fixed chronology. Neither a chronological nor an economic definition is useful in relation to surface material such as that from Alimini, which naturally lacks radiocarbon dates and faunal remains. The assemblages from San Foca and Torre Testa were attributed to the Mesolithic on the basis of the abundance of geometric microliths at these sites, while at Alimini geometrics are comparatively rare. However, the presence and relative abundance of type fossils such as geometrics is surely dependent on factors such as site function, sampling, and tool curation, and as there appear to be no clear

typological and technological differences between these three assemblages and the Final Epigravettian assemblages which I have already discussed, I will briefly point out their salient features. The assemblage from SAN FOCA consists of a total of 3391 artifacts, the majority of which are small unretouched flakes and bladelets. Small flake and bladelet cores, and core and tool rejuvenation flakes are also present. Among the backed bladelets, obtuse ended types predominate over pointed and truncated types, and bipolar backing retouch is common. *Piquant trièdre* truncations are present, as are geometric microliths (semilunates and trapezes) and microburins. The endscrapers are circular, subcircular and carinated forms, while the burins are described as 'nucleiform' (Ingravallo 1980). The assemblage from TORRE TESTA consists of a total of 26,094 artifacts, the majority of which are small unretouched flakes and bladelets which measure between 0.5 and 2 centimetres. Prismatic and pyramidal bladelet cores and polyhedral flake cores, and core and tool rejuvenation flakes were also found. The backed bladelets are predominantly obtuse ended, then truncated and pointed. The geometric microliths consist of semilunates, isosceles and scalene triangles, and trapezes, and the endscrapers are predominantly circular. An interesting feature is a pit containing a cache of typologically Middle Palaeolithic tools which had been used as raw material by the late Palaeolithic occupants of the site (Punzi 1967, 1968; Cremonesi 1967, 1978). The assemblage from MASSERIA PAIARONE at Alimini consists of 3756 artifacts, the majority of which (81%) are small unretouched flakes and, more rarely, bladelets. Only one blade was found, and one obsidian bladelet. There were no large primary flakes with cortex, and the majority of the unretouched flakes measure between 0.5 and 1 centimetre, which suggests that prepared cores were imported onto the site and then subsequently reduced to make blanks for tools. The majority of the cores (2%) are either fragments or exhausted, which indicates a high degree of core utilization. These features, and the abundance of rejuvenation flakes (5%), seem to reflect the shortage of raw material. The retouched tools (12%) are predominantly endscrapers and backed bladelets. The endscrapers are for the most part circular, subcircular and carinated, and the backed bladelets are mainly

obtuse ended, then pointed and truncated. *Piquant trièdre* truncations, geometric microliths (triangles and trapezes) and microburins are all present (Milliken and Skeates 1990).

In summary, the Salento peninsula presents a large enough number of sites to offer a picture of the nature of the late Palaeolithic industries of the area, although the scarcity of radiocarbon dates means that the majority of them have been dated on the basis of their typology. One characteristic of this sub-region is that there appears to be little significant temporal change in the industries. In terms of tool classes, the majority of the assemblages are dominated by backed bladelets and linear retouched tools, except at Grotta Romanelli and Grotta delle Cipolliane level 1 where the predominant combinations are endscrapers and backed bladelets, and at Grotta di Uluzzo where the assemblage composition fluctuates through a variety of predominant classes. There appears to be no temporal significance in the relative abundance of backed bladelet tip morphology, except in the case of the predominance of truncated types at Ugento Bocca Cesira and Pozzo Zecca, Romanelli E-D and C. On the other hand, the relative increase in the abundance of circular, carinated and nosed endscraper forms is a feature which does seem to have some temporal significance. The evidence for the intentional use of microburin technique for the truncation of backed bladelets and the manufacture of geometric microliths is rather disparate, and I shall return to this point in the discussion at the end of this chapter.

The available data concerning the assemblages with debitage are summarized in Table 6:12, with the sites arranged in approximate chronological order. In order to place these data in a comparative context, control assemblages have been chosen from outside the study area. The rockshelter at Palidoro, in Lazio, contains a lithic industry dating to the Evolved Epigravettian, and has a scarce but local supply of raw material (Bietti 1977). Grotta Polesini, also in Lazio, contains a lithic industry which dates to the Final Epigravettian, and has an abundant local supply of raw material (Radmilli 1974). Considering the large absolute distances involved, the significance of

differences in the relative proximity of the Salento peninsula sites to the raw material sources is likely to be negligible. If the relative degree of curation of an assemblage can be measured using the percentage of retouched tools and rejuvenation flakes, Table 6:12 shows that the assemblages from Taurisano and Grotta delle Cipolliane seem to have been more heavily curated than those from Grotta delle Prazziche, Grotta di Uluzzo, Grotta Carlo Cosma and Alimini, and that the assemblages from all six sites are more heavily curated than those from the external comparative site of Grotta Polesini, where there is abundant local raw material. Looking at the chronology of these Salento peninsula sites, there would seem to be some temporal significance in the relative degree of curation and expediency, although it must be taken into account that the sample provided by the sites studied here is very small, slightly more than a quarter of the sites in the sub-region, and therefore it cannot be assumed that these data are necessarily representative. Other features suggestive of raw material economy, which seem to have some chronological significance are the use of silicified limestone for the manufacture of macrolithic tools at the Epiromanellian sites of Grotta del Cavallo, Grotta delle Prazziche, Porto Badisco and Grotta di Uluzzo, and the raw material cache of collected older artifacts found at Torre Testa.

6:3 THE MURGE

To date there are only five sites with assemblages that have been attributed to the late Palaeolithic. The sites are spread over an area of 2500 square kilometres; three of the sites lie along the coastal zone, while the other two are located inland (see Figure 3:6). The sites are between 90 and 180 kilometres from the chert sources of the Gargano promontory, and between 80 and 120 kilometres from the sources in Basilicata (see Figure 2:3). None of the sites has radiocarbon dates.

GROTTA DELLE MURA

The industry from the original excavations at Grotta delle Mura was studied by Cornaggia Castiglione and Palma di Cesnola (1964), and later by Laplace (1964b,

1966b). The assemblage from level G was attributed to the phase of shouldered backed bladelets of the Ancient Epigravettian (Cornaggia Castiglione and Palma di Cesnola 1964). The assemblage from levels F-D, which were grouped together by Laplace (1966b) and treated as one, was initially attributed to the phase of truncations of the Salentine facies in the Final Tardigravettian (Laplace 1964b), and more recently has been reassigned to the pre-Romanellian phase of the Final Epigravettian (Palma di Cesnola 1987). The assemblage from level C has been attributed to a late stage of the Final Epigravettian (Palma di Cesnola *et al.* 1983). All three assemblages are made on chert from the Gargano promontory (Palma di Cesnola 1987).

Level G: The retouched tools (n.149) are predominantly linear retouched tools and endscrapers (Table 6:13). The assemblage is of a large format, and includes a blade measuring 8.5 centimetres. Obtuse ended backed bladelets are marginally more abundant than pointed types, and truncated backed bladelets are absent. The backing retouch on the pointed backed bladelets is predominantly invasive, while that on the obtuse ended bladelets is predominantly marginal. Shouldered types are present, and 7% of the backed bladelets are fragments. Geometric microliths and microburins are absent. The majority of the burins are made on retouch/truncation, and the majority of the endscrapers are made on long blanks. Circular endscrapers are absent, while nosed and carinated forms are present. There is a slight predominance of linear retouched tools made on flake blanks. The retouch on the flake blanks is for the most part invasive, while that on the laminar blanks is predominantly marginal. The two composite tools consist of a burin-endscraper and an endscraper-point.

Levels F-D: The retouched tools (n.150) are predominantly linear retouched tools and endscrapers (Table 6:13). Pointed backed bladelets predominate over obtuse and truncated types. The pointed backed bladelets all have invasive backing retouch, while the obtuse ended bladelets have exclusively marginal backing. None of the backed bladelets are fragments. Shouldered backed bladelets, *piquant trièdre* truncations, geometric microliths and microburins are all absent. The burins are predominantly made on retouch/truncation, and the majority of the endscrapers are

made on short blanks. Circular forms are absent, while nosed and carinated forms are present. In addition, there are numerous endscrapers made on rejuvenation flakes (endscrapers with lateral escarpment). The linear retouched tools are predominantly made on laminar blanks with marginal retouch. There are three composite tools: two burin-endscrapers and an endscraper-denticulate. The industry has been described as being less laminar and smaller than that in level G (Palma di Cesnola 1987b).

Level C: The retouched tools (circa n.250) from the middle and lower spits of level C are characterized by an abundance of circular endscrapers and microlithic 'thumbnail' types. The backed bladelets, also abundant, include curved and partially backed points and bilaterally backed points. Geometric microliths are absent, while microburins are present. A characteristic feature of the assemblage is the abundance of points made on carinated flakes or blades with invasive retouch, similar to those found at Grotta Romanelli. There are no quantitative data on the assemblage composition. The results of a new excavation which started in 1985-86 are still unpublished, but a preliminary report describes the assemblage of level C as being microlithic, with abundant circular endscrapers and a virtual absence of burins, an abundance of geometrics (triangles retouched on all three sides and semilunates) and backed bladelets (more obtuse ended than pointed). The industry has been attributed to a post-Romanellian/Mesolithic facies (Calattini 1986).

The assemblage composition in terms of the tool classes changes little between levels G and levels F-D, apart from an increase in the endscrapers (Figure 6:14). The main changes in the morphological and retouch attributes are the shift to a predominance of pointed backed bladelets and the introduction of truncated types, and the shift to a predominance of endscrapers made on short blanks and linear retouched tools made on laminar blanks. On the basis of the available data for level C, the main changes seem to be the introduction of circular endscrapers and geometric microliths. There are no data on the debitage.

GROTTA SANTA CROCE

The only data concerning the industry from Grotta Santa Croce is the type-list published by Laplace (1966b). The industry was originally attributed by Laplace (1964b) to the Garganian facies of the Final Tardigravettian (phase of geometrics and denticulates). Subsequently it was reassigned to the post-12,000 BP subphase of the central/southern facies of the Final Epigravettian (Bartolomei *et al.* 1979), and more recently it has been returned to the northern Puglian facies and assigned to the second subphase of the Final Epigravettian (Palma di Cesnola *et al.* 1983). According to Palma di Cesnola (1987), the typology of the industry from Grotta Santa Croce suggests that it falls within the hiatus between levels F-D and level C at Grotta delle Mura.

The retouched tools (n.150) are predominantly endscrapers and linear retouched tools (Table 6:14; Figure 6:14). The backed bladelets are predominantly pointed, then obtuse, while truncated backed bladelets are absent. The backing retouch is for the most part invasive on both the pointed and obtuse ended types, and shouldered backed bladelets are absent. 69% of the backed bladelets are fragments. The geometric microliths consist of two semilunates, a scalene triangle and a rectangle trapeze, and there is one microburin. The majority of the burins are simple (unmodified). The endscrapers are predominantly made on short blanks, and circular, nosed and carinated types are all present. The linear retouched tools are predominantly made on laminar blanks with invasive retouch, and there is one composite tool, an endscraper-point. There are no data on the debitage.

A surface assemblage from MONTICELLO containing 244 retouched tools has been attributed to the Romanellian facies of the Final Epigravettian (Gambassini 1969). The backed bladelets are predominantly obtuse, with truncated and pointed types equally abundant. The backing retouch on the pointed and obtuse ended types is for the most part invasive. Shouldered backed bladelets are present, as are geometric microliths (2 semilunates, 1 isosceles trapeze, 1 rectangular trapeze and 1 rhomboid)

and microburins (n.11). The burins are small, and are predominantly made on retouched/truncated flakes. Some are described as 'nucleiform'. Among the endscrapers there is a complete absence of long types, and circular and carinated types are present. Eight of the endscrapers are made on cortical flakes, and two on *pièces esquillées*. The linear retouched tools are predominantly made on flake blanks with invasive retouch. In addition to the retouched tools, 95 flake and bladelet cores and *pièces esquillées* and an unquantified number of unretouched blanks were found.

Finally, the assemblage from GROTTA SIMONE (also known as GROTTA MACCHIONE) near Conversano, which contains short 'thumbnail' endscrapers and backed bladelets, and that from GROTTA DI CORTO MARTINO near Acquaviva delle Fonti, have both been attributed to the Final Epigravettian (Palma di Cesnola 1987). Details of these assemblages have not been published, and they were unavailable for study.

The characteristics of the late Palaeolithic industries of the Murge are difficult to assess on the basis of so few sites, and the absence of radiocarbon dates means that all the assemblages have been assigned to their respective chronostratigraphic phases by the highly dubious procedure of typological dating. The characteristics which stand out from this data and which might be significant in comparisons with the other sub-regions are the presence of microburin technique for making geometric microliths, and the presence of small circular endscrapers in the Final Epigravettian. As there are no data concerning debitage except at Monticello, which is the site closest to the chert sources in Basilicata (80 km), it is difficult to assess the relative degree of curation or expediency of these few assemblages.

6:4 THE GARGANO PROMONTORY

To date there are only two cave sites and three surface localities with assemblages which have been attributed to the late Palaeolithic. The sites are located

within an area of 1000 square kilometres (see Figure 3:7), and in close proximity to sources of chert. The site of Macchione is located on the *Scaglia rossa* limestone facies, while Foresta Umbra and Macelli are located on the *Rodi Garganico* facies. Grotta Scaloria and Grotta Paglicci lie 8 and 24 kilometres respectively from an outcrop of the *Rodi Gargaico* facies.

GROTTA PAGLICCI

The initial excavation in 1961-63 by Zorzi and Mezzena explored a trench along the north-west wall inside the cave (Figure 6:15). The Epigravettian sequence was divided into two main complexes: a lower one, comprising levels 18-10; and an upper one comprising levels 9-1. Within the two complexes the levels were grouped into a total of ten phases on the basis of certain diagnostic criteria: the burin/endscraper index; the relative abundance of the four tool groups (burins and endscrapers, backed bladelets, foliates and the substrate); the dominant type(s) among each group; and the presence/absence of diagnostic types in each group, such as shouldered backed bladelets and geometrics. The tools were described to the level of the primary type according to the Laplace analytical method, with little data on secondary retouch (Mezzena and Palma di Cesnola 1967).

