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CUEVA NEGRA DEL ESTRECHO DEL RÍO QUÍPAR (MURCIA, SOUTHEAST SPAIN): AN ACHEULIAN AND LEVALLOISO-MOUSTEROID ASSEMBLAGE OF PALEOLITHIC ARTIFACTS EXCAVATED IN A MIDDLE PLEISTOCENE FAUNAL CONTEXT WITH HOMININ SKELETAL REMAINS

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Abstract

Cueva Negra del Estrecho del Río Quípar (Black Cave of the River Quípar Gorge) has been the object of systematic excavation annually since 1990. Early finds of six teeth and two bones comparable to Neanderthal forms are most likely those of a Neanderthal forerunner, or "Pre-Neanderthal", such as European *H. heidelbergensis*. The sedimentary fill of the rockshelter has been found to cover bedrock at a depth of 5 m in a test pit of 1m^2. Over an area of 12 m^2 a depth of between 2 m and 2.5 m has been excavated so far. Latterly, well-preserved, fresh paleontological and Paleolithic remains in a sealed stratigraphical deposit, almost 2 m down, demonstrate contemporaneity between a late Cromerian fauna and an Acheulo-Levalloiso-Mousteroid assemblage that includes both a bifacial component, notably a limestone Acheulian hand-axe, and also small Levalloisian chert flakes. Elsewhere in the site, chert and limestone flakes and fragments with abrupt Mousterian-like edge-retouch have been excavated, as well as informal artifacts, and surface finds of chert and limestone discoidal cores have been made. Small mammals identified include arvicolid rodents (voles), namely, *Allophaiomys chalinei*, *Mimomys savini*, *Arvicola* cf. *deucalion*, and *Pliomys episcopalis*, all of which had become extinct by mid-Middle Pleistocene times in western Europe, as well as two other descendants of *Allophaiomys*, namely, *Microtus brecciensis brecciensis* and *Terricola (Pitymys) huescarensis huescarensis*. Other extinct rodents include the hamster, *Allocricetus bursae*, and the wood mouse, *Apodemus flavicollis,* cf. *A.* aff. *mystacinus* (rock mouse). Lagomorphs include the pika, *Prolagus calpensis*, as well as *Lepus* and *Oryctolagus*, and among the insectivores there is the hedgehog, *Erinaceus*, and an indeterminate soricid (shrew). Extinct large mammals include *Stephanorhinus* (*Dicerorhinus*) *hemitoechus*, a very large cervid, probably *Megaloceros* (*Megaceros*) *giganteus*, *Bison* sp. and *Macaca* cf. *sylvanus* (the last three taxa lingered on into the earlier Upper Pleistocene in Spain), as well as an indeterminate elephantid mandibular ramus fragment. There are several examples of large mammalian genera that are represented in Spain today, over sixty species of birds, and abundant tortoise remains. It should be remarked that the arvicolid rodents are well distributed both horizontally and vertically throughout the upper 2–2.5 m of sedimentary depth that have been extensively excavated in compact beige sediment (litharenite), which is extremely hard due to impregnation with calcium carbonate and was covered only by a thin layer of very loose, dark soil containing evidence of human activity in recent decades. There are no deposits corresponding to the Holocene, Upper Pleistocene or late Middle Pleistocene. The beige sediment accumulated during the earlier Middle Pleistocene, when swamps on the Quípar flood-plain must have invaded the rock-shelter sporadically. There were then several lakes in the valley that were a haven for wildlife and water-fowl, and pollen analysis of the beige sediment also demonstrates humid surroundings. Subsequent fluviatile erosion in the valley did not impinge on the sediment accumulated in the rock-shelter because the hillside in which it lies was lifted up by late Quaternary tectonic activity. Middle Pleistocene lakes nearby had pebble shores (to which surviving conglomerate outcrops testify) from which cobbles, mostly of chert and limestone, were taken to the cave and broken apart, though some chert seems to have come from as far away as 30 km, and may well have been sought after because local chert tends to shatter (to which a high frequency of informal tools is testimony). Nevertheless, Paleolithic versatility at the site was such as to be able to get around the difficulties sometimes, and even to embrace the very different core-reduction sequences of bifacial flaking to form an Acheulian hand-axe on a core and the Levalloisian technique of core-preparation for removal of flakes of desired shape, in some cases for subsequent edge-retouch, including abrupt Mousterian-like edge-retouch. This draws attention to the capacity for both dexterity and perception on the part of *H. heidelbergensis* in Spain 0.5 m.y.a. (0.5 million years ago), including ability to use alternative techniques to reduce stone blanks, with a resulting variety of Acheulo-Levalloiso-Mousteroid Paleolithic forms. The article considers aspects of micromammalian biochronology at the site; site-formation and site-use at Cueva Negra in the context of the Middle Pleistocene Quípar valley and available natural resources; revision of the antiquity of the site; procurement of stone and production of a variety of artifacts at the site; and a discussion of its significance in the context of modern reassessment of the significance of early Paleolithic variation in western Europe and elsewhere during the Middle Pleistocene. (Because the hominin skeletal remains have been described elsewhere, in the interest of brevity they will be mentioned here only in passing.)

