2 The earliest occupation of Europe: Italy

Mussi, M.

Margherita Mussi

2 The earliest occupation of Europe: Italy

This paper reviews various aspects of the rich Lower Palaeolithic record of Italy, where human groups were certainly living by about 500 to 600 Kyr BP; the evidence for an earlier occupation is not compelling yet. Open and composite environments were favoured by the first inhabitants, whose artefacts are found associated with animal bones at several sites, though unambiguous evidence for human involvement with these faunas is rare. Part of the Italian "Lower Palaeolithic success" might be related to the richness and the variety of environments.

1. Introduction

Italy is known to have a significant Lower Palaeolithic record (Fig. 1) (Mussi 1992). In this paper, we will examine the overall site preservation, and present a survey of key sites. Then controversial aspects of dating will be discussed, palaeoenvironments characterised, and the evidence related to subsistence, as well as to some aspects of lithic typology and technology, will be commented upon. Minor sites, or sites which are just poorly dated, will also be taken into account. In our conclusions, we will consider Italy in a broader perspective, and put forward some hypothesis on the causes favouring an early settlement in the area.

Not including the many uncontrolled surface collections, some 40 sites are claimed to be as early as, or earlier than, OIS 9: that is, they are approximately more than 300 Kyr old. We will not discuss here what such a "site" is: it is enough to remember that they range from Valchetta Cartoni, with two flake implements, to Venosa or Isernia, where multi-layered deposits are currently excavated over areas of hundreds of square metres.

The chronology is based on different sets of evidence, such as radiometric dates, palaeomagnetism, geo-stratigraphical correlations and evolutionary characteristics of associated faunas. In this respect, we will not take into account references to technological or typological characteristics of the industries, often leading to seriations from supposedly more archaic to more evolved industries.

Radiometric dates are available at several sites, because of the many volcanoes which have been active during the Pliocene and the Pleistocene (Fig. 2). This is in turn related to the intense tectonic activity from the late Miocene onwards, when the Apennines started to raise from the previous shallow sea (Cremaschi and Chiesa 1992). The orogenesis of the Apennines, which are the backbone of the peninsula and continue into Sicily, is also relevant to archaeology for another reason: while their eastern edge experienced compressive tectonics, resulting in an alternation of deepened basins and uplifted areas, their western edge experienced distensive tectonics, which later on led to the formation of fluvio-lacustrine basins which, as at Isernia, Venosa, Anagni, attracted herds of herbivores and their predators, and human groups as well (Fig. 3). Bone preservation is often good in such environments, which accounts for an important part of the archaeological record.

Palaeomagnetic determinations are often attempted. However, even when this method is feasible and appropriate, specific determinations are meaningful only if fitted into a complete sequence of events of known chronology (see Aitken, this volume) – which is not always the case for archaeological sites.

Geo-stratigraphic correlations must take into account the geographical peculiarities of Italy. The elongated and narrow peninsula and the islands have almost 9000 km of coasts, and fluvial systems of limited extent: the Po, which is by far the major river, is 652 km long, while there are dozens of rivers in the range of 100 km long. A large part of the geomorphological and sedimentary processes is consequently directly linked to sea level fluctuations. Correlations with isotopic stages are appropriate and more significant than in fully continental parts of Europe. However, the "marine control" of the sedimentation is a problem in itself: inland, extensive erosion surfaces develop as a consequence of falling sea-levels. Any geo-chronological scheme includes a full set of erosional phases, correlated to the glacial ones, contrasting with interglacial deposition periods (see for instance Ambrosetti *et al.* 1972). It is no surprise that the archaeological record is much biased towards warm climatic phases, and odd-numbered isotopic stages, when sediments were deposited, not eroded. The gaps can be filled where natural "sedimentary traps" occur, such as caves and tectonically controlled basins.

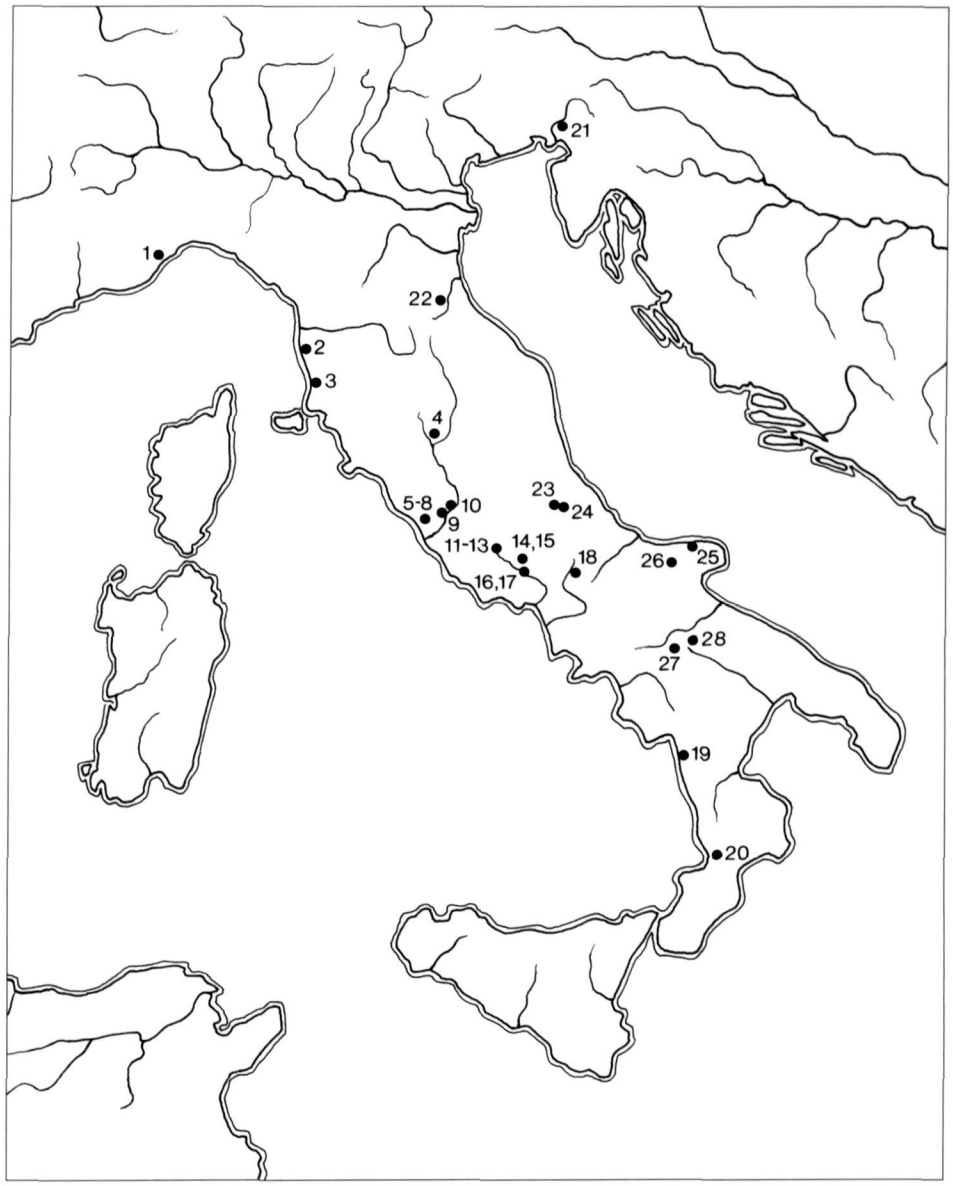

Fig. 1. Site location. 1: Gr. del Colombo; 2: Collinaia; 3: Bibbona; 4: Monte Peglia; 5: Torre in Pietra; 6: Castel di Guido; 7: La Polledrara; 8: Malagrotta; 9: Valchetta Cartoni; 10: Riano; 11: Fontana Ranuccio; 12: Colle Marino; 13: Nocicchio; 14: Arce; 15: Fontana Liri; 16: Castro dei Volsci; 17: Cava Pompi; 18: Isernia La Pineta; 19: Rosaneto; 20: Casella di Maida; 21: Visogliano; 22: Monte Poggiolo; 23: Le Svolte; 24: Valle Giumentina; 25: Foce del Torrente Romandato; 26: Grotta Paglicci (Rip. esterno); 27: Atella; 28: Venosa Loreto, Venosa Notarchirico.

As the many intra-Apennine basins have preserved an extensive array of faunal assemblages, a widely used biochronology has been worked out, which is mainly based on the larger mammals. It is also used at archaeological sites, if bones are preserved. However, large mammal evolution is rather slow, and does not allow high chronological resolution. Furthermore, it is a relative time-scale, which must be anchored to absolute chronology by dated reference assemblages. Any change in the age of the latter ones has consequences on a large number of occurrences and can lead to a re-interpretation of a whole sequence (see Roebroeks and Van Kolfschoten, this volume).

2. Key sites

The sites which have been more accurately dated form a reference grid for many others. We will briefly describe and discuss the more relevant ones.

2.1. Monte Poggiolo (Romagna)

Monte Poggiolo, between Bologna and Rimini, is situated at an altitude of 200 m above sea level, some 40 km away from the modern Adriatic shores (Antoniazzi *et al.* 1984; Antoniazzi *et al.* 1988; Antoniazzi *et al.* 1993; Peretto 1992). However, it is assumed that when people settled there for the first time the coast was nearer and the Po valley still a gulf of the sea.

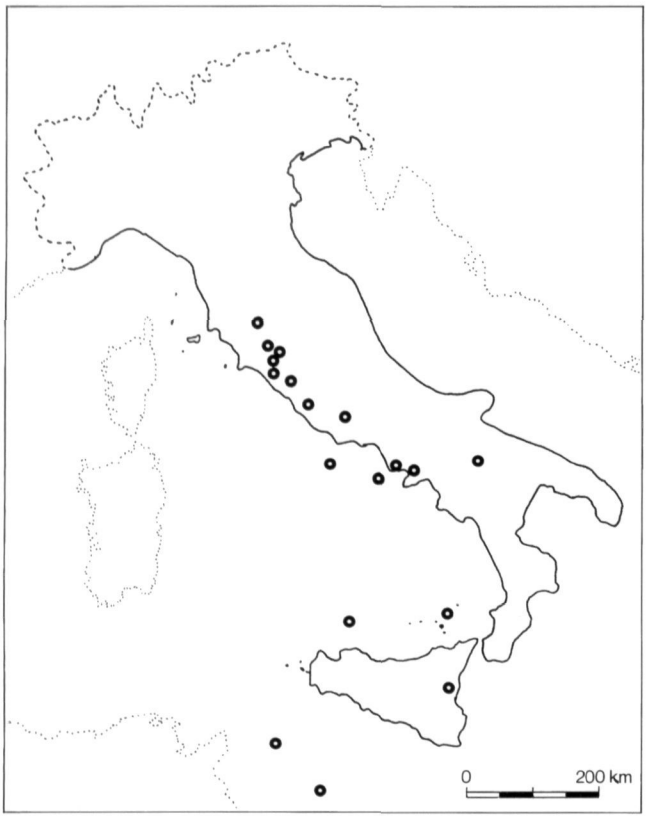

Fig. 2. The volcanoes (circles) active during the Pleistocene.