The industry of the lower complex is made for the most part on long blades, and is described as being of 'classical typology' (Mezzena and Palma di Cesnola 1967). Phase A (level 18) was originally attributed to the typical final Gravettian. Phase B (levels 17-15) consists of a first stage (BI) characterized by 'Solutrean type' leaf-shaped points, followed by a second stage (BII) with a marked development of points, backed blades and shouldered blades. Phase C (levels 14-12) sees a decrease of shouldered types. The lower complex ends with levels 11-10 (Phase D) which is considered to contain tools which infiltrated from the levels above. The lower complex was originally assigned to the Gravettian (Mezzena and Palma di Cesnola 1967), and was later reassigned to various phases of the Ancient Epigravettian: the initial phase

(level 18); the phase with foliate points (level 17); and the phase with shouldered bladelets (levels 16-10) (Palma di Cesnola and Bietti 1983).

The upper complex consists of an industry of 'less classical aspect', a reduction in size and a decline in quality (Palma di Cesnola 1975b). Phase E (levels 9-8) constitutes the transition between the lower and the upper complex, with shouldered backed points still present. Phase F (levels 7-4) is characterized by a considerable increase of endscrapers, and is divided into two stages: FI (levels 7-6) and FII (levels 5-4). The latter is characterized by an abundance of truncations and truncated backed bladelets. Phase G (levels 3-2) sees the appearance of geometric microliths, including semilunates, triangles and trapezes, and an abundance of denticulates. The assemblage from Phase H (level 1) is sparse. The upper complex was originally assigned to the pre-Romanellian phase of the post-Gravettian (Mezzena and Palma di Cesnola 1967), and was later reassigned to the Evolved Epigravettian (levels 9-8) and the Final Epigravettian (levels 7-1) (Palma di Cesnola *et al.* 1983).

The relative proportions of the tool classes from the 1961-63 excavation are presented in Tables 6:15-6:17 and Figures 6:16-6:20. Backed bladelets are the predominant tool class in all levels except level 9, where linear retouched tools predominate. The discussion here will focus on the Final Epigravettian levels 7-4.

The excavation in 1972-73 explored a trench adjacent to that opened in the 1960s (Figure 6:15), and a detailed tool-by-tool description of the assemblage from the Final Epigravettian levels 7-4 was published without comment (Galiberti 1979). This data therefore presents an opportunity for an attribute analysis of the type done for Grotta delle Cipolliane, and the assemblage is of a similar size (Tables 6:18-6:19). Spits 4a-6a and spits 6c-7c were excavated in two separate but adjacent trenches. The ^{14}C dates range between $14,820 \pm 210$ BP (level 7) and $11,950 \pm 190$ BP (spits 4a-4c) (Azzi *et al.* 1977). The industry is made from chert from the *Rodi Garganico* facies, the nearest outcrop of which is located 24 kilometres east of Grotta Paglicci.

Backed bladelets (n.274, 31%) (Tables 6:20-6:21). Of the backed bladelets, 231 (84%) are fragments. None of the fragments could be matched using the data provided on the widths and thicknesses and the attributes of the edge morphology and retouch, which might suggest that the estimation of the minimum number of backed bladelets at Grotta delle Cipolliane was too simplistic. The rate of breakage ranges between 75% and 95%, but there is no linear temporal trend. The fragments are predominantly medial (45%), then proximal (29%) and distal (26%). There is little variation from this norm, except for the predominance of proximal fragments in spits 7c, 5a and 4b. Two of the backed bladelets are longer than 5 centimetres, in spits 7c and 5b, and therefore these should be classified as blades. The backing retouch is predominantly unilateral (97%), and of these sinister and dexter backing are present in roughly equal proportions (48% and 52% respectively). Bilateral bladelets are sporadic. The morphology of the backed edge is predominantly rectilinear (54%) and then curved (46%). Shouldered types are absent. The distal ends are predominantly obtuse (72%), then pointed (18%) and truncated (10%). The proximal ends are also predominantly obtuse (83%), then pointed (10%) and truncated (7%). There are no double pointed and no bitruncated backed bladelets. The truncations are predominantly right-angle (83%) and direct (72%), and inverse truncations are restricted to levels 4 and 5. *Piquant trièdre* truncations are absent. The backing retouch is for the most part direct (78%), then bipolar (16%), inverse (3%) and alternate (3%). The amplitude is predominantly invasive (94%), and only 12% of the bladelets have partial backing. Proximal and distal ventral retouch is present on only 4% of the backed bladelets, and is restricted stratigraphically to spits 6a-4b. Secondary lateral retouch is present on the majority (82%) of the bladelets. The extent of this retouch is for the most part continuous (53%), then partial proximal (31%) and partial distal (16%). The angle of the retouch is predominantly simple (92%), then abrupt (7%), with one flat example in spit 5c. The amplitude of the retouch is mostly marginal (88%), while the direction of

the retouch is predominantly direct (50%), then inverse (30%), alternate (16%), and bifacial (4%).

Linear retouched tools (n.314, 36%) (Table 6:22-6:23). Flake and bladelet blanks are present in roughly equal quantities (40% and 44% respectively), while blades (16%) are absent from spits 6d-c and 4a. The majority of the tools are medium sized (52%), then small (30%) and large (18%). The maximum length is 9 cm. There are no significant temporal variations in the relative proportions of blank types and sizes. The retouch is predominantly unilateral (70%), and the relative proportions of sinister (28%) and dexter (26%) retouch fluctuate through the stratigraphy. 16% are transversal. The cross-section of the blank is predominantly flat (91%). Considering the assemblage as a whole, the morphology of the retouched edges is for the most part curved (54%), though the transversal edges are predominantly rectilinear (80%). Concave edges are absent from spits 7b-6c. Abrupt retouch is comparatively rare (6%), except on the transversal edges (33%). The amplitude of the retouch is predominantly marginal (92%), while the direction of the retouch is mostly direct (69%), then alternate (22%) and inverse (9%). Bifacial retouch is absent. 166 (53%) of the linear retouched tools from Grotta Paglicci 7-4 are fragments, and there are no significant temporal fluctuations in the rate of breakage.

Burins (n.30, 3%) (Tables 6:24-6:25). The burins are predominantly made on flakes (60%), then bladelets (23%) and blades (17%), and there is no temporal variation from this norm. The majority of the burins are medium sized (60%), with small and large burins equally abundant (20% each). Medium sized burins are predominant throughout the stratigraphy with the exception of spit 5b, where the majority are smaller than 2.5 cm. The location of the burin bit is predominantly distal (53%), then double (33%) and proximal (13%). The directions of the facets are for the most part lateral (88%), then transversal (7%) and latero-transversal (5%). Transversal burins are restricted to spits 5a-4b. Of the four manufactural types recorded at Grotta delle Cipolliane, only three are present at Grotta Paglicci: unmodified burins (40%),

burins on transversal break (25%), and burins on retouch (35%). None is truncated. The burins are predominantly simple (unmodified and on break) throughout levels 7-4. The angle of the retouch is for the most part abrupt (57%), then simple (36%) and elevated (7%). The morphology of the burin profile is exclusively angle, with the exception of one proximal axial burin in spit 7c. With regard to the morphology of the facet convergence line, there is a slight predominance of rectilinear (53%) over polygonal (45%), with one proximal sigmoid in spit 7c. The relative predominance of rectilinear and polygonal types fluctuates through the stratigraphy. There are marginally more burins with secondary retouch (57%) than without, and this retouch is predominantly dexter (71%), while bilateral secondary retouch is absent. With the exception of one burin with abrupt retouch in spit 5a, the angle of the retouch is exclusively simple. The amplitude of the retouch is predominantly marginal (76%), and the direction of the retouch is for the most part direct (59%), then inverse (23%) and bifacial (18%). Bifacial retouch is restricted to spits 6a-5a. None of the burins is broken. Scatterplots of the length/width, length/thickness and width/thickness ratios are presented in Figure 6:21.

Endscrapers (n.57, 7%) (Table 6:26). The endscrapers are predominantly made on flakes (82%), and then bladelets (16%), with only one endscraper on a blade in spit 7a. The majority are medium sized (60%), then small (35%) and large (5%). Carinated endscrapers are present only in spits 5a-4b. The majority of the endscrapers are short (88%), with long endscrapers present in low quantities throughout. None is circular. The location of the scraper edge is predominantly distal (82%), then proximal (11%) and double (7%). Double endscrapers are restricted to spits 5c-4b. Nosed endscrapers (16%) are all distal with the exception of one proximal in spit 5c. The majority of the endscrapers have secondary retouch (86%), and this retouch is for the most part unilateral (86%); the lateralization of the retouch is predominantly dexter (51%), then sinister (35%), with no temporal variation from this norm. All the retouch is simple, except for one abrupt example in spit 5b. The amplitude of the retouch is

predominantly marginal (78%), while the direction of the retouch is for the most part direct (71%), then alternate (22%) and inverse (6%). Inverse retouch is restricted to spits 4b-4a. Thirty (53%) of the endscrapers are fragments, but the sample sizes are too small to be able to monitor changes in the rate of breakage through the spits.

Notches (n.35, 4%) (Table 6:27). The notches are predominantly made on flakes (89%), then bladelets (8%), with one on a blade in spit 6a. The size of the blanks is for the most part small (54%). The locations of the notches are dexter (49%), sinister (23%), and distal (28%). The angle of the notch retouch is predominantly simple (86%), marginal (57%), and direct (83%). Invasive notches are restricted to levels 5 and 4. Secondary retouch is present on 71% of the tools, and it is predominantly lateral (60%), then transversal (28%), and bilateral (12%). The retouch is exclusively simple and marginal, except in spit 4b where it is abrupt and invasive. The direction of the retouch is predominantly direct (52%), then alternate (32%) and inverse (16%). Inverse retouch is restricted to spits 5a-4b. Fifteen (43%) of the notches are fragments.

Denticulates (n.19, 2%) (Table 6:28). The denticulates are predominantly made on flakes (63%), and blade forms are absent. The majority (58%) are smaller than 2.5 centimetres. The lateralization of the denticulate retouch is predominantly sinister (53%), then dexter, (21%), transversal (21%) and bilateral (5%). The angle of the denticulate retouch is exclusively simple, with the exception of one abrupt example in spit 5c. The retouch is predominantly marginal (63%) and direct (79%). Inverse retouch is restricted to level 5, while alternate retouch occurs only in spits 6d and 5a. Secondary retouch is present on the majority (63%) of the denticulates. The retouch is exclusively simple and marginal, except for one invasive example in spit 7a. The direction of the secondary retouch is predominantly inverse (42%), then direct (33%) and alternate (25%). Seven (37%) of the denticulates are fragments.

Points (n.21, 2%) (Table 6:29). The points are predominantly made on laminar blanks (85%), with bladelets and blades accounting for 52% and 33% respectively. The size of the blanks is for the most part medium (43%), then large (33%) and small (24%). Carinated points are present only in spit 6d. The retouch is predominantly bilateral (52%), then sinister (29%) and dexter (19%). The angle of the retouch is mostly simple (81%). Flat retouch (9%) is restricted to spits 7c-5c, and abrupt retouch is absent. The amplitude of the retouch is predominantly invasive (48%), then marginal (33%) and total (19%). The direction of the retouch is for the most part direct (76%), then alternate (14%) and inverse (10%). Inverse retouch is restricted to level 5, while alternate retouch is restricted to spits 6a and 5a. Twelve (57%) of the points are fragments.

Truncations (n.78, 9%) (Table 6:30). The truncations are predominantly made on bladelets (50%) and flakes (44%), while blades (6%) are restricted to spits 6a-5b. There is only a marginal predominance of small blanks (50%) over medium (44%), and few large blanks (6%). The location of the truncation is predominantly distal (69%), with no temporal variation from this norm. The angle of the truncation is predominantly right-angle (79%), then oblique (21%), and the morphology of the truncation is for the most part straight (88%). Concave truncations (9%) are particularly abundant in spit 5c, while chevron truncations (3%) are restricted to spits 5b-5a. The truncation retouch is predominantly simple (59%), marginal (62%) and direct (81%). Secondary retouch is present on the majority (83%) of the truncations, and is predominantly simple (96%), marginal (90%) and direct (65%). Inverse (12%) and alternate retouch (22%) are present in most spits, while bifacial retouch (1%) is restricted to spit 4a. Twenty-four (31%) of the truncations are fragments.

Perforators (n.11, 1%) (Tables 6:31-6:32). Perforators are made exclusively on laminar blanks, which are predominantly bladelets (73%). The majority of the perforators are small (45%), with medium and large amounting to 27% each. The

location of the perforator is predominantly distal (64%), except in spits 7c and 5a. The position of the perforator in relation to the axis of the blank is predominantly angle (54%). Three different techniques of manufacture are present: bilateral retouch (45%), retouch/notch (36%) and truncation/retouch (18%). The angle of the truncations are right-angle (50%) and oblique (50%), and both are straight. Retouch is predominantly abrupt (64%), invasive (82%), and direct (91%), with one alternate example in spit 7c. Secondary retouch, which is present on the majority of the perforators (64%), is predominantly simple (86%), marginal (86%), and alternate (57%). Five (45%) of the perforators are fragments.

Composite tools (n.12, 1%) are significantly absent from level 4 (Table 6:33). Composite tools are made on flakes or bladelets in equal quantities (42% each), and on blades only in spits 7b and 5a. They are predominantly medium (75%) or large. None are smaller than 2.5 centimetres. The tool class combinations are endscraper-truncation (42%), burin-endscraper (42%), endscraper-point (8%) and truncation-notch (8%). Only one (8%) composite tool is a fragment.

Geometrics (n.19, 2%) (Tables 6:34-6:35). The geometrics are all made on bladelets, with the exception of one (a rhomboid) in spit 5b which is made on a flake. All are small, apart from one medium sized isosceles trapeze in spit 5a. The geometrics are predominantly semilunates (84%), with one rhomboid in spit 5b, and one trapezoidal segment and one isosceles trapeze in spit 5a. The angle of the retouch is exclusively abrupt, and predominantly invasive except for one (the rhomboid) in spit 5b which has marginal backing. The direction of the retouch is mostly direct (79%), then bipolar (16%) and alternate (5%). There are marginally more geometrics with secondary retouch than without (58%), and its extent is either continuous or partial. The secondary retouch is exclusively simple and marginal. Direct and inverse retouch are equally abundant (45% each), and alternate retouch (9%) is present in spit 5a. Eight (47%) of the geometrics are fragments.

Microburins (n.11) occur in spit 4a (n.5), spit 4b (n.1), spit 5a (n.2, 1 Krukowski), spit 5b (n.1), spit 5c (n.1) and spit 7c (n.1). Of these, nine are proximal, and two from spit 4a are distal.

