პირველყოფილი ადამიანები ევროპის კარიბჭესთან

Early Humans at the Gates of Europe

Les premiers Hommes aux portes de l'Europe

Edited by David Lordkipanidze,Ofer Bar-Yosef and Marcel Otte

ERAUL 92

Liège 2000

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Dmanisi,Tbilisi(Georgia) Septembre 1998

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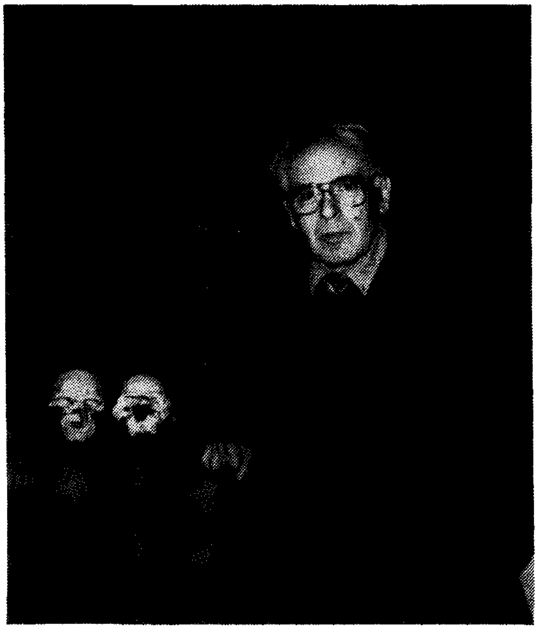
Au Professeur Léo Gabounia



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Preface

The Republic of Georgia was recently brought into the paleanthropological limelight by the discovery of exceedingly ancient early hominids and stone tools at Dmanisi. Dating techniques such as paleomagnetism and Ar40/39Ar confirm preliminary observations that hominid remains date to about 1.8-1.7 Ma. In addition, the deposits at Dmanisi yielded a rich faunal assemblage, including sabretooth tigers, ostriches, giraffes, elephants and rhinos.

As part of the progress achieved in the excavations and study of Dmanisi, an International Symposium was organized. The goals of the symposium were to discuss the role of the Caucasus region in early human dispersals and to look at other possible routes taken by hominids during their migrations into Eurasia.

The first International Symposium, entitled “Early Humans at the Gates of Europe” was held on 13-16 September 1998, in Dmanisi and Tbilisi, Georgia. The Symposium was organized by the Dmanisi Regional Department of the Archaeological Center of the Georgian Academy of Sciences and the Georgian State Museum in cooperation with the Georgian National Committee of INQUA and the Römisch-Germanisches Zentralmuseum in Mainz. The Symposium was financially supported by special funds of President of Georgia Mr. Eduard Shevardnadze.

This volume includes the papers presented by many of the participants in the symposium, as well as some by those who for various reasons could not attend the meeting. Several of those who took an active part in the meeting did not submit their papers. Their oral contributions are mentioned here.

The papers presented in this volume concentrate mainly on Georgian sites. Dr. J. Kopaliani (Georgia) delivered a presentation on the medieval history of the Dmanisi region and the history of the discovery of the site. L. Gabunia and associates presented the results of current research in Dmanisi. The joint paper of L. Gabounia and M.A. de Lumley (France) was a detailed study of the human metatarsal from Dmanisi.

M. Gabunia (Georgia) summarized the results of her excavations in the Lower Paleolithic sites of Akhalkalaki in Southern Georgia, dated to ca. 0.8-1.0 Ma. V. Liubin and E. Beliaeva (Russia) gave an oral presentation on results from the excavations of the Acheulian cave sites of Kudaro in the Central Caucasus (dated to approximately 0.5-0.6 Ma).

Several contributions were made on the issue of early colonizations and adaptations to new environments. These included a paper by Bar-Yosef and Belfer-Cohen examining the environmental advantages for humans outside Africa.

An overview of the early Paleolithic in Asia by A. Derevianko (Russia) and M. Otte (Belgium) brought the issue of hominid adaptations in Siberia and Central Asia to the fore. In his paper, M. Otte presents a model of migration routes of early hominids into and from Asia. The Brunhes/Matuyama boundary (0.78 Ma) was identified within the sequence of the early sites. The archaeological horizons of the layers accumulated over a period estimated as 100-150 ka.

The volume benefits from an overall survey by D. Roe (UK) on Lower Paleolithic occupation of the Northern Caucasus. An additional overview is offered by P. Dolukhanov (UK), who summarized the microenvironments of the initial hominid settlements in Western Asia. The discussion of this region continues with the paper of V.B. Doronichev (Russia) on Lower Paleolithic occupation of the Northern Caucasus. L. Golovanova (Russia) describes the results of her excavations at Treugolnaia, a cave site on the northern slopes of the Caucasus, where layers dated to 0.5-0.6 Ma were uncovered.

R. Kahlke (Germany) summarizes his research in the Untermassfeld site (0.9-1.0 Ma). H. Hemmer (Germany) discusses the paleoecological scenario of human and carnivore guild interactions.

J. Rafiafar (Iran) contributed an oral presentation on the early appearence of humans in Iran. V. Ranov (Tadjikistan) delivered an oral contribution on the evolution of the Paleolithic industries in the long and complex sequence of loess deposits in Southern Tadjikistan. The earliest artifacts in this sequence are currently dated to 0.8 Ma.

Moving further west, J. Agusti and associates (Spain) describe and discuss the magneto-biochronological background of early human occupations in Spain. The age of Venta-Micena and Fuente-Nueva-3 (Orce, Spain) are now considered to be greater than 1 Ma.

The paper of O. Soffer (USA) discusses the adaptations of archaic hominids, focusing on the distribution of the most recent Neandertal remains in Europe.

The study of Dmanisi is a work in progress. In the summer of 1999, the same level that produced the mandible also yielded two hominid skulls. The first specimen (D-2280) represents an almost complete cranium vault, while the second (D-2282) is a cranium vault and a fragment of the maxilla. Preliminary studies clearly link these new specimens with the African *Homo erectus/Homo ergaster* group.

Other studies of Georgian prehistory are currently underway. Among these we would like to mention the joint Georgian, Israeli and American excavation projects in the caves of Western Georgia, aimed at clarifying the Middle-Upper Paleolithic transition. In Eastern Georgia (the Udabno area), a new field project with the goal of finding additional fossil primates is in progress.

Finally, we would like to dedicate this volume to Professor Leo Gabunia on the occasion of his 80th birthday and in appreciation of his many contributions to the discovery of the prehistoric past of Georgia.

D. Lordkipanidze, O. Bar-Yosef, M. Otte

ERAUL 92, 2000, p. 11 à 12.

DMANISI AND ITS PAST

Jumber Kopaliani
Director of the Dmanisi Archaeological expedition

An important region of Georgia, Lower Kartli was populated by ancient Georgian tribes, who occupied four principal river valleys: the Debeda, the Mashavera, the Khrami, and the Algeti. This has given rise to a rich Georgian culture, formed here throughout dozens of centuries.

The region of Dmanisi contains a wealth of diverse archaeological and architectural remains from the Early, Middle and Late Bronze, Early Iron, Classical, and Medieval periods.

One of the main attributes of the culture of a people is possession of its own writing. The Georgian nation, with its own script, holds a place of honor among the 14 peoples of the world with their own writing system. The oldest (5th century AD) examples of Georgian writing in Georgia have been found in Lower Kartli: in Bolnisi and Dmanisi. Scholars are inclined to believe that this region was the cradle of Georgian culture.

The ancient city site of Dmanisi is a unique monument in Lower Kartli, situated within 80 km of Tbilisi, on a high bluff overlooking the confluence of the Mashavera and Pinezauri Rivers. In the Middle Ages, Dmanisi was one of the strongest cities, after the Georgian capital Tbilisi. Traces of all periods of history have been brought to light on its territory.

In the 9th century, a fortified city was built on the site, preceded by an urban-type settlement. Furthermore, traces of dense population have been discovered for the Bronze Age, especially demonstrated by the abundance of Late Bronze archaeological material.

Dmanisi is first mentioned in written sources in the 6th and then in the 9th centuries A.D. Henceforth, written evidence on Dmanisi becomes frequent.

In the 11th century, the city was razed to the ground as a result of the inroads of the Seljuk Turks who had come from Central Asia and settled in the Near East. After their expulsion from Georgia the city was rebuilt at the turn of the 12th century. The city gradually gained in strength, reaching its acme in the 13th century. Georgian coins were minted here at this time.

Ceramic and glass manufacture was at a high level in Dmanisi, and local production was in great demand.

As a major city, Dmanisi had close trade and economic relations with many countries of the world, including Byzantium, Iran, Arabia, Europe and China. This is attested to by items, for example the coins of these countries discovered in archaeological excavations at the site.

After the 13th century, Georgia, including Dmanisi, came under Mongol rule, which caused the weakening of the country. At the turn of the 15th century, Georgia was devastated by the numerous invasions of Timur Lenk, Dmanisi suffering the same lot. The city was partially rebuilt in the 16th-18th centuries. In this period, only the citadel of the city continued to function, but the repeated invasions of external enemies (including Iran and Turkey) brought about the total destruction of Lower Kartli, in particular of Dmanisi. Most of its population perished fighting the enemy, and those who survived found refuge in different regions of Georgia. The Dmanisi area lay waste, the once flourishing city a ruin.

The city was built on a bluff (13ha in size), and was inaccessible on three sides. The gate of the city was on the southern side. The inner fortress, or citadel of the city was also built on this side, and separated from the city by a specially constructed rampart wall. The Dmanisi Church of the Virgin, the chief ecclesiastical center (episcopate) of the city and of the region was built beside the fortress. This three-nave basilica was erected in the 8th and 9th centuries. In the first quarter of the 13th century, a porch, embellished with rich and varied ornaments, was built on the western part. A long Georgian inscription in the asomtavruli (capital) script was detailed on the western facade. The inscription mentions Lasha-Giorgi, the Georgian king of the period and son of Queen Tamari, as well as the builder of the porch, Kalnapetisdze. Of great interest in this inscription is the following piece of evidence: "Newly-married couples are exempt from the church tax." Although the Dmanisi region was at this time densely populated, it seems that the church officials took active steps towards improving the demographic situation.

Archaeological excavations have brought to light the entire perimeter of the city wall, with buttresses and towers, and the palace with baths, and dwelling and economic structures (three-storey houses are evidenced). The ground was paved with flat bricks, while the buildings were covered with plain and grooved tiles.

Rich archaeological materials have been brought to light: pottery (glazed and unglazed); faience; metal and glass vessels, both local and imported; coins (up to 2000) of many countries - mostly Georgian; and a large number of ornaments: gold, silver, glass, etc.

The uniqueness of the Dmanisi city site lies also in the fact that here, beneath the medieval structures, in the solid stratum - earlier believed to be the bedrock - an Early Palaeolithic site of ancient humans has been discovered, its study yielding an extremely interesting result.

The Dmanisi Archeological Expedition (directed by V. Japaridze) conducted excavations in the central part of the Dmanisi city site for many years, in order to identify a quarter of the medieval city. A large refuse pit was found in the "soil" at floor level. After cleaning the pit, bones of fossil animals were found in the walls and at the bottom. The bones were studied by Professor Abesalom Vekua, a well-known paleontologist and researcher at the Institute of Palaeobiology (Director Acad. Leo Gabunia), in the Georgian Academy of Sciences. The bones proved to be those of a rhinoceros and other ancient animals.

In 1982, I excavated rooms B and C of the same quarter, which yielded analogous pits and bones of animals. It was therefore decided to conduct a test of the earlier deposits, carried out in the summer of 1983, involving plot XI, near the above-mentioned large pit. Along with palaeontological materials, stone tools were also unearthed.

In the same year, the well-known specialist of the Palaeolithic, David Tushabramishvili, accompanied by young specialists of the same period: Zaal Kikodze and Tengiz Meshveliani, visited Dmanisi to familiarize themselves with the materials brought to light. Impressed by what he had seen, D. Tushabramishvili recognized "a discovery of world significance."

The expedition developed a plan for the study of the site, and a special team was formed directed by Tamaz Bugianishvili and Nugzar Mgeladze. From 1984-89, this team conducted an intensive study of the early Palaeolithic site. Palaeontologist Abesalom Vekua, geologist Givi Maisuradze, geophysicists Jemal Sologhashvili and Elisabed Pavlenishvili, and palynologist Nino Klopotovskaya were invited to join the expedition. Plot XI and one square (2x2m) in plot X were excavated in their entirety. A large amount of material was brought to light-both palaeontological and archaeological. A study of this material has led Georgian scholars to the conclusion that the Dmanisi Early Palaeolithic site can be dated to a period prior to one million years ago.

Information about this site has reached beyond the boundaries of Georgia. In 1990, by invitation of his former student David Lordkipanidze, Dmanisi was visited by Professor Gerhard Bosinski, a well-known specialist of the Palaeolithic period. The material discovered made him, too, so enthusiastic as to ask for permission to participate in the excavation and the study of the site. In 1991, a special team was formed in the Dmanisi Archaeological Expedition for the study of the paleolithic deposits with Dr. Medea Nioradze, Abesalom Vekua, Givi Maisuradze, Jemal Sologhashvili, Elisabed Pavlenishvili, Nino Klopotovskaya, David Tushabramishvili, David Lordkipanidze, Merab Tvalchrelidze and German scientists Gerhard Bosinski and Antje Justus.

It was decided as a first priority to expand the excavation of the square in structure X, and on 24th September of the same year, human remains were discovered here: the mandible with 16 teeth. As a result of anthropological study it was attributed to *Homo erectus* and with other material determined to have an age of 1.8 million years.

The first international symposium held in Dmanisi emphasizes the great scientific value of the Dmanisi ancient man's site and its world significance.

ERAUL 92, 2000, p. 13 à 27.

CURRENT RESEARCH ON THE HOMINID SITE OF DMANISI

Leo Gabunia, Abesalom Vekua, David Lordkipanidze, Reid Ferring, Antje Justus, Givi Maisuradze, Alexander Mouskhelishvili, Medea Nioradze, Djemal Sologashvili, Carl Swisher III, Merab Tvalchrelidze

Geology and Geochronology

The early Paleolithic site of Dmanisi is in the province of Kvemo-Kartli (East Georgia), on the territory of the medieval town of Dmanisi.

Dmanisi is located about 85 km southwest of Tbilisi (44° 20' N, 41°) in the Mashavera River Valley, which drains the Javaheti volcanic chain to the west of the site (fig. 1).

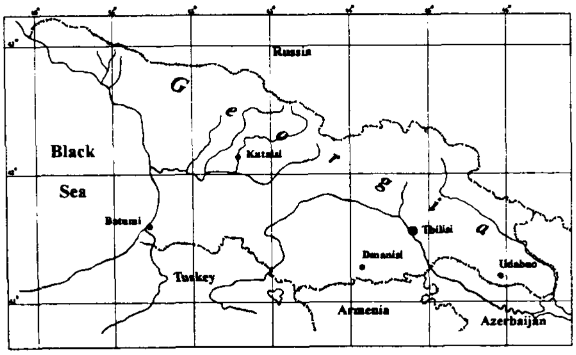


Figure 1. Map.

The site is situated on a promontory elevated about 80 m above the confluence of the Mashavera and Pinezouri valleys (fig. 2). The hominid and artifact-bearing deposits, the full extension of which is unknown, cover the original surface of Mashavera basalt. The age of Mashavera lava flow is 1.85 ± 0.01 MA. The lavas are normally magnetized and clearly correspond to the Olduvai paleomagnetic event. These lavas fill the Mashavera valley and also extended into the Pinesouri valley. The Paleolithic site had accumulated in direct association with a lake, which was formed when a lava stream blocked one of the Dmanisi rivers (fig. 3).

Today, the Dmanisi bone deposits lie over almost unweathered basalts, which extend over an area of some 5,000 sq.m. Up to date 150 m² was excavated (fig. 4).

The fossiliferous deposits are up to 4 m. in thickness and are covered by the remains of a medieval town and middens.

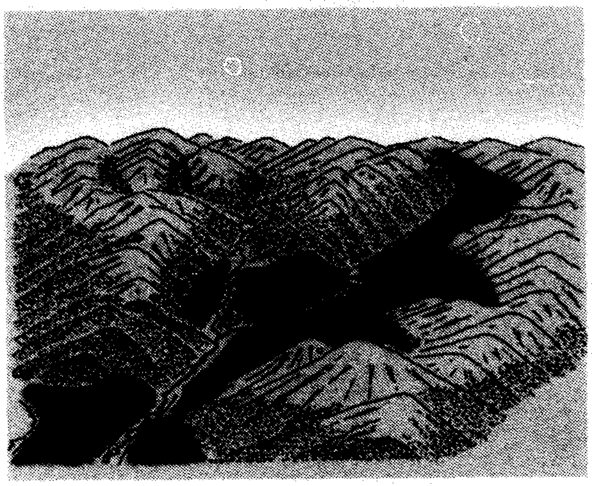


Figure 2. The site of Dmanisi today.

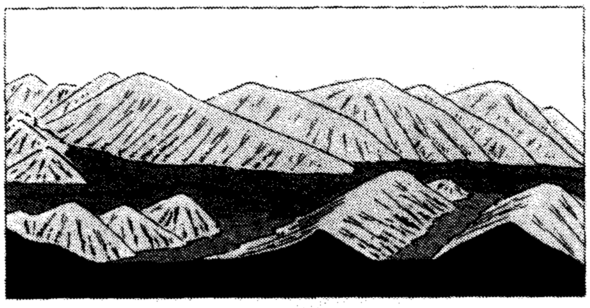


Figure 3. The site of Dmanisi 1.7-1.8 Ma ago.

We can distinguish the following three main stratigraphic units in the sections (fig. 5, by Gabunia *et al.*, 1999). The lowest one (layers V and IV), contains volcanic ash as well as colluvial and fluvio-lacustrine sediments. The lowest layer corresponds to the formerly defined Layer VI (Djaparidze *et al.*, 1989). This basal deposit is a black, basaltic, tuffaceous loamy sand, comprised mainly of pumaceous glass, plagioclase and associated mafics. The tuff is up to almost 50 cm thick, variably filling crevasses and low areas on the irregular, unweathered surface of the Masavera Basalt.

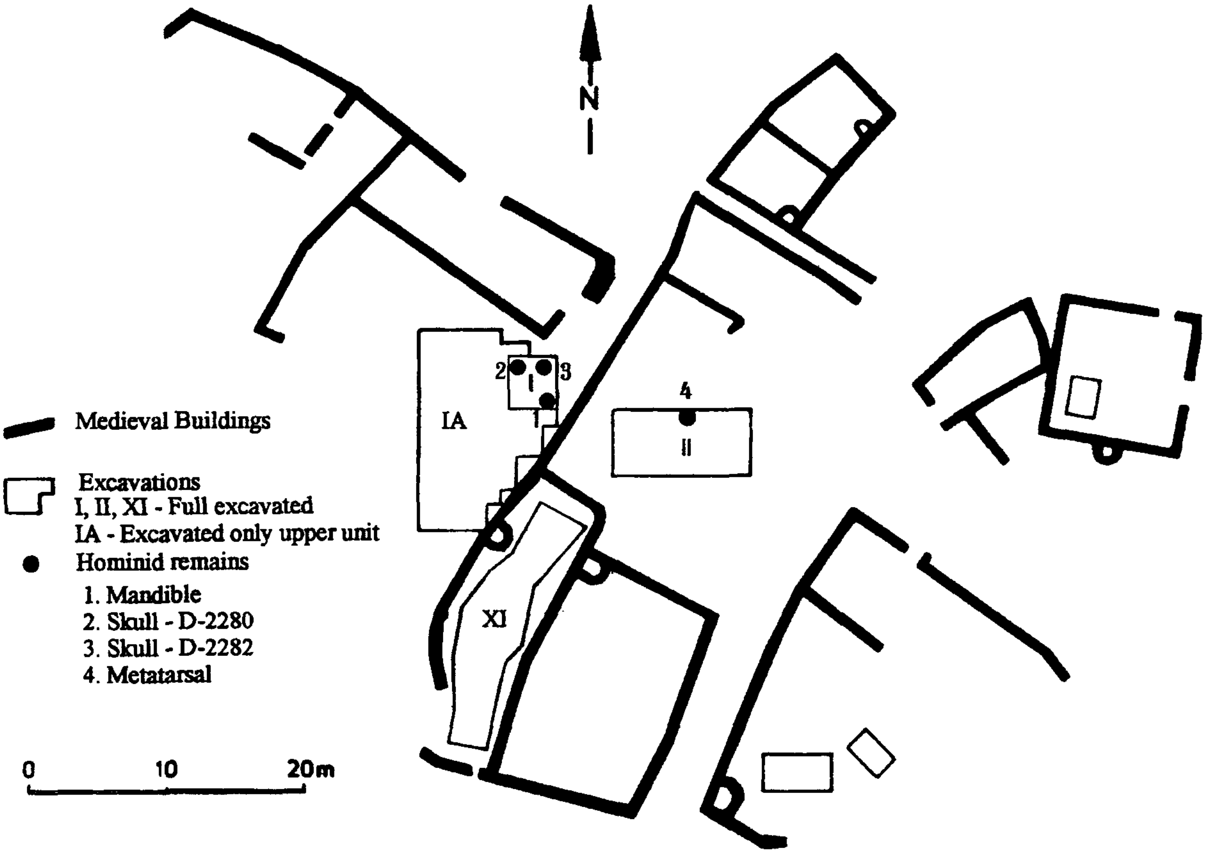


Figure 4. Plan of excavations.

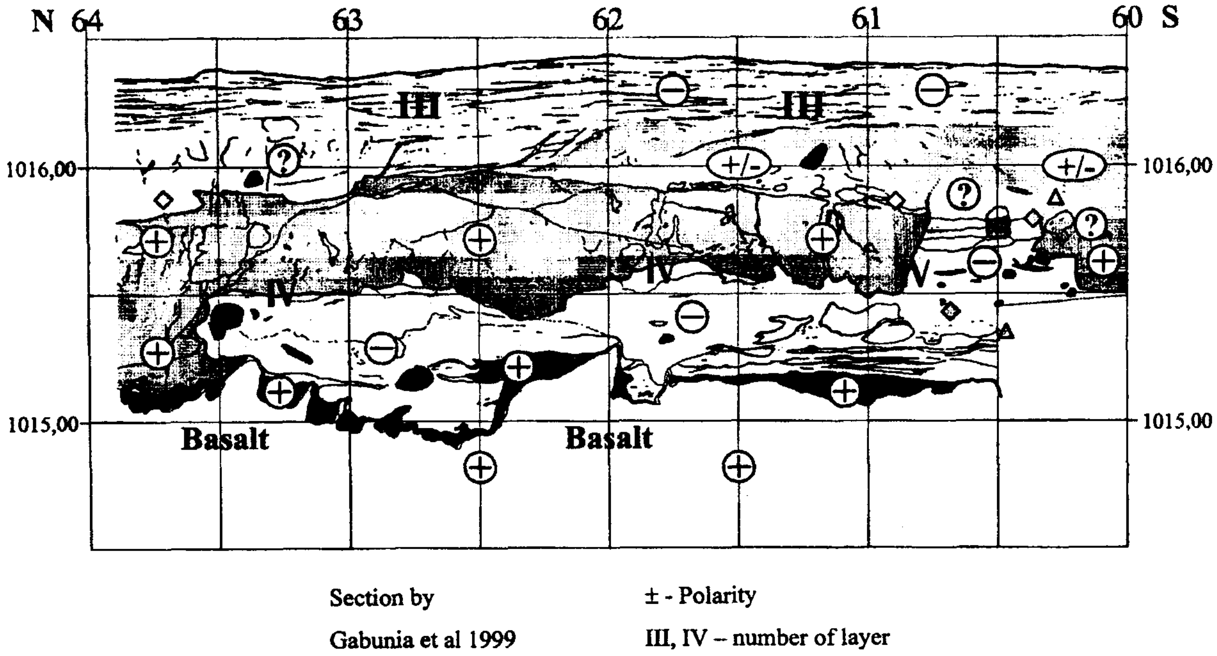


Figure 5. The section by Gabunia *et al.*, 1999.

Level IV is up to 2,5 m. thickness its corresponds contains former levels IV and V (Djaparidze *et al.*, 1989).

The unit is a massive to thinly bedded, very dark grayish-brown tuffaceous loamy sand that grades upward to a calcareous, dark yellowish-brown tuffaceous fine loamy sand; this unit has weak angular blocky structure, many carbonate veins and cavity linings, and is weakly indurated by 5-13% secondary carbonate.

This unit includes numerous remains of large mammals as well as some stone tools. In this unit we have samples with normal magnetization as well as samples with reverse polarity. The fossil remains come from nestlike lenses, which include whole crania as well as postcranial elements. The positions of the bones as well as the presence of the axial skeletons indicate that post-depositional movements have not affected them. All hominid remains recovered to date were found in this unit.

The Second unit Level III is represented by an indurate carbonate crust. This crust also contains fossilized fauna and stone tools. It covers the entire area of the site and serves as an important stratigraphic marker bed. The presence of this crust precluded any displacement of the bones or of stone tools from higher levels into the lower part of the section. This very hard carbonate zone must have contributed to the remarkable bone preservation in the underlying sediments. There is no evidence that the carbonate zone was broken or penetrated until the Medieval period. This unit has reverse polarity.

The upper unit (level II and I) contains mostly colluvial pebbles. This stratum has yielded the largest number of stone artifacts and few bones. This unit has reverse polarity.

The lower part is a massive, dark yellowish brown tuffaceous loamy sand, ca. 1.2 m thick. The upper 50 cm of this unit is a yellowish brown pedogenic calcrete, with laminar, massive and nodular fabrics. This soil, roughly the equivalent of Layer I (Djaparidze *et al.*, 1989), formed during a long period of surface stability.

Accumulation of the bone deposits directly above the Mashavera lava does not seem to have been separated by a geologically perceptible interval, as the surface of the basalt has no noticeable signs of erosion. Additionally, there are no traces of pedogenesis between the lavas and the observable cultural layers. Our observations suggest that this interval lasted no longer than the period between the dated Mashavera flow and the Olduvai-Matuyama boundary.

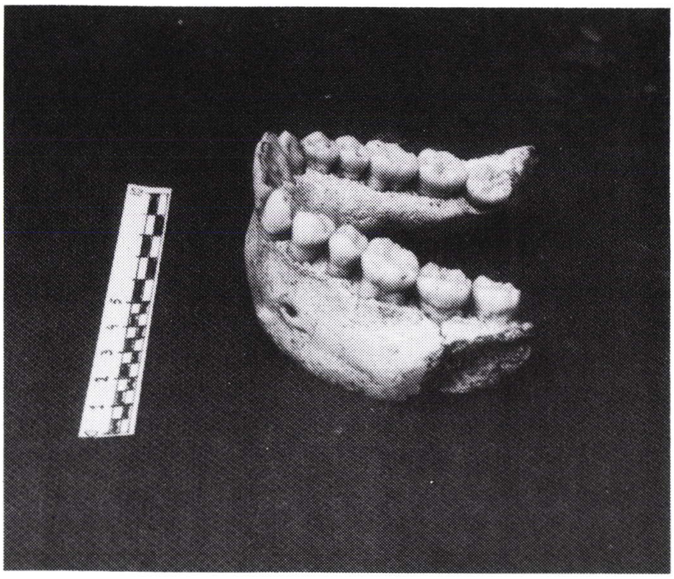
Dmanisi hominids

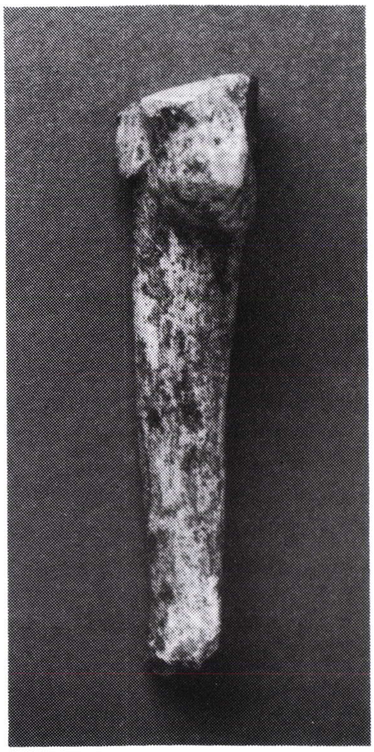
To date we have recovered four hominid remains in Dmanisi (fig. 4). This includes a mandible, (found in 1991), third metatarsal bone (found in 1997) and two hominid skulls in summer 1999 from the same level that produced the mandible.

When we attributed the Dmanisi mandible to *Homo erectus*, we noted that some of its characteristics are remarkable and unique (Gabunia and Vekua, 1993 and 1995). The mandible is different from all known *Homo erectus* specimens, but at the same time displays a certain similarity to several African fossils from Koobi Fora and Ileret (e.g., ER 992, and ER 730). It resembles these specimens in the general form and robustness of the jaw (fig. 6), in the anterior position of the ascending ramus which includes the edge of the retromolar space; in the absence of trigonum mentale, and in some other particularities. At the same time, it differs from those specimens in some important features. In particular the molars decreased in size from M^1 to M^3, P^2 is very small and the anterior surface of the symphysis is less receding among other features. One may suggest that the clear apomorphic character of these distinctive traits point to its possible affinity to the later *Homo erectus* (Brauer and Schulz, 1996). However, we think that these characteristics, which are generally considered as signifying advanced evolution, should be regarded in some cases as kinds of traits of accelerated development, whose phylogenetic significance is not always clear.

It is noticeable that such early representatives of genus *Homo* like *Homo rudolfensis* have a clear evidence of a trigonum mentale (Schrenk *et al.*, 1993). If we attribute a decisive systematic importance to the presence of chin triangle, then we should regard, *e.g.*, the *Homo erectus* from Tighenif as *Homo sapiens*. The weak mental protuberance is also marked on *H. erectus* from Koobi-Fora (ER 730), which has a trait of tuberculum marginales anterius. This feature is well developed on Sangiran 9, an archaic *H. erectus* from Java.

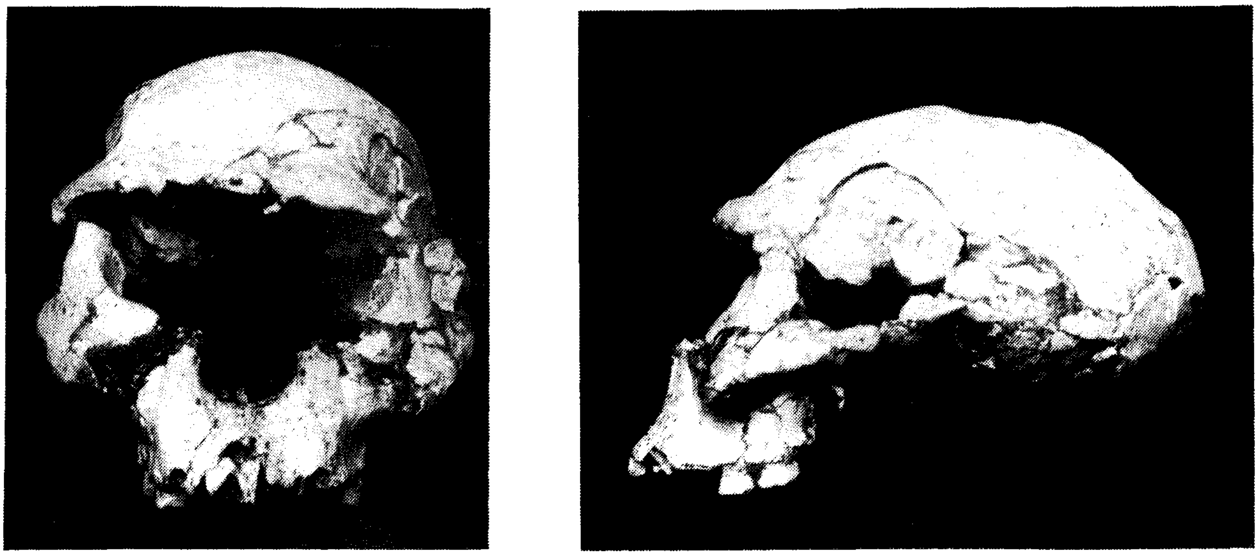
As to the distal molar reduction, which is generally regarded as a progressive trait, it might have appeared independently and at different times by various hominids. We would remind the reader that





6	7
8	9

Figures 6. Hominid Mandible; 7. Hominid Metatarsal; 8. D-2280 frontal view; 9. D-2280 lateral view.



Figures 10. D-2282 frontal view; 11. D-2282 lateral view; 12. D-2282 dentition.

early *H. erectus* from Koobi Fora (ER730) and from Nariokotome (WT 15000) have M^1 and M^2 approximately of the same-size, and the reduction of M^2 to M^3 is evident not only in the above mentioned forms but also in ER 992 from Koobi Fora, KGA 10-1 from Konso-Gardula (Asfaw *et al.,* 1992).

The distal molar reduction and other progressive characteristics are combined in the Dmanisi specimen, which also possesses archaic features in the structure of the jaw and even in its teeth. The reduction in the size of M^2 and M^3 could be linked with the anterior-posterior compression of the jaw. M^3 shows not only a notable decrease in size but is also slightly shifted medially, giving the impression that there is no room for it in the jaw.

We consider that the Dmanisi mandible is close to *Homo ergaster* group e.g., ER 992, ER 730,and WT 1500. Some scholars agree with this conclusion (Rosas and Bermudes-Castro, 1998), while others see the Dmanisi specimen as a very developed form linked to the late *Homo erectus* group (Brauer and Shulz, 1996).

The find of a hominid III metatarsal in Dmanisi (fig. 7) in Layer 4 does not contradict to its closeness with the early representatives of the *Homo erectus* group of Africa. According to its size and ratio (proximal and lat/med. breadth 12.1 mm, dorso-planter depth 18.1 mm., lat/med. breadth 6.1 mm. dorso-planter depth 8.7 mm.). it reveals close similarity to metatarsals 803 j and 1500 M from Kenya (Gabunia *et al.*, this volume).

In the summer 1999, the same level that produced the mandible also yielded two hominid skulls. The first specimen (D-2280) represents an almost complete cranial vault while the second (D-2282) is a cranium vault and a fragment of the maxilla (fig.8-12).

The first fossil specimen, D2280 (fig. 8-9), is an almost complete calvaria including a partial cranial base retaining slightly damaged nuchal and basilar portions of the occipital, parts of the greater wing of the sphenoid, and most of the left mandibular fossa of the temporal. The second and more complete cranium, D2282 (fig. 9-12), retains much of the face and cranial vault but has undergone lateral and dorso-ventral post-mortem deformation. The occipital and temporal regions are crushed on the left side, as are the zygomatic bones. The base is largely absent. Much of the median upper facial skeleton is missing including the supraorbital torus at glabella, nasal bones, and frontal processes of the maxillae. However, the maxillae are well-preserved laterally and inferiorly and retain the slightly worn right P^4-M^2, the left M^1 and M^2, and the alveoli of all other adult teeth including those of M^3 which are visible on radiograph. D2282 is the smaller of the two crania and based on gracile muscle attachment areas, less well-developed cranial superstructures, light dental wear, and well-demarcated cranial sutures may be either an older subadult or young adult and possibly a female.

Both crania are small with endocranial volumes below 800 cm^3. A direct measurement using seeds yielded an endocranial volume of 775 cm^3 for D2280. The cranial capacity calculated from the length, breadth, and cranial index of D2282 is about 650 cm^3.

Cranial shape is similar in both specimens, spheroidal in superior view and relatively low and angular in lateral view. Greatest cranial breadth is low at the level of the well-pneumatized mastoid processes. The occipitals are relatively narrow and angular. The occipital angle in D2280 is 108°. A continuous occipital torus is present in each specimen, and D2280 exhibits a larger torus and more rugose nuchal muscle markings than does D2282. A pronounced occipital crest extends from the external occipital protuberance to the foramen magnum in D2280. The frontal sinus and ethmoid pneumatization are visible in D2280. A wide supratoral sulcus is present in D2282 where it is less developed in D2280. Postorbital constriction is significant. Cranial bones are moderately thick and no cranial cresting is present (the temporal lines are separated by at least 23 mm in D2280). Traces of an angular torus are present in both specimens and a small sagittal keel is present in D2282. An apparent metopic eminence and sagittal keel on D2280 is likely pathological. The glenoid fossae of the temporal are mediolaterally and anteroposteriorly long and relatively deep. The entoarticular process in D2282 is projecting and formed by both temporal and sphenoidal contributions as is foramen spinosum. Temporal squamae are moderately long and low, although somewhat taller in D2282 than in D2280.

The D2282 facial skeleton is well-preserved at Estimates of the facial, orbital, and zygomatic heights and orbital breadths are comparable to those of the Koobi Fora specimens assigned to *H. ergaster*. The pyriform aperture is comparatively narrow, blunt sided, and has a small pre-nasal fossa. The naso-alveolar clivus is wide and somewhat flattened, forming an angle close to 46° to the alveolar plane. The jugum alveolare canini is well developed, forming a distinctly flattened convexity, rising over the lower edge of the pyriform aperture. The palate is moderately long, narrow and deep. The tooth rows diverge minimally from one another. The anterior zygomatic is positioned at M^1.

The maxillary dentition of D2282 is similar in size and morphology to that of KNM-ER 3733 and KNM-WT 15000. The P^4 is single-rooted and narrow crowned. Molar crown area is larger in M^1 than in M^2.

The combination of the features of the Dmanisi hominids appear more similar to *H. ergaster* than to *H. erectus sensu stricto* (or to any of the habilines). This conclusion is consistent with our studies of the Dmanisi mandible. We thus assign the Dmanisi hominids to *Homo ex gr. ergaster.*

The Biostratigraphy of the Vertebrate Faunas

The Dmanisi faunal assemblage consists mainly of Villafranchian mammals, the majority of which can be attributed to the top of Middle Villafranchian or Villanyan and to the Lower Biharian (fig. 13). The inventory includes: *Megantereon megantereon, Homotherium crenatidens, Pantera gomgaszoegensis, Ursus etruscus, Equus stenonis, Dicerorhinus etruscus* and several others which are found throughout the entire Villafranchian and therefore cannot provide an accurate geological age for the Dmanisi complex (Turner, 1994). Instead, we consider the following species as better chronological markers: (1) the very large ostrich - *Struthio dmanisensis*, which is similar in size to *S. transcaucasicus* from Kvabebi (Vekua, 1972), and is also reminiscent of the gigantic ostrich *Struthio oldwaji* from Olduvai I (Leakey, 1967), (2) *Mimomys tornensis, (3) Mimomys ostramosensis, (4) Kowalskia sp., (5) Pachycrocuta perrieri, (6) Cervus perrieri and Cervidae cf. Arvernoceros, (7) Gazella cf. borbonica and finally, (8) Giraffidae cf. Paleotraginae.*

These species are widely represented in the layer 4. In Layer 2, to date, we found only *Pachycrocuta perrieri, Cervus perrier, and Giraffidae cf. Paleotraginae.* These data, as discussed below, indicate that the Dmanisi fauna is older than the end of the Late Villafranchian (fig. 13).

It should be noted that in the East Paratethys region ostriches are not known from deposits younger than the Pliocene (Dubrovo and Kapelist, 1979). In the Caucasus their late representatives - namely, the large type of *Struthio* - are found in Lower Apsheronian of Taribana (correlated with the Dmanisi horizon) and of Palan - Tukan in west Azerbaijan (Burchak-Abramovich, 1953).

The discovery at Dmanisi of *Mimomys tornensis* and *Mimomys ostramosensis* indicates that the Dmanisi fauna cannot be younger than basal Biharian.

The genus *Kowalskia* is known mainly from the late Miocene and the Lower Pliocene (Mein, 1989). It occurs less commonly in the late Pliocene (Zheng, 1984) and has not been found to date in the Pleistocene. The discovery of this species at Dmanisi clearly supports the antiquity of the Dmanisi complex.

The remains of giraffes at Dmanisi were also unexpected because, in Georgia, late representatives of this taxon are known from the lower part of the Upper Pliocene (Gabunia and Buachidze, 1970).

Pachycrocuta perrieri and *Cervus perrieri,* characteristic of the early and middle Villafranchian faunas of western Europe, and middle-sized deer, reminiscent of *Arvernoceros ardei*, all also indicate affinities with middle Villafranchian and basal late Villafranchian faunas (Turner, 1994).

Our recovery of *Gazella cf. borbonica* is significant because in western Europe this taxon is not found in deposits younger than the Middle Villafranchian (Agusti and Moya-Sola, 1992).

The archaic faunal component at Dmanisi also includes *Archidoskodon meridionalis taribanensis*, a southern elephant who possibly requires a new species designation (Alekseeva, 1977).

Comparatively younger forms are also present at Dmanisi, such as *Soergelia*, which first appears in the Upper Villafranchian and lasts through the Middle Pleistocene. It is important to note, however, that the palaeontological history of this species has been poorly studied to date, and it may have been present earlier than has previously been thought. One form was recently identified in Venta-Micena (Spain) in the context of Early Pleistocene fauna (Agusti and Moya-Sola,1992).

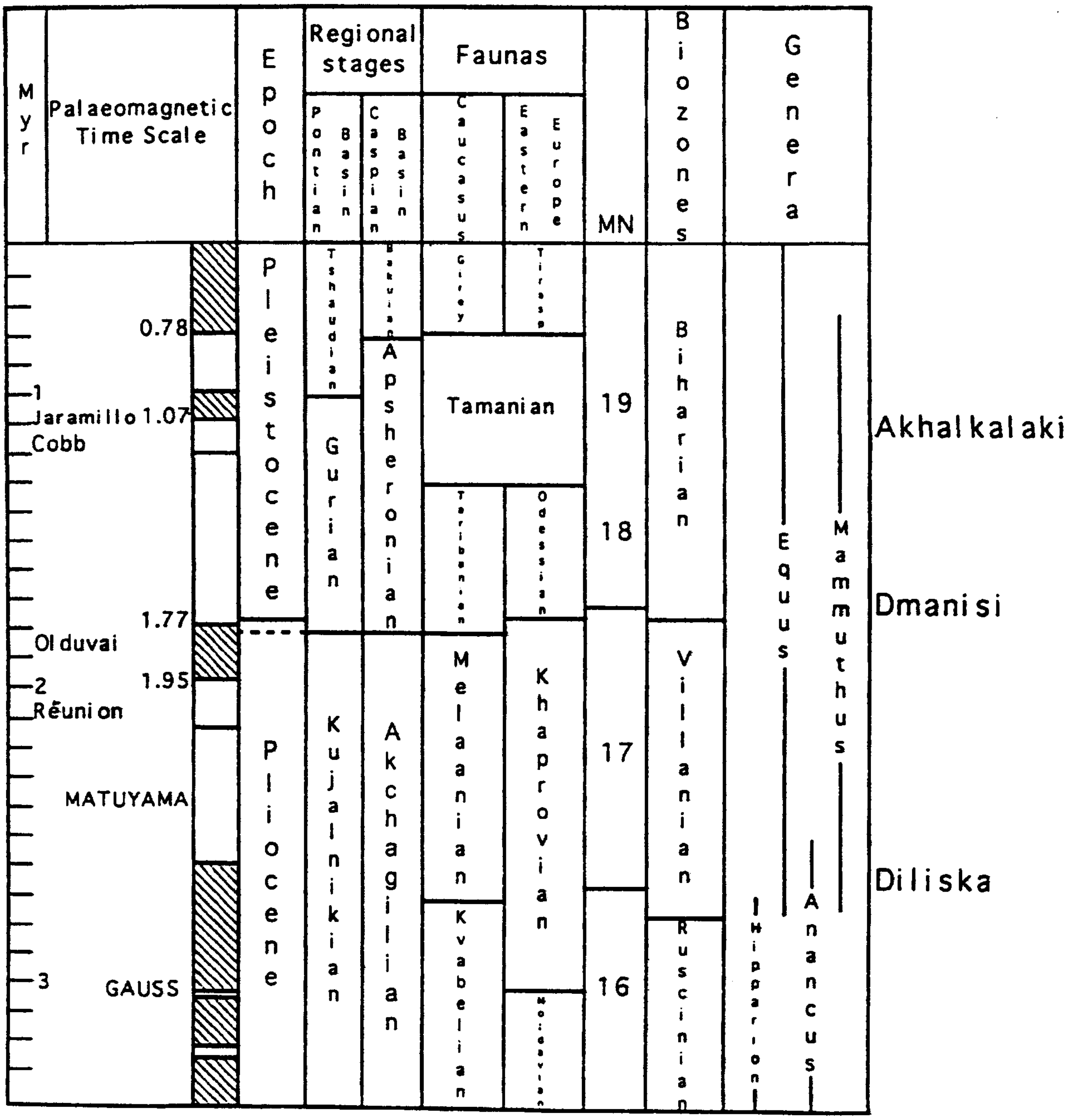


Figure 13. Stratigraphical shema.

Considering that *Soergelia* is probably of Asian origin and that its migration required some time, the appearance of early representatives of this genus in Transcaucasia at the beginning of the Pleistocene or even at the end of the Pliocene is not surprising.

In Europe the first appearance of *Pantera gomgaszoegensis* coincides with the disappearance of *Pachycrocuta perrieri* (Turner, 1994). In Dmanisi both species coexisted. It is possible that *P. Gomgaszoegensis* as well as *Canis etruscus* dispersed here from the East. Traces of *P. gomgaszoegensis* in Transcaucasus are older than those from western Europe, where the earliest appearance of this species are reported from Olivola and Tegelen (Turner, 1994) and where they are found together with *Pachycrocuta brevirostris*.

In western Europe, *Dama nesti* is limited mainly to the Late Villafranchian (Azzaroli *et al.*, 1988) but its presence in Transcaucasia at the beginning by this time or even at the end of the Middle Villafranchian cannot be excluded. It seems that at Dmanisi it is present at the beginning of Apsheronian, (the basal part of the Lower Pleistocene) (fig. 13). The same can be said for some other members of the Dmanisi fauna with comparably broad stratigraphical spread (*Hypolagus brachygnathus, Apodemus cf. dominans, Megantereon megantereon, Canis etruscus, Ursus etruscus* and others).

The Dmanisi bovid is a new genus and species that was named, *Dmanisibos georgicus* (Burchak-Abramovich and Vekua, 1992). It is difficult to assess its bio-stratigraphic implications. However, such features as the flatness of its forehead, an occiput notably stretched in length, and a distinctive position of the horn pivot, place it in an intermediate position between the *Tshaudian Eobison* (Flerov, 1979) and the more archaic *Adjiderobos* (Dubrovo and Burchak Abramovich, 1984) from the Late Akchagylian. This nicely correlates the chronological horizon of the Taribana-Dmanisi fauna.

A small complex of vertebrates from the Lowest Apsheronian of Taribana (Kotsakhuri region) consists of *Testudo sp., Emys orbicularis, Struthio sp., Archidiskodon meridionalis taribanensis, Equus stenosis stenosis, Dicerorhinus cf. etruscus, Camelus sp., Protoryx sp., Leptobos sp.* and others (Gabunia and Vekua, 1981; Vekua and Kvavadze, 1981). The Dmanisi fauna is very close to that of Taribana and may date to the basal part of the Apsheronian. These two faunal localities are geographically quite close to each other and, as discussed below, represent the same paleoenvironment.

The small faunal collection from Tsalka is also assigned to the Dmanisi-Taribana complex. It contains *Homotherium cf. crenatidens, Dama cf. nesti, Eucladoceros sp., Leptobos sp.* (Vekua *et al.*, 1985). Long-range comparisons extend through Europe and the Near East. When the Dmanisi complex is compared to Eastern Europe, it corresponds to the late phase of the Khaprov faunal complex (Alekseeva, 1977), where Hipparion and Annancus are already absent. However, the presence of *Ellasmotherium, Paracamelus* and some other species separates them from the Dmanisi complex and reflect the more severe climate that prevailed in Kharpov. The Dacic basin (Romania) is of special interest because its Tatou complex is close to the Dmanisi fauna (Radulescu and Samson, 1990) and also contains artifacts. The fauna includes *Archidiskodon meridionalis, Ursus etruscus, Pachycrocuta perrieri, Homotherium crenatidens, Megantereon megantereon, Equus stenonis, girafid Mitilanotherium.* Another site, Shandalia (former Yugoslavia), is also similar to Dmanisi in terms of the mammalian fauna and the remains of a lithic inventory (Malez, 1975). These examples offer evidence that at the beginning of the Pleistocene, Transcaucasia was more closely linked with the Dacian-Balkan region than with Eastern Europe.

In spite of the absence of good faunal correlations with western Europe, the assemblages of Le-Coupet, Olivola, Seneze, and Tasso are generally comparable as they all contain typical forms of *Archidiskodon meridionalis, Equus stenonis, Ursus etruscus* and other taxa (Guerin, 1982; Bonadonna and Alberdi, 1987; Azzaroli *et al.*, 1988). These complexes are also characterized by other species which reflect regional specificities in western Mediterranean and, in some cases, differences in the geological ages. They are dated to the Middle Upper Villafranchian, from the upper part of Zone 17 and Zone 18 as defined by Guerin (1982). Among the Late Villafranichian western European mammalian faunas of western Europe, the Venta-Micena complex is more similar to Dmanisi (Martinez, 1992). It differs from Dmanisi in its regional characteristics but may represent the comparatively advanced evolution of representatives of some common forms.

The Dmanisi fauna bear a distant resemblance to Ubeidya (Israel) which contains different forms of fossil vertebrates, rare remains of *Homo sp.* and rich lithic assemblages (Tchernov *et al.*, 1986). Ubeidya, however, is not only younger than Dmanisi, but also differs from it by the presence of *Archidskodon meridionalis tamanensis, Hippopotamus* and other taxa which indicate different ecological conditions. At the same time, both sites contain several common species: *Hypolagus brachygnatus, Canis etruscus, Ursus etruscus, Dicerorhinus etruscus*. The discovery of *Parameriones cf. obedediensesis* at Dmanisi is of special interest. Tchernov and colleagues (1986) consider this taxon as endemic to the Ubeidiya region.

Overall, the Dmanisi fauna contain species with diverse points of origin where Palearctic elements prevail over Paleotropical ones. Although it is difficult to assign specific origins to the Palearctic species, most of them likely dispersed here from Asia. The origin of *Megantereon* remains moot. Some researchers argue that this taxon belongs to the African *Megantereon whitei* (Martinez-Navarro and Palmkvist, 1996). We remain to be convinced. The sum of these data, however, do indicate that during the Plio-Pleistocene, extensive faunal interchanges occurred via the territory of Transcaucasus.

The Paleoecology of Dmanisi

It is important to note that our excavations at Dmanisi are still in progress. Although we do not have complete information about the ecological structure of this fauna, a preliminary analysis is currently underway.

Figure 14 shows that the fauna from Layer 2, which is separated from Layers 4-5 by a calcareous crust, substantially differs from that recovered from the lower part of the section.

Figure also shows that layer 4 contains substantially more bones and more species than do layers 2 and 3. No rodents or reptiles have been recovered from the upper layers. The almost complete absence of carnivores from the upper layers does not seem accidental but likely reflects paleoecological changes. While acknowledging taphonomic factors, we suggest that the observed decreases in species richness towards the upper levels likely also reflects a climatic changes which correlates with the general trend to aridisation of eastern Georgia in the Lower Pleistocene (Shatilova and Ramishvili, 1990).

The Dmanisi faunal assemblage contains representatives of different habitats. Denizens of the forest-steppe ecosystem predominate, while *Struthio, Ochotona*, and some other taxa indicate the importance of steppic conditions. The presence of xerophytic plant communities is also reflected in Dmanisi reptiles in such forms as *Coluber najadum* (Chkhikvadze and Kharabadze, 1995), *Gerbillus* sp., *Hypolagus brachygnathus* and *Archidiskodon*, etc. Steppic conditions are also evident in the preliminary data on terrestrial gastropods, the following species of which have been identified to date: *Helicopsis sp., Pseudochondrula tuberifera, Helix aff. pomatia, Jaminia sp.*, etc. (I. Taktakishvili, personal communication 1998).

At the same time, the abundance of deer at Dmanisi, where they represent >80% of Artiodactyla, points to the important role played by forested areas. The abundance of *Cervids* distinguishes Dmanisi from coterminous faunal complexes of the Paleotropical realms as well as from some Palearctic ones. *Cervids,* for example, are absent from such nearby sites as Taribana (Kotsakhuri). We believe that at Dmanisi the richness of the *Cervid* fauna partially reflects the vertical zonality of the nearby forested mountainous areas. *Dama cf. nesti*, like the modern *Dama dama,* could have preferred open landscapes and forest edges (Pidoplichko, 1954). *Cervus perrieri* and *Cervidae cf. Arvenoceros* likely favored foothills and the lowest parts of the forest zone. *Eucladocerus cf. senesensis*, like *Cervus elaphus* which today inhabits the southern slope of the Major Caucasus and inhabits the Lagodekhi region some 70 km north of Dmanisi, possibly preferred the middle range of mountainous forests. Such *Caprinis* as *Soergilia* could be lived in middle and high mountainous forests. Other indicators of forests include *Sorex sp.*, and possibly wild cattle (*Dmanisibos georgicus).*

The co-occurrence of such different large carnivores as *Pachycrocuta perrieri, Pantera gombaszoegensis, Megantereon megantereon, and Homotherium crenatidens* in Layers 4 and 5 at Dmanisi indicates the diversity of the landscapes in this region.

The sum of these data show that when Layer 4 accumulated, Dmanisi was located in a mixed mosaic environment of open landscapes, gallery forests along the river valleys and forested mountains. Forested areas were reduced in size during the formation of Layers 3 and 2.

The Dmanisi community structure differs somewhat from those identified at other early hominid sites. In contrast to Olduvai, Dmanisi has no Suids but does have a large number of *Cervids.* Ubeidiya, likewise, contains few *Cervids*. The closest counterpart to the Dmanisi mammalian community is to be found at the Early Pleistocene site of Orce (Palmqvist and Martinez-Navarro, 1996).

The validity of our reconstructions of the Dmanisi paleoenvironments can be independently tested with floral data.

New pollen studies done at Dmanisi only partially corroborate the earlier floral evidence retrieved from the coprolite which indicated rich forest spectra (Klopotovskaja *et al.*, 1989). In a sample from Layer 4, shrub and herb elements predominate (*Chenopodiaceae, Artemisia, Ephedra* and others). Arboreal vegetation is represented by mostly single pollen grains of *Betula and Pinus*, and only one sample produced the pollen of *Tilia.*

At the same time, thousands of seeds of *Borraginaceae, Anchusa, Lycopsis, Lithosprmum* and of other species were present in all cultural

Species in ***Dmanisi***	**Level 2**	**Level 3**	**Level 4**
Erix sp.			**X**
Natrix sp.			**X**
Coluber najadum			**X**
Coluber robertmertensi			**X**
Elaphe aff. dione			**X**
Pelias sp.			**X**
Daboia cf.raddei			**X**
Struthio dmanisensis			1\1
Ochotona cf.lagreli			2\1
Hypolagus brachyagnatus	1\1		70\4
Apodemus dominans			9\3
Kowalskia sp			1\1
Cricetus sp.			1\1
Mimomys tornensis			2\1
Mimomys ostramonensis			2\1
Parameriones cf.obeidiensis			10\3
Gerbillus sp.			1\1
Marmota sp.			1\1
Canis etruscus	7\3	2\1	127\9
Ursus etruscus	7\2		66\5
Martes sp.			1\1
Megantereon megantereon			43\4
Homotherium crenatidens			17\3
Panthera gombaszoegensis			31\1
Pachycrocuta perrieri	1\1		7\2
Archidiskodon meridionalis	4\1	4\1	44\9
Equus stenonis	38\5	4\1	260\23
Dicerorhinus etruscus etruscus	5\1	2\1	76\9
Gazella borbonica			24\7
Soergelia sp.	7\2		66\9
Dmanisibos georgicus	9\3	2\1	131\23
Cervus perieri	19\4	5\2	256\11
Eucladocerus aff.senezensis	5\1		82\8
Cervidae cf. Arvernoceros			22\5
Dama nesti	2\1		291\18
Paleotragus sp.	1\1		5\2
Homo sp.			4\2

Figure 14. Fauna of Dmanisi.

layers. While a great number of seeds from the beetroot family found at Dmanisi are inedible, such edible species as hackberry (*Celtis*) are rather frequent. Although these taxa are characteristic of savanna flora (Leme, 1974), today they also grow in the woodlands of the Caucasus and of central Asia (Gulisashvili, 1980). We suggest that hackberries and, perhaps, the fruits of *Ephedra* were consumed by Dmanisi hominids. Seeds of *Celtis* are frequent in other early Paleolithic sites - e.g. at Zhoukoudian (Dohnal, 1961), Lazaret, Terra-Amata, Tautavel and others (Bahn, 1984) - and may represent components of hominid diets.

The abundance of *Borraginaceae* seeds at Dmanisi merits special attention. These xerophytes are anthropophites, often found in archaeological sites of later time periods. In the Near East these taxa are seen as indicators of human occupation (van Zeist, 1991). Their presence at Dmanisi may indicate that already at this early a time hominids had an impact on local plant associations which resulted in the increased reproduction of weeds and pioneer vegetation.