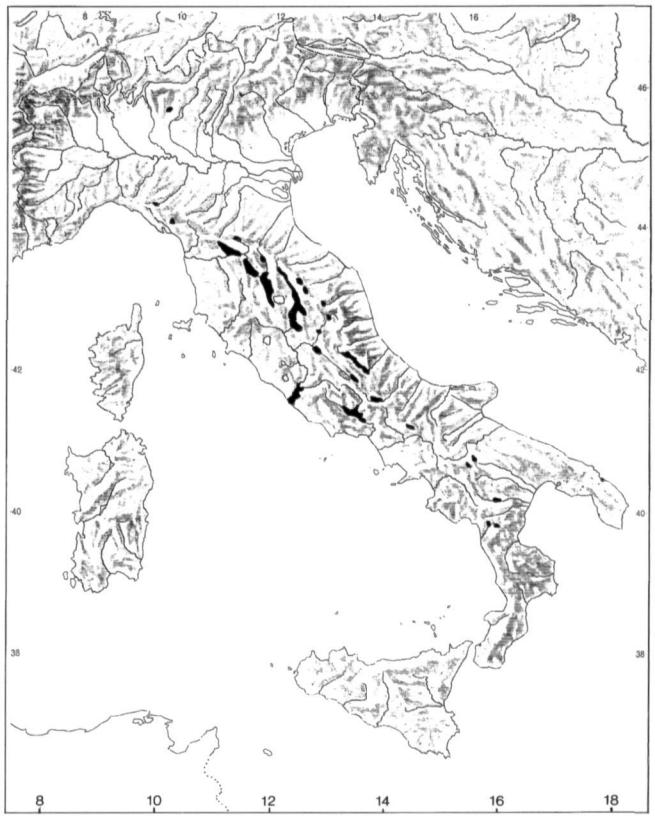

Fig. 3. Pleistocene fluvio-lacustrine basins (after Desio 1973, Fig. 176, with modifications).

At the base of the local sequence, there are marine clays, the "Argille Azzurre", 1.4-1.3 Myr old. The archaeological remains are included in the overlaying gravels of a deltaic deposit. In a single level of the latter one (lev. 107), remnants of negative palaeomagnetism were preserved. This was interpreted as meaning that the deposit is pre-Brunhes, and therefore more than 0.73 Myr old.

The deltaic gravels have been correlated with part of a sandy deposit called "Sabbie Gialle", a marker in the regional geological sequence. After the malacological assemblage found at its base, the palaeomagnetic sequence worked out in it, and two ESR dates on quartzite grains heated by exposure to sun light, an age in the range of 1 Myr has been put forward for the "Sabbie Gialle" and, consequently, for the archaeological site in the deltaic deposit.

No bones are preserved. Some 4000 lithic implements, fresh or slightly patinated, were retrieved by surface collection. They are quite small in size as flint pebbles usually less than 10 cm long were used. This assemblage includes 220 retouched flake tools – mostly notches, denticulates and side scrapers. A substantial number of core tools is described as unifacial as well as bifacial chopping-tools. Two polyhedrons and two "protohandaxes" are also recorded. There are also hundreds of pebbles from which only a single flake was struck.

Regular excavations, down to 4 m below datum, furthermore yielded 1166 flake implements, and 153 core implements, most of them from the upper part of the stratigraphic sequence. The retouched tools are just 12: 5 scrapers and 7 denticulates, while no clear-cut distinction was possible between cores and chopping-tools. About 2/3 of the flakes are totally or partially cortical, with plain or cortical butts, and most of the cores have just one striking platform. It seems that most of the activity on this peculiar spot was related to rather expedient knapping of the locally available pebbles.

Other sites with a similar industry and in the same general setting have been found in the area, but not fully investigated.

2.2. Isernia La Pineta (Molise)

Isernia is located further south, more or less in the centre of the peninsula (Bahain 1993; Coltorti *et al.* 1982;

Cremaschi and Peretto 1988a; Giusberti and Peretto 1991; Peretto 1991; Peretto *et al.* 1983). The archaeological deposit extends with a varying density over an estimated area of more than 30,000 square metres. Three separate archaeological layers were investigated at first, which are believed to be close in time. Excavations were undertaken in two different if nearby areas, *settori* or "sectors". In *settore* I there are two archaeological layers – t.3c, the earliest, followed by t.3a. In *settore* II there is only one layer – also named t.3a – which is the most recent one of the sequence. Therefore, from the earliest to the latest, we have: Sett. I t.3c, Sett. I t.3a, Sett. II t.3a. A further archaeological horizon has recently been discovered in a stratigraphical position in between the levels already known (Anconetani *et al.* 1992). The most spectacular layer is Sett. I t.3a, which is an astonishing accumulation of faunal remains (mostly bison, rhino and elephant bones) and lithic implements. The archaeological levels are sandwiched between the final deposits of a series of lacustrine origin and fluvial deposits.

The following animal species were found, mostly in "Sett.I t.3a", but without major differences between one archaeological layer and the next, the bison being the most frequent animal: *Panthera leo fossilis* (a single tooth), *Ursus* cfr. *deningeri*, *Elephas antiquus*, *Stephanorhinus hemitoechus*, *Hippopotamus amphibius*, *Sus scrofa*, *Megaceros* sp., *Dama* sp., Cervidae, *Bison schoetensacki*, *Hemitragus* cfr. *bonali*, *Lepus* sp. Several rodent species were also recognised: *Pliomys episcopalis*, *P. lenki*, *P.* cfr. *lenki*, *Clethrionomys* sp., *Arvicola mosbachensis* (= *Arvicola terrestris cantiana*), *Microtus arvalis/M. agrestis*, *M. brecciensis*, *Pitymys* sp.

Well over 10,000 lithic implements have been collected during excavations. The industry is quite similar in the various layers, except for the lack of pebble tools in "Sett. II t.3a", where there is also a very limited amount of bones. The raw material was available next to the site. Flint is mostly of poor quality, and splits following natural fissures. Many of the implements are accordingly difficult to recognise, and it cannot be said if they are, or not, broken parts of once larger ones. Limestone pebbles were also easily located in the surroundings, and used for chopping-tools.

A detailed description is available for the industry of "Sett. II t.3a" where, as said, there are no pebble tools. 40% of tools are on "nucleiform" supports, i.e. exhausted cores and *plaquettes*, and fragments of them. Not considering occasional retouches, half of them are classified as borers, with many varieties, including "monolateral" ones – i.e. implements with retouches or notches adjacent to fractures, butts etc... Next come the denticulates (32.6%), and then the endscrapers (7.1%).

The absolute age of the archaeological deposit was worked out through different methods. They include K/Ar on sanidine crystals from the alluvial deposit covering "Sett. I t.3a" – and accordingly in a reworked position – which was dated to 736 ± 4 Kyr BP. Other samples, from different if correlated deposits, stratigraphically overlying the Palaeolithic level, were consistently dated to 680 ± 6 Kyr BP and 730 ± 7 Kyr BP. Higher up in the sequence the results are in the range of 500 Kyr BP.

Seven samples, i.e. elephant, rhino and bear teeth from the archaeological layer, were dated by aminoacid racemization, and found to be 550 ± 140 Kyr old, with a mean value of 545 Kyr BP. Five teeth of elephant, rhino and bison, had an ESR age in the range of 150-100 Kyr BP. Preliminary palaeomagnetic investigations point to inverted polarity. Taking into account the radiometric date of 730 Kyr BP, the site was assigned to a time close to the Matuyama-Brunhes transition.

2.3. Venosa (Basilicata)

Venosa is located in southern Italy, within the Apennines. After recent research, the basin of Venosa is a depositional surface of late Pliocene age, eroded during the Early Pleistocene by local streams into a long and narrow valley, 100 m deep (Lefèvre *et al.* 1993a; Soprintendenza Speciale al Museo Nazionale Preistorico Etnografico "L. Pigorini" 1991). Around the transition between the Early and the Middle Pleistocene, the effusive activity of M. Vulture, a volcano distant some 20 km, produced large amounts of sediments that the streams were unable to carry away. The hydrogeological balance was much altered. As a consequence, while the volcanic activity continued, shallow lakes and marshes developed over an area of approximately 50 by 3 km. The depression was progressively filled up by 30 to 50 m of sediments. The latter were eventually eroded after new tectonic activity during the Late Pleistocene and are now found as terraced remnants.

There are several important sites in the Venosa Basin. We will consider here the sequences found in two nearby localities, *Loreto* and *Notarchirico*. They were excavated at different times by different teams, and it is not yet possible to correlate accurately the two of them, which present quite distinct sequences.

Venosa - Loreto

A stratigraphic sequence of 30 m, including 42 levels, was described from this site (Baïssas 1980; Barral and Simone 1983). Archaeological remains were found in lev. 21 (=A), lev. 18 (=B), and lev. 3 (=C) (Fig. 4). We will not further consider level C, which is later and outside our chronological range. Most of the research concentrated on layer A, 40 to 60 cm thick, which was excavated over 25 square metres.

After Baïssas (1980), at Loreto there is an excellent and most complete palaeomagnetic sequence. The Matuyama-Brunhes boundary was located in levels 38-37, the Levantin event in levels 9-8, and the Jamaica event in levels 4-2. After sedimentological analyses, he also identified a sequence of 8 cold episodes, alternating with milder ones. He eventually correlates occupation layer A with OIS 13, and occupation layer B with OIS 11.

Faunal remains are abundant, if very fragmented. In a preliminary study of the fauna, M-F. Bonifay (1977) recognised several archaic, i.e. Villafranchian, species. A revision of the fauna, however, ruled out their presence (Alberdi *et al.* 1988; Angelelli *et al.* 1978; Caloi and Palombo 1979; Caloi and Palombo 1980). The many horse remains are now identified as belonging to *Equus* aff. *süssenbornensis* and *Equus altidens*. The bovids are *Bos primigenius* and an archaic bison, i.e. *Bison schoetensacki* cfr. *voigtstedtensis*. There is a canid with many affinities with jackal. Hippos, elephants, several rhinos, many deer and a few bears are also present.

The many flake implements are mostly of flint, often of poor quality (Crovetto 1991). Denticulates made by adjacent clactonian notches form 45% of the retouched flakes, denticulates made with continuous retouch 22%, notches 19%, scrapers 9%, piercers 6% (Fig. 5).

Unifacial chopping-tools were flaked from limestone or silicious limestone pebbles. There is a single amygdaloid handaxe, of flint, and many broken pebbles.

The revised faunal analysis underlines chronological problems. After Alberdi *et al.* (1988), the equid association is relatively archaic, and would indicate an early Middle Pleistocene age. This is in contrast with an attribution to OIS 13 or 11, and to an age in the range of 500 to 450 Kyr BP, i.e. almost identical to Fontana Ranuccio (see below), where the fauna is much more modern. Furthermore the bison is less evolved at Loreto than at Isernia, while the rhinoceros is relatively primitive (Caloi and Palombo 1980).

Venosa-Notarchirico

In this area more than 500 square metres have been excavated (Belli *et al.* 1991; Cassoli *et al.* 1993; Lefèvre *et al.* 1993b; Piperno *et al.* 1990; Soprintendenza Speciale al Museo Nazionale Preistorico Etnografico "L. Pigorini" 1991). Twelve levels were found in a stratigraphic sequence of 7 m. Each is separated from the other by 10 to 100 cm of sterile deposit. Most of the bone remains belong to *Elephas antiquus* and to Cervids (*Dama clactoniana* and *Megaceros solilhacus*), followed by *Bos* sp. and *Bison schoetensacki*.