On the basis of the radiocarbon dates, Palma di Cesnola *et al.* (1983) have suggested the presence of a stratigraphic hiatus between level 5 (13,590±200 BP) and level 4 (11,950±190 BP). Although the relatively small number of spits in levels 7-4 makes it difficult to monitor temporal trends and changes and to interpret their significance, the attribute analysis of the individual tool classes revealed strong continuity between the spits in both the morphological and the retouch attributes. The only significant change occurs within the backed bladelets, where the occurrence of ventral invasive retouch is restricted to spits 6a-4b, and this may be related to a change in hafting technology. With regard to the tool classes (Tables 6:18-6:19), points, perforators and composite tools are all present in level 5 and absent from level 4, but there are no significant proportional shifts other than a relative increase of notches.

The industry from levels 7-4 is predominantly laminar (68%), with the percentage of laminar blanks in each spit ranging between 61% to 83%, and with no linear temporal trend (Table 6:36). When the backed bladelets are excluded from the calculation, the industry is still predominantly laminar (53%), except in spits 7c, 7a-6c and 4b (Table 6:37). Again there is no linear temporal trend, although the percentage of laminar tools in spit 4a is considerably higher than in any other level. Blade tools are absent from spits 6c and 4a, but only in spit 4a is this significant. The majority of the blade tools are linear retouched tools (n.49, 65%), then points (9%), truncations and burins (7% each), perforators (4%), backed bladelets and composite tools (3% each), and notches and endscrapers (1% each). The number of different tool classes in each spit with blade tools ranges between one (spit 6d) and six (spit 6a).

The size of the industry is predominantly small when the backed bladelets are included (49%), except in spits 5b-5a (Table 6:38), and predominantly medium sized

(49%) when the backed bladelets are excluded (Table 6:39), except in spits 7b-6d and 4a. There is no linear temporal trend according to either calculation.

Cortex is present on 183 (21%) of the tools (Table 6:40). The percentage of cortical tools per spit ranges between 7% and 24%, with no linear temporal trend. Cortex is present on 38% of the points, 37% of the linear retouched tools, 30% of the endscrapers, 26% of the burins, 25% of the composite tools, 21% of the denticulates, 20% of the notches, 14% of the truncations and 4% of the backed bladelets. Cortex is absent from the perforators and the geometrics. 55% of the cortical tools are flakes, 34% are bladelets, and 11% are blades (Table 6:41). Cortical flake tools predominate throughout, except in spits 7a-6d, 5b and 4a. Considering the size of the samples from these spits, only in spit 5b is the predominance of cortical laminar tools significant. With the exception of two blades in spit 7a, the cortical blades are restricted to spits 6a-4b. With regard to the size of the cortical tools, 57% are medium sized, 27% are small and 16% large (Table 6:42). Medium sized blanks predominate throughout, except in spit 4b. The size of the unbroken cortical blanks ranges between 1 and 8 centimetres, with no linear temporal trend.

Finally, 57% of all the retouched tools from this sample from levels 7-4 are fragments (Table 6:43). The rate of breakage within the individual spits ranges from 46% to 90%, with no linear temporal trend.

The debitage from the total sample resulting from both excavations of spit 4a comprises six bladelet cores (0.2%), 2002 unretouched flakes and bladelets smaller than 2 centimetres (70%), and 325 unretouched flakes and bladelets larger than 2 centimetres (11%), while retouched tools account for the remaining 18% (Donahue 1986). There are no data concerning the presence or absence of rejuvenation flakes. On the basis of the abundance of tertiary retouched flakes, the presence of bladelet cores and the absence of blade cores, comparatively few primary (cortical) flakes, and yet the presence of many large and well-formed blades among the tools, Donahue (1986) suggests that during the occupation of spit (level) 4a the raw material was

imported onto the site in the form of prepared bladelet cores, prepared blanks, and finished tools.

One of the reasons for such a detailed attribute analysis of this assemblage from Grotta Paglicci was to enable comparisons with Grotta delle Cipolliane. According to the chronostratigraphic scheme of Palma di Cesnola *et al.* (1983), the assemblage from Grotta Paglicci levels 7-4 is broadly contemporary with level 2 at Grotta delle Cipolliane. The assemblage from the 1964 excavation of level 2 is too small to be able to make meaningful comparisons with that from Grotta Paglicci, but as both of the samples analysed showed strong continuity in their morphological and retouch attributes, it is possible to compare the entire sequence from Grotta delle Cipolliane (n.849) with the assemblage from Grotta Paglicci levels 7-4 (n.870), and still expect to get meaningful results. Firstly, there is clear evidence that the microburin technique was used at Grotta Paglicci for the manufacture of geometric microliths, while at Grotta delle Cipolliane geometrics are absent, and the presence of only one microburin and one *piquant trièdre* backed bladelet from level 2 does not constitute sufficient evidence for the intentional use of the technique for the truncation of bladelets. Secondly, there are more laminar tools at Grotta Paglicci, in both the total assemblage (68% compared with 62%) and in the assemblage excluding backed bladelets (53% compared with 40%). A large part of this difference can be accounted for by the fact that the burins, points and perforators are all predominantly made on laminar blanks, compared with a predominance of flake blanks at Grotta delle Cipolliane. Thirdly, the tools are larger at Grotta Paglicci, with a predominance of tools larger than 2.5 centimetres in both the total assemblage (51% compared with 32%), and in the assemblage excluding backed bladelets (64% compared with 41%). The difference in the size of the tools is largely accounted for by the fact that the burins, endscrapers and composite tools at Grotta Paglicci are all predominantly larger than 2.5 centimetres, while at Grotta delle Cipolliane they are all predominantly smaller than 2.5 centimetres. Until a provenance study has been done for the assemblage from

Grotta delle Cipolliane, we cannot directly test the postulate that the differences in size and laminarity result from the effect of different qualities of raw material on the strategies of tool production, which might arise if the hunter-gatherers at Grotta delle Cipolliane were exploiting the chert sources in Basilicata which are nearer than those in the Gargano promontory. However, if this was the case, we would expect the differences in size and laminarity to characterize the whole assemblage from each site. Instead we see that the differences are restricted to certain tool classes, and this requires an alternative explanation. The fact that the burins, endscrapers and composite tools at Grotta Paglicci are the only tools which are significantly larger than those at Grotta delle Cipolliane might result from a more intense rejuvenation of these tools at the latter site, which would suggest different strategies of tool use and maintenance rather than of tool production. On the other hand, the fact that the proportion of blade tools at Grotta Paglicci is significantly higher than at Grotta delle Cipolliane, both in the assemblage as a whole (9% compared with 1%), and in the assemblage excluding backed bladelets (12% compared with 1%), suggests that the differential availability of raw material did have some influence on tool production strategies at the two sites. It is not immediately apparent why the burins, points and perforators at Grotta Paglicci are all predominantly made on laminar blanks rather than on flake blanks as at Grotta delle Cipolliane, but this may relate to functional or stylistic differences. The fact that there is a higher rate of breakage at Grotta Paglicci (57% compared with 33%) is surprising, as one might expect that because of the comparatively local availability of raw material the tools at this site would have been used more expediently than those at Grotta delle Cipolliane. However, the higher rate at Grotta Paglicci is caused primarily by a significantly higher rate of breakage among the backed bladelets (84% compared with 47%), and the other tool classes show a lower rate of breakage compared with those at Grotta delle Cipolliane, with the exception of the burins and the endscrapers where the difference is marginal. It has to be taken into account that the contrast in the rate of backed bladelet breakage could result, at least in part, from differences in the excavation methods and recovery techniques. It may also relate to differences in the

nature of the occupations at the two sites, the activities for which these tools were used, and the opportunities for replacing them. I will return to this point in Chapter 7.

In addition to the technological differences between the two assemblages, there are also a number of typological differences. Shouldered, double pointed and bitruncated backed bladelets are all absent at Grotta Paglicci. Among the linear retouched tools at Grotta Paglicci the morphology of the retouched edge is predominantly curved rather than rectilinear, while the amplitude of the retouch is for the most part marginal rather than invasive. The majority of the burins, endscrapers, notches, and denticulates all have secondary retouch which is predominantly marginal, in contrast to Grotta delle Cipolliane where it is mostly absent but invasive where present. The angles of the truncations at Grotta Paglicci are predominantly simple, rather than exclusively abrupt. Finally, the frequent occurrence of alternate retouch at Grotta Paglicci is in stark contrast with its comparative rarity at Grotta delle Cipolliane. These are the most obvious differences between the two assemblages, but there is no *a priori* reason why they should be attributed exclusively to stylistic factors. Technological differences that can be attributed to the differential influence of raw material constraints are likely to have had some influence on the typology of the artifacts. For example, the predominance of marginal retouch on the linear retouched tools suggests that at Grotta Paglicci blank production was more standardized, and therefore the blanks required less shaping to achieve the desired size and shape. The absence of shouldered, bitruncated and bipointed backed bladelets can all be attributed to chronological factors. Although the attribute analysis of the assemblage at Grotta delle Cipolliane showed that shouldered backed bladelets are not exclusively restricted to the Ancient Epigravettian as is normally assumed, this review of the other assemblages in the region has shown that they tend not to occur in the Final Epigravettian, which could explain the absence of these types at Grotta Paglicci. Bitruncated and bipointed backed bladelets at Grotta delle Cipolliane were restricted to the Evolved Epigravettian, and this could account for their absence from Grotta Paglicci 7-4. The reasons behind the differences in the angle and retouch of the

truncations and in the relative abundance of alternate retouch are not immediately apparent, and they may have some stylistic significance. I will return to discuss this further in Chapter 7.

Surface assemblages from the FORESTA UMBRA (Galiberti 1974) and MACELLI near Vico del Gargano (unpublished) have both been attributed to the Ancient Epigravettian (Palma di Cesnola 1984). The assemblage from the Foresta Umbra (n.1392) consists of unretouched blanks (58%), cores (4%) and retouched tools (38%). The unretouched blanks and the tool blanks are predominantly flakes (63%), blades (30%), and bladelets (7%). The majority (65%) of the blanks are larger than 5 centimetres, and of these 37 (9%) are larger than 10 centimetres. 272 (20%) of the blanks have cortex. The assemblages from the Foresta Umbra and Macelli are believed to be lithic workshops (Palma di Cesnola 1984), and both sites are located on the chert-bearing *Rodi Garganico* limestone facies.

Assemblages from two further localities in the Gargano promontory, GROTTA SCALORIA and MACCHIONE, which are both unpublished, have been attributed to the Final Epigravettian (Palma di Cesnola 1984). The industry from Grotta Scaloria comes from levels which date between $11,040 \pm 190$ BP and $9,030 \pm 120$ BP (Linick 1984). The industry from Macchione, which is a surface site and for which there are no dates, is reported as being 'typologically later' than the end of the Grotta Paglicci sequence (Palma di Cesnola 1984).

The data available for the three surface sites and Grotta Scaloria contributes little to our understanding of the nature of the late Palaeolithic industries of the Gargano promontory. The paucity of sites in this sub-region is partly a function of the nature of the terrain, which is mountainous and densely forested, and this may have inhibited both occupation originally and discovery by archaeologists, but it is likely that there are more sites along the coast which have yet to be found. The Epigravettian sequence at Grotta Paglicci is truncated; the youngest radiocarbon date is $11,440 \pm 180$ BP in level 3a (Azzi *et al.* 1977), and on top of this there is the sparse occupation of

levels 2 and 1. The oldest date from Grotta Scaloria ($11,040 \pm 190$ BP) suggests an occupation that may be contemporary with Grotta Paglicci levels 2-1, and the levels above this ($10,790 \pm 210$ BP to $9,560 \pm 140$ BP) should provide the part of the late Palaeolithic sequence that is missing from Grotta Paglicci. Therefore the results of the excavations at Grotta Scaloria will be very interesting if and when they are published. In the meantime we are restricted to the sequence from Grotta Paglicci, and although its virtually continuous stratigraphy and its abundance of lithics and radiocarbon dates are impressive, there is no *a priori* reason why it should necessarily be considered to be typical of the late Palaeolithic occupation of the Gargano promontory.

6:5 DISCUSSION

The purpose of this chapter was to consider variability in the spatial organization of lithic technology in the south-east Italian late Palaeolithic, on the premise that the different occupations at Grotta delle Cipolliane probably represent only part of the annually mobile settlement system of a group, and therefore other parts of this system should be represented at penecontemporaneous sites in the research area. For synchronic explanations we really need first to control the dimension of time. However, because of the scarcity of radiocarbon dates from these sites, the position of the majority of the assemblages within the various chronostratigraphic schemes has usually been established on the basis of typological dating, and consequently there is the danger of making a circular argument.

It will be recalled that, according to Laplace (1964b), the region of Puglia can be divided into two cultural facies which retain their distinctive identities throughout the Epigravettian: the 'Garganian facies' and the 'Salentine facies', and the Murge was considered to be part of the latter. The schemes of Bartolomei *et al.* (1979) and Palma di Cesnola *et al.* (1983) differ from that of Laplace in the fact that the Murge is considered to be part of the Garganian facies, and in that the cultural differentiation between the two sub-regions started in the Final Epigravettian according to the first

scheme, and in the Evolved Epigravettian according to the second. Within the three chronostratigraphic schemes there is much variability in the diagnostic tool types and indices used for the temporal phasing of sites (see Chapter 1), but they share broadly the same characteristics for differentiating between the two cultural facies: the development of truncated backed bladelets and circular endscrapers in the Salentine; and the development of geometric microliths in the Garganian.

Support for such a parallel-phyla model in the Epigravettian, whereby two separate industrial traditions coexisted in the region, would require sophisticated control of regional systematics and chronology, which at present is lacking. There are only seven sites in Puglia with assemblages which have been attributed to the Ancient Epigravettian, and of these only two have radiocarbon dates. The sample of sites with assemblages that have been attributed to the Evolved Epigravettian is either three or two, depending on whether the ^{14}C date from Taurisano spits 5-1 is accepted or not. The sample of sites with assemblages that have been attributed to the Final Epigravettian is considerably larger, with either 26 or 27 which again depends on the status of the top spits at Taurisano, but only two of these sites have radiocarbon dates, and thirteen of them are surface assemblages whose chronological integrity is therefore dubious. This chapter has also highlighted the variability in the spatial distribution of the sites: twenty in the Salento peninsula, five in the Murge, and five in the Gargano promontory.