The presence of the pollen of *Abies, Pinus, Alnus* and, less frequently, of *Ulmus* and *Salix* (Klopotovskaja *et al*., 1989; Kvavadze, 1997) at Dmanisi reflects a considerable variety of vegetation and possibly some vertical zonality. The predominance of herbs here, like at Taribana, of grass forms is in good accord with the herpeto assemblages as well as with the associations of certain mammals and birds. Forests probably covered the middle mountain ranges as well as grew along river channels while the flat river valleys were covered by savanna vegetation.

We can summarize the above data by arguing that warm climatic conditions prevailed at Dmanisi during the Lower Paleolithic. The climate was warmer and dryer than the present day one and corresponded to the Mediterranean type of climate. This paleoclimatic reconstruction is in good accord with evidence for a general aridisation of east Georgia landscapes at the end of the Pliocene (Late Akchagylian-Early Apsheronian). This increased aridity resulted in a considerable reduction of wooded areas and in the spreading of open vegetation (Shatilova and Ramishvili, 1990). Pollen data from Taribana support this interpretation and indicate more arid conditions than existed during the preceding periods (Vekua, 1972). At Taribana the rich NAP component is dominated by *Poaceas* (about 47%) along with pollen of *Chenopodiace*ae and *Artemisia* (Vekua and Kvavadze, 1981). Arboreal elements include *Platanus orientalis, Alnus,* and *Pinus*. This paleofloristic spectrum indicates a mixed forest-steppe environment, one which perhaps resembles a modern savanna. While steppes spread in the lowlands, forests grew in the river valleys and at higher elevations. During this time, one corresponding to the Olduvai paleomagnetic subchron, warm climates predominated almost everywhere in Europe (De Jong, 1988).

Lithic Artifacts

Lithic artifacts are present in all horizons. To day over 800 stone artifacts have been recovered. Lithic artifacts are particularly common in Layer II (more than 90 % of all quantity) but are also present in Layers III and IV. It is still not possible to recognize differences in the typology or technology of the various layers.

The artifacts are mainly manufactured from silicified volcanic tuffs and are occasionally of quartz. Petrographic analyses of the recovered stone tools show that hominids here exploited the pebbles and cobbles available in a gorge near the site (Tvalchrelidze and Lordkipanidze, 1998). They are struck from cobbles which occur in the valleys of the Mashavera and Pinezaouri.

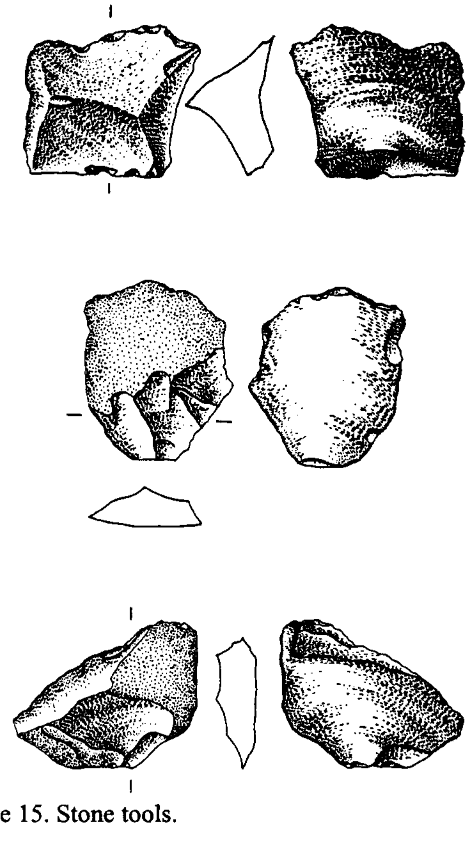


Figure 15. Stone tools.

Flakes make up the majority of the artifacts (fig. 15-16). A number of the smaller flakes are struck from more highly silicified flint-like tuffs, which are only rarely found in the river gravels.

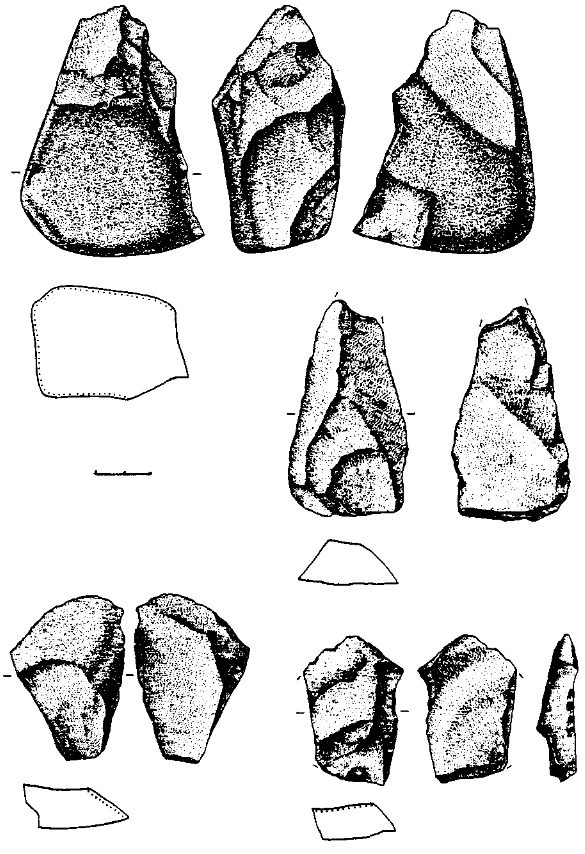


Figure 16. Stone tools.

The dorsal surfaces of the flakes normally have flake scars which are usually struck from the same direction as the flake itself and show serial knapping of flakes. The flakes edge commonly show definite use wear (marginal retouch, splintering, small notches).

Retouched flakes (fig. 16) are rare, but present in the form of edge retouch and stepped retouch. A multiple burin is present, manufactured on a large flake with an edge retouched ventral face.

Cores are mainly spherical/polyhedric and struck from several directions (fig. 16-17). There are also conical cores whose striking platform is formed by one or, at most, a few blows. Pebble tools are both unifacially and bifacially worked and show a great overlap with the category of cores (fig. 18-19).

No bifaces or developed Oldowan artifacts have been found. Most of the artifacts retain sharp edges suggesting little transport and no refits of flakes or tools were observed. By the basic knapping technique Dmanisi lithic complex clearly belongs to the Oldowan or mode 1 industries. The Dmanisi artifacts are compatible with pre-Acheulean assemblages of East Africa.

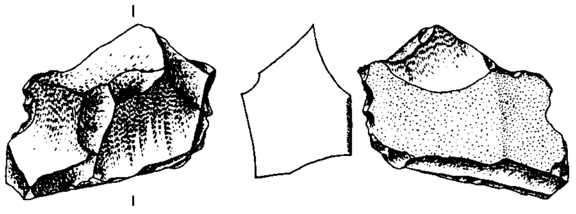


Figure 17. Stone tools.

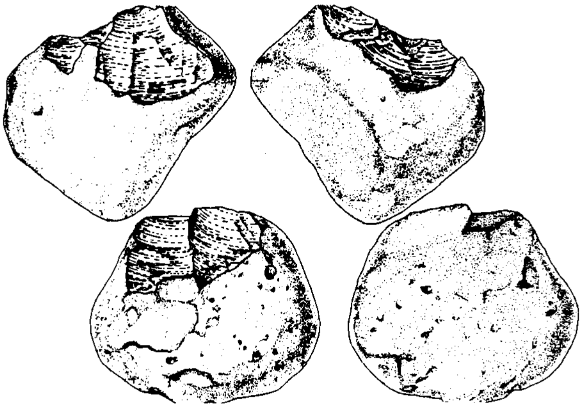


Figure 18. Stone tools.

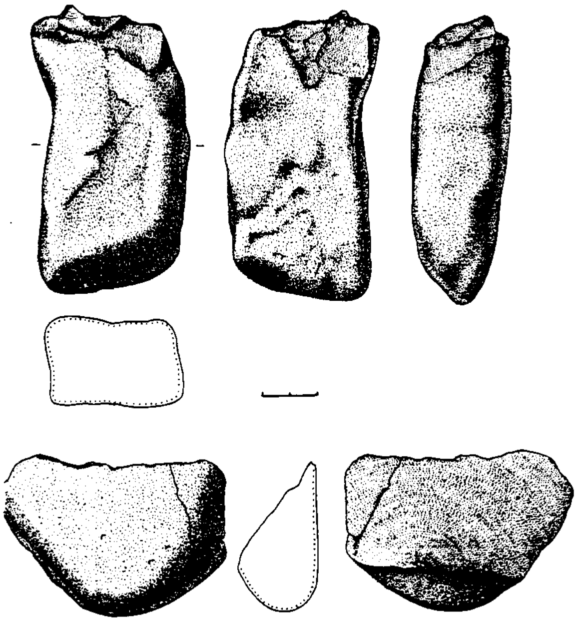


Figure 19. Stone tools.

Conclusions

Dmanisi is the oldest hominid site found in western Eurasia to date. The geological age of the Dmanisi fauna corresponds to an early phase of the Upper Villafranchian (Upper Villanyan or Lower Biharian, transition MN 17 to MN 18).

Paleontological, archeological, geochronological, and paleomagnetic data from Dmanisi all indicate an earliest Pleistocene age of about 1.7 MA.

The Dmanisi fauna reflect quite diverse landscapes - an interpretation supported by paleobotanical evidence. The data from Dmanisi reflect the prevalence of a moderately dry climate and the presence of fairly extensive open landscapes.

The hominid site itself was likely located near a lake or pond, rich in lacustrine resources. This biome, together with the adjacent forest-steppe formations, created a highly productive ecotone rich in animal and plant resources. The nearby river gravels provided hominids with extensive lithic resources (pebbles and cobbles) used for tool production.

The Dmanisi hominid remains are the first hominids discovered outside of Africa to show clear affinities to African *H. ergaster* rather than to more typical Asian *H. erectus* or to any European hominid.

Further research at Dmanisi will enable us to refine the geologic age of site as well as to retrieve new data which will enrich our understanding of the Dmanisi hominids and their way of life.

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MORPHOLOGIE ET FONCTION DU TROISIÈME MÉTATARSIEN DE DMANISSI, GÉORGIE ORIENTALE

Léo Gabounia, Marie-Antoinette de Lumley et Gilles Berillon

Résumé

L'élément d'un pied humain a été reconnu parmi le matériel archéologique provenant des fouilles effectuées en 1997 à Dmanissi, au niveau de la couche IV, attribuée à la fin de l'épisode oldowayen ou au début de Matuyama post-oldowayen. Il s'agit d'un métatarsien III droit, D2O21, dont les caractéristiques anatomiques évoquent chez cet individu, vraisemblablement de sexe féminin, la présence d'une voûte osseuse plantaire longitudinale faiblement marquée, compensée par une forte musculature destinée à augmenter la voussure de l'arche transversale. Cette disposition rappelle celle observée sur les hominidés du Pléistocène inférieur africains de Koobi-Fora, Omo et Olduvai, datés entre 1,8 et 1,5 Ma.

Abstract

A human foot element has been identified in the archaeological materiel of the 1997 Dmanissi field season, on the level with the layer IV which is attributed to the end of the oldowayan episode or the beginning of post-oldowayen Matuyama. It is a right metatarsal bone, D2021, which anatomical features evoque that the foot of this individual, very likely female, associated a low longitudinal plantar arch with a compensatory strong muscles which allows to increase the transversal arch. This arrangement is similar to the one of the lower Pleistocene African hominids from Koobi Fora, Omo and Olduvai and dated of 1.8-1.5 My.

Au cours de la fouille du mois d'août 1997, un troisième métatarsien droit humain a été recueilli dans la couche IV du carré 64/59 ($14^{ème}$ bâtiment) du site de Dmanissi, n° D2021 (Gabounia *et al.*, 1999). C'est le deuxième reste humain découvert sur ce site après la mandibule.

Le métatarsien était associé à une mandibule de *Canis etruscus*, un cubitus et une M3 inférieure d'*Archidiskodon meridionalis*, une ramure de *Cervus perrieri*, une omoplate de cf. *Soergaelia* et quelques autres mammifères. L'industrie lithique est attribuée au Paléolithique inférieur. Le premier reste humain, une mandibule, découvert en automne 1991 était dans la couche V sous-jacente, situé à une dizaine de mètres de distance de celui du métatarsien. Les couches IV et V présentent de grandes similitudes au point de vue paléontologique, archéologique et sédimentologique. Cet ensemble est attribué à la fin de l'épisode oldowayen ou au début de Matuyama post-oldowayen. Il s'agit d'une période à climat tempéré, modérément sec, avec une végétation demi-steppique.

La faune est caractérisée par la présence d'équidés, de rhinocérotidés, de girafidés, d'autruches, de différents cervidés et de gros carnivores comme *Megantereon* (tigre à dent de sabre), *Homotherium*, *Canis etruscus*, un grand hyénidé *Pachycrocuta cf. perrieri*, et de rongeurs du groupe *Mimomys pliocaenicus*. Cette association traduit le début du Pléistocène inférieur et une assez grande diversité du paysage liée à la situation géographique du site de Dmanissi à proximité du versant nord du petit Caucase.

Etat de conservation, age, sexe

Le métatarsien de Dmanissi est cassé distalement au niveau des tubercules dorsaux ; seul le tubercule médial est préservé. Ils constituent la limite dorsale et distale du point d'ossification principal correspondant au corps, et se situent au contact de la zone métaphysaire en arrière du point d'ossification secondaire correspondant à la tête. La cassure est oblique et passe en avant du tubercule médial et en arrière du tubercule latéral. Elle est nette et ne laisse voir aucune trace de métaphyse. Le point d'ossification secondaire correspondant à la tête du métatarsien devait être soudé au corps de l'os. L'ossification et la croissance du métatarsien devait être terminée. L'individu devait être âgé de plus de 18 ans selon les tables relatives à l'homme actuel (Flecker, 1942).

Les données dimensionnelles et l'aspect morphologique gracile de l'os évoquent une appartenance à un adulte de sexe féminin (fig. 1).

Figure 1. Métatarsien III droit, D2021, vues dorsale (a), latérale (b), plantaire (c), médiale (d), proximale (e) appartenant à un adulte vraisemblablement de sexe féminin découvert en 1997 dans la couche IV du site de Dmanissi (Géorgie orientale), daté d'environ 1,7 Ma. *Gr.nat.X2. Clichés labo. photo. Musée de l'Homme.*

Dimensions générales

Le métatarsien III de Dmanissi est comparé aux fossiles et échantillons actuels suivants :

- les métatarsiens III du Pléistocène inférieur découverts en Afrique de l'Est :
  - Omo F 511-16 du member H de la formation de Shungura (Éthiopie) daté de 1,6-1,8MA (Coppens, 1975 ; Howell et Coppens, 1976) et attribué à un hominidé de genre et d'espèce indéterminés (McHenry, 1994),
  - KNM-ER 803 découvert à Ileret area 8A (Kenya) (Leakey, 1972; Day et Leakey, 1974), daté de 1,5-1,6MA (Fiebel *et al.*, 1989) et attribué par leurs inventeurs au genre *Homo*,
  - OH8 découvert à Olduvai (Tanzanie) dans le niveau FLKNN du Bed I (Leakey, 1960), daté d'environ 1,78 Ma (Walter *et al.*, 1991), paratype de *Homo habilis* (Leakey L.S.B. *et al.*, 1964; Day et Napier, 1964).
- les métatarsiens des néandertaliens de Krapina 247-1, Kiik-Koba 1, La Ferrassie 1 et 2, Subalyuk1, Tabun C1, ainsi qu'aux données de la littérature relatives aux néandertaliens de Shanidar (Trinkaus, 1983),
- 20 métatarsiens épipaléolithiques (Taforalt, Maroc),
- deux échantillons d'hommes actuels provenant des collections du laboratoire d'Anthropologie Biologique du Muséum National d'Histoire Naturelle (Paris) et du Musée Bocage (Lisbonne).

Les définitions des mesures sont données dans le texte et illustrées par la figure 2. Les valeurs sont données dans les tableaux 1 à 4.

Longueur de l'os et estimation de la stature

Dmanissi est cassé au niveau de la tête. Le corps du métatarsien est complet ainsi que l'extrémité proximale (base). Il est possible de relever deux longueurs (tableau 1) :

Lcorps : Longueur du corps, distance du milieu du bord supérieur de l'extrémité proximale jusqu'à la base du tubercule distal le plus éloigné, c'est à dire le tubercule médial (ou interne).

Lmax : Longueur maximum, distance du milieu de la surface articulaire proximale au point distal le plus éloigné, parallèlement au grand axe du corps (Martin *et al.*, 1957). La mesure de Ferembach (1962), distance du milieu du bord supérieur de l'extrémité proximale jusqu'au point le plus éloigné distalement, correspond à une longueur maximum hors tout. La mesure de Ferembach est légèrement plus élevée que celle de Martin *et al.*, la différence est due à l'obliquité de la facette articulaire proximale qui réduit la longueur de l'os. La mesure de Volkov (1904) est prise sur le pied monté, et correspond à la distance de l'articulation du métatarsien avec le cunéiforme latéral jusqu'à l'articulation du métatarsien avec la phalange proximale ; cette longueur est donc plus courte que celle proposée par Ferembach et Martin *et al.*

La longueur du corps de Dmanissi peut être mesurée directement, elle est faible, inférieure aux valeurs des autres fossiles et de l'homme actuel. La longueur maximum du métatarsien de Dmanissi (mesure de Ferembach) est située dans les valeurs inférieures des hommes fossiles et actuels et proche de la plus faible valeur des néandertaliens, Shanidar 8 attribué au sexe féminin. Cette longueur (mesure de Martin *et al.*) a été estimée à partir d'une formule établie par l'un des auteurs (G.B.) sur un échantillon d'hommes actuels (Collection du Musée Bocage, Lisbonne) qui donne : $Log(Ltot) = 0,9354Log(Lcorps) + 0,1748$, $R^2=0,9594$. Estimée à 60,25 mm, elle est faible et inférieure à toutes les valeurs des hommes fossiles et actuels.

La formule de Byers *et al.* (1989), établie à partir d'un échantillon de 129 hommes actuels des deux sexes et d'origine variée ($stature = 675+13,4Lmax$) permet d'estimer la stature de l'individu de Dmanissi à 1,48 m avec une erreur standard de 65,4 mm. Cette valeur rejoint la première estimation proposée par Gabounia *et al.* (1999) basée sur la proportion du troisième métatarsien dans la longueur du pied, cette dernière représentant 15 % de la stature ; cette méthode a été utilisée par Bontch-Osmolovskij (1954) pour estimer la stature de l'adulte de Kiik Koba.

Diamètre au milieu ou épaisseur du corps

Le métatarsien de Dmanissi présente un diamètre médio-latéral faible relativement au diamètre supéro-inférieur ce qui traduit un net aplatissement médio-latéral (tableau 2). Ce fort aplatissement est nettement supérieur à celui des néandertaliens de Shanidar et à la valeur moyenne des hommes actuels et se rapproche de la moyenne des femmes actuelles, sans atteindre le très fort aplatissement du métatarsien KNM-ER 803 de Koobi-Fora attribué à *Homo*.

La torsion de l'os

La torsion de l'os (M-11) est bien marquée sur Dmanissi. L'angle de torsion défini par Martin *et*

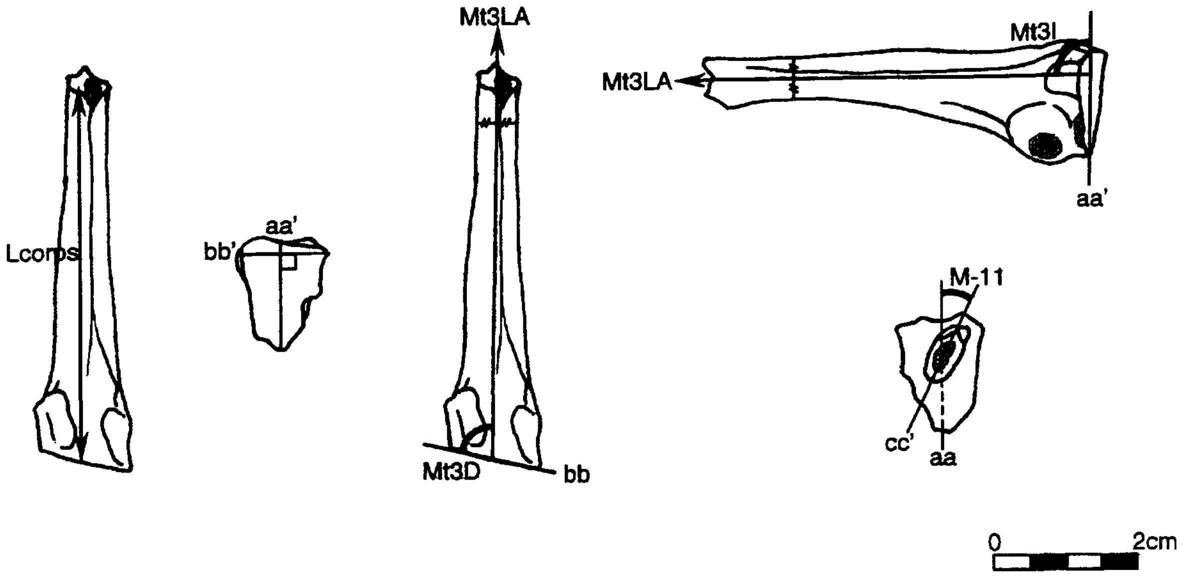

Figure 2. Dimensions et angles mesurés sur le métatarsien III de Dmanissi : longueur du corps (Lcorps), angle horizontal (Mt3D), angle vertical (Mt3I), angle de torsion (Mt3T). aa' et bb' sont respectivement la hauteur et la largeur de la surface articulaire proximale du métatarsien, cc' est la hauteur du corps au niveau de la cassure et Mt3LA est l'axe d'allongement du métatarsien.

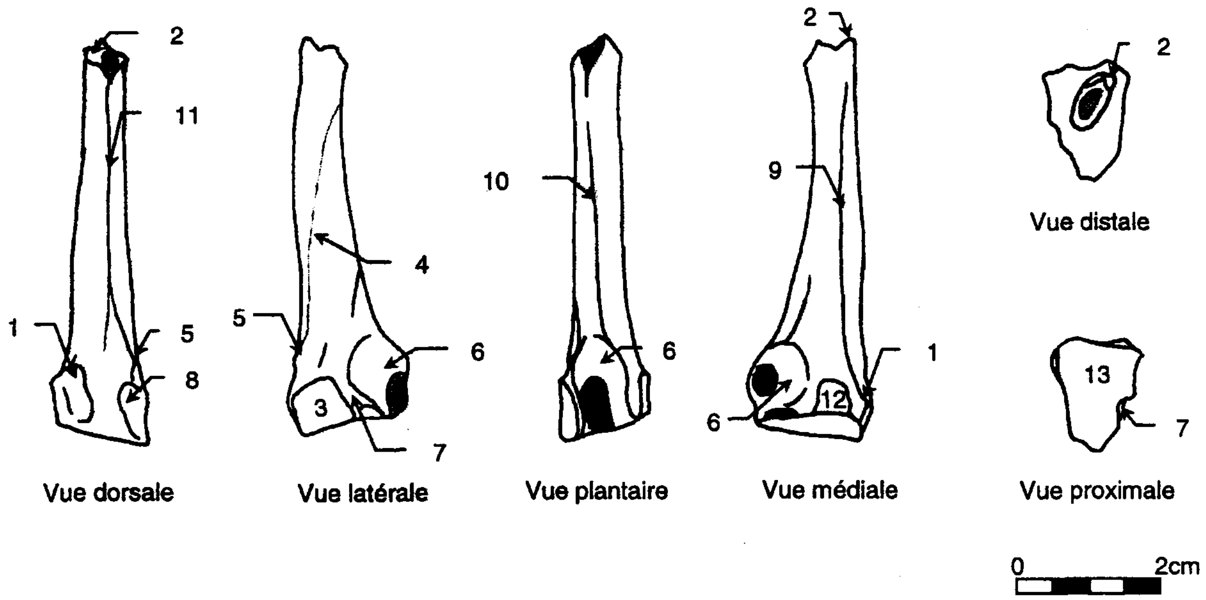

Figure 3. Les surfaces articulaires, les crêtes et les tubercules observés sur le métatarcien III de Dmanissi (cf. texte). *Gr.nat.*

al. est l'angle formé par l'axe dorso-plantaire de la surface articulaire proximale (fig. 2, aa') et l'axe dorso-plantaire du corps (cc'). L'angle de 24° est supérieur à celui des néandertaliens, La Ferrassie 2 et Shanidar 1, 6 et 8. Il est supérieur à celui de Omo F 511-16. Il est proche de ceux de KNM-ER 803 et Kiik-Koba 1. Il est compris entre les valeurs moyennes relevées sur les hommes actuels et les hommes épipaléolithiques de Taforalt (tableau 3).

En fait, une grande variation peut être observée sur les métatarsiens fossiles. Il est intéressant de noter une certaine homogénéité sur les métatarsiens des néandertaliens de Shanidar (7-15°). La plus faible valeur correspondant à la plus faible torsion est relevée sur Shanidar 1 attribué au sexe masculin. Les deux néandertaliens aux valeurs plus élevées (Shanidar 6 et 8) sont attribuées au sexe féminin. Bien que, chez l'homme actuel, il n'existe pas de différence statistique significative de torsion entre les deux sexes, la torsion la plus faible est en général relevée chez les mâles ; cette observation est valable pour les individus de Shanidar.

Une autre interprétation, peut être évoquée. La forte torsion pourrait être mise en relation avec une voûte plantaire longitudinale peu marquée. La torsion des métatarsiens est médiale sur les 4 métatarsiens latéraux (Berillon, 1998). La forte torsion de Dmanissi correspondrait à un pied à voûte plantaire présente mais peu marquée. D'autres éléments appuient cette interprétation.

Orientation du corps par rapport à la surface articulaire proximale

Deux angles peuvent être mesurés (fig. 2) :

Mt3D : Angle horizontal, en vue dorsale, angle entre l'axe horizontal de la surface articulaire proximale (fig. 2, bb') et l'axe du métatarsien (Mt3LA).

Mt3I : Angle vertical, en vue médiale, angle entre l'axe vertical (aa') de la surface articulaire proximale et l'axe du métatarsien (Mt3LA).

Les valeurs de ces deux angles (tableau 4) sur le métatarsien de Dmanissi sont comprises dans la variabilité actuelle et fossile ; ces valeurs sont relativement constantes chez les hommes actuels des deux sexes et chez les néandertaliens. Elles n'ont pas de signification architecturale ni sexuelle.

Description anatomique, morphologique et fonctionnelle

Courbure longitudinale

Le métatarsien III de Dmanissi est bien rectiligne, aucune incurvation n'est visible, comme sur tous les métatarsiens attribués à *Homo*. Rectiligne dans les deux sens, horizontal et vertical, il a une forme effilée, le diamètre dorso-plantaire du corps décroît régulièrement de l'arrière vers l'avant (fig. 3 et 4).

Le corps

Le corps se caractérise par *un fort aplatissement médio-latéral* qui réduit la face dorsale à une largeur de 8 à 4 mm de l'arrière vers l'avant. Les métatarsiens actuels ont en général une section de forme triangulaire à base dorsale et à sommet plantaire. Le corps de l'os de Dmanissi présente une *torsion sur son axe* de telle sorte que la surface dorsale tend à devenir médiale (ou interne) en se rapprochant de l'extrémité distale.

Sur Dmanissi, la surface de *la face dorsale* n'est pas lisse mais elle est parsemée de fines irrégularités qui jouxtent le bord latéral. Cette zone correspond à l'insertion du muscle troisième interosseux dorsal qui a un rôle dans la flexion de la première phalange et l'extension des deux autres et dans l'abduction ou l'écartement des troisième et quatrième orteils du second.

La face latérale ou externe, limitée par le bord latéral et le bord inférieur ou plantaire, est vaste, plus large en arrière qu'en avant. Elle est traversée obliquement d'arrière en avant par *une fine crête mousse* (4) qui s'étend du tubercule pour l'insertion du second ligament interosseux entre le métatarsien III et IV (5) près de la facette articulaire pour le métatarsien IV et rejoint le bord inférieur ou plantaire en avant. Sur les métatarsiens III actuels, cette fine crête oblique n'est pas visible; seul le bord inférieur est marqué.

La face médiale ou interne est limitée par le bord médial (9) et le bord inférieur. Sa surface est lisse et légèrement convexe verticalement.

Le bord latéral, anguleux, s'étend en arrière du tubercule d'insertion du second ligament interosseux entre les métatarsiens III et IV (5), passe en position dorsale et vient se terminer en avant. Il dessine une courbe à concavité externe.

Le bord médial (9), mousse, s'étend en arrière de la zone située entre le tubercule pour l'insertion du ligament interosseux dorsal entre les métatarsiens II et III (1) et la facette articulaire dorsale pour le métatarsien II (12). Il suit un trajet légèrement convexe du côté médial (ou interne) et se termine en avant à la base du tubercule médial (ou interne) (2).

Le bord plantaire ou inférieur (10), mousse en arrière et saillant en avant, s'étend du tubercule pour l'insertion des ligaments plantaires (6) en arrière, selon un trajet rectiligne, jusqu'à son extrémité antérieure.

Sur les métatarsiens actuels, le bord plantaire peut être plus ou moins aiguë et suivre un trajet plus ou moins rectiligne. Le bord inférieur de Dmanissi peut être classé parmi les bords moyennent aigus.

Extrémité distale ou tête
Le métatarsien III de Dmanissi est cassé à son extrémité distale. La cassure passe entre le tubercule médial et la surface articulaire de la tête et se dirige obliquement en arrière du tubercule latéral. La présence du tubercule médial a permis d'obtenir la longueur du corps.

Extrémité proximale ou base
La base est bien conservée, complète avec juste une perte de la paroi osseuse de l'extrémité latérale près de l'angle plantaire ou inférieur. La moitié plantaire du bord médial de la surface articulaire pour le cunéiforme latéral (13) présente une légère érosion qui a mis à nu les travées osseuses spongieuses.

Dans son ensemble l'extrémité postérieure est triangulaire avec une base supérieure ou dorsale et un sommet inférieur ou plantaire. Elle présente trois faces : une non articulaire, dans le prolongement de la face dorsale du corps et deux articulaires, l'une médiale (ou interne) avec une seule facette supérieure (12) bien visible sur Dmanissi, l'autre latérale (ou externe) (3) avec une large facette articulaire destinée au métatarsien IV.

La face dorsale de forme trapézoïdale est limitée en arrière par le bord rectiligne (13mm) de la surface articulaire postérieure, du côté médial par un bord rectiligne plus court (6mm) et latéralement par un bord irrégulier (13mm). La surface est irrégulière, elle présente *trois* reliefs plus ou moins saillants ou *tubercules*. Deux de taille semblable (1, 8), allongés parallèlement aux bords latéral et médial de la base donnent insertion aux ligaments intermétatarsiens dorsaux, le troisième (5) bien individualisé et plus petit, arrondi, est accolé à l'extrémité antérieure du tubercule latéral précédent, il est destiné à l'insertion du 2ème ligament interosseux entre le métatarsien III et IV.

Sur les métatarsiens III actuels, ce troisième petit tubercule est, soit absent, soit plus ou moins bien individualisé et plus ou moins éloigné de l'angle de l'extrémité proximale. Sur une vue dorsale, il est rarement visible. Lorsqu'il existe, il est totalement situé sur la face latérale. Il n'a pas été observé sur les autres fossiles.

La face latérale présente *une vaste facette articulaire* pour la connexion avec le métatarsien IV (3), qui occupe la moitié supérieure de cette face. L'autre moitié est occupée par une vaste saillie rugueuse (6) séparée de la facette articulaire par *une étroite et profonde gouttière*. En fait, cette saillie déborde l'angle plantaire sur la face médiale pour constituer *une volumineuse apophyse plantaire* (ou inférieure). Les deux ligaments plantaires les plus profonds, interne et moyen, unissent le troisième métatarsien d'une part, au deuxième métatarsien et d'autre part, au quatrième métatarsien. Sur un plan plus superficiel, s'attache l'extrémité distale du feuillet superficiel du ligament calcanéo-cuboïdien ou grand ligament de la plante (ligament long plantaire).

Deux muscles se terminent sur la base du troisième métatarsien :

Le jambier postérieur (muscle tibial postérieur) envoie à son extrémité inférieure des expansions terminales dont l'une s'accroche sur le tubercule plantaire du troisième métatarsien. Il a une action de flexion plantaire, il amène le pied en dedans (adduction) et en rotation interne (inversion).

L'adducteur (abducteur pour Testut) du gros orteil dégage un faisceau oblique qui s'insère sur la base des métatarsiens III et IV. Il a une action de rapprochement du premier orteil avec les autres orteils et contribue à la tension de la voûte plantaire.

Il est intéressant de noter la contradiction apparente entre la forte torsion du corps du métatarsien de Dmanissi qui traduirait un pied ostéologiquement plat et une attache musculaire très développée (tubercule plantaire très fort) pour l'adducteur du gros orteil qui traduit une action de forte tension de la voûte plantaire.

Autrement dit, la torsion du corps traduit plutôt un affaissement du pied et la proéminence du tubercule plantaire traduit un resserrement de l'ensemble du métatarse avec une augmentation de la voussure de l'arche transversale qui passe à la base des métatarsiens. Il pourrait s'agir ici d'une manifestation d'une compensation musculaire à une structure osseuse. Il serait intéressant de repérer s'il existe sur les troisièmes métatarsiens une corrélation entre le degré de torsion du corps et le développement du tubercule plantaire.

La facette articulaire latérale (3) a une forme en demi-cercle de 9mm de diamètre. Elle est légèrement concave dans les deux sens horizontal et vertical. Elle est destinée à s'articuler avec la facette correspondante du quatrième métatarsien. Elle est relativement vaste par rapport aux facettes observées sur les os actuels. Elle est séparée du tubercule plantaire par une étroite et profonde gouttière de 2,5mm de profondeur (7). Cette profonde dépression dessine une encoche très nette sur le bord latéral (ou externe) de la surface articulaire proximale. Le fond de la dépression est parsemée de fins foramens. A l'intérieur de cette gouttière glisse le ligament interosseux cunéo-métatarsien ou interosseux externe qui assure la stabilité de l'articulation tarso-métatarsienne (articulation de Lisfranc). Il faut rappeler que, dans le contexte anatomique, le cunéiforme latéral en contact avec le troisième métatarsien, pénètre en avant à l'intérieur de la ligne métatarsienne postérieure. Cette pénétration, avec celle du métatarsien II à l'intérieur de la rangée des cunéiformes assure le ferme maintien de l'ensemble tarso-métatarsien en particulier en son milieu, qui correspond au sommet de la voûte plantaire transversale métatarsienne postérieure.

Le troisième tubercule (5) décrit sur la face dorsale, bien individualisé, est saillant sur la face latérale.

La face médiale porte la tubérosité plantaire sur sa portion inférieure. Elle présente *une facette articulaire* sur la portion *supérieure* (12). De forme semi-circulaire (7x5,5mm) elle est légèrement allongée d'avant en arrière et plus petite que la facette latérale. Plane, elle est destinée à l'articulation avec le deuxième métatarsien contigu.

La facette inférieure n'est pas repérable. L'érosion du bord médial (6mm de haut x 2mm de large) empêche l'observation de la présence éventuelle d'une étroite facette de contact inférieure destinée au deuxième métatarsien. Chez l'homme actuel (tableau 5), cette facette est inférieure à 2mm dans 42% des cas et absente chez environ 20% des individus (femmes, 16,1% ; hommes, 25,8%). Sur les os de Taforalt, cette facette est rarement absente (10%), le plus souvent supérieure à 2mm (70%) et peut atteindre 4mm de même que sur les os actuels examinés. Présente sur le métatarsien des néandertaliens observés, elle est absente sur le métatarsien de OH8. Sur le métatarsien de Dmanissi, l'érosion ne dépasse pas 2mm, ce qui veut dire que même si l'os était intact, l'extension de cette facette était très faible (2mm maximum). L'absence de forte connexion avec le deuxième métatarsien pourrait traduire une voûte plantaire peu arquée. Cette observation est à rapprocher de la forte torsion du corps qui traduiraient toutes deux une arche plantaire à voussure faible, associée à des insertions ligamentaires et musculaires développées pour compenser cette disposition.

La face postérieure est totalement articulaire, de forme triangulaire à base dorsale. Elle est limitée par trois bords. Le bord dorsal est irrégulièrement convexe vers le haut (13mm de longueur). Le bord latéral est cassé à la base ; il mesure environ 15mm. Son trajet légèrement concave dans sa portion supérieure (7mm) dessine une concavité de 1,5mm correspondant à la gouttière latérale de la base (7) et est interrompue dans sa portion inférieure. Le bord médial est rectiligne sur pratiquement toute sa longueur (13mm) et dessine une convexité près de l'angle plantaire. La longueur totale du bord est de 15mm. La surface articulaire est lisse avec une imperceptible convexité dans les deux sens vertical et horizontal. Elle s'articule avec le cunéiforme latéral. Sur les os d'hommes actuels observés, la face articulaire est en général plane ou légèrement concave alors qu'à Dmanissi, elle est nettement mais faiblement convexe. Cette convexité pourrait permettre des mouvements de flexion de l'articulation cunéo-métatarsienne. Il serait intéressant de voir si il existe une association entre cette possibilité de flexion et l'absence de contact articulaire plantaire avec le deuxième métatarsien. La disposition moderne qui associe une articulation plane et une forte cohésion plantaire entre les métatarsiens II et III traduit une congruence plus serrée à ce niveau où l'arche transversale est la plus haute.

La disposition de Dmanissi à arche plantaire transversale atténuée est comparable à celle de OH8 dont le métatarsien III est dépourvu, lui aussi, de facette articulaire plantaire pour le deuxième métatarsien. Sur ces deux fossiles, cette disposition est compensée par un renfort ligamentaire et musculaire très net, en particulier des muscles jambier postérieur et adducteur de l'hallux.

La structure interne

La radiographie met en évidence une corticale épaisse (2,5mmX2 au milieu du corps) et une cavité médullaire étroite sur toute la hauteur de l'os (2,5mm). La cavité occupe 33% du diamètre total (fig. 4). Sur les métatarsiens en vue dorsale des hommes actuels observés (7 individus), la cavité médullaire plus importante occupe au même niveau, en moyenne 41% du diamètre du corps avec un minimum de 31% et un maximum de 50%.

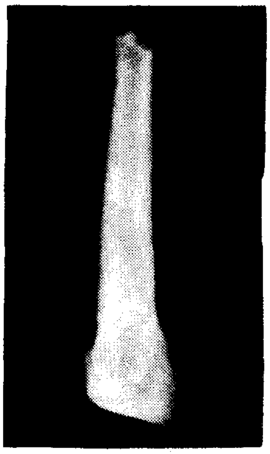

Figure 4. Radiographie du métatarsien III de Dmanissi D2021 en vue plantaire. *Gr.nat. Service Pr. Cabanis, Hopital XV-XX, Paris.*

Figure 5. Coupe transversale du corps du métatarsien III de Dmanissi D2021 au milieu. *Gr.nat.X6. service Pr. Cabanis, Hopital XV-XX, Paris.*

Une analyse au scanner (fig. 5) permet de préciser le long de l'os : le rapport épaisseur de la corticale - lumière du canal médullaire, d'effectuer des coupes verticales et de repérer l'aplatissement médio-latéral, la saillie de la crête latérale, l'orientation des travées osseuses au niveau de la base de l'os.

Aucune anomalie d'ossification ou pathologique n'est repérable. L'os est bien conservé dans son ensemble.

Conclusion

Le troisième métatarsien droit de Dmanissi bien conservé devait appartenir à un individu adulte et par ses dimensions générales pourrait être attribué à un individu de sexe féminin.

Il se caractérise par :

- un aplatissement médio-latéral du corps marqué,
- une torsion du corps forte,
- l'absence ou la faible extension de la facette articulaire plantaire pour le deuxième métatarsien,
- un effilement du corps vers l'avant,
- un fort développement du tubercule plantaire,
- une profonde gouttière latérale de la base,
- une individualisation du troisième tubercule latéral de la base, avec une extension sur la face dorsale,
- une crête oblique sur la face latérale du corps,
- une corticale très épaisse.

Les cinq derniers critères paraissent liés à une fonction avec de fortes sollicitations ligamentaires et musculaires. Les quatre premiers pourraient être des caractères anatomiques constitutionnels. L'aplatissement médio-latéral existe aussi sur le métatarsien III de Koobi Fora KNM-ER 803J, daté entre 1,6 et 1,5 Ma et attribué à *Homo* (Day et Leakey , 1974). Le fossile de Dmanissi pourrait être contemporain et attribué à *Homo erectus*.

Parmi les caractères angulaires, les valeurs des angles horizontal et vertical rentrent dans la variabilité du genre *Homo* actuel et fossile. Par contre, l'angle de torsion indique sur Dmanissi une importante torsion du corps qui pourrait traduire une faible mais présente voûte plantaire longitudinale. La torsion est comparable à celle de KNM-ER 803J. Sur Omo F511-16, elle est moins marquée. Ces deux métatarsiens africains ont par ailleurs de plus grandes dimensions que l'os de Dmanissi et pourraient appartenir à des individus de sexe masculin à voûte plantaire longitudinale plus ou moins marquée. La différence de torsion entre les os africains pourraient être attribuée à une diversité biologique ou une différence sexuelle. Ce critère de torsion peut en l'état actuel des découvertes, être considéré comme un élément à confirmer sur des os appartenant au même stade évolutif.

Cette forte torsion est corrélée à une voûte plantaire affaissée, elle-même compensée par un renforcement ligamentaire et musculaire au niveau de l'ensemble tarso-métatarsien, zone clé de la voûte plantaire transversale. A une voûte plantaire longitudinale affaissée s'associe une tension musculaire transversale forte et stable sur le fossile de Dmanissi. D'autre part, la légère convexité de la facette articulaire pour le cunéiforme associée à la réduction ou à l'absence de la facette articulaire plantaire pour le deuxième métatarsien traduisent une plus grande aptitude à la flexion de l'articulation cunéo-métatarsienne qui n'existe pas chez les hommes actuels. La grande similitude entre Dmanissi et OH8 évoque une disposition fonctionnelle identique.

Cette disposition anatomico-fonctionnelle caractérise le pied de l'individu de Dmanissi. Elle est différente de celle des néandertaliens par l'aspect général de l'os. Chez les néandertaliens, le troisième métatarsien est plus massif avec une base plus large, un aplatissement médio-latéral beaucoup moins marqué. Chez les hommes modernes, l'aplatissement médio-latéral est faible, la corticale est fine et les structures ligamentaires et musculaires sont graciles. Par contre, le corps constitue un cylindre régulier de l'arrière à l'avant avec peu de différences entre la hauteur en arrière et la hauteur en avant.

La configuration de Dmanissi rappelle celle observée sur les hominidés fossiles du Pléistocène inférieur africains, de Koobi Fora, Omo et Olduvai datés entre 1,8 et 1,5 Ma.

La voûte osseuse de Dmanissi est peu marquée comme sur OH8. Néanmoins elle est suffisante pour la pratique d'une bipédie permanente. Elle est associée à une mobilité accrue dorso-plantaire de la troisième articulation cunéo-métatarsienne. L'ensemble, sous-tendu par une forte tension musculaire, permet un appui du pied au sol plus souple que dans le fonctionnement podal humain actuel.

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Métatarsiens III		Longueur maximum (mm)		Longueur du corps (mm)
		Ferembach	Martin *et al.*	
Dmanissi, d		(64) (1)	(60,25)	52
KNM-ER 803 J,g (2)		-	-	60,3
Omo F 511-16 g (2)		-	-	60,5
Shanidar 1, d (M) (3)		73,2	71,1	62,5
Shanidar 6, g (F) (3)		66,8	65,3	
Shanidar 8, d (F) (3)		64,7	63,2	
Krapina 247-1, d		72,8		
Kiik-Koba 1, d (M)		73,4		
Taforalt	N	(32)(4)		20
	min	65		55,3
	max	79		68,6
	moy	72,4		61,9
Actuels (5) :				
femmes (31)	moy		64,4	56,0
	DS		3,3	3,0
	min		57,3	49,2
	max		70,0	60,7
hommes (31)	moy		68,4	59,4
	DS		3,8	3,6
	min		60,4	51,5
	max		76,6	67,8

(1) estimée à 65mm par Gabounia *et al.* (1999), (2) Deloison (1993), (3) Trinkaus (1983), (4) Ferembach (1962), (5) Berillon (collection du Musée Bocage, Lisbonne).

Tableau 1. Longueur maximale estimée et longueur du corps du métatarsien de Dmanissi comparées à celles de métatarsiens d'hominidés du Pléistocène moyen et supérieur, des hommes de Taforalt (Epipaléolithique) et l'homme actuels.

Métatarsiens III		Diamètres au milieu du corps (mm)		Indice
		supéro-inférieur	médio-latéral	
Dmanissi, d		9,3	6,3	67,7
Dmanissi, d (1)		8,2	7,3	89
KNM-ER 803 J, g (2)		10,4	6,1	58,6
KNM-ER 803 J, g (3)		10,7	6,4	59,8
Shanidar 1, d (M) (4)		9,2	7,7	83,7
Shanidar 6, g (F) (4)		7,5	75	100
Shanidar 8, d (F) (4)		8,5	6,8	80
Actuels (5) :				
femmes (31)	moy	8,7	5,5	69,4
	DS	5,5	0,7	12,9
	min	5,7	4,2	19,4
	max	38,2	7,4	86,1
hommes (31)	moy	8,4	6,6	78,9
	DS	0,6	0,7	10,0
	min	6,9	5,1	62,2
	max	9,6	8,0	102,6

(1)Gabounia *et al.* (1999), (2) Deloison (1993), (3) Day et Leakey (1974), (4) Trinkaus (1983), (5) Berillon (collection du Musée Bocage, Lisbonne).

Tableau 2. Diamètres au milieu ou épaisseur du corps du métatarsien de Dmanissi comparés à ceux de métatarsiens d'hominidés du Pléistocène moyen et supérieur et d'homme actuels.

Métatarsiens III		Angle de torsion (M-11) (en degré)
Dmanissi, d		24
KNM-ER 803 J (3)		26
Omo F 511-16, g (1)		7
Shanidar 1, d (M) (2)		7
Shanidar 6, g (F) (2)		11
Shanidar 8, d (F) (2)		15
Kiik-Koba 1, d (M) (1)		29
La Ferrassie 2 (M)		8
Taforalt (20)	min	8
	max	18
	moy	10,9
Actuels (43) (1)	min	11
	max	43
	moy	28,3
Actuels (4) :		
femmes (31)	moy	22,5
	DS	6,2
	min	11,0
	max	36,0
hommes (31)	moy	19,8
	DS	6,7
	min	4,0
	max	32,0

(1) Berillon (1998), (2) Trinkaus (1983), (3) Day et Leakey (1974), (4) Berillon (collection du Musée Bocage, Lisbonne).

Tableau 3. Angle de torsion du métatarsien III de Dmanissi comparé à celui de métatarsiens d'hominidés du Pléistocène moyen et supérieur, des hommes de Taforalt (Epipaléolithique) et d'hommes actuels.

Métatarsien III		Angle horizontal Mt3D (en degré)	Angle vertical Mt3I (en degré)
Dmanissi, d		76	90
KNM-ER 803 J ,g(1)		75	95
Omo F 511-16, g (1)		73	95
Shanidar 1, d (M) (2)		73	89
Shanidar 4 (M) (2)		80	
Shanidar 6, g (F) (2)		78	
Shanidar 8, d (F) (2)		82	
Néandertaliens (6), moy.(1)		77	91,6
Actuels (43) (1)	min	70	89
	max	90	103
	Moy	78,9	94,7
Actuels (3):			
Femmes (31)	moy	77,9	91,7
	DS	3,6	2,8
	min	68,0	86,0
	max	85,0	97,0
Hommes (31)	moy	78,2	92,6
	DS	4,1	2,9
	min	68,0	86,0
	max	85,0	98,0

(1) Berillon (1998), (2) Trinkaus (1983), (3) Berillon (collection du Musée Bocage, Lisbonne).

Tableau 4 : Angles horizontal et vertical du métatarsien III de Dmanissi comparés à ceux de métatarsiens d'hominidés du Pléistocène moyen et supérieur et d'hommes actuels.

Métatarsien III	Facette plantaire pour le métatarsien II							
	Hommes actuels						Taforalt (20)	
	femmes (31)		hommes (31)		cumulé (62)			
	N	%	N	%	N	%	N	%
Absente	5	16,13	8	25,81	13	20,97	2	10
<=2mm	8	25,81	5	16,13	13	20,97	4	20
>2mm	18	58,06	18	58,06	36	58,06	14	70

Tableau 5 : Effectifs (N) et fréquences (%) des morphotypes de la facette articulaire plantaire pour le métatarsien II chez les Hommes de Taforalt (épipaléolithique) et un échantillon d'hommes actuels (collection du Musée Bocage, Lisbonne).

ERAUL 92, 2000, p. 43 à 47.

ON ANCIENT MAN IN THE VOLCANIC MOUNTAINOUS REGION OF SOUTH GEORGIA

Manana Gabunia

A large number of sites of ancient Stone Age is unequally distributed on the territory of Georgia. Six regions of their distribution are known (Kalandadze, 1969:13), of which two - the low mountainous stretch of the right bank of the Mtkvari-Kvemo Kartli and the Javakheti Plateau - are within the range of volcanic highlands of south Georgia. It can be said that the latter has been most poorly represented by the old Stone Age sites until now.

This state of affairs has radically altered over the last dozen years. The growth of interest may be due on the one hand to the fact that the region had barely been investigated at all, and on the other to the discovery of the now well-known Old Stone Age site of Dmanisi (Gabunia *et al.*, 1988:36-46; Bosinski *et al.*, 1989:93-107). According to its isotopic age (1.8±0.1 Ma) and paleomagnetic data (the so-called Olduvai episode, 1.9±0.1 Ma) the site of Dmanisi can be attributed to the early Pleistocene (Bosinski *et al.*, 1989:93-107; Gabunia *et al.*, 1988:36-46; Gabunia *et al.*, 1996:36-46, Gabunia *et al.*, this volume).

Fossil remains found here belong to the hominid group *Homo erectus*, and evidently to one of the oldest groups in Eurasia. These remains allow scholars to regard this region as possibly an original settlement of hominids (Gabunia *et al.*, 1993:3-5; Gabunia *et al.*, 1996:36-46). In addition to this, the known sites distributed on the Javakheti Plateau directly adjacent to the Dmanisi region Akhalkalaki I, II, III, IV, Diliska (Murdjl), Chikiani, etc. - were represented only by surface finds, and thus lacked lithographic - stratigraphical characteristics (Grigolia, 1965:5-9; Gabunia *et al.*, 1980:2-3; Gabunia, 1994:3-19). Here, however, we have discovered ancient sites rich in biostratigraphic data, such as Amiranis-Gora in Akhalkhalaki, which was known as a site rich in Early Pleistocene mammalian remains (Vekua, 1962:5-176).

Javakheti Plateau is a vast geomorphological region with a highly complicated structure. Its western and central parts are comprised of the Akhalkhalaki Plateau, built up by eruptions during the Postpaleogene volcanic cycle. These include Mio-Pliocene range pyroclastolyths and lavas of sour and moderate composition; and relatively young basalt effusives of a formation whose geologic age is identified as Pliocene-Lower Pleistocene (Maruashvili, 1971:358-363; Gamkrelidze, 1957:135; Tsereteli, 1958:124-151; Paphengolts, 1951:19; Tchernov *et al.*, 1969:3-16).

Absolute heights within the borders of the Javakheti Plateau range from 1130-2500m. The somewhat dull relief of the plateau is disturbed by the extrusive tower of Amiranis-Gora, springing up east of the town of Akhalkalaki. This mountain is composed of andesite dacites of the Goderdzi Miopliocene. Its absolute height is 1883m, and it rises 150m above the level of the river Paravani (Akhalkalaki-Water)(fig.1).

In the early 60s, the paleontologist A. Vekua excavated and investigated a complex rich in fossil mammals and dated it to the lowest stage of the Pleistocene (Vekua, 1962:174-176), equivalent to the base of the Middle Pleistocene on the modern European scale.

The overview of the Akhalkalaki fauna and the topographic conditions of its location permitted the assumption that it could have been a site of ancient man.

It is noteworthy that the very first section excavated confirmed this assumption (Gabunia *et al.*, 1994:237-239). In 1992, a scraper made of basalt flake (fig. 2:3) was found with mammalian fauna, at 0.85m below modern surface level and 1.25m below datum. In succeeding years, including 1997, minor archaeological excavations were carried out near the east foothill of the Amiranis-Gora. An area of 48m² was excavated. As the profiles found there are identical, a description of one of the sections

Figure 1. Map.

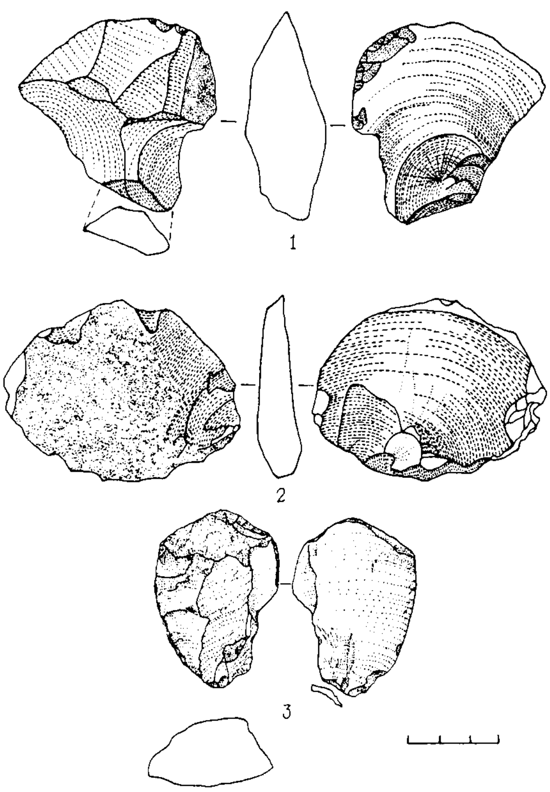

Figure 2. 1, retouched flake; 2, unretouched flake; 3, scraper.

serves to form an overall picture. The succession of layers is as follows: I-humus, black ground (thickness is 10-15 cm); II-light yellow loams, color changes slightly in some cases. Among these are encountered andesite-dacites of different sizes, and square cornered stones (1-5 cm, rarely, bigger ones are 30x40 cm). The capacity of the loam is more than 1.75 to 2.20m. The floor excavated at this level is covered with rocks. Encountered in the sections are dark spots of powdery clay, undoubtedly of secondary development, constituting rodent holes (Gabunia *et al.*, 1994:327-329). At about 50 cm, the loam becomes very solid. At about 0.85-0.91m to 1.10-1.15m below datum this layer yields fossil bones and, much more rarely, archaeological remains.

Mineral and chemical analyses of the loam surrounding the cultural remains reveal its deluvial-proluvial origin and its development as a result of weathering (Tvalcrelidze, 1992:1-5; Tvalcrelidze, 1993:1-3; Tvalcrelidze, 1995:1-4).

The excavations conducted here have exposed mammal types identical to those identified earlier in the Akhalkalaki fauna (Gabunia *et al.*, 1962:5-176). They are as follows: *Mammuthus aff. Trogontherii, Archidiscodon meridionalis, Equus süssenbornensis, Equus hipparionoides, Dicerorhinus etruscus, Felis silvestris, Praemegaceros verticornis, and Bison sp.* Besides these, new elements have been discovered: *Homotherium sp. and Vulpes vulpes sp.* (Gabunia, 1994:3-19). Most frequently represented in the given complex are *Equus süssenbornensis* - 76.5% and *Bison sp.* - 13.5%. All other species of animals constitute 10%. This new find, like the complex discovered and investigated by A. Vekua earlier, confirms the fact that primarily half-steppe landscapes prevailed in the Javakheti Region of Georgia during the Lower Pleistocene and the beginning of the Middle Pleistocene. This is shown by the ecological peculiarities of most mammalian species, the frequency of terrestrial molluscs characteristic of a relatively arid environment, and the scattered regions covered with light forests and bushes (*Mammuthus aff.*

Trogontherii, Meles sp. etc.). The climate must evidently have been moderately hot, as was characteristic of the greater part of the Mediterranean (Vekua, 1962:174-175; Gabunia, 1994:3-19).

It is of interest that the formation of similar natural environments was noticeable at the very beginning of the Pleistocene. The Dmanisi ancient Stone Age paleontological site complex (Gabunia *et al.*, 1993:3-53) bear's some ecological similarities to the Amiranis-Gora fauna. For example, *Archidiscodon meridionalis*, *Dicerorhinus etruscus*, *Homotherium sp.* etc are found in both the complexes. But that the Akhalkalaki fauna also comprises *Equus süssenbornensis* and *Mammuthus aff. trogontherii* makes it significantly younger. In both complexes, the inhabitants of forest/steppe ecosystems prevail: *Strutio sp., Orses sp., Antilopes sp., and Rodentia Achotona sp., Marmota sp., and Meriones sp. in Dmanisi, and Cricetus sp. in Dmanisi and Akhalkalaki* (Gabunia *et al.*, 1996:36-46).