After a preliminary analysis, lithic technology and typology are rather similar in levels A, B, C, D, F, G and H. Pebble tools, of limestone and silicious limestone, are

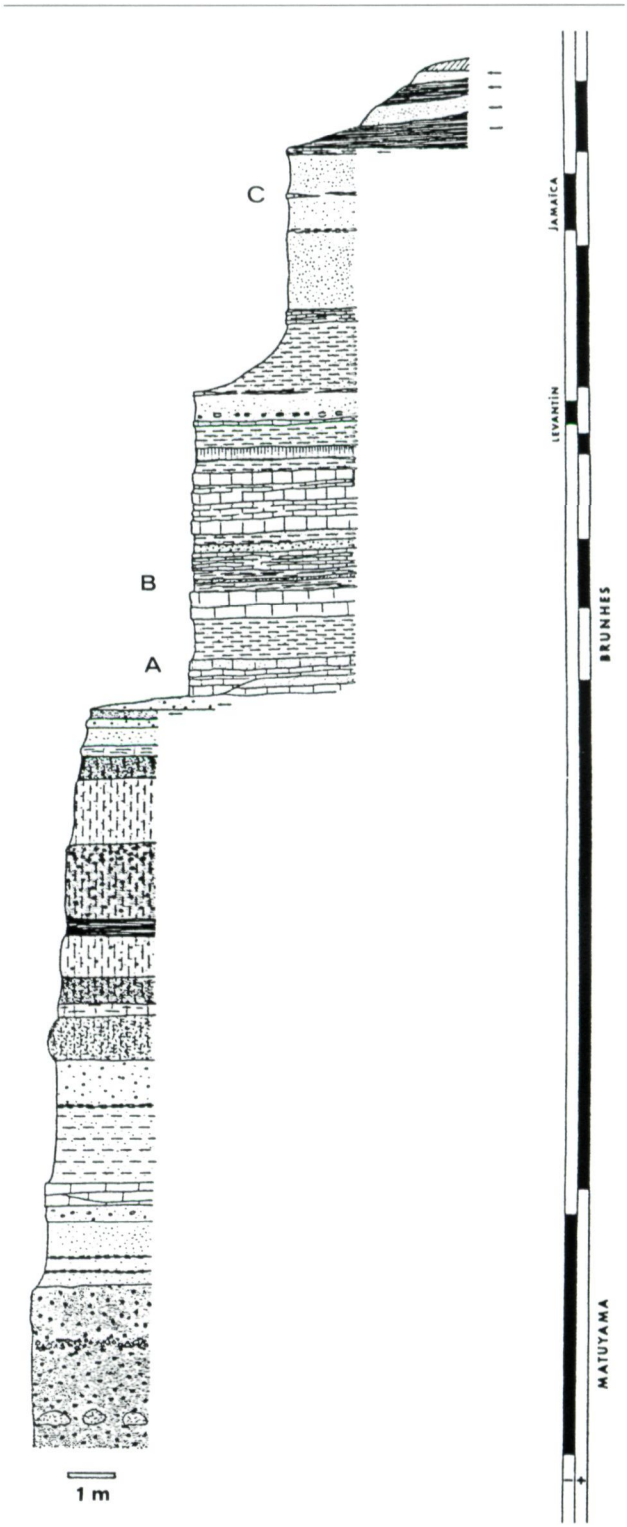

Fig. 4. The stratigraphic sequence of Venosa-Loreto (simplified after Barral and Simone 1983).

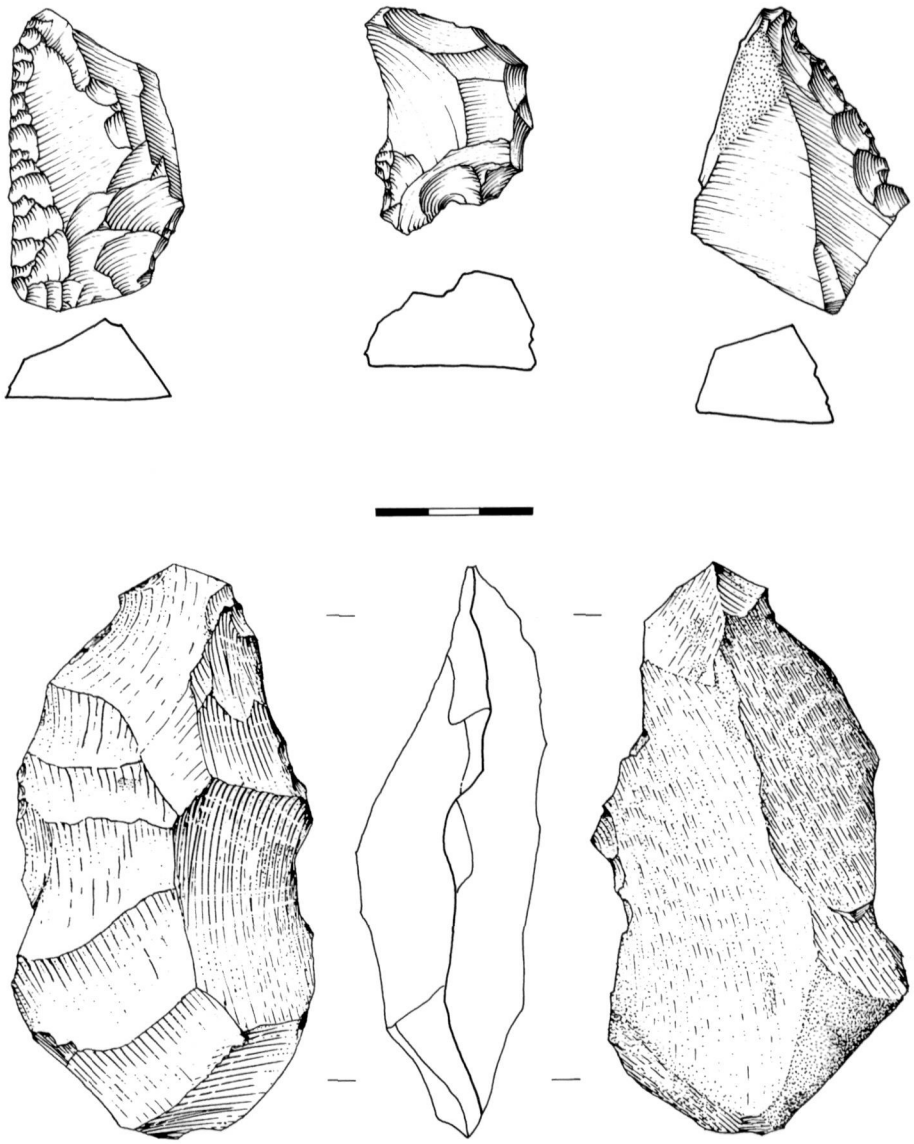

Fig. 5. Lithic implements from Venosa-Loreto level A (redrawn after Barral and Simone 1983). Scale in cm.

predominant: there are mostly chopping-tools, and some *rabots* and thick endscrapers as well. Many pebbles are just broken. There are a few flint and quartzite handaxes, rather thick and with sinuous edges. Flake tools, in a limited number, are usually quite small. Butts are plain and wide.

In levels Alfa, E and E1, on the opposite, retouched and unretouched flakes are predominant, and flint is the most frequent raw material. The associated pebble tools are of limestone. So far, handaxes have not been retrieved.

Absolute dating was attempted using several methods. A level of pyroclastic sands capping the whole archaeological sequence was dated by TL on quartz crystals to 260 ±40 Kyr BP. A human bone, found 15 cm above level Alfa was dated by U/Th, U/Pa, and Pa/Th: the average age is 359 +154/-97 Kyr. A *Bos primigenius* tooth from level Alfa was dated by isoleucine epimerization, with a resulting age of 500 Kyr ±25-30%. Another pyroclastic sand level, overlying one of the lowermost layers, i.e. level F, was dated by TL on quartz crystals to 753±60 Kyr BP.

The micromammals from level E1, however, just above this volcanic level, are indicative of a substantially later age: the assemblage of *Apodemus* sp., *Pliomys episcopalis*, *Arvicola terrestris, Microtus* gr. *arvalis-agrestis*, *Microtus nivalis*, *Microtus (Terricola)* sp., suggests, after Sala (1989), a climate cooler and moister than today, and an age in the middle part of the Middle Pleistocene.

2.4. Fontana Ranuccio (Lazio)

Fontana Ranuccio is another open-air site in the inner part of the peninsula, at some 60 km southeast of Rome, and excavated over about 60 square metres (Fig. 6). As the area is a volcanic one, K/Ar dating was possible (Biddittu *et al.* 1979; Biddittu and Segre 1982; Biddittu and Segre 1984; Gatti 1993; Segre and Ascenzi 1984; Segre *et al.* 1987). The only archaeological level was found to be 458 ± 5.7 Kyr old. This date is bracketed by a determination of 366 ± 4.5 Kyr BP higher up in the stratigraphic sequence, and by 487 ± 7.5 Kyr BP at a lower level. Caloi and Palombo (1986), in a thorough review of faunas from Latium, correlate the faunal assemblage, which points to a temperate and rather open environment with OIS 11.

The following species were determined in the faunal assemblage: *Cuon* cfr. *alpinus, Ursus deningeri*, *Panthera leo spelaea*, *Elephas antiquus*, *Equus* cfr. *mosbachensis*, *Stephanorhinus hemitoechus*, *Hippopotamus* cfr. *amphibius*, *Sus scrofa ferus*, *Megaceros* cfr. *verticornis*, *Dama clactoniana*, *Cervus elaphus*, *Capreolus capreolus*, *Bos primigenius*, *Bison* sp.

The lithic industry is not abundant, with scrapers, notches and denticulates on tiny flakes (Fig. 7). Flint and lava were used as raw materials. Five handaxes and a chopping tool were also found. There are also bones with reportedly retouched edges, including bone handaxes, interpreted as the result of the scarcity of good lithic raw material.

2.5. The sites of Via Aurelia (Lazio)

In the surroundings of Rome, a group of sites clusters along the coast in the vicinity of the Roman Via Aurelia. They are included in deposits known as the "Formazione Aurelia" or "Aurelian Formation" (Conato *et al.* 1980) (Fig. 8). The Aurelian Formation is later than the rolled fragments of volcanites included in it: the latter are the

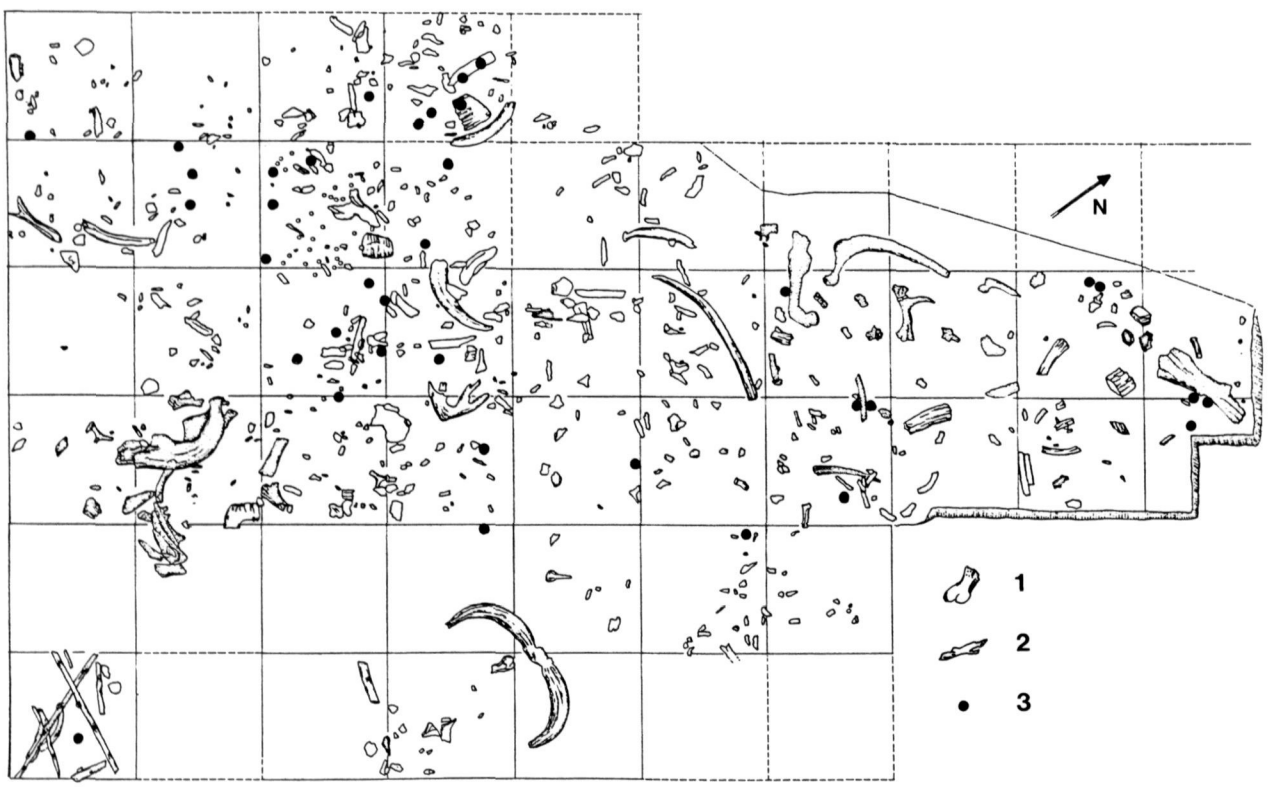

Fig. 6. The archaeological deposit at Fontana Ranuccio, grid in square metres (after Gatti 1993, with modifications).
1: bone fragment, 2: wood fragment, 3: stone artefact.