The use of geometric microliths and truncated backed bladelets as type fossils for differentiating between the Garganian and the Salentine facies is unsatisfactory, because their presence and relative abundance is surely dependent on factors such as site function, sampling and tool curation. There is more heuristic interest in examining the techniques by which these types were manufactured. Such techniques are part of the general technical tradition of a group, and as such it should be possible to use them as stylistic and chronological markers. In the assemblages discussed in this chapter, there is apparent temporal and spatial variability both in the degree of utilization of the

microburin technique and in the various alternative applications of this technique in the fabrication of tools. In the Evolved Epigravettian sites in the Salento peninsula, the presence of *piquant trièdre* backed bladelets suggests that the microburin technique was used as a means for truncating these tools, while in the Final Epigravettian sites the technique was used for truncating backed bladelets and/or for manufacturing geometric microliths. There are no Evolved Epigravettian assemblages from the Murge, and in the Final Epigravettian there the microburin technique only appears to have been used for making geometrics. At Grotta Paglicci, the technique was used exclusively for making geometric microliths in the Evolved Epigravettian, but the evidence for its use in the Final Epigravettian is ambiguous. While the 1972-73 excavation of levels 7-4 demonstrated the use of the technique for manufacturing geometric microliths but not for the truncation of backed bladelets, the 1961-63 excavation found six *piquant trièdre* backed bladelets in levels 7-4 as well as geometrics. This recalls the point raised in Chapter 5 concerning whether it can be established that *piquant trièdre* facets result from an intentional use of the microburin technique, or whether they occurred accidentally during the application of backing retouch as has been demonstrated by Bordes (1957:582). According to Henry (1974), in order to be confident that the microburin technique was used intentionally, the minimum number of microburins in an assemblage should be 100. The problem with imposing this kind of arbitrary criterion is that it is not met by any of the south-east Italian assemblages, and it excludes all small assemblages in general. The largest number of microburins in any one assemblage occurs in Grotta Romanelli level C (n.94), while in the majority of the other assemblages there are only a few. Considering the quality of recovery techniques at the time when these sites were excavated this is hardly surprising, but it does suggest that the comparatively high number in Romanelli level C may be significant.

An alternative criterion for comparing the use of microburin technique between assemblages is the 'restricted microburin index' (rIMbt), which is computed on the basis of the number of tools fabricated by the microburin technique as a percentage of

the total number of tools, rather than on the number of microburins themselves (Henry 1974). This may be a better source of assistance with the problem of determining whether the microburin technique was intentionally used but, as was discussed in relation to the backed bladelet assemblage at Grotta delle Cipolliane, some of the *piquant trièdre* facets may have been subsequently retouched, making them impossible to recognize, and therefore the use of the technique is likely to be underrepresented. In addition, the value of the index will be dependent on the sample size and tool class composition of the assemblage. This can be demonstrated by comparing Grotta Romanelli level C, where the number of *piquant trièdre* backed bladelets and geometric microliths totals 34 and the restricted microburin index is 4.8, with Grotta Paglicci (1972-73) spit 4a, where the number of geometrics is only 3 but the restricted microburin index is 11.5. Therefore this index is not useful either, and the problem of assessing the degree of utilization of the microburin technique and its various applications cannot be resolved satisfactorily. In summary, it would appear that in the Evolved Epigravettian the use of the microburin technique for the truncation of backed bladelets was restricted to the Salento peninsula, while the use of this technique for making geometric microliths was restricted to the Gargano promontory. In the Final Epigravettian the technique appears to have been used for both applications in both sub-regions. Although this might appear to support a parallel-phyla model for the Evolved Epigravettian, the number of sites on which this is based (n.4) is far too small for us to be confident of its significance. The role that the Murge plays in this is uncertain because Evolved Epigravettian assemblages are absent, and the apparent lack of evidence for the use of the technique for truncating backed bladelets in the Final Epigravettian may not be significant considering the number of sites in this sub-region.

According to the traditional chronostratigraphic schemes, the abundance of circular endscrapers in the Final Epigravettian assemblages of the Salento peninsula is believed to be a clearly defined cultural trait, and in particular they are used as the type fossil for distinguishing the 'Romanellian' industries. I have suggested however that

the diminution in the size of endscrapers and the abundance of circular forms in the Final Epigravettian of the Salento peninsula might be related to raw material economy. Although circular endscrapers are present in the assemblages from the Murge and the Gargano promontory, they are comparatively rare, and the spatial distribution of these forms would therefore appear to indicate a simple-distance decay model operating on the morphology of the endscrapers. However, it has to be noted that circular endscrapers similar to those of the Salento peninsula are also abundant in Liguria, at sites such as Arma dello Stefanin levels V-IV and Arma di Nasino levels XIII-XII, where these types account for up to 26% and 52% respectively of the endscrapers in each level (Palma di Cesnola 1974a, 1974b, 1983), and where local raw material is abundant. The diminution in the size of endscrapers and the appearance of circular forms is also a characteristic of many of the European late Palaeolithic and early Mesolithic industries, such as the Final Magdalenian and Azilian in France and Spain (Rozoy 1980; Demars and Laurent 1989), with no clear indication that shortage of raw material is responsible in every case. Given the unequal numbers of sites in the three sub-regions of Puglia, one could perhaps take the view that, irrespective of raw material supply factors, it is only in the Salento peninsula that there is the development of a final facies of the late Palaeolithic, rich in these endscraper types, that is entirely in accordance with assemblages of the same age elsewhere in Europe. In fact, we have seen that the Epigravettian sequence at Grotta Paglicci is truncated, and that the youngest date ($11,440 \pm 180$ BP) is considerably earlier than the dates from Grotta Romanelli ($10,640 \pm 100$ BP to $9,050 \pm 100$ BP) where these types are most abundant. Better knowledge of the age of the sites in the Murge is crucial, but if the Final Epigravettian industries in the Murge and the Gargano do differ in date from those in the Salento, the notion of parallel phyla need not arise.

The comparison of the attribute analyses of Grotta delle Cipolliane and Grotta Paglicci levels 7-4 did not establish sufficient stylistic differences for us to be able to state with confidence that Grotta Paglicci was *not* part of the same settlement system.

Considering the distance between the two sites, 300 kilometres, I will discuss the likelihood of this in the next chapter. The attribute analysis of the backed bladelets from Taurisano and Ugento and the points from Grotta Romanelli, and the comparison of these tool classes with those from Grotta delle Cipolliane, led to the conclusion that so far as these artifact types are concerned, the assemblages are very similar. The question therefore arises as to whether this may be stylistically and hence socially significant. However, one should perhaps first ask whether we are capable of correctly identifying stylistic attributes at all. Bietti's (1980a) comparative analysis of a sample of shouldered backed bladelets from Taurisano spits 23-6 and Grotta Paglicci levels 17-10 revealed an overall homogeneity of the metrical and morphological attributes, although the shouldered backed bladelets from Grotta Paglicci are slightly larger (between 2.2 and 6.4 cm) than those from Taurisano (between 1.7 and 3.7 cm). On the basis of these results, Bietti concludes that they are samples from the same population which indicates 'cultural unity', and he attributes the difference in size to the influence of raw material availability, rather than to any stylistic/cultural difference. Mussi and Zampetti (1988), who criticise Bietti's argument on theoretical grounds as being a case of mechanical determinism, believe that the metrical differences between the two sites *are* a stylistic trait, because although raw material constraints may have put a limit on the maximum size of backed bladelets at Taurisano, this would not have been the case at Grotta Paglicci. The general validity of Mussi and Zampetti's argument would appear to be supported by the fact that at Ugento, where there were clearly raw material constraints, there seems to have been the deliberate selection of bladelets smaller than 3 centimetres for the production of backed bladelets, even though longer blanks were available. However, one cannot automatically assume that an attribute which has stylistic significance for one group of people necessarily has the same significance for another. Wiessner's (1983) study of stylistic variation among Kalahari San projectile points is interesting in this connection: it revealed that particular types could be correlated with individual linguistic groups, but also that no single attribute consistently carried information about this. Thus the !Kung used size for this

purpose, while the G/Wi and the !Xo used tip and body shape. In !Kung projectile points, while size carries clear information about linguistic group affiliation, other attributes such as tip, body and base shape merely contain individual expression. Therefore particular attributes in a given item can simultaneously carry different social messages. Wiessner's study shows that style was contained in a wide range of attributes on projectile points, including some which would certainly have important functional properties, such as size and tip thickness. Therefore functional factors should not necessarily be excluded from having stylistic significance, although this is often thought to be a prerequisite in the search for stylistic attributes (eg., Close 1977, 1978, 1989; Binford 1989). I will return to discuss this further in Chapter 7.

The process of periodization using abstract typological indices as temporal markers and ethnic identifiers is based on the *a priori* assumption of time as a causal factor explaining diachronic variability, and of culture as the causal factor explaining synchronic variability. There is no doubt that a chronological framework is essential for creating sense and order, but the traditional chronostratigraphic schemes neither adequately describe the range of assemblage variability, nor do they serve to *explain* that variability. The schemes focus on a particular pattern of what is assumed to be general diachronic change, resulting in trichotomies such as Laplace's (1964b) *typical*, *prolonged* and *terminal* subphases of the Ancient Epigravettian. These tell us only about when the change starts, when it is happening, and when it has happened, but there is no sense of connection with the environmental or sociocultural phenomena that produce the changes we are observing. Instead, the analysts seem happy to suppose that the tools evolved of their own accord. I believe that time should be seen as a referent rather than as a causal factor, and in any case, it is one thing to observe a stratified sequence of typology at a single site, and quite another to establish correlations of such sequences from site to site in the absence of good quality chronometric dates.

The analysis of thedebitage from the six sites in the Salento peninsula (see Table 6:12) suggested that there was a change in raw material economy which appears to have some temporal significance. This trend towards relative expediency in the 'Epiromanellian' may be related to changing economic and social strategies, such as a change in the procurement strategy which resulted in increased access to raw material sources. Assemblage composition may also be affected by ecological shifts which alter either the regional pattern of the man-land relationship, or the role of a particular site in terms of the seasonal round or in relationship to local resources. Alternatively, or in addition, raw material availability may be related to social constraints on access, or may have been at least partially achieved through exchange, even over long distances. Explanation for changes in assemblage composition may therefore usefully be sought by examining late glacial economic and social strategies, and this will be done in the next chapter. It has however to be acknowledged that it has not been possible, in the present state of the archaeological and chronological evidence, to link specifically any other Salento lithic assemblages with Grotta delle Cipolliane as being certainly the same product of the same human group. On the other hand, it has not been possible to reject the possibility that sites in the Murge and Gargano may be the product of the same human group as those in the Salento peninsula.

CHAPTER 7

SOCIAL AND ECONOMIC STRATEGIES IN THE SOUTH-EAST ITALIAN LATE PALAEOLITHIC

7:1 INTRODUCTION

The aim of this chapter is to seek explanation for the observed temporal and spatial variability in the south-east Italian late Palaeolithic assemblages, by considering the role of lithic technology in social and economic strategies. *Economy* refers to the way in which a consumer population organizes and manages its raw material and subsistence resources, while *social* refers to the mutual relations within and between consumer populations. The concept of *strategies* can be used to describe in a synthetic way the assemblage of economic and social decisions practised in a given context.

Technology reflects functional needs, and therefore responds to changes in function. These in turn may be the result of changes in the economy and social organization. Technology may be constrained by economic factors; for example, techniques may be adopted that conserve raw material when it is expensive to procure, or that reduce the risk of failing to procure a subsistence resource. Social relations may also restrict or facilitate raw material procurement, and may influence the scheduling of economic activities. Variability in tool-making techniques and the resulting tool morphologies can thus be at least partially understood as a function of the role of stone tools, which is to solve the problems of spatial and temporal differences between the location of lithic raw material and the location of stone tool use, and the functional needs of the task(s) for which the tool is used (Kelly 1988). More broadly, the manufacture of any lithic tool can be said to be the result of a series of technical, economic and social options, the combinations of which can be expressed in terms of strategies.

This chapter considers how the temporal and spatial variability in the assemblages that was highlighted in the preceding two chapters may be related to different raw material economies, subsistence economies, and settlement patterns and social relations. The discussion at the end of the chapter summarizes the main characteristics of the nature of prehistoric human adaptations in the region during the late glacial period.

7:2 RAW MATERIAL ECONOMIES

The concept of the 'economy' of a lithic industry provides a context within which to examine the differential management of lithic resources and products. The economy of a lithic industry has three constituent parts which, though complementary and interrelated, occur in temporal succession: the economy of the raw material, where the strategies identified are interpreted as a function of differential acquisition, quality and intended use; the economy of tool production, which determines differential utilization of products at each technical stage of the *chaîne opératoire*; and the economy of the toolkit, which demonstrates differential management of tools in terms of cycles of utilization, transformation, and rejection (Perlès 1987a). This section of the chapter considers how different strategies of raw material procurement may be responsible for creating some of the observed spatial and temporal variability in the late Palaeolithic assemblages of south-east Italy. According to Nelson (1991), if hunter-gatherers have settled in a non-source area, then it is social, economic and technological decisions which primarily affect tool and core design, and any resultant scarcity of raw material is only secondary in conditioning tool maintenance and recycling. This view contrasts with that of Bamforth (1986), who places the availability of raw material ahead of other conditioners of technological organization. According to Bamforth, maintenance and recycling are closely related to raw material availability, and are not directly or solely related to settlement organization, or to time limits on the activities for which the tools were used. Therefore tools will be maintained and recycled only when raw

material is in short supply, in other words, when it costs more to replace a tool than to rejuvenate it (Bamforth 1986). While both of these arguments are theoretically tenable, multiple factors should be kept in mind when trying to understand variability in prehistoric technology, rather than prime mover models.