This similarity of natural environment is also observed in the paleontological data. In the diverse spectra of pollen, as at Amiranis-Gora, the remains of *Celtis sp.* and *Lithospermum arvense L.* point to the existence of savanna-type landscapes (Gabunia *et al.*, 1996:36-46; Gabunia and Vekua, 1980:56-5 7; Avakov, 1960:3-5).

In general, by the close of the Pliocene and the Lower Pleistocene, a paleolandscape similar to the Javakheti Plateau was widespread all over Asia Minor (Vereshchagin, 1959:1-80; Coon, 1951:3-5; Fiuron, 1955:1-90; Vekua, 1962:174-175; Gabunia, 1994:3-19; Gabunia *et al.*, 1996:36-46). Thus, it is quite natural to suppose that at that time, Asia Minor and the Caucasian Near East, including at least its south-east territory, formed a single zoogeographical zone (Vekua, 1962:174-175; Gabunia *et al.*, 1996:36-46; Gabunia, 1994:3-19), and that suitable paleoclimatic and landscape conditions already prevailed in its individual regions. This is attested to by the respective paleogeographical data of the above-mentioned territories, particularly for such archaeological-paleontological and paleontological complexes as Dmanisi, Akhalkalaki, Bethlehem, Ubeidiya (Gabunia and Vekua, 1993:3-53; Gabunia *et al.*, 1996:36-46; Hooijer, 1958:9-10; Tchernov *et al.*, 1986:351-398) and some others, the analysis of which shows that, despite many similarities (the so-called Villafranchian faunal elements) they relate to different stages of the Early and Middle Pleistocene (except for Dmanisi, which is known to belong to the Villafranchian in its own right).

After a brief survey of the paleolandscape conditions, let us return once more to Amiranis-Gora, where, as we have already mentioned, in 1992-1997, along with fossil vertebrates, a few stone artifacts of andesite-basalt were obtained. The collection is now comprised of 20 artifacts: a scraper, sharp-hack tools, pointed-tools, cores, and retouched and un-retouched flakes. Besides those enumerated, a fragment of red ochre and obvious manuports were also obtained (fig. 2-5).

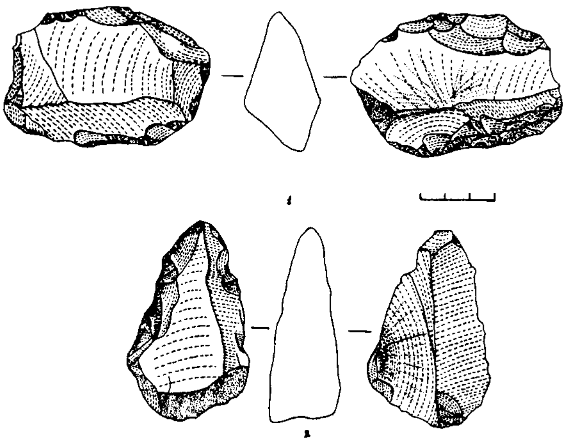

Figure 3. Sharp-hack tools.

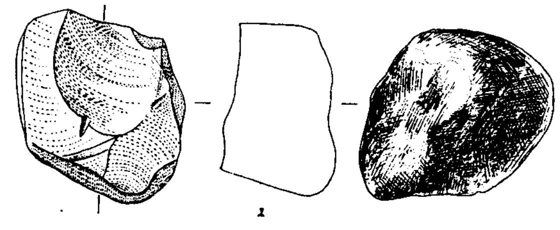

Figure 4. Sharp-hack tools.

Most of these artifacts are is covered in a deep grayish patina, with lime deposits here and there. The tools are worked by wide facet retouch from one or both sides; the retouch is clear-cut, without any trace of rolling, which suggests that the material has not been transferred too far from the site of its fossilization.

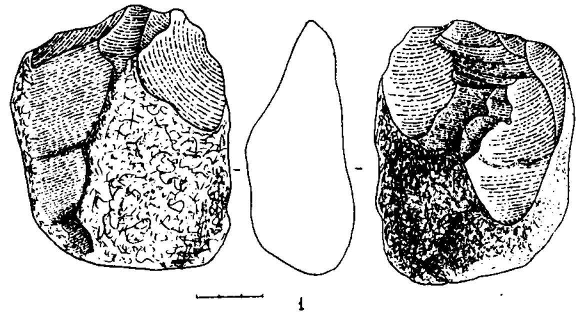

Figure 5. Cores.

Although the archaeological data obtained is as yet limited, it is nevertheless rather significant, as it bears obvious archaic traits, both in reduction technique and in the lines of its secondary processing, typology, which is characteristic of the Early Paleolithic.

As regards the dating of the site of Amiranis-Gora, it should be noted that the stratigraphy of the south Georgian volcanic deposits is based on the vertebrate fauna found in the deposits spread primarily here. Their geologic age is the end of the Lower Pleistocene or the beginning of the Middle Pleistocene, and this means that the archaeological material discovered must be related to the early Acheulean.

Diverse materials obtained in the northeast, the southwest, and various levels of the south and east slopes of Amiranis-Gora are worth noting. They are as follows: sharp-hack tools, choppers, scrapers, bifaces, cores, flakes, etc., artifacts made on basalt. This material is also covered with a gray patina and has clear-cut edges.

On the volcanic highlands of Georgia certain materials are easily obtainable. Among these are almond-like basalt bifaces processed on both sides obtained near the village of Persati in the Akhaltziche region, and a rough, ax-like tool processed on both sides found in the village of Ude in the Adigeni region, in the layer of feudal age.

These materials and the aforementioned open sites of Javakheti (Chikiani, Akhalkalaki I-IV, Diliska etc.), which, according to their technical and typological features must be attributed to different stages of the Acheulean, allow us to investigate the scale and intensity of the settlement of ancient man on the south Georgian volcanic highlands during the Lower and Middle Pleistocene.

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LATE ACHEULEAN OF THE NORTHERN CAUCASUS AND THE PROBLEM OF TRANSITION TO THE MIDDLE PALEOLITHIC

Liubov.V. Golovanova

Abstract
Late Acheulean sites on the Northern Caucasus are found from the Black Sea coast (Mis Kadosh) in the west to Northern Ossetia (Hutor Popov 1 in the Terek River valley) in the east (fig. 1). A total of nearly 40 locations (Autlev, 1961; 1981; Golovanova, 1986; Formozov, 1965) are known here now. The majority of them are situated in the Belaya River basin. This partly reflects the fact that most field research was conducted in the area, but it may also be due to specific conditions of the Paleolithic remains taphonomy in the region. Three local groups of the Late Acheulean sites are of particular interest now. They are concentrated in a relatively small area of the Northwestern Caucasus, and include the Abadzeh and Khadjoh groups in the middle part of the Belaya River valley, and the Abin group near Krasnodar.

Key words : Prehistory, Paleolithic, Late Acheulean, Northern Caucasus

Geomorphologic position of the Late Acheulean sites

The majority of the Late Acheulean locations, on which the implements were gathered in river deposits, do not carry any information about geomorphologic position of the original sites. Only the Sredniy Khadjoh open air site is connected with an ancient terrace, as well as the Abadzeh and Abin locations, on which the implements were moved to lower terraces, adjacent to those, where the original sites were located.

Currently there is not enough material for river terrace dating on the Northwestern Caucasus. Their local nomenclature applied in the paper reflects only a succession of the terrace formation and assumes a different correlation with a local paleographical scale, as well with subdivisions of the more common one. The local nomenclature takes into account the usual increase of a number of terraces up the mountain river valleys, i.e. their "splitting". According to a local scheme of terrace formation, on the Northwestern Caucasus the Middle and Upper Pleistocene terraces are united into four assemblages (Nesmeyanov, 1986): Vozdvijensk, Gulkevich, Gireisk, and Kuban. Finds of the Tiraspol faunal complex are connected with the Vozdvijensk assemblage. The Gulkevich assemblage is divided usually into two parts. Its early part (Kurdjips terrace) is dated by finds of the Khazar fauna, and the latter one (Khadjoh terrace) by finds of the Upper Paleolithic faunal complex; the latter is also presented in the Vjushat and Maikop terraces of the Gireisk assemblage. Regional terraces of the Gulkevich assemblage split often. The Kurdjips terrace splits in two and the Khadjoh terrace - in two or more. S. Nesmeyanov suggests a correlation of the Khadjokh terrace with the Moscow Glaciation (= Late Riss Glaciation) and the Mikulino Interglaciation (= Riss-Würm Interglaciation) on the Russian Plain.

Based on a currently recognized correlation of these paleo-climatic events with the oxygen-isotope scale one can conclude that the most preserved Late Acheulean locations on the Northern Caucasus, described in the article, are dated to stage 6 of the scale. Moreover, the Sredniy Khadjoh site, probably, represents the latest among them (table 1).

The Abin location is situated on the right side of the Abin river valley, at a distance of 2 km from the river, on the left slope of its small tributary, and 3 km south from the town of Abinsk. High concentration of finds on an area of 0,5 km x 0,5 km is connected with several young terraces situated lower than the Kurdjips terrace as well with the last one, the accumulative cover of which is fully destroyed. On this basis, one can suggest that the primary cultural layer was connected with the Kurdjips terrace and localized near its outer edge. This layer, probably, was formed during the Khadjoh stage of river cutting, when the Kurdjips terrace was the only one above a flood plain.

On the Abadzeh location, artifacts were collected in a riverbed and on surfaces of the Maikop and Vjushat terraces of the Fiunt river valley, a right tributary of the Belaya River. The primary site was

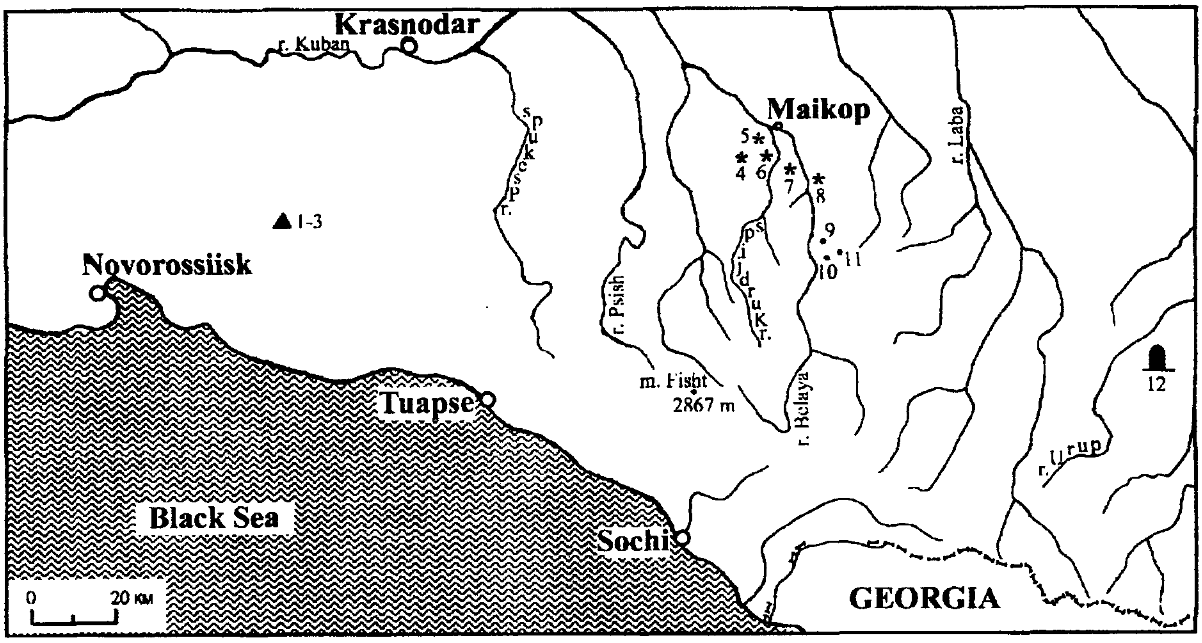

Figure 1. Distribution of the main Late Acheulean sites on the Northern Caucasus. Abin Group (1-3 Abin, Adagum and Khabl locations); Abadzeh Group, including later sites of the same type (4. Juchka, 5. Fortepyanka, 6. Kurdjips, 7. Semiyablonya, 8. Abadzeh locations); Khadjoh Group (9. Shahan location, 10. Sredniy Khadjoh site, 11. Shahan site); 12. Treugol'naya Cave.

probably located either on the Khadjoh terrace or the Kurdjips one.

The Sredniy Khadjoh open-air site is situated on the right side of the Sredniy Khadjoh River valley, a right tributary of the Belaya River (fig. 1). Its lower cultural layers 4 and 5, perhaps slightly moved, are dated by the beginning of the covering loamy deposits accumulation, that last overly river sand of the late Khadjoh terrace. The site is situated near the terrace back seam, where facial substitution of the upper horizons of alluvium by the cover loamy deposits is possible. For this reason, it is quite reasonable to correlate periods of the most active occupation of the Sredniy Khadjoh site with the middle part of the late Khadjoh stage. The Shahan workshop, situated not far from the Sredniy Khadjoh site, is connected with a relict of the Vozdvijensk terrace.

Khadjoh group of the Late Acheulean sites

Sites of this local group are situated in the middle flow of the Belaya River, on one of its small right tributaries, the Sredniy Khadjoh River (fig. 1). The first Paleolithic implements in the riverbed were collected during fieldwork of the Northern Caucasus Paleolithic expedition led by A. Formozov and A. Stolayr (Formozov, 1965). In 1964-65, P. Autlev found a lot of material within a cultural layer (Muratov & Autlev, 1971; Autlev, 1981). In 1982-83, Kuban Paleolithic Team under the guidance of L. Golovanova (Golovanova, 1985; 1986), continued work on the site. During that period, the Shakhan location was discovered, dated to the end of the Acheulean – beginning of the Mousterian (Golovanova, 1986), as well as a workshop of the Late Acheulean period on the Shahan II mountain (Doronichev & Golovanova, 1986).

Information on paleo-climate in the Late Acheulean period on the Northern Caucasus are still quite fragmentary. G. Levkovskaya's study of specimens taken from deposits at the Sredniy Khadjoh site showed three pollen horizons. Late Acheulean artifacts presented four levels of concentration within three strata. They were deposited under a cool (approximately 5° C cooler than today) and humid climate. In the upper strata, there is a horizon of temperature rise and the appearance of forests. The pollen of swampy cypress was extracted in the horizon. This cypress existed even in the relic region of Kolhida (Levkovskaya, 1986) only up to the Karangat transgression. The latter is correlated by Georgian researches with Riss-Würm. Therefore, layers of the Sredniy Khadjoh site could be comparable in age with Karangat and may even precede it. This data corresponds to the geomorphologic position of the site.

Techno-typological characteristics of all the Khadjoh group sites permit the group to be

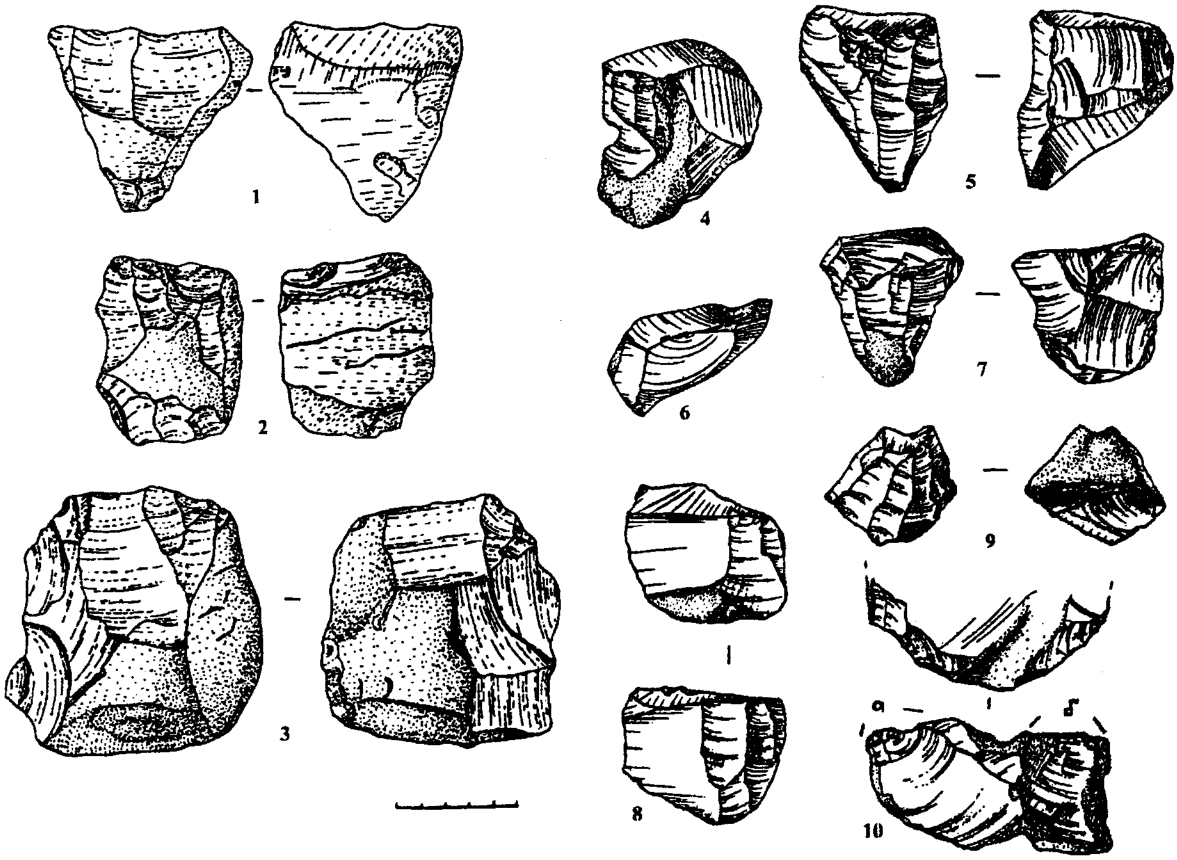

Figure 2. 1-3, Abin Group; 4-10, Khadjoh Group. Cores

described. Technique of flaking marks out these sites especially. This technique has no analogies in Acheulean sites of the region. A method of parallel flaking from slightly convex surfaces is characteristic. Core preparation is characterized by one blow preparation of each striking platform. Striking platform trimming by two or more blows are few. Previous scar negatives were used as striking platforms very frequently (fig. 2:4-10). Multi-side technique of core utilization with striking surfaces situated under different angles to each other (Doronichev, 1986) is a specific feature of these assemblages.

The typological appearance of the Khadjoh industry is defined best from the richest assemblage of level 3d at the Sredniy Khadjoh site. At other levels of the site, as well at the Shahan location and at Shahan workshop, tools are rare. A peculiarity of the Khadjoh industry is the use of flint pieces for tool making (31,5% of all blanks).

Study of retouch facets on tools from the sites under consideration indicates the presence of four distinct peaks on a diagram, which suggest the use of several techniques of retouch for tool making (Golovanova, 1984). The presence of flakes with burin spalls, not present in other Northern Caucasus sites, sharply points out the Khadjoh group assemblages. The first type is formed on fragments or flake angles by one or several burin spalls (fig. 3:13). Tools of the second type are made on distal ends of flakes by two burin spalls, like dihedral burins (fig. 3:14). Tools of the third type are also made on distal flake angles by flat burin spalls flaked from an end-scraper element, like a burin on retouched truncation (fig. 3:10). At the Shahan site and Shahan workshop tools with burin spalls are also marked out, accordingly two and five items (fig. 3:16). Different types of end-scrapers are also present in these sites: made by elongated facets (fig. 3:3), formed by rounded retouch (fig. 3:4), on flint fragments of high form (fig. 3:5), with scale retouch formed distal ends. It is interesting that specific forms were made on heavy, relatively large, fragments with distal ends sharpened by retouch (fig. 3:11).

Specific forms are denticulate tools, formed on steep transversal ends of flakes or fragments. Their "working elements" are formed by rounded retouch facets, which, alternating from dorsal to

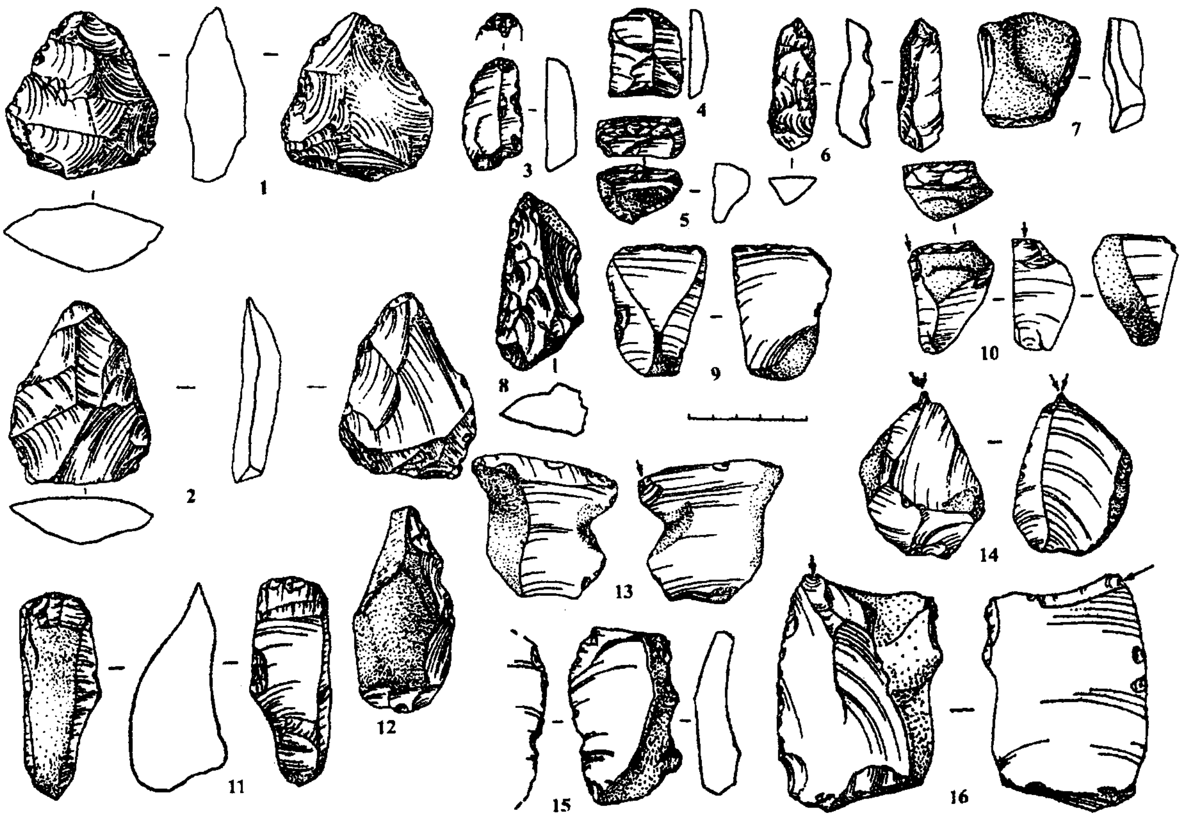

Figure 3. Khadjoh Group. Tools.

ventral surface, form a denticulated edge (fig. 3:9). A characteristic peculiarity of all Khadjoh sites is a small number of side-scrapers, formed by scale retouch (fig. 3:7-8). Clacton notches are poorly represented. At Sredniy Khadjoh there are only two denticulate tools made by small Clacton notches; in the Shahan workshop there are four such pieces (fig. 3:12). Notches made by scale retouch are also quite a few. There are usual backed forms of denticulate tools, made by alternating small facets (fig. 3:15).

Implements made by chipping are present at the Khadjoh group. At Sredniy Khadjoh, a backed form with bifacially trimming side present. There is a core-like tool in the Shahan site, another at Shahan workshop, and two more at Sredniy Khadjoh. Sub-triangular double convex bifaces, made by wide deep scars (fig. 3:1-2), are present in the Khadjoh group. Quinson points form a specific feature of Khadjoh sites (fig. 3:6). They are of leaf-like form with convex edge (Ronen, 1970).

Abadzeh group of the Late Acheulean sites

Late Acheulean sites of the Abadzeh group are located in the middle flow of the Belaya River (fig. 1). A location on the Fortepyanka River was the first Acheulian site on the Northern Caucasus, which was initially identified as the Shellean (Zamianin, 1961). Kurdjips and Abadzeh locations were discovered later. Later the Fortepyanka location was re-dated to the Middle Acheulean and Kurdjips was re-dated to Early Mousterian (Autlev, 1981). Only the Abadzeh location has, for more than 20 years, kept its Late Acheulean dating (Autlev, 1963; 1981; Lubin, 1984).

Study of collections of the sites permits them to be considered as a single grouped industry. Analysis of cores shows that the proto-prismatic flaking technique in slightly convex planes had been used in all three sites. A preparation technique consisted in forming of a striking platform by several scars or by retouch. Core utilization was carried out mainly on one side (fig. 4:1-4) by increase in the number of striking platforms.

The larger flakes were used for tool making. Retouch facet measurements, proportion of length to width of a facet, and the consequent diagram setting for each of the sites made it clear that retouch facets form four main categories. Experimental conclusions attest to the use of different retouch techniques for the different retouch facets types (Golovanova, 1984).

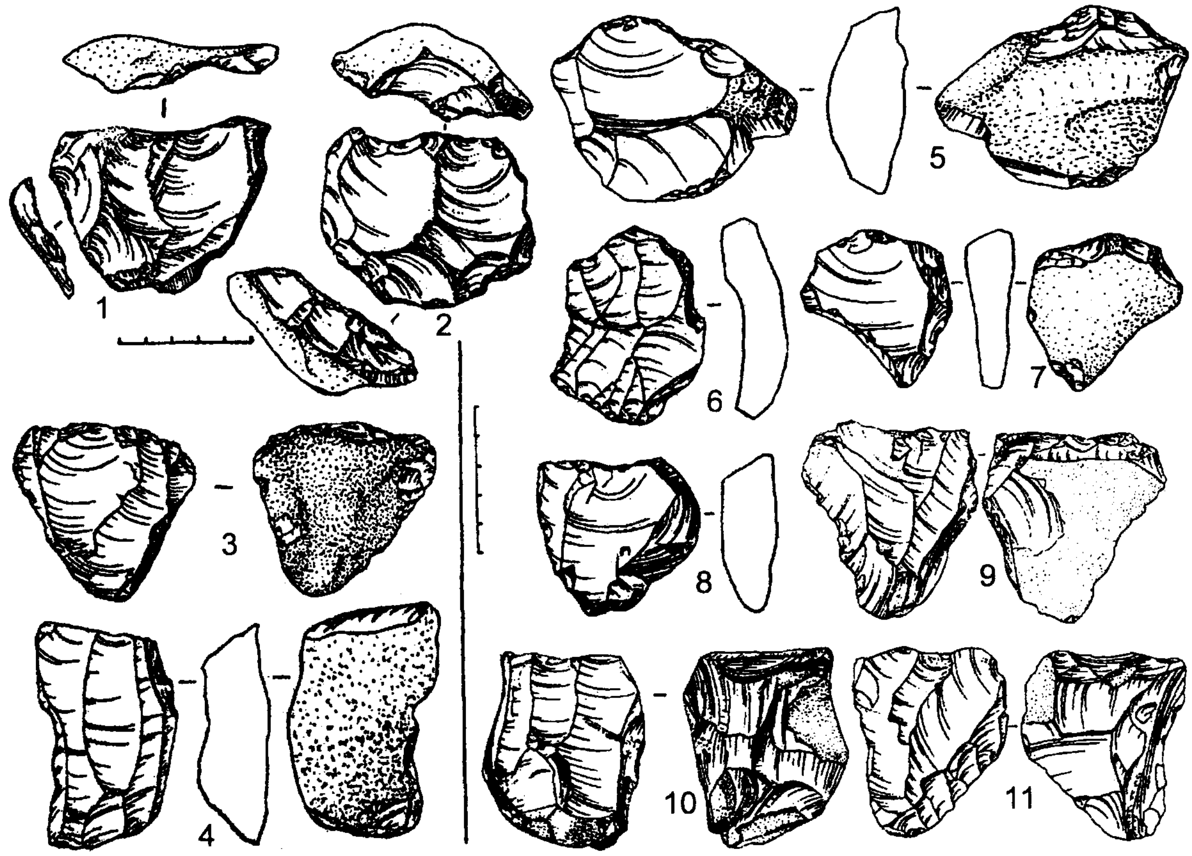

Figure 4. 1-4, Abadzeh Group. Cores; 5-11, Luchka and Semiyablonya. Cores.

Subsequent analysis of collections revealed that, in the Abadzeh group sites, usage of different retouch techniques for tool making was approximately identical.

For all the sites, the presence of end-scrapers of two types is typical. Elongated facets form working elements of the first type; one can trace small short facets on semi-abrupt edges of the majority of these tools (fig. 5:13). End-scrapers of the second type have elements formed by rounded facets; there are no signs of damage or trimming on edges of these implements (fig. 5:12). Notches do not always mark out end-scrapers of the first type, but for another type notches are obligatory. The first are made mostly on distal ends of elongated blanks, the second are made on flakes. End-scrapers made by elongated facets were found in all sites of the Abadzeh group. Side-scrapers formed by elongated facets (fig.5:7-8) and scale retouch are typical for this group (fig. 5:4-6), as well a specific form of side-scrapers (fig. 5:9).

Notches (fig.5:11) and denticulate tools are present. Denticulate tools are made by rounded facets (fig. 5:14-15), scale retouch (fig. 5:19) and Clacton notches (fig. 5:18). The presence of beak-like tools and implements with sharpened angles is characteristic of the Abadzeh group sites. Beak-like tools have small "working elements", formed by flat scale retouch. Tools with sharpened angles are divided to two types. Wide elongated facets (fig. 5:20) characterize the first type; and scale facets (fig. 5:16) form the second type.

The presence of sub-triangular plane-convex bifaces (fig. 5:1, 3) is typical: one at Fortepyanka, one at Kurdjips, and seven at Abadzeh. In additions there is one sub-cordiform double convex, one sub-triangular double convex, and one Micoquian biface at the Abadzeh location. They are formed by large elongated scars, ore often close to a leaf-like form (fig. 5:2), and have great size and rough trimming. Additionally, there are choppers (fig. 6:3), unifaces on pebble halves (fig. 5:10) and core-like backed tools with arched edge and end-scraper-like forming angle called Abadzeh type (fig. 6:1).

The cited techno-typological peculiarities of Abadzeh, Fortepyanka and Kurdjips locations allow them to be considered as a local group of the

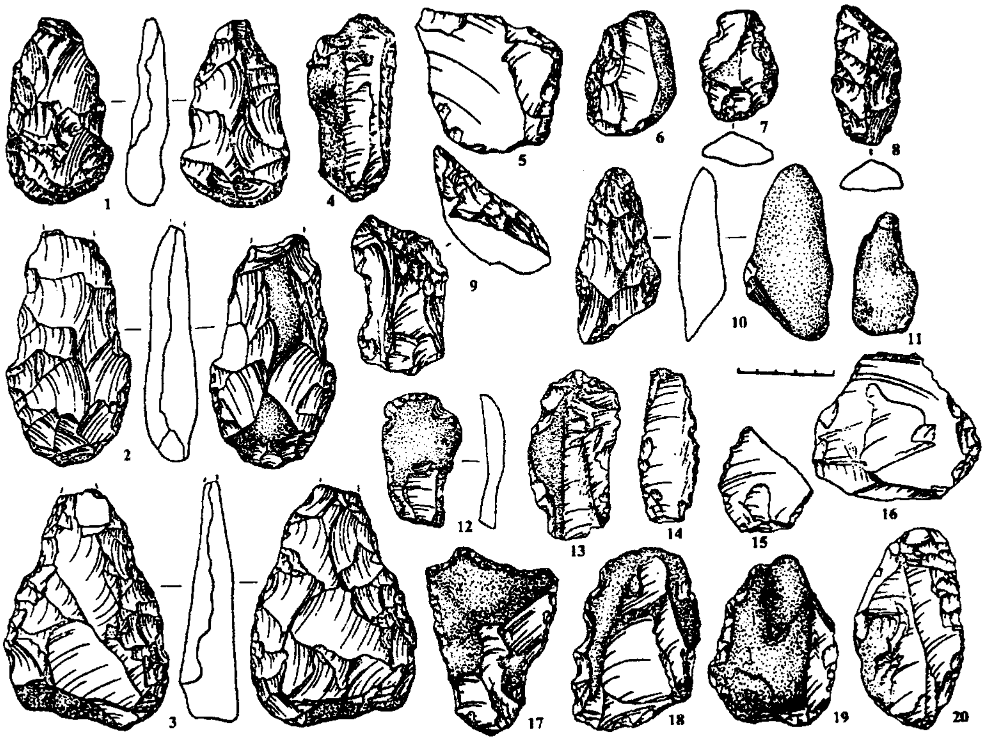

Figure 5. Abadzeh Group. Tools.

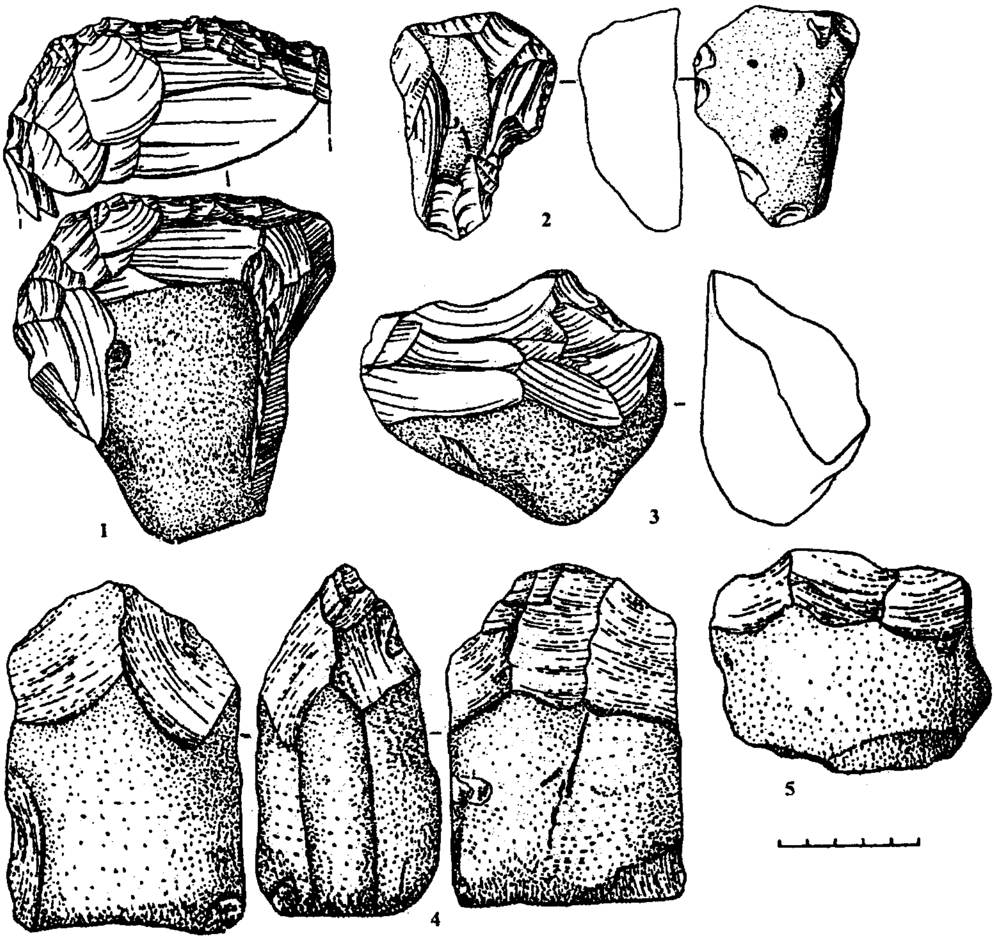

Figure 6. Heavy duty tools. 1-3, Abadzeh group; 2, Semiyablonya location; 4-5, Abin Group.

Late Acheulean sites. As implements found at Kurdjips and Fortepyanka locations were moved to riverbeds, dating of the group is based only on the geomorphologic position of the Abadzeh lacation, which, perhaps, is not older than 130,000 yr.

Abin group of the Late Acheulean sites

The Abin group of the Late Acheulean sites was discovered by P. Autlev in 1978-79 (Autlev, 1981) in the Abin and Crimea districts of the Krasnodar region. The Abin location has been studied more completely and a large collection of stone tools has been gathered. Only about 20 implements were found at the Adagum location, including one biface with an interception. At the Khabl location three implements were found, including one biface. The three sites are similar in raw material used for tool making. River boulders and pebbles of alevrolite and quartzite sandstone were the main raw materials. These kinds of raw material are rarely presented in the Paleolithic Kuban River basin sites. No flint artifacts have been found.

Plane parallel flaking is a characteristic of a flaking technique in these industries (fig. 2:1-3). Amorphous cores of a primary stage of flaking represent more than half the cores of the Abin group. For a utilization technique, one-side cores are typical, usually one-platform (25,6%) and multi-platform (15,3%), sometimes two-platform (2,6%).

A typological peculiarity of the Abin group is that tools make up to 28,2% of total (216 items). But the strongest peculiarity is that heavy-duty tools and bifaces prevail, respectively 37,5% (81 items) and 32,9% (71 items). Among the heavy-duty tools, one-sided choppers predominate (fig. 6:5) (54 items), but bifacially trimmed chopping-tools are also present (27 items) (fig. 6:4). There are several types of bifaces: triangular, sub-triangular (fig. 8:1-3), oval, elongated oval. A series of bifacial foliate points is also present (fig. 8:4-5).

Among flake tools, side-scrapers strongly prevail, making up 18,5% of the total (40 items) (IR - 29). Simple side-scrapers are mainly present (17 items) (fig. 8:6). There are two side-scrapers with ventral retouch (fig.8:7), two transversal and déjeté ones. Side-scrapers are formed mainly by scale retouch. Two end-scrapers (fig. 8:8-9), one borer, six naturally backed knives, two notches, and two proto-limaces are also present. A poor proportion of the Upper Paleolithic tools and complete lack of denticulate tools also determine specific features of the group.

Conclusions: the Late Acheulean of the Northern Caucasus

Studies of the geomorphologic positions of the Late Acheulean sites allow dating them in a wide range from about 100,000 to 150,000 yr. Typological features point only to the Late Acheulean age of the sites. There are no reasons to suppose development of one group into another. Facial variability of the industries is also excluded, because proportions of cores/flakes/tools in all the sites are similar (table 2), and only the Shahan location is interpreted as a workshop on the basis of lower tool percentage. Raw material quality didnot greatly influence technical indexes of these industries. In the Abadzeh group, for example, different sorts of raw material were used in each site. However, all the group industries both in technical and typological aspects are nearly identical.

Detailed techno-typological analyses allowed grouping of the sites inside the Abadzeh, Abin and Khadjoh groups. In all the Late Acheulean sites on the Northern Caucasus, primary flaking was performed by a method of parallel flaking in slightly convex planes. The main differences appear in core preparation for flaking and technique of utilization (table 3, 4). A specific characteristic for the Khadjoh group is the use of former scar negatives as striking platforms (25% for the Shahan workshop) and multi-faced technique of utilization. In contrasts, core utilization of one plane is typical for the Abadzeh group. The striking technique in the Abadzeh group sites gave a greater number of blades and elongated flakes: 13,5% in Abadzeh, 13,5% in Fortepyanka, and 19,0% in Kurdjips. In the Khadjoh group sites, blades are completely absent, and elongated flakes make up 4,3% at Sredniy Khadjoh, 8,8% at the Shahan workshop, and 4,0% at the Shahan location. Larger flakes were chosen for tool making. Sites of the Khadjoh group differ sufficiently from the Abadzeh group sites in usage of flint fragments for tool making.

Differences between the two groups are obvious in the retouched tool typology (table 5). A comparison of tool models (Golovanova, 1984) also shows the presence of quite substantial differences, such as end-scrapers, made by elongated retouch and end-scrapers, formed by rounded facets. A number of models are present only in one or another group. These are chisel-like tools in the Khadjoh group, and side-scrapers made by elongated facets, denticulate tools made by scale retouch, tools with sharpened angles, and

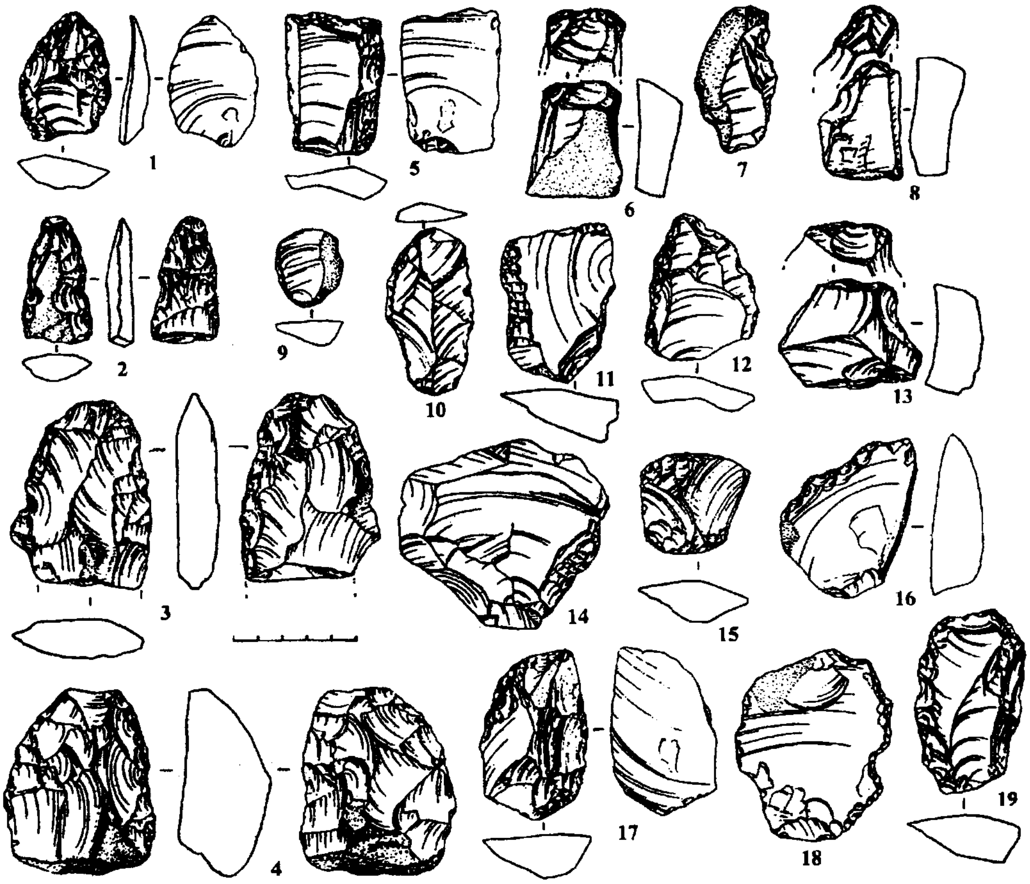

Figure 7. Luchka and Semiyablonya. Tools.

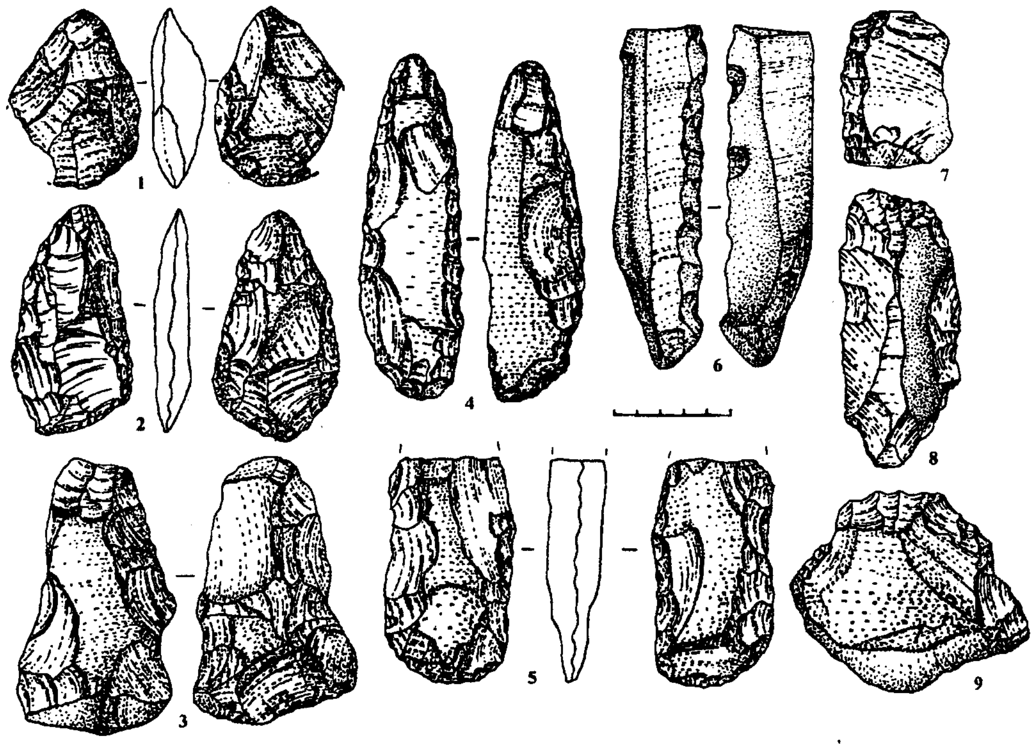

Figure 8. Abin Group. Tools.

beak-like tools in the Abadzeh group. A number of retouched tools, such as side-scrapers made by rounded facets, denticulate tools made by a series of clacton notches, as well single clacton notches, is presented in the Abadzeh and Khadjoh groups in different quantities. The same significant differences between sites of the two groups can be traced through comparing chipping tools. In the Abadzeh group sites, the major part of bifaces have a plane-convex cross-section, thinned base, made by short wide scars. In addition, there are choppers, chopping-tools, Abadzeh-type tools, and unifaces on pebbles. In the Khadjoh group sites there are no tools like these. Calculation of χ^2 coefficient (Riabushkin a.o., 1981) showed insufficiency of differences within each of these groups (table 6).

Comparison of sites using F. Bordes typology (Bordes, 1961) (table 7, 8) indicates that greater numbers of side-scrapers and the Upper Paleolithic tools are typical for the Khadjoh group (31,5-37,7%). There are quite few bifaces in both Abadzeh and Khadjoh groups. In contrast, a number of bifaces in the Abin group make up to 32,9%, and 29,2% is represented by side-scrapers, as well as a great number of choppers and chopping-tools.

Thus, today one can speak about intensive settlement of the Northern Caucasus during the Late Acheulean. All the Late Acheulean sites of the region are characterized by a plane parallel flaking, and pointed biface forms. Moreover, finding some analogies with the Near-Eastern and European sites, they could not be identified with any of them, although the Abadzeh group sites seem closest to such sites as Evron, Kissufim, En-el-Assad (Rollefson, 1980). The latter are characterized by a high development of Levallois knapping technique, pointed forms of bifaces (amingoloid, cordiform), a great percentage of side-scrapers. Sites of the Abadzeh group are also characterized by developed plane parallel flaking, traditionally called Levallois, cordiform and subtriangular forms of bifaces and a high amount of side-scrapers (25,9%). But there is a strong difference in the biface index among these sites: 36% for Kissufim, 40% for Evron, and only 0,2% for Abadzeh, as well 1,7% for Fortepyanka. In additions, there is a rather high persentage of Jabrudian elements (28,3% at En-el-Assad, and 21,6% at Kissufim), which are completely absent in the Abadzeh location industry. The same is true for the Abin group.

The Late Acheulean industries of Tabun E (Jelinek, 1975: t. 1-8) are also characterized by the presence of bifaces (from 1,9% to 32% according different authors), as well as high scraper indexes (16-68%), and blade indexes (20-40%). The main difference of these industries is a presence of a rich and variable canted side-scraper group (0,5-8,2%). This feature sharply distinguishes the Near-Eastern Late Acheulean sites.

Unfortunately, Transcaucasus Late Acheulean sites are found only at surface locations, the dating of which is difficult. Moreover, the majority of the collections is selected. On the reason collections from the Satani-Dar, Djraber and other Armenian locations are strongly dominated by bifaces while flake-tools are almost completely absent. Their common feature is a prevailing of sub-triangular and sub-cordiform bifaces, as well presence of blade technique.

In Europe, the Markkleeberg location is close in age to the North-Caucasus Late Acheulean sites. Earlier it was dated by the end of Mindel-Riss to the beginning of Riss. Long triangular, short and small triangular, and asymmetric oval bifaces are numbered here to 0,2%. Among the flake-tools simple side-scrapers prevail. Blade index is 10%. But in contrast with the North-Caucasus materials, there are here Mousterian points and a series of pointed tools called *Spitzklingen* (Baumann a.o., 1983). The Reuretsruh location includes the same elements, as well as Upper Paleolithic and even Neolithic intrusive materials (Luttropp & Bosinski, 1971), so that its dating is difficult.

The lower layers in the Weinberg caves (Danube region) are dated to the Late Pleistocene. Their industries are characterized by the presence of broad, flat hand-axes, flake-tools, and “typical Middle Paleolithic cores” (Müller-Beck, 1988). In other regions too were found sites of Riss age, that include a small number of bifaces, such as Abri Suard, La Chaise in Charente, France (Debenath, 1988). But they have a completely different set of flake-tools. For example, Kostenki and Chatelperron knives were found in La Chaise.

The Khadjoh group has quite unexpected and interesting analogs in the industry of the Muret site in Northern Alps (Malenfant, 1976), namely, in primitive plane flaking, small blade index (6,9% - Muret, 4,4% - Sredniy Khadjoh), low facetage index. Typologically, these sites are characterized by small numbers of side-scrapers (Muret - 9,85%, Khadjoh - 10,1%), presence of end-scrapers, Quinson points, burins, partly bifacial tools, and side-scrapers with bifacial retouch.

The majority of the so-called Late Acheulean of Levallois facies sites, recognized in Northern France (Somme and Oise basins), Southern Germany (Salzgitter-Lebenstedt, Hannover-Dohren, Rethen, Herne, Balver Höhle), and Belgium (Grotte de l'Hermitage, Docteur), are dated prior to the beginning of Wurm glaciation (Bosinski, 1967; Ulrix-Closset, 1975). A lot of them have small numbers of triangular or cordiform bifaces; Levallois technique is noted. But most of these sites are characterized by the presence of Levallois or Mousterian points, bifacial side-scrapers, leaf-shaped bifacial side-scrapers, and triangular flakes with retouched tops. The majority of the sites like the North-Caucasus ones do not have absolute dates.

However, all the mentioned industries, chronologically close to the North-Caucasus Late Acheulean sites, exhibit only a very high level similarity: a presence of some number, often small, of sub-triangular and sub-cordiform bifaces, as well as Levallois or blade techniques. The majority of the European sites have Mousterian points and other pointed tools. The Near-Eastern sites are also distinguished by the presence of canted tools.

The comparaisons mentioned above give no grounds to establish genetic connections of any Late Acheulean industries on the Northern Caucasus with ones in the Middle East or in Central Europe. But they suggest that the Late Acheulean of the Northern Caucasus had a more complex nature, than previously considered.

Problems of the Lower to Middle Paleolithic transition

The question of the evolution of the local Acheulean culture into the Mousterian has been propounded for the North-Western Caucasus only supposedly, mainly on the basis of the fact that some sites with small bifaces exist here.

The study of the collections revealed considerable differences between the sites. First of all, the bifacial tools, which were considered as an indication of the Early Mousterian age of the sites, have analogies in different time industries. Two bifaces from the Semiyablonya location (fig. 7:3-4) are analogous to those coming from the Abadzeh site, as well are two tools close to the Abadzekh type (fig. 6:2). Side-scrapers (fig. 7:9-12, 14) and denticulate tools (fig. 7:16,18-19) prevail among flake-tools from the Semiyablonya and Luchka locations. In this respect, the latter are close to the Abadzeh group of the Late Acheulean sites. Side-scrapers made by elongated facets were found in both sites (fig. 7:11, 14), as well as in the Abadzeh group sites only. The same is true for a specific side-scraper form (fig. 7:17) close to one from the Abadzeh location (fig. 5:9). Tools with sharpened angles (fig. 7:15) present one more tool type closing these sites with the Abadzeh group. End-scrapers in these sites also have clear analogies in the Late Acheulean sites. It is especially true for high end-scrapers: similar tools present both at the Abadzeh and Khadjoh sites (fig. 7:7-8, 13). Therefore, affinity of the sites under consideration with the Late Acheulean sites is quite obvious. This is revealed not only in the percentage of tools, but also in their principal characteristics.

However, in the collections of the Semiyablonya and Luchka, there are some elements which have analogies in the Mousterian industries. There are two Mousterian points (fig. 7:1) from the first and a fragment of bifacial leaf-shaped point from the second (fig. 7:2). The latter finds analogies in the materials of Il'skaya and Mezmaiskaya cave. Besides, in the materials of Luchka one can note truncated-facetted pieces (trimming of a ventral face and then dorsal thinning), which is very characteristic for the nearest Mousterian sites (Monasheskaya, Barakaevskaya and Mezmaiskaya caves). A convergent side-scraper has also been found at Semiyablonya (fig. 7:5).

The study of the flaking technologies of the industries under discussion shows that the technology of parallel flaking from slightly convex flake surfaces was used. Core reduction was carried out mainly in one plane by means of turning a core and forming the next striking platform (fig. 4:5-11). However, the industries differ from each other regarding the technologies of core preparation. The highest index of platform preparation was noted for Semiyablonya. At Luchka it is much lower. At the same time, in their core preparation, flaking and reduction technologies, both sites are rather close to the Abadzeh Late Acheulean group. Probably, they represent a later stage when technology of core preparation came into wider use. The well-developed technology of core preparation led to the increase in the number of high-quality blanks at Semiyablonya. Blades and elongated flakes make up 17,2%. The indices of trimmed and facetted platforms are more than 19,3% and 15,7% respectively. They exceed considerably the data obtained for Acheulean sites, but are more than two times less than the indices characteristic of Mousterian industries. At Luchka these indices are considerably lower.

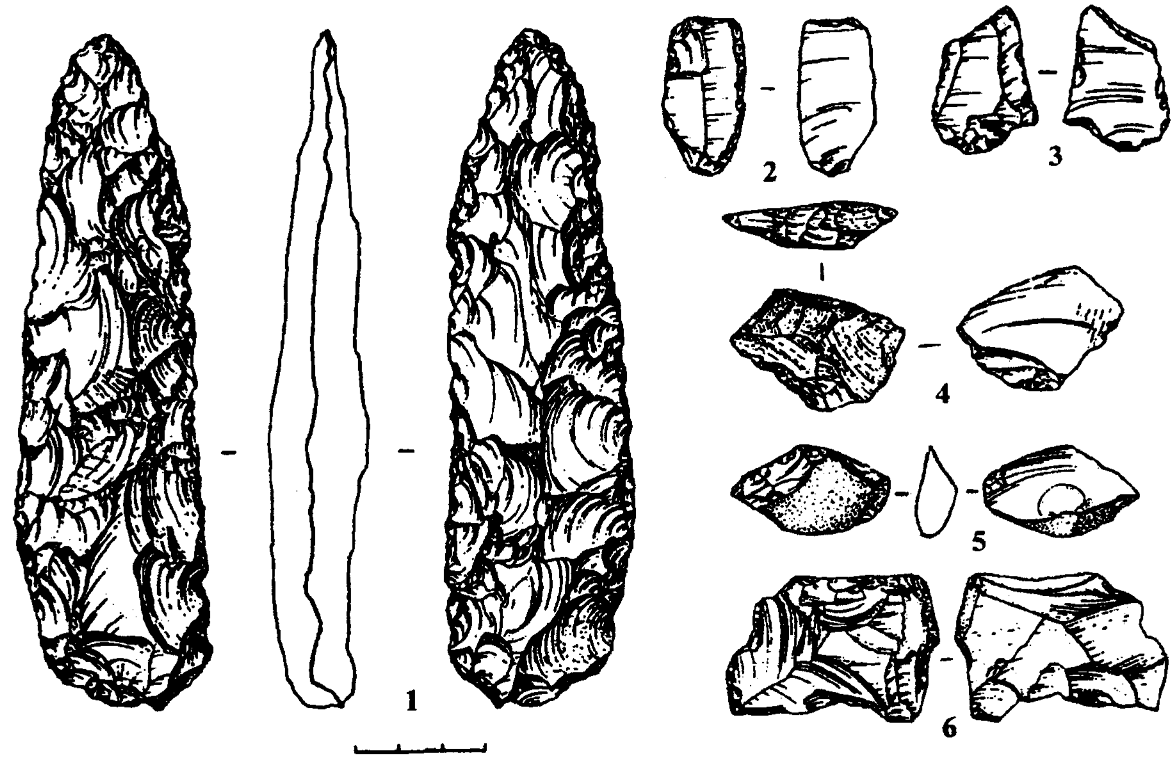

Figure 9. Matuzka Cave. Artifacts from Layer 5B.