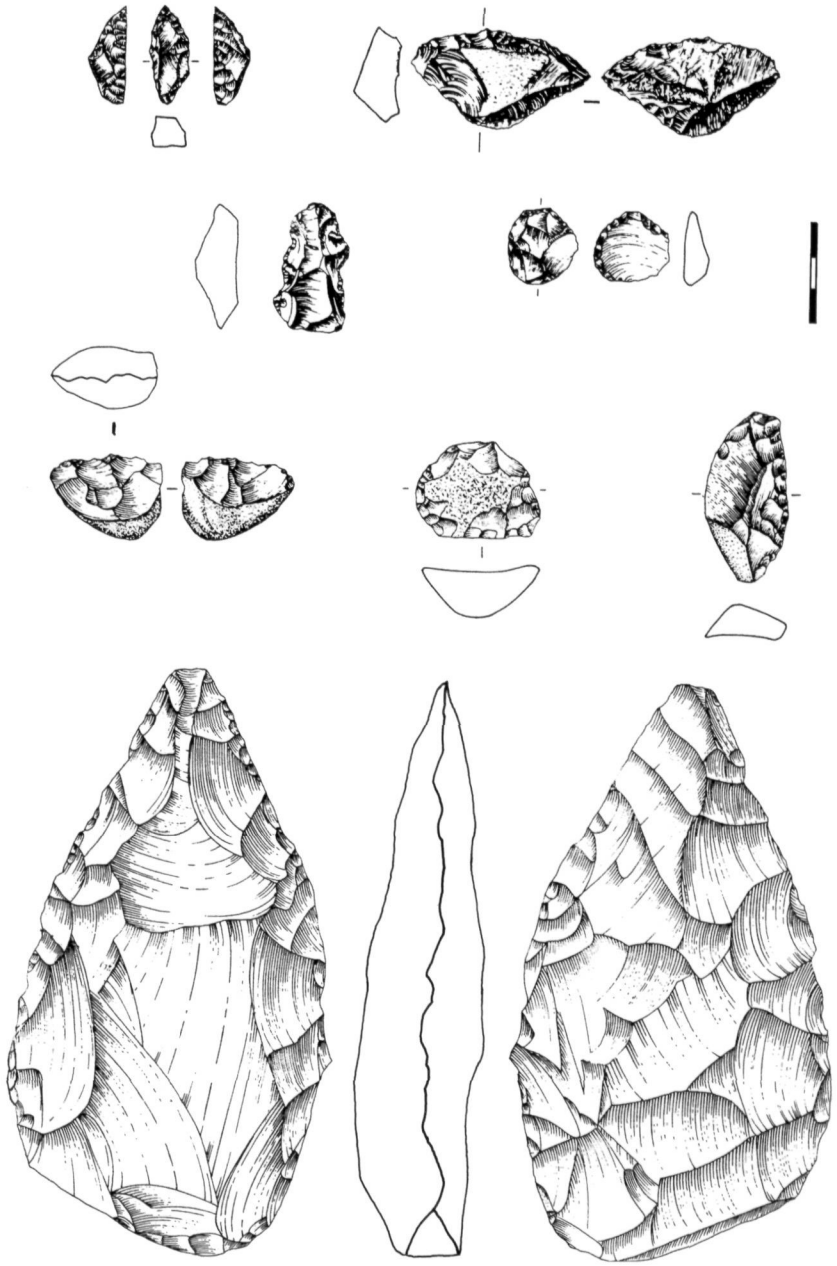

Fig. 7. Lithic industry from Fontana Ranuccio (after Biddittu and Segre 1984, and Gatti 1993). Scale in cm.

"tufo rosso a scorie nere", now dated to 442 ± 7 Kyr BP, and the "tufo litoide", with an age close to 366 ± 4.5 Kyr BP (Fornaseri 1985). The Aurelian Formation was directly dated by ESR on *Glycimeris* shells at 320-305 Kyr BP (Radtke *et al.* 1981). As a whole, it is correlated with OIS 9 (Caloi and Palombo 1986).

Torre in Pietra

Some 200 square metres have been excavated at "Torre del Pagliaccetto", in the territory of Torre in Pietra. Acheulean implements were found at the base of the series belonging to the Formazione Aurelia, and referred to as from "level m" (Malatesta 1978). This level includes

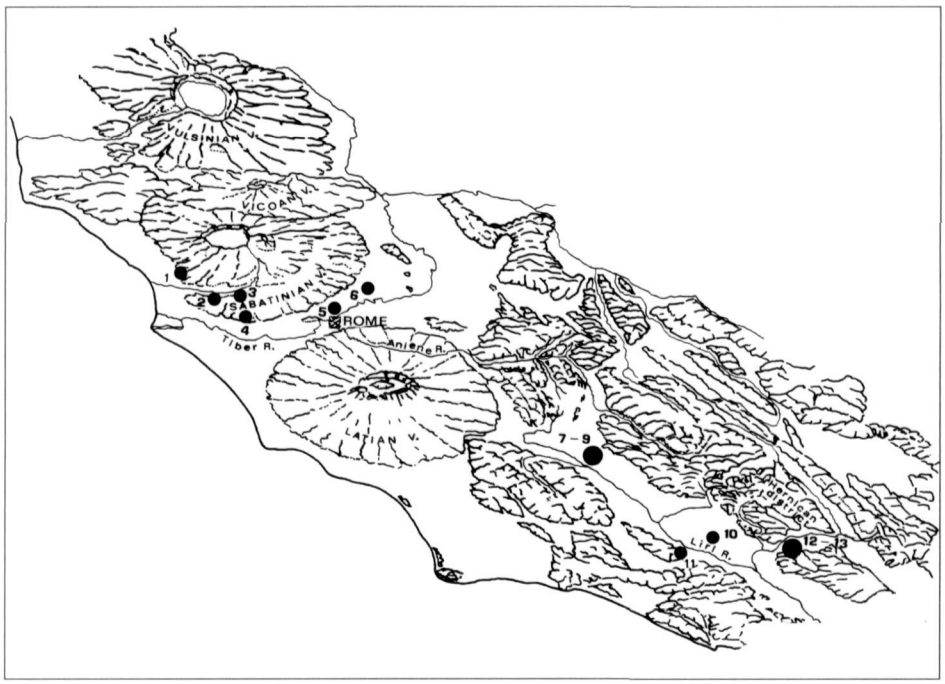

Fig. 8. The sites in the volcanic surroundings of Rome. 1: Torre in Pietra; 2: Castel di Guido; 3: La Polledrara; 4: Malagrotta; 5: Valchetta Cartoni; 6: Riano; 7: Fontana Ranuccio; 8: Colle Marino; 9: Nocicchio; 10: Cava Pompi; 11: Castro dei Volsci; 12: Arce; 13: Fontana Liri. The coast is approximately 200 km long, as the crow flies. (Modified after an original drawing by M.Parotto).

elements of a redeposited volcanic tuff known as "tufo rosso a scorie nere" (see above). It was first dated in a pioneering work by Evernden and Curtis (1965), who erroneously gave the Acheulean deposit an age close to the one of the volcanic elements: the archaeological layer is actually substantially later (see above).

The Acheulean level is not a living floor: it formed through the redeposition of eroded remnants of one or more sites. Most of the faunal assemblage consists of horse, red deer, aurochs and elephant, with some rhino bones and sporadic carnivores, including lion.

Small pebbles of limestone, silicious limestone and flint were used to make artefacts (Piperno and Biddittu 1978). Retouched tools number 173, and include 51 handaxes, 24 chopping- tools, 38 scrapers (mostly simple side scrapers), 12 notches, 10 denticulates, retouched flakes and a few borers, naturally backed knives and endscrapers.

Castel di Guido

An extensive palaeosurface with Acheulean industry has been excavated in two different if close areas, over some 350 square metres altogether (Anzidei and Sebastiani 1984; Boschian 1993; Mallegni *et al.* 1983; Radmilli 1984). Archaeological remains are mostly concentrated within an erosion channel, some 20 m wide and a few m deep. They were covered by a volcanic deposit.

In the excavated material, elephants (often young or immature), horses and aurochsen are the most frequent animal species, followed by deer, while wild boars and bears are quite rare.

Approximately 300 lithic implements were found altogether during excavations. As at La Polledrara (see below), where differential preservation was suggested, they include mostly core tools: monofacial and bifacial chopping-tools, handaxes and split pebbles, all of them in limestone or silicious limestone. Then there is a restricted number of flake tools of flint, most of them being denticulates. No *débitage* was retrieved. Some flaked bones were described as intentionally modified, and include bone handaxes.

La Polledrara

The site is currently under excavation, and more than 350 square metres have been excavated so far (Anzidei *et al.* 1988; Anzidei *et al.* 1989; Anzidei and Arnoldus-Huyzendveld 1992; Anzidei *et al.* in press; Arnoldus-Huyzendveld and Anzidei 1993).

The deposit is a former paludal basin in an essentially flat landscape of lakes, moors and ephemeral streams. One such stream caused the local shallow palaeo-incision, and

forming a curve gradually displaced it laterally from east to west. A concentration of large mammal bones and of lithic industry is found on this palaeosurface (Fig. 9).

The stream was too weak to move large skeletal elements, which were left undisturbed and sometimes partially articulated, but it was strong enough to concentrate smaller ones in the deeper part of the basin, or to pile them up on larger remains. Over 6000 animal bones have been discovered so far. There are a dozen or so of elephants, with mature and immature animals, and tusks up to 3.5 m long, and many *Bos primigenius* remains of great size, other species being less abundant.

Some 250 lithic implements were recovered. Small flint pebbles were mostly used, and there are a few larger silicious limestone pebbles. Raw material was possibly difficult to procure, because of the volcanic nature of the area and the consequent lack of flint.

Unretouched flakes are quite small (7-31mm) and present in a very limited amount (12%), probably due to the dynamics of the palaeoenvironment. Most of the tools, including scrapers and denticulates, are core tools, usually on pebbles. They often have more than one retouched edge and multiple tools are frequent.

Scrapers are prevalent. There are several endscrapers, many notches and denticulates, a few burins and piercers, and many chopping-tools. Some flaked bones are possible bone tools.

Dating of aurochsen teeth yielded an age of 450 ±120 Kyr BP by aminoacid racemization, and one of 186 ±45 Kyr BP by ESR. The results are blurred by the high natural radioactivity of the area.

3. Chronology and chronological problems

A first set of problems lies with sites for which a Early to early Middle Pleistocene age has been claimed.

The earliest Italian site would be Monte Poggiolo. Dating difficulties stem from the effectiveness of the correlation between the "Sabbie Gialle" and the archaeological deposit: an age of 1 Myr and more was put forward for the "Sabbie Gialle", while the latter was not directly dated.

The evidence from Isernia is sounder. However, there are problems with the microfauna, which includes *Arvicola mosbachensis*, a junior synonym of *Arvicola terrestris cantiana*: the latter is an important biostratigraphical marker which is definitely later in age at any other European site (Roebroeks and Van Kolfschoten, this volume; Von Koenigswald and Van Kolfschoten, in press). Furthermore, the bison is more evolved towards modern forms than at Venosa-Loreto, a site supposedly 200 or 300 Kyr later than Isernia (Caloi and Palombo 1980). A later age for this superb site would better fit biostratigraphical correlations.