Factors influencing strategies of raw material economy can be broadly divided into two types: those directly related to raw material, such as distance and seasonal variations in access; and those reflecting certain settlement or activity circumstances (Rolland 1990). Distance to the source is a measure of the time and effort costs of raw material procurement. Therefore, one would expect the relative cost of raw material provisioning at the sites in the Salento peninsula and the Murge to have been significantly higher than at the sites in the Gargano promontory, and that this will be reflected in the morphologies of the stone tools. A distance-decay relationship is generally recognized in situations in which prehistoric populations inhabited areas distant from raw material sources. Johnson's (1989) distance-decay model is based on decreasing size of artifacts with distance from the source, whereby the progressive decline in the size of artifacts with the increase in distance is essentially viewed as an economising strategy by which a greater number of implements could be made from scarce raw material. The comparison in Chapter 6 of the assemblages from Grotta delle Cipolliane and Grotta Paglicci fails to support the expected distance-decay trend with regard to size. The difference in tool size was found not to characterize the assemblages as a whole, but rather it was restricted to specific tool classes, namely the burins, endscrapers and composite tools, and I suggested that the smaller size of these tools at Grotta delle Cipolliane might result from their curation, while at Grotta Paglicci they may have been used in a relatively more expedient fashion, and therefore less intensively maintained. Analogous situations where the assemblage characteristics failed to support a distance-decay model with regard to size have been found in industries from Natufian sites in Jordan and Late Prehistoric sites in Oklahoma (Henry 1989). The reduction of tools and the relative degree of curation and expediency are

likely to be closely linked to the role of a site within a larger land-use system and the kinds of activities carried out at the site, rather than with distance from the source. An alternative distance-decay model is that of Renfrew (1977:72), according to which there will be a direct inverse relationship between the amount of raw material obtained and used and the distance from its origin, if distance to the source is the only cost of raw material acquisition. Although theoretically tenable, this is difficult to test as all the assemblages discussed in this thesis come from the partial excavation of sites, and therefore their size in relation to what was originally present at each site can never be known.

The distance between the raw material source and a site can be expected to have influenced strategies of raw material transportation. Units of raw material can enter a site in various different stages of reduction, and the weight of the transported raw material, and therefore the cost in terms of energy, will vary accordingly. As the transport costs of cores are high, one would expect the degree of core reduction to be closely linked to distance from the source. A rough measure of the degree of core reduction can be ascertained from the size of the residual cores, or alternatively from their relative frequency on the premise that intense reduction to the point of exhaustion will lead to the loss of their archaeological visibility. Unfortunately, the size of the cores from the sites in the Gargano promontory and the Murge is unknown. With regard to their relative frequency, the percentage of cores at Grotta Paglicci level 4a (0.2%) is considerably *lower* than at the sites in the Salento peninsula for which data are available, and where the range is between 0.2% (at Grotta Carlo Cosma) and 6% (at Grotta delle Prazziche). This would seem to suggest either that cores were being transported to Grotta Paglicci to a lesser degree than they were to the sites in the Salento peninsula, or that they were being more intensively reduced there, neither of which conforms to the expectations of the model. One possible explanation for this apparent ambiguity resides in the fact that if raw material was transported in the form of cores, the spectrum of possible uses of that raw material would have been considerably wider than if the raw material was transported in the form of tool blanks

and finished tools, where the exact uses to which the raw material could be put would have been more circumscribed. This difference in the relative flexibility of transported raw material is likely to have been related to considerations such as the kinds of activities to be performed at and around the sites, and also to the relative availability of opportunities for replacing tools. Tools are the means by which subsistence choices are carried out, and by their presence or absence during a foraging trip they may make some courses of action possible and remove others. Therefore, while the transportation of tool blanks and finished tools to the Salento peninsula would have been least costly in terms of energy, this may have limited the types of prey which could be exploited and therefore increased the possibility of failing to meet dietary requirements. The greater flexibility offered by the transport of cores could thus be seen as part of a strategy of risk reduction. On the other hand, production efficiency would have been increased by advancing the core reduction process closer to the finished tool while still in the source area, as in this way the cost of portaging raw material destined to be lost in production failures would have been reduced or eliminated. The import of a small component of prepared blanks or tools is suggested by the presence of rare blades in the assemblages at Grotta Romanelli, Grotta delle Cipolliane and Grotta del Cavallo. In the Murge, imported blades occur alongside a more microlithic assemblage in level C at Grotta delle Mura, while prepared blanks and tools were also imported in level 4a at Grotta Paglicci. The question of raw material transportation strategies is far too complex to be explored satisfactorily in the absence of data on core refitting, but on the basis of the present evidence, spatial variability does not appear to be exclusively related to distance from the source.

If the costs of raw material procurement were simply a function of the distance from the source to the site, one would expect to see no temporal variability in raw material economy. However, a change in raw material economy *was* observed at Grotta delle Cipolliane, indicated by a more intense reduction of the cores to the point of exhaustion, and a more intense utilization and maintenance of the toolkit. At

Taurisano, the relative increase in retouched tools and the decrease in rejuvenation flakes suggested a change in the strategy of toolkit maintenance to one focusing on resharpening, which is more economical in terms of raw material conservation than maintenance by rejuvenation (Hayden 1989). In addition, the change in the size and type of cores suggested, as at Grotta delle Cipolliane, more intense reduction. At both of these sites the changes can be interpreted in terms of an *increase* in raw material economy, while the trend towards relative expediency that was observed in the Epiromanellian assemblages from the Salento peninsula (see Table 6:12) can be seen as a *decrease*.

Another feature suggestive of raw material economy which seems to have some temporal significance is the use of limestone for the manufacture of macrolithic tools in the Epiromanellian assemblages at Grotta delle Prazziche, Grotta del Cavallo, Grotta di Uluzzo and Porto Badisco. An analogous situation is found in the Iberomaurusian assemblages in northern Africa, where the use of limestone and other non-siliceous rocks in addition to flint can be accounted for by the difficulty of obtaining adequate supplies of flint along the Maghreb littoral. There, the non-siliceous rocks were used for the chopping and scraping component of the toolkit (Lubell *et al.* 1984:149).

In the Salento peninsula in the lower Palaeolithic, all the handaxes are made from local limestone, in contrast to those from the Gargano promontory which are made from local chert. In the Middle Palaeolithic, the industries at Grotta delle Prazziche, Grotta del Cavallo, Grotta Carlo Cosma and Grotta Romanelli are again made from limestone, in contrast to those in the Gargano promontory, such as at Irchio (Mancini and Palma di Cesnola 1958), where the industry is made from chert. In the other Middle Palaeolithic industries of the Salento peninsula, the majority of the tools are made from a combination of local limestone, shell (*Meretrix chione*), and a very small component of chert. At Grotta del Cavallo there is a change in raw material economy through the Early Upper Palaeolithic, from a predominance of limestone accompanied by rare chert in the archaic Uluzzian, to a predominance of chert

accompanied by rare limestone in the late Uluzzian¹. An interesting analogy with the assemblages of the Salento peninsula is provided by Bacho Kiro cave in Bulgaria, where the Upper Palaeolithic industry is made exclusively from imported flint, from sources 100-200 kilometres away in both an eastern and a western direction from the site. Unmodified blocks of flint were absent from all layers, and the low proportion of cores (1% to 4%) in the assemblage indicates the import of ready-made blanks, and also suggests a very intensive utilization of all the cores available (Koslowski 1982:159). This pattern of activity was dictated by the lack of flint deposits or other similar rocks within a 100 km radius from Bacho Kiro. The Upper Palaeolithic raw material strategy contrasts with that of the Middle Palaeolithic levels at the site, where local volcanic rocks make up between 67% and 80% of the chipped stone assemblage (Koslowski 1982:82). Another example of long distance transportation of raw material in the Upper Palaeolithic is the Slovakian radiolarite, which travelled in the form of finished tools over distances of up to 300-350 kilometres from the source (Koslowski and Sachse-Koslowska 1976, 1980).

According to Bahn (1982), the selection of higher quality raw materials was related to the development of late Palaeolithic core reduction strategies to produce microlithic bladelets and complex hafting technologies. The return to a limestone component in the Epiromanellian industries of the Salento peninsula marks a reversal in a long-term trend which requires explanation. Possible reasons for the change in raw material economy that was observed in the assemblages from Taurisano and Grotta delle Cipolliane, and for the relative increase in expediency at the Epiromanellian sites in the Salento peninsula, also need to be explored. One factor which might promote a temporal change in strategies of raw material procurement is that of restricted access to raw material sources, which may have been imposed by both the physical environment and the social environment. With regard to the physical environment, raw material procurement may have been hampered by seasonal variation

¹ See Chapter 1 page 7 for the bibliographic references

in ground water levels and snow cover (Rolland 1981; Hayden and Nelson 1981). The chert sources in the Gargano promontory are located at between 850 and 1000 metres above sea-level, while those in the Basilicata Apennines are located at 1500 metres above sea-level. The lowering of the snow line during continental arid phases, and in particular during the Younger Dryas event (11-10,000 BP) which saw the return to almost full glacial conditions, may have induced a change in the strategy of raw material procurement at sites in the Salento peninsula, such as a shift from exploiting the sources in Basilicata which were nearer but which would have become inaccessible under such conditions, to those in the Gargano promontory. This may have been accompanied by a more intense utilization and maintenance of the toolkit, in order to minimize procurement costs which would have risen with the increase in the distance to a raw material source. However, the increase in raw material economy at both Taurisano and Grotta delle Cipolliane occurs with the passage from a continental arid phase to a more temperate humid one, and snow is therefore unlikely to have restricted access to the raw material sources.

Access to raw material may have changed through time as a result of changes in group mobility and settlement patterns, which may have been prompted indirectly by palaeoclimatic change. Vegetation shifts and animal biomass fluctuations would undoubtedly have affected hunter-gatherer land-use strategies, and these in turn are likely to have affected strategies of raw material procurement, tool use and maintenance. In milder episodes, higher proportions of arboreal vegetation would have resulted in a lower herbivore biomass. Greater mobility may have been necessary in response to these changes, and this in turn may have resulted in more opportunities for raw material procurement, thereby allowing for a more profligate use of lithic raw material. Colder episodes, on the other hand, would have led to an expansion of more open landscape which would have been favourable to an increase in the size of game herds. More intensive settlements would thus have been possible, and the reduction in mobility would have necessitated a more parsimonious use of lithic raw material.

Again, the fact that the increase in raw material economy at Grotta delle Cipolliane and Taurisano coincides with a temperate climatic phase, which therefore should have seen an increase in mobility, does not conform to the expectations of this model. One reason for this may be that the model assumes that an *embedded procurement strategy* (Binford 1979) was in operation, whereby raw material procurement was done in conjunction with subsistence activities, and that the ensemble of economic activities dictated the mobility of the whole group. In a strategy of *direct procurement*, on the other hand, the scheduling of raw material procurement would have been independent of other economic activities, and would have been performed by a specific task-group. Binford (1979) argues on theoretical grounds that hunter-gatherers will rarely make a trip specifically to secure raw material for tool manufacture, although this strategy has been observed in the Central and Western Deserts of Australia (Gould, Koster and Sontz 1971; Gould 1978). One way of minimizing the effort incurred by inconvenient procurement trips would have been to cache raw material at regularly used campsites, but the only evidence for a raw material cache in the late Palaeolithic of south-east Italy is the cache of older artifacts that was found at the Epiromanellian site of Torre Testa. The recycling of older artifacts is a practice that has also been observed among the Nakada of Australia, who gleaned out old implements from archaeological sites and reworked them when they moved to areas where they were unable to find mining places for new stone (Tindale 1974:87).

It is possible that stock-piling of raw material did take place, and the absence of caches from the archaeological record of this region can easily be accounted for by the fact that they would have been exhausted. However, stock-piling can only provide a short-term solution to the problem of raw material availability. Absolute limits on the amount of lithic material that can feasibly be transported, combined with its steady consumption, mean that raw material would have been in regular demand and the caches would have needed to be constantly replenished. Gould (1977) estimated that among the Aborigines of the Western Desert, twenty kilograms of lithic raw material would have been used up per person per year, or approximately forty tools a year.

However, it has to be taken into account that each situation is different, and the number of tools that were needed at any one of the sites in the region will have depended in part on the type and duration of the activities being performed, and the extent to which these activities consumed raw material.

The question of whether raw material procurement strategies in the Salento peninsula were embedded or not depends on the nature of the occupations at these sites, and on their role within a larger settlement system. If the sites in the Salento peninsula represent parts of a settlement system that was restricted in its seasonal mobility to just that part of the region, then direct procurement would have been necessary. If, on the other hand, the settlement system incorporated either the mountains of the Gargano promontory or Basilicata in its seasonal round, then embedded procurement would have been possible. General patterns of residential mobility, scheduling of subsistence resources, and the spatial concordance between raw material sources and subsistence resources are therefore likely to have determined how and when it was practical to procure raw material. This section of the chapter has concentrated on the few sites for which adequate data concerning raw material economy are available, and has served to illustrate how complex the topic is. The next two sections of this chapter will broaden the discussion to include all the sites of the region.

7:2 SUBSISTENCE ECONOMIES

The nature of the subsistence resource base under a given technology is often considered to be a major determinant of assemblage variability. Scarce, unpredictable and dispersed resources result in generalized and opportunistic exploitation patterns, which creates habitation sites with uniform assemblage characteristics but does not create archaeologically visible procurement sites. In contrast, dense, predictable and spatially clumped resources result in the extended occupation of procurement sites and

specialized tool assemblages (Hayden 1986). This section of the chapter examines the evidence concerning subsistence economies in late Palaeolithic south-east Italy, and then considers how technology was adapted to satisfy subsistence choices. Table 7:1 presents a summary of the data to be discussed.

The faunal data available for this period and region are extremely limited. The majority of the site reports record only the presence of a species, and more rarely give either a qualitative indication of its relative abundance, or a percentage. These percentages are based on the number of identified specimens (NISP), which is the number of bones and bone fragments that may be assigned to a species. The use of this index as a measure of relative abundance involves three major problems: it ignores the fact that the skeletons of some species have more parts than the skeletons of others; it overemphasizes a species which reaches a site intact rather than a species which was dismembered before transport; and it is very sensitive to bone fragmentation, which does not necessarily affect all species equally (Grayson 1984; Klein and Cruz-Uribe 1984). The potential role played by carnivores in the accumulation of these faunal assemblages is also unknown, as none of them have been studied for cut marks or signs of bone modification. Carnivores were present in most of the faunal assemblages, consisting of wolf, badger, wild cat, lynx, red fox, pine marten and weasel. The foxes and mustelids may have been hunted by humans for their fur, but otherwise it is likely that the presence of carnivores can be attributed to natural processes of bone accumulation, and therefore they have been excluded from Table 7:1. The lagomorphs (hares and rabbits) and reptiles have also been excluded from Table 7:1, as there is no evidence from any of the sites that they were abundant, and various of the carnivore species could be responsible for their presence in the assemblages.