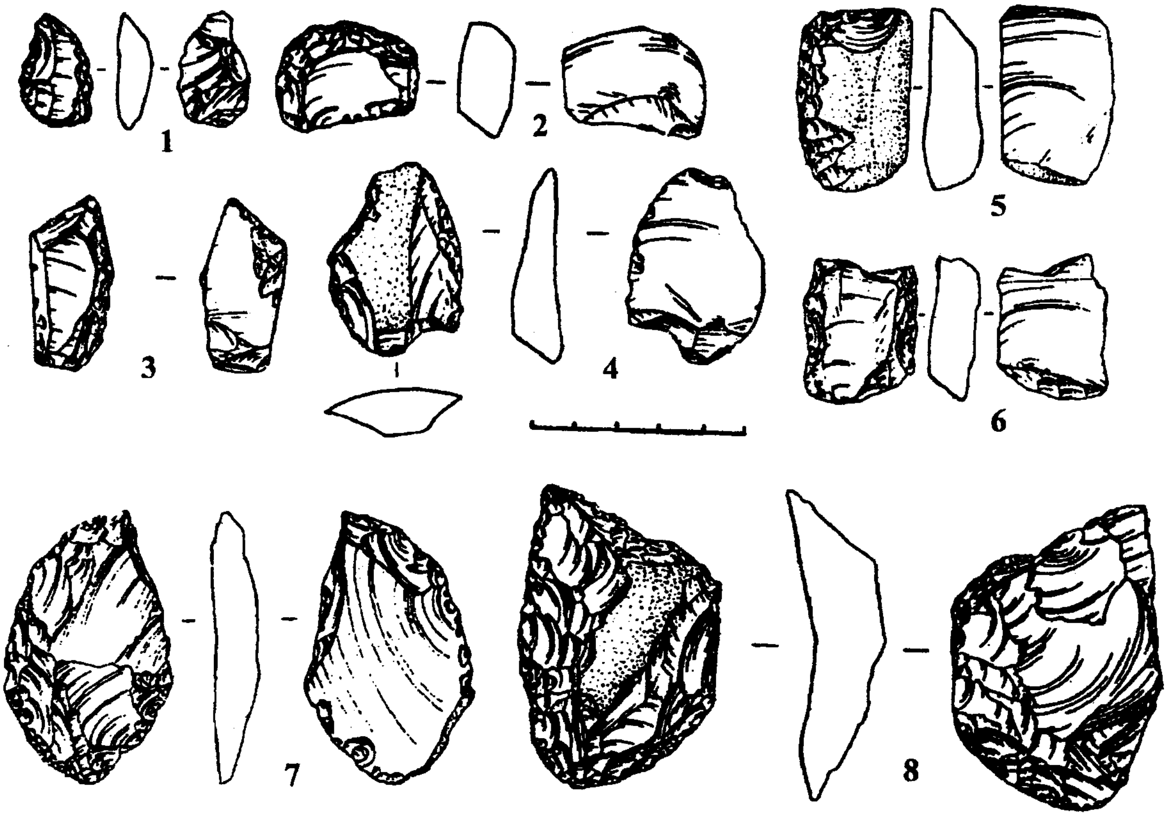

Figure 10 Matuzka Cave. Tools from Layer 6.

The material coming from the lower levels of the Matuzka cave is very important with respect to the question of the Lower to Middle Paleolithic transition and the initial stage of the Mousterian on the North-Western Caucasus. The Matuzka cave is situated at an elevation of 720 m a.s.l. near the northern edge of the Lago-Naki massif of the Upper Jurassic limestone. The total area excavated in 1985-1991 is 54 m². The section of the cave deposits includes two Holocene and 12 Pleistocene layers. With the exception of layer 5a, stone tools are present in all the Pleistocene layers. The stone industry from layers 3b and 4a has analogies with the Levallois blade-focused industries of the Khosta culture sites near the Sochi. The industries from strata 4b and 4c are typologically close to the Gubs culture (Typical Mousterian). Layers 3a-c and 4a-d can be dated to the Middle Würm or stage 3 of the oxygen-isotope scale. Layer 4b of Matuzka has the date 34.200±1.410 kyr B.P. (LU-3692). Layers 5-6 are older than the Middle Würm. Layer 7 was preliminarily dated back to the Riss-Würm.

Samples for paleo-magnetic study (Pospelova a.o., 1996) were taken from layers 7, 8a, and 8, while samples from layers 6, 7, 8a, and 8 were also used for the study of composition and structure of the magnetic grains. On the basis of the NRM (t) and Irs (t) curves, one can establish that the magnetic properties of the sediments are caused by fine-grained hematite. Magnetic parameters of the sediments vary in different layers of the cave. Sediments of the layers 8a and 8 have normal polarity last of thermal demagnetisation before 600° C. In the lower part of layer 7, a transition from normal polarity is revealed. The upper part of the layer has reverse polarity. VGP's are placed near the South Pole (λ=114° E, Φ=83° S). We suppose that in layer 7, the Blake geomagnetic excursion is recorded. This supposition is confirmed by geological and geomorphologic data of S.A. Nesmeyanov that the age of layer 7 is 100,000-120,000 yr. On the basis of the faunal data, G.F. Baryshnikov dated the layer to the Riss-Würm/Late Riss time.

Thus, the industries of layers 5-7 are dated to the period from Riss-Würm to Early Würm. In spite of the small numbers of artifacts, these industries demonstrate significant cultural peculiarities. Altogether 166 artifacts come from these levels. At every level, cores are single (fig. 9:6; 11:9). All of them have parallel scars on their striking surfaces. Platforms are usually plain; only one core has a retouched platform. All the cores were reshaped into tools except one strongly exhausted core from level 5b (fig. 9:6). The shortage of raw material exerted a great influence on the appearance of the industry. The majority of flakes from each layer have negatives on dorsal surfaces that coincide with the axe of the flake itself. Blades were found in layer 5 only (fig. 9:3), while in underlying layers 6 and 7 only elongated flakes present. Most striking platforms on the flakes are plain. Trimmed or facetted platforms are single (fig. 10:6; 11:3-4).

The small but sufficiently impressive industry from levels 5-7 of Matuzka does not have complete analogies in the Early and Middle Paleolithic industries of the Northern Caucasus. In the collection from layer 5, the most striking form is a bifacial point (fig. 9:1), which resembles to some extent bifacial points from the Tcona cave in Georgia and the Abin Late Acheulean location on the Northern Caucasus. Besides, the collection contains three end-scrapers of high form (fig. 9:4-5) like those often presented in the Late Acheulean sites of the North-Western Caucasus. In layer 6, there are several specific tools: an unfinished leaf-shaped point (fig. 10:7), a small triangular biface (fig. 10:1), and a side-scraper made on a core (fig. 10:8). High end-scrapers present too (fig. 10:2). There are also two *déjeté* side-scrapers of original type unknown in the nearest Mousterian sites (fig. 10:5). In layer 7 large tools on limestone pebbles and slabs are present, including a chopper (fig. 11:6). Here there are also high end-scrapers (fig. 11:5) and an atypical *déjeté* side-scraper (fig. 11:1). However, the most common forms in layers 5-7 are single side-scrapers (fig. 9:2; 10:3, 4, 6; 11:2-4, 8), as well denticulate and notched tools including a convergent denticulate tool (fig. 11:7).

Thus, the industries of levels 5-7 of Matuzka have analogies both in Acheulean and Mousterian sites. However, no complete analogies are revealed. These industries have no chronologically close sites in this region, probably, except of layers 5-7 of Il'skaya 2, which are dated to Riss-Würmian age, but remain almost unpublished.

The main characteristics of the materials from the Semiyablonya and Luchka locations are close to the Late Acheulean sites. Numerous analogies among bifacial and flake tools also render these sites similar to the Late Acheulean ones. Though the appearance of Mousterian points augments the percentage of convergent forms, the latter is still much lower than in the Mousterian assemblages. The industries under consideration are close to the local Late Acheulean industries of the Abadzeh group and, probably, belong to the same group of sites, but are somewhat later in age. It should be

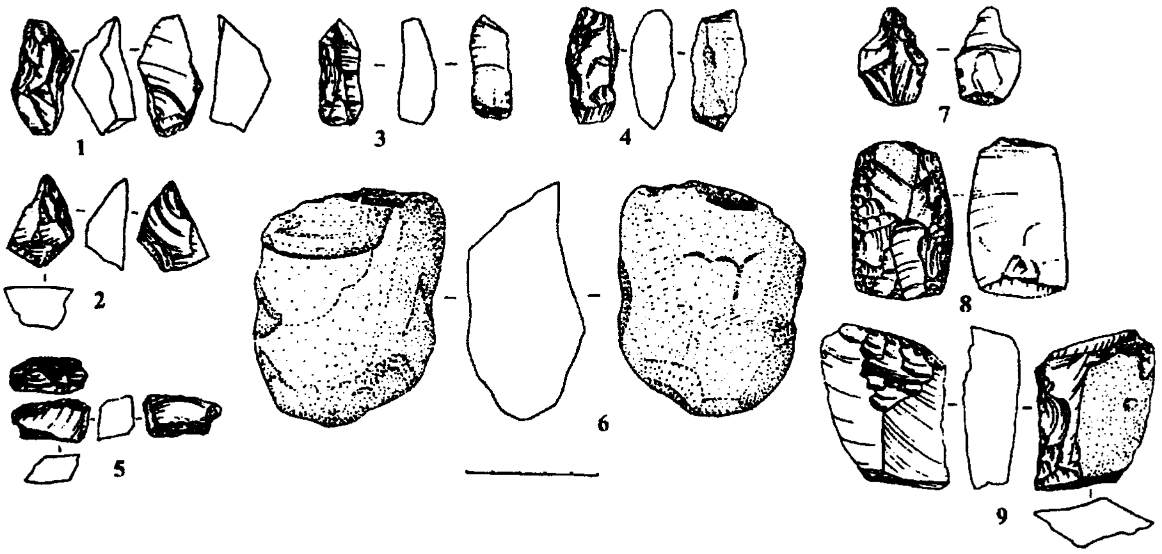

Figure 11. Matuzka Cave. Artifacts from Layer 7.

noted that the analyzed industries have no continuation in the later Mousterian sites. In the end of Riss-Würm – beginning of the Würm, the East European Micoquian appeared in the Northern Caucasus. A break exists between the local Late Acheulean and Mousterian industries.

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O18 Scale	Age Kyr	Alpine scale	SITES
4	68		
5	125	R-W	Matuzka layer 5 ? Matuzka layer 6 Matuzka layer 7
6	180	Late Riss	Semiyablonya, Luchka Sredniy Khadjoh, Shahan st., Shahan w. Abadzeh, Fortepyanka, Kurdjips Abin, Habl

Table 1.

Total proportions	Total number	Cores % (n)	Flakes % (n)	Tools % (n)
Abadzeh location	2691	14,2 (382)	82,3 (2242)	22,6 (610)
Fortepyanka loc.	569	24,4 (139)	74,2 (422)	11,4 (65)
Kurdjips location	582	17,5 (102)	80,6 (469)	11,7 (68)
S. Khadjoh, level 3	346	7,2 (25)	64,5 (223)	28,6 (99)
Shahan location	583	9,4 (55)	90,1 (525)	5,1 (130)
Abin location	710	11,1 (78)	59,2 (416)	28,2 (216)

Table 2.

Striking platforms	Facetted %	Trimming %
Abadzeh location	38,1	23,6
Fortepyanka loc.	10,0	14,3
Kurdjips location	31,0	23,9
S. Khadjoh, level 3	-	14,3
Shahan location	-	17,9

Table 3.

Cores	Many-sided %	One-sided, 2-4 platforms %
Abadzeh location	8,6	41,4
Fortepyanka loc.	27,4	46,1
Kurdjips location	3,9	44,0
S. Khadjoh, level 3	42,9	-
Shahan location	45,1	2,0

Table 4.

Sites	Abadzeh Location	Fortepyanka Location	Kurdjips Location	Sredniy Khadjoh site	Shahan workshop	Shahan Site
Comparisons	1	2	3	4	5	6
Total number of tools	495	50	49	68	26	7
Double-convex bifaces	-	-	-	3	1	1
Flat-convex bifaces	19	2	3	-	-	-
Choppers/chopping-tools	5	2	1	-	-	-
"Abadzeh" type tools	7	1	-	-	-	-
Unifaces on pebble shalves	1	1	-	-	-	-
Quinson Points	-	-	-	2	-	-
Tools with burin spalls	-	-	-	20	5	2
End-scrapers w/elongated r.	24	2	6	3	1	-
End-scrapers w/rounded r.	17	6	4	-	3	-
Side-scrapers w/elongated r.	6	2	3	-	-	-
Side-scrapers w/rounded r.	54	-	-	12	2	-
Side-scrapers w/scale retouch	101	10	20	6	5	2
Denticulate tools w/rounded r.	67	9	-	9	-	-
Denticulate tools w/scale r.	28	-	1	-	-	-
Denticulate tools w/clacton n.	77	6	3	2	3	-
Notches w/rounded retouch	3	-	-	-	-	-
Notches w/scale retouch	8	8	1	8	3	2
Clacton notches	9	-	-	3	-	-
Tools w/elongated r. angles	8	-	3	-	3	-
Tools w/scale retouch angles	13	-	4	-	-	-
Beak-like tools	48	1	-	-	-	-

Table 5.

Comparisons	1-2	1-3	2-3	4-5	4-6	5-6	1-4
χ^2 value	14.7003	21.9881	18.1827	6.9457	2.7284	2.7692	31.7568
Table χ^2 value	30.1000	30.1000	30.1000	30.1000	30.1000	30.1000	30.1000
Result	Difference not sufficient	Difference not sufficient	Difference not sufficient	Difference not sufficient	Difference not sufficient	Difference not sufficient	Difference sufficient

Table 6.

Sites	IR	IC	IDent	IUP	IB
Abadzeh location	31,5	17,0	37,7	6,4	3,1
Fortepyanka location	27,3	18,2	27,3	14,5	3,1
Kudjips location	40,6	31,3	6,3	15,6	4,4
Sredniy Khadjoh site	6,7	-	38,2	25,8	3,0
Shahan workshop	27,6	-	13,8	31,0	3,3
Abin location	29,2	5,1	-	2,2	32,9

Table 7.

Tool types (by F. Bordes)	Abadzeh location	Fortepyanka location	Kurdjips location	Sredniy Khadjoh	Shahan site	Shahan workshop	Abin location
Total of tools	559	55	64	89	7	29	208
Simple straight Side-scrapers	19	-	-	-	-	-	6
Simple convex Side-scrapers	68	6	11	6	2	6	2
Simple concave Side-scrapers	35	3	-	-	-	-	6
Simple convex-concave Side-scrapers	-	-	-	-	-	-	3
Double straight side-scrapers	5	-	-	-	-	-	-
Double Double-convex side-scrapers	9	-	-	-	-	-	-
Double Double-concave side-scrapers	2	-	-	-	-	-	-
Convergent convex side-scrapers	-	-	2	-	-	-	-
Canted Side-scrapers	1	-	-	-	-	-	2
Transversal Straight Side-scrapers	3	-	-	-	-	-	2
Transversal Convex Side-scrapers	18	1	4	-	-	2	2
Transversal concave Side-scrapers	6	3	5	-	-	-	5
Inverse Side-scrapers	6	2	3	-	-	-	12
Biface Side-scrapers	4	-	3	-	-	-	-
End-scrapers	36	8	10	3	-	4	1
Borers	-	-	-	-	-	-	1
Burins	-	-	-	20	2	5	-
Notches	30	8	1	11	2	3	2
Denticulate tools	211	15	4	34	-	4	-
End-scrapers Of high form	3	-	6	6	-	2	-
Choppers	4	1	1	-	-	-	54
Chopping-tools	1	1	-	-	-	-	27
Miscellaneous	98	7	14	9	1	3	3
Leaf-like tools	-	-	-	-	-	-	8

Table 8.

ERAUL 92, 2000, p. 67 à 77.

LOWER PALEOLITHIC OCCUPATION OF THE NORTHERN CAUCASUS

Vladimir. B. Doronichev

Abstract

Today only Treugol'naya Cave presents reliably dated evidence of human settlement on the northern slope of the Caucasus Mountains from its initial stage at the beginning of the Middle Pleistocene through the end of this period, as well as being one of the oldest sites in Europe. The cave is a small karstic cavity situated 1500 m above sea level in the Upper Kuban' Basin, and filled with up to 4.5 m of loam and rubble. Layers containing stone artifacts are dated (ESR, pale-magnetism, pollen, and fauna) to the early through late phases of the Middle Pleistocene. The artifact assemblages are assigned to the Lower Paleolithic flake and pebble tool industries completely lacking in hand axes.

Keywords

Prehistory, Lower Paleolithic, Middle Pleistocene, Caucasus

Introduction

Till recently any arguments concerning the initial colonization of the Northern Caucasus, and the peculiarities of the Lower Paleolithic culture as a whole in the region had been too hypothetical, due to the absence of reliably dated Lower Paleolithic sites. The well-known non-stratified finds of stone artifacts previously assigned to the Lower Paleolithic in quarry Tcimbal and Ignatenkov's Kutok location (Northwestern Caucasus) can be used today only as a ground for speculation (Liubin, 1984:57-58; Liubin & Bosinski, 1995:218; Bosinski, 1996:55; Liubin, 1998), but not as a scientific fact. The first yielded only two artifacts which had been found on a modern

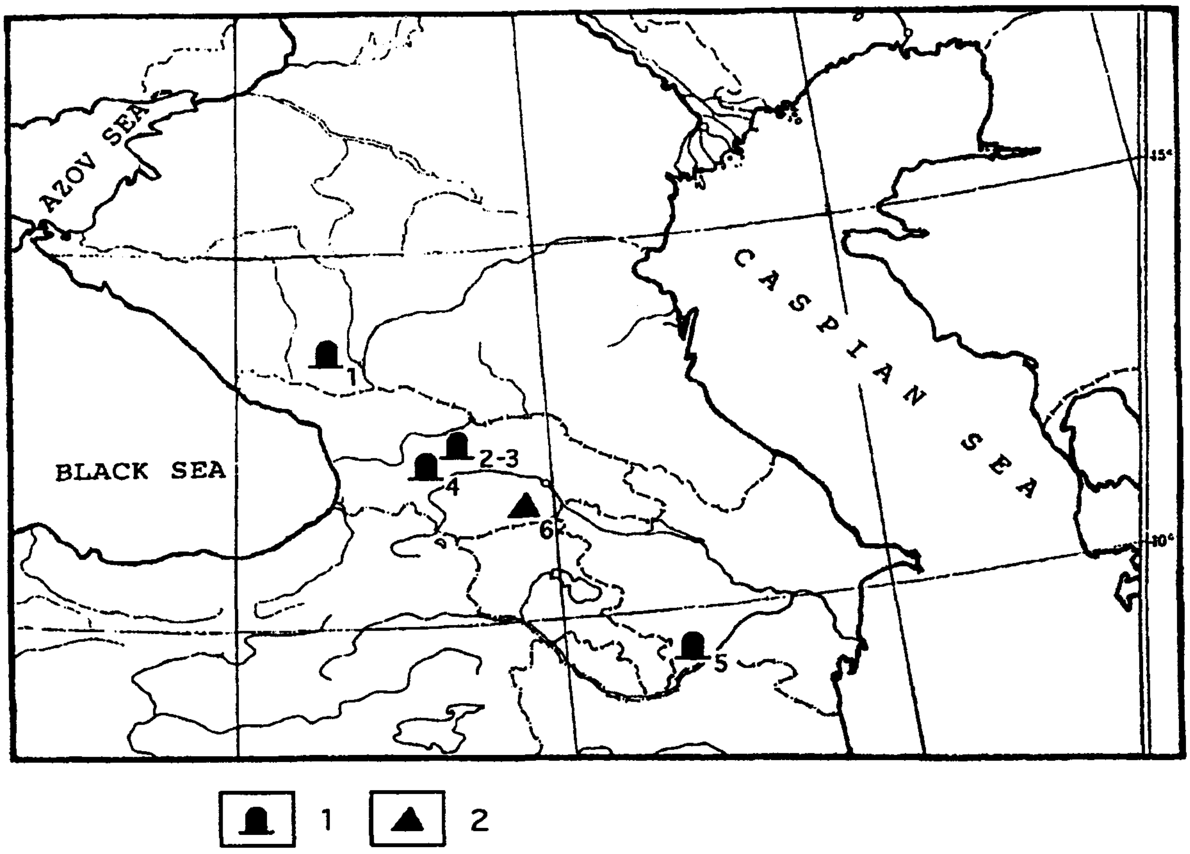

Figure 1. The map of Caucasus showing the main Lower Paleolithic sites. Legend: 1 - cave site; 2 - open-air site. Numbers: 1. Treugol'naya; 2-3. Kudaro 1 and 3; 4. Tcona; 5. Azykh; 6. Dmanisi.

strongly eroded surface of sediments containing the Lower Pleistocene mammal fauna. The second is represented by a richer assemblage of artifacts found under a high river terrace containing the early Middle Pleistocene mammal fauna, but none of the artifacts have a confirmed association with the fauna in spite of very long discussion (e. g., Zamiatnin, 1961).

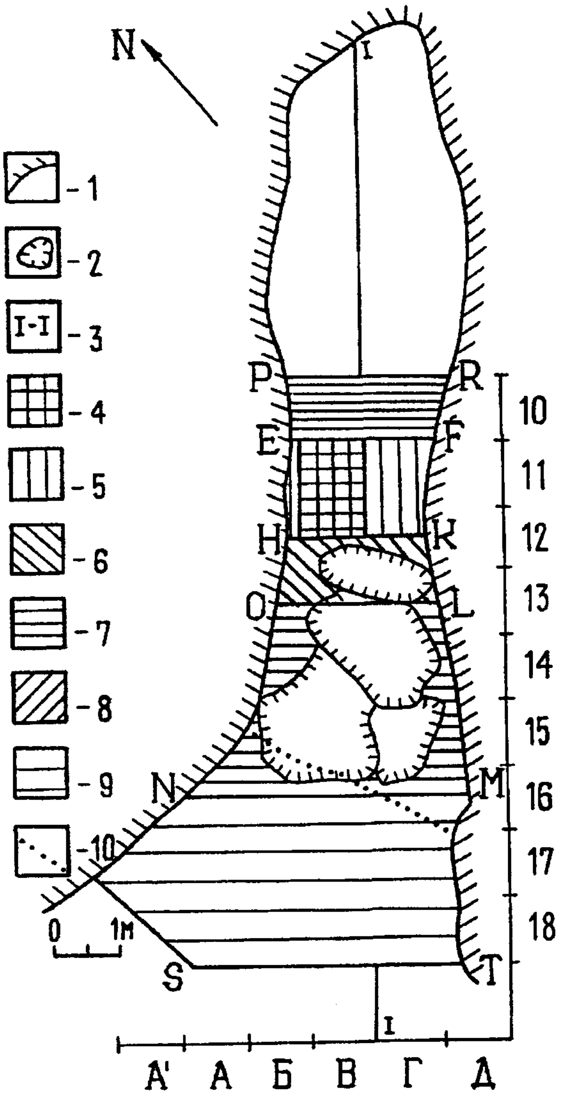

Figure 2. Plan of the Treugol'naya Cave showing excavation areas and cross-section labels. 1. walls of the cave; 2. limestone blocks; 3. longitudinal axes of the cave; 4-9. excavation areas (4. 1986; 5. 1987; 6. 1988; 7. 1989; 8. 1990; 9. 1991); 10. modern drop line.

The discovery in 1986 by L.V. Golovanova of Treugol'naya Cave in the Northern Caucasus (fig.1) has provided the first reliably dated traces of Lower Paleolithic settlement in this part of Eastern Europe. The cave, which is located in the Upper Kuban' Basin, in the Karachai-Circassian Republic, Russia, was excavated by V.B. Doronichev during 1987-1991 on a total area of 28 square m (fig.2) (Doronichev, 1987; 1991; 1992; Golovanova & Doronichev, 1993), and 1995 (last year's materials are not included in this article).

The cave is situated on the Baranaha plateau, which represents an orographic segment of the Skalisty Range. The plateau lies between the valleys of the Urup (a tributary of the Kuban) and the Kuva (a tributary of the Urup). The cave is in the middle part of the plateau, in the upper reaches of a deep ravine, at the base of a precipice where a bed of Upper Jurassic limestone (10 m thick) crops out. It lies at an elevation of 1500 m above sea level and 40 m above the ravine bed, in the upper part of the Vozdvijensk erosive cut according to a local geomorphologic scheme (by S.A. Nesmeyanov). The latter indicates that the mouth of the cave was probably exposed at the beginning of the Middle Pleistocene, most probably near the Matuyama-Brunhes boundary, i.e. not earlier than 780,000 years ago. Treugol'naya is a karstic cave of the gallery type, measuring 12 m in length, 2.5-3 m in width, and up to 5 m in height at the entrance, which opens to the southwest. The area of the cave does not exceed 30 sq. m. Before the cave there is a small terrace.

Stratigraphy

The stratigraphy of the deposits has been recorded in 6 cross-sections and one longitudinal profile along the axial line of the cave. The cross-section designated PR is the primary one. It exhibits the greatest thickness (4-4.5 m) and contains the most complete sequence of sediments (fig.3).

Generally, the section presents a modern layer 1, Upper Pleistocene layers 2, 3a, and 3b, as well eleven Middle Pleistocene layers 4a, 4b, 4c, 5a, 5b, 5c, 6, 7a, 7b, and 8. The oldest sediments of layer 8, most probably, were deposited before the cave was opened by erosion. The deposits can be divided into units corresponding to the main stages of sedimentation, which, in turn, can be tentatively correlated with the stages of development of the Urup river valley and Kuban Basin rivers as whole.

According to the results of paleo-magnetic dating, all the deposits beginning from layer 7b were formed during the Brunhes Normal Epoch, i.e. they are younger than 780,000 years (Pospelova & Levkovskaya, 1994). This is consistent with the conclusion that the cave was opened by erosion at the beginning of the Middle Pleistocene. ESR dates were obtained for layers 7a and 5b on shells of mollusks included into the sediments (Molod'kov,

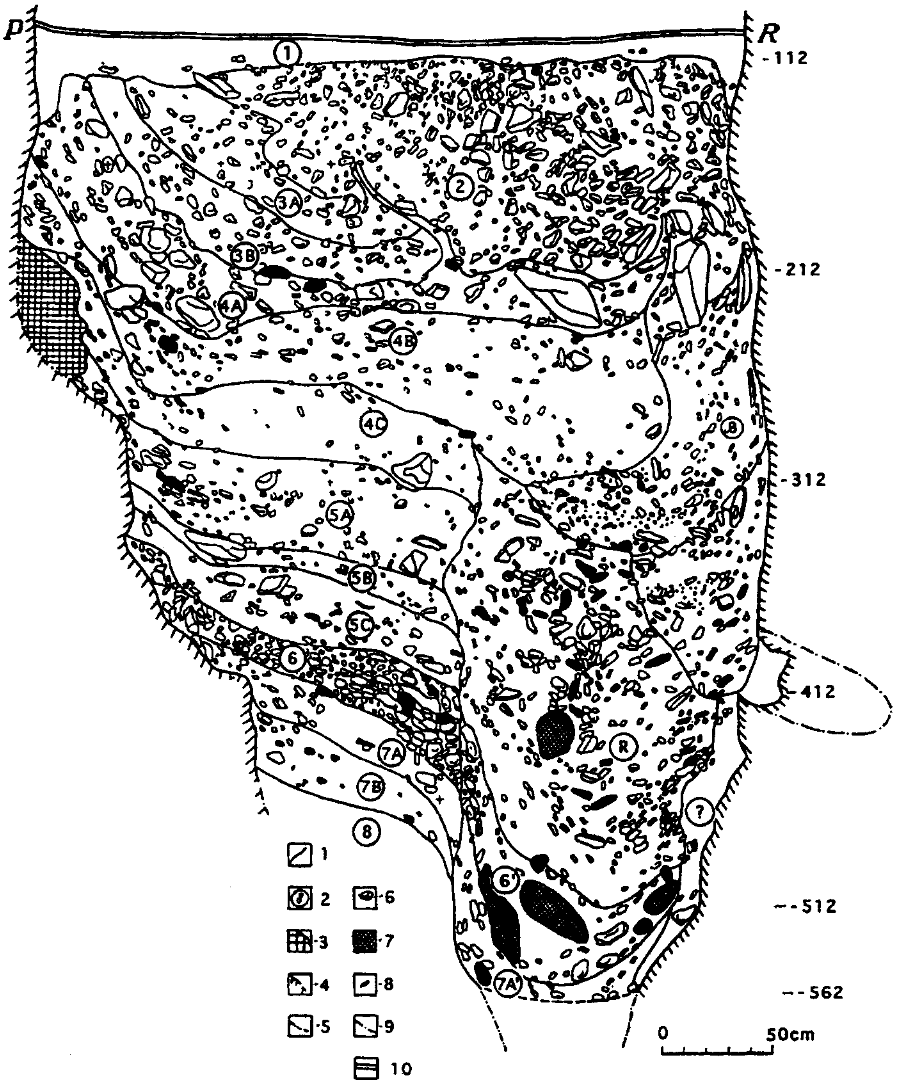

Figure 3. Transversal section PR in Treugol'naya Cave. 1. strata boundary; 2. strata number; 3. breccia; 4. bedrock; 5. lower boundary of the section; 6. limestone detritus; 7. glauconitic sandstone block; 8. bone; 9. proposed boundaries of erosional cuts into the floor and walls of the cave; 10. modern floor of the cave.

Layer	Character of deposits	Thickness (m)
1	Black, strongly humic sandy loam	0,05-0,35
2	Dark-gray sandy loam with blocks and angular detritus	0,05-1,10
3a	Orange-brown sandy loam	0,05-0,40
3b	Dark-brown loam with small detritus	0,05-0,35
4a	Orange-brown sandy loam with fragments of limestone, tuff and detritus	0,05-0,90
4b	Grey sandy loam with small detritus	0,10-1,06
4c	Light-gray sandy loam with small detritus	0,05-0,60
Lens ß	Filling of an erosive cut, consisting of thin layers of orange-brown and gray sandy loam and dark-brown loam	0,05-2,00
5a	Grey-brown sandy loam	0,10-0,50
5b	Dark-brown loam	0,10-0,15
5c	Brown sandy loam with detritus and isolated pebbles	0,15-0,35
Lens R	Grey sandy loam with limestone and sandstone detritus	0,05-1,50
6	Gravel, consisting of limestone pebbles and red-brown sandy loam	0,10-0,55
7a	Brown sandy loam	0,05-0,20
7b	Green-brown sandy loam	0,05-0,30
8	Fine-grained green glauconitic sand	0,05-0,30

1992; 1993). Two dates are available for layer 5b (420,000 and 365,000 yr.), whose average age is 393,000±27,000 yr. The average age of layer 7a, for which six dates were obtained (545,000 yr., 565,000 yr., 570,000 yr., 600,000 yr., 610,000 yr., 610,000 yr.), is 583,000±25,000 yr. Proceeding from the available absolute dates and a variation of the scalar magnetic properties of sediments (after G.A. Pospelova, personal communication), layers 7a-b may be correlated with oxygen-isotope stage 15, layers 5a-c with stages 10-13, and layers 4a-c with stages 7-8 (table 1).

Strata	Archaeology (V. Doronichev)		Terrace complex (S. Nesmeyanov)	Pollen analysis (G. Levkovskaya)	Faunal analysis (G.Barishnikov)	Correlation 18O scale (kyr)
	Layer	Assemblage				
1	Late Medieval layer		Kuban complex	no data	Modern fauna	**Stage 1** 12
Erosion cut			~ 15 kyr.			
2	No		Gireisk complex		Upper Pleistocene Fauna extremely cold, very humid	**Stages 2-4** 71
Erosion cut						
3a	Redeposited Lower Paleolithic					
3b	Redeposited Lower Paleolithic					
Deep erosion cut			~ 120 kyr. ?			no correlation
4a	L.P. layer 1	Cultural-Chronological Assemblage I	Gulkevich complex ~ 300 kyr. ?	Stage II no transregional exotics	Singil faunal Complex cooler, dryer	**Stage 7** 245
4b	L.P. layer 2					
Deep erosion cut						**Stage 8** 303
4c	Lower Paleolithic Layer 3		Vozdvijensk complex	extremely cold		
Erosion cut				no data		339 **Stage 9?**
4d	L.P. layer 4	II				
5a	L.P. layer 5	Cultural-Chronological Assemblage III		very warm, humid (interglacial)		362 **Stage 10**
5b	L.P. layer 6		ESR - 393±27 kyr (A.Molod'kov)		warmer, moister	**Stage 11** 423
5c	L.P. layer 7				cooler, dryer	**Stage 12-13** 524
Deep erosion cut					Late Tiraspol faunal complex very warm, dry	**Stages 14?** 565
6	Sterile					
7a	L.P. layer 8	IV	ESR - 583±25 kyr (A.Molod'kov)	cool, humid	cooler, moister	**Stage 15** 620
7b	Sterile				warm, dry	
Deep erosion cut			Bruhnes ~780 kyr		no data	**Stages 16-18 ?**
8	Sterile		(G. Pospelova) Shahan	Stage I Transregional Exotics no data		

Table 1. The correlation of results of multi-disciplinary investigations at Treugol'naya Cave. Note: for stages 1-16, ages are as given in the SPECMAP calibration of Imbrie *et al.*, 1984.

Palynology

At present, Treugol'naya Cave is situated in the sub-alpine zone. Palynological data (by G.M. Levkovskaya) indicate that the local vegetation underwent significant change during the period when layers 8-4a were being formed. Two major stages in the development of the paleoflora can be distinguished, the first corresponding to layers 8-5a (stage I), and the second to layers 4c-4a (stage II). The paleoflora of stage I includes transregional exotics, which today are found in habitats very distant from the Caucasus, such as *Engelhardtia, Cinnamonum, Taxodiaceae, Taxodium, Weigelia, Alanqium, Tsuga, Alnaster*, etc. In contrast, the paleoflora of stage II contains no transregional exotics.

According to the pollen data, layer 7a formed under cool and humid conditions. Layer 5b formed during an interglacial optimum (Mindel-Riss?), and contains the highest diversity of the pollen of transregional exotics; *Juglans* dominated the forests of that period. The lower part of layer 4c formed under extremely cold conditions. On the basis of the pollen data, which are consistent with the absolute dates, layer 5b may be correlated with oxygen-isotope stage 11 (Pospelova & Levkovskaya, 1994), and layer 7a with stage 15 (not 16 as was previously supposed).

Paleontology

Numerous bones of vertebrates were collected in the cave deposits. The majority of micro-faunal materials are now under study and only preliminary results are available (Baryshnikov, 1990; 1991). Specific analyses have been conducted on voles of the genus *Chionomys* (Nadachovski & Baryshnokov, 1991), on birds (Baryshnikov & Potapova, 1992; Potapova & Baryshnikov, 1993), and large mammals (Baryshnikov, 1993).

Birds. The remains of birds assigned to 22 species were found in the cave. It is possible to divide the sequence of deposits into three units containing different ornithological assemblages, which may be further subdivided into 9 avian-phases reflecting the climatic and landscape alterations in the environs of the cave.

For layers 7a-b and 6 the following species were determined: *Alectoris graeca mediterranea, Perdiz palaeoperdix, Coturnix coturnix, Delichon urbica, Melanocorypha calandra, Eremophila alpestris, Motacilla alba, Pyrrhocorax pyrrhocorax primigenius*, and *Pyrrhocorax graculus vetus*. Layers 6 and 7b yielded some species indicative of warm and dry climate. Layer 7a formed under somewhat cooler and moister conditions. During the period when layers 6-7 were being formed, the cave was surrounded by an open rocky landscape.

In layers 4-5 there were found some of the species listed above, as well as *Phasianus colchinus, Columba livia, Asio flammeus, Apus apus, Hirundo rustica, Melanocorypha yeltoniensis, Lullula arborea, Alauda arvensis*, and *Emberiza calandra*. The ornithological materials of layers 5a-b indicate a moister and warmer climate compared with layers 5c and 4b-c.

Layers 2-3 yielded 6 species, including *Tetraogallus caucasicus, Perdix perdix, Turdus torquatus*, and *Turdus sp.*, which suggest a significant downward shift of the alpine zone and reflect the coldest and most humid climates of the sequence.

Mammals. More 38.000 bone fragments of 22 species of large mammals have been studied in the cave. Most of them are highly fragmented, in paret due to human, but mostly large predators activities. In the human occupation layers, large mammals are dominated by red deer (*Cervus elaphus acoronatus*). Mammal remains were accumulated in the cave by humans as well as carnivores; the cave sometimes served as a den for cave bears.

For layers 7a-b, medium and large mammal remains include *Spelaearctos deningeri cf. deningeri, Crocuta crocuta cf. praespelaea, Cervus elaphus acoronatus*, and *Bison shoetensacki*. Rodents are represented by *Ellobius sp.*, *Chionomys gud* (an archaic form), and *Terricola sp.* In layer 6, these taxa are supplemented by *Meles hollitzeri, Equus cf. namadicus* (a small horse), *Stephanorhinus etruscus brachycephalus, Capreolus cf. sussenbornensis*, and *Capra sp.*. The cave bear is similar to the subspecies *Ursus deningeri kudarensis*. Among small mammals, there are abundant remains of *Sorex sp., Apodemus sp., Clethrionomys sp., Arvicola cantiana, Chionomys gud, Ochotona transcaucasica cf. Vekua*, and *Terricola ex gr. majori*. The fauna is indicative of a warm climate (oxygen-isotope stage 15). The species represented in layers 6-7 of the Treugol'naya cave have been assigned to the Urup Middle Pleistocene faunal complex of the Northern Caucasus. This is correlated with the late stage of the Tiraspol complex in Eastern Europe and the late stage of the Galerian in Western Europe, corresponding to the bio-stratigraphic zone MNQ 21 (Baryshnikov, 1993:42-43).

Layers 4-5 contain fossil remains of *Canis mosbachensis, Selenarctos mediterraneus, Spelaearctos deningeri cf. deningeri, Meles hollitzeri, Mustela nivalis, Panthera leo, Felis cf. lybica, Capreolus cf. sussenbornensis, Praedama sp., Dama sp., Cervus elaphus acoronatus, Bison shoetensacki, Capra sp.* (a large form), *Cricetulus sp., Lagurus cf. transiens, Eolagurus cf. volgensis*, and *Terricola sp.*. This assemblage indicates a drier and colder climate if compared with layer 6, and may also be assigned to the Middle Pleistocene. The fauna is analogous to the Singil complex in Eastern Europe.

Layer 3 contains the remains of *Vulpes vulpes, Cervus elaphus, Capra caucasicus*, and *Ovis orientalis*. Rodents are represented by *Spermophilus sp., Spalax sp., Arvicola terrestris, Chionomys nivalis*, and *Microtus arvalis* (predominant). Such a fauna is typical for the Late Pleistocene of the Greater Caucasus. The cave was surrounded at this time by alpine grasslands.

Archaeology

Treugol'naya Cave contains eight layers yielding *in situ* stone artifacts (layers 4a, 4b, 4c, 4d, 5a, 5b, 5c, and 7a). On the basis of typology, the author has grouped both *in situ* and redeposited artifact collections into four cultural-chronological assemblages. Artifacts and faunal remains in the lowest occupation level (layer 7a, Assemblage IV) are dispersed across most of the excavated area, with the exception of the area adjacent to the cave entrance. Artifacts in layers 5a-c (Assemblage III) are few, in spite of the highest density of faunal debris found on these levels. The remains on all three cultural levels are distributed over most of the excavated area inside the cave, and artifacts in layer 5c also were found in the area adjacent to the cave entrance. The artifacts and faunal remains in layers 5a and 5b are dispersed throughout the sediments. Unlike these layers, horizon 1 of level 5c near the cave entrance, probably, can be interpreted as an occupation level. Cultural-chronological Assemblage II yields only little information about spatial distribution of the finds because only a small residue of layer 4d is preserved along the cave wall. Evidently, the layer formerly was very thick; in cross-sections EF, HK, and OL, its thickness reaches 1.3 m, 1.0 m, and 1.5 m, respectively. All the stone artifacts found in layer 4d are derived from its uppermost level (35-40 cm in thickness). Faunal remains in layers 4a-c (Assemblage I) are few, and stone artifacts are dispersed throughout the deposits.

Cultural-chronological Assemblage IV. The stone industry of the lowermost assemblage is represented by 11 artifacts only, which includes four small (up to 5 cm) non-Levallois flakes with cortical or plain beveled butts, five tools on the same flakes, a chip (tiny flake), and a small pebble fragment. Among the tools there are three naturally backed side-scrapers (fig. 4-11) and two combined tools (fig. 4-10, 12).

Cultural-chronological Assemblage III. The industry of this assemblage numbers 18 artifacts from cultural layers 5-7. The artifacts in these layers were combined both on the basis of their low numbers and typological uniformity. The industry includes eight tools, three non-Levallois flakes with plain beveled butts (fig. 4-8), six small flakes, and a core-like pebble fragment. The tools are represented by a high-form end-scraper (fig. 4-6), and an end-scraper on a flake with small denticulate retouch (fig. 4-7) from layer 5c; a transverse concave side-scraper on a flake with a massive cortical butt (fig. 4-9), and a triangle with a retouched notch (fig. 4-4) from layer 5b; an end-scraper on a flake fragment (fig. 4-3), a double end-scraper on a flake (fig. 4-5), an atypical *limace* (fig. 4-1), and a chopper on a limestone pebble from layer 5a (fig. 6-4). The predominance of end-scrapers gives the industry a Tayacoid appearance and provides a contrast with Assemblage IV dominated by backed side-scrapers.

Cultural-chronological Assemblage II. The industry of assemblage II is notable for the fact that almost all the artifacts are made of local raw materials: limestone pebbles and slabs. The debitage includes medium-sized (5-10 cm) pebble fragments with scars of flaking as well generally large (> 10 cm) pebbles and slabs with one or more flake scars; a single-platform core, and two three-platform, one-sided pebble cores (fig. 6-1); two polyhedrons and a sub-spheroid; small (< 5 cm long) non-Levallois flakes, among which there are most numerous cortical and semi-cortical ones with cortical or plain strongly beveled butts.

Flake tools are represented by a transverse convex side-scraper on a pebble flake, a flake with a Clactonian notch, an end-scraper like tool on a flake fragment, an end-scraper on a flake, and a small fragment of a tool. The overwhelming majority of tools are made on limestone pebbles and slabs. Choppers make up about 60% of all tools. Over 70% are side choppers (fig. 5-1; 6-2) and end choppers (fig. 5-3; 6-5). Almost all choppers have convex working edges formed by small (1-5 cm) and medium (5-10 cm) flake scars. Usually the choppers are unifacially flaked; only three tools possess bifacially worked edges (fig. 5-1). The base and lateral edges of the choppers often represent either natural surfaces (fig. 5-1,2; 6-2,3) or breaks (fig. 5-6; 6-5), and they often exhibit clear signs of intentional fragmentation (fig. 5-3,5; 6-5). There are five choppers with two working edges, which are rather heterogeneous (fig. 5-5,6). There are also pebble scrapers that may be distinguished from choppers by their smaller size and, more importantly, by the character of preparation of their working edges which are formed by heavy retouch (< 1 cm) and small flake removals. The pebble scrapers can be divided into side convex forms and end convex forms. Large cutting tools include proto-bifaces or pointed choppers, and an atypical biface (fig. 5-2). Proto-bifaces are partly bifacially worked, though, as characteristic of nearly all pebble tools from Assemblage II, only one surface is flaked intensively, while the opposite one has traces of 2-

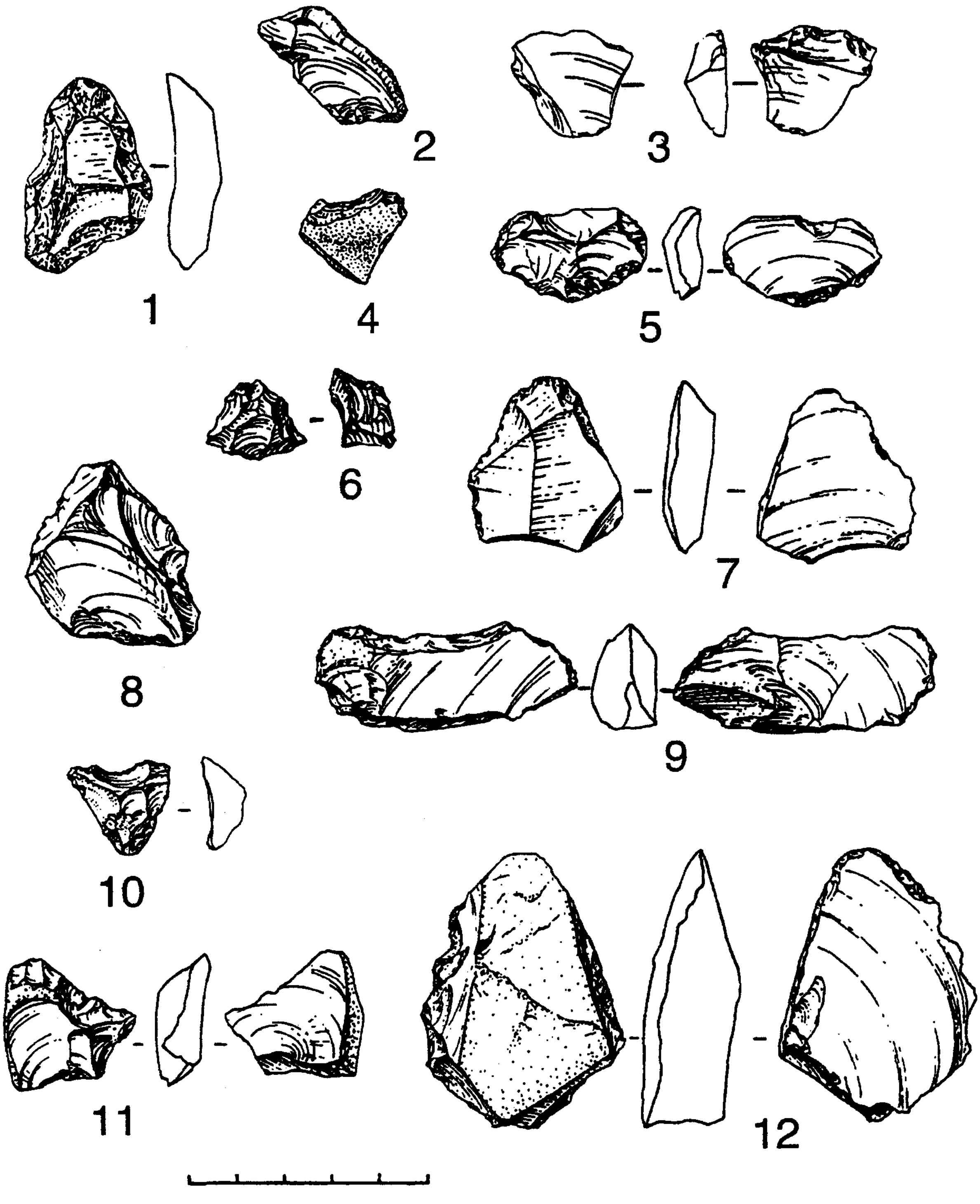

Figure 4. Stone artifacts from the lower assemblages: 1, 3-9. Assemblage III; 2. Assemblage II; 10-12. Assemblage IV.

3 removals (fig. 5-4; 6-3).

Cultural-chronological Assemblage I. The distinctive feature of the stone industry of the uppermost assemblage is the prevalence of artifacts made of gray flint that is not known on the Baranaha plateau. This is a flake industry characterized by small flakes (3-5 cm) with shortened proportions, relatively massive sections, and mainly plain beveled butts. Only two flakes can be defined as Levallois (fig. 7-3,9). Their dorsal surfaces bear usually irregular flake scars, often combined with cortical areas, although a series of parallel scars also are sometimes found. Cores are represented either by exhausted specimens (fig. 7-2), or by formless core-like pieces. Secondary treatment was mainly carried out using of small marginal, scalar (fig. 7-1,4,9,10)

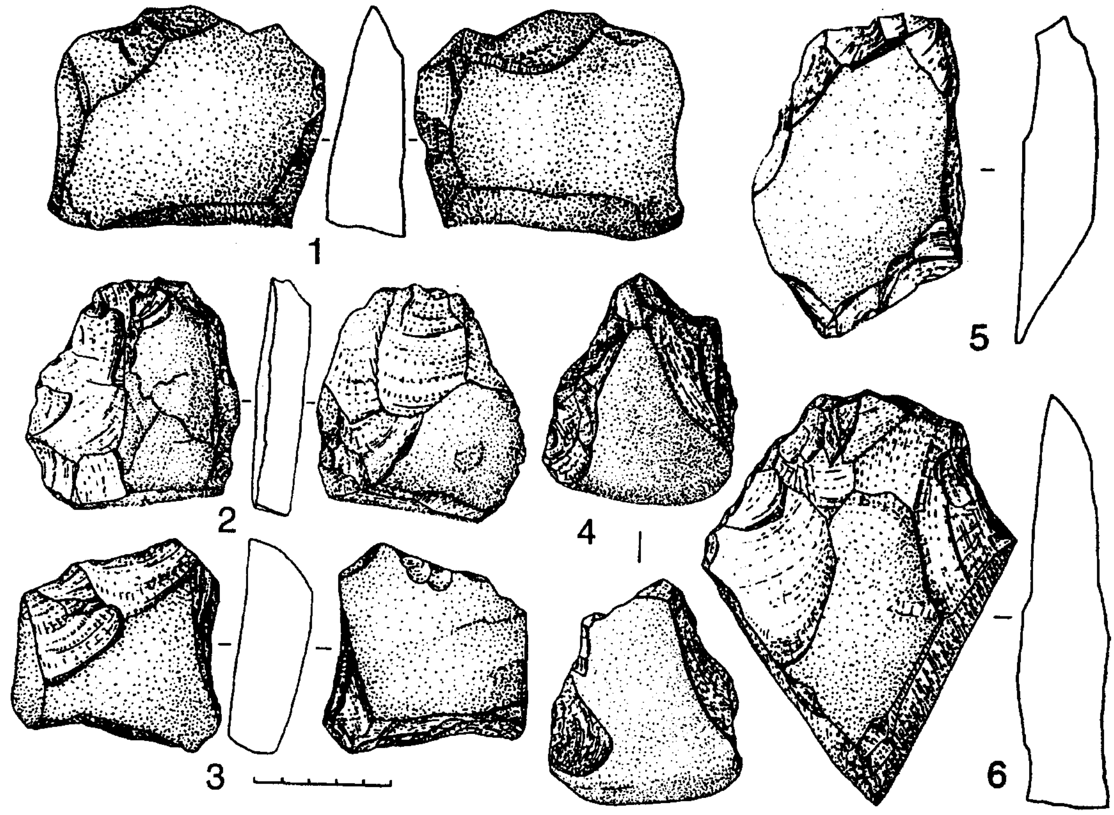

Figure 5. Stone artifacts from Assemblage II.

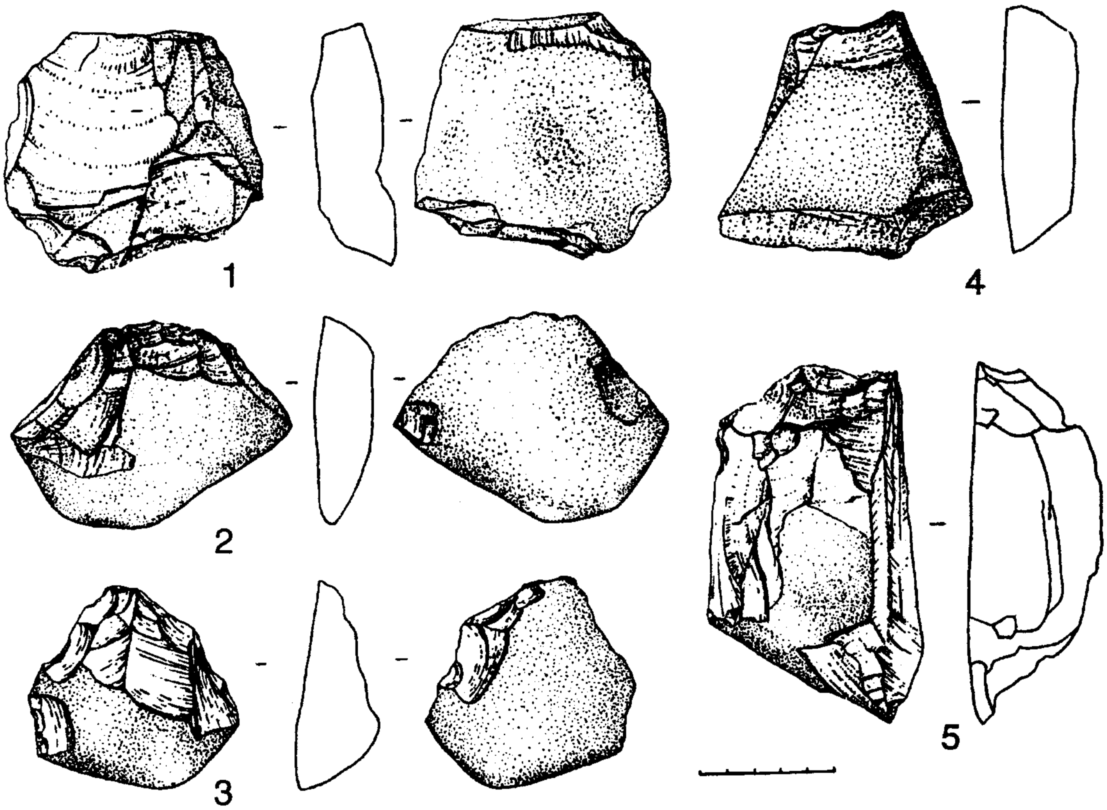

Figure 6. Stone artifacts from Assemblage II.

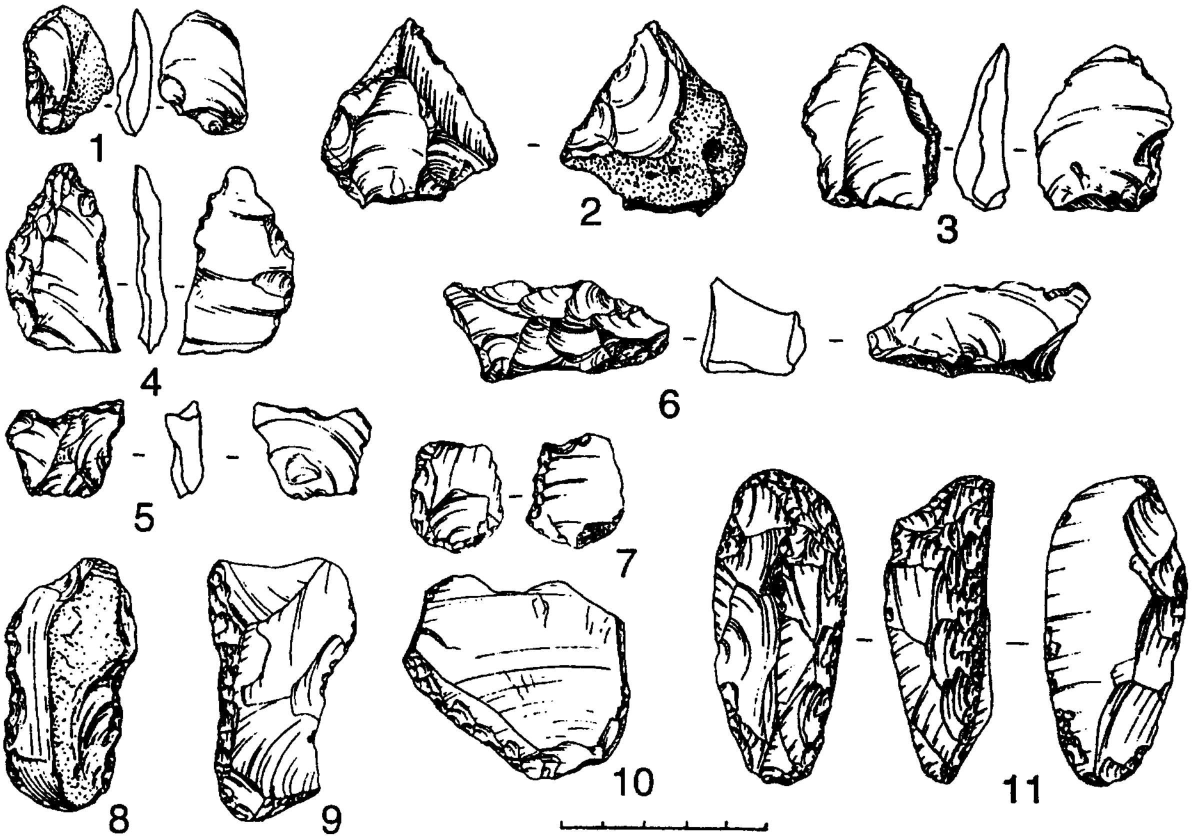

Figure 7. Stone artifacts from Assemblage I.

or denticulate (fig. 7-7,8) retouch. Quina (fig. 7-11) and abrupt retouch, as well as deep sub-parallel (*surélevée*) retouch (fig. 7-6) were used very seldom. Numerous retouched flakes have, probably, utilization retouch (irregular, often very small, sometimes the *grignotée* type retouch) (fig. 7-3).