At Venosa-Notarchirico, an age in excess of 700 Kyr BP for the lowermost part of the sequence would also be quite early, if compared with other Acheulean industries of Europe (see Tuffreau and Antoine, this volume), and this early date still has to be confirmed by further investigations. It is also in contrast with the chronological indications given by the micromammals, which include *Arvicola terrestris*.

The chronology of other supposedly very early sites is much less well assessed. Monte Peglia, in Central Italy, yielded microfaunal assemblages dominated by *Mimomys blanci* and *Allophaiomys* sp. and referred to the Early Biharian (Van der Meulen 1973). Five lithic implements were retrieved out of stratigraphical context, and it is not even proved beyond any doubt that they were actually flaked by humans (Piperno 1972). At Arce and nearby Fontana Liri, south-east of Rome, pebble tools and flakes were picked from deposits devoid of volcanic elements, and therefore assumed to precede the local volcanic activity (Biddittu 1972; Piperno *et al.* 1984) (Fig. 8). The latter, in the so-called Hernican volcanic district, started at 700 ±20 Kyr BP (Fornaseri 1985). The assemblages from Colle Marino and Nocicchio, not far away, also assumed to be older than 700 Kyr, are dated through regional correlations which have been modified several times (Biddittu and Segre 1982; Biddittu *et al.* 1979; Segre *et al.* 1987; Gatti 1993).

Other sites are claimed to be in the range of 500 Kyr BP. At Cava Pompi, in southern Latium again, lithic implements, as well as human and animal bones, were collected and excavated. They are said to be stratigraphically overlain by a basalt flow of c. 400 Kyr BP (Piperno *et al.* 1984). This correlation was never illustrated in any detail. In a previous publication, it was underlined that it was a rather dubious one, for reasons including the distance between the outcrop and the archaeological site (Biddittu and Segre 1978). In the Atella Basin – close to Venosa – an age preceding the activity of the Vulture volcano, i.e. earlier than 500 Kyr BP, is put forward for sites with an Acheulean industry (Borzatti von Löwenstern *et al.* 1990). Unfortunately, there is no detailed geostratigraphical study of the archaeological deposits. On the coast of Tuscany, at Bibbona and Collinaia, collected lithic assemblages were dated to OIS 11, after long-distance and short-distance geostratigraphical correlations (Galiberti 1982; Malatesta and Zarlenga 1988; Sarti and Stoduti 1982). The typological characteristics of the industry, devoid of handaxes, are assumed to date the deposit, and there is no independent clue for absolute chronology.

It is not that the above-mentioned sites cannot be as old as suggested in the literature, but the point is that their chronology is not fully assessed. Many more could be mentioned, including the earliest sites of Sicily and

Fig. 9. Partial view of the excavations at La Polledrara. On the left, an area damaged by ploughing. (Courtesy of the Soprintendenza archeologica di Roma).

Sardinia: lithic series with chopping-tools and flake tools have been collected in Sicily, and assemblages with flake tools only have been excavated in Sardinia (Broglio *et al.* 1992; Martini 1992; Segre *et al.* 1982), but in neither instance is there any sound evidence for their supposed great antiquity.

An age in the range of 600 to 400 Kyr is reasonably supported by the evidence from Venosa-Loreto, part of Venosa-Notarchirico, Fontana Ranuccio, and even the minor site of Valchetta Cartoni in the surroundings of Rome: in 1936 two flakes were located by A.C. Blanc, E. Tongiorgi and H. Breuil below the "tufo rosso at scorie nere", an ignimbrite now dated at 442 ±7 Kyr BP (Blanc 1935-1937; Fornaseri 1985).

Later sites, in the range of 350-300 Kyr BP, are better exemplified by those alongside Via Aurelia, while many more of probably similar age are poorly dated. Some will be mentioned below.

4. Preferred environments

There is some agreement that the many remains of herbivores at several sites must be related to a rather open environment, which provided enough pasture for the herds (Alberdi *et al.* 1988; Boschian 1993; Caloi and Palombo 1978; Sala 1983). However, shrubs and thickets were also growing, and herbivore assemblages do not point to treeless grasslands or steppes. For instance, the ubiquitous *Elephas antiquus* is assumed to have been a forest animal, based on anatomical characteristics including the very long straight tusks, not appropriate for grazing. Tusks 3 to 3.5 m long are often mentioned, compared with those of modern African elephants which only exceptionally reach 2.5 m (Haynes 1991). It is assumed that it was basically a browser, in good accordance with mounting evidence of the nutritional importance of shrubby and arboreal forage for modern elephants (Haynes 1991).

More circumstantial evidence is available at some sites. At Monte Poggiolo, a rather limited amount of pollen from the archaeological deposit suggests a cool or even cold climate, and open vegetation (Cattani 1992): non-arboreal pollen are dominant, and include steppic elements, while *Pinus* and *Abies* are well represented amongst the trees. The gastropods – with *Cochlodina laminata*, now a mountain species – also point to a rather cold climate.

At Isernia, a sample from the palaeosurface "Sett. I t.3a" includes 80% non-arboreal pollen, Gramineae being dominant. The few arboreal pollen are from *Alnus*, *Salix* cfr. *populus*, *Platanus*, *Pinus*, *Cedrus* and oaks (Accorsi 1985).

Preliminary results are available for the upper part of the sequence of Venosa-Notarchirico, between levels C and Alfa (Soprintendenza Speciale al Museo Nazionale Preistorico Etnografico "L. Pigorini" 1991). The environment was a grassland, with a very limited amount of trees, such as fir, pine, oaks. At Venosa-Notarchirico, the malacological associations from the lowermost archaeological level (level A), are indicative of a rather humid and forested environment, but the pollen point to an arid and warm climate in association with level B, the next human occupation (Durante and Settepassi 1978). The large mammals of level A, however, include many equids, as

well as other species of open environment (Alberdi *et al.* 1988): the molluscs are probably indicative of local conditions only.

Some further evidence comes from a cave site, Grotta Paglicci (Riparo esterno) in Apulia (Bartolomei 1980; Mezzena and Palma di Cesnola 1971). The micromammal assemblage, with *Oryctolagus* sp., *Eliomys* sp., *Allocricetus bursae*, *Apodemus* sp., *Microtus dentatus*, *M. brecciensis*, *M. arvalis*, and *Pitymys* sp., is indicative of an arid and steppic landscape. Unfortunately, there is no sound chronological evidence for the archaeological deposit, which yielded some fine bifaces, but an age close to the sites of the Aurelian Formation would be a good estimate. The environment, however, is completely different and possibly glacial (see Final Remarks).

Palaeobotanical investigations have not been carried out in the Acheulean levels of the sites alongside Via Aurelia, while a general reconstruction of the environment is available (Jacobacci 1978; Malatesta 1978; Conato *et al.* 1980; Anzidei *et al.* 1989; Anzidei and Arnoldus-Huyzendveld 1992; Arnoldus Huyzendveld and Anzidei 1993). During OIS 9, the rising sea-level and volcanic activity affected the landscape. The area which was already rather flat became characterised by small depressions and moors filled by the activity of ephemeral meandering streams. Muddy areas were ubiquitous, and alternated with sands and other alluvial deposits, as well as with volcanic deposits. Closer to the coast lagoons developed. The many bodies of water, from fresh to brackish and from stagnant to running, are reflected in the fauna: hippos at Castel di Guido and Malagrotta, a minor site (Cassoli *et al.* 1982) (surface collections only), beavers at Malagrotta, aquatic birds at Torre in Pietra and Malagrotta again.

This densely settled area can be compared with another one, devoid of human occupation during this same time span, i.e. the Riano lake basin, just north of Rome, which is also part of the Aurelian Formation. (Accordi and Maccagno 1962; Ambrosetti *et al.* 1972; Ambrosetti *et al.* 1980; Bonadonna 1965; Follieri 1961-1963; Leonardi and Petronio 1974; Leonardi and Petronio 1976; Maccagno 1962). Based on the count of annual levels in varved diatomites, the little lake was in existence for 15,000 to 20,000 years. It progressively shrank from a maximum initial extension of 650×250 m. Volcanic tuffs embedded in the diatomite deposit were dated to 225 ±60 Kyr BP by K/Ar, and to 280 ±30 Kyr BP by fission tracks. Animal remains were found at different levels, in the basin itself as well as in its immediate surroundings. They include well preserved and still articulated remains of a limited range of species: two almost complete skeletons and a skull of *Elephas antiquus*, fragments of *Stephanorhinus* cfr. *hemitoechus*, five complete or partial skeletons of *Cervus elaphus*, a single one of *Dama clactoniana*, and isolated bones.

The flora is known both by pollen analysis, and by the study of macrobotanical remains, as leaves, fruits and seeds were extremely well preserved. It is therefore possible to cross-check the results of different lines of analyses, and to obtain a direct knowledge of the local vegetation. A very dense forest of broad-leaved trees was in existence throughout the stratigraphic sequence, while the grass cover was extremely restricted. The forest was of oceanic-temperate type below the dated tuff level, with much *Carpinus* and *Pterocarya*, and of oceanic cool type above it, with increasing percentages of beech and fir.

As mentioned above, there are so far no archaeological remains from the forests of the Riano basin: a scanty series of lithic artefacts was only collected from the earthy brown tuff which tops the lacustrine diatomitic series (Accordi and Maccagno 1962).

Evidence of settlement in forested environment is found at Visogliano, a karstic depression close to Trieste, where there are also the remains of a collapsed rockshelter. Two stratigraphic sequences (A and B) are known, but their chronological relationships have not been worked out. The age of the deposits is loosely bracketed between 700 and 300 Kyr BP (Cattani *et al.* 1991). Pollen was preserved in some levels only. A broad-leaved forest was in existence, with an association of *Carpinus*, *Fraxinus* and *Quercus* (Cattani 1992; Cattani *et al.* 1991). In the upper part of sequence A, however, which is devoid of pollen, the micromammals are typical of steppes or grasslands (Bartolomei 1980). Anyhow, the archaeological remains are extremely scarce at Visogliano, and point to discontinuous and short-lived occupation there.

As a conclusion, the available evidence suggests that open or composite environments were favoured by the first inhabitants, while densely forested ones were apparently rather avoided. Lacustrine or even marshy basins were looked for, possibly just because gregarious herbivores congregated there to water and to die. However, we must also remember that site preservation is better in such basins, as deposits accumulate rather quickly, so that we cannot rule out the possibility that they are over-represented.

5. Scavenging and hunting

There is no question that stone tools are found associated with animal bones at several sites. Positive evidence of interaction between humans and animals, however, is rather rare.

At Isernia (Sett. I t.3a), the huge accumulation of bones mainly consists of elephant, rhino and bison remains. According to G. Giusberti *et al.* (1991), the elephant remains

include many long bones and tusks, and a more limited amount of teeth, pelves, ribs and vertebrae; bison bones are mostly cranial ones – specially horns – omoplates and iliac bones; rhinos are represented by skulls, teeth and half mandibles. Their conclusions are that the bones were sorted by humans and laid on the ground on purpose. Furthermore, some remains were broken into pieces when fresh, and dislocated over a restricted area (so that refitting is possible). This, too, is said to have been the result of human activity. The general conclusions are that the remains are indicative both of a dwelling structure and of butchering activities.

Positive evidence, however, is scarce. Dwelling structures of Lower Palaeolithic age are problematic, to put it mildly (Farizy 1988-1989), and such an interpretation should be presented in considerable detail, in order to allow the reader to evaluate its merits. As far as butchering is concerned, there is no preserved cut mark (Giusberti and Peretto 1991). Most of the bone surfaces were affected by animal trampling as well as by abrasion by water and sand in a muddy deposit. Artificial breakage scars have been actually detected on a dozen of the thousands of bones of the various levels (Anconetani *et al.* 1992; Anconetani *et al.* 1993; Giusberti and Peretto 1991). The selected elements are from bison forequarters. So far, it is safer just to assume that marrow was looked for and consumed.