INTRODUCTION

Cueva Negra del Estrecho del Río Quípar is a large north-facing rock-shelter at 780 m above sea level and 40 m above the River Quípar where it flows northwards out of a gorge in the Murcian uplands of southeastern Spain (Fig. 1:1, Fig. 2). The Quípar joins the River Segura which drains into the Mediterranean Sea. The sedimentary fill of the cave underwent cursory exploration in 1981 (Martínez Andreu *et al.*, 1989). In 1990 systematic excavation was begun and has been carried out annually ever since (Walker, 2001; Walker, Gibert, *et al.*, 2004; Walker, Gibert Clols, *et al.*, 2004). In a one meter square test pit (Fig. 1:3) we have found there to be a depth of 5 m of indurated Pleistocene sediment lying on bed-rock inside the cave, though natural erosion of the terrace outside reveals sediment lying on bed rock at 8 m below the highest point of the sediment within. Over an area of 12 m^2 a depth of between 2–2.5 m has been excavated to date, and also a roughly similar area has been excavated to a much lesser depth, of barely 1.5 m (Fig. 1:4; Fig. 3: 1–3).

A variable layer of loose, dark-gray soil (unit I), with tell-tale signs of twentieth-century disturbance, covered the Pleistocene sediment in the cave and filled several pits that had been dug into it at about the time of the Spanish Civil War of 1936–39; we photographed marks left by pick axes that were used to dig out the pits in the indurated Pleistocene sediment, the cemented hardness of which precluded contamination of the sediment by material in the pits. No layers with Upper Paleolithic or later prehistoric finds intervene between that superficial dark-gray soil and the immediately underlying, horizontally-bedded, indurated Middle Pleistocene sediment, which is beige, yellow, or orange in color (7.5YR7/4–

Fig. 1. Cueva Negra del Estrecho del Río Quípar: 1 – Cueva Negra with the Río Quípar in the foreground below it; 2 – Jean-Luc Schwenninger investigating the Cueva Negra sedimentary fill for optical sediment luminescence dating in 2005; 3 – test pit (meter-square C2a) when bedrock was reached in 2004; 4 – area under excavation in 2003, which includes that drawn in Fig. 10

7.5YR7/6), indicating long interludes of dry, oxidizing conditions (ephemeral red lenses in it hint at sporadical lateritic development). Retraction fissures that penetrate deep in the sediment suggest dry, cold episodes (perhaps during the Upper Pleistocene, long after the sediment had formed). Dry conditions prevailing inside the rock-shelter were fundamental to its repeated use by Paleolithic visitors and no level has been excavated that lacks traces of their presence (the situation strikingly recalls the ill-differentiated stratigraphical "jumble" at Terra Amata described by Villa, 1983:71–73). Below about 1–1.5 m down in that sediment its color becomes somewhat grayer in hue (7.5YR8/4 to 7.5YR8/6) for roughly another meter downwards, suggesting humid, reducing conditions. The two aforementioned colorimetrical phases are tentatively called units II_{i} (layers and spits 2a through 2i) and $\mathrm{II}_{\mathrm{ii}}$ (3a through 3j; see Fig. 3).

There is a sedimentary break between 3j and 3k, in the form of a roughly horizontal crack, beneath which a bright gray zone of compact sediment is perceptible to the naked eye, containing rolled fine gravel (< 10 mm) sporadically in its uppermost part; this is noteworthy because the sedimentary fill of the cave usually has no rolled gravel. Although the grayness becomes less distinct downwards to the naked eye, Munsell Chart comparisons of dry sediment powder reveal gray hues, and spits 3k through 3x are assigned to unit III. The sedimentary break between 3j and 3k was not appreciated during the early years of excavation, owing to a very large fallen rock in the rather