Side-scrapers make up 50% of all tools. Most numerous are simple convex, simple straight (fig. 7-1,10), and transverse convex side-scrapers. Concave side-scrapers are much less common. Some simple side scrapers are naturally backed. *Déjeté* side-scrapers are presented by two hump-shaped tools (*incurvé*), and a triple one. Three side-scrapers are notable by the thickness of the blanks and steep convex working edges formed by Quina retouch (fig. 7-11). There are also denticulate tools on flakes (fig. 7-8). Three tools are notches. End-scrapers can be divided into two groups : 1) made on flakes, and 2) high end-scrapers made on shivers. The collection contains also two perforators with retouched points, a backed knife, and combined tools. The latter include a tool, which combines a lateral convex side-scraper with a nosed end-scraper formed on the proximal end of a flake (fig. 7-4); a small flake with one edge formed by scalar retouch and the other by denticulate retouch (fig. 7-7); and a small flake combining a retouched point and a nosed end-scraper (fig. 7-5).

Conclusions

As indicated by the available data, including absolute dates, geomorphologic context, pale-ontological and pale-botanical remains, and stone artifacts (table 1), the assemblages from Treugol'naya Cave are among the oldest Paleolithic industries of the Caucasus and adjacent regions. Recently on the territory of Eastern Europe there are known less than ten Paleolithic sites which could be dated prior to isotope stage 6, i.e. before 200 ka BP. Only two of them yielded relatively abundant lithic artifacts in good stratigraphic contexts, the oldest of which are dated by the beginning of Middle Pleistocene. They are Korolevo I in the west and Treugol'naya Cave in the south of Eastern Europe. These two sites have shed light on the initial settlement of Eastern Europe, and the development of the Lower Paleolithic culture in this part of the world. The Treugol'naya cave material is the most significant for the study of the Lower Paleolithic colonization of the Northern Caucasus, as well leading to the north regions of Eastern Europe.

Aside from Assemblage IV, the absolute date of which by 600,000 yr., points to its early Middle Pleistocene age, only two archaeological occurrences are currently known in the Caucasus region that date back to this time range or earlier. These are Dmanisi in southern Georgia, with its supposed considerably earlier age of more 1.5 my BP, and, probably, layers VII-X of Azykh Cave in Azerbaijan. Both of them represent the Pebble industry while the Assemblage IV of Treugol'naya has not any pebble tools. Moreover, although both lower assemblages IV and III of the cave are represented by very poor flake industries, which cultural appearances are hardly identified, they indicate that the initial colonization of the southern region of Eastern Europe, including the Northern Caucasus, began about 600 ka BP, and until nearly 350 ka BP, the Lower Paleolithic culture of the region likely had no Pebble appearance, but some Proto-Charentian or Tayacoid.

By 350-300 ka BP the first appearance on the Northern Caucasus of the Pebble culture is representing by Assemblage II in the Treugol'naya Cave. It has no analogues in the Paleolithic of the Caucasus or Eastern Europe excluding the pebble industries of Dmanisi, mentioned above, and Korolevo 1, layer VI in Transcarpathian Ukraine. The latter was classified as "Carpathian facies of the Unifacial Acheulean" (Sitliviy, 1988; Gladilin and Sitliviy, 1990:129-130), and, surprisingly, has the same age of 350 ka BP. Coming from a currently supposed very large chronological gap between the pebble industry of the Treugol'naya Cave and the Dmanisi materials, it is difficult to compare these sites. Therefore, now one may only speak tentatively, first, about a cultural affinity of Assemblage II with some Middle Pleistocene pebble industries known in Europe, including the so-called Carpathian facies; second, about a possibility of Central European origin of the Pebble culture in Eastern Europe. Due to this it has to be noted that 400-300 ka BP was a starting point for the wide spread of pebble industries in the southern regions of Europe (Tieu, 1991: fig.12).

The uppermost assemblage I (layers 4a-b) in Treugol'naya Cave has a clear Proto-Charentian appearance like the Proto-Charentian industries defined by V.P.Liubin, probably of the same age in the Transcaucasian caves Kudaro 1, Kudaro 3, and Azykh. This assemblage, however, differs from the latter by a complete absence of Acheulean bifaces. It is difficult now to discuss the genesis of Assemblage 1, because neither its origin nor relationship with the other coeval sites is clear.

Thus, assemblages IV and III of Treugol'naya occupy an intermediate position between the Pre-Acheulian pebble industry of Dmanisi, on the one hand, and the Acheulian industries of Kudaro I and Azykh, on the other hand, whereas Assemblages II and I are broadly coeval to the latter. The significance of Treugol'naya cave as the oldest Lower Paleolithic site in European Russia is beyond any doubt.

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EARLY HUMAN DISPERSALS: THE UNEXPLORED CONSTRAINT OF AFRICAN DISEASES

Ofer Bar-Yosef and Anna Belfer-Cohen

Introductory Remarks

This paper aims to present certain aspects of the dispersal phenomena of hominids migrating out of Africa, a series of episodic events which took place after a long *statis* in early human evolution (Klein, 1999). Currently, most authorities agree that the first 'sorties' from Africa occurred around 1.7/1.5 Ma (*e.g.*, Arribas and Palmqvist, 1999; Bar-Yosef, 1994, 1998; Gabunia and Vekua, 1995; Klein, 1989, 1999; Potts, 1998a, b; Schick and Toth, 1993; Tchernov, 1998, 1999). These dates are derived from a suite of archaeological sites and fossils from Eurasia and are interpreted as evidence for the incipient migrations. Gaps in regional sequences are considered to indicate the extinction of particular hominid lineages (Bar-Yosef, 1994, 1998), supporting the notion that, at least at the beginning, migrations were not incremental or always successful.

We would like herewith to focus on the particular bio-behavioral traits of the hominids involved in these dispersal events from 1.8-1.0 Ma ago that enabled them to accomplish this feat, as well as to discuss apparent advantages of moving out of their African "homeland," which we feel have not been sufficiently emphasized in previous publications.

Before we delve into the more detailed interpretations of the hominid capacities and present a few remarks concerning the archaeological and fossil record, it would be useful to reiterate the terms paleoanthropologists use, which derive from the domain of biogeography. The common usage of these terms has recently been summarized by Tchernov (1992) and Burney (1996), as follows:

(a) Jump dispersal sweepstakes. These are accidental cases of dispersals that do not necessarily lead to successful colonization.

(b) Diffusion gradual movements. These are selective in the number of participating species. When movements across the land are slow, they permit speciation among the taxa involved. Hence, one must define time trajectories along dispersal lines and identify colonizers in their homeland and along their geographic trail.

(c) Immigration mass movement through a geographic corridor. The migrating species will be the same in their homeland and target landing. This can also mean the successful colonization of an entire suite of species.

Hominid Propensities and Capacities

The behavioral repertoire mastered by early *Homo* populations while in Africa, was undoubtedly a prerequisite for their ability to adjust to various environmental circumstances, and facilitated the occupation of Eurasia. Among the bio-behavioral features identified and discussed by various scholars (see Klein, 1999 and references therein), in our view the following are the most crucial in accounting for the success of Eurasian hominid adaptations:

1. Steady and prolonged walking capacity at normal pace (Steudel, 1994).
2. Heat adaptation as reflected in the particular body shape and skull morphology of *Homo erectus*, (Falk, 1992; Walker and Leakey, 1993; Wheeler, 1993).
3. A greater brain capacity than that of the contemporaneous bi-pedal *Australopithecinae*, justifying their being called 'human,' whichever the cause be it related to heat resistance adaptation, or social complexity and learning (Aiello and Dunbar, 1993; Aiello and Wheeler, 1995).
4. A social structure different from that of the Chimpanzee, more human-like, as inferred from the archaeological data directly reflecting hominid behavior such as site patterning (*e.g.*, Kroll, 1994), and exploitation of animal tissues (*e.g.*, Rose and Marshall, 1996 and references therein). The biological studies indicate additional features, such as taking care of sick group members (Walker and Shipman, 1996 as regards KNM-ER 1808 who suffered from vitaminosis A, and see also Walker *et al.*,

1982), reduced sexual dimorphism (McHenry, 1994; McHenry and Berger, 1998), and increasing neocortex size (Dunbar, 1996 and references therein; O'Connell *et al.,* 1999).

5. Behavioral flexibility in subsistence adaptation in the face of climatic fluctuations (for a detailed discussion see Cachel and Harris, 1998). Though we lack a detailed picture of the *Homo erectus* diet, undoubtedly the ratios and importance of its various components such as animal tissues and vegetal sources changed according to their reliability, accessibility, predictability, and the procurement techniques practised.

A debatable issue is whether the adaptive flexibility of *Homo erectus* and its immediate predecessors (*Homo habilis* and *Homo rudolfensis*) is indeed reflected in their material culture. Neither the Early Acheulian nor the Developed Oldowan, as defined by M.D. Leakey (Leakey, 1971; and see Leakey and Roe, 1994), demonstrate the presence of a complex operational sequence (*chaîne opératoire*), when compared to the later stages of the Acheulian (*e.g.,* Belfer-Cohen and Goren-Inbar, 1994; Gowlett, 1990; Roche and Texier, 1995) or to the complexity of the Levallois methods (*e.g.,* Boëda, 1995; Meignen, 1995). Certain hominid groups continued to produce Oldowan or core-chopper (also labeled core and flake) industries, whereas contemporaneous groups began to shape the Acheulian bifaces along with various retouched flakes. A variety of the bifaces is present among the Developed Oldowan assemblages (Bar-Yosef and Goren-Inbar, 1993; Leakey and Roe, 1994), often considered as a 'facies' within the Acheulian complex. Thus, *Homo erectus* groups were the bearers of both Acheulian and core-chopper industries. Identifying *Homo erectus* solely with the Acheulian is completely erroneous. The evidence from beyond the "Movius line," in Asia as well as from Eastern and Central Europe, indicates that several *Homo erectus* populations and later archaic *Homo sapiens* held distinct operational sequences for making core-choppers, and never made bifaces. This assertion is supported by experiments aimed at replicating stone chipping techniques and the use of the produced blanks. Studies of operational sequences demonstrate that the dominant artifact forms resulted from different learned behavioral traditions, ignoring in many instances the constraints of the locally available raw materials (*e.g.,* Boëda, 1995; Bordes, 1977; Roche and Texier, 1995; Schick and Zhuan, 1993).

The African Environmental Constraints

The geographic distribution of archaeological sites in Africa dated to 1.8-1.0 Ma is rather limited, if one takes into account the overall surface size of the continent and climatic changes that caused certain areas to open up or close down for human exploitation. We can assume that population growth in the African 'homeland' was constrained not necessarily simply by predation, but particularly by diseases, as is the case for the living pongids. For example, 55 % of chimpanzees die of diseases (Goodall, 1986). It should be remembered that Africa is the home of most zoonotic diseases (caused by organisms that rely primarily on other plants or animals rather than people, *e.g.,* the 'sleeping sickness'). These have a relatively severe impact on the living body. Since the disease-causing organism is not dependent on human transmission, the selection of a strain of the parasite that is less virulent or more compatible with human life is unnecessary. Moreover, many zoonotic diseases attack adults more than they attack children. Indeed, these diseases are different from the more recent common infectious diseases, which are density-dependent, such as 'measles,' 'mumps,' 'rubella,' 'influenza' and the 'common cold' (Cohen, 1989; Karlen, 1995). The latter are self-limiting in isolated populations below a certain threshold size (see below). The worst post-Second World War new diseases appeared in Africa, as "a growing population exploited the environment and invited zoonoses..." (Karlen, 1995:163). In this sense, Africa can be considered as a garden of germs.

Africa's ecology included (and continues to include) a dense array of microparasites that evolved with humanity itself. They are so adjusted to the human presence that any notable increase in human numbers promptly provokes a sharp intensification of infection and infestation. Together with limitations on the availability of food, tropical microparasites sufficed to keep our remote ancestors relatively rare in the balance of nature (McNeill, 1980:11).

Although apes suffer from a variety of worms and other intestinal parasites that affect people, they generally move less rapidly and less widely, and they inhabit moister habitats hence more parasite-tolerant soil regimes. Thus, once humans moved out of the zoonotic infected zones, they were left with fewer parasites altogether (especially if they moved to colder environments).

The Spread into New Habitats

The triggers for the movement of humans out of Africa are not well known. Among the reasons considered are population increase (as every successful species expands beyond its original homeland), or climatic changes that severely reduced and modified the size of the exploitable territories (Larick and Ciochon, 1996). A major climatic change that affected the African environment is currently recognized in the Olduvai subchron, which was accompanied by the desertification of numerous wet and lush environments (Potts, 1998a).

Another current explanation for early humans (*i.e., Homo erectus*) urge to expand their exploitation grounds lies in the notion that this was the hominid species which evolved into an efficient predator (Walker and Shipman, 1996). Walker and Shipman bring forth evidence for humans becoming a social predator that needed to lower its population density. The options are either to eliminate most of its total population or to spread that population over a much larger geographic range. As Walker and Shipman give a very detailed account of their hypothesis, suffice it to say that they believe humans increased their home range size and thus decreased population densities and the mechanism was migrations out of the *Homo erectus* homeland into the great beyond.

The spread into new habitats in Eurasia, where hominids were previously unknown, meant that they escaped their many biological foes, the insect transmitted diseases such as 'sleeping sickness', 'malaria' and 'elephantiasis,' that decimate primate populations as well as those of other mammals (McNeill, 1976).

Moving away into new environments, especially from the tropics to cooler, drier environments reduces the danger of being exposed to zoonotic diseases. That humans were exposed to them for a long duration of time is indicated by the phenomena of genetic mutations. While in a homozygotic condition these mutations induce illness (as for example 'sickle-cell' anaemia), in heterozygotic conditions they provide a certain immunity to a particular zoonotic disease in this case 'malaria.' It is of interest to note that to date no mutations have been reported that help humans to compete with non-zoonotic infections.

In considering the role of diseases in the past, it is important to stress that the current distribution of diseases and plagues cannot be used as an analogy for the situation during the Lower Pleistocene. In a world without today's rapid transportation, most zoonotic diseases would have had their distribution dramatically limited by the dispersal rates of the wild host and vector species.

In addition, the viral infections 'smallpox,' 'measles,' 'whooping cough,' and the like can exist only among large human populations, which allow the chain of virus generations to continue uninterrupted. In recent times, for example, 'measles' required a community of between 300,000 and 40,000 persons in order to survive (McNeill, 1976:63). Clearly, such a disease could exist on a permanent basis only among civilized societies, where human populations are comparatively dense and communication nets far-flung.

The Eurasian archaeological evidence for early dispersals (fig. 1)

The Javanese *Homo erectus* is currently believed to have arrived in Southeast Asia some 1.8-1.6 Ma ago (Swisher *et al.*, 1994). This date is still debated in the literature by Southeast Asia archaeologists (*e.g.*, Keates, 1998). An age earlier than 1.0 Ma has already been suggested by several geochronological observations in Southwestern Asia: (a) the presence of early stone industries on the Israeli coastal plain, the Lebanese shorelines, and the Syrian fluvial deposits (Horowitz, 1979; Hours, 1975, 1981; Sanlaville *et al.*, 1993); (b) the detailed analysis and Eurasian correlations of faunal collections from 'Ubeidiya (Tchernov, 1986, 1987, 1992, 1999; Aziz *et al.*, 1999; De Vos *et al.*, 1999; Sondaar *et al.*, 1999; Van Den Bergh *et al.*, 1999); (c) the recent discovery at Dmanisi in Georgia (Dzaparidze *et al.*, 1989), where a *Homo erectus* jaw was found (Gabunia and Vekua, 1995). The Dmanisi mandible was retrieved from a deposit that seems to have been a large burrow (bearing a reverse magnetic signal), which lies within layers of normal polarity immediately above a 1.8 Ma K/Ar dated lava flow (Dzaparidze *et al.*, 1989; Ferring and Swisher, pers. comm.).

When taken together, the distribution of Lower Paleolithic sites in Western Asia, including the Caucasus presents several potential routes of *Homo erectus* into Eurasia.

Within the Mediterranean basin, archaeological evidence from the Lower Paleolithic of the Iberian peninsula (Freeman, 1975; Gibert, 1992; Raposo and Santonja, 1995; Roe, 1995; Turq *et al.*, 1996), for a date around 1.5-1.0 Ma, may indicate that

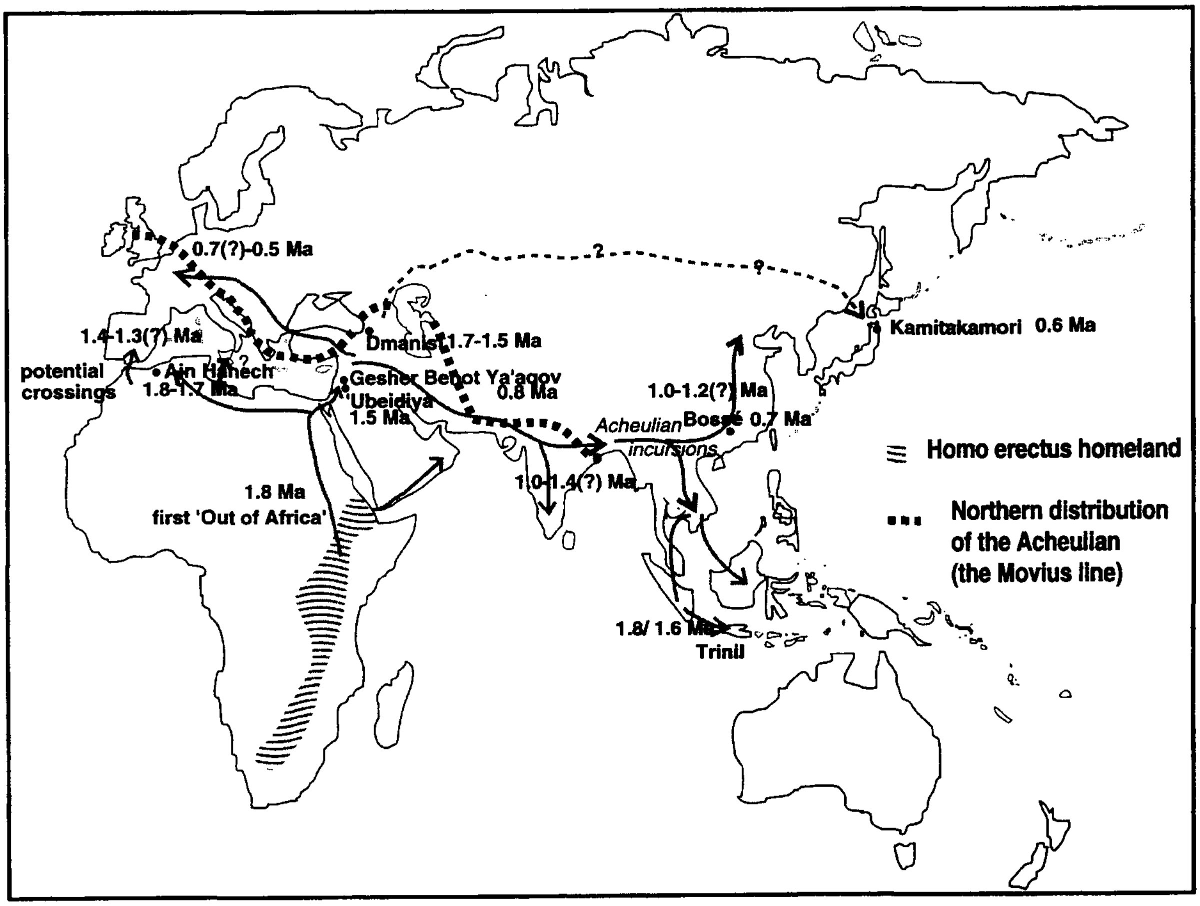

Figure 1.

early crossings from Africa to Mediterranean Europe could have taken place through the Gibraltar Straits (Arribas and Palmqvist, 1999). Another potential pathway across the Mediterranean could have been by way of Sicily (Alimen, 1979), as indicated by the spread of the Acheulian in Italy and the presence of core-chopper assemblages in localities such as Monte Poggiolo and Isernia (*e.g.*, Mussi, 1995; Peretto, 1991, 1994). However, there is as yet no positive archaeological evidence in support of this hypothetical route.

The presence of these variable industries and sites indicate, in our view, that there was more than one "out of Africa" event. One such example from Western Asia is the basalt cleaver/biface Acheulian industry of Gesher Benot Ya'aqov. Despite the fact that large portions of Western Asia are covered with lava flows, no similar industry has yet been reported. In lava plateaux such as the Golan, Upper Acheulian assemblages are generally made of flint (*e.g.*, Goren-Inbar, 1985). It was therefore suggested that the assemblages of Gesher Benot Ya'aqov, represent the migration of a group of people out of Africa (Bar-Yosef, 1987; Goren-Inbar and Saragusti, 1996) at about 0.78 Ma (Verosub *et al.*, 1998). Another assemblage conveying the same impression, produced from andesite, was uncovered in Saffaqah near the Red Sea (Whalen *et al.*, 1984), but unfortunately, no absolute dates are currently available.

Producers of core-choppers could have colonized the Maghreb if the sequence established by Biberson (1961) is supported by further fieldwork (Raynal *et al.*, 1995; Sahnouni *et al.*, 1997). Similar groups could have been among the first to colonize western and eastern Asia (Schick and Zhuan, 1993) or among those who ventured to colonize Mediterranean Western Europe (Roe, 1995). However, claims for dated sites around 2.0 Ma or isolated, supposedly human-made stone tools in Pakistan (Dennell *et al.*, 1988) and China (Wanpo *et al.*, 1995) cannot be accepted without additional, well established evidence. Although the earliest dates for the colonization of temperate Europe are also debatable (Dennell and Roebroeks, 1996), the Middle Pleistocene inhabitants of central and eastern Europe who made core-choppers could have been late migrants from Africa or from a region where such a core-chopper tradition lasted longer, such as East Asia. On the other hand, Acheulian bearers could have ventured into East Asia. Isolated occurrences of bifaces have been reported from China, in sites such as Bosse, currently dated to ca. 0.7 Ma (Huang and Wang, 1995; Schick and Zhuan, 1993), but most of them are of unknown age. The distribution of long-lasting core-chopper assemblages beyond the Eurasian "Movius line" (fig. 1) stands in contrast to Western Europe and Western Asia, where Acheulian occurrences dominate. The stratigraphical interspersal of Acheulian and core-chopper industries (known by various labels such as Clactonian, Tayacian, etc.) in several sub regions seems to be an established phenomenon, although it has been interpreted by Ohel (1977) and Ashton (Ashton *et al.*, 1994) as two 'facies' of the same cultural phenomenon.

The Nature of the Dispersals

From all of the above it becomes clear that the dispersals of early hominids from the late Pliocene or early Pleistocene into Eurasia were essentially sporadic. Little geographic and temporal continuity is observed between the various dated archaeological contexts. The archaeological assemblages do not demonstrate a techno-morphological continuity, as already observed by Movius (1944). The presence of a boundary between the Acheulian and the core-choppers assemblages has been noted by various scholars (*e.g.*, Rolland, 1998 and references therein). The archaeological evidence from 1.8 to 1.0 Ma indicates at least two waves of early migrations, but there were probably more than two. The earliest was of bearers of core-chopper industries while the following was by producers of the Early Acheulian. During the late Lower Pleistocene regional continuities in the production of artifacts are discernible. Within the Acheulian territories the general production of bifaces continues, while beyond the "Movius line," core-chopper assemblages (or core and flake industries) were dominant.

While dietary constraints are of great importance in human evolution, most of the vegetal food consumed by early hominids such as the *Habilines*, was probably similar to that of the Australopithecines, namely, sedges and grasses (*e.g.*, Sponheimer and Lee-Thorpe, 1999). Underground resources, known as USOs, were presumably discovered by *Homo erectus*, but even if the cooking or parching of these tubers is considered as triggering a major breakthrough from the old, primate-like social structure (Wrangham *et al.*, in press), the scarcity of tubers in the Mediterranean basin or Western Asia means that they were not an essential element in the course of the successful colonization of these regions.

Conclusions

The sum reasons for why early humans dispersed from Africa into Eurasia includes the 'push' of environmental change and demographic pressure, as well as the opening of new niches. Whether humans gained their meat supplies from carcasses following carnivores or became themselves active predators (*e.g.*, Arribas and Palmqvist, 1999; Bar-Yosef, 1994; Rolland, 1998; Turner, 1992) is yet unresolved. Even if the trigger for the initial dispersal of *Homo erectus* remains unknown, the success of the hominid occupation of the Eurasian habitats was not necessarily facilitated by the availability of food, or the human flexibility in food procuring techniques, but by the absence of the zoonotic diseases that plagued and constrained hominids in their 'cradle of evolution', East Africa.

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EARLY HUMAN MIGRATIONS: USING ALL THE EVIDENCE

Derek A. Roe

Introduction

This paper was the final one given at the conference, in a session at Tbilisi mainly devoted to more general topics. Many speakers during the conference, if not discussing aspects of the Dmanisi site itself, had very helpfully chosen to review the earliest Palaeolithic sites of their own home regions. It seemed to me, however, that I had done this recently for Britain (1996) and my country's geographical location in any case made its earliest Palaeolithic occupation only marginally relevant to a conference considering Early Humans at the Gates of Europe: some might feel that Britain only became a gate of Europe with the opening of London's Heathrow airport, well into the Holocene. At the time for choosing topics, my understanding was that Spain would be well represented at the conference; otherwise, I might have spoken about the 1995 International Congress held at Orce in Andalucia, and discussed the significance of the Orce Basin sites in relation to Dmanisi. As it was, I chose a general theme which seemed to me worth stating clearly to a combined audience of archaeologists and physical anthropologists - though, in the event, fewer of the latter were able to attend than had been expected. Perhaps some of those who were unable to come will read my comments here.

The text that forms section 2 is the long abstract of my communication, pre-circulated with the conference papers, and is unaltered here except for the correction of two typing errors and the insertion of a small number of references. At the conference session itself, I used my twenty minute slot to illustrate with slides some of the points made in the precirculated abstract, offering a few specific examples, and in Section 3 below I will briefly summarise that presentation. Section 4 is a short retrospect at the end of the conference, the paper itself naturally having been prepared in advance. This whole published version accordingly presents the actual communication I gave, rather than being a subsequent re-write with hindsight.

The precirculated text (early human migrations: using all the evidence)

It is always extremely important when hominid fossil remains are discovered, especially if they are in datable deposits: they offer the best possible proof of human presence in a particular area at a particular time, for example when we are trying to trace when and how early humans moved out of Africa and colonised other parts of the Old World, whether it be Georgia, Britain and other parts of Europe, or China and Southeast Asia. At their best, the human fossils can be identified to species level, and help us to understand which human species were capable of long-distance migrations, and also how new species emerged as humans adapted to the very different living conditions of higher latitudes and other climatic or temperature zones. A positive example of this is the development of the classic Neanderthal form in Europe, while a negative one is the apparent absence of any occurrence of an Australopithecine outside Sub-Saharan Africa.

But hominid fossils are not always found well-preserved, in an ideal diagnostic state. Sometimes, it may not even be possible to be sure of their genus, let alone species, and the literature has various examples of supposedly human bones or teeth which eventually turned out to belong instead to animals. Much as we might like to have the story of the first human migrations fully documented by abundant hominid fossil evidence in all areas and at all the important archaeological sites, it simply is not so and never will be. Britain and India are two examples of areas where hominid fossils are sadly scarce. We must therefore be prepared to make full use of all the other evidence that is available, and the largest single category is early Palaeolithic artefacts, especially those made of stone, which have a superb capacity for survival and a high level of identifiability.

Any individual early hominid had only a single skeleton to leave behind, and could leave it (by dying) only on one occasion - unless he or she might previously have lost the occasional tooth. By contrast, each individual hominid may have been responsible for the creation of many hundred artefacts in his or her lifetime - many thousands, if knapping debris is counted - and could leave them behind in many different places, as a genuine trail of evidence. Whether we like it or not, there will always be many more artefacts than hominid fossils in the Early Palaeolithic archaeological record. Dmanisi is one of those precious sites that has both these kinds of evidence, and more, in association; but even here, the point could be made that artefacts greatly outnumber human fossils. It is true that, if there were no stone artefacts at Dmanisi, we should still regard it as a vitally important site for tracing early human migration in the direction of Europe, because of the *Homo erectus* mandible. But the converse is also true: take away the mandible, and we still know that early humans were here, and there is still much to be learned at Dmanisi from the presence of undeniable artefacts and the associated faunal, environmental and dating evidence. Similarly, at Orce, in southern Spain, at the other Gate of Europe, the claimed hominid fossil evidence has created a certain degree of controversy (cf. Gibert *et al.*, 1998a, with further references), and even on the most optimistic view it remains rather unsatisfactory; but the presence of definite stone artefacts in the same levels, or in levels of the same age nearby, still places Orce beyond doubt as a site where early humans were present. One might think too of the excitement justifiably caused by the find of early stone artefacts on the island of Flores, Indonesia, although no hominid fossil was recovered with them (Morwood *et al.*, 1998).

If early hominid fossils are sometimes hard to assign with confidence to a particular human species, artefacts can of course *never* be so assigned, and that is their great drawback in the present context. For example, we still do not really know which human type was the first to make handaxes, although the handaxe is a tool-type of considerable significance in our attempts to trace early human movements. Why there are so few true handaxes and cleavers east of the Indian sub-continent is a question with many possible answers.

On the other hand, artefacts, as they are commonly studied today, still have some interesting information about humans to convey. At undisturbed Palaeolithic sites, studies of the *chaînes opératoires* that created the artefacts can enable us to confront directly early human thought processes and decision-making at various levels, and to observe how these change as time passes. This kind of information is certainly well worth considering against the background of human evolution - such aspects as brain development and manual dexterity - as revealed by the whole mass of surviving fossil evidence. Again, perfectly preserved stone artefacts may sometimes yield to microwear analysis definite information concerning how they were used, and on what materials - wood, meat, hide, bone, plant material and a few more. That kind of information is perhaps very broadly comparable to studies by physical anthropologists of dental wear patterns, or their analysis of the chemical content of bones, when they seek to reconstruct human diet.

Other examples could be given, but we can fairly conclude that the evidence of stone artefacts has much to offer the student of human evolution and early human migration. But I have a sense that, at the moment, there is to some extent a needless atmosphere of competitiveness and perhaps even mutual suspicion between human palaeontologists and archaeologists, when really they need each others' contributions as never before. It is only to be expected that I, as an archaeologist, should view this from the side of archaeology, and should feel that those whose chief concern is with discovering artefacts and extracting the maximum information from them are in certain circles perceived as second-class citizens. Research funding and publication are two risk areas: why should it need the discovery of a human bone fragment or a couple of teeth to make the grants and attention flow in for a Palaeolithic site that has also produced highly informative artefacts, and environmental evidence, both in abundance - as we saw, for example, at Boxgrove, in England (Roberts *et al.*, 1994)? And I wonder whether we should all be here to confer about Dmanisi today, if there were no hominid mandible amongst the finds? As regards the matter of publication, I will simply offer the example of the journal *Nature* and invite you to consider the papers it has accepted and rejected over the past ten or twenty years that are relevant to the study of the opening stages of the human story - let us say from the late Pliocene down to the end of the Middle Pleistocene. One would expect and indeed applaud the rapid publication of every major hominid fossil find, but what about the rest of the evidence? Pure archaeological contributions are almost entirely absent - a fine exception was the report by Hartmut Thieme (1997) on the magnificent wooden hunting spears from Schöningen in Germany. Usually, any archaeology that actually appears does so under heavy escort from physical anthropology, and all the editorial interest seems to be in the relatively small number of sites where hominid remains have come to light, enabling sometimes rather speculative and temporary assertions to be made about human evolution. There seems to be no corresponding concern with human activities. What was the point of all that dedicated evolving by the early hominids, if they and their successors were not going to indulge in some interesting and researchable behaviour and activities, whether it be making the first migrations to the Gates of Europe, or exerting an iron control on the editorial policies of international journals?

For human behaviour and activities in the opening phase of the Palaeolithic period, the majority of the evidence is likely to be provided by artefacts and the contexts in which they occur. Many excellent examples already exist. Let us here in Georgia resolve to consider fairly and equally all the classes of evidence that can help us to understand the origins and dispersal over the Old World of the earliest humans.

Examples and illustrations

In addressing the conference, I began by emphasising the point that the occurrence of undoubted artefacts constitutes clear and important evidence for human presence, whether or not hominid remains are found with them. It being the end of a long and hard-working conference, I even made the somewhat outlandish but perfectly valid point that an actual (if temporary) human presence on the Moon during the later 20th Century AD could be clearly demonstrated by future archaeologists, from careful consideration of the artefacts abandoned on the moon's surface, adding the rather more speculative comment that I doubted whether, if they offered a paper to *Nature* on their work, it would be accepted, because they would have recovered no hominid remains with the artefacts. More relevantly, I turned to the site of Orce, in southern Spain, showing a slide of the controversial bones claimed to be hominid, and several of the contemporary artefacts and the excavations that produced them at the sites of Fuentenueva 3 and Barranco León. The artefacts' genuine nature is clear (Roe, 1993; Tixier *et al.*, 1995; Turq *et al.*, 1996; Gibert *et al.*, 1998b), and indeed was never questioned by the 200 or more participants at the 1995 Orce Congress. They constitute unassailable evidence for human presence in a southern extremity of mainland Europe during the Early Pleistocene, on a minimal view somewhat earlier than 1.0 m.y.a., and accordingly they are a find of great significance to all students of the human past.

To illustrate the special kinds of information which stone artefacts can yield about the abilities and behaviour of their makers, I next showed some slides of the distinctive microwear traces that develop when flint edges are used to process various substances, such as bone, plant material or hide. The classic approach of the microwear analyst is to create such traces by controlled experiment, and to use the resulting 'reference collection' to interpret the microwear patterns preserved on actual archaeological material. Clearly, the raw material of which the experimental pieces are made must correspond closely to that of the originals, and the study involves far more than the simple examination of microwear 'polishes', since a tool is affected in many ways when it is used (cf. Mitchell, 1998). Microwear analysis can yield remarkable results, and it is also worth remembering that it can on occasion be applied to artefacts of very early age, as it was at Koobi Fora, Kenya (Keeley & Toth, 1981; Keeley, 1997). I then referred to the conjoining of artefacts and the highly productive *châine opératoire* approach, which can not only tell us a great deal about lithic technology, and the economic side of raw material procurement and use, but can also on occasion enable us to study directly the mental processes of humans at work, in this case craftsman knappers. Surely, such information should be of interest to anyone concerned with the evolution of the human brain and the progress of human cognition, whatever may be the discipline within which they themselves address the topic? Seeking a single example of the kind of detailed information that can be obtained when the conjoining of fresh artefacts is combined with microwear analysis, I chose an old favourite of mine: the picture presented by Cahen and Keeley of the knappers and bone-workers at Meer, Belgium (1980; see also their contributions in Van Noten, 1978).

Finally, I spoke briefly about the British Lower Palaeolithic site of Boxgrove, Sussex, and showed half a dozen slides of the finds there, drawing together many of the points previously made. At Boxgrove, large numbers of artefacts occur in extremely fresh condition, with some important clusters preserved at different points on an extensive Early Middle Pleistocene land surface (Roberts, 1986; Roberts *et al.*, 1997; Pitts & Roberts, 1997; a monograph edited by M.B. Roberts and S.A. Parfitt is in the press for publication in 1999). There are knapping places and also working areas, particularly places where animals such as rhinoceros, horse and deer were butchered: the evidence includes cut marks on animal bones and microwear traces appropriate to butchery on the edges of flint artefacts, especially handaxes (Mitchell, 1996, 1998). A whole variety of evidence has also permitted a detailed reconstruction of the local topography and environment during the human occupation. By British standards, and indeed on a far wider scale than that, this is a quite exceptional Lower Palaeolithic site, and the prolific stone artefacts have yielded rich information, both by their own nature and from the contexts in which they occurred. Yet I had to conclude with the observation that only after a fragmentary hominid tibia tentatively assigned to *Homo heidelbergensis* was discovered in 1993, followed later by two teeth, did Boxgrove receive attention on a massive scale, an appropriate injection of funding and - yes - even coverage in *Nature* (Gamble, 1994; Roberts *et al.,* 1994).

Concluding comments

To anyone with more than a passing interest in the study of stone artefacts, the foregoing text should contain few surprises. But it is remarkable how frequently one may encounter the view, usually not very carefully considered, that stone artefacts are not worth studying in these enlightened times, because there is nothing one can learn from them beyond typology and technology. That may well have been true up to the middle years of the present century, but several decades of research since then have been carrying artefact studies forward in the directions I have sought to indicate, and the progress has not come to a halt : indeed, it is tending to accelerate. Microwear analysis, for example, after a rather stagnant period, has recently benefitted greatly from a new generation of microscope technology and from direct linking of microscopes and cameras to computing equipment in ways that could not have been imagined a few years ago (see for example Mitchell, 1998). Yet all the advances still depend on the availability of high-quality artefact assemblages to study, and it is part of the work of the Palaeolithic archaeologist to provide these. Typology and technology have not gone away, of course: they remain as essential starting points when any artefact assemblage comes to be studied, but so much more is now possible beyond them.

Dmanisi was a very impressive site to visit, and the finds it has already produced are of the greatest importance. One of the surprises at the conference, to me at least, was the immense quantity of the stone artefacts that have been recovered: over ten thousand, where I had somehow expected only a few hundred, perhaps because there had been few published illustrations. It was explained to us that they do not seem to be in an undisturbed primary context, though many are fresh, but they clearly offer a wonderful opportunity for detailed study. Typology and technology will once again be the starting points, and the consistently simple nature of both at Dmanisi (if the specimens displayed to the conference are a fair guide) requires an explanation. But it is very much to be hoped that the whole assemblage will offer far more opportunities than that, as the work proceeds. With all the geological and sedimentological evidence, the excellent faunal remains, and the superb hominid fossil finds, plus the abundant artefacts, Dmanisi is a crucial site for the study of early human migrations, and I am sure the research team will ensure that the final output of information is indeed the result of what I have advocated here : using all the evidence.

On re-reading at proof stage my comments about the chances of *Nature*'s accepting an article concerning early stone artefacts, I feel I may have been too pessimistic. Doubtless the chances of acceptance woulg be greatly enhanced if one could somehow include word *Drosophila* in the title: difficult, of course, but perhaps not impossible.

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MICROENVIRONMENT AND THE INITIAL HOMINID SETTLEMENT IN WESTERN ASIA

Pavel M. Dolukhanov

Abstract

The initial settlement of tool-making hominids 'out of Africa' 2.0 - 1.8 Ma. ago proceeded in an environment of climatic cooling and aridity. The spreading groups of hominids followed a similar environmental pattern which was largely defined by the tectonics: the junction of African, Arabian and Eurasian plates. In these conditions special types of landscapes have developed, which included lacustrine basins with the diversity of savannah-like grassland, open and closed woodland. These landscapes became particularly attractive for hominids. From the very beginning the subsistence of tool-making hominids was based on scavenging with the wide use of aquatic resources and plant life. These habitats provided the hominids with comparatively stable food resources, yet they did not preclude competition with other predators and scavengers.

Introduction

Two major events have marked the beginning of the Human era: the conscious and systematic tool-making acknowledgeable in archaeologically-identifiable artefacts, and the proliferation of tool-making hominids (apparently *Homo erectus)* in the wider area of the Old World. In light of recently available evidence, it becomes increasingly likely that these two events have occurred very closely in time: 2.0 - 1.8 Ma, or earlier.

Two elements became apparent when these events are set in a wide palaeoenvironmental context. First, the spatial orientation of the sites along the global tectonic structures, and secondly, their temporal coincidence with major climatic changes.

Tectonics

According to the theory of plate tectonics, the surface layers of the Earth are composed of a set of large and small plates, which together constitute the rigid lithosphere. These plates are massive, irregularly shaped slabs of solid rock, generally consisting of both continental and oceanic segments. The plates are in constant movement which normally takes the form of collisions and subduction resulting in raised mountain ranges and the formation of marine basins.

In the wider area where the earlier evidence of tool-making activities are acknowledgeable, two 'southern' plates were impacted against the huge 'Eurasian' plate. As the result of this collision, several minor plates emerged: Aegean, Turkish and Iranian. Dramatic development has occurred in the eastern Mediterranean area, where the tectonic uplift (approximately 1 km) in the Early Miocene was followed by shallow-water carbonate deposition and the ensuing 'Messinian desiccation crisis'. During the Early Pliocene the platform subsided to abyssal depths. Subsidence accelerated in the Late Pliocene-Early Pleistocene, reaching a present-day maximum depth of ca. 2500 m (Robertson, 1998). At the same time, the surrounding areas have experienced a large-scale uplifting, where impressive folded mountains were formed. During the Neogene the Hellenic mountains were subjected to clockwise rotations in the west and counterclockwise rotations in the east, while post-early Messinian clockwise rotations have occurred on Crete (Duermeijer *et al.*, 1998).

In eastern Africa the straight coastlines of Eritrea and northern Somalia were created by the drifting away of the Arabian Peninsula, which opened up the Red Sea and the Gulf of Aden. Extensive faulting has raised and lowered vast blocks of land; the flows of lava from numerous volcanoes have formed elevated plateaux. This has led to the development of the African Rift System which includes the Great Rift Valley. Its southern end is found in the coastal area of the Indian Ocean, in Mozambique; it continues northward through the Shire River valley and Mozambique Plain. It extends further north to the Lake Nyasa (Lake Malawi) and forms a great arc that includes the Lakes Rukwa, Tanganyika, Kivu, Edward, and Albert (Mobutu Sese Seko), stretching on to Lakes Rudolf (Turkana), Naivasha, and Magadi in

Kenya. It continues into the Ethiopian Denakil and further north along the Red Sea, the Gulf of Aqaba. In the north the rift corresponds to the Jordan River valley and the Beqaa. Further north the Rift is lost beneath the tectonic structures of the eastern Mediterranean area, the Taurus and Anatolides. The northern end of the axis forms the impressive tectonic structure of the Lesser Caucasus, where the folded and faulted sedimentary strata were intruded with volcanic rocks (Dumitrashko *et al.*, 1977).

Climatic change

The northward drift of Australia and South America during the middle Cenozoic created a new circumglobal seaway around Antarctica that remained centred on the South Pole. A vigorous circum-Antarctic current developed, isolating the southern continent from the warmer waters to the north. At the same time, the equatorial current system became blocked, first in the Indo-Pacific region, next in the Middle East and eastern Mediterranean, then at Gibraltar, and finally, about 5 million years ago, by the emergence of the Isthmus of Panama. As a result, the equatorial waters were heated less and the mid-latitude ocean gyres were not as effective in keeping the high latitudes warm. Because of this, an ice cap began to form on Antarctica some 20 million years ago and grew to roughly its present size about 5 million years later. This ice cap cooled the waters of the adjacent ocean to such a low temperature that the waters sank and initiated the north-directed abyssal flow that marks the present deep circulation (Margolis *et al.*, 1977).

Marine oxygen-isotopic signals show several cool stages, one of the most significant occurring ca 3.2-3.2 Ma. Yet a more important episode of cooling coincided with the Gauss/Matuyama magnetic reversal at 2.6-2.5 MA. The latter episode marked a substantial modification of the environmental setting on the global scale: first major ice-sheet started emerging in the temperate latitudes of the Northern Hemisphere. Glacial marine ice-rafted debris became abundant in the sediments of polar oceans at 2.7-2.6 Ma (Jansen and Sjoh0lm, 1991). A high-resolution magnetic chronostratigraphy indicates the massive discharge events of non pelagic deposits in the North Atlantic that has occurred between 2.5 and 2.0 Ma and was probably related to fluctuations of the major (Laurentide) ice sheet (Barthes *et al.*, 1999).

At this stage the cool water penetrated the Mediterranean basin. This cooling was accompanied by the general aridisation of climate: the steppe increasingly supplanted tropical and sub-tropical forest; the hordes of hipparions roving the prairies of southern Europe (Kukla, 1989).

Oxygen-isotopic and pollen records suggest that considerable changes in the climate and vegetation of tropical Africa became pronounced by 2.8 Ma; short-term yet significant shifts occurred also later, at 1.8 and 1.6 Ma. These changes took form of the climate becoming periodically cooler and drier and the vegetation shifting from 'closed canopy' to 'open savannah' (de Manocal, 1995).

This evidence is further substantiated by the fossil mammal records. The gradual decline in abundance of arboreal mammals in Africa became apparent after 3.4 Ma, which is seen as an evidence of increased aridity of climate and the shift towards more pronounced seasonality with pronounced dry seasons. This may have led to the 'movement or extinction' of arboreal and frugivorous animals and the related expansion of grazing mammals after 1.8 Ma (Reed, 1997).

Microhabitats

The East African Rift System is usually seen as the main arena of early evolution of tool-making hominids. Previous investigations had stressed that early hominids lived predominantly in an open savannah. Yet in view of the above-cited evidence indicative of the general climatic change occurring in Eastern Africa 4-2 Ma, that took form of a transition from mesic closed to xeric open habitats, the implication is that the hominids at that stage existed in the mesic environs which included wooded landscapes. This conclusion was corroborated by the mammal evidence showing that *Australopithecus* species existed in fairly wooded, well-watered regions. As for the *Paranthropus* species, according to the same evidence, they lived in similar and in more open environs, that also include wetlands (Reeds, 1997).

Spencer (1997), based on a different set of arguments, arrives to similar conclusions: the primary habitats of the hominids in Eastern Africa included edaphic grasslands with seasonally flooded valleys, as well as secondary, relatively dry grasslands. Following the increased aridity of climate these secondary grassland habitats became increasingly influential in the development and livelihood of *Homo erectus sensu lato* after 2 Ma. These primary habitats of the hominids largely defined their diet and the dietary strategies. Basing on the functional anatomy of extant and fossil carnivores Lewis (1997) argues that the diet strategy included as its crucial element the procurement of meat and marrow that involved a wider range of behaviours than modern carnivores. All along the scavenging constituted the principal dietary strategy, and at the time of initial tool-making the habitats in eastern Africa provided the hominids with a greater range of scavenging opportunities than in any other part of Africa during the Plio-Pleistocene. Yet the increased aridity of climate following 2 Ma led to local and continent-wide extinction events in large-bodied carnivoran guilds and had a substantial effect on carcass availability and the risk to hominid scavengers. These structural changes in the carnivore guild may have provided an opportunity for hominids to widen their niche with respect to dietary behaviour.

New zooarchaeological data reported from three Early Pleistocene assemblages in Olduvai Gorge Bed II (Monahan, 1996) clearly show, that at several locations the bone assemblages refer to bone- crunching carnivores, and not the hominids, implying that stone tool-using hominids and bone-crunching carnivores foraged in the same general habitat. The comparisons to the artefact sites from Bed I, Olduvai Gorge and to the Turkana Basin in northern Kenya suggest that hominid behavioural variability had significantly increased starting approximately 1.7 Ma, probably as a result of increased environmental stress and the intraspecies competition of the scarce resources.

Basically similar conclusions were arrived at with the use of a different approach, based on the estimate of total energy expenditure (TEE) derived from the body size, resting metabolism, and activity budgets for selected anthropoid species and human hunter-gatherers (Leonard and Robertson, 1997). This analysis shows that the TEE values increased substantially with the emergence of *Homo erectus*. This increase is partly attributable to larger body size as well as likely increases in day range and activity level. Assuming similar activity budgets for all early hominid species, estimated TEE for *H. erectus* is 40-45% greater than for the australopithecines. These changes were conspicuously related to changing patterns of resource distribution following the increased aridity between 2.5 and 1.5 Ma. Such ecological changes likely would have made animal foods a more attractive resource. Moreover, greater use of animal foods and the resulting higher quality diet would have been important for supporting the larger day ranges and greater energy requirements that appear to have been associated with the evolution of a human-like hunting and gathering strategy.

The last important point to be addressed in this context concerns the hominids' ability for locomotion which had guaranteed its wide dispersal over a geologically limited period of time. New data suggest (Steudel, 1996) that the transition to bipedal locomotion in itself would not have accrued the energetic efficiency, yet selection for improved efficiency in the bipedal stance would have occurred once the transition was made.

Thus, based on the available evidence on early African tool-making hominids and their habitat, several conclusions may be drawn.

1. The intensive tool-making coincided with an important climatic shift which included the general aridisation and the seasonality with the prolonged dry season, and the development of more open landscape that included wetlands;
2. Scavenging constituted the principal dietary strategy, yet the increased aridity of climate following 2 Ma had a substantial effect on carcass availability and the risk to hominid scavengers;
3. Within their initial habitats the hominids were exposed to substantial competition on the part of bone-crunching carnivores foraging in the same general setting;
4. Bipedal locomotion and the ability of wide dispersal was an element of the biological adaptation of the hominids even at an early stage.

Dmanisi Case

The discovery in late 1991 of a well preserved early human mandible at Dmanisi in a clear association with Late Villafranchian mammalian fossils and dated to 1.8 and 1.6 Ma (Gabunia and Vekua, 1995) provided a new and important dimension to the early dispersal of hominids.

The analysis of the palaeoenvironmental setting, as well as its comparison with that of early hominids in East Africa and the Middle East show their striking similarity. In the case of Dmanisi, the site was located in an area of a small lacustrine basin in the vicinity of the volcanic outcrops (Tvalchrelidze and Lordkipanidze, 1998;

Maisuradze *et al.*, 1998). The similarity was further substantiated by data on the palaeoecology which indicates the combination of open and wood ecotones and marshes (Ganbunia, Vekua and Lordkipanidze, 1998).

Summing up the available evidence (Kvavadze and Vekua, 1993), the following vegetative zones could be identified within the catchment of the Dmanisi site:

1. Closed woodland: high-mountain forests with *Abies, Betula, Pinus* and *Vaccinium* in the undergrowth;
2. Open broad-leaved forests in the middle mountain stage with *Fagus, Carpinus* and *Ulmus*, and *Castanea, Tilia* and *Quercus* in the lower mountains.
3. Grassland: meadow, steppe and savannah-like vegetation with *Gramineae, Chenopodiaceae, Compositae* and *Artemisia* on the adjacent elevated plateaux.
4. Floodplain forests with *Alnus, Corylus* and *Cornus*.

Among the vertebrates inhabitants of open habitats, such as the horse, Etruscan rhino, southern elephants, hyenas, hamster, gigantic oyster, are in a clear dominance. At the same time, the number of forest game is significant and includes the bear, red deer, roe deer, leopard, lynx and wolf.

The deposition of the faunal remains at the Dmanisi site, namely, the accumulation bones of the animals often in anatomic order, amongst which the hominid mandible, found in an aquatic environment, strongly suggests a 'death assemblage', an arena of natural deaths of animals and the subsequent scavenging rather than a conscientious hunting activity. This was the case of a great many African open-air sites (Klein, 1989).

The presence of hyena, identifiable by the coproliths, is significant. This strong predator and scavenger, fed largely on carrion, should have constituted a strong competition to the hominids.

Conclusions

Summing up the available evidence one may suggest the following:

1. The initial tool-making and the dispersal of the hominids in Africa and Western Asia were practically identical in time coinciding with the global aridisation of climate.
2. The area of initial tool-making and the dispersal was spatially confined to the major tectonic structures which included the collision area of the African and Eurasian plates and the Rift system.

3. The initial habitats of tool-making hominids included lacustrine basins with the diversity of savannah-like grassland, open and closed woodland.

4. From the very beginning the subsistence of tool-making hominids was based on scavenging with the wide use of aquatic resources and plant life.

5. These habitats, providing the hominids with a comparatively stable food resources, did not preclude competition with other predators and scavengers.

6. The survival package of the hominids in their precarious environment included tool-making, opportunistic scavenging, long-distance locomotion and a system of social communication.

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OUT OF ASIA: A PALEOECOLOGICAL SCENARIO OF MAN AND HIS CARNIVOROUS COMPETITORS IN THE EUROPEAN LOWER PLEISTOCENE

Helmut Hemmer

Summary

When early man entered Europe during the Lower Pleistocene, staying at the southeastern gate of the continent on the Pliocene/Pleistocene boundary, he had to compete successfully with the large carnivorous species, as he depended on animal food resources. The paleoecological scene of the rich predator guild and large herbivore community of the Epivillafranchian reference horizon at Untermassfeld (Germany) provide an excellent basis for developing a plausible scenario for man's placement in European Lower Pleistocene habitats. Only with possession of a deadly weapon would man have been able to ensure himself a place in the carnivore interspecific hierarchy enabling him to enjoy nearly unlimited large mammal food resources. Without it, no niche existed. No mammalian predator species in the Upper Villafranchian and Epivillafranchian faunas has possible African roots much later than the Middle Pliocene. In contrast, there was obvious penetration of large carnivore elements from east Asia ending in the European Epivillafranchian, as well as herbivore dispersal events from the Eurasian east to the west. For man, as an integrated member of this large mammal fauna, there should not be any real doubt that his way into Europe was out of Asia, but not out of Africa. The specific mosaic morphological pattern of early man at the southeastern gate of Europe may easily be understood in terms of a common archaic ancestor population dispersed from roots in Africa and Asia not later than about 2.5 myr ago and undergoing geographically different progressive evolution before finally starting from Asia to Europe.

Introduction

Survival of early man in temperate Eurasia, whatever was the time of his arrival, depended in a year-round view on sufficient animal food resources. As there is general agreement on this point, no new reasoning may be necessary (e.g., Turner 1992, who considers terrestrial mammals likely to have been a key resource). An obligatory carivory, even if contributing only partially and seasonally to man's food spectrum, is putting man inevitably in the role of a member of the guild of larger terrestrial carnivores. He was forced to stay in competition with them, whether mainly as a hunter or mainly as a scavenger (e.g., Blumenschine, 1987 and comments in this paper, also Schüle & Schuster, 1996).

Therefore, the early dispersal of man into any region of temperate Eurasia in general, and into Europe in particular, had to meet the requirements of being successfully competitive within the interspecific carnivore hierarchy. The earliest undebatable evidence of man at the gates of Europe is the Dmanisi mandible (Caucasia Minor, Georgia). It is actually dated to within the Olduvai paleomagnetic event at about 1.9-1.7 myr (Sologasvili *et al.*, 1996, Schmincke & van den Bogaard, 1996), at the boundary of the Pliocene and Pleistocene. The fauna essentially corresponds to the Upper Villafranchian mammal age of the Lower Pleistocene (Vekua, 1996). In the west of Europe it is obvious that man did not disperse before the end of the Upper Villafranchian, as traces remain in sites with an Epivillafranchian faunal complex, such as Venta Micena (Orce, Granada, south-eastern Spain, Palmqvist *et al.*, 1996, Gibert *et al.*, 1998) or Vallonet (south-eastern France, de Lumley *et al.*, 1988). The fossil-bearing sands of Untermassfeld (Thuringia, Germany), free of human remains and dated at about 1 myr to the onset of the Jaramillo paleomagnetic event, were chosen as the reference horizon of this Late Villafranchian/early Middle Pleistocene transitional zone (Kahlke, this volume). The paleoecology of the rich carnivore guild of the Untermassfeld site has been broadly discussed within the framework of a study of the felid species (Hemmer, in press). This provides the basis for the development of a scenario for man's fitting into the interspecific hierarchy of his competitors in the late Lower Pleistocene. Looking at the felid species at the paleo-population level adds to the knowledge of geographic affiliations of large mammals in Europe at the time of the arrival of man, and also indicates his possible way in.

The paleoecological scene of European Epivillafranchian large carnivores

The Untermassfeld site comprises all large felid species of the European Lower Pleistocene, with well-preserved dentition, skull and postcranial specimens. Abundant in the river valley was the European jaguar (*Panthera onca gombaszoegensis*, revised at the specific level by Hemmer, in press), a huge-sized pantherine cat with a body weight range between 90 and 180kg for the Untermassfeld remains, and 70 to 210kg over all European sites. This makes that population comparable with modern Indo chinese tigers (100-195kg) or modern Indian lions (110-190kg) (for methods and details of body weight estimations and for references concerning this species as well as the following ones see Hemmer, in press). The second felid species was the giant European cheetah (*Acinonyx pardinensis*). The body weight estimates for this species span between 60 and 130kg during its late Pliocene and Lower Pleistocene history, the Untermassfeld specimen occupying the largest size. This is just double the weight of the modern African cheetah (35-65kg). A leopard-sized cat was for a long time the most enigmatic felid of the European Villafranchian. Now it is understood as an European puma (*Puma pardoides*, syn. *Viretailurus schaubi*) representing a basic level of puma evolution and a forerunner of the modern American pumas. This species is represented in Untermassfeld by a 40-45kg animal. The weights of Villafranchian European pumas altogether are to be estimated as 35-45kg for females and 60-100kg in males, which equals the size of the American puma. The lynx of Untermassfeld (*Lynx issiodorensis* ssp. ex aff. *spelaeus*) was smaller than the earlier European Villafranchian lynxes, with a body weight in the range of 15-25kg; comparable in weight to the actual northern lynx, but with a somewhat more stocky stature. The sabertooth cats are represented by two species. The dirktooth cat (*Megantereon cultridens*) was a very stocky, short-limbed, small-headed cat with extremely long dirk-like canines and powerful forelimbs. Its body weight, compiled over the whole Villafranchian and Epivillafranchian time span, obviously varied between 60 and 210kg, comparable to the modern, now extinct, Turkmenian tiger. The second sabertooth species of the Untermassfeld site and other European Villafranchian and Epivillafranchian faunas was the mighty scimitar cat (*Homotherium crenatidens*), larger than the Siberian tiger, with body weights to be estimated from 210 up to 400kg for the Untermassfeld specimens. This species was characterized by a somewhat hyena-like and also - in its massiveness - a bear-like stature with elongated forelimbs and a sloping back and by large, flattened and recurved canines with sharp serrated edges.