Which ungulate species dominates any individual level or site could be the result of one or several factors other than hunter-gatherer decision making, planning and hunting strategies. The nature of the physical environment, the nature of the

ecological relationships between the different ungulate species, and the season of the hunting episodes are all potential factors which have to be taken into account (Straus 1987a). A change in the faunal representation within the stratigraphic sequence of a site could reflect a change in the environment, or a shift in the role of the site within a hunter-gatherer settlement system. These factors have to be controlled for before the nature of the fauna can be interpreted as being reflective of selection processes in subsistence economies. The relationship between fauna and climate can be eliminated if the faunal species are found to transcend climatic changes. If the dominant species in the faunal spectrum from a site does not 'match' the local terrain, then one could suggest that this is an indication of deliberate selection, rather than of exploiting what was locally, and therefore most readily, available. Terrain signifies the relative accessibility of a piece of ground to various animal species. Rough terrain is only accessible to ibex and roe deer, while moderate terrain is accessible to ibex, roe deer and red deer. Gentle or flat terrain is accessible to roe deer, red deer, horse, wild ass, aurochs and wild boar (Sturdy and Webley 1988). The nature of the ecological relationships between the different ungulate species can be assessed by investigating the behavioural characteristics of each species, but the season of the hunting episodes is more difficult to establish, as this kind of data is lacking for these faunal assemblages. In Chapter 2, the behavioural and ecological characteristics of the various ungulate species was presented, and in Chapter 3 the microenvironment of each site was reconstructed according to the nature of the climate, topography and terrain, and sea-levels. This information can now be used to see whether the species composition of the faunal assemblages reflects a deliberate strategy of selection in the late Palaeolithic subsistence economies.

Table 7:1 highlights the spatial variability in the composition of the ungulate faunal assemblages. Roe deer is present in the Salento peninsula at sites on the Adriatic coast (Grotta delle Cipolliane, Grotta Romanelli and Grotta delle Prazziche), but is absent from the inland sites (Taurisano and Parabita) and from those on the Ionian

coast (Ugento, Grotta del Cavallo, Grotta di Uluzzo and Grotta Carlo Cosma). There is also variability between the sites on the Adriatic coast, with horse absent at Grotta delle Prazziche and Grotta Romanelli, and present at Grotta delle Cipolliane. Grotta delle Cipolliane sees a progressive expansion of the subsistence base through the stratigraphy, characterized by the addition of new ungulate species rather than by a process of replacement, while Grotta Romanelli sees a reduction between levels C and B-A, with the disappearance of ibex and roe deer. In contrast to the Adriatic coastal sites, the faunal assemblages from the sites on the Ionian coast and the two inland sites are very homogeneous, and the only observable change is the disappearance of wild boar in the top levels at Taurisano. The dominant species at the sites in the Salento peninsula is either *Equus caballus* or *Bos primigenius*, except at Grotta delle Prazziche where *Cervus elaphus* is predominant. Faunal assemblages have been published for only two of the sites in the Murge. At Grotta Santa Croce, only the presence of wild ass was recorded but, considering the nature of the publication of the site, this cannot necessarily be taken as an indication that it was the only species found. At Grotta delle Mura, wild boar is replaced by roe deer in levels F-D, while the faunal spectrum in level C is identical to that of the Ionian coastal sites in the Salento peninsula. The dominant species throughout the stratigraphy is *Bos primigenius*. Finally, Grotta Paglicci is the only site in the Gargano promontory for which faunal data are available, and in Table 7:1 only the species from levels 7-4 have been recorded, as these were the levels that were discussed in most detail in the lithic analysis. The transition between levels 6 and 5 sees the disappearance of horse, and its replacement by roe deer and chamois. The dominant species changes from *Capra ibex* in level 7, to *Sus scrofa* in levels 6-5, and then *Equus asinus hydruntinus* in level 4.

It is necessary to consider whether these changes in the ungulate fauna simply reflect changes in the environment, rather than conscious changes in subsistence economies, and it should now become clear why in Chapters 2 and 3 so much emphasis was put on trying to reconstruct the regional and local palaeoenvironment *independently* of the faunal remains. In fact, the faunal changes which occur all seem

to be in accordance with the climatic reconstruction for the late glacial period. Considering that the present-day habitat of ibex is high alpine meadows, the presence of this species at Grotta Romanelli might at first seem surprising, as the highest altitude in the vicinity of the site is only 128 metres above sea-level. However, it is likely that the present-day distribution of the species is the result of displacement caused by human pressure, and that during the late Pleistocene ibex would have been present at much lower altitudes (Straus 1987b). The presence of chamois in levels 5 and 4 at Grotta Paglicci cannot necessarily be read as an indication that the hunters there were ranging up to the snow-line to procure these animals. As with ibex, it is believed that studies of the ecology and behaviour of modern chamois which stress their adaptation to alpine environments (eg., Corbet 1966; Kurtén 1968) may be misleading when applied to the late glacial period (Miracle and Sturdy 1991). At none of the sites in the region does the faunal spectrum not 'match' the local terrain or the climate that prevailed, and therefore it would appear that, as far as the ungulate component is concerned, the subsistence economies were focused towards exploiting what was locally and therefore most readily available. The relative abundance of the predominant species at some of these sites does however suggest that these economies may have been specialized, and I will return to discuss this shortly.

One site which stands out in its faunal assemblages is Grotta Romanelli, where the bones were recovered of forty-six species of bird, including various species of goose and duck (G.A.Blanc 1961; G.A.Blanc and Blanc 1961a). While the presence of some species, such as the raptorial birds, is almost certainly the result of natural causes, one can only be sure that bird bones actually derive from human activity if they show signs of butchery. Cut marks were observed on the bones of *Pterocles* sp. (sandgrouse), which are also reported as being burnt (Cassoli 1972), but a systematic study oriented towards resolving this problem has yet to be done. One factor which suggests that the geese and ducks were being hunted by humans at Grotta Romanelli is that the bones are predominantly limb elements, especially humeri and femora, while

body and cranial elements are rare. Limb-bones tend to be over-represented in human food debris, whereas with birds that died of natural causes or that were hunted by raptors the natural decomposition factors act in the opposite way, with limb-bones being under-represented (Mourer-Chauviré 1983; Ericson 1987). The majority of the species that are present in the late Pleistocene levels at Grotta Romanelli are today seasonal visitors to the region during the autumn and winter months. While bird bones have been recovered from other sites in the region such as Grotta di Uluzzo and Grotta Santa Croce, the types of species present and their comparative rarity suggests that they were not part of the human subsistence economies at these sites.

The presence or absence of marine molluscs at the late Palaeolithic sites is shown in Table 7:1. Although shellfish did not necessarily play a substantial role in the diet of coastal groups, either in terms of volume or in their nutritional and calorific contribution (Bailey 1975), they represent a food source that would have been available throughout the year, and thus they would have provided an ideal buffer during periods of food shortage. It is also important not to underestimate their potential value in relieving the monotony of a diet. As far as one can tell from the literature, at none of these sites are marine molluscs present in large enough quantities to justify the use of the term 'midden', but this does not necessarily mean that their role within late Palaeolithic subsistence economies in the region was insignificant. Unfortunately, none of the molluscan assemblages from this region have yet been studied with a view to establishing the season of their collection.

Coastal environments present a particularly structured and visible pattern of resource availability. The many species of mollusc are highly varied in their behaviour patterns and accessibility to human predation, and highly specific in terms of their habitat requirements (Bailey and Parkington 1988). As molluscs are subject to zonation within the intertidal zone, they vary in their relative ease of collection. While some species live high in the intertidal zone and are available at all low tides, others are found in the subtidal zone where they are exposed only at extreme low water during

spring tides. Molluscs are also highly varied and quite specific in their requirements for a suitable substrate and conditions of salinity (Bailey and Parkington 1988).

The late glacial sea-level rise, and changes in sea temperature and salinity, would all have influenced the nature of the regional shore and therefore also its resources. In Chapter 3, the changing position of the late glacial shoreline was reconstructed in relation to each site. Combined with the information that was collated concerning molluscan habitats (see Table 2:1), this provides a baseline for establishing which species would have been *potentially* available for human exploitation, independently of archaeological information about the resources *actually* exploited. In this way it should be possible to detect selection processes in shellfish gathering.

The low sea-level of the last glacial maximum is estimated to have lasted from 24,000 BP to 15,000 BP. Such a long period of stability generally leads to well-developed, largely sedimentary coasts (Shackleton 1983, 1988). The region of Puglia would have been fringed by an extensive coastal plain, with the shoreline between 10 and 25 kilometres from the sites on the Adriatic coast, and between 10 and 16 kilometres from the sites on the Ionian coast. There then followed a rapid period of sea-level rise, from 15-11,000 BP, during which the shoreline would only have remained stable for relatively short periods of time. The coasts that form under such conditions tend to be transitory and hence poorly developed (Shackleton 1983, 1988), especially in areas of low sediment supply such as the Salento peninsula, and would probably have been characterized by thin beaches with lagoonal or mudflat deposits. Under these conditions the shore would have had less sand and mud and more exposed hard substrate than coasts that were given more time to develop. Such ephemeral coasts provide limited environmental opportunities for shellfish populations requiring soft substrates, and restrict the time available for the full development of shellfish. This is the likely situation at 11,000 BP, when the distance to the shore is estimated at between 0.5 and 4 kilometres from the sites on the Adriatic coast, and between 5 and 8 kilometres from the sites on the Ionian coast. The halt in sea-level rise

during the Younger Dryas event (11-10,000 BP) would have seen a brief return to more sedimentary coasts.

With only two exceptions, *Monodonta* sp. and *Patella* sp. are the dominant species in each of the molluscan assemblages. *Monodonta* sp. and *Patella* sp. are found high on the shore in shallow water, and would therefore have been the easiest to collect in terms of least effort. Being exposed on the rocks, they have a high visibility, and *Patella* sp. (limpets) live in fixed colonies which would therefore have provided a predictable food source. Considering the depths at which they live, *Dentalium* sp. and *Glycimeris* (*Pectunculus*) sp. were probably collected as empty shells, and while the other molluscan species may have been exploited as a food source, they are present in such low numbers that their role in human subsistence economies must have been insignificant. The first of the exceptions to this general pattern is the molluscan assemblage from levels F and E at Grotta di Uluzzo, where *Murex* sp. is as abundant as *Monodonta* sp. and *Patella* sp.. *Murex* sp. live in the subtidal zone, and their colonies would therefore only have been exposed with the low water levels which occur during spring tides. It is also interesting to note that this species is absent from Grotta Carlo Cosma, and very rare at Grotta del Cavallo, as all three sites are located in the same bay within 500 metres of one another, and are penecontemporary. The other exception to the general pattern is level C at Grotta Romanelli, where *Glycimeris glycimeris* is very abundant. It is unlikely that this species was being harvested live as a food source, as this would have involved diving from boats, and therefore their abundance suggests that they were being systematically collected from the beach.

The presence or absence of marine molluscs at a site gives some indication of the size of the site catchment areas. As Table 7:1 shows, molluscs are absent from levels 4, 3 and 2 at Grotta delle Cipolliane, when the shoreline would have been approximately 10 kilometres distant, and are present in level 1 when the shoreline was 6 kilometres distant. Likewise, at Grotta delle Mura molluscs are absent from levels G-D, when the shoreline is estimated to have been between 13 and 10 kilometres distant,

and are present in level C when the shoreline had moved to only 4 kilometres from the site. Marine molluscs are absent from all sites when the shoreline was more than 6 kilometres distant. This is in accordance with Bailey's (1983) observation that the critical distance thresholds for bulk transportation of molluscs tend to be less than 5 kilometres, and can be as low as 1 kilometre.

With regard to the chronology of the sites with molluscan assemblages, Ugento, Grotta Romanelli and Grotta delle Mura have been attributed to the Romanellian, while the other five sites have been attributed to the Epiromanellian (Palma di Cesnola *et al.* 1983). It could be argued that shellfish did play a role in subsistence economies during earlier periods when the sea-level would have been lower, and that this would have resulted in the processing and consumption of the catch at sites which are now submerged. The presence of marine molluscs at Final Epigravettian coastal sites could therefore simply be a function of the reduced distance to the sea shore which resulted from the sea-level rise. Alternatively, the sea-level rise may have been a powerful environmental force which brought pressure to bear on the pre-existing economies based exclusively on ungulate herds, and thus provided the dynamic for the exploitation of previously neglected resources such as molluscs. The *type* of land lost may have been more important than the areal extent involved, and the now submerged areas could have assumed an importance in the exploitation of resources beyond that of a mere extension of the existing type of territory. For example, it has been suggested that rising sea-levels would have reduced the grazing lands of the coastal plains, and forced herbivore herds either to retreat or to accept major shifts and segmentation of their annual territory (Shackleton 1985; Shackleton and Van Andel 1986). Which of these hypotheses is correct can only really be tested when underwater sites have been found and excavated. However, at Grotta del Cavallo there is no change in the faunal spectrum coincident with the addition of marine molluscs to the subsistence economy, while at Grotta delle Cipolliane and Grotta delle Mura the appearance of shellfish coincides with a diversification in the ungulate fauna. Therefore the drowning of the coastal plains does not seem to have

affected the availability of ungulate species, although the extent to which the productivity of the herds may have been affected, and how this in turn may have affected the size of human groups that could be supported by them, is not known.

With the scarcity of quantitative data on the faunal remains, it is difficult to judge the extent to which these late Palaeolithic subsistence economies can be said to be *specialized*. At Grotta delle Venere, where the percentages are based on the number of identified specimens, *Bos primigenius* accounts for up to 73% of the faunal spectrum, accompanied by *Cervus elaphus* (<17%), *Sus scrofa* (<8%), *Equus caballus* (<5%), and *Equus asinus hydruntinus* (<4%). At Taurisano, *Equus caballus* and *Bos primigenius* together account for between 75% and 94% of the fauna in each spit, while the relative predominance of the two species fluctuates through the stratigraphy in an apparently random fashion. At Grotta delle Mura, the same two species account for between 80% and 100% of the faunal assemblage from levels G-D, where they are present in fairly equal quantities. In the Romanellian level C, *Bos primigenius* alone makes up between 56% and 79%, while *Equus caballus* declines in importance. The last site for which there is quantitative data is Grotta Paglicci, where the difference between the relative percentages of each species is much less marked, and the highest percentage attributed to any one species is *Sus scrofa* (50%) in spit 6a. Despite the problems associated with using the number of identified specimens as a measure of relative abundance, it would seem reasonable to suggest that the subsistence economies practised^{at} Grotta delle Venere, Taurisano and Grotta delle Mura were specialized, while that at Grotta Paglicci levels 7-4 was comparatively diversified. It is surprising therefore that all three of the sites with specialized subsistence economies have relatively open site exploitation territories, which would have been suitable for generalized or eclectic hunting. Other sites, such as Grotta delle Prazziche, Grotta delle Cipolliane, and Grotta Santa Croce are located by gulleys or ravines which may have favoured specialized hunting or herding, but the quality of the faunal data does not allow this to be explored. The location of Grotta Paglicci on an

ecotone, with mountains above and the flat plain of the Tavoliere below, could explain why the subsistence economy there is more diversified.