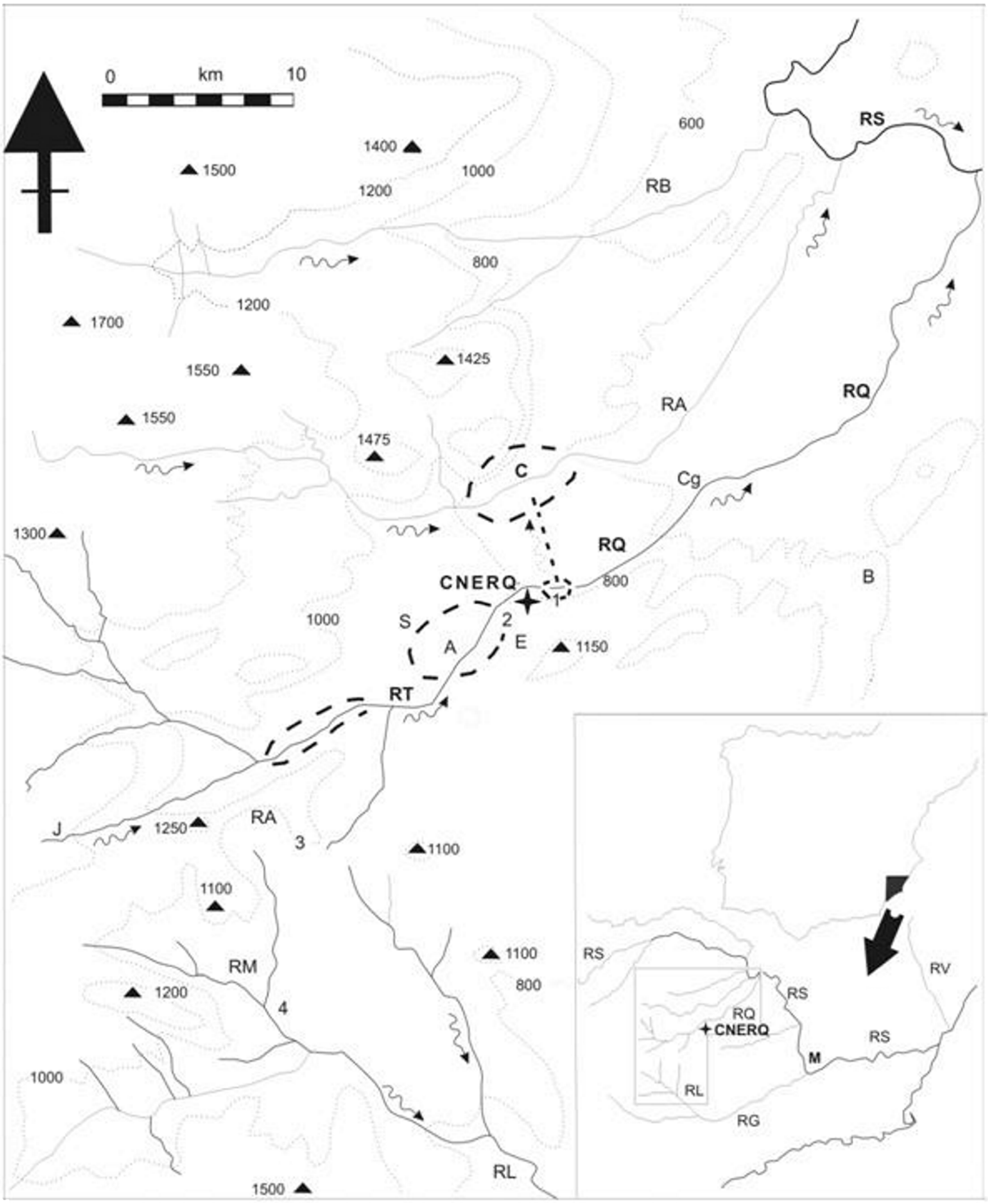

Fig. 2. Map showing the Quípar Valley and Cueva Negra del Estrecho del Río Quípar. Map key: CNERQ – Cueva Negra del Estrecho del Río Quípar; RQ – Río Quípar; RA – Rio Argos; C – Caravaca; Cg – Cehegín; B – Bullas; RT – Rambla de Tarragoya (Taragolla); E – La Encarnación; A – Almudema (Almudena); S – Singla; J – Junquera; RM – Rambla Mayor; RL – Río Luchena; 1, 2, 3, 4 – sources of chert (see text); broken lines – former Pleistocene lakes and former drainage of Río Quípar; heights – meters, rounded to nearest 25 m. Inset key: CNERQ – Cueva Negra del Estrecho del Río Quípar; RQ – Río Quípar; M –Murcia; RS – Río Segura; RG – Río Guadalentín; RL – Río Luchena; RV – Río Vinalopó