There were no other great cat species in Villafranchian and Epivillafranchian European faunas. The report of the lion (*Panthera leo*) from Vallonet (de Lumley *et al.*, 1988) is based on an upper canine that could well have belonged to a jaguar, reports of a leopard (*Panthera pardus*) from Vallonet (de Lumley *et al.*, l.c.) and from Venta Micena (Pons Moyá, 1987) look rather to be based on puma and jaguar remains (Hemmer, in press).

In addition to the felids, a giant hyena (*Pachycrocuta brevirostris*) is common in the Epivillafranchian faunas, being very abundant at Untermassfeld (Kahlke, this volume). This species of lion-like size was obviously extremely powerful, but seemingly less well-equipped for running than the modern hyenas (Turner & Antón, 1996). A body weight in the region of 100 to 150kg seems not to be unrealistic (Hemmer, in press). A related, but smaller species, *Pachycrocuta perrieri* (possibly conspecific with the modern brown hyena, *Hyaena brunnea*: Turner, 1990), disappeared in Europe for the time being in the early Lower Pleistocene. Besides the giant hyena lived, a very large canid, the European hunting dog (*Xenocyon lycaonoides*), comparable in size to a large modern wolf. The true wolf (*Canis lupus mosbachensis*), a frequent element of the Untermassfeld fauna (Kahlke, this volume), was a relatively small canid, to be compared with the modern southern wolves of the Arabian Peninsula and India. The bear frequently occurring at this site is placed into the ancestry of brown bears (Musil, see Kahlke, this volume).

For those carnivores that have near living relatives, the spectrum of favored prey species can be outlined with a high degree of reliability. The size of the ideal prey follows the size of the predator within each type of functional specialization. Looking at the hunting biology of the modern felids and taking into account the factor body weight and specific functional correlates in the modern counterparts, the main target species of jaguar, puma, cheetah and lynx within the series of large herbivores of the Untermassfeld fauna (for the list see Kahlke, this volume) become obvious

(Hemmer, in press). The ideal prey for the European jaguar were surely the medium-sized and large deer species *Cervus nestii* and *Eucladoceros giulii*, and the wild pig (*Sus scrofa*). Less importance should be given to the larger moose (*Alces carnutorum*) and bison (*Bison menneri*), and to the smaller roe deer (*Capreolus* sp.) and the large rodents *Castor fiber* and *Troqontherium cuvieri*. Calves of elephant (*Mammuthus troqontherii*), rhino (*Stephanorhinus etruscus*) and hippopotamus (*Hippopotamus amphibius antiquus*) are to be considered as of only marginal interest for this predator. The European puma would have favored small and medium-sized ungulates, represented in the Untermassfeld fauna by *Cervus nestii*, *Capreolus* sp. and *Sus scrofa*, also by calves of the larger deer species. Foals of the equid (*Equus* sp.) and hares may mark the boundary of the usual puma prey size range. The main victims of the European cheetah would have been ungulates dwelling in more open landscapes and weighing between 30 and 120kg. In the Untermassfeld herbivore fauna, these requirements were best met by *Cervus nestii* and foals of *Equus* sp. The main pillars of the prey spectrum of the lynx are roe deer and hares, additionally calves of the medium-sized deer species and piglets of *Sus scrofa*, as well as different rodents.

The problems arising from ideas of the hunting or scavenging behavior of the sabertooth cats have been widely discussed. Conclusions reached by the author (Hemmer, in press) by integrating knowledge of felid ethology with the results of studies on comparative functional morphology of dentition, skull and postcranial elements allow the drawing of a consistent picture. The dirktooth cat, as a sturdy, short-limbed forest hunter may not have been able to attain a balanced energy budget and to minimize the risk of canine breakage when regularly hunting herbivores of the same size category as favorable by the European jaguar of comparable body weight. Adult bison and especially rhino meet the functional requirements of *Megantereon cultridens* more satisfactorily. The same should hold true for young hippos on the riverbank, or for elephant calves approaching the forest-edge. The scimitar cat was obviously adapted to a more cursorial life than the modern felids, roaming over a broad range of habitats. It seems that this species was a prime predator of elephant calves and other pachyderms and well adapted to deal with fresh carcasses of these large-sized mammals.

There are no convincing arguments (vs. Turner & Antón, 1996) that the feeding behavior of the giant hyena was not the same one as that shown today by the brown hyena, feeding as a scavenger with only a few exceptions (Mills, 1978). A quantitative paleoecological study of the Venta Micena large mammal assemblage does in fact suggest that *Pachycrocuta brevirostris* was a bone-cracking scavenger that fed largely on the carcasses of ungulates preyed upon and partially consumed by fresh-meat-eating carnivores (Palmqvist *et al.*, 1996). For a well-founded opinion on the predatory behavior of the great hunting dog in the Epivillafranchian faunas, it is crucial to know relative brain size, as a correlate of grouping ability. With the African wild dog (*Lycaon pictus*), pack size decides not only the upper size limit of the prey to be hunted down, but also its position in the interspecific carnivore hierarchy (Eaton, 1979). The ability of *Xenocyon lycanoides* likewise to hunt in large packs is assumed here. On that basis, the reach of this large canid could have been extended to the smaller pachyderms (again in comparison with the broad prey spectrum of the much smaller modern African wild dog). The small wolf of the Epivillafranchian faunas may not have attacked herbivores larger than the medium-sized deer. Opportunistic scavenging as found in the living southern wolves, coyotes and jackals, also cannot be denied for this early wolf. Finally, the bears of Epivillafranchian sites should be considered as occasional and opportunistic predators as are most modern bear species in addition to their vegetable diet. Compared with actual brown bears, the upper limit of prey size may have been that of the large cervids. Carrion feeding surely played some role, too.

Taking the favored prey spectra of the large carnivores of Untermassfeld outlined above together, we see a picture of the different rates the herbivore species had to pay to the predator guild, also of the different rates paid by immature and mature animals. This picture correlates well with the minimum number of individuals of these species and their age stages in the herbivore fossil assemblage of this site (Hemmer, in press). Thus, a well-functioning and balanced large mammal community is indicated despite the considerable number and diversity of predator species. Looking at their probable interspecific behavioral rank as deduced from the comparative study of modern carnivore guilds, from the size range of the species in question and from their functional specializations, there is a clear picture of a well-balanced community of all the carnivores involved (Hemmer, in press). Without doubt, the large

European jaguar dominated the European puma, resulting in a low-density puma population when jaguars were plentiful. On the other hand, an accumulation of pumas may have lowered the lynx density. In more open landscapes, the giant cheetah could have played a limiting role for the puma population. A confrontation of jaguar and cheetah would usually have resulted in a lower rank for the latter, if this happened despite the different habitat preferences of the species. Different prey-size ranges of the jaguar and the dirktooth cat surely allowed their coexistence. In cases of conflict, the dirktooth cat was probably superior to the jaguar of comparable size, allowing the former to take jaguar prey in active confrontation. Such behavior may have negatively influenced jaguar density, when there was not enough supply of typical *Megantereon* prey. Finally, there should be no doubt of the top position held by the mighty scimitar cat in the felid interspecific hierarchy, allowing the presumably widely roaming *Homotherium*. opportunistic confrontational scavenging.

With the situation for the modern African pair of leopard and brown hyena, the European jaguar may have been higher ranking than the giant hyena, if this species was not group-living like also the modern *Hyaena* species. In terms of the modern brown hyena and cheetah pair, *Pachycrocuta brevirostris* should have been dominant over the giant cheetah, allowing the hyena to take cheetah prey in active confrontation. The European hunting dog was surely the top carnivore of the whole Epivillafranchian predator guild, if it did hunt in large packs. As a solitary hunter, it was presumably dominated even by the large cheetah.

Integrating these concepts of habitat, of favored prey and of the mutual relations within the guild of large predators, a scenario of carnivore feeding biology can be outlined for the Untermassfeld assemblage (Hemmer, in press). A very high hunting success rate of the giant cheetah as a sprinter in open landscapes, allowed this species the position of the most important carcass producer. An occasional loss of prey through encounters with predators ranking higher in the interspecific hierarchy was presumably quite tolerable. The cheetah must be considered to be a typical flesh eater, in contrast to the less specialized pantherine cats with some bone-crushing capabilities (Marean, 1989), and so its hunting activity always provided partially consumed carcasses to be used by less specialized felids, by wolves and by the bone-crunching giant hyena in the role of carcass destroyers. The dirktooth and scimitar cat would surely have seized any opportunity of taking large to medium-sized fresh kills by active confrontation with other carcass producers. This being the case, in addition to pachyderm hunting, the two sabertooth species in their role of extremely specialized flesh eaters with a complete inability to process bone must have left a considerable quantity of scavengeable flesh and bones to be used by most of the other carnivores (Blumenschine, 1987; Marean, 1989; Turner, 1992). In the riparian woodlands and forested areas, the European jaguar must be considered as an important carcass producer, as was the giant cheetah in more open landscapes. What was left by this cat was available for further processing, especially by wolves and bears. The large hunting dog also seems to have ranged among the top carcass producers, especially in open habitats. It should not be assumed that there was much scavengeable food left by their pack activity. The solitary living cat species ranging near the end of the interspecific predator hierarchy had to eat smaller prey animals immediately, or safeguard carcasses against competing carcass destroyers. In the case of the European puma, this could have been effected by covering them with movable materials found nearby as is done by the American puma or by carrying them up into trees as is favored by the leopard. The left-overs of puma and lynx kills was then available for wolves, and also for small carnivores, wild pigs and birds.

Fitting man into the carnivore scenario

Man the carnivore must now be fitted into this community. In the role of man the hunted, he may possibly have been part of the prey spectrum of the tiger-sized European jaguar and also of the giant cheetah, as the latter was much larger and therefore more inclined to attack man than is its modern relative. The European puma may have been inclined to prey upon man more sporadically. Lower down the chain, man surely did not fit well into the prey specifications of the two sabertooth cat species. The large hunting dog, on the other hand, is assumed to have been a formidable threat if hunting in pack, whereas the small wolf only may have been dangerous for small children alone. Despite its mighty dentition and powerful stature, the giant hyena may not have been a great problem, at least as long as scavenging.

This scene will have changed dramatically when man became a carcass-owner. Attracting roaming carnivores with the smell of flesh would have provoked confrontational scavenging, making especially the hyenas abundant in the more open landscapes and likewise the bears in the woodlands formidable rivals. Without the possession of deadly weapons pointed to each actually relevant competing predator man would have not been able to survive long within this large predator guild, being himself a carnivore and thus repeatedly a carcass owner. Without such weapons also to employ for hunting, it would already have been very hard to gain enough fresh flesh through scavenging. Dietary considerations meant that only relatively fresh meat could be consumed by man without the risk of serious disorder (Schüle & Schuster, 1996). The considerable habitat difference of carcass availability as shown for East African ecosystems by Blumenschine (1987, 1989) must not be expected for Epivillafranchian Europe. The rate of decomposition of carcasses left by the great cats in East Africa corresponds to the density of spotted hyenas, who prefer open vegetation habitats to riparian woodlands (Blumenschine l.c.). A large carcass destroyer superior in competition with unarmed man in woodland habitats is lacking in this African model, but was of course present in the form of the bear in Europe, leaving there no distinct scavenging niche to be occupied by man.

In summary, it seems obvious that there was no good place for man, dependent on large terrestrial mammals as a key food resource, in the large carnivore guild in Epivillafranchian Europe, as long as he had no weapon at his disposal suited to deal successfully with his carnivore competitors.

Having such a weapon, however, allowed man to rise to the top of the carnivore hierarchy and ensured him enough animal food resources by active hunting as well as by confrontational scavenging, even in conflict with large sabertooth cats on fresh kills. As, in the Lower Pleistocene, man succeeded in dispersing from the southeastern gate of Europe into the Iberian southwest, thereby making himself part of the carnivore community, he must have been able to integrate, i.e., he must have possessed a suitable weapon, advocated by Schüle & Schuster (1996) to be a wooden spear.

Martinez-Navarro & Palmqvist (1996, Palmqvist *et al.*, 1996) present the idea that only the presence of the dirktooth cat, considered to be a hypercarnivorous felid generating large amounts of carrion, made the first dispersal of hominids to Eurasia in the Lower Pleistocene possible. In principle, they consider early man to be a scavenger dependent on the hunting activity of the dirktooth cat, following it over the continent. They don't attempt to explain how man, who, if forced to earn his animal food resources by scavenging only, must be considered unarmed, could have managed to survive side-by-side with his mighty carnivorous competitors in the Lower Pleistocene predator guild. Man able to drive off sabertooth cats from their kills must also have been able to do a good bit of hunting himself, making him independent of any carnivore species. Indeed, in the long run, man may possibly have influenced *Megantereon cultridens* populations in a negative sense, if frequently disturbing the dirktooth cat by confrontational scavenging. This species is characterized by a relative small flesh processing dentition in relation to body weight. To meet its energy needs it therefore had to stay longer at the kill than other cat species of the same size, e.g., the European jaguar. Within the interspecific predator hierarchy this was surely no problem for a species with top rank in its woodland habitat, just as long as man didn't enter the scene with weapons (Hemmer, in press).

Looking for indications of man the hunter at Epivillafranchian sites with human traces seems to be in vain in Venta Micena, where hyenas were obviously responsible for the bone assemblage (Palmqvist *et al.*, 1996). Biotic origin is also assumed for bone layers of the Vallonet cave. An unusually large number of well-preserved rhino postcranial elements is one of the characteristics of this assemblage (de Lumley *et al.*, 1988). The most frequent carnivores at this site, bears, were hardly the rhino killers. The sabertooth cats as pachyderm specialists are not represented in that fauna and they surely were not inclined to drag bodies weighing a ton to a cave. Their dentition was also not very useful in disarticulating rhino legs before a transport. Rhino don't fit the prey spectrum of the European jaguar for such a high percentage. The giant hyena surely didn't prey on rhino, but may well be responsible for bone transport. It seems improbable that rhinos moved themselves into the cave to die. Only man the hunter can indeed provide a plausible explanation of rhino killing and subsequent transport of the disarticulated fleshy parts to the cave.

Biogeographic implications of the carnivore guild

Martinez-Navarro & Palmqvist (1995, 1996) advocated the arrival of an African dirktooth cat (*Megantereon whitei*) in Europe towards the end of the Villafranchian, immediately followed by man feeding on the remnants of the kills of this cat. Unfortunately, the statistics used by these authors to separate an African species *Megantereon whitei* from the Eurasian species *M. cultridens* and *M. falconeri* accomplished this result by omitting an African specimen that would have reduced the basic problem to sexual dimorphism, not to different clades. The specific traits of the dentition of dirktooth cats found at Untermassfeld, Venta Micena and Dmanisi may be interpreted as the end of a chronocline beginning in the European Lower Villafranchian as well as by descent from east Asian relatives (*M. cultridens nihowanensis*), this being by no means less probable than a relationship with an African population (Hemmer, in press).

Turner (1992), when discussing European carnivore immigration events around 1.0 myr, stresses the presence of the lion and the leopard in the Vallonet fauna for a possible African origin. Indeed, these scanty remains may rather be attributed to the European jaguar and the European puma, excluding the lion and the leopard from the Epivillafranchian European scene (Hemmer, in press).

The jaguar was obviously a holoarctic species in the Lower Pleistocene. Its dispersal over Europe took place in the uppermost Pliocene. An ancestor of the European puma, living here since the Lower Villafranchian, may have existed in Africa as early as in the Lower Pliocene (Hemmer, in press). No Lower Pleistocene African connection can be demonstrated with these two species. From the Lower Pleistocene on, the lynxes separated in regional evolutionary lineages. Giant cheetahs dispersed worldwide in the Pliocene at about 3 myr ago. Nevertheless the cheetah of the Epivillafranchian Untermassfeld so clearly matches the east Asian Middle Villafranchian-lower Middle Pleistocene cheetah, that at least a Lower Pleistocene transpalearctic gene flow from east to west must be assumed, if not a new European colonization from the east (Hemmer, in press). Obviously a fully comparable situation existed for the scimitar cat-distributed nearly world-wide during the Upper Pliocene, but having in the European Epivillafranchian population extremely flattened saber canines, present before only in central and east Asian populations (Hemmer, in press).

The giant hyena entered Europe at the end of the Upper Pliocene, but was present earlier in Asia as well as in Africa, in both continents reaching back to about 3.0 myr (Turner & Antón, 1996) . The European hunting dog may have evolved from a pool of large canids dispersing in Europe in the Lower Pleistocene but distributed in Asia since 2.5 myr and settling in Africa at the end of the Pliocene (Torre *et al.*, 1992). Wolves never had an African connection. The same is true of the evolutionary line of the modern bears.

This short survey of the large carnivore competitors of earliest man in Europe clearly shows that there was no species with a possible African origin much later than the Lower Villafranchian in the Middle Pliocene. Indeed, looking at the population level of such far-roaming species as the giant cheetah and the scimitar cat, possibly also the dirktooth cat, clear morphological connections of the European populations to older east Asian relatives show up just at the time of the dispersal of man in Europe in the Lower Pleistocene. It seems insignificant to this basic statement whether these connections were only from gene flow from the east within existing populations or from new colonizations of Europe by new waves of these species in areas previously depleted of them. Be this as it may, there was obviously a penetration of large carnivore elements into Europe that may have started in east Asia in the Middle Villafranchian, reaching the eastern gates of Europe possibly during the Upper Villafranchian and ending in the west in the Epivillafranchian. This movement in the carnivore community paralleled the same movement in large herbivore species, which also have clear Asian connections in the Lower Pleistocene of Europe. The most striking seem to be the so-called *Megaloceros* (*Megaceroides*) dispersal events, but the appearance of primitive bisons, of caprines and ovibovines from the east also marked this period (Torre *et al.* 1992). There seems no conclusive reason why man, ecologically integrated in the carnivore guild and in the large mammal community in general, should not have been a member during the dispersal from Asia to and over Europe. Only the hippopotamus obviously reached Europe from Africa as an active swimmer or by drift from coast to coast over the

Mediterranean Sea (Kahlke, 1997). Man lacked the evolutionary adaptations to follow suit.

Finally, we turn to the evolution of man himself. The oldest specimen of *Homo* at the southeastern gate of Europe, the Dmanisi mandible shows a mosaic of archaic features of early African *Homo* of roughly the same absolute age and even, though it is less pronounced, of *Australopithecus*. This is combined with progressive characteristics already foreshadowing the late *erectus* morphotype (Bräuer *et al.*, 1996). Such a pattern may easily be understood on the basis of a common archaic *Homo* population dispersing over Africa and Asia not later than the Middle Villafranchian, beginning at about 2.5 myr ago and afterwards undergoing geographically different progressive evolution. The first traces of early man at the base of the Middle Villafranchian in Africa as well as in southwestern Asia (up-to-date tabulated compilation of sites: Henke & Rothe, 1999) fits well in the framework of a broad faunal exchange at that time.

Dedication

This paper is dedicated to Prof. Dr. Dr. Hans-Dietrich Kahlke, nestor of Eurasian Quaternary Paleontology, on the occasion of his 75th birthday on May 27, 1999.

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ERAUL 92, 2000, p. 107 à 111.

RECHERCHES RECENTES SUR LE PALEOLITHIQUE INFERIEUR D'ASIE

Marcel Otte

Les données

Deux campagnes de fouilles ont conduit à revoir les contextes paléolithiques observés des deux côtés de la chaîne du Caucase.

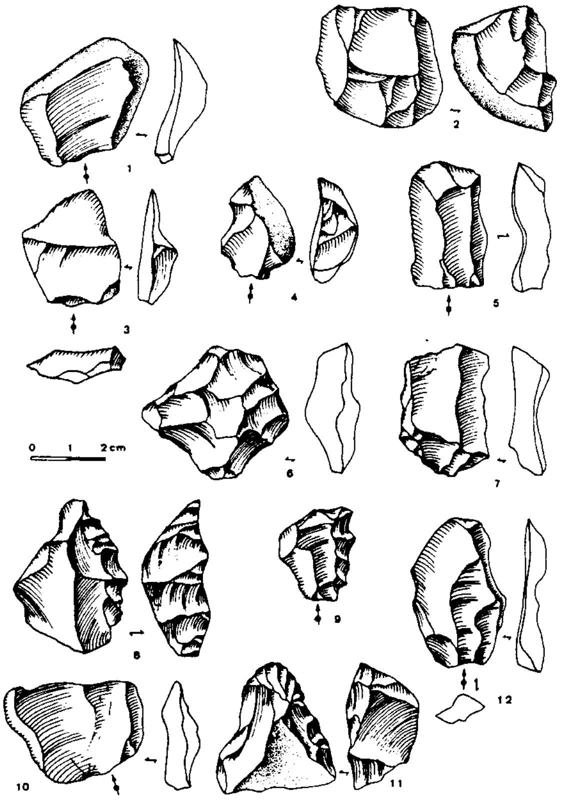

Figure 1. Tchoktas. Les industries à éclats de l'Asie centrale (fouilles dirigées par A. Derevianko).

Du côté oriental, les steppes d'Asie centrale firent l'objet de prospections intenses, puis de fouilles systématiques, par des équipes conjointes dirigées par Anatoly Derevianko. Encore au stade de l'étude, ces travaux montrent déjà toutefois l'extrême densité des occupations paléolithiques du Kazakhstan et leur probable très longue durée. Il s'agit exclusivement d'industries sur éclats grossiers, épais et transformés souvent en denticulés (fig. 1). Les estimations actuelles les situent, d'après la faune et les datations radiométriques, vers 500 mille ans. Une immense aire géographique appartient donc à cette tendance technique, semblant prolonger celles connues en Chine (Wu et Olsen, 1985), à Java (Swischer *et al.*, 1994) ou au Pakistan (Dennell, 1997; Dennel *et al.* 1988).

La seconde zone touche à l'Anatolie centrale, où les fouilles menées en collaboration avec Işin Yalçinkaya livrèrent une très longue séquence du Pléistocène moyen à Karain (fig. 2). Sous les divers niveaux de "Charentien" ou "Levalloisien", le véritable Paléolithique inférieur fut traversé sur plusieurs mètres d'épaisseur. Il s'agit, là aussi, d'industries dites "clactoniennes", à éclats épais, à talons lisses et dépourvus de préparation formelle. Les datations et les estimations fauniques situent ces ensembles vers 500 mille ans également (Otte *et al.*, 1998).

Par contre, toute l'aire orientale anatolienne (haut Euphrate) appartient aux traditions levantines (Albrecht et Müller-Beek, 1994). Cet axe se greffe, vers le sud, sur les sites anciens d'Israël (Oubeidiya et Gesher Benet Yakov), ceux de Syrie (Nadaouyeh; Latamné), de Géorgie et du Caucase septentrionale (travaux de V. Lioubine) où ils s'arrêtent.

Mouvement général

Ainsi, les industries dites "acheuléennes" se retrouvent-elles également à l'extrême Ouest de l'Eurasie, aux sites de la Meseta espagnole (Ambrona et Torralba; Panera Gallego et Rubio Jara, 1997), puis du Sud-Ouest français, jusqu'aux îles britanniques (Boxgrove; Roe, 1981; Roberts *et al.*, 1997). Le mouvement occidental paraît toutefois nettement "plus récent" qu'à l'Est; aucun site d'Espagne, de France et d'Angleterre ne semble antérieur à 500 mille ans environ. Seul, l'un des sites de Venosa, en Italie méridionale, pourrait être daté avant 600 mille ans, signifiant ainsi la possibilité de deux passages occidentaux "récents": par Gibraltar et par la Sicile.

Si ce mouvement évoque ce qu'il est convenu d'appeler la "ligne Movius" (Movius, 1948), il s'agit aujourd'hui bien davantage d'une période que d'une aire géographique. En effet, les sites largement antérieurs à cette phase sont nombreux dans toute l'Europe occidentale, centrale et orientale (voir Bosinski, 1992). Orce au Sud de l'Espagne, Atapuerca au centre, Tautavel en France, Isernia en Italie sont, parmi d'autres, d'évidents témoignages d'une "présence humaine" en Europe bien antérieure à ce mouvement acheuléen aux affinités africaines si nettes.

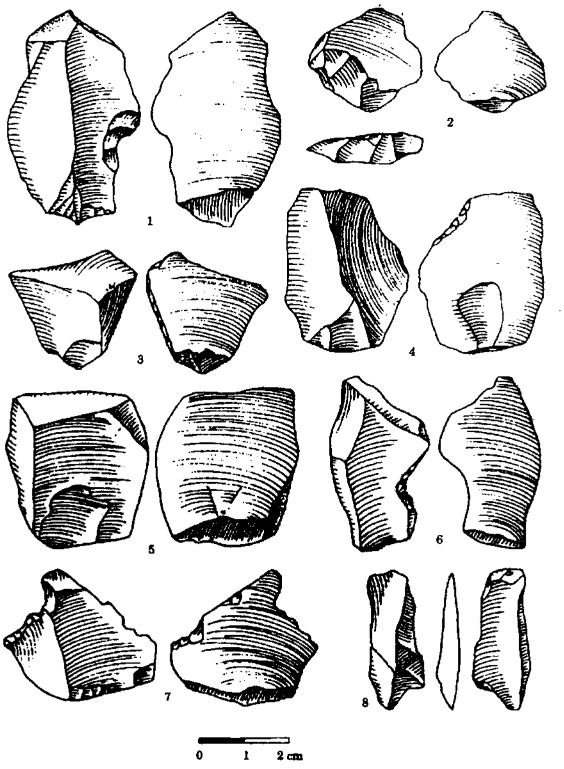

Figure 2. Karain E. Les industries à éclats d'Anatolie (fouilles dirigées par I. Yalçinkaya).

Comme les vagues migratoires bien connues pour la faune au cours du Pléistocène inférieur et moyen, le fond de population européenne semble bien originaire des steppes d'Asie centrale, largement ouvertes, au Nord du Caucase, du Zagros et de la Mer Noire.

De telle sorte qu'en Europe au moins, il faut supposer diverses vagues migratoires, essentiellement asiatiques aux origines, puis plus tardivement et de façon très limitée, d'origine africaine, comme en Orient.

A l'Est de l'Europe, les traditions asiatiques se poursuivent jusqu'en plein Paléolithique moyen (et même au-delà !).

La mer Méditerranée, ayant constitué longtemps une "barrière filtrante", a donc favorisé les échanges latéraux, très naturellement. Les contacts trans-méditerranéens, bien qu'incontestables, furent probablement limités dans le temps et l'espace, lors de passages ponctuels y compris à travers les milieux marins (comme certains animaux aussi le firent: Turq *et al.*, 1996).

L'aire orientale

Le mouvement oriental paraît à la fois beaucoup plus complexe et, surtout, beaucoup plus ancien qu'en Europe. Par exemple, les hautes datations rapportées par la présence humaine à Java ou au Pakistan attestent d'un mouvement migratoire antérieur ou proche des deux millions d'années, soit au stade technique de Shungura, de Gona ou d'Olduvai-inférieur.

Cette migration originelle semble limitée à l'aire méridionale, tropicale et boisée, et fut peut-être antérieure au stade morphologique achevé et connu à Java sous la forme des Pithécanthropes.

Quoiqu'il en soit, ce mouvement persiste en Asie extrême-orientale et donne apparemment lieu aux populations progressivement adaptées aux latitudes septentrionales et à la steppe. C'est apparemment à partir de cette population primitive que l'Asie centrale fut occupée, comme en témoignent les longues séquences du Tadjikistan (Dodonov *et al.*, 1992).

Dmanisi

Dans ce tableau complexe, la Géorgie et le Caucase se présentent telles des aires intermédiaires, voire des refuges, où les diverses tendances se sont accumulées ou croisées. La composante africaine "classique" ne fait guère de doute, illustrée par ces superbes séries d'industries à bifaces acheuléennes. Cependant, les industries "grossières" à éclats frustes ne font pas défaut non plus. Tenant compte des dates anciennes obtenues à Dmanisi (vers 1,7 m.a.; Gabounia et Vekua, 1995a) et des aspects composites de la faune (Gabounia et Vekua, 1995b), deux scénarios peuvent y être envisagés. Il s'agit soit d'une première "vague" africaine, antérieure à l'Acheuléen d'Oubeidiya (1,4 m.a.; Tchernov, 1987), soit d'un "retour" d'origine asiatique et appartenant encore aux migrations primitives, telles celles connues en Asie centrale, en Chine ou à Java.

Quoiqu'il en soit, la région mérite d'être davantage prise en compte dans les reconstitutions générales, favorisant trop souvent le facteur africain exclusivement. Tous les ensembles d'Europe orientale, y compris les plus anciens (Korolevo; Gladilin, 1989), appartiennent à la tradition asiatique et, jamais, à influence africaine, quelque furent les dénominations qu'on en a données.

Les deux conceptions

Loin d'être une anecdote technique, la différence entre les deux traditions est fondamentale et renseigne, en fait, sur deux modes de pensée complètement différents qu'il ne faudrait pas confondre. Dans l'Acheuléen, l'outil est saisi au cœur du bloc, telle une sculpture d'âge classique ("l'esclave" de Michel-Ange le rappelle très bien). Le bloc *contient* l'outil et toute la démarche du tailleur consiste à l'en faire sortir, à l'en dégager en retirant, masse par masse, les éléments étrangers et superflus. L'autre conception au contraire comporte un enchaînement dynamique de gestes, combinant les actions prévues et les matériaux différents en une séquence, greffée par une emprise souple : du bloc à l'éclat, de celui-ci à l'outil (bois), de l'outil à l'action et ainsi de suite. Il existe bien sûr des aires de superposition entre ces deux conceptions (les éclats sont aussi utilisés dans les industries à bifaces), mais la conception dominante, vis-à-vis de la roche où elle s'exprime, reste radicalement différente. Au reste, il n'est pas nécessaire de découvrir "le" biface pour estimer la nature d'une industrie étudiée, car la plupart des "déchets" qui en sont produits reflètent cette attitude particulière par rapport à la roche traitée. Ces deux conceptions reflètent donc en fait deux formes de pensée distinctes, appliquées à la roche, et dont l'origine ultime remonte à plus de deux millions d'années. Qu'il s'agisse, à ce stade, d'une opération d'origine asiatique ou africaine reste conjectural, car où - finalement - fut opéré le passage vers ces premiers outils, extra-anatomiques ? Et s'agirait-il d'une ou plusieurs origines, dans la mesure où les modifications essentielles furent déjà réalisées, bien avant l'apparition de ces premiers documents.

Si un enclenchement fut opéré, par exemple à la suite des transformations locomotrices fondamentales, il a pu suivre des développements autonomes dans des aires géographiques si profondément séparées que le furent l'Afrique centrale et l'Asie orientale. Ainsi, populations et traditions se seraient-elles transformées sur des voies parallèles, se rejoignant seulement à l'issue d'adaptations "tardives" aux aires steppiques septentrionales et dans les points de contacts géographiques naturels que furent la Géorgie et l'Extrême-Occident. Une province géorgienne ne s'appelle-t-elle pas "Ibérie", tout un présage...

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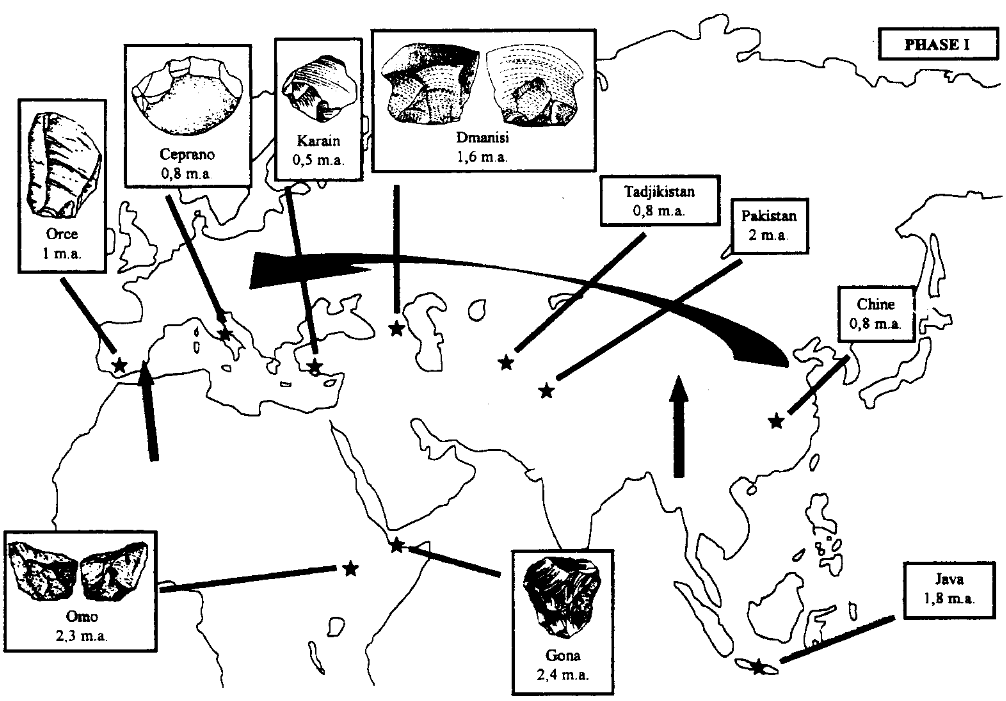

Figure 3. Les traces de la population eurasiatique originelle se trouvent, sous différentes formes, dès les phases les plus archaïques et se maintiennent très tardivement en certaines aires géographiques: Europe orientale et centrale, Asie centrale et orientale. Une mise en garde méthodologique doit être soulignée ici: certaines formes «bifaciales» sont en fait des ébauches de nucléus préparés ou de «feuilles» appointées du Moustérien local, dont la conception n'est pas saisie dans le bloc, tel un biface acheuléen. Origine des illustrations: Ascenzi *et al.*, 1996; Dzaparidze *et al.*, 1989; Merrick *et al.*, 1997; Otte *et al.*, 1998; Semaw *et al.*, 1997; Turq *et al.*, 1996).

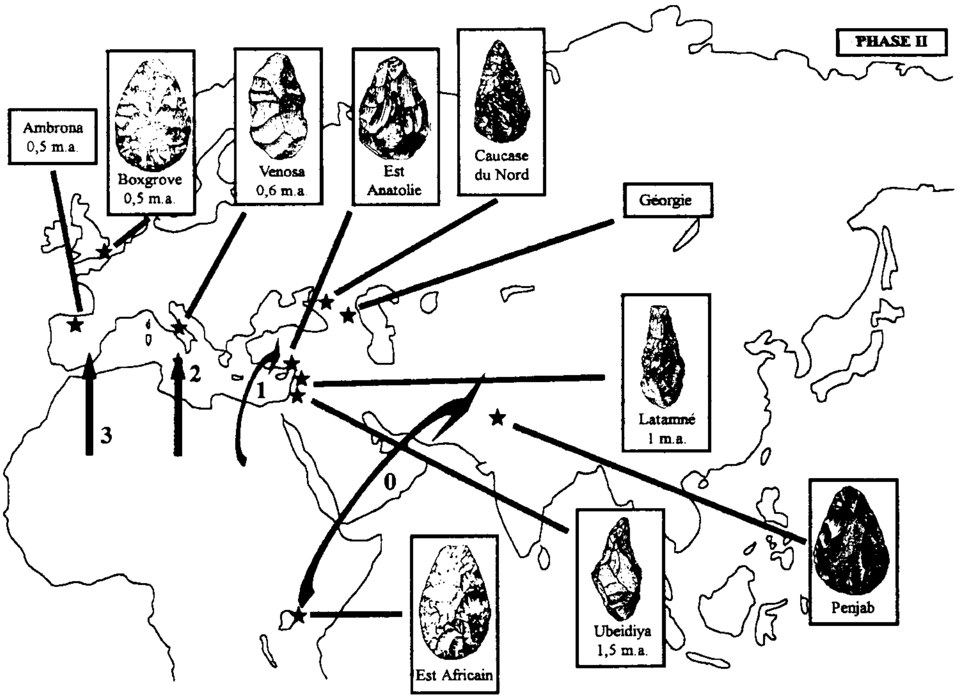

Figure 4. La seconde «nappe» est, elle, d'origine clairement africaine et d'âge différent selon les aires considérées. Le Levant connut une pénétration très précoce mais limitée, tandis que le Sud-Ouest européen poursuivit les traditions eurasiatiques très tardivement. Les «migrations» acheuléennes semblent passer à la fois par Gibraltar (Ambrona) et par la Sicile (Venosa); elles s'y superposent aux traditions locales plus anciennes (Isernia et Atapuerca) puis, finalement, s'y fondent en traditions moustériennes ambiguës («Moustérien de Tradition Acheuléenne»), elles-mêmes limitées à l'ouest européen. Origine des illustrations: Bar-Yosef, 1984; Borishkovski, 1984; Chavaillon, 1996; Clark, 1967; Harmankaya et Tanindi, 1996; Piperno, 1996; Ripoll López, 1996; Roberts *et al.*, 1997).

DATING AND CORRELATION OF EARLY HUMAN OCCUPATION IN THE BAZA FORMATION (GUADIX-BAZA BASIN, SE SPAIN)

Jorge Agustí, Oriol Oms, Josep M. Parés, Bienvenido Martínez-Navarro and Alain Turq

Abstract

The magnetostratigraphic and paleontologic studies carried out in the sections of Fuente Nueva and Cortes de Baza-Cúllar in the Guadix-Baza Basin (SE Spain) have enabled an accurate calibration of the early-middle Pleistocene sites of this basin and their correlation with other early Paleolithic localities in the Mediterranean area (Atapuerca, Le Vallonet, Isernia, Ubeidiya). The paleontological record (rodents) in the Cortes de Baza section indicates an age ranging from the earliest Pleistocene (latest Villanyian or early Biharian) to the late early Pleistocene (late Biharian). The whole Cortes de Baza Section is placed in a reverse magnetic interval identified as the upper part of the Matuyama chron. This datum confirms an upper Matuyama, pre-Bruhnes age for the archaeological site of Fuente Nueva 3. Also in the Guadix-Baza Basin, the section of Cúllar Baza, where the Middle Pleistocene (early Toringian) paleontologiucal and archaeological site of Cúllar-Baza 1 is placed, has been extended to the early Pleistocene (late Biharian). Thus, the locality of Cúllar-Baza B is placed in a reversed magnetozone correlated with the uppermost Matuyama, while the locality of Cúllar-Baza C is placed in a normal magnetozone correlated to the lower Bruhnes epoch. Therefore, the site of Cúllar Baza 1 falls well within the Bruhnes epoch. This result is consistent with what is found in other early-middle Pleistocene sections of Spain (Atapuerca Gran Dolina) but is in contrast with the upper Matuyama age initially given for the Paleolithic site of Isernia.

Keywords

Early Paleolithic, paleomagnetic dating, Early Pleistocene, Guadix-Baza Basin.

Introduction

Study of earliest human occupation in Europe is usually hampered by the absence of an accurate chronostratigraphic background ("dating") of the early to early-middle Pleistocene sites (Roebroeks and Kolfshoten, 1995). This is best exemplified in the Iberian peninsula, where uncertainities on the age of several early Paleolithic localities such as El Aculadero or Puig d'en Roca remain as a main topic of discussion (Raposo and Santonja, 1995). In spite of the existence of several mammal sites, the interpretation of this record is often confused because of the absence of long terrestrial sections with reference localities, suitable for an accurate biostratigraphic and magnetostratigraphic correlation. In this context, a noticeable exception is the Guadix-Baza Basin (SE Spain), where a number of fossiliferous levels are located in long sections which have being calibrated magnetobiostratigraphically (Agustí, 1986; Oms *et al.*, 1994; Garcés *et al.*, 1996; Agustí *et al.*, 1997). After years of dubious and controversial findings (Gibert and Palmqvist, 1995; Moyà-Solà and Köhler, 1997; Palmqvist, 1997), the paleoanthropological interest of this basin has been raised again after the description of lithic artefacts at Fuente Nueva-3, a well calibrated stratigraphic site of early Pleistocene age (Martínez-Navarro *et al.*, 1997). Besides Fuente Nueva-3, other previously described early Paleolithic sites such as Cúllar Baza-1, in the Baza Formation, deserve interest for the question of the first settlement of the basin (Vega-Toscano, 1989; Raposo and Santonja, 1995). Recent magnetobiostragraphical work undertaken in some sections of the Baza Formation enable the authors to calibrate these previous findings and correlate them with other Mediterranean sites. Several paleomagnetic studies have been carried out in different sections in the Baza Formation (Oms *et al.*, 1994, Oms *et al.*, 1996, Garcés *et al.*, 1996) with the aim of constraining the Pliocene and Pleistocene continental biozonations.

Concerning the two studied sections in the present work, the paleomagnetism of the Cortes de Baza section has been previously discussed by Oms *et al.* (1994) and has furnished a sucession of 43 sites with continuous reversed polarities. Thus, here we only report the paleomagnetic results concerning the Cúllar Baza section.

Geological setting

The Guadix-Baza Basin is an intramontane basin located in the Alpine Betic chain, south of the Iberian Peninsula (fig. 1). This chain has a complex structure of fold and thrust sheets that can be grouped in two areas: the Internal zone (basically made up of Paleozoic and Triassic basement units) and the External zone (made up of Cenozoic and Tertiary cover units). Such areas belong to the mesomediterranean block and the southiberian margin, respectively. They collided during the Middle Miocene and raised the chain (Sanz de Galdeano and Vera, 1992). The Guadix-Baza Basin sediments were deposited in a depression spread over the two zones and the contact between them (fig. 1). Such sediments are Upper Miocene, Pliocene and Pleistocene in age and provide excellent exposures of terrestrial flat rocks that host a large number of Pliocene and Pleistocene paleontological sites (Agustí, 1986).

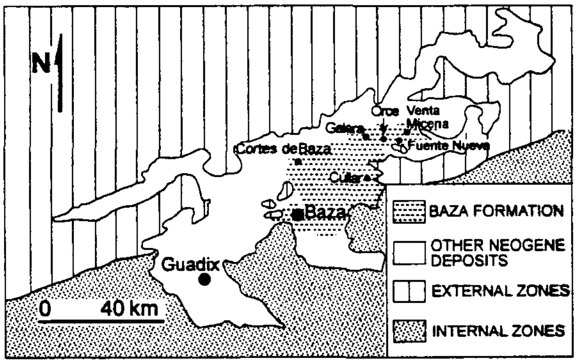

Figure 1. Geological sketch map of the Guadix-Baza Basin and extension of the Baza Formation.

The paleogeography of the basin depicts two main environments: a distal and a marginal one (Vera, 1970). The first one is mainly alluvial and is basically represented by the conglomeratic Guadix Formation and the second one is mainly made up of rocks belonguing to the Baza Formation (Vera, 1970). The Baza Formation is widely spread in the central area of the basin and records a deposition in a slightly saline lake (Anadón *et al.*, 1986). Vera *et al.* (1985) provided a clear and useful characterization of the main stratigraphic features of the Orce - Fuente Nueva - Venta Micena area. Three members were differentiated in the Baza formation: (1) a lower "calcareous member", (2) a middle "red detrital member", and (3) an upper "silty calcareous member" (hereafter abridged as lower, middle and upper members, respectively). Above all these materials a topmost level was also distinguished.

The lower member is mainly built up by limestones that were deposited in a shallow lacustrine environment with occasional subaerial exposure and terrigenous supply. The middle member is formed by reddish mudstones and sandstones that resulted from the deposition in an alluvial plain with small channels and palustrine areas. The upper member was built up by limestones (calcretes and others), carbonate silts and dark mudstones, all of them deposited in a lacustrine environment with a thin water lake level where episodes of vegetation expansion occurred. The topmost level was interpreted as piedmont and alluvial fan deposits located at the margins of the basin that evolved to a glacis towards the center of the basin. In general, all these deposits are considered to record a lake flanked by minor fluvial currents that formed small coarse grained deltas.

The age of the Baza Formation ranges from the late early Pliocene (MN15, Upper Ruscinian; Agustí, 1986; Garcés *et al.*, 1997) to the middle Pleistocene (Torinagian; Agustí *et al.*, 1987b). Numerous paleontological sites are described in several studies (Agustí, 1986; Agustí *et al.*, 1987a and b) and most of them are restricted to the triangle defined by the villages of Orce, Cortes de Baza and Cúllar Baza where excellent exposures of flat lying materials occur. The sites here reported belong to the most recent outcrops of the Baza formation and are located in a similar latitude in the basin.

The Fuente Nueva section

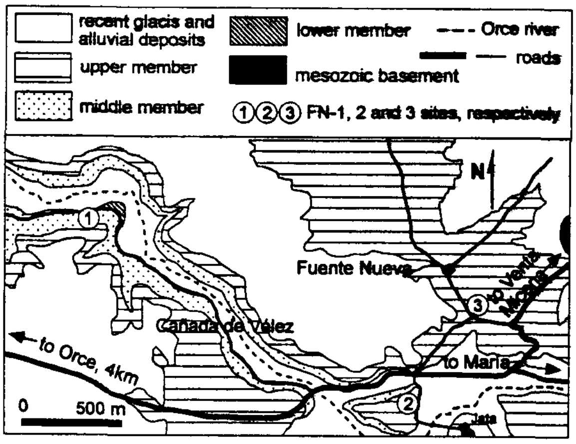

Figure 2. Geological map (after Vera *et al.*, 1985 and Soria *et al.*, 1987) of the Fuente Nueva sector and location of the three main sites.

The Fuente Nueva sector hosts a number of fossiliferous localities (fig. 2 and 3) which are included in three main sections. The Fuente Nueva-1 section displays the lower, middle and upper members of the Baza Formation (see the former paragraph). The lower member is mainly build up of whitish limestones that host the Fuente Nueva 1 site (see later). They can be observed in

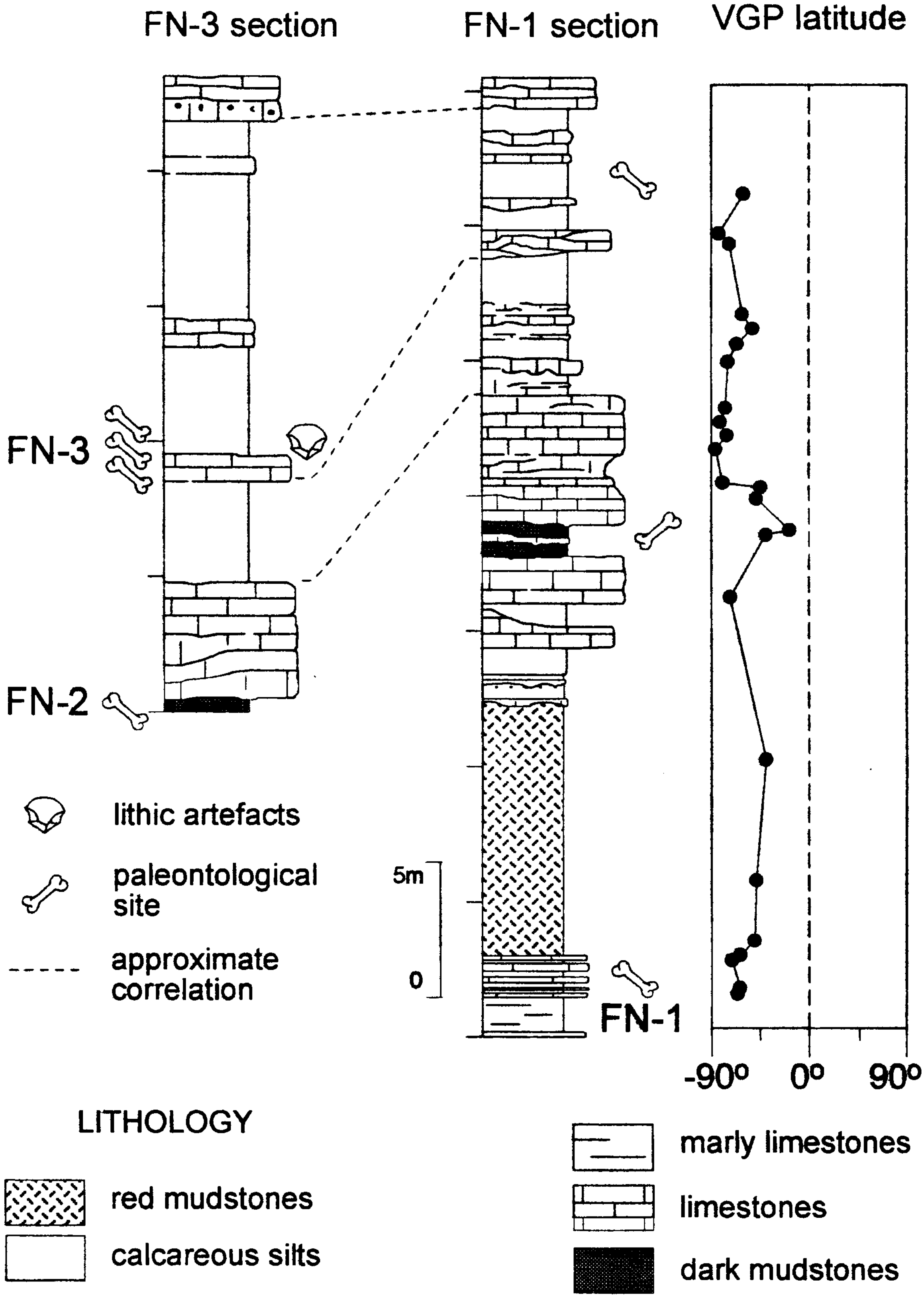

Figure 3. The Fuente Nueva-1 section (redrawn from Martínez-Navarro *et al.*, 1997) and tentative correlation to the Fuente Nueva-3 section. Paleomagnetic results by Oms *et al.*, 1996.

the road bend where large flint nodules are found. The middle member is built up of soft materials (mostly reddish mudstones) that are generally covered. On the other hand, the upper member is pretty well exposed as spectacular limestone cliffs, although other lithologies are found.

Fuente Nueva-1 is the oldest mammalian paleontological site at the Orce - Fuente Nueva area. It was discovered during the construction of the road that follows the south lowermost side of the Cañada de Vélez, between Fuente Nueva and the town of Orce. The site is placed in the lacustrine calcareous lower member of the Baza Fm, just below the middle fluviatile member (Vera *et al.* 1985). A first field-campaign by a joint team of the Institut of Paleontology M. Crusafont (Sabadell) and the Department of Paleontology of the University of Granada (1982-1985) led to the recovery of several remains of a typical late Pliocene (MN 17) association with *Gazella borbonica, Equus stenonis vireti, Mimomys* sp. (aff. *medasensis*), *Castillomys crusafonti ssp.* and *Apodemus dominans* (Moyà-Solà *et al.* 1987, Marín, 1987). This association can be correlated with other late Pliocene (MN 17) localities in Spain such as La Puebla de Valverde, Valdeganga 1-2 and Rincón 1, and is younger than the MN 16 site of Villarroya.

The Fuente Nueva 2 site, placed between Fuente Nueva 1 and 3, delivered an early Biharian mammal association including *Allophaiomys pliocaenicus, Apodemus* aff. *mystacinus, Castillomys crusafonti, Hystrix major* and *Equus stenonis granatensis* (Agustí *et al.*, 1987a; Marín, 1987). *Allophaiomys pliocaenicus* from Fuente Nueva 2 coincides in size and morphology with the specimens from Venta Micena 1 and 2 and suggests a similar age. The other faunal elements in Fuente Nueva 2 are also present at the famous site near Orce, thus confirming the isochrony of both localities. The main interest of this locality comes from its intermediate position between the two other large mammals sites in the section, Fuente Nueva 1 and Fuente Nueva 3.

The site at Fuente Nueva-3 was found on May the 5th, 1991 by the amateur archeologist Mr. Alain Bocquet, who in the same day reported the finding to one of us (BMN). The locality is found in carbonate sediments of the Fuente Nueva section in the Upper lacustrine silty-calcareous member of the Baza Fm (Vera *et al.*, 1985). In this area during the excavations made the last week of April of 1994 and all August of 1995, it was possible to conduct a precise geological study of the sedimentary cycle of the paleo-lake of Orce to the depth of some 5 m. From one upper limestone level to another lower limestone and marl level, six geological units have been identified:

I) assemblage of limestones and marls,
II) carbonated clays,
III) clays and silts,
IV) carbonated clays and marls,
V) green clays oxidized at their summit,
VI) marly limestones.

Parallel with this deposit, three archeological levels with an extension that can be exploited for more than 100 m^2, have been identified. These are characterized by an accumulation of fauna and the more or less abundant presence of lithic artefacts. The archeological level 1 is found in the geological unit III, the archeological level 2 in the geological unit V, and the archeological level 3 in the geological unit VI (table 1). Since deposition the stratigraphic sequence has not suffered any significant post-depositional modifications.

The assemblage of mammal fauna at Fuente Nueva-3 includes the following species (Martínez-Navarro *et al.*, 1997): *Mammuthus meridionalis, Hippopotamus antiquus, Stephanorhinus etruscus, Equus altidens, Megaloceros (Megaceroides) solilhacus, Cervus sp.*, Bovini *cf. Bos sp.*, Bovini gen. et sp. indet., *Hemitragus sp., Megantereon whitei, Ursus sp., Hystrix major, Allophaiomys burgondiae, Allophaiomys chalinei, Mimomys savini, Mimomys oswaldoreigi* and *Castillomys crusafonti.* The assemblage of small and large mammals at Fuente Nueva-3 and the degree of evolution of *Allophaiomys bourgondiae* and *A. chalinei* shows that this locality is older than the lowermost levels of the Gran Dolina of Atapuerca. In accordance with these biostratigraphic and paleomagnetic data (Oms *et al.* 1996; Martínez Navarro *et al.* 1997), this site is located in the reverse Chron 1r.2r, below the Jaramillo normal event (Chron 1r.1n).

The lithic artefacts from Fuente Nueva 3 are composed of limestone cobbles and knapped flint (Tixier *et al.* 1995; Turq *et al.* 1997; Martínez Navarro *et al.* 1997). The former, around 100 altered objects, show no traces of having been intentionally worked. The diverse types of limestones present certain particularities of the modules, all weighing between 100 g and 2 kg, make it difficult to explain their presence at the site by any natural agent. The flint materials -

composed until now of 114 pieces, 60 of them found *in situ* and the other 54 when cleaning the surface - originate from the alluvial formations of the paleo-channels which fed the lake. All display unquestionable signs of having been intentionally worked. All the stages of the *chaîne opératoire* (operational/reduction sequence) are represented. The debitage (stone working) was performed with a hard, stone hammer (indicated by double bulbs of percussion and Siret-type accidents). The butts are cortical, plain, inclined, and rarely facetted. The intended use is still unclear, but apparently multiple (debitage products with nearly complete cutting edges, relatively thin flakes, rare cortically-backed flakes). The debitage modes are diverse, with reduction beginning directly from a raw block, or from a large flake (exploiting the interior surface). The most frequent type consists of short series with relatively frequent changes of the debitage surface. The orientation of detachments can be unipolar, which yields products with a blade-like tendency or centripetal. These characteristics are more common in the Middle Paleolithic assemblages than in the more ancient series. A large number of flakes are transformed, probably through utilization, into "pièces esquillées" in the assemblage from the archeological level 2. These layer, and the "bâtonnets" which are the characteristic fragments, represent by themselves close to 25% of the artefacts. Retouched tools are exceptional but present, represented by scrapers, notches and denticulates.

This lithic sequence, together with that of the base of the Gran Dolina of Atapuerca (TD-6) (Carbonell *et al.* 1995), confirms the existence in Western Europe of lithic industries older than 0.5 Ma (Dennell and Roebroeks, 1996). It represents a lithic assemblage different from the typical Lower Paleolithic series in Europe, displaying characteristics which more readily evoke those of the evolved Oldowan in East Africa.

The Cortes de Baza-Cúllar composite section.

The Cortes de Baza section (see figs. 1 and 5) is located in the western area of the Baza Formation and has been reported in some previous works (Peña *et al.*, 1977; Oms *et al.*, 1994). The studied outcrop (road cut east of the Cortes de Baza village; see fig. 1) displays 135 m of yellowish silts and silty sandstones, limestones, silty mudstones and a few dark mudstones. Sometimes levels with gypsum occur and are known as Benamaurel Evaporites. Most of the sediments are laminated and fine-grained. Sediments (both clastics and carbonates) may have a laminated appearance. Limestones never record palaeosoils as happens in all the marginal areas of the Baza Formation (Orce and Cúllar areas). In general, all the sedimentary record account for sediments being deposited in the depocenter of a relatively shallow lake where wave reworking can be recognized.