In terms of tool class composition, the assemblages from the region are spatially fairly homogeneous, and I will discuss this further in the next section. Some temporal change is however apparent, which seems to be related to changes in the subsistence economies. At Grotta del Cavallo, there is an increase of endscrapers and denticulates, and a decrease of backed bladelets and linear retouched tools, which coincides with the appearance of marine molluscs in the subsistence economy, while at both Grotta di Uluzzo and Grotta Carlo Cosma where there is an increase of denticulates. The development of denticulates at these Epiromanellian sites appears to confirm Bietti's (1980b) suggestion that these tools were associated with the exploitation of shellfish.

According to Zvelebil (1986:170), the advantage of using a composite tool with geometric microliths set in wooden or bone hafts, as opposed to a blade technology, is because it is more flexible, easier to repair, and more economical in terms of raw material, and these characteristics would therefore have made it an appropriate technology for use when activities were highly 'time-stressed'. Activities are likely to be highly time-stressed when subsistence economies rely on a limited range of mobile resources, and this results in technological specialization and task efficiency (Torrence 1983). Diversified subsistence economies, on the other hand, do not require or allow specialized tools, since flexibility is the key to survival (Torrence 1983). While in theory technological choices and changes can therefore be understood by reference to their implications for procurement reliability and efficiency, there is in fact no clear correlation between specific toolkits and subsistence economies in the south-east Italian late Palaeolithic. Variation in the tip morphology of the backed bladelets does not appear to correlate with subsistence changes, such as in the type or size of the fauna, while geometric microliths appear to be associated with a whole range of different subsistence resources of varying degrees of mobility. The fact that

geometric microliths are more flexible, easier to repair, and more economical in terms of raw material, may mean that their presence at some sites and their absence from others is more closely related to the general nature of the occupation of a site, and to the scheduling of time between various different types of activities, rather than specifically with subsistence economies.

7:4 SETTLEMENT PATTERNS AND SOCIAL RELATIONS

In south-east Italy, there has been no comprehensive or systematic regional survey to look for late Palaeolithic sites. Research has tended to be localized in certain areas, and in particular has focused on the excavation of caves and rockshelters, and this is largely responsible for the uneven distribution of sites in the region (see Figure 3:1). As a result, one cannot know what percentage of a total settlement system is represented by the sites discussed in this thesis and, more importantly, how representative they are from the point of view of their role within that settlement system. In addition, as was discussed at the beginning of Chapter 6, there is the problem of establishing to what extent any of them can be said to be contemporaneous, either broadly or precisely, and therefore of whether they can be regarded as part of the same settlement strategy. These factors have to be borne in mind in the course of making a hypothetical reconstruction of settlement patterns and social relations.

According to Jochim (1981:151), the *location* of sites can be viewed as the result of a strategy for attaining both economic and social ends. While the distribution of sites represents the arrangement of consumers, producers and technology in relation to the resources exploited, settlement patterns also structure the relationship of people to one another, in terms of competition, cooperation and communication. Settlements also tend to be located in relation to several resources, rather than just one. For example, the Pitjandjara of Australia situate their camps to balance the pulls of standing water, firewood and plant resources (Tindale 1972). Fixed resources such as these are

important to settlement strategies than mobile resources, as they are predictable in time and space and therefore more reliable to procure. In arid environments, water sources are normally the principal foci of base camp placements (eg., Hayden 1978; Lee 1972). Extremely clustered resources will attract population aggregation, and therefore one would expect larger settlements in more heterogeneous environments and smaller, more dispersed settlements in more homogeneous environments (Jochim 1981). Settlement patterns are also likely to shift in response to environmental changes and/or to changes in the subsistence economies.

It is surprising to note that in south-east Italy the number of sites *increases* with increasing distance from the raw material sources. The majority of the sites are located in the Salento peninsula, and are concentrated around the coast. This concentration around the coast may be in part a result of the hydrology of the region, as in karstic landscapes such as this the majority of springs emerge at sea-level, while inland there is virtually no water. The distribution of sites is also likely to be a function of the fact that the majority of caves and rockshelters are distributed along the coastal cliffs, with the exception of a few that are located inland along fault lines. Despite this, the spacing of the cave occupations may still be significant, as there are many caves along the coast that were available and which were not occupied during this period. Certain caves and rockshelters were repeatedly and more or less continuously occupied from the Middle Palaeolithic onwards, such as Grotta Paglicci, and these can be regarded as highly preferred sites. Other sites, which appear to us to be equally suitable for occupation, show only relatively rare or sporadic occupation over a long period of time. For example, at Grotta delle Cipolliane there are no vestiges of human occupation predating the Epigravettian period, very sparse occupation during two continental arid periods (levels 4 and 2), and a hiatus of 1.5-2.5 kyr duration between the occupations of levels 2 and 1. Only in a few cases, such as at Taurisano, Ugento and Grotta Romanelli, can the lack of occupation dating to a particular period be attributed to the fact that the entrance to the cave was blocked by a landslide.

Highly preferred sites may be expected to show features in common with each other, including proximity to subsistence resources and good shelter. One potentially relevant factor is the microclimate of the cave. Legge (1972) considered altitude, orientation and the degree of enclosure to be significant in this respect. Orientation and the degree of enclosure of a cave affects the amount of direct insolation received by a site, or in other words the number of sunlight hours entering the cave. The amount of direct insolation affects the amount of heat that is stored in the bare rock wall, which in turn affects the night-time temperature in the cave. Orientation and the degree of enclosure could therefore be relevant in determining whether the cave was suitable for occupation in winter. However, the extent to which the inhabitants of a cave may have sought to modify the interior and consequently the microclimate in which they lived, by means of structures such as wind-shields, remains unknown. If hearths are found arranged at the rear wall of a cave, this suggests that heat storage and the radiant properties of the rock wall were being used to advantage (Legge 1972). Hearths were found at Grotta delle Cipolliane (levels 4-2), Grotta Romanelli E-D, Grotta di Uluzzo and Grotta Paglicci levels 7-6 and 4, but their exact location within these caves was not recorded. Considering the shape and the orientation of the caves, the amount of direct insolation received at southwest-facing Grotta Paglicci (see Figure 6:15) would be minimal compared with east-facing Grotta delle Cipolliane (see Figure 5:1), which suggests that other factors besides microenvironment are responsible for the differences in occupation history.

Archaeologists tend to view caves and rockshelters as centres of operation in the Palaeolithic. However, Binford's (1978b) comparative ethnographic study revealed that caves tend *not* to be used as residential base camps by contemporary or historically documented hunter-gatherers in temperate or colder latitudes. The role that rockshelters and caves play in the Eskimo system is exclusively as a natural shelter that permits a foraging party to travel without the bulk of a portable shelter, and among the Nunamiut Eskimos routes are therefore planned with respect to known locations of

rockshelters. Eskimo reasons that render caves unsuitable for habitation include damp in winter, their distribution away from fuel, and the fact that they are located in valleys which is also where the best hunting is to be found. According to Eskimo lore, living where one must hunt ensures that the hunt will not be successful. Because the location of certain activities is topographically specialized, the same caves and rockshelters are used repeatedly for essentially the same purpose, that is as a natural shelter for hunting parties exploiting the surrounding area, during specified seasons or for specific game. Binford's observations do not mean that all groups would use these natural facilities in the same way, as clearly there is much variability from region to region in the topographic setting of caves and rockshelters. Similarly, there are gross differences among environments in the relative distribution of critical resources such as fuel, water and food. In environments where water and fuel are widely distributed, natural shelters may assume more general roles in the subsistence settlement system, and such usage is more likely to increase in environments with increasing biomass and decreasing seasonal fluctuation in resource production. Specialized use of caves and rockshelters, on the other hand, will increase in relation to residential use as a function of increasing seasonal variance in the environment. As it gets colder, such shelters are *less* likely to be used for residential purposes (Binford 1978b). For the Nunamiut, the basic distribution of foods and the seasonal behaviour of food animals in their environment is quite predictable. Any change in the basic structure of the environment that results in changes in game distribution and behaviour would be the major factor conditioning change in the use of special-purpose locations.

These observations may explain the contrast in the intensity of occupation at Grotta delle Cipolliane. The relative intensity of the occupation of a site can be assessed according to the density of lithics, which is measured by the number of lithics (by quantity or weight) in relation to an independent variable (volume of sediments or time). Ideally, weight would be a better indicator of density than quantity, because many small flakes or many broken flakes would appear to give a higher density than the same weight of larger or unbroken flakes, but such data are unavailable. There are

also problems with the independent variables of sediment volume and time. Different types of sediment have different granulometries and rates of deposition, while the absence or unreliability of radiocarbon dates makes it difficult to measure time accurately. The calculation of lithic density at Grotta delle Cipolliane is based on data from the 1962 excavations, and is expressed as the quantity of lithics per cubic metre of sediment: 134/m³ (level 4), 900/m³ (level 3), 54/m³ (level 2), and 460/m³ (level 1). Levels 4 and 2 represent continental arid phases, while levels 3 and 1 represent more temperate, humid climates. There would therefore appear to be a strong correlation between the intensity of occupation at Grotta delle Cipolliane, and the climate that prevailed. Unfortunately, the majority of the site-reports of the late Palaeolithic sites in the region do not record the size of the surface area of the excavation, which is necessary for calculating the volume of the sediment. In fact, the only other site where the intensity of occupation can be assessed is at Grotta del Cavallo, where the lithic density declines progressively from 555 lithics/m³ (level BIIb), to 222/m³ (level BIIa) and finally 111/m³ (level BI). These densities are very low when compared with other contemporary sites in the Mediterranean: 1200/m³ at Franchthi (Perlès 1987b); between 1994/m³ and 6720/m³ at Asprochaliko, and 8874/m³ at Kastritsa (Bailey *et al.* 1983); and between 3000/m³ and 6000/m³ at various Magdalenian sites in northern Spain (Straus 1983). At Grotta Polesini in Lazio, the quantity of lithics in one spit ranges between 6000 and 60,000 (Radmilli 1974), giving an average of 3828/m³. There is no *a priori* reason to assume that Grotta delle Cipolliane and Grotta del Cavallo are necessarily typical of the intensity of the occupation of the region as a whole, although the size of the assemblages discussed in Chapter 6, which range between 33 lithics in Grotta di Uluzzo level E, and 1248 lithics in Grotta Paglicci level 4 (1961-63), do seem to be very small. In contrast, the assemblages from the open sites of San Foca and Torre Testa are comparatively large, with 3391 lithics at the first site and 26,094 lithics at the second. However, as these are surface assemblages there is the problem that they could be huge palimpsests representing centuries, if not millennia, of occupation.

Critical resources in the form of food, water, shelter and raw materials are rarely aggregated and clustered in such a way as to enable the procurement of all these things in one spot. *Mobility* is a settlement strategy which solves the problems of the spatial and temporal differences between resources, by redistributing people in the environment (Hayden 1978; Kelly 1983). Binford's (1978a, 1978b, 1979, 1980, 1982) model of hunter-gatherer mobility recognizes two distinct forms of mobility: *residential mobility*, whereby small groups of producers and consumers move as a unit throughout the seasonal round; and *logistical mobility*, in which consumers remain at a more or less permanent base camp for several seasons, while small groups of producers procure distant resources and bring them back to the consumers. For example, in late Palaeolithic central Italy the hunters developed mobile and specialized economies focused on two seasonally migrant species, red deer and steppe horse, and followed the herds in their seasonal migrations up into highland areas in the summer, and down into lowland areas in winter (Barker 1981). This kind of settlement strategy would therefore be described as residentially mobile.

A residential mobility settlement pattern is composed of a series of residential camps occupied by a microband for a short period of time only, and for the express purpose of exploiting the vicinity. A logistical mobility settlement pattern, on the other hand, is composed of a base camp as well as field camps which are often associated with special activities. *Base camps*, or residential sites, are the locus of mixed sex maintenance and habitation activities, and should therefore contain large and heterogeneous assemblages. *Field camps*, on the other hand, are special purpose, short-term, single sex occupations, and therefore one should expect smaller and more homogeneous assemblages. The differences in settlement strategy are also likely to result in different tool production and maintenance strategies. According to Binford's model, most tool production takes place in base camps of prolonged occupation, or at factory sites related to quarries. In field camps such as hunting stands, on the other hand, lithic production activity is limited to the maintenance and repair of armatures.

Mobility also places constraints upon technology by imposing carrying costs (Torrence 1983). As the gross number of tools which can be transported is ultimately limited, the degree of specialization of the toolkit is also limited, and therefore highly mobile groups can be expected to have small toolkits composed of versatile and flexible tools which are not function-specific. Thus assemblage diversity, or the number of different tools, will decline as mobility increases either in terms of frequency or magnitude (Gibson 1984; Shott 1986). Mobility may also impose other design criteria on the tools, such as size and weight (Ebert 1979; Keeley 1982). This relationship between mobility, tool design and the size of technological inventories has been documented ethnographically among the !Kung San of southern Africa, where tools are few in number, and are designed to be multipurpose and lightweight (Lee 1979:119). Therefore, residually mobile groups would be expected to have a smaller, lighter, and more homogeneous and versatile toolkit than a logistically mobile group.

Problems are encountered when moving from behavioural, or ethnographic, contexts to archaeological contexts. Unknown variables, such as the possibility that sites were reoccupied for a different purpose, and the stratigraphic mixing of more than one discrete behavioural assemblage into a single archaeological assemblage, raise the question of whether it is realistic to try to identify site type at all. Because of the sample size-effect, larger assemblages will contain greater diversity, while smaller assemblages will appear more homogeneous (Thomas 1983). In addition, there is no *a priori* reason to assume the presence of activity areas and functionally specific tool kits in a site. The activity model, which was introduced by Binford and Binford (1966) to explain the nature of Mousterian assemblage variability, conceives of activities as functionally, spatially and temporally discrete, and involving the use of a few task-specific tools. This assumption that the functional and spatial dimensions of tool technology overlap, such that artifacts which are found together must have been used together, is unfounded. Artifact co-occurrence may have as much to do with stochastic processes, such as dropping, breakage, loss, as by the performance of specific

assemblages (Ammerman and Feldman 1974). In fact, a multitude of factors and processes may affect artifact class co-occurrence as it is revealed in the archaeological record, and specific human activities need not be among them. According to Binford's (1981) "Pompeii Premise", assemblages formed by the sudden loss or abandonment of tools are representative of the systemic frequency of various tool classes. However, such assemblages are rare. Most assemblages, even those from brief occupations, are the product of several formation processes rather than a single one. Assemblages do not represent a single technological strategy, but are likely to be composed of tools representing several strategies. These may have been deposited at one time by a single individual or group, or may be the result of several separate but indistinguishable episodes. Yellen's (1977) description of !Kung artifact production, whereby the production of tools is not limited in time and place, but carried out at all base camps, has important implications for interpreting site type.