At Venosa-Loreto level A, bones are generally broken, most of them being herbivore remains. Broken diaphyses sometimes have cut marks and scars left by stone tools which scratched the bone surface. The site is cautiously interpreted as a possible butchering area (Barral and Simone 1983).

At Venosa-Notarchirico, the skull of a young elephant was found turned upside down, with the mandible detached and broken: after it, the area of the discovery was named "Area dell'Elefante", i.e. "Elephant Area". Further parts of the skeleton are expected to lay outside the area so far excavated. Some dozens of handaxes and choppers, and just four flake tools, were in direct contact with the carcass, clearly associated with it. The "Elephant Area" site is interpreted as a probable butchering site (Cassoli *et al.* 1993).

A taphonomic study of La Polledrara is under way and artificial breakage patterns have been detected (Anzidei *et al.* in press). As a preliminary hypothesis, it seems that at least part of the animals died a natural death in the small muddy basin and that human beings took advantage of this (Anzidei *et al.* 1988). Hunting activities are not ruled out: killing weak animals trapped in the mud and scavenging carcasses of dead ones were two possible options.

Some possible butchering marks have been detected on elephant bones of Castel di Guido, but only preliminary observations are available for this site (Boschian 1993).

There is therefore some evidence that, from the first presence onwards, human groups were interacting with animals, taking their share of meat and marrow.

6. Diversity in lithic tools

We will concentrate on two aspects of lithic technology and typology: the presence or absence of handaxes, and the appearance of the Levallois flaking technique.

Handaxes so far are the only prerequisite to define an Acheulean industry as such. In Africa, industries devoid of handaxes are known to precede Acheulean industries during a period of about one million years. In Europe, as a consequence, Lower Palaeolithic industries without handaxes are usually assumed to be earlier than Acheulean industries. In Italy, the lack of handaxes at sites such as Monte Poggiolo, Isernia, Bibbona, Collinaia, Arce, Colle Marino, Fontana Liri, Casella di Maida as well as in Sicily and Sardinia, has been widely accepted as suggesting a great antiquity. Furthermore, it is often more or less implicitly assumed that handaxes are just more refined chopping-tools, related to the same or similar activities. The archaeological evidence, however, is not that clear-cut.

Monte Poggiolo is an area where raw material was easily available in the form of flint pebbles. Much primary knapping was performed, as it can be seen in the overwhelming ratio of unretouched to retouched flakes, the high amount of cortex on implements and the many cores which are difficult to discriminate from chopping-tools (Antoniazzi *et al.* 1993). A limited set of activities was going on, and retouched tools were scarcely needed.

At Isernia, too, flint was abundant in the immediate surroundings of the site, but of very poor quality: it is found as small blocks and *plaquettes*, which are much fissured and split easily, so that it is just impossible to recognise natural from man-made fractures (Ferrari *et al.* 1991). Limestone pebbles were used for choppers and chopping-tools. Pebble tools, however, are lacking from Sett. II t.3a, excavated over an area of 18 m × 4 m (Ferrari *et al.* 1991). Interestingly, animal remains, which are usually abundant, are scanty in this part of the deposit.

At Venosa-Notarchirico, industries with and without handaxes are interstratified: bifacial tools are not abundant, and are absent in level Alfa, at the top of the local sequence, and in levels E and E1, in the middle part of it. All levels have been extensively excavated. In the Elephant Area, in close association with the bones, there are many handaxes and choppers, and very few flake tools (Cassoli *et al.* 1993).

Amongst the sites of the Aurelian Formation, Torre in Pietra, Castel di Guido and Malagrotta yielded handaxes, while these were not found at La Polledrara. Once again, the excavations were extensive, and sampling bias is

probably not involved. At La Polledrara elephant skeletons were found partially articulated (Anzidei *et al.* 1989). The bone accumulation cannot be directly compared with the ones from Torre in Pietra and Malagrotta, which are definitely disturbed and possibly redeposited, while only preliminary information is available for Castel di Guido.

The quality of raw material would account, in part or totally, for the lack of handaxes at sites such as Isernia. There is also some suggestion that pebble tools were preferred when large carcasses were available and marrow was to be extracted from heavily-built bones. However, we need further research before understanding the meaning of "handaxe sites" compared with "chopper sites" – the two being usually not exclusive of each other. The only definite evidence is that, in the Italian Lower Palaeolithic, they do not follow each other neatly in any chronological sequence.

Turning to the Levallois technique, "Protolevalloisian" industries, i.e. assemblages of flakes having dorsal scars related to some kind of core preparation, and unfacetted butts, are sometimes mentioned in the Italian literature (Radmilli 1977; Palma di Cesnola 1982). The "Protolevalloisian" supposedly derives from the Clactonian, including choppers and flakes with large and inclinated butts. In some sites only a handful of implements are retrieved, while elsewhere larger collections are available, as at Le Svolte and Valle Giumentina in Abruzzo, and Foce del Torrente Romandato in Apulia. Such industries, however, are found in reworked conditions, and are invariably rolled. Their age is an open question.

Cremaschi and Peretto (1988b) examined "Protolevalloisian" collections of northern Italy and presented evidence that they had been sorted by stream activity to some standard size and weight, and that handaxes were included in several such assemblages. Therefore, they are better described as Acheulean, while the flaking technique has not yet been properly described. On the basis of geo-stratigraphic correlations they date them to "an early part of the Middle Pleistocene".

As a rule, flaking is rather crude in Lower Palaeolithic assemblages. At sites such as Monte Poggiolo, Arce, Colle Marino, Venosa-Loreto only a single flake was often detached, while bipolar flaking technique was common. The latter was also in use at Isernia, and is frequent in the Acheulean assemblages collected in the basin of Atella (Borzatti von Löwenstern and Vianello 1993). There are discoidal cores at Fontana Ranuccio, but they are rarely mentioned elsewhere. The Levallois technique is not found at any site prior to OIS 9. By then, single Levallois flakes, or Levallois cores, are occasionally mentioned or just illustrated in the literature. At Grotta del Colombo in Liguria, for instance, more than 200 flake implements were found in level 11: two are Levallois flakes, and one is an atypical Levallois blade (Tozzi 1965). After some admittedly tentative correlations with a dated stalagmite in the rear of the cave, and sedimentological and palaeontological studies, the layer was deposited during OIS 9 (Baïssas *et al.* 1986).

The only site at which the Levallois technique is fully represented and developed is Rosaneto, in Calabria. Unfortunately, the 1000 or so collected implements are only known through preliminary publications (Piperno *et al.* 1984). After Malatesta and Zarlenga (1988) the terrace of Rosaneto belongs to what they call "Second Middle Pleistocene cycle deposits", and to OIS 9. However, the industry itself is a major dating element in their reconstruction, which leads to circular arguments. The development of the Levallois technique at this site is unparalleled elsewhere at this stage and we suggest that this fact points to a later age.

7. Final considerations

The age of the first human settlement of Italy has been claimed to be in the range of 1 Myr. In our opinion, it is not fully substantiated at this very early date. Human groups were certainly living in the peninsula by 600 to 500 Kyr BP, while the age of the Sicilian and Sardinian supposed Lower Palaeolithic is still an open question.

The colonization of Sicily is relevant for the first settlement of Europe, as the hypothesis of a discontinuous land bridge between Africa and Europe through Sicily has been put forward, albeit for a later phase of the Lower Palaeolithic (Alimen 1975).

We assume that natural conditions allowing the crossing of arms of the sea by archaic humans would have favoured other large mammals as well. However, the most recent immigrations of animal species from Africa happened during the Middle Pliocene, if not during the late Miocene (Palombo 1985). During the Middle Pleistocene, the Sicilian faunal assemblages are characterised by the well known dwarf pachyderms, and mostly by the little elephants, *Elephas mnaidriensis* and *Elephas falconeri*. As the second species is even more reduced than the first one, it has long been assumed that it was later, and derived from the slightly larger species. *Elephas mnaidriensis*, in turn, would had evolved from a subspecies of the European *Elephas antiquus*, i.e. *Elephas antiquus leonardii*.

The picture changed after absolute dating of several assemblages through isoleucine epimerization (Bada and Belluomini 1985; Bada *et al.* 1991): the dates cluster into two different intervals, at 455 ± 90 Kyr BP, and at 200 ± 40 Kyr BP respectively. Both the tiny *E. falconeri* and the slightly larger *E. mnaidriensis* are found in the earlier group, while only the second one is in the later one. It is now assumed that the two dwarf species are not in a

phyletic relation, and that the so-called *E. mnaidriensis* of the later group is possibly a still different species, related to a new immigration of elephants. The species from which *E. falconeri* derived is consequently unknown. It cannot be ruled out that a reconsideration of the problem, as well as the study of new and unpublished faunas, could lead to a new interest in African connections (T. Kotsakis pers. com. 1994). If we accept a short chronology for the first settlement of Europe – i.e. in the range of 600 to 500 Kyr BP – an immigration of elephants from Africa around this time, admittedly so far unsubstantiated and just hypothetical, would open new and intriguing perspectives for the arrival of humans as well.

The environmental changes are recorded in a discontinuous way prior to 300 Kyr BP. However, the core extracted from Valle di Castiglione, 20 km east of Rome, goes back to c. 250 Kyr BP (Follieri *et al.* 1988). In this core, steppic assemblages are present during most of the time, interrupted by phases of forest expansion. We are inclined to believe that the situation was not that different in an earlier part of the Middle Pleistocene. The only evidence of steppic environment from archaeological sites is from the undated upper part of the sequence of Visogliano and from Grotta Paglicci. We suggest that they both formed during fully glacial periods. As said in the Introduction, because of differential preservation of sites the Italian record is much biased towards interglacials, and it is no coincidence that evidence of glacial periods is found in caves. Evidence of cold climate and of some steppic elements was also presented for Monte Poggiolo.

Even in the interglacial sites, the environment is invariably described as rather open – which is of interest, in view of the ongoing discussion on the Palaeolithic settlement of Northern Europe (Gamble 1986; Roebroeks *et al.* 1992). When comparisons are possible with densely wooded areas, as within the sites of the Aurelian Formation, the later ones are found to be devoid of human occupation.

Different environments existed even during full interglacials. This is better understood if we consider the geographical setting: Italy expands in a north-western to south-eastern direction over some 10 degrees of latitude, i.e. from the Alps to the latitude of Northern Algeria, Tunisia and Syria. The climatological effects of this gradient are contrasted by the ranges of mountains, which follow the same direction, all the way long: during our modern interglacial winters, the mountains of Calabria and Sicily covered by snow are a common sight. At the same time, the mitigating effect of the sea means that, in northern Italy, the Riviera of Liguria nowadays enjoys warm and sunny winters, and palms are freely growing.

As a consequence, extensive ecological zonation has never been possible, and mosaic environments prevailed. This can be seen at Valle di Castiglione: the growth of plant populations was exponential when climatic conditions changed, and we assume that many refugium areas were always in existence. Even now, the vegetation of Latium is known to be both extremely rich in species and markedly heterogeneous (Caloi *et al.* 1989).

Ecologists have often linked the Pleistocene extinction of animal and plant species in Europe to the fact that seas and mountains prevented the north-south migrations and recolonizations which were possible in America or Africa. The patchy environment of Italy possibly explains the late disappearance, during the last glacial, of elephants, hippos, rhinos, as well as of plant species such as *Pterocarya* and *Zelkova*. We consider the tiny peninsula, and its major islands, as a possible refugium for many European species during the Pleistocene.

The Lower Palaeolithic record is impressive in Italy, if compared with other parts of Europe. We suggest that part of this "Lower Palaeolithic success" was linked to the richness and variety of environments over short distances, and to the fact that unspecialised hunter-gatherers were able to take advantage of this.

Acknowledgements

I am grateful to M. Parotto, Dipartimento di Scienze della Terra, Università di Roma "La Sapienza", for allowing use of an original line drawing of coastal Latium. A.P. Anzidei, Soprintendenza archeologica di Roma, kindly provided an unpublished picture of La Polledrara.

references

Accordi, B., A.M. Maccagno — 1962 — Researches in the Pleistocene of Riano (Rome), *Geologica Romana* 1, 25-32.