The Cortes de Baza section includes at least three fossiliferous levels which have yielded significant remains of micromammals. These levels are called CB 1, CB 41 and CB 88. The level of CB 1, at the base of the series, has delivered an abundant microfauna including *Mimomys* cf. *blanci, Mimomys* sp., *Castillomys crusafonti* and *Apodemus* aff. *sylvaticus*. *Mimomys* cf. *blanci* is a small, advanced *Mimomys* species probably related to *Mimomys oswaldoreigi* from the locality of Gilena 2 (Agustí *et al.*, 1993). The anteroconid cap is short and the anteroconid complex presents a straight neck. An enamel island is present in the third upper molars. Together with these species, a second larger *Mimomys* is represented by few teeth. It could represent a member of the *M. tornensis-M. malezi* lineage. The CB 1 assemblage, with its advanced *Mimomys* species is typical of the latest Villanyian-earliest Biharian localities such as Schambach (Koenigswald, 1977). Above the CB 1 level, *Mimomys* cf. *blanci* is still present in the level CB 18 of the Cortes de Baza section.

The most significant level above the lower levels of the section is CB 41, characterized by the presence of a more evolved *Allophaiomys* species assigned to *Allophaiomys* cf. *vandermeuleni.* This form is represented by large sized molars with abundant cement and bearing undifferentiated or slightly *Mimomys*-like enamel. In the first lower molars the anteroconid cap is very simple and T1, T2 and T3 (*sensu* Meulen, 1973) are communicated. *Allophaiomys vandermeuleni* is a typically Iberian arvicolid species, previously defined in the early Biharian site of Barranco Conejos, in the Guadix-Baza Basin (Agustí, 1991).

Above the level CB 41, no significant assemblages of rodents have been found. However, the level CB 88 delivered fragments of a rootless arvicolid bearing *Microtus*-type enamel. In spite of their scarcity, this material indicates that at least a *Microtus* (s.s.) species was already present at this level in the Cortes de Baza section.

The palaeontological record (rodents) in the Cortes de Baza section indicates an age ranging from the earliest Pleistocene (latest Villanyian or early Biharian) to the late Early Pleistocene (late Biharian). In the Guadix-Baza Basin, the Middle Pleistocene (early Toringian) was already known at the locality of Cúllar-Baza I, but new studies in the area enabled also the recognition of Early Pleistocene deposits in the lower part of the section.

The Cúllar area (fig. 4) is classically known because of the occurrence of the Cúllar-Baza 1 palaeontological and archaeological site, which delivered an abundant early Middle Pleistocene (early Toringian) fauna including small and large mammals associated with an early Paleolithic industry (Vega-Toscano, 1989). This fauna includes *Arvicola cantiana, Iberomys brecciensis, Allocricetus bursae duranciensis, Apodemus* aff. *sylvaticus, Eliomys quercinus helleri, Lepus* cf. *granatensis, Canis etruscus, Crocuta crocuta, Mammuthus trogontherii, Equus altidens, Equus sussenbornensis, Stephanorhinus hundsheimensis, Sus* cf. *scropha, Bison* sp., *Capra* sp. and *Megaceros savini (*Ruiz-Bustos and Michaux, 1976; Alberdi *et al.*, 1989). On the other hand, stratigraphically below the Cúllar-Baza-1 site there are other localities (levels of Cúllar B and C), as seen in figure 5.

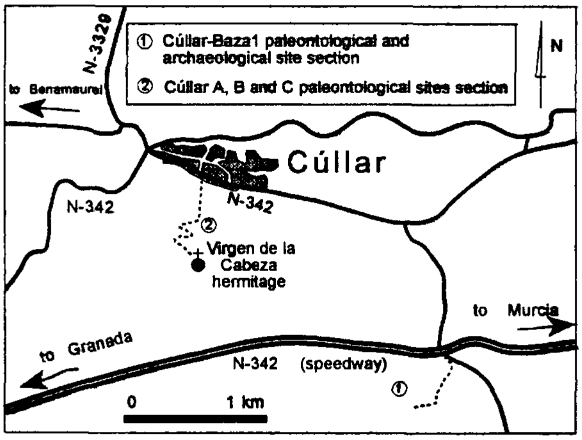

Figure 4. Location of the Cúllar Baza 1 and Cúllar A, B and C sites. 1. lower Cúllar section; 2. upper Cúllar section.

The lower Cúllar section (Cullar B and C fossiliferous levels) belongs to a set of outcrops adjacents to the village, in the south rim of the Cúllar river. The section is located in the eastern boundary of the Baza formation and also the edge of the basin and includes the locality of Cúllar-Baza 1 as well as the ones resulting from the new samplings in the area. The Cullar B and C localities resemble the Cortes de Baza area depositional environment (sandy distal lake with few evidences of subaerial exposition).

The most significant faunal element at the level Cu -C is *Terricola arvalidens*. 10 m below this level, the level of Cu-B still delivered some remains of *Castillomys crusafonti*, a relictual murid that became extinct before the beginning of the Middle Pleistocene and which is already absent in the lowermost levels of Atapuerca TD (uppermost Biharian).

Calibration of Early to Middle Pleistocene sites in the Baza Formation and correlation with the Mediterranean record

The magnebiostratigraphic calibration of the Cortes de Baza and Cúllar sections sheds light on some of the previously existing datings of early to middle Pleistocene sites with lithic artefacts in Europe. The whole Cortes de Baza section presents a long reverse interval that has been identified as the upper Matuyama chron (Oms *et al.*, 1994). The level of CB-41 is characterized by the presence of advanced specimens of species *Allophaiomys vandermeuleni* and can be therefore ascribed to the early Biharian. *Allophaiomys vandermeuleni* appears as the most plausible ancestor for *Terricola jordanica* from Ubeidiya (Agustí, 1992), a conclusion which is reinforced by the morphology and morphometrics of the specimens from Cortes de Baza.

The presence of an evolved microtine with *Microtus* enamel differentiation in the level of CB 88 indicates that the boundary between the early Biharian (*Allophaiomys pliocaenicus* Zone) and the late Biharian (characterized by advanced *Allophaiomys* species with *Microtus* enamel differentiation; *Allophaiomys burgondiae* Zone) is placed within the upper part of the Matuyama chron.

The lower part of the Cúllar section which contains the level of Cu-B with *Castillomys crusafonti* is still in a reverse magnetized interval. On the contrary, the level of Cu-C, with *Terricola arvalidens*, is placed in the normal interval at the top of the series. The Cúllar section is in a stratigraphic position above the Cortes de Baza section (fig. 5 and 6), although it is difficult to exactly quantify the vertical span between the two areas. This means that the short reversed interval at the base of the Cúllar section, where the level of Cu-B is placed, still belongs, as the whole Cortes

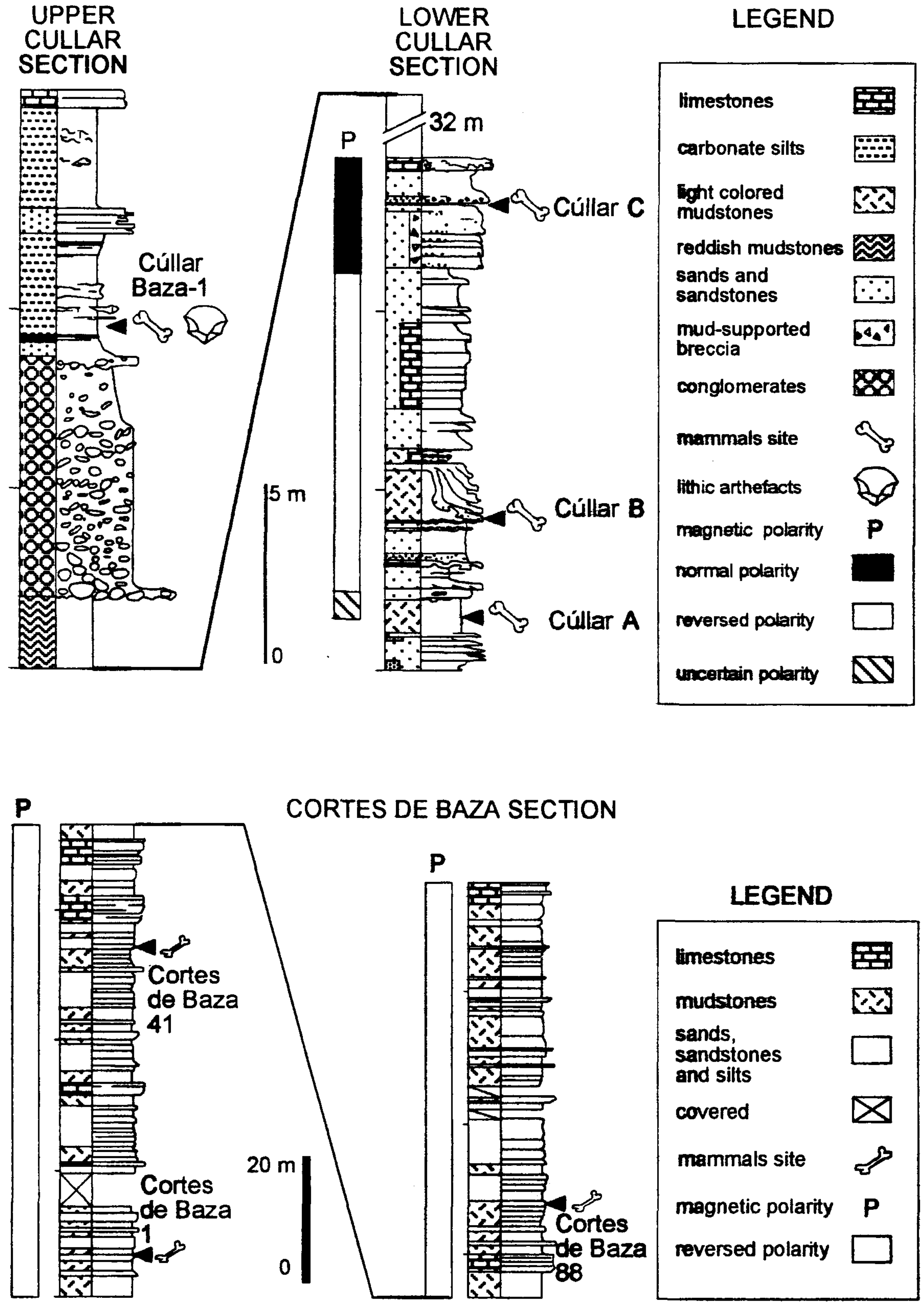

Figure 5. The Cortes de Baza and Cúllar sections. Top: composite Cúllar section (see Agusti *et al.*, 1999 for further details). Bottom: Cortes de Baza section (modified from Oms *et al.*, 1994). Note that the Cortes de Baza and Cúllar sections have different scales.

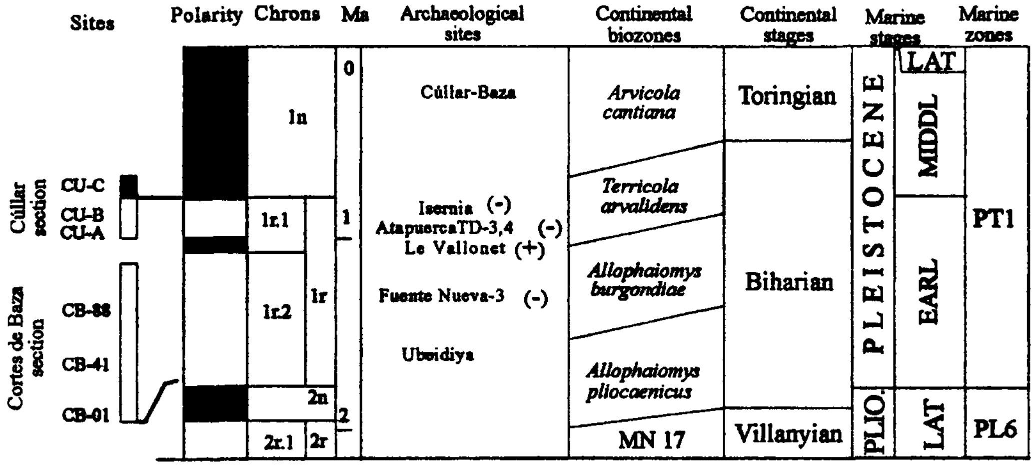

Figure 6. Correlation of the main early and middle Pleistocene archaeological sites and coeval rodent biozones to the Geomagnetic Polarity Time Scale, as established in the Guadix-Baza Basin.

de Baza Section, to the upper Matuyama chron. Therefore, the normal interval where the Cu-C level is placed could represent either the Jaramillo or the Bruhnes chrons. However, the presence of *Terricola arvalidens* indicates a close correlation with the lower levels of Atapuerca TD, which contains a typical association with *Mimomys savini, Terricola arvalidens* and *Stenocranius gregaloides* and where the Bruhnes-Matuyama boundary has been identified according to the data by Parés and Pérez-González (1995).

Also, the presence of *Terricola arvalidens* in Cu-C indicates an age younger than the locality of Le Vallonet (France), a normally magnetized early Paleolithic site which has been placed within the Jaramillo chron (Lumley, 1976; Gagnepain *et al.*, 1995 a and b). Le Vallonet presents an advanced *Allophaiomys* species (Cf. *"Microtus nivaloides"* in Chaline, 1985) and can be correlated with the *Allophaiomys burgondiae* Zone of the Guadix-Baza Basin. All these data reinforce the identification of the reverse-normal interval in the Cúllar Section as the Matuyama-Bruhnes boundary and place the limit between the *Allophaiomys burgondiae* Zone and the *Terricola arvalidens* Zone (= *"Pitymys" gregaloides* Zone in Agustí *et al.*, 1987b) still within the upper Matuyama epoch. Moreover, this confirms the Upper Matuyama age established for the archaeological site of Fuente Nueva-3, which presents a rodent association still belonging to the *Allophaiomys burgondiae* Zone.

On the other hand, the paleomagnetic analysis carried out in the Cúllar Section indicates that the upper part of the *Terricola arvalidens* Zone (latest Biharian) is already included in the lowermost part of the Bruhnes chron. Therefore, the middle Pleistocene (early Toringian) locality of Cúllar-Baza 1, more than 50 m above the level of Cu-C, is clearly placed within this Bruhnes chron. This result is in contrast with previous analysis developed in another early Paleolithic site in the Mediterranean, the locality of Isernia la Pineta (Italy), where a fauna including *Arvicola cantiana, Terricola* cf. *arvaloides* and *Microtus arvalinus* was intially found to be included in a reverse interval immediately overlained by a tuff dated at 0.73 Ma and which placed the earliest *Arvicola* faunas in the uppermost part of the Matuyama chron (Coltori *et al.*, 1982). However, recent analysis of the section inidicates that the fossiliferous locality is placed within a normally margnetized chron identified as the Bruhnes chron (McPherron *et al.*, in Peretto, 1983; Gagnepain *et al.*, 1995 a and b). Besides the Cúllar Section, this interpretation is also supported by the results in the section of Kärlich (Germany), where a similar fauna with *Arvicola cantiana* is also placed in a normal interval correlated to the lower part of the Bruhnes chron (Brunnacker *et al.*, 1976; Kolfshoten,1990). The analysis carried out in the Guadix-Baza Basin strongly supports the placement of the Biharian-Toringian boundary (early-middle Pleistocene boundary) in the lower part of the Bruhnes chron.

Summary

According to the magnetobiostratigraphical dating of the Cortes-Cúllar composite section, the Cúllar Baza-1 early Paleolithic site can be placed in the early part of the Bruhnes chron. This result also suggest an early Bruhnes age for the Italian site of Isernia La Pineta, in contrast with the first datings of this site (but see also Gagnepain *et al.*, 1995 a and b). On the other hand, the levels belonging to the *Allophaiomys burgondiae* Zone are included in the upper part of the Matuyama epoch. This results confirms an upper Matuyama, pre-Bruhnes age for the site of Fuentenueva-3, older than the Atapuerca TD levels. A post-Olduvai, upper Matuyama age of the early site of Ubeidiya is supported by the magnetobiostratigraphical results in the Cortes de baza section, on the basis of the assumed ancestor-descendent relationship established between *Allophaiomys vandermeuleni* (CB-1) and *Tibericola jordanica* (Ubeidiya).

Acknowledgements

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THE EARLY PLEISTOCENE (EPIVILLAFRANCHIAN) FAUNAL SITE OF UNTERMASSFELD (THURINGIA, CENTRAL GERMANY) SYNTHESIS OF NEW RESULTS

Ralf-Dietrich Kahlke

Summary

The Pleistocene fauna of Untermassfeld (Southern Thuringia, Central Germany) comprises some 99 taxa, among them 43 mammalian species. The faunal remains were accumulated by repeated high flood events on the lee-side of a clastic fan of interfingering fluviatile sediments. Approximately 50% of larger mammal individuals (total MNI=310) indicated from the site fell victim to floods. The survival pattern of members of the recovered species was primarily determined by their respective specific behavior and motor abilities. Most animals died between October and the end of March/early April.

A Pleistocene landscape consisting of a more or less damp river valley with thicket-like bank vegetation, low growing to higher mixed forests, limestone slopes with dry meadows and poor shrub to tree vegetation, as well as park-like to open landscapes out of the valley is deduced. The fossil assemblage mainly consists of moderate and thermophile elements, which illustrate a prevailing warm and humid climate balanced by atlanto-mediterranean influence. The summers with more than 60 days of air temperature above 25° C were warmer than recorded in the area today. Mainly during autumn and winter, extensive rainfalls led to repeated flood events. The mild winters were characterized by minimum temperatures of only a few degrees below 0° C.

Combined lithostratigraphic, paleomagnetic and paleozoologic data make it more likely that the deposition of the fossiliferous sands of Untermassfeld can be assigned to the onset of the Jaramillo event (late Early Pleistocene), rather than to the Matuyama/Brunhes boundary.

Introduction

In 1978, the fossil site of Untermassfeld was discovered on the right slope of the River Werra, 2 km south of the town of Meiningen in Southern Thuringia (Central Germany). Until 1997, an area of about 600m^2 had been excavated annually in four to five month field seasons (R-D. Kahlke, 1997a, in press a). Some 9500 determinable remains of larger mammals, as well as approximately 3000 finds of smaller vertebrates have been recovered. The bio-diversity, quality and quantity of the fossil material, as well as the rarity of such complete vertebrate assemblages of Early Pleistocene age in Eurasia, and especially in Central Europe, required a multidisciplinary approach to the site and its fossil contents. It soon became obvious that the Untermassfeld fossil assemblage illustrates an important step in the transition from Latest Villafranchian to Early Middle Pleistocene faunas in Europe.

Geology and Paleomagnetism

Near Untermassfeld, the eastern slope of the Werra Valley cuts through Lower and Middle Triassic sediments. In the subsoil of the excavated area, at 69m relative height above the present day river floodplain (359m above sea level), the Pleistocene sequence (fig. 1) starts with a 7-8m thick bed of coarse gravels, the Younger "*Zersatzgrobschotter*", which, according to the terrace sequence of the Werra Valley (Ellenberg and R-D. Kahlke, 1997:31f; Ellenberg *et al.*, 1997:38) were deposited during the Eburonian (Early Pleistocene). The "*Zersatzgrobschotter*" is covered by up to 21m of floodplain deposits (*Auesediment*).

In a normal stratigraphic sequence, fine and medium grained sands, called the Lower Fluviatile Sands (*Untere Fluviatile Sande*) follow. According to their lithologic characteristics these sands, which have produced well preserved bone material in recent years, represent high flood deposits of the Early Pleistocene Werra River. The Upper Fluviatile Sands (*Obere Fluviatile Sande*) form an up to 4m thick bed preserved as the infill of a channel which had cut through the Lower Fluviatile Sands. An up to 3m thick basal part forms the main fossiliferous horizon of the site (fig. 1, right).

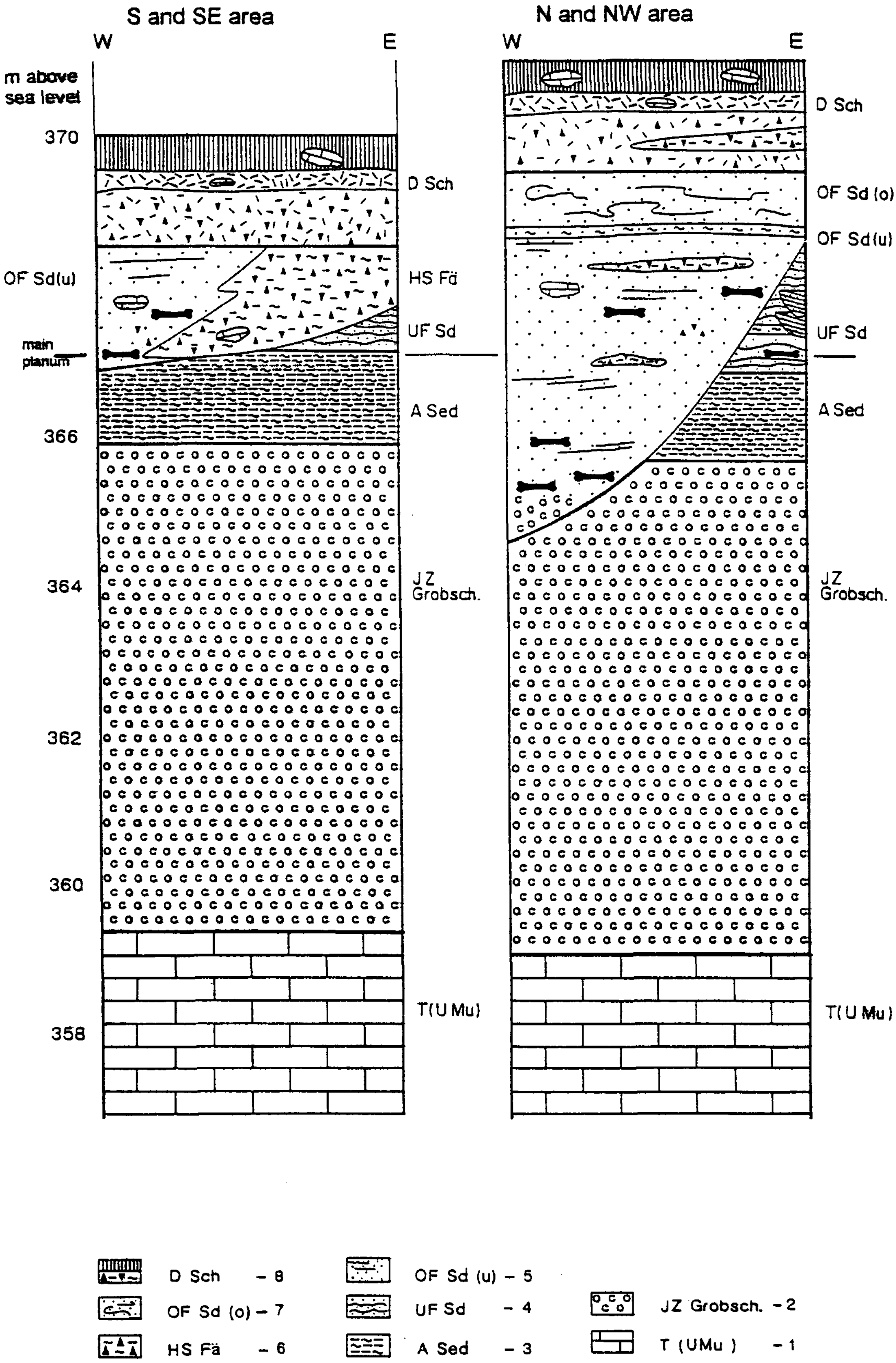

Figure 1. Untermassfeld, diagrammatic sections of the excavated area (neotectonic movements eliminated). 1. T (U Mu): Triassic (Lower Muschelkalk limestones); 2. JZ Grobsch.: Younger Coarse Gravels; 3. A Sed: flood plain deposits; 4. UF Sd: Lower Fluviatile Sands; 5. OF Sd (u): Upper Fluviatile Sands (lower part); 6. HS Fä: coarse elastic mudflow fan; 7. OF Sd (o): Upper Fluviatile Sands (upper part); 8. D Sch: cover sediments (final drawing: N. Fiebig).

In the southern to south-eastern area of the excavated site, i.e. upstream, the fossiliferous lower part of the Upper Fluviatile Sand interfingers with an up to 1m thick coarse clastic mudflow fan (*Hangschuttfächer*) (fig. 1, left). Within the excavated area it may be observed that the fluviatile and accumulative processes had been significantly influenced by this situation (fig. 5; see also below). Lee-side (north) of the clastic fan, skeletal remains of several hundred vertebrate individuals (see below) have accumulated. A predominantly silty-clayish complex of cover sediments (*Deckschichten*) some 1-2m thick overlay the fluviatile sequence.

According to Wiegank (1997), the Younger Zersatzgrobschotter, as well as the basal and middle part of the Lower Fluviatile Sands, are primarily magnetically reversed. However, the uppermost part of the Lower Fluviatile Sands, along with the find level, shows normal polarization.

Fauna

To date (1st November 1998), the faunal spectrum from Untermassfeld comprises some 99 taxa (species/forms) from the following classes: Gastropoda (36), Osteichtyes (3), Amphibia (7), Reptilia (3), Mammalia (43) (preliminary faunal list in R-D. Kahlke, 1997c:387–390; emended in R-D. Kahlke, in press d).

Amongst the moderately abundant gastropod remains from Untermassfeld (Krolopp, 1997) terrestrial forms dominate, with 95.1% of the total number of individuals. The scarce fish remains (Esocidae, Cyprinidae) (Rutte, 1997) represent only a minor part of the assumed ichthyofauna. Evidence of amphibians is comprised of caudates (*Triturus* cf. *cristatus, Triturus* cf. *vulgaris*) and anurans (*Bufo* cf. *bufo*), *Bufo* cf. *viridis, Hyla* cf. *arborea, Rana* cf. *arvalis, Rana* cf. *dalmatina*) (Böhme, 1997). Isolated finds of reptiles belong to squamates (*Chalcides* sp., *Eublepharis* sp.) as well as to a pond tortoise (Emydini, gen. et sp. indet. - Maul, 1997). The avian fauna consists of waterfowl (*Cygnus* sp. (cf. *olor*), *Anser* sp. (aff. *subanser*), birds of prey (*Haliaëtus* sp. (aff. *brevipes*)), gallinaceous birds (*Francolinus (Lambrechtia) capeki*) and perching birds (*Turdus* sp. (aff. *philomelos*), *Corvus* sp. (aff. *janossyi*), *Garrulus* aff. *glandarius*) (Jánossy, 1997).

Special attention was paid to the mammal remains of the site. More than 1000 finds belong to a large and long legged, but not heavily built form of true bison, established as a new species *Bison menneri* by Sher (1997) (fig. 2c). The many cervid remains include at least four species in differing proportions (H-D. Kahlke, 1997, in press a). One antler beam as well as a few fragments of dentition and postcranial elements illustrate the occurrence of a form of roe deer (fig. 2b), more primitive than *Capreolus suessenbornensis*. Another rare faunal element is a large sized, delicately constructed moose (*Alces carnutorum*) (fig. 2a) which links the Villafranchian *A. gallicus* of Europe and Middle Asia with the holarctically dispersed *A. latifrons* of the early Middle Pleistocene (H-D. Kahlke, 1995). More abundant at Untermassfeld are remains of a moderately small cervid preliminarily named *Cervus* s. l. *nestii vallonnetensis* by H-D. Kahlke (1997) (fig. 2e, f). These forms derived from a Villafranchian stock of Mediterranean origin (genus *Pseudodama* in the terminology of Azzaroli, 1992). Recently, Pfeiffer (in press) includes fallow deer-like cervids of Early to early Middle Pleistocene age without any antler palmation in the genus *Dama* (subgenus *Pseudodama*). A trend of relative shortening of the premolar rows in the Late Villafranchian *nestii* - "populations" is continued by the slightly younger small deer from Untermassfeld. The most common cervid from Untermassfeld, recorded by more than 1000 pieces and primarily characterized by its antler morphology, is an advanced member of the genus *Eucladoceros* (fig. 2d). For this long-legged and very large form, the new species *E. giulii* was established (H-D. Kahlke, 1997).

The remains of hippopotamus (*Hippopotamus amphibius antiquus*) (fig. 3a-d) form the most complete assemblage of material from this species known so far in mainland Europe and, for the first time, allowed a description and osteometric analysis of almost all skeletal parts of the population (R-D. Kahlke, 1997b). Bone configurations within the facial part of the skull as well as the complete reduction of the incisor dentition to tetraprotodonty place the fossil population of Untermassfeld into the *amphibius* branch of the African-European *Hippopotamus* stock. Advanced morphological features of a newly found adult skull (R-D. Kahlke, in press b) indicate a more evolved condition in comparison with the Upper Villafranchian lectotype from Figline (Upper Valdarno, Italy).

Further, a few suid remains have been recovered at

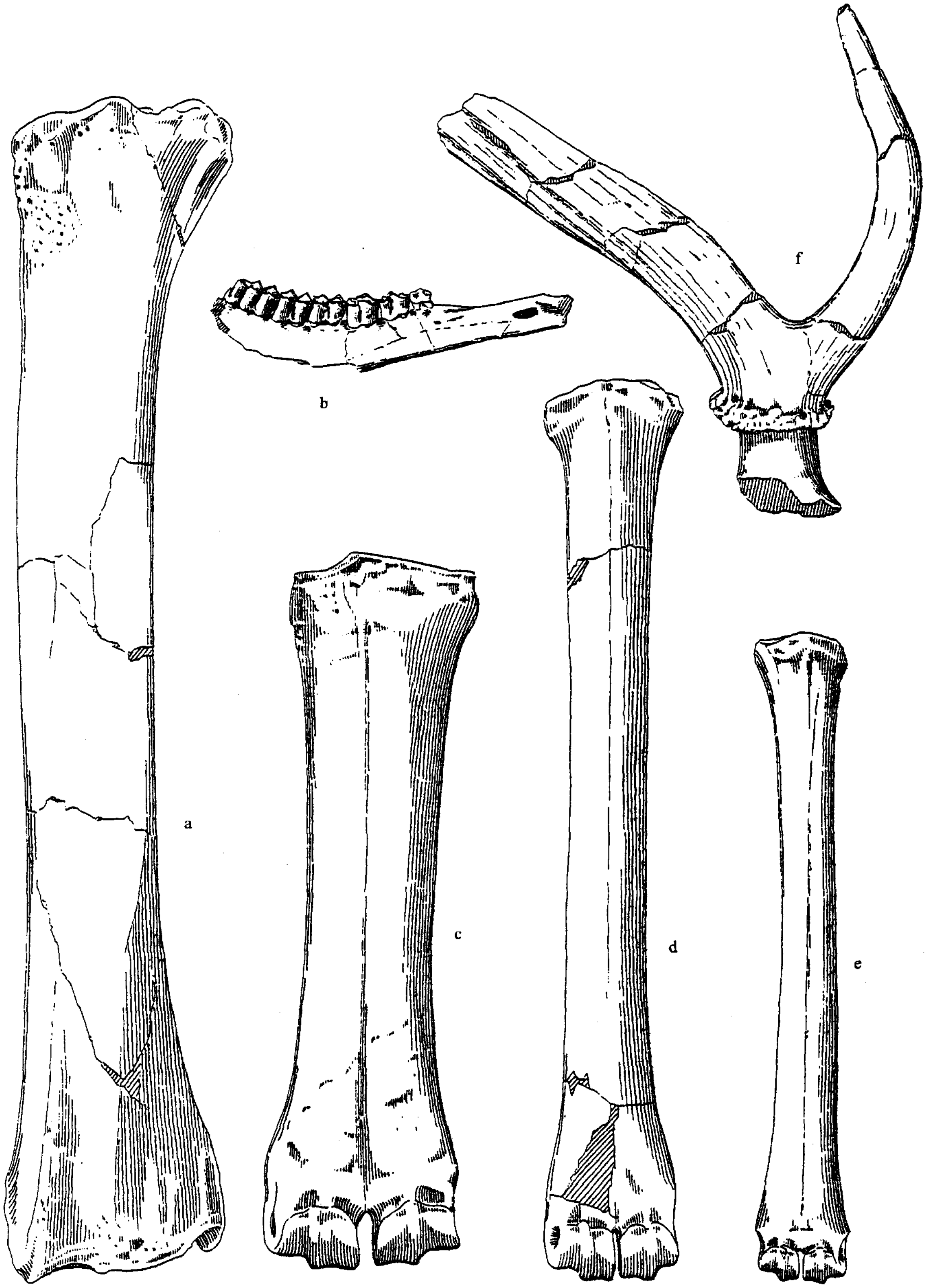

Figure 2. Untermassfeld. a. *Alces carnutorum* (Laugel), radius sin. [IQW 1981/17 632 (Mei. 17 154)]; b. *Capreolus* sp., mandibula dex. with P_2–M_3 [IQW 1982/18 586 (Mei. 18 106) + IQW 1983/18 900 (Mei. 18 420)]; c. *Bison menneri* Sher, metacarpal III + IV dex. (holotype) [IQW 1982/17 948 (Mei. 17 468)]; d. *Eucladoceros giulii* Kahlke, metacarpal III + IV dex. [IQW 1980/17 138 (Mei. 16 659)]; e. *Cervus s.l. nestii vallonnetensis* de Lumley, Kahlke, Moigne et Moullé, metacarpal III + IV sin. [IQW 1982/18 266 (Mei. 17 786)]; f - *Cervus s.l. nestii vallonnetensis* de Lumley, Kahlke, Moigne et Moullé, left antler frontlet [IQW 1983/19 031 (Mei. 18 551)]. ca. 1:2 nat. size (drawing: H. Wöllner).

Untermassfeld (Guérin and Faure, 1997). The material belongs to a large-sized wild boar, *Sus scrofa priscus*. Some 700 finds of *Stephanorhinus etruscus* (fig. 3f-h) characterize the Untermassfeld rhino population as morphometrically intermediate between the Upper Villafranchian type material of the Upper Valdarno and forms from stratigraphically younger sites such as Voigtstedt and Süssenborn (H-D. Kahlke, in press b). Some 180 horse remains can be referred to one medium-sized stenonid form only (Musil, in press a) (fig. 3e), whereas most Villafranchian to earliest Middle Pleistocene localities of Eurasia indicate two sympatric species (Forstén, 1988:24-25).

Compared to other groups of animal, elephant finds remain scanty. Based on the morphology of the only complete tooth (D^4) from the site, as well as the aserial configuration of a reconstructed carpus, Dubrovo (in press) refers the material to large-sized individuals of *Mammuthus trogontherii trogontherii.*

Remarkable and comparatively rich Carnivore material has been found as part of the Untermassfeld fossil assemblage. At present, remains of eleven medium to large-sized species have been recorded. Smaller forms are, however, more or less lacking so far. Felids are represented by the relatively abundant *Panthera onca gombaszoegensis,* by a large individual of *Acinonyx pardinensis pleistocaenicus* (fig. 4e, f), and by *Puma pardoides* (Syn. *Viretailurus schaubi*), *Lynx issiodorensis* ssp. ex aff. *spelaeus, Megantereon cultridens adroveri* and *Homotherium crenatidens* (Hemmer, this volume, in press).

Among the around 100 finds of *Pachycrocuta brevirostris* (fig. 4g-h) of different individual age stages, cubs predominate (table 1) (Turner, in press). Crushing and gnawing marks on the bones of nearly all recorded larger vertebrate species (see for instance R-D. Kahlke, 1997b; table 2, 3), as well as the presence of some 160 coprolites (Keiler, in press), document the activities of this powerful hyena in the area of the site. *Meles* is attested to by only two fragments (Wolsan, in press).

Bear remains from Untermassfeld are as common as are those of hyenas. The "arctoid" character of the dentition, as well as the slender metapodials place the fossil population in the ancestry of brown bears (Musil, in press, additional finds in R-D. Kahlke and Kierdorf, 1997).

The faunal communities of several Early to early Middle Pleistocene sites of the Palearctic contain two sympatric canids of different body size. At Untermassfeld, the large and rarer *Canis (Xenocyon) lycaonoides* (fig. 4c-d) is associated with the more common *Canis mosbachensis* (fig. 4a-b). More than 300 pieces of the latter have been studied. Dental features and limb bone proportions indicate an early, i.e., late Early Pleistocene member of the *mosbachensis*-line (Sotnikova, in press).

Rodents form the major part of the micromammals. Maul (1990, in press a) identified 12 taxa. A few finds attest to squirrels (*Sciurus* cf. *whitei*), characterized by significantly smaller molars compared to those of the recent *S. vulgaris*. Most abundant are the remains of ground squirrel (*Spermophilus (Urocitellus)* ex gr. *primigenius/polonicus*). The rarity of beaver finds can be explained by the model of the site assemblage (see below). A few teeth and mandibles show the occurrence of *Castor fiber* and of *Trogontherium cuvieri*. Gnawing marks on several bones of larger mammals led Maul (in press b) to conclude the occurrence of *Hystrix* sp. in the Untermassfeld fauna. Corresponding dental or skeletal remains of porcupine have not been found so far.

Some dormouse teeth fit the size range of *Glis sackdillingensis*. According to the tooth dimensions, the remains of large hamster have to be assigned to *Cricetus* cf. *runtonensis*. A few finds indicate bank vole (*Clethrionomys* cf. *hintonianus*). More numerous are the voles *Pliomys episcopalis*, *Mimomys savini* and *Mimomys (Cseria) pusillus*. *Microtus thenii* is very common in the Untermassfeld find layers. Some fragments of dentition also indicate *Apodemus* cf. *sylvaticus*. Minor differences to the recent form are visible in the formation of accessory cusps in the M_1.

Leporids belong to the rarest finds of the Untermassfeld fauna. So far, one upper premolar as well as two fragments of humeri have been identified. The latter could fit with *Lepus* as well as with *Hypolagus*. The premolar is that of a hare (cf. *Lepus* sp.).

The Untermassfeld assemblage contains six species of insectivores (Maul, 1990, in press a).

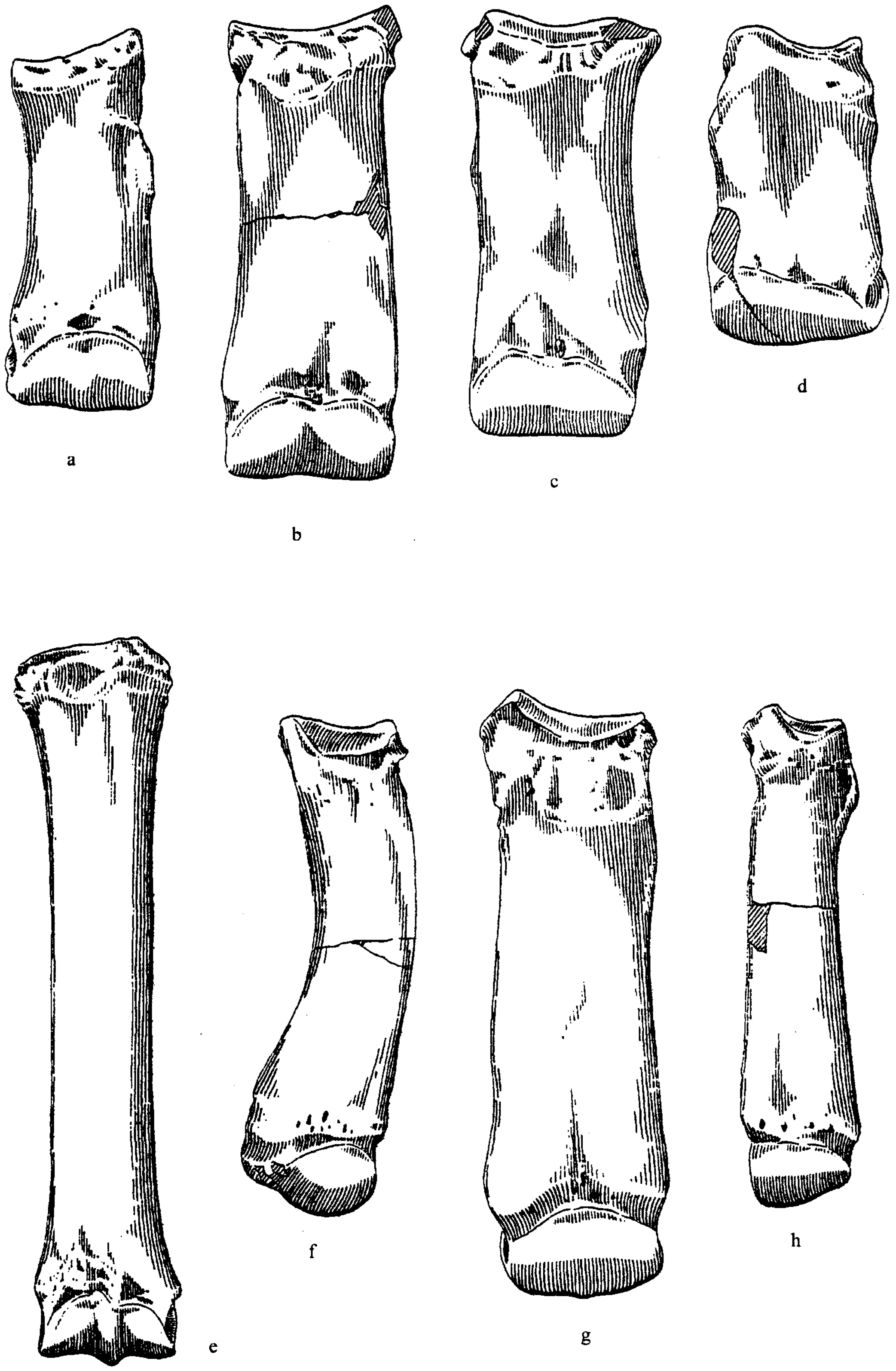

Figure 3. Untermassfeld. a–d. *Hippopotamus amphibius antiquus* Desmarest, a. metacarpal II sin. [IQW 1982/18 216 (Mei. 17 736)], b. metacarpal III sin. [IQW 1982/18 215 (Mei. 17 735)], c. metacarpal IV sin. [IQW 1982/18 217 (Mei. 17 737)], d. metacarpal V sin. [IQW 1982/18 214 (Mei. 17 734)]; e. *Equus* sp., metacarpal III sin. [IQW 1980/15 438 (Mei. 14 950)]; f–h. *Stephanorhinus etruscus* (Falconer), f. metacarpal IV dex. [IQW 1983/19 030 (Mei. 18 550)], g. metacarpal III dex. [IQW 1980/16 503 (Mei. 16 024)], h. metacarpal II dex. [IQW 1980/15 882 (Mei. 15 393)]. ca. 1:2 nat. size (drawing: H. Wöllner).

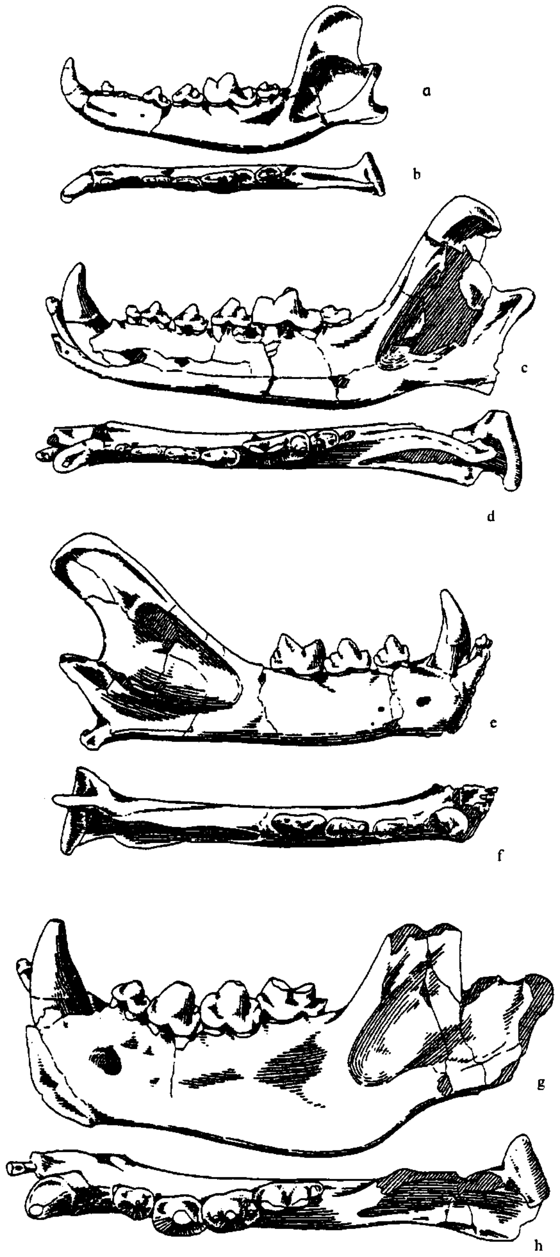

Figure 4. Untermassfeld. A-b. *Canis mosbachensis*, mandibula sin. with C, P_1, P_3 - M_2 [IQW 1980/15 309 (Mei. 14 821)]; c-d. *Canis (Xenocyon) lycaonoides*, mandibula sin. with I_3 - M_2 [IQW 1985/20 535 (Mei. 20 074)]; e-f. *Acinonyx pardinensis pleistocaenicus*, mandibula dex. with I_1 - M_1 [IQW 1980/15 503 (Mei. 15 015)]; g-h. *Pachycrocuta brevirostris*, mandibula sin. with I_3 - M_1 [IQW 1980/15 918 (Mei. 15 429)]. ca. 1:3 nat. size. (drawing: H. Wöllner).

Several finds can be referred to hedgehog (*Erinaceus* cf. *europaeus*) and to moles of different body sizes (*Talpa* cf. *europaea*, *T.* cf. *minor*). Further, some shrews (*Sorex runtonensis*, *Sorex (Drepanosorex)* ex gr. *margaritodon - savini* (transitional form), *Beremendia* cf. *fissidens*) are indicated.

Some isolated teeth of *Macaca sylvanus* can be referred to a male as well as to a female individual (Zapfe, in press). A subspecific determination is not so far possible.

Within the rich Untermassfeld collection, hominid remains have not been identified, nor have any traces of intentional activities of humans come to light. The overall taphonomic situation of the site shows no anthropogenic influence at all (see below).

Taphonomy

Due to a more or less constant carbonate impregnation of the fluviatile sand body (originating from Middle Triassic limestones slopeside of the locality), the bulk of recovered bones show good to excellent preservation. Most of the larger mammal remains, as well as the microvertebrate finds, show no traces of rolling or abrasion. Notable exceptions are a very few abraded pieces, which have undergone a longer phase of transportation as defleshed skeletal elements. The absence of stronger traces of weathering indicates that the bones had been covered by sediment quite rapidly.

The finds are heterogenously distributed within the channel infill (Upper Fluviatile Sands, see above, fig. 1) forming the main fossiliferous part of the site. Directly lee-side of the coarse clastic mudflow fan, smaller, lighter and in many cases badly fragmented skeletal elements dominate. The concentration of finds as well as their size/weight and degree of articulation increases toward the central part of the bone accumulation (detailed maps of the excavated area will be given in R-D. Kahlke, in press d). The northern and northeastern parts of the investigated area are characterized by a slight decrease in the average weight of the finds, as well as in the number of anatomically connected units. A modified situation was observed in the deepest levels of the channel infill. Here, unusually high concentrations (up to 100 finds per m^2) of mostly disarticulated and in part fragmented skeletal elements of medium size occurred.

The area excavated within the Lower Fluviatile Sands so far is smaller than the investigated area within the channel infill. It produced well preserved bones in lesser concentration (detailed plans and maps in R-D. Kahlke, in press d). A remarkable exception observed in the Lower Sands was a bone concentration of some 800 pieces covering an area of less than 8m^2, which is interpreted as a drift line formed in shallow water near to the river bank.

More detailed information to reconstruct the processes of disarticulation and accumulation of corpses and skeletal material within the area of the site can be taken from an analysis of the fine scale distribution pattern of the finds. The arrangement of bones is subdivided into anatomically connected units, isolated finds, polyspecific bone concentrations - i.e., accumulations of single bones from different species and individuals - and larger bone aggregations. Complete skeletons are lacking.

Anatomically connected finds are those elements recovered in normal anatomical association to each other or, notably, disarticulated elements whose close spatial juxtaposition indicates the original affiliation of the individual bones. These units consist mainly of complete or partially preserved extremities which have always been disconnected from the rest of the carcass at the shoulder or the pelvic girdle. An exemplary series of hippopotamus extremities, testifying to disarticulation sequences largely unmodified by carnivore activities, is given by R-D. Kahlke (1997c, Abb. 1-6). The more or less pronounced activities probably of all carnivore species (see above) represented in the thanatocoenosis of Untermassfeld could have modified the decomposition of the carcasses and skeletal units prior to and after deposition at the site.

The disarticulation of individual bones or the complete disintegration of skeletons produced a large number of isolated finds. There are only few indications of a patterned orientation of the bones deposited at the site. Remains of smaller vertebrates were found isolated in nearly all cases.

As a result of fluviatile processes within the area of the site, isolated finds became deposited as polyspecific bone concentrations. Large or bulky bones ("obstruction bones") probably acted as mechanical barriers on which other drifting skeletal elements became entangled in the shallow and gently flowing streams. In the deepest part of the channel infill a bone aggregation covering 11m^2 has been recovered. Such an accumulation can be interpreted as a series of overlapping polyspecific bone concentrations.

Corresponding left and right counterparts of dental or skeletal elements have been identified from nearly all recorded larger mammal species. As well as the excellent preservation of the majority of bones, the relatively high number of 160 anatomically connected units, which were either found *in situ* or reconstructed (R-D. Kahlke, 1997c, in press d, e), indicates the influx of the skeletal material into the site as more or less intact cadavers. Analysis of sufficiently large bone samples (NISP=3399) of six species of different body weight (*Hippopotamus amphibius antiquus, Stephanorhinus etruscus, Bison menneri, Eucladoceros giulii, Equus sp., Cervus* s.l. *nestii vallonnetensis*) shows that robustly built animal species are represented by an evidently higher number of individually connected finds (R-D. Kahlke, 1997c). Smaller animal forms, with a more delicately built anatomy, more rapidly fell victim to biotic and abiotic processes of decomposition.

Complete axial skeletons are lacking for all cases studied. Even intact vertebrae and complete ribs are underrepresented, although fragments of both have commonly been found. Crania, too, are only recovered intact in exceptional cases. Bulky parts of skeletons such as shed antlers or antler frontlets, cranial fragments of adult bison with horncores, elephant tusks and intact hippopotamus mandibles with fully erupted canines, were also found in low numbers or were absent.

Based on the characteristics of dentitions and bones found at Untermassfeld up to 1995, a minimum number of 310 individuals (MNI) can be reckoned for the larger mammals so far (table 1).

The individual age structure shows for several of the more abundant species a high proportion of juvenile to subadult animals (*Bison menneri, Eucladoceros giulii, Hippopotamus amphibius antiquus, Sus scrofa priscus, Stephanorhinus etruscus, Equus* sp., *Mammuthus trogontherii trogontherii, Panthera onca gombaszoegensis, Pachycrocuta brevirostris*).

Synthesis of site assemblage[1]

From the geological data on the fossiliferous parts of Lower and Upper Fluviatile Sands the following processes are to be concluded: the accumulation of vertebrate remains in both of the sand bodies

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[1] A more detailed discussion of the assemblage model of the site will be given in R.-D. Kahlke (in press c).

occurred in identical positions lee-site of a clastic mudflow fan interfingering with fluviatile sediments. Lithological data from the different layers of the Lower Fluviatile Sands establish repeated high flood events. Several of these more or less similar flood situations deposited animal remains. Just after the accumulation of the Lower Fluviatile Sands, a new flood event with unusually high erosive power cut a channel up to 4m deep into the sands and refilled it immediately (fig. 5). A high influx of necromass took place, mainly during the very beginning of channel filling.

The recent geomorphology of the middle and upper reach of the Werra River and minor tributaries, as well as the configuration of upstream-formed river terraces, has allowed the reconstruction of the potential flood area (R-D. Kahlke, in press d). Altogether, the finds concentrated in the site originated from approximately 94 km^2 of flood plain. The high floods eroded the larger areas upstream of the site. Any available necromass, including plant remains, isolated bones and cadaver fragments was washed away. The catastrophic impact of the high flood events on the animal life of the river valley was increased by a significant narrowing of the valley (the so-called "Nadelöhr" - eye of the needle) from >1.5 km to <1.0 km some 12 km upstream of the place of final deposition. During flood situations, the resulting bottleneck caused a rapid raising of water levels upstream of the narrowing. Around the narrowest pass of the valley, the rapidly swollen river water combined with an increase in the velocity of currents and turbulence, which would have proven fatal even for the good swimmers among the mammals, such as the cervids and perhaps even the adult hippos.

In keeping with the different biotope preferences and lifestyles of the recorded species, their causes of death could have been various. However, from the activities of the diverse guild of carnivores (see above), including many active hunters (Hemmer, this volume, in press), the permanent occurrence of cadavers in successive stages of decomposition within the flood plain of the Werra River has to be concluded. Further loss, for instance among cervid calves, probably happened during periods of high humidity. Other animals died of disease, exhaustion, or weakness due to old age.

The relatively high quantity of matching left and right skeletal elements, as well as the specific and individual composition of the thanatocoenosis indicate a large portion of fresh flood victims among the recovered animals. Taking into account the percentage of carnivore prey estimated by Hemmer (in press) and the much lower number of individuals dying from "minor" causes, approximately 50% of the whole quantity of larger mammal individuals from the site fell victim to flood events. Crucially important for determining the numbers, ages and sex of individual species preserved are the population densities of different species within their Lower Pleistocene biotope, the specific patterns of behavior and motor abilities - especially swimming and climbing capabilities - and the typical resting spots of these animals, as well as absolute weight and transportability of the carcasses.

First of all in flooded areas island complexes of different sizes form according to the geomorphological situation. Such islands are used by endangered animals to avoid the rising water. With further flooding, these refugia have to be given up. According to the numbers of individuals as well as the length of time of isolation, some of these animals would begin to suffer from food limitation.

The obviously high number of freshly dead victims within the Untermassfeld assemblage allows us to discuss the individual age structure of the more common species of larger mammals (see table 1). The pattern of vulnerability is in some ways similar between a carnivore-accumulated and catastrophic flood event assemblage. For the *Bison menneri* remains, Sher (1997:104) showed an age and sex ratio close to that of a natural population. It seems bison groups with herd-like structure met their death here. The analysis of *Eucladoceros giulii* mandibular tooth wear has permitted a detailed reconstruction of the age classes of this species in the fossil sample (H-D. Kahlke, 1997:243). Very young and old individuals predominate. Prime-aged adults are much rarer. However, analysis of the mandibles of *Cervus* s.l. *nestii vallonnetensis* indicate an age-class distribution clearly different to that of *Eucladoceros* (H-D. Kahlke, 1997:204). Remains of this "small cervid" include only a few calves, while the bulk of the material must be referred to prime-age adults. The lower physical capability of the fallow deer-sized, smaller cervid led to an endangering of all age stages during the flood, while the stronger prime-aged individuals of *Eucladoceros* were able to escape the water in higher numbers.

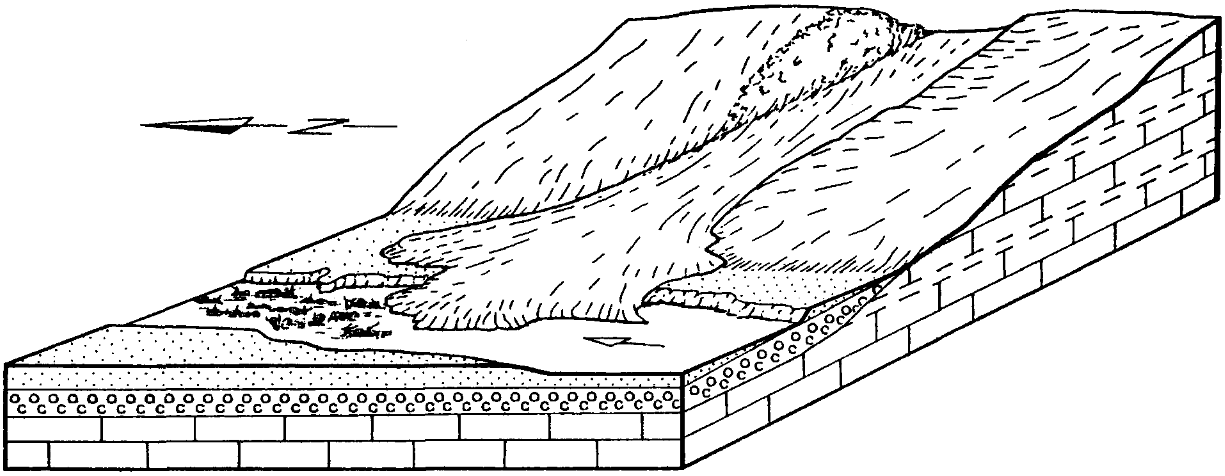

Fig. 5 Untermassfeld, reconstruction of the site during accumulation of the Upper Fluviatile Sands (channel refilling) (final drawing: N. Fiebig).