Despite all these problems, it is still worthwhile to attempt a tentative reconstruction of late Palaeolithic settlement patterns in south-east Italy. Starting with site types, level 4a at Grotta Paglicci has been interpreted as a winter hunting stand (Donahue 1985, 1986, 1988). The season of occupation was suggested on the basis of the microwear analysis, which revealed the presence of hide working and the absence of antler or plant processing, while the interpretation as a hunting stand was made on the basis of the site's location, the small size of the occupation area, the composition of the lithic assemblage, and the scarcity of long bones, which are richest in meat. Although this supports Barker's (1975, 1981) idea of seasonal transhumance following migratory herds between the highlands in summer and the lowlands in winter, the implication is that Grotta Paglicci is a specialized site rather than a residential site, and therefore that the settlement system of which it forms a part was logistically rather than residentially mobile (Donahue 1985, 1986, 1988). According to Palma di Cesnola (1984), the assemblages from Macelli and Foresta Umbra in the Gargano promontory are both lithic workshops, which would make sense considering that they are both located on the chert-bearing *Rodi Garganico* facies. The high

proportion of teeth compared with other bones at Taurisano suggests that this may be a kill site.

Beyond this, the identification of site type becomes more difficult. The faunal data is of too poor quality to be able to identify factors such as seasonality, or even to allow for the distinction to be made between, for example, kill and butchery sites. In terms of tool class composition, the south-east Italian assemblages are fairly homogeneous, both in time and in space. At Grotta delle Cipolliane and Grotta Romanelli, the toolkits are dominated by endscrapers and backed bladelets, while at the vast majority of the other sites in the Salento peninsula the toolkits are dominated by backed bladelets and linear retouched tools. In the Murge, the assemblages from both Grotta delle Mura and Grotta Santa Croce are dominated by linear retouched tools and endscrapers, while the assemblage composition at Grotta Paglicci is similar to that of the majority of the Salento sites, with backed bladelets and linear retouched tools dominant. This homogeneity would seem to suggest that there is no great difference between the sites in terms of the activities that were being performed. While the sites in the Murge would appear to represent a distinct group, simple form and function correlations are extremely unsatisfactory, and the validity of this distinction, and indeed of the apparent homogeneity of the other sites, can only be resolved using microwear analysis.

According to Binford's model, if the sites are part of residentially mobile settlement strategies, then there should be no base camp or limited activity site distinction, while if the sites are part of logistically mobile settlement strategies, then base camps and limited activity sites should be recognizable by their distinctive faunal and lithic components. It is not possible on the basis of the available data to be confident which, if any, of the two models applies here, but the theoretical likelihood of each can be discussed. Firstly, the duration of the occupations of these sites is difficult to estimate precisely. While the range of activities apparently represented in the assemblages in the Murge and in the Salento peninsula argues for more than a fleeting visit to the majority of these sites, the lack of both raw material and water is

likely to have precluded year-round occupation. The size of the assemblages also suggests that none of these are 'residential sites'. It was suggested in Chapter 2 that the Adriatic coastal plain before 15,000 BP may have been sufficiently productive to support semi-sedentary hunting bands throughout the year, without necessitating summer forays into high country. If this was so, then the sites in the Salento peninsula and the Murge may represent the field camps of *logistically* mobile settlement strategies, where the residential sites located on the coastal plain would have been submerged by the sea-level rise. In such a settlement system, direct procurement strategies of raw material provisioning would have been necessary. The drowning of the residential sites on the Adriatic coastal plain would not have necessitated a change in the settlement system, but simply a spatial shift, and the large surface assemblages at San Foca and Torre Testa, and the abundance of sites around the Alimini lakes, may represent the new residential sites.

The residential site of the settlement system of which Grotta Paglicci forms a part may well have been located on the Tavoliere, which is now covered by thick deposits of Holocene alluvium. The Tavoliere would have been well watered by springs and rivers, and it is likely to have been able to support dense populations of both herbivores and humans during the late glacial period. In such a settlement system, raw material procurement could easily have been embedded in subsistence forays into the mountains of the Gargano promontory.

If the raw material procurement strategies of the sites in the Salento peninsula and the Murge were direct rather than embedded, according to the model outlined above, then this would have necessitated the maintenance of long-distance social relations with groups living in the source area(s). In the analysis of spatial and temporal variability in lithic artifacts, it is commonly assumed or implied that prehistoric populations of hunter-gatherers lived in spatially discrete and isolated units, forming tightly bounded social, economic and cultural entities. The analysis of the lithic assemblages in Chapter 6 failed to find much evidence either for spatial or

temporal discreteness. It is more likely that the occupation residues at these sites represent a network of loosely defined social groups and communities linked by a variety of social relationships, and that these extended over vast areas. While some of these social relationships would have been clearly economic in nature, such as those conditioning raw material procurement, others are likely to have been organized in accordance with less overtly economic factors, such as the acquisition of mating partners. By focusing on strategies of settlement organization oriented around economic activities, Binford's approach to hunter-gatherer settlement systems overlooks the importance of considering the social environment. Although there is certainly a strong association between resource procurement strategies and settlement mobility, the redistribution of personnel may also have been a social strategy in order to facilitate communication, and therefore help to avoid risks and reduce stress. Although ecological relations may be *determinant*, the social relations must be viewed as ultimately *dominant* (Ingold 1980, 1981) in specifying how an environment was exploited.

Organizational variation in the late Palaeolithic of south-east Italy should thus be seen to be the result of both organization around resources *and* organization around other persons in social relations of production. Long-distance social relations are well documented in the ethnographic record. For example, the circulation of both goods and personnel in Australia created 'chains of connection' (Mulvaney 1976) stretching over distances of more than 800 kilometres, which Gould (1980) interprets as indicators of regional insurance policies, where the exchange of items promotes interaction and facilitates the movement of personnel in times of crisis. In this context, it is interesting to mention again the obsidian bladelet from Grotta Romanelli, which probably comes a distance of 340 kilometres from the island of Lipari.

Due to the constraints of time, this discussion of settlement patterns and social relations has been very brief and restricted in its scope, and has essentially been concerned with how strategies of land-use may have affected raw material

procurement. The rich and varied nature of the archaeological record from the late Palaeolithic of this region, which includes parietal art, mobile art, burials, and ornaments, provides an invaluable opportunity for exploring in depth the nature of social relations during the late glacial period, and it is with regret that discussion of these cannot be included here.

7:5 DISCUSSION

This thesis has tried to stress the importance of considering the ways in which local conditions mediate the effects of global aspects of human adaptations. Different strategies of tool production, use and maintenance were recognized in the south-east Italian late Palaeolithic assemblages, and three important factors operating at a regional scale have been identified as contributing to the structure of the observed assemblage variability: the availability of raw material, and the alternative strategies by which it was procured; the particular activities in which the tools were made and used; and the role of the sites within a settlement system. The thesis has also demonstrated how assemblage variability is likely to arise from the interaction between *multiple* causal factors as conditioners of technology, and consequently it was not always possible to attribute a specific phenomenon to a specific cause. The common focus on single conditioners of technology, such as either raw material availability (Bamforth 1986), or time stress (Torrence 1983), or risk reduction (Bleed 1986), or mobility (Shott 1986; Parry and Kelly 1987), therefore artificially reduces the complexity of human behaviour, and glosses the problem of translating globally defined adaptive patterns into a concrete set of local conditions under which tools were made and used.

The analysis of the lithic assemblages failed to find support for the traditional parallel-phyla model in the Epigravettian, whereby two separate industrial types coexisted in the region. The brief discussion of late glacial settlement patterns and social relations served to illustrate that it is in fact unlikely that such a closed social

system existed. Instead, groups were probably linked by a variety of social and economic relationships which extended over large areas. Stone tools are not a good means of access to past social groupings, as it is unlikely that artisans would even have bothered to deliberately invest style in the majority of them. The fact is often overlooked that the tools from these assemblages are probably the durable parts of multicomponent tools that were originally mounted in perishable hafts. This is especially likely for tools such as the backed bladelets and geometric microliths, and it was suggested that some of the endscraper forms would also have needed to be hafted. More suitable vehicles for symbolic expression would have been available in other aspects of the material culture repertoire, such as clothing, body markings, ornamentation, and art, and if deliberate style *was* invested in weapons and implements, it would probably have been confined to the hafts or handles. The thesis also demonstrated that the existing typological approach masks rather than reveals sociocultural information, and that the traditional chronostratigraphic schemes, whereby industries are seen to evolve on their own accord through different phases of an Epigravettian tradition, does not adequately explain the observed temporal variability.

This last chapter in particular has been hampered by the inadequacies of the regional late Palaeolithic data base, and has highlighted those areas which need to be developed in order to improve the quality of that data and the interpretations that can be made from it. Future work should concentrate on better quantification of the faunal assemblages and on the analysis of cut marks, and should be oriented towards establishing the seasonality of exploitation. Microwear analyses are needed of tools from a much larger sample of sites, and refitting of the cores. For these, and for the fauna, new and systematic excavations are vital. The provenience of the lithic raw material from the Salento peninsula and the Murge needs to be established, and experiments conducted to compare the flaking qualities of chert from the Basilicata Apennines with that from the Gargano promontory. My own fieldwork around the

Alimini lakes was oriented towards gaining a better understanding of the nature of open site settlement in the region, and much more survey is needed to find other sites, and to reduce the current cave bias. Of paramount importance is the need to refine the chronology of the late glacial regional sequence by means of good quality radiocarbon dates, in order to provide a stable framework within which to operate. In the absence of all these things, the interpretations made in this thesis have of necessity been at a fairly general level, and tentative. However, the alternative theoretical and methodological approach used here has provided fresh insight into diachronic change and synchronic variability in the assemblages of the south-east Italian late Palaeolithic, and has revealed ways in which that variability can be not only observed, but also explained.

CHAPTER 8

CONCLUSIONS

This chapter presents a brief summary of the main conclusions of this thesis.

Chapter 1 provided the historical background of previous research into the south-east Italian late Palaeolithic, and assessed the state of current theoretical approaches in Italian Palaeolithic studies. The late Palaeolithic assemblages have been studied previously by Italian archaeologists from a rigid typological stance, with various schemes put forward suggesting typological evolution of the assemblages through various stages of an Epigravettian tradition. A critical review of this provided the context within which the aims and theoretical methodology of this thesis were introduced. The aims of the thesis were to explore the traditional interpretations of the south-east Italian late Palaeolithic assemblages, to identify diachronic change and synchronic variability in these assemblages by means of an alternative theoretical and methodological approach, and to seek explanation for that variability in terms of social and economic strategies.

Chapter 2 presented a reconstruction of the regional palaeoenvironment, and examined the nature of the late glacial environmental changes. The identification of key environmental variables, such as the location of raw material sources, the location of water, and the spatial and temporal distribution of food resources in relation to changing littoral and terrestrial habitats, was considered to be an important preliminary to understanding regional lithic assemblage variability. Particular emphasis was placed on the former existence of an extensive coastal plain, and to the sea-level rise which submerged it.

Chapter 3 introduced the sites in south-east Italy with assemblages that have been attributed to the Epigravettian period, and described their locations, their

stratigraphies, and their relative and absolute chronologies. Reconstructions of the relationship of each site to the changing late glacial shoreline were proposed. The microenvironment of each site was reconstructed using the nature of the sediments as an indicator of the climate that prevailed during their deposition, and an attempt was then made to correlate the sites with one another according to the stratigraphic correlation of their sediments. It was proposed that the volcanic sediments which occur at some of the sites could be tentatively correlated with dated volcanic eruptions, and this method was used to provide limiting dates for the previously undated assemblages at Grotta delle Mura and the sites in the Baia di Uluzzo.

Chapter 4 presented a detailed and critical review of the Laplace analytical typology, and described the methodology of the attribute analysis and the terminology used in this thesis.

Chapter 5 presented a reanalysis of the lithic industry from Grotta delle Cipolliane. The reanalysis was aimed at identifying temporal variability within the assemblage sequence that might be accounted for in terms of functional or stylistic factors, or in terms of changing strategies of raw material economy. The reanalysis revealed that, though some temporal variability is apparent, the retouched tool sequence from Grotta delle Cipolliane is characterized by strong continuity, which suggested that there was no change in the technical tradition. In addition, the majority of the traditional type fossils were shown not to be as temporally diagnostic as is normally assumed. The discussion considered the evidence for technological strategies of tool production, and how these were influenced by raw material constraints. An increase in raw material economy was identified, which suggested that the costs of raw material procurement were not simply a function of distance from the source.

Chapter 6 presented a review of the Epigravettian assemblages in south-east Italy, and considered the spatial organization of lithic technology and how it varies temporally. The analysis of these assemblages failed to find support for the traditional

parallel-phyla model of the Epigravettian, and it was suggested that the differences between the assemblages from the Gargano promontory and the Salento peninsula may result in part from a difference in chronology. The analysis also revealed various differences in raw material economy which appeared to have some spatial and temporal significance.

Chapter 7 considered various social and economic strategies that might account for the observed synchronic and diachronic assemblage variability, and focused on a discussion of raw material economies, subsistence economies, and settlement patterns and social relations. Various different factors which influence strategies of raw material economy were examined, to see whether they were responsible for the observed variability in the south-east Italian late Palaeolithic. The spatial and temporal variability in the subsistence economies was then examined, to see how this may have affected the observed differences in subsistence technology. A settlement strategy model was then proposed for the late Palaeolithic occupation of the region. The thesis concluded that three main factors operating at a regional level had contributed to the structure of the observed assemblage variability: raw material availability; the particular activities in which the tools were used; and the role of the sites in a settlement system. It was stressed that interpretations of assemblage variability should take into account multiple causal factors as conditioners of technology.

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