Accorsi, C.A. — 1985 — The contribution of palynology in the reconstruction of the environment. In: C. Peretto (ed.), *Homo, Journey to the Origin's of Man History*, 192-201, Venezia: Marsilio.

Aitken, M.J., — this volume — Chronometric techniques for the Middle Pleistocene.

Alberdi, M.-T., L. Caloi, M.R. Palombo — 1988 — The Quaternary fauna of Venosa: Equids, *Bulletin du Musée d'Anthropologie préhistorique de Monaco* 31, 5-39.

Alimen, M.H. — 1975 — Les "isthmes" hispano-marocain et siculo- tunisien aux temps acheuléens, *L'Anthropologie* 79, 399-436.

Ambrosetti, P., A. Azzaroli, F.P. Bonadonna, M. Follieri — 1972 — A scheme of Pleistocene chronology for the Tyrrhenian side of Central Italy, *Bollettino della Società Geologica Italiana* 91, 169-184.

Ambrosetti, P., F. Cigala Fulgosi, C. Petronio — 1980 — Mammiferi del Pleistocene medio. In: *I vertebrati fossili italiani – Catalogo della Mostra*, 227-232, Verona: Museo Civico di Storia Naturale.

Anconetani, P., C. Crovetto, M. Ferrari, G. Giusberti, L. Longo, C. Peretto, F. Vianello — 1992 — Nuove ricerche nel giacimento di Isernia La Pineta, *Rivista di Scienze Preistoriche* 44, 3-41.

Anconetani, P., G. Giusberti, C. Peretto — 1993 — Su alcuni nuovi reperti di bisonte (*Bison schoetensacki* Freudenberg) con tracce di fratturazione intenzionale del giacimento paleolitico di Isernia La Pineta, *Atti della XXX° Riunione scientifica dell'Istituto Italiano di Preistoria e Protostoria*, 211-218.

Angelelli, F., L. Caloi, A. Malatesta, M.R. Palombo — 1978 — Fauna quaternaria di Venosa: cenni preliminari, *Atti della XX° Riunione scientifica dell'Istituto Italiano di Preistoria e Protostoria*, 133-140.

Antoniazzi, A., L. Cattani, M. Cremaschi, L. Fontana, G. Giusberti, C. Peretto, R. Posenato, F. Proli, S. Ungaro — 1984 — Primi risultati delle ricerche nel giacimento del Paleolitico inferiore di Ca' Belvedere (Monte Poggiolo, Forlì), *Preistoria alpina* 20, 7-14.

Antoniazzi, A., L. Cattani, M. Cremaschi, L. Fontana, C. Peretto, R. Posenato, F. Proli, S. Ungaro — 1988 — Le gisement du Paléolithique inférieur de Ca' Belvedere di Monte Poggiolo (Forlì, Italie) (Résultats préliminaires), *L'Anthropologie* 92, 629-642.

Antoniazzi, A., M. Ferrari, C. Peretto — 1993 — Il giacimento di Ca' Belvedere di Monte Poggiolo del Pleistocene inferiore con industria litica (Forlì), *Bullettino di Paletnologia italiana* 84, 1-56.

Anzidei, A.P., A. Angelelli, A. Arnoldus-Huyzendveld, L. Caloi, M.R. Palombo, A.G. Segre — 1989 — Le gisement pléistocène de La Polledrara di Cecanibbio (Rome, Italie), *L'Anthropologie* 93, 749-782.

Anzidei, A.P., F. Angelelli, L. Caloi, I. Damiani, M. Pacciarelli, M.R. Palombo, A.C. Saltini, A.G. Segre — 1988 — Il giacimento pleistocenico de "La Polledrara" di Cecanibbio (Roma) – Relazione preliminare, *Archeologia Laziale* 9, 361-368.

Anzidei, A.P., A. Arnoldus-Huyzendveld — 1992 — The Lower Palaeolithic site of La Polledrara di Cecanibbio (Rome, Italy). In: E. Herring, R. Whitehouse, J. Wilkins (eds), *New developments in Italian Archaeology*, Part 1, Papers of the Fourth Conference of Italian Archaeology, 141-153, London: Accordia Research Centre.

Anzidei, A.P., R. Sebastiani — 1984 — Saggi di scavo nel deposito pleistocenico al Km. 19,300 della Via Aurelia (Castel di Guido). In: A.M. Bietti Sestieri (ed.), *Preistoria e Protostoria nel territorio di Roma*, 86-93, Roma: De Luca.

Anzidei, A.P., P. Villa, P., E. Cerilli — (in press) — La Polledrara di Cecanibbio (Roma). Dati preliminari sull'analisi tafonomica dei reperti faunistici. Atti del Convegno Farnese *Preistoria e Protostoria in Etruria*, Viterbo 21-23 maggio 1993.

Arnoldus-Huyzendveld, A., A.P. Anzidei — 1993 — Ricostruzione di un ambiente fluvio-lacustre nella regione vulcanica di Roma (La Polledrara di Cecanibbio), *Atti della XXX° Riunione scientifica dell'Istituto Italiano di Preistoria e Protostoria*, 151-165.

Bada, J.L., G. Belluomini — 1985 — Isoleucine epimerization ages of the dwarf elephants of Sicily, *Geology* 13, 451-452.

Bada, J.L., G. Belluomini, L. Bonfiglio, M. Branca, E. Burgio, L. Delitata — 1991 — Isoleucine epimerization ages of Quaternary mammals from Sicily, *Il Quaternario* 4, 49-54.

Bahain, J.-J. 1993 *Datation par résonance de Spin électronique (ESR) du carbonates et d'émail dentaire quaternaires: potentiel et problèmes*, Thèse de Doctorat du Muséum National d'Histoire Naturelle, Paris: Institut de Paléontologie Humaine.

Baïssas, P. 1980 Données paléomagnétique et sédimentologique sur les dépôts de la coupe de Loreto, *Bulletin du Musée d'Anthropologie préhistorique de Monaco* 24, 13-56.

Baïssas, P., L. Barral, P. Simon, S. Simone 1986 Le Pleistocène moyen à la grotte du Colombo (Toirano, Ligurie italienne), *Bulletin du Musée d'Anthropologie préhistorique de Monaco* 29, 5-24.

Barral, L., S. Simone 1983 Le bassin fluvio-lacustre de Venosa, *Bulletin du Musée d'Anthropologie préhistorique de Monaco* 27, 5-19.

Bartolomei, G. 1980 Micromammiferi del Plio-Pleistocene. In: *I vertebrati fossili italiani*, Catalogo della Mostra, 249-258, Verona.

Belli, G., G. Belluomini, P.F. Cassoli, S. Cecchi, M. Cucarzi, L. Delitala, G. Fornaciari, F. Mallegni, M. Piperno, A.G. Segre, E. Segre Naldini 1991 Découverte d'un fémur humain acheuléen à Notarchirico (Vénosa, Basilicate), *L'Anthropologie* 95, 47-88.

Biddittu, I. 1972 Pleistocene e industrie litiche pre-acheuleane ad Arce e Fontana Liri, *Quaternaria* XVI, 35-52.

Biddittu, I., P.F. Cassoli, F. Radicati di Brozolo, A.G. Segre, E. Segre Naldini, I. Villa 1979 Anagni, a K-Ar dated Early and Middle Pleistocene Site, Central Italy: preliminary report, *Quaternaria* XXI, 53-71.

Biddittu, I., A.G. Segre 1978 Paleolitico inferiore a Cava Pompi presso Pofi (Frosinone), *Quaderni del Centro Studi per l'Archeologia Etrusco-Italica* 1, 77-79.

1982 Pleistocene medio-superiore con industria arcaica su ciottolo nel bacino di Anagni (Lazio), *Atti della XXIII° Riunione scientifica dell'Istituto Italiano di Preistoria e Protostoria*, 567-576.

1984 Industria su scheggia e bifacciali: nuovi reperti del Paleolitico inferiore ad Anagni-Fontana Ranuccio, Frosinone, *Atti della XXIV° Riunione scientifica dell'Istituto Italiano di Preistoria e Protostoria*, 105-114.

Blanc, A.C. 1935-1937 Scheggia di tecnica clactoniana rinvenuta *in situ* nel Quaternario della Valchetta-Cartoni (Roma), *Rivista di Antropologia* XXXI, 253-266.

Bonadonna, F.P. 1965 Further information on the research in the Middle Pleistocene diatomite quarry of Valle dell'Inferno (Riano, Rome), *Quaternaria* VII, 279-299.

Bonifay, M.-F. 1977 Liste préliminaire de la grande faune du gisement préhistorique de Venosa, *Bulletin du Musée d'Anthropologie préhistorique de Monaco* 21, 115-125.

Borzatti von Löwenstern, E., M. Sozzi, S. Vannucci, F. Vianello — 1990 — L'Acheuleano del cimitero di Atella (PZ). Prime indagini sulla stratigrafia del sedimento e sulle industrie litiche, *Studi per l'Ecologia del Quaternario* 12, 9-29.

Borzatti von Löwenstern, E., F. Vianello — 1993 — Luoghi di sosta e e di insediamento lungo le rive del lago pleistocenico di Atella (Potenza), *Atti della XXX° Riunione scientifica dell'Istituto Italiano di Preistoria e Protostoria*, 139-150.

Boschian, G. — 1993 — Castel di Guido - Scavi 1980-1991, *Atti della XXX° Riunione scientifica dell'Istituto Italiano di Preistoria e Protostoria*, 167-178.

Broglio, A., I. Di Geronimo, E. Di Mauro, J.K. Kozlowski — 1992 — Nouvelles contributions à la connaissances du Paléolithique inférieur de la région de Catania dans le cadre du Paléolithique de la Sicile. In: C. Peretto (ed.), *I primi abitanti della Valle Padana: Monte Poggiolo*, 189-226, Milano: Jaca Book.

Caloi, L., G.B.L. Coccolini, M. Mussi, M.R. Palombo, S. Vitagliano, D. Zampetti — 1989 — Le Moustérien du Latium (Italie centrale): archéologie, milieu naturel, chronologie, *L'Anthropologie* 93, 73-98.

Caloi, L., M.R. Palombo — 1978 — Anfibi, rettili e mammiferi di Torre del Pagliaccetto (Torre in Pietra, Roma), *Quaternaria* XX, 315-440.

1979 — La fauna quaternaria di Venosa: "Canis sp.", *Quaternaria* XXI, 115-128.

1980 — La fauna quaternaria di Venosa: Bovidi, *Bollettino del Servizio geologico d'Italia* C, 101-140.

1986 — Le mammalofaune plio-pleistoceniche dell'area laziale: problemi biostratigrafici ed implicazioni paleoclimatiche, *Memorie della Società geologica italiana* 35, 99-126.

Cassoli, P.F., C. De Giuli, A.M. Radmilli, A.G. Segre — 1982 — Giacimento del Paleolitico inferiore a Malagrotta (Roma), *Atti della XXIII° Riunione scientifica dell'Istituto Italiano di Preistoria e Protostoria*, 531-549.

Cassoli, P.F., D. Lefèvre, M. Piperno, J.-P. Raynal, A. Tagliacozzo — 1993 — Una paleosuperficie con resti di *Elephas (Palaeoloxodon) antiquus* e industria acheuleana nel sito di Notarchirico (Venosa, Basilicata), *Atti della XXX° Riunione scientifica dell'Istituto Italiano di Preistoria e Protostoria*, 101-116.

Cattani, L. — 1992 — Il ricoprimento vegetale nell'area padana durante il Pleistocene inferiore e medio. In: C. Peretto (ed.), *I primi abitanti della Valle Padana: Monte Poggiolo*, 291-302, Milano: Jaca Book.