The proportion of calves with milk dentition among *Hippopotamus amphibius antiquus* is slightly higher than that observed in recent populations. Today the main cause of death among juvenile African hippos is separation from their mothers by flowing water. *Stephanorhinus etruscus* was not a powerful swimmer. Its abilities should be estimated as between those of the African black rhino (*Diceros bicornis*) and the Asian species. Generally, juvenile as well as adult individuals of the Untermassfeld population were endangered by rising waters levels. This is also true for the Untermassfeld horses (*Equus* sp.).

Elephants are good swimmers. Their trunk used as a snorkel, and the pneumatic construction of the upper skull region supports their ability to survive in water (Sondaar, 1986). At the site of Untermassfeld, remains of only six individuals have been found, half of them juvenile to sub-adult animals. Probably some of these elephants failed to reach a safe bank because of their poor climbing ability.

For the felid fauna, rich in species and poor in number of individuals, the question remains of whether the individual animals fell victim to the rising flood, or were lured by other flood victims and met their death while preying. Amongst the rather common finds of *Pachycrocuta brevirostris*, cubs predominate. Because of this, the occurrence of hyena dens containing highly vulnerable juveniles within the flooded area can be assumed. In contrast to hyenas, the material of the "small wolf" *Canis mosbachensis* mostly represents adults of both sexes. This case does not reflect a natural age distribution - obviously the packs' dens and the "rendez-vous" of the juveniles were distributed outside the flooded area. The brown bear (*Ursus* sp.) is attested to only by fully adult individuals, with the exception of one younger animal. These bears may have been accustomed to fishing in shallow river waters. Nevertheless, the huge flooded plains overextended their physical power. In addition, it is possible that some of the recorded individuals were taken by surprise by the rising river during hibernation.

Within the Untermassfeld thanatocoenosis, smaller sized species of body weight less than 10 kg are lacking. Juveniles of larger species, which extend this weight class only to a lesser degree are also under-represented. Whether as prey, or during fluviatile transportation, cadavers of this size are destroyed more completely and much faster than large-sized carcasses (see above). Furthermore, animal bodies of smaller dimensions can be filtered out more easily from the running water by bushes or tree branches than can larger and heavier cadavers.

Remains of microvertebrates were collected from the site in rather large quantities (160 tons of screen washed sediments). Maul (1990:88) calculates 23 small mammal remains per ton for the main collecting period (1983–1989). The dental and skeletal fragments originate from reworked bird pellets as well as from the droppings of mammalian hunters. The number and specific representation of the finds, as well as the osteological spectra result from various ecologic and taphonomic selection processes (Maul, in press a).

The more or less complete cadavers washed from upstream areas of the flooded valley underwent successive destructive processes during transportation and after deposition at the fossil site. The sequence of disintegration and redeposition of skeletal material at the site includes the following steps: partial skeleton (anatomically connected unit) - individual skeletal element (isolated find) - and local accumulation of bones (polyspecific bone concentration) (see above).

The disintegration of the skeletal material was supported and modified by the activities of scavengers. An individual rhino skeleton reconstructed from isolated and mostly gnawed bones (H-D. Kahlke, in press b) illustrates the destructive activities of carnivores at the site. Most of the crushing and gnaw marks observed on the bones originate from *Pachycrocuta brevirostris* - fewer pieces have been chewed by other species. Obviously, the cadaver fragments were easily available to scavengers in the area of the site. This supports the conclusion of bone deposition in mainly shallow waters after the climax of the floods.

It seems the accumulation surfaces of the site may have dried out from time to time. Signs marking the occasional drying of at least parts of the fluviatile sands include the excellent state of preservation of the recovered coprolites, with undamaged surfaces, as well as the occurrence of grouped, fossil droppings representing remains of latrines (Keiler, in press). Gnaw marks by rodents (primarily by *Hystrix* sp.) observed on bone surfaces also indicate a periodic lack of water cover at the site (Maul, in press b). The good state of preservation of such marks and the concentration of the finds within very few of the excavated squares (m^2) make transportation of rodent gnawed-specimens from upstream floodplain areas into the site not a very likely scenario. In contrast, one isolated find showing traces of herbivorous osteophagy was certainly redeposited (R-D. Kahlke, in press c).

Data on the seasonality of the bone accumulations at Untermassfeld are first of all available from antler finds (H-D. Kahlke, in press a). The majority are not shed. Therefore most of the animals met their death between October and the end of March/early April. To obtain more detailed information on seasonal processes, root cementum of a series of isolated cervid teeth has been analyzed (H. Kierdorf, Köln). Unfortunately, diagenetic recrystallization within the samples prevents further results.

During sedimentation of the upper part of the Upper Fluviatile Sands (see above) the clastic mudflow fan lost its accumulating effect within the running water. The deposition of vertebrate remains in the area of the site came to an end.

The Untermassfeld fossil assemblage in its stratigraphic context documents the accumulation and modification of a paleontological site which formed in a geologically short period, i.e., over a biostratigraphically insignificant length of time.

Paleoecology[2]

By using all geological, paleontological and taphonomical data available for the site of Untermassfeld, a rather detailed ecological picture can be painted. During times of normal water levels, the flat and mostly broad Lower Pleistocene Werra Valley was traversed by a dynamic river. Its bed and banks were formed by colored gravels, reddish sands and darker, fine-grained floodplain deposits. On parts of the river bottom, rich plant cover was developed. At more protected positions of the river, clear and open waters with a gentle current existed. Besides the main stream and its more or less active side channels and tributaries, in wetter parts of the flood plain there were stagnating waters and regions filled with sediment. A rapid swelling of the river caused by particular meteorologic and hydrologic combinations could lead to powerful flowing water and, at a bottleneck-like narrowing of the valley, to a dangerously turbulent stream. Large areas of the valley were regularly (probably seasonally) flooded.

As a result of the high floods within the Early Pleistocene Werra Valley, temporary ponds and pools persisted due to the unstable relief of the valley bottom. Depending on their depth and the intensity of insolation, these water bodies attained different temperatures. Damp floodplain meadows included swamp areas. In moist places, for instance on the riverbanks, thicket-like lightwoods grew in larger quantities. In areas badly endangered by flooding, the remaining forest was

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[2] A detailed compilation and discussion of the ecological parameters of the faunal elements from Untermassfeld will be given in R.-D. Kahlke (in press d).

low-growing and affected by the duration and sequence of water cover. In dryer, more stable parts of the valley, higher and clearer mixed forest was dispersed with little undergrowth. On soft soils, rich herbaceous vegetation developed.

The limestone slopes near the site included biotopes with poor tree to shrub vegetation, as well as open areas. Dry slope meadows and debris fields expanded mainly on the right slope of the valley (locality side). Downslope, rocky-clayish fans formed. The sandstone subsoil of areas outside the river valley was covered by sandy to loamy sediments. Loamy-clayish soils rich in stone debris developed in limestone areas, and tended to dry up quickly. Depending on soil quality and the availability of water, park-like landscapes, and, over larger areas, biotopes poor in trees expanded outside the Werra valley.

The composition of the Untermassfeld faunal spectrum and the resulting sketch of the landscape indicate undoubtedly warm climatic conditions. The fossil assemblage mainly consists of moderate to thermophile elements linked to differing biotopes in varying manners and degrees. Animals of cool to cold environmental conditions are completely lacking.

Summer temperatures higher than recorded today in southern Thuringia are signaled by a find of pond tortoise. The embryos of Emydini can be incubated only with more than 60 summer days of air temperatures above 25°C (Maul, 1997:92-93). Winter temperatures can be estimated from the frequent occurrence of *Hippopotamus amphibius antiquus*. Because the survival of hippos is impossible when ice covers their water habitats, mild winters with minimum temperatures of a few degrees below 0° C have to be concluded. Regular and permanent snow cover during the winter seems unlikely, at least in the close vicinity of the site. For the valley bottom as well as the slopes and the park-like plains outside the river valley, several local climates are concluded, according to differing degrees of moisture and insolation. There was enough precipitation to allow standing water and damp floodplains within the valley around the year. Mainly during the autumn and winter, extensive rainfalls led to repeated floods. Because of drainage, the adjacent area was generally dryer than the river valley itself, but had more or less similar air temperatures. The limestone slopes were not capable of storing much water. Especially in southern exposed positions, the dryness of the summers was combined with a higher than average warming of soil and air.

Generally, a warm humid climate without extreme daily and yearly variation of temperature prevailed, balanced by an atlanto-mediterranean influence.

Stratigraphy

Based on lithostratigraphic data on the evolutionary history of the Werra Valley, a timespan of latest Waalian to earliest Cromerian s.l. was established for the deposition of the fossiliferous sands of Untermassfeld (Ellenberg and R-D. Kahlke, 1997). A combination of available paleomagnetic data (see above) together with the paleontological record, seems to indicate a more precise date for the age of the site. The composition of the faunal community, as well as the evolutionary level of corresponding taxa, make it most likely that the interpretation of the change in polarity from reverse to normal just below the bone bearing part of the fluviatile sands equates to the base of the Jaramillo event rather than to the Matuyama/Brunhes boundary. For the Jaramillo onset, Shackleton (1995:243) gives an absolute date of 1.07 myr B.P. (recent radiometric calibration 1.05±0.11 myr B.P., 1.01 myr B.P.; for references see Shackleton, 1995, tab. 17.2).

The mammalian faunal community of Untermassfeld primarily includes survivors from the Villafranchian, as well as more evolved forms characteristic to the early Middle Pleistocene. Due to the lack of a term commonly used for larger mammal associations of the Late Villafranchian/early Middle Pleistocene transitional zone in Eurasia, the name Epivillafranchian, first introduced by Bourdier (1961:745-249), is available (see also Lumley *et al.*, 1988:420). The Epivillafranchian, with the fossiliferous sands of Untermassfeld as European reference horizon, fits into the MNQ zone 20 of Guérin (1982:596f).

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	Juvenile/ Subadult	Adult	Total	Established by
Bison menneri	10+3[3]	27+6[3]	46	A. V. Sher
Capreolus sp.	0	5	5	H-D. Kahlke
Alces carnutorum	1	3	4	H-D. Kahlke
Cervus s.l. *nestii vallonnetensis*	7	40	47	H-D. Kahlke
Eucladoceros giulii	28	32	60	H-D. Kahlke
Hippopotamus amphibius antiquus	11	9	20	R-D. Kahlke
Sus scrofa priscus	3	3	6	R-D. Kahlke
Stephanorhinus etruscus	13	16	29	H-D. Kahlke
Equus sp.	5	8	13	R-D. Kahlke
Mammuthus trogontherii trogontherii	4	2	6	I. Dubrovo R-D. Kahlke
Panthera onca gombaszoegensis	2	3	5	H. Hemmer
Acinonyx pardinensis pleistocaenicus	0	1	1	H. Hemmer
Puma pardoides	0	1	1	H. Hemmer
Lynx issiodorensis ssp. ex aff. *spelaeus*	0	2	2	H. Hemmer
Megantereon cultridens adroveri	1	1	2	H. Hemmer
Homotherium crenatidens	0	3	3	H. Hemmer
Pachycrocuta brevirostris	17	5	22	A. Turner R-D. Kahlke
Meles sp.	0	1	1	M. Wolsan
Ursus sp.	1	8	9	R-D. Kahlke
Canis (Xenocyon) lycaonoides	0	5	5	R-D. Kahlke
Canis mosbachensis	2	16	18	R-D. Kahlke
Castor fiber	0	2	2	L. Maul
Trogontherium cuvieri	0	1	1	L. Maul
Macaca sylvanus	0	2	2	H. Zapfe
Total MNI	**108**	**202**	**310**	

Table 1 Untermassfeld, minimum number of individuals (MNI) of larger mammals according to dental and skeletal remains, based on the material excavated up to 1995.

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[3] Estimated MNI of additional finds recovered from the site after Sher's studies, material not yet prepared completely.

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THE LAST NEANDERTHALS

Olga Soffer

Introduction

This volume, like it's parent conference, focuses on the "firsts" - the oldest this or that hominid taxon somewhere in space. Although such a focus has great antiquity in our field - it is also one which addresses the least interesting and most static question about the past: the "when". This chapter looks not at the "oldest" but at the "youngest" or "last" archaic humans in Eurasia. I do so because, as Mellars (1996) has pointed out, questions about demographic histories and spatial distributions of Pleistocene hominids have received little attention in the literature. Yet, as Howell (1994) notes, in order to understand human evolution we must consider such factors as group size, spatial and temporal continuity of occupation, isolation, and extinction. These are basic biological concepts that affect evolution through such processes as the founders effect, gene flow, and genetic drift. Without considering them we are doomed to putting "dots on maps" and generating static scenarios that offer few answers to the most interesting questions about the past - why was there change? why did evolution occur?

Change in geologic or archaeological time, be it evolution or extinction, does not happen to individuals - it happens to populations. All populations, including Pleistocene hominid populations, have histories: periods of success when they expand and colonize new habitats as well as periods of stress when they contract into refugia. Sometimes refuging is temporary and populations rebound. When no rebounding is possible, local extinctions follow. Research on the extinction of mammoths has shown that it is serial local extinctions that ultimately bring about the extinction of the taxon (Sher *et al.*, 1995; Soffer, 1993). The young dates for the last mammoths on Wrangel Island, where they existed until some 4,000 years ago, reveal just how slow a sequence of serial local population extinctions can be before the demise of the last representatives of the taxon occurs (Vartayan, 1998; Vartnyan *et al.*, 1993).

The young Wrangel mammoths also inform us about the relationship between refugia and lifeways. Specifically, refugia are locations which provide a species with a suitable niche - offering stable environmental conditions for its way of life - which permit populations to survive and compete successfully.

Neanderthals and archaic lifeways

Recent research on prehistoric human populations, from both the Pleistocene and the Holocene documents that pre-Neolithic populations were not stable in space or though time. Instead, from initial colonization onward, all continents witnessed settlement discontinuities including local population extinctions (Lahr, 1996, 1997). Thus, human history is comprised of multiple dispersals and regional demographic instabilities.

The Pleistocene archaeological records from the occupied Old World amply confirm this. During the Last Glacial Maximum (LGM) some 20,000 - 18,000 years ago, for example, southwestern France and the East European Plain served as refugia for European populations (Housley *et al.*, 1997; Soffer and Gamble, 1990). Likewise, both Africa and Australia saw populations contract into optimal habitats (Burzer, 1991; Lahr, 1997).

We see the same refuging phenomenon when we look at the youngest Neanderthals and the last of Middle Paleolithic lifeways. Specifically, I argue that the adaptations developed by these archaic hominids over many millennia gave them competitive advantages in very specific regions of Eurasia where they persisted until as late as some 27,000 years ago.

I underscore that in this discussion I neither assume a 1:1 relationship between this taxon and a particular technology. Nor do I assume that in the last Neanderthals we see a taxon before extinction. These are not Wrangel mammoths. These are hominids with behavioral flexibility which could allow for significant behavioral changes - for new lifeways. That is exactly what we see happening outside these refugia at such places as St. Cesaire and Arcy (Harrold, 1989; D'Errico *et al.*, 1998). Thus, rather than discussing species extinction, this chapter examines an end to a particular way of life.

1. Regional Distributions

Figure 1 plots the distribution of the last

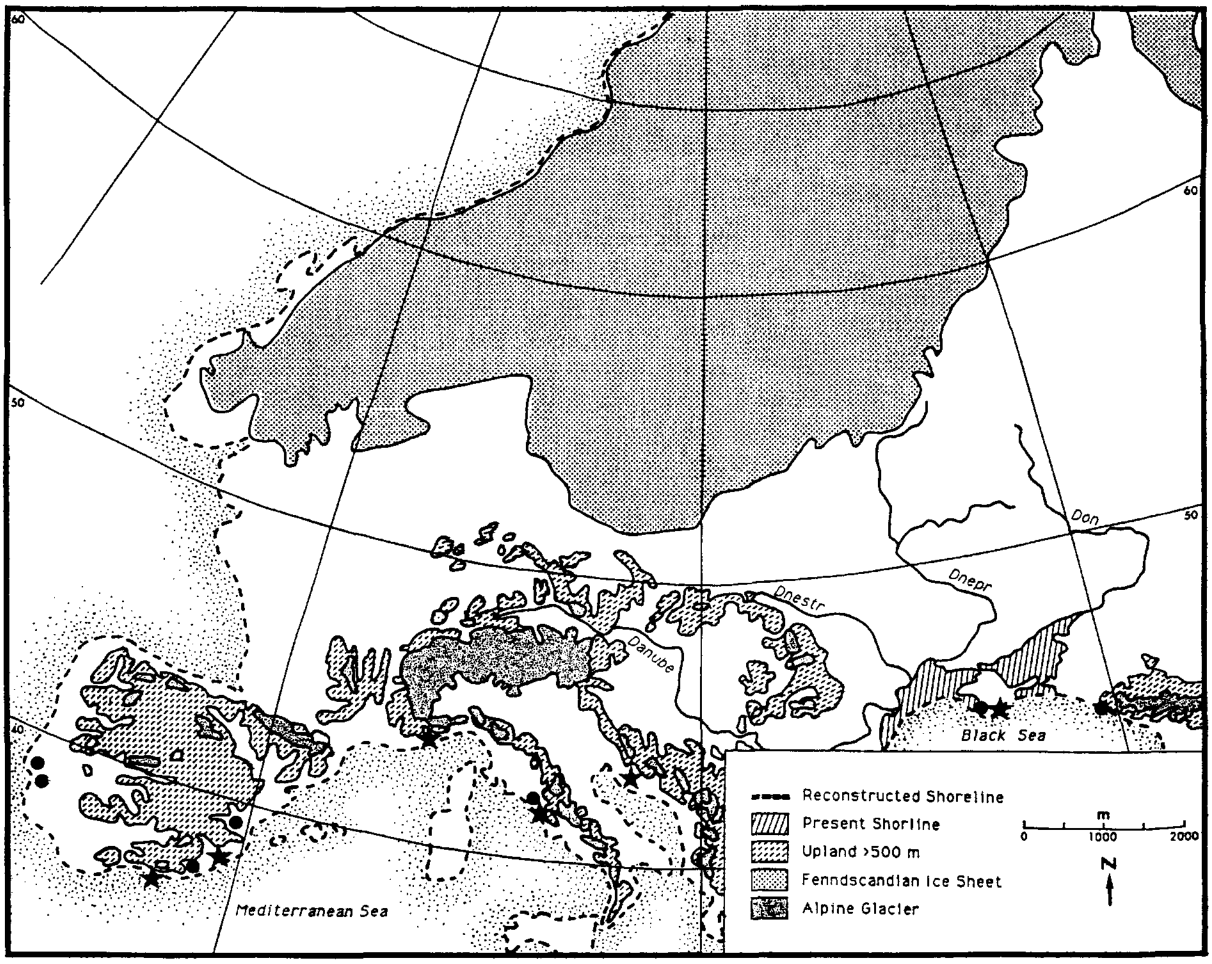

Figure 1. The distribution of the Neanderthal skeletal remains and Middle Paleolithic inventories dating < 35,000 BP in Europe. ★ hominid remains; ● archaeological remains.

chronometrically dated Neanderthal and Middle Paleolithic sites in Europe. All date between some 35,000 and 27,000 years ago. The utilized radiocarbon dates are uncalibrated - meaning that with calibrations they would date from 2 - 4,000 years older in calendar years (Van Andel, 1998 with references). Beginning in the west, they include sites along the Portuguese littoral (e.g. Gruta Nova, Figueira Brava), southern Spain, Gibraltar, and the Spanish Levant (e.g. Gorham's Cave, Zafarrya) (Barton *et al.*, in press; D'Errico *et al.*, 1998; Straus, 1997), possibly southern France (e.g. Hortus) (Wolpoff, 1996), central Italy (e.g. Grotta Breuil) (Bietti, 1997), southwestern Balkans (e.g. Vindija) (Kozlowski, 1996; Wolpoff, 1996) and Crimea (e.g. Buran-Kaya III, Kabazi II, Starosel'e) (Marks and Chabai, 1998; Pettit, in press). Similarly young ages are reported from Western Georgia (e.g. Akhshtyrskaia, Malaia Voronovitsa) (Boriskovskij, 1982, 1989; Liubin, 1993), as well as from the eastern Eurasian sites in the Altai and the Saian (e.g. Denisova and Okladnikov Caves) (Derev'anko, 1997; Kuzmin and Orlova, 1998).

The period in question falls in the second half of Oxygen Isotope Stage (OIS) 3 - a stage from some 59 - 24 ky characterized by numerous very brief sharp climatic oscillations including a well marked warm episode at about 40,000 and a cold one at 30,000 years ago in the calendar year chronology of ice and deep sea core data (Van Andel and Tsedakis, 1996, 1998). Figure 2 depicts reconstructions of biotic zones during an OIS 3 warm around 40,000 ky and a preceding cold intervals. This cold interval, although preceding the one at 30,000, can be used as its proxy. These reconstructions shows that regions occupied by late Middle Paleolithic populations were covered by nemoral vegetation - a mix of broadleaf and conifer arboreal growth which remained in these areas, although somewhat reduced in extent, throughout the cold stadials (Grichuk, 1992). Van Andel and Tzedakis' (1998) reconstructions clearly show that it is precisely these regions that served as refuges for both deciduous and coniferous species as well as for some Mediterranean evergreens. It is important to underscore that arboreal refugia existed here not only during this

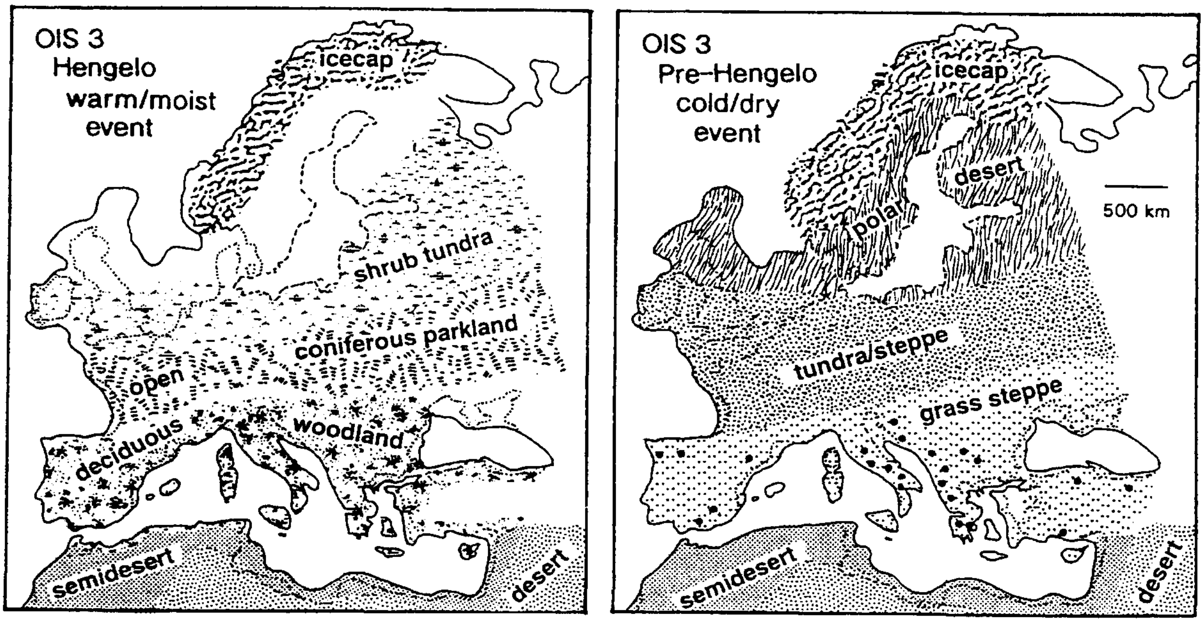

Figure 2. European paleoenvironments at OIS 3 warm/moist interstade, ca. 40 ky, and at the preceding cold/dry stade, ca. 45 ky (after Van Andel and Tsedakis 1998: fig. 6.6). ● tree refugia.

OIS but also in the next one, throughout the maximal cold and arid times of the LGM (Grichuk, 1992).

Although these illustrations focus on western and central Europe, research on Late Pleistocene Eurasian faunal communities repeatedly shows that these regions, namely southwestern France and adjacent Iberian peninsula, peninsular Italy, western Balkans, Crimea, and the western Caucasus, featured the mildest climates during the last glaciation and served as refuges for a number of relict species (Gabunia *et al.*, in press; Lordkipanidze, 1997, this volume; Markova *et al.*, 1995; Musil, 1985).

While it is tempting to correlate the distribution of the Last Neanderthals with warm Mediterranean climates - their absence from the Levant in southwestern Asia and presence in the Altai and Saian - suggests a more complex scenario. To unravel it we need to consider pertinent morphological, demographic, physiogeographic, and archaeological data.

2. Insights from Neanderthal Morphology

Neanderthals are seen as much more robust than anatomically modern humans, adapted to significantly greater physical exertion (e.g. Trinkaus, 1984; Wolpoff, 1996). Inter- populational comparisons note a greater gracility of Near Eastern Neanderthals inhabiting lower latitudes when compared to European populations in higher ones - with the more robust Neanderthals reflecting morphological adaptations to life in more stressed northern environments. Neanderthal morphology, in fact, has been characterized as "hyperpolar" - reflecting adaptations to glacial cold in highly physical ways, little relaxed by culture (Holiday, 1997; Wolpoff, 1996). This characterization is true for both male and female Neanderthals (Frayer, 1986). Recent studies of Neanderthal bone chemistry suggest that they were hyper-carnivorous (Boherens *et al.*, 1991, in press; Fizet *et al.*, 1995; Toussaint *et al.*, 1998). This, in turn, implies that to survive, like all other carnivores in northern latitudes, they needed to exploit either very large day ranges or highly diverse environments - a prediction made by Geist (1978) over 20 years ago on theoretical grounds.

3. Archaeological Data and Archaic Demography

Research on the distribution of Middle Paleolithic sites across Europe suggests regional differences in the intensity of occupation with the lower warmer provinces witnessing a continuous human presence throughout the late Pleistocene while the northern areas were not permanently occupied before the Upper Paleolithic (Gamble, 1986, 1994). These differences were not about latitude, however - but about the distribution of resources. Specifically, I have argued elsewhere that Neanderthals occupied permanently only those regions where the proximity of the plains, foothills, and mountain ranges created a number of ecotones with more complex, diverse, and productive biotic communities during both stadial and interstadial times (Soffer, 1994). Such areas featured the greatest vertical and biotic diversification - niche stacking in Steele and Gamble's (1998) terminology - and it is they that saw more continuous occupation while other more homogeneous loessic parts of Europe witnessed a pattern of sporadic and discontinuous colonization and abandonment.

The occupation record of eastern Eurasia mirrors this pattern also. The western Caucuses has numerous stratified Middle Paleolithic sites (Liubin, 1993; Lordkipanidze, 1997; Minusakas, 1992) in fact, like Crimea (Bibikov, 1971; Chabai, 1998), it has considerably more Middle than Upper Paleolithic ones. The same regionalization is in evidence in Central Asia, while the Siberian record shows multi-layered Middle Paleolithic sites clustering in the southern most diversified landscapes around the Altai and Saian ranges (Derev'anko, 1997).

In sum, data from Eurasia, suggest that the continents were not fully packed with Middle Paleolithic groups from the Atlantic to the Pacific, but that they were localized in discrete regional patches and continuously present only in regions with vertical differentiation and proximal resource diversification (Butzer, 1991; Soffer, 1994).

A regional rather than a site specific focus on faunal data from the European Middle Paleolithic sites indicates regionally circumscribed opportunistic subsistence strategies - something that Farizy (1994) has termed locational fidelity during the Middle Paleolithic rather than cultural geography evident in the Upper Paleolithic (Binford, 1987; Soffer, 1994).

This is supported by evidence for raw material procurement and use and for the utilization of space at the Middle Paleolithic sites. The lithic inventories show a redundant use of lithic raw materials regardless of their quality, suggesting a very localized and a highly mobile settlement system - something Steele and Gamble (1998) characterize as having large home ranges in relatively small core areas.

Relatively small concentrations of cultural remains which often at least partially over-lap one another, are characteristic of the known Middle Paleolithic sites and likely reflect repeated palimpsest occupations (Soffer, 1994 with references).

The small site size we see in the Middle Paleolithic, coupled with the use of local raw materials, opportunistic exploitation of biotic resources, a general absence of clear cut site types, and a regionalization of the sites, suggests the existence of small, stable, co-residential units who moved often but within very restricted geographic space.

I have argued elsewhere that these data, together with evidence for muscle hypertrophy in both sexes, an inherited pattern of dimorphic feeding ranges postulated for the sexes during the early and middle Pleistocene, and very equivocal evidence for division of labor and extensive food sharing, suggest that adult members of these small sized co-residential units all provisioned themselves (Soffer, 1994). The dimorphism between the sexes in feeding behavior documented for a number of primate species, including human foragers, further implies that Neanderthal females and their young likely had more restricted day ranges than did the males.

4. Neanderthal Niches

I have previously argued that the structure of the resource base in northern environments in Eurasia presented hominids with a set of specific problems solved one way by the Neanderthals and another by early anatomically modern humans (Soffer, 1994). The latitudinal increase in the patchiness and unpredictability of the food resources - their season-specific availability - as well a decrease in vegetal resources, confronted human omnivores with the need to exploit much larger territories than in lower latitudes. The Neanderthal solution may have been hypercarnivory. Ecological realities in these territories made animal resources more predictable, yet the hypercarnivory apparently adopted by Neanderthals, exacerbated the need for even greater territories. The structural need for carnivores to exploit huge territories and be residentially highly mobile, would have been extraordinarily stressful to the females, especially pregnant and lactating ones, as well as to the young. It is not surprising, therefore, that Neanderthal solution was to permanently occupy those regions with stacked niches where female day ranges could be minimized. The physiogeographic realities of Eurasia relegated these to just some areas of the continent.

Neanderthal refugia

These insights help us understand the demographic clustering and patchy distribution of the last Neanderthals (fig. 1). A cursory look at their loci shows them in their optimal niches, which in the terminology of evolutionary biology can be termed refugia - places where their adaptations were successful and permitted them, for a time, to continue traditional ways of life.

Using insights from evolutionary biology, Lahr

(1997) has recently pointed out that population refuges can take one of two forms: either geographic refugia which new groups do not reach because of insurmountable geographical barriers, or they can be ecological refugia - where relict populations with well honed adaptations occupy stable niches and remain competitive. D'Errico and colleagues (1998) have recently hypothesized that late Middle Paleolithic lifeways persisted south of the Erbo in Iberia because the specific evironments there - namely more wooded landscapes. While agreeing with them that specific environments were indeed more favorable for Middle Paleolithic lifeways, I argue here that these lifeways persisted in these refugia for so long not because of arboreal vegetation, but because of the highly specific ways in which archaic hominids exploited the Eurasian environments.

Since by some 25,000 years ago we have no Middle Paleolithic sites left in Eurasia, apparently this time there was no rebound for this adaptive strategy and it went extinct.

Discussion, conclusions, implications

The existence of these refugia partially support hypotheses that the distribution of Neanderthals was environmentally determined (e.g. Butzer, 1991; Stringer and Gamble, 1993). The support is partial because of the disjunction between anatomy and culture - the fact that we find Neanderthals with Upper Paleolithic inventories and the reverse. Furthermore, parts of Eurasia show changes in adaptations deep in the Middle Paleolithic. Thus, for example, Stiner (1994) and Kuhn (1995) document changes in subsistence practices and raw material exploitation in Lantium at some 55,000 B.P., well before any other humans are present on the continent. Data from the East European Plain, on the other hand, show the probably coterminous presence of two distinct adaptations systems during the Early Upper Paleolithic - one more Middle Paleolithic and the other more Upper Paleolithic in nature (Soffer, 1989). These data suggest that we are not dealing with innate differences in the capacity for particular behavior between the Neanderthals and their successors, but rather just with the habitual practice of that behavior - a practice which may have begun in the late Middle but became entrenched in the Upper Paleolithic.

What became extinct, then, is not necessarily a taxon but a good part of its behavioral repertoire. How this occurred is hotly debated, but the multivocality of the record suggests multiplex causes.

The last Neanderthals offer a number of insights for both our understanding of what happened to them in the different regions in particular as well as for our understanding of the behavior and the distribution of their predecessors.

First, I suggest that we need to embrace evolutionary biology and focus on the distribution of populations through time and space. Such distributions tell us not only about climate, but about behavioral repertoires of taxons and the degree of their plasticity.

Second, when looking at the histories of populations, we clearly need to remember that populations do not consist of identical clones, but of different age and sex groups who bear different energetic costs throughout their life cycles. Since all populations contain such disparate constituencies, they will all incorporate this diversity in need in their adaptive practices and structure their ways of life to satisfy them.

Finally, since this record indicates that the last Neanderthals appear to be associated with mixed woodland rather than with open cold environments, it raises questions about the "hyperpolarity" of their morphology. Precursors of distinctive Neanderthal morphology appears to be present on the Iberian peninsula by some 300,000 years ago (e.g. Atapuerca). It persists and intensifies through the last interglacial. It is present in the Levant where conditions at all times were far from glacial and where Neanderthals lived long enough to lose all "hyperpolar" traits. All this raises issues about the appropriateness of using exclusively Eskimo analogies for the deciphering Neanderthal morphology.

Answers to why the Neanderthals looked the way they did and lived where they lived are to be found in Darwinian insights that consider both natural and sexual selection, and thus couple not only climate, but more importantly, behavior with morphology - and that behavior is revealed through population demographies.

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ACHEULEAN OF THE CAUCASUS
(aspects of chronology, paleoecology and adaptation)

V.P. Lioubine

1. To date in the Caucasus there were discovered six stratified Acheulean cave sites (Azykh, Kudaro I, Kudaro III, Tsona, Akhshtyr, Treugol'naya) and a large number of open air occurences. The earliest stages of Acheulean have not been ascertained there yet. The mentioned sites and Dmanisi are divided with interval about 1,0 Myr. The present data on absolute age (TL and ESR dates around 500-600 Kyr BP for the lowermost Acheulean layers in the cave sites of Kudaro III and Treugol'naya) and biostratigraphy suggests that the earliest Acheulean levels may be assigned to the second part of Cromerian.

2. The Acheulean period in the Caucasus is characterized by repeated and considerable changes of natural circumstances. To judge by the pollen data during Acheulean occupation of the Azykh cave five alterations of climate happened, in Kudaro I there were seven and in Kudaro III, at least, ten such oscillations. Environments changed from subtropical conditions to subalpine ones.

3. Compared with the southern areas and, in particular, the Levant where the origins of the Caucasus Acheulean are thought to be placed the Pleistocene natural stresses in the Caucasian mountain region were much stronger and more contrasting. This was reflected in certain peculiarities of adaptive behavior manifested by Acheulean hominides in this area. They are as follows :

1. Much earlier, than in Levant, occupation of caves resulted probably from deterioration of climate (pollen data from Azykh, Kudaro III and Treugol'naya).
2. Sufficiently frequent using of fire. At Azykh where the sediments did not suffered from erosion the hearthes and ashy streaks remained within five Acheulean levels and the largest streak is almost 10 sq.m in area and 0,26 m in thickness. Traces of former hearth were observed also in the Bed 5 of Kudaro III and in two levels of both Kudaro I and III the clusters of small charcoal pieces have been found by the use of microscopic analysis of pollen samples.
3. Certain inter-regional migrations of population influenced likely by changes of glacial climatic conditions (for example, the late Acheulean is not presented in the cave sites).
4. Owing to wide spectrum of altitudinal belts and their nearness resulting in mosaic landscape there was a possibility to hunt animals of different biotopes. Owerall list of the game mammals whose remains have been found in the Acheulean levels of the caves contains more than 40 species. Changes of their composition and quantity of remaines appeared aves of Kudaro I and Kudaro III there was fishing that may be regarded as one of the most interesting examples of adaptation to local natural resources. 6. Technological and typological characteristics of the Acheulean wich existed in different parts of the Caucasus reflect both local tradition and adaptation to different kinds of raw material. Industries to different kinds of raw material.

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ARCHAIC ELEMENTS IN ACHEULEAN OF THE CAUCASUS

V.P. Lioubine, E.V. Beliaeva

1. Spatial distribution of Acheulean sites and especially of those with numerous bifaces in the Caucasus undicates that Acheulean people started to occupy the Caucasus isthmus from the South, i.e. from the Transcaucasian volcanic upland. There there is a considerable number of open air occurences situated often at an altitude of 1500-2500 m (Satani-Dar, Djraber, Areguni-Blur. Chikiani, Persati etc). Some of them contain a number of sufficiently archaic tool forms.

2. Presence there of this kind of sites suggests that the early period of the Acheulean settlement in the Caucasus appeared to coinside with some warm phase of Pleistocene. Since the lowermost levels of Acheulean cave sites occupied most likely later are assigned to the upper part of Cromerian (TL and ESR dates around 600 Kyr BP, pollen and faunal data) it is pemissible to assume that the initial arrival of Acheuleans to the Caucasus might take place as early as during one of the earlier warm phase of Cromerian.

3. As the most archaic elements of the Caucasian Acheulean on may regard a few thick, roughly fachioned, rounded and weathered bifaces which have been found at the open air occurences of Satani-Dar and Chikiani (Transcaucasian upland), Yashtukh (Black Sea-side) and Ignatenkov Kutok (North Caucasus, the Kuban river basin). In particular, the finds from the latter, according to S.N. Zamiatnin, M.Z. Panichkina and N.D. Praslov, were associated originally with the pebble bed where there were also such faunal remains as Elephas meridionalis, Rhinoceros etruscus, Equus stenonis etc. This may be treated as traces of some early Acheulean industries penetrating the North Caucasus.

4. As to the Acheulean cave sites the most archaic lithic assemblage appears to be presented by a number of rounded artifacts found in the Bed VI of the Azykh cave (rough bifaces, choppers, cleaver-like tools, heavy duty scrapers etc.).

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THOUGHTS ON ROUTES OF SETTLING THE CAUCASUS IN LOWER PALEOLITHIC

S.A. KULAKOV

1. Recently, ecpecially after publication of the extremely important materials from the Dmanisi site there is increase of special interest to such problems as initial occupation of the Caucasus and the South of Russia as well as genesis of the regional Paleolithic industries. In my opinion, these questions need to be discussed with more extensive use of data obtained from the comprehensive morphological, technological and use-wear analyses of lithic industries.

2. Results of my researches into lithic collections from several Lower Paleolithic workshops (Djraber, Fontan, Kendarasy (Armenia), Bogos (the Sochi Black sea-side), Abadzekhskoye (North Caucasus) permit to conclude that the studied knapping technologies were very similar as to blank types, techniques of preparing and reduction of cores etc. It may indicate to similar levels of technological development and, probably, near ages of the sites. At the same time, their tool assemblages are quite different that suggests different origins of these industries. The industry of Abadzekhskoe seems to belong to the East-European Micoquian tradition. All the Armenian assemblages dominated by bifaces have analogies in Acheulean occurences of Western Asia and Near East. The Bogos industry was assigned to peculiar variant of Tayacian located in the Black sea-side and may be regarded as binding link between the local Denticulate industries of Middle Paleolithic and Acheulean of so-called "the Ubeidiya-Latamne tradition" (after I.I.Korobkov).

3. So, detailed investigation into both technological and morphological features of certain Lower Paleolithic industries appeared to confirm both present hypotheses concerning the routes of early human migrations to the Caucasus. The characters of the considered Armenian industries and those of the Bogos industry are in accordance with assumption about two main stof early human movements from Near East to the Caucasus (V.P.Lioubine). The assemblage of Abadzekhskoye semms to be an evidence in support of opinion that the North Caucasus was initially occupied by Acheulean people from Europe (L.V.Golovanova).

STRATIGRAPHY, PALEOECOLOGY AND EVOLUTION OF LOESSIC PALAEOLITHIC INDUSTRIES IN SOUTHERN TADJIKISTAN

V.A. Ranov, P.M. Sosin, J. Schafer

In this year the quarter of centure have passed since begining of loessic palaeolithic studies. We can dividing this period to two parts. The first one when loess-palesoils stratigraphy was based on the series termoluminescentes dates obtained by V.I. Shelkoplas (Dodonov, 1986). The second one begin in 1994 when group of western schoolars proposed the correlation of loess-palesoils formation with OXY climatical stages. Now there are in the region mentioned above two stratigraphical schemes which are quite different for the chronology : the dates for palaeolithic sites in last one are in two or three times bigger as Schelkopljas' chronology.

From 1994 a new studies of palecology was beginning and in the place of main division on the loess, "baby soil", soil of climatical optimum and illuvial horizon-loess, the more detrailed division of paleosoils is coming. This take the possibility for new palecological reconstractions. The palaeolithic finds in loess-palesoils formation in South Tadjikistan is unique in the World. Now with exception of 9 and 10 palesoils there are the uninterrupted palaeolithic finds from 1 to 12 palesoils i.e. during 800 th. years. The loessic palaeolithic industries in Southern Tadjikistan yielded the local evolution techno-typological assemblages – the Lower Palaeolithic pebble-tools karatau culture in 12-4 palesoils and Middle Palaeolithic in palesoils 3-1. It is possible that appearence of Middle Palaeolithic industries was tied with the western migration.

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THE APPEARANCE OF MAN IN IRAN

Jalal Rafifar

Scattered nomadic bands of Paleolithic people must have reached Iran in search of food and shelter about one million years ago. These bands must have ground the environmental conditions favorable and by ca. 200,000 years ago had spread into Western, northeastern, and southeastern Iran.

Scant pieces of chopped stones is the only evidence to date of the presence of the Paleolithic man in Iran; therefore, the species of these early inhabitants of Iran is unknown, though it is warranted to attribute this stone industry to *Homo erectus*.

Archeological evidence for the middle Paleolithic Period (between ca. 100.000-35000 years ago) is richer and the skeletons found with the chipped industry of this period belong to the Neanderthal Species Except for a few scattered sites in the central plateau and northwestern Iran, the mid altitude of the Zagros mountains in western Iran with suitable environment seems to have Been the most populated region in this period.

Unlike their contemporary Neanderthal communities in the Levant, who lived both in caves and open sites, the Zagros groups lived only in caves; this, of course, can be the accident of discovery. Warwasi, khar, Bistun, and Yafteh are among the most famous caves in Zagros piedmont in western Iran where the Neanderthal flourished. From shanider cave in the northern Zagros, there seems to be evidence of burial customs and rites.

As in Europe and the Levant, the processes that led to the displacement of the Neanderthal by the *homo sapiens* are not well understood. But we do know that by the upper Paleolithic period (ca. 35009-18000 years ago), the Neanderthal disappeared in Iran and was replaced by the homo sapiens. The following Mesolithic. Period (18000-10000 B.C) witnessed The retrieval of the last Ice Age glaciers. The gradual increase in the temperatures and the development of mild climate in the northern hemisphere had attending environmental and demographic consequences that forever changed the course of human history.

THE GESHER BENOT YA'AQOV ACHEULIAN SITE - ADDITIONAL EVIDENCE FOR THE "OUT OF AFRICA" BEHAVIORAL MODEL

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The renewed multidisciplinary research on the waterlogged Gesher Benot Ya'aqov Acheulian site has yielded a wealth of data contributing much to the understanding of hominid complex behavior and subsistence strategies in southwestern Asia.

Starting in 1989, a series of previously unknown exposures of the Benot Ya'aqov Formation has been investigated in seven field seasons which took place south of locations of previous archaeological activities. Field work in the study area revealed a 34 m long sequence of lake margin and fluvial deposits of the paleo-Lake Hula. The strata at the GBY site include a diversity of lithofacies, and are strongly cyclical; most of the rich archaeological and paleontological rich finds have been found within the beach facies.A paleomagnetic study of the sediments has shown that it consists of a reversed polarity zone at the base of the sequence overlain by a normal polarity zone. The boundary between the zones is assigned to the Matuyama/Brunhes boundary, dated at 780 ka, and the duration of the sequence is estimated to be in the order of 100-150 kyr.

The archaeological data comprise lithic, paleontological and palaeobotanical assemblages. All of the seven archaeological sites excavated are assigned to the Acheulian Industrial Complex. The lithic assemblages are characterized by a single mode of raw material exploitation which makes use of three types of raw material: basalt, flint and limestone. Repetitively the basalt is mainly used for the modification of bifaces, limestone for that of chopping-tools and flint for flakes and flake tools. The blanks for bifacial tool modification (handaxes and cleavers) are mostly shaped on large flakes which have been obtained by different methods, including among others the Kombewa and prepared core techniques. The end-products (the bifacial morphotypes) are extremely similar to one another regardless of the production techniques, demonstrating both the depth of planning and the foresight abilities of the Early/Middle Pleistocene hominids. The earliest Levantine appearance of the Levallois and the soft hammer techniques are also documented at the Gesher Benot Ya'aqov site.

The typological composition, the raw material preferences and the techniques employed for the production of the bifacial tools and the stylistic characteristics of their shaping are of distinct African affinities. Despite the variability (functional?) encountered in the different archaeological horizons, the same African features continue throughout the sequence and all differ drastically from those encountered at the earlier Acheulian site of Ubeidiya. Due to this cultural difference, the Gesher Benot Ya'aqov cultural sequence is viewed as evidence of a distinct and separate episode of the "Out of Africa" phenomenon. It is considered a distinct wave in a probable sequence of which only the sites of Ubeidiya and Gesher Benot Ya'aqov are presently known. A variety of large and small mammal remains and abundant paleobotanical finds in the form of wood, bark seeds and fruits (over 100 taxa presently defined), as well as a wealth of other data originating from the multidisciplinary studies, indicate that the paleoenvironment of the paleo-Lake Hula provided optimal conditions for the Early/Middle Pleistocene hominids. These enabled a repetitive pattern of hominid occupations along the shores of the lakes situated in the Dead Sea Rift, the northern sector of the African Rift Valley, and a corridor leading to Eurasia.

NEANDERTHAL PEOPLE AT THE GATES OF EUROPE

Takeru Akazawa, Sultan Muhesen, Hajime Ishida, and Osamu Kondo

In 1997, a joint Syria-Japan project discovered the skull of a Neanderthal child in the Dederiyeh Cave in northern Syria. Although the skeletons of other several Neanderthals had previously discovered in the cave, this is the first discovery made in Syria that enables paleoanthropologists to reconstruct the face of a Neanderthal child. Dederiyeh Cave is about 400 km N of Damascus and 60 km NW of Aleppo, Syria. The cave at an elevation of 450 m above sea level, lies on the left bank of Wadi Dederiyeh which crosses the western slope of Jabal Samaan, the east boundary of Afrin Valley in the northern extremity of the Dead Sea Rift. Excavation has been under way in the cave since 1989; in 1993, the mostly complete skeleton of a two-year-old child was discovered. Other discoveries include thousands of Middle Paleolithic flints and the bones of fossilized remains of animals such as Ovis/Capra, Gazella, Equus, Sus, Rhinoceros, as well as petrified Celtis (hackberries). Many fire rings measuring 30-40 cm in diameter were also found. The Dederiyeh Cave has thus produced new data on the stratigraphic association between Neanderthals and the Middle Paleolithic industry in the Levant, and on the distribution of the stratigraphic association between Neanderthals and the Middle Paleolithic in the northern extremity of the Dead Sea Rift.

HUMAN FOSSIL REMAINS FROM THE GRAN DOLINA LOWER PLEISTOCENE SITE (SIERRA DE ATAPUERCA, SPAIN)

José María Bermúdez de Castro, Antonio Rosas, Jan van der Made & Jesús Rodriguez

The Gran Dolina (TD) Lower Pleistocene site in the Sierra de Atapuerca (Burgos, Spain) has provided clear evidences to demonstrate the presence of hominids in Western Europe more than 780,000 years ago (Carbonell *et al.*, 1995). Thus, the hypothesis that a settlement of Europe took place less than 500,000 years ago (Roebroeks & van Kolfschoten, 1994) is rejected.

The 18 meter section of the TD karst filling can be divided into 11 lithological levels, numbered from bottom to top. Excavation of a 6 m square meters planar section in the TD site was begun in 1993. During the 1994 season, excavation had reached level 6 and one of the TD6 strata, the so-called Aurora stratum, yielded a rich faunal and lithic assemblage. The top of the Aurora stratum is about one meter below the Matuyama/Brunhes boundary (Parés & Pérez-González, 1995). Excavation of the Aurora stratum finished in 1996, and a total of 85 human fossil remains have been identified. The TD6 human hypodigm includes numerous postcranial remains representing different skeletal parts, as well as some facial, neurocranial, mandibular, and dental specimens. Based on dental evidence, a minimum of six individuals have been identified in this human assemblage.

Because of the presence in the current TD6 human hypodigm of an unique combination of cranial, dental, and mandibular traits we have named a new Homo species, *H. antecessor* , to include these human fossil remains (Bermúdez de Castro *et al.*, 1997). We contend that the new species represents the last common ancestor of the Neandertals and modern humans. That is, *H. antecessor* is the origin of two evolutionary lines, one of them exclusively European and formed by two chronospecies, *H. heidelbergensis* and *H. neanderthalensis,* whereas the other led to *H. sapiens*, probably in the African continent.

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FAUNA AND PALAEOECOLOGY OF GRAN DOLINA-TD6 (SIERRA DE ATAPUERCA, SPAIN)

Jesús Rodriguez, Jan van der Made, Antonio Rosas & José María Bermúdez de Castro

The Sierra de Atapuerca is a low limestone range situated in central northern Spain, 15 Km east of Burgos city. Several karst cavities in the range are filled with Pleistocene sediments. Gran Dolina, one of these deposits, contains over 18 m of sediments, which can be divided into 11 lithostratigraphic levels named TD1-TD11, from bottom to top. A paleomagnetic reversal has been detected within the TD7 level of Gran Dolina (Parés & Pérez González, 1995) indicating a late Early Pleistocene age for for TD1 to TD6 levels, and a Middle Pleistocene age for the upper levels. TD6 includes the Aurora stratum, where several stone tools and Homo antecessor remains were found (Carbonell *et al.*, 1995). The ungulate fauna from TD6 includes *Stephanorhinus etruscus*, a stenonine *Equus*, *Sus scrofa*, *Dama dama vallonetensis*, *Cervus elaphus*, *Megaloceros* and *sp*, *Bison sp*. This fauna is in agreement with a late early Pleistocene Age for this level. The microfauna from TDW4 and TDW4b is characteristic of the Biharian (Cuenca *et al.*, 1995).

The paleoecology of the lower levels of Gran Dolina has been studied using ecological diversity analysis (Andrews *et al.*, 1979). A data set of 92 recent mammalian faunas is used for comparison. The 5 assemblages studied (TDW4, TDW4b, TD6inf, TD6Au and TD8) share some characteristics that set them apart from all the recent communities analysed, namely a high proportion of large herbivores combined with the absence of arboreal and climbing mammals, and a low number of small carnivores. The abundance of large herbivores and the absence of arboreal mammals are considered unique features of the Pleistocene communities. The community structure of TD6inf, TD6Au, and TD8 resembles that of the recent European forest communities, however TDW4 and TDW4b have a community structure different from any recent community from the holartic region.

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THE MACROVERTEBRATE ASSEMBLAGES FROM THE LOWER PLEISTOCENE SITES AT VENTA MICENA AND FUENTE NUEVA-3 (ORCE, SPAIN): FAUNAL COMPARISON WITH DMANISI (EAST GEORGIA) AND OTHER EUROPEAN SITES

Bienvenido Martínez-Navarro, Paul Palmqvist & Alfonso Arribas

The comparative systematic study of those species of large mammals preserved in the Lower Pleistocene sites at Venta Micena and Fuente Nueva-3 (Orce, Guadix-Baza Basin, Southeastern Spain) has revealed a faunal assemblage which is clearly different to those of typical European Villafranchian and Galerian faunas.

The faunal composition of this assemblage includes a small number of European species of large mammals of Villafranchian age, such as *Mammuthus meridionalis, Stephanorhinus etruscus* and *Ursus etruscus*. However, most species were originated in Asia, especially in the case of ruminants (*Bos (cf. Dmanisibos) sp.*, Bovini gen. et sp. indet., *Praeovibos sp., Soergelia minor, Hemitragus alba,* Caprini gen. et sp. indet., *Megaloceros (Megaceroides) solilhacus* (*Eucladoceros giulii* in Kahlke, 1997), and Cervidae gen. et sp. indet.), and several others are immigrants to Europe from Africa (v.g., *Megantereon whitei, Pachycrocuta brevirostris,* and *Hippopotamus antiquus*). The origin of a few species, like *Equus altidens* or *Homotherium latidens*, has not been yet determined. The large canids (*Canis (Xenocyon) falconeri* and *Canis etruscus*) are evolved forms of their typical representatives from the Italian Villafranchian Units of Olivola and Valdarno.

The faunal composition of the macrovertebrate assemblages from the Orce sites is very similar to that of Dmanisi and also resembles that of Apollonia (Macedonia, Greece), Pirro Nord (Italy) and Untermassfeld (Germany). Taken all together, these assemblages allow to identify a biostratigraphical time interval placed between the last Villafranchian and the first Galerian, of which the most significant species would be *Megantereon whitei* and *Soergelia.* This biostratigraphic level is also related with the first arrival of the genus *Homo* in Europe (Martínez-Navarro & Palmqvist, 1995, 1996; Martínez-Navarro *et al.*, 1997).

The comparative study of the taphonomic relationships between Venta Micena, Dmanisi and Apollonia (all of them open-air stratified deposits) is promising, due to the important role played by scavenger carnivores in the bone-collecting process at these three sites. Until the present moment, only Venta Micena in Europe has been described as resulting from the accumulation of bones around the dens of the large, short faced hyaenid *Pachycrocuta brevirostris* (Palmqvist *et al.*, 1996; Arribas & Palmqvist, 1998); however, the evidence recently collected in Apollonia and Dmanisi suggests that bone-cracking activities of scavenger carnivores are at least as important, or even more, as in Venta Micena. The results of the behavior on bones of carrion-eaters in these three sites is evidenced in those anatomical regions of long bones which were preserved (v.g., the abundance of epiphyses is probably related to their structural density and the frequency of long bones which were preserved complete seems to be related with their marrow content) and specially in the craniodental remains, as deduced from the abundance of isolated maxillae with both tooth rows, which show a high density of gnawing marks, and craneal vaults of ruminants which preserve the base of horn. The systematic excavation made in Dmanisi will presumably allow to conduct detailed taphonomical and paleoecological studies in relation with the activities and competence between hominids and hyaenids during Lower Pleistocene times in Eurasia.

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THE LITHIC ARTEFACTS OF THE LOWER PLEISTOCENE SITE AT FUENTE NUEVA-3 (ORCE, GRANADA, SPAIN)

Alain Turq and Bienvenido Martínez-Navarro

About a hundred lithic artefacts, found in two of the three archaeological levels of Fuente Nueva III, give unquestionable evidence of human occupation in the Orce region during the lower Pleistocene. The faunal assemblage of micro and macromammals and the paleomagnetic data reveals that this site is located in the reverse chron 1r.2r, below the Jaramillo normal event (chron 1r.1n). The association of these artefacts and the fauna in a sedimentary envinronment excluding any risk of reworking, and a remarkable state of freshness of the lithic pieces, guarantee the homogeneity of the lithic assemblages. The use of local alluvial flint pebbles allow the production of blanks from a preferential debitage surface. Very rare flakes are retouched and some are used unretouched or turned into 'pièces esquillées'.

The complete absence of soft hammer use and of biface debris, seem to exclude the attribution to the Acheulean (Martínez-Navarro *et al.*, 1997), which is really no evidence in Spain before 400.000 years.

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ERAUL 92, 2000, p. 169.

THE ORIGIN OF HUMAN POPULATION IN THE ITALIAN PENINSULA

Carlo Peretto, Sarah Milliken

On the basis of recent research, the oldest population of Italy can be dated to a period older that 1 million years ago. Among the most important sites, that of Ca' Belvedere di Monte Poggiolo stands out. The multidisciplinary study of the site and the palaeomagnetic and absolute dates indicate an age of slightly more than 1 million years. The industry is characterised by flaked pebbles (cores) and a large quantity of flakes, many of which refit together.

The presence of a simple and opportunistic technology seems to be a common characteristic in other Italian sites which date to the same period or to slightly more recent phases; these sites are found all over the country, and in particular in those regions where most fieldwork has been carried out, such as in Tuscany, Lazio and Emilia-Romagna. The first population of the Italian peninsula therefore seems to have been a consistent and widespread phenomenon, rather than occasional and sporadic. The simple lithic technology was aimed at the production of a large number of artifacts with cutting edges (flakes) which were used in daily subsistence activities, as is demonstrated by the traces of use wear found on their surfaces. The presence of retouched artifacts, on the other hand, is minimal, and there is no suggestion that they were intentionally produced.

This first phase of the human population of the Italian peninsula was followed by the spread of Acheulean industries from about 700,000 years ago onwards; these industries include not only handaxes but also a wide range of retouched tool with specific morphologies and more articulated production techniques. There is no proof for an in situ 'evolution' from the oldest industries to the Acheulean ones, and we suggest that the two distinct phases (the with core and flake industries and the second with handaxes) may represent two different migrations by different hominids.

This chronological sequence, which bears a general resemblance to that in Africa, is decidedly more recent compared with the latter. Various hypotheses can be proposed to explain this chronological difference, though we suggest that it is only by developing the research and in particular the dating of the European sites that we will be able to resolve this problem.

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