Cattani, L., M. Cremaschi, M.R. Ferraris, F. Mallegni, F. Masini, V. Scola, C. Tozzi — 1991 — Le gisement du Pleistocène moyen de Visogliano (Trieste): restes humains, industries, environnement, *L'Anthropologie* 95, 9-36

Coltorti, M., M. Cremaschi, M.C. Delitala, D. Esu, M. Fornaseri, A. McPherron, M. Nicoletti, R. van Otterloo, C. Peretto, B. Sala, V. Schmidt, J. Sevink 1982 Reversed magnetic polarity at an early Lower Palaeolithic site in Central Italy, *Nature* 300, 173-176.

Conato, V., D. Esu, A. Malatesta, F. Zarlenga 1980 New data on the Pleistocene of Rome, *Quaternaria* XXII, 131-176.

Cremaschi, M., S. Chiesa 1992 Ambiente e clima. In: A. Guidi, M. Piperno (eds), *Italia preistorica*, 3-45, Roma: Laterza.

Cremaschi, M., C. Peretto 1988a Les sols d'habitat du site paléolithique d'Isernia La Pineta (Molise, Italie centrale), *L'Anthropologie* 92, 1017-1040.

1988b Le Paléolithique inférieur de la plaine orientale du Pô, *L'Anthropologie* 92, 643-682.

Crovetto, C. 1991 Résultats préliminaires de la comparaison des industries d'Isernia La Pineta et de Venosa-Loreto. In: C. Peretto (ed.), *Isernia La Pineta - Nuovi contributi scientifici*, 79-95, Isernia: Istituto regionale per gli studi storici del Molise "V. Cuoco".

Desio, A. (ed.) 1973 *Geologia dell'Italia*, Torino: UTET.

Durante, S., F. Settepassi 1978 Nota sulle associazioni malacologiche del giacimento fluviolacustre di Loreto, Venosa, *Atti della XXIII° Riunione scientifica dell'Istituto Italiano di Preistoria e Protostoria*, 141-145.

Evernden, J.F., H. Curtis 1965 The potassium-argon dating of Late Cenozoic rocks in East Africa and Italy, *Current Anthropology* 6, 343-369.

Farizy, C. 1988-1989 Spatial organization and Middle Palaeolithic open air sites, *Origini* 14, 39-50.

Ferrari, M., C. Peretto, F. Vianello 1991 Aspetti tecno-tipologici e distribuzione areale dell'industria del II settore di Isernia La Pineta (Molise, italia). In: Peretto C. (ed.), *Isernia La Pineta, nuovi contributi scientifici*, 49-78, Isernia: Istituto regionale per gli studi storici del Molise "V. Cuoco".

Follieri, M. 1961-1963 La foresta colchica fossile di Riano Romano. II. Analisi polliniche, *Annali di Botanica*, 245-280.

Follieri, M., D. Magri, L. Sadori 1988 250,000-year pollen record from Valle di Castiglione (Roma), *Pollen et Spores* 30, 329-356.

Fornaseri, M. 1985 Geochronology of volcanic rocks from Latium (Italy), *Rendiconti della Società italiana di Mineralogia e Petrologia* 40, 73-106

Galiberti, A. 1982 L'industria di tipo "Pebble Culture" di Bibbona (Livorno) (Nota preliminare), *Atti della XXIII° Riunione scientifica dell'Istituto Italiano di Preistoria e Protostoria*, 463-479.

Gamble, C. 1986 *The Palaeolithic Settlement of Europe*. Cambridge: Cambridge University Press.

Gatti, S. (ed.) 1993 *Dives Anagnia - Archeologia nella valle del Sacco*. Roma: "L'Erma" di Bretschneider.

Giusberti, G., M. Ferrari, C. Peretto 1991 Tipologia, frequenza e distribuzione dei reperti paleontologici e paletnologici della paleosuperficie T.3a del I settore di scavo di Isernia La Pineta (Isernia, Molise). In: Peretto C. (ed.), *Isernia La Pineta, nuovi contributi scientifici*, 5-42, Isernia:Istituto regionale per gli studi storici del Molise "V. Cuoco".

Giusberti, G., C. Peretto 1991 Evidences de la fracturation intentionnelle d'ossements animaux avec moëlle dans le gisement de "La Pineta" de Isernia (Molise), Italie, *L'Anthropologie* 95, 765-778.

Haynes, G. 1991 *Mammoths, Mastodonts & Elephants*. Cambridge: Cambridge University Press.

Jacobacci, A. 1978 Il rilevamento geologico dei dintorni di Torre in Pietra (F 149 Cerveteri), *Quaternaria* XX, 209-224.

Koenigswald, W. von T. van Kolfschoten in press The *Mimomys-Arvicola* boundary and the enamel thickness quotient (SDQ) of *Arvicola* as stratigraphic markers in the Middle Pleistocene, *Proceedings of the SEQS Cromer Symposium, 1990*.

Lefèvre, D., J.-P. Raynal, G. Vernet 1993a Sedimentary dynamics and tecto-volcanism in the Venosa Basin (Basilicata). In: M. Mollieri, O. Girotti, T. Kotsakis, A. Taddeucci, C. Turner (eds), *Abstracts. Symposium "Quaternary stratigraphy in volcanic areas"*, 43, Rome: INQUA SEQS, CNR, Università degli Studi di Roma "La Sapienza".

Lefèvre, D., J.P. Raynal, T. Pilleyre, G. Vernet 1993b Contribution à la chronostratigraphie de la série de Venosa-Notarchirico (Basilicata), *Atti della XXX° Riunione scientifica dell'Istituto Italiano di Preistoria e Protostoria*, 116-128.

Leonardi, G., C. Petronio 1974 I cervi pleistocenici del bacino diatomitico di Riano (Roma), *Atti della Accademia Nazionale dei Lincei - Memorie (Classe Sc. fis. mat. nat.)*, Serie VIII, 12, 109-208.

1976 The Fallow Deer of European Pleistocene, *Geologica Romana* 15, 1-67.

Maccagno, A.M. 1962 Gli elefanti fossili di Riano, *Geologica Romana* 1, 33-132.

Malatesta, A. 1978 La serie di Torre in Pietra nel quadro del Pleistocene Romano, *Quaternaria* XX, 537-577.

Malatesta, A., F. Zarlenga 1988 Evidence of Middle Pleistocene transgressions along the Mediterranean coast, *Palaeogeography, Palaeoclimatology, Palaeoecology* 68, 311-315.

Mallegni, F., R. Mariani-Costantini, G. Fornaciari, E.T. Longo, G. Giacobini, A.M. Radmilli 1983 New European fossil hominid material from an Acheulean site near Rome (Castel di Guido), *American Journal of Physical Anthropology* 62, 263-274.

Martini, F. 1992 Il più antico popolamento umano delle isole: la Sardegna. In: Peretto C. (ed.), *I primi abitanti della Valle Padana: Monte Poggiolo*, 175-187. Milano, Jaca Book.

Meulen, A.J. van der 1973 Middle Pleistocene smaller mammals from the Monte Peglia (Orvieto, Italy), with special reference to the phylogeny of *Microtus* (Arvicolidae, Rodentia), *Quaternaria* XVII, 1-144.

Mezzena, F., A. Palma di Cesnola 1971 Industria acheuleana nei depositi esterni della Grotta Paglicci, *Rivista di Scienze preistoriche* 26, 3-29.

Mussi, M. 1992 *Il Paleolitico e il Mesolitico in Italia.* Popoli e Civiltà dell'Italia antica vol. 10. Bologna: Stilus.

Palma di Cesnola, A. 1982 Il Paleolitico inferiore in Puglia, *Atti della XXIII° Riunione scientifica dell'Istituto Italiano di Preistoria e Protostoria*, 225-248.

Palombo, M.R. 1985 I grandi mammiferi pleistocenici delle isole del Mediterraneo: tempi e vie di migrazione, *Bullettino della Società Paleontologica Italiana* 24, 201-224.

Peretto, C. (ed.) 1991 *Isernia La Pineta, nuovi contributi scientifici.* Isernia: Istituto regionale per gli studi storici del Molise "V. Cuoco".

1992 *I primi abitanti della Valle Padana: Monte Poggiolo.* Milano: Jaca Book.

Peretto, C., C. Terzani, M. Cremaschi (eds) 1983 *Isernia La Pineta, un accampamento più antico di 700.000 anni.* Bologna: Calderini.

Piperno, M. 1972 The Monte Peglia lithic industry, *Quaternaria* XVI, 53-65.

Piperno, M., I. Biddittu 1978 Studio tipologico e interpretazione dell'industria acheuleana e pre-musteriana dei livelli m e d di Torre in Pietra (Roma), *Quaternaria* XX, 441-536.

Piperno, M., M.G. Bulgarelli, F. Zevi (eds) 1984 *I primi abitanti d'Europa.* Roma: De Luca.

Piperno, M., F. Mallegni, Y. Yokoyama 1990 Découverte d'un fémur humain dans les niveaux acheuléens de Notarchirico (Venosa, Basilicata, Italie), *Comptes Rendus de l'Académie des Sciences de Paris* 311 (ser. II), 1097-1102.

Radmilli, A.M. 1977 *Storia dell'Abruzzo dalle origini all'età del Bronzo.* Pisa: Giardini.

1984 Scavi nel giacimento del Paleolitico inferiore di Castel di Guido presso Roma. In: A.M. Bietti Sestieri (ed.), *Preistoria e Protostoria nel territorio di Roma*, 75-85, Roma: De Luca.

Radtke, U., G.J. Hennig, W. Linke, J. Müngersdor 1981 230 Th /234 U- and ESR- dating problems of fossil shells in Pleistocene marine terraces (Northern Latium, Central Italy), *Quaternaria* XXIII, 37-50.

Roebroeks, W., N.J. Conard, T. van Kolfschoten 1992 Dense Forests, Cold Steppes, and the Palaeolithic Settlement of Northern Europe, *Current Anthropology* 33, 551-586.

Roebroeks, W T. van Kolfschoten this volume The earliest occupation of Europe: A reappraisal of artefactual and chronological evidence.

Sala, B. 1983 La fauna del giacimento di Isernia La Pineta. In: C. Peretto, C. Terzani, M. Cremaschi (eds), *Isernia La Pineta, un accampamento più antico di 700.000 anni*, 71-79, Bologna: Calderini.

	1989	A Preliminary Report on the Microvertebrates of Notarchirico, Venosa, *Preistoria Alpina* 25, 7-14.
Sarti, A. P. Stoduti	1982	Stazione litica riferibile alla "Pebble Culture" scoperta nel Livornese, *Atti della XXIII° Riunione scientifica dell'Istituto Italiano di Preistoria e Protostoria*, 447-461.
Segre, A. A. Ascenzi	1984	Fontana Ranuccio: Italy's Earliest Middle Pleistocene Hominid Site, *Current Anthropology* 25, 230- 233.
Segre, A.G. I. Biddittu, F. Guadagnoli	1987	Nuovi dati sul giacimento del Paleolitico inferiore di Anagni-Fontana Ranuccio, *Archeologia Laziale* VII, 239-243.
Segre, A.G. I. Biddittu, M. Piperno	1982	Il Paleolitico inferiore nel Lazio, nella Basilicata e in Sicilia, *Atti della XXIII° Riunione scientifica dell'Istituto Italiano di Preistoria e Protostoria*, 177-206.
Soprintendenza Speciale al Museo Nazionale Preistorico Etnografico "L. Pigorini".	1991	*Escursioni a Notarchirico e Isernia La Pineta*, Libro Guida, XXX° Riunione scientifica dell'Istituto Italiano di Preistoria e Protostoria.
Tozzi, C.	1965	La Grotta del Colombo a Toirano, *Rivista di Studi liguri* 31, 5-43.
Tuffreau, A. P. Antoine	this volume	The earliest occupation of Europe: Continental Northwestern Europe.

Margherita Mussi
Dip. di Scienze Storiche, Archeologiche e
Antropologiche dell'Antichità
Università di Roma "La Sapienza"
Via Palestro 63
00185 Roma, Italy