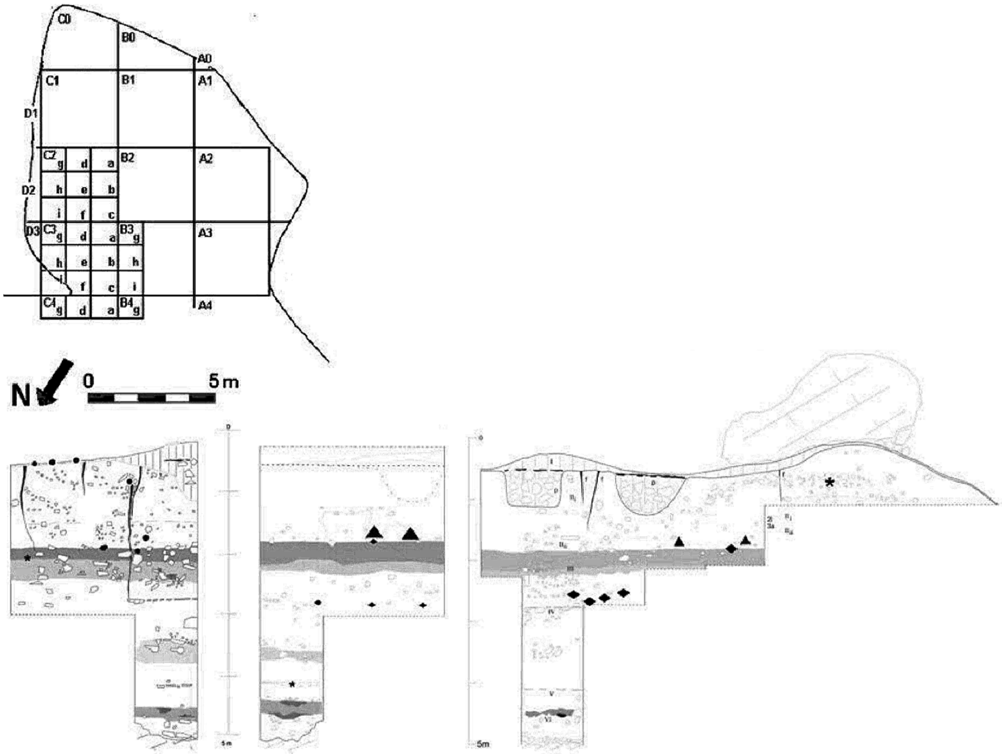

Fig. 3. Cueva Negra: Ground plan and sections of excavations: 1 – ground plan of area excavated showing identification of meter squares; 2 – stratigraphical profile from C2a to B4g; 3 – stratigraphical profiles at right angles to Fig. 3.2. Left: from C2a to C2g. Right: composite profile, from C2b to C2h, C2c to C2i, C3a to C3g. Key: I–VI –lithostratigraphical units (note that unit Iii comprises layers 2a through 2i and unit IIIi comprises layers 3a through 3y; p – twentieth-century pit; f – retraction fissure; black triangles – limestone hand-axe and chopping tool; black lozenges – excavated Paleolithic chert or flint artifacts cited in the text; black spots – rolled limestone cobbles (manuports); asterisk – indicates sampling for optical sediment luminescence determinations; shading – color changes in sediment as mentioned in the text; widely-spaced vertical lines – superficial disturbed soil (unit I); narrow horizontal bands with narrowly-spaced vertical bars – calcium-rich bands; dotted lines – large blocks fallen from cave roof in antiquity, now removed by excavation; broken lines – different levels of surface of unit II corresponding to profiles C2b to C2h, C2c to C2i; C3a to C3g respectively

restricted area under exploration, and it was only several seasons later on that a large enough area was exposed for the horizontal break to be recognizable as a continuous feature. It seems to be associated with angular rocks and stones that had fallen from the roof. Although freeze-thaw cannot be excluded as a cause of rock falls, given that even today temperatures may fall below zero at any time from early November to late April, neither can earthquakes, given that the entire region is today subject to frequent tremors. In that regard, geomorphological research points to Middle Pleistocene tectonic uplift of the opposite flank of the Quípar valley as having deflected the course of the river (González Hernández, *et al.*, 1997). It is tempting to envisage that it may not only have provoked a rock fall, but also facilitated entry into the cave of a meander or a braided channel on the flood-plain, responsible both for ponding and transient introduction of fine rolled gravel, which were followed, before deposition of units II_i and II_{ii} had recommenced, by erosion at the surface of the bright gray sedimentary deposit and formation of calcretions in its perhaps softened surface.

Unit IV again begins with sporadical rolled, fine gravel (<10 mm) and incomplete, thin plaques of crumbly calcrete, which lie above a thickness of 1.3 m of sediment resembling unit II in color and texture (unit IV = layers and spits 3y, 3z, and 4a through 4z). Unit V is barely 0.3 m thick and begins with incomplete thin plaques of crumbly calcrete beneath which there is loose sediment flecked with carbon (unit V = layer and spits 5a through 5g). It passes into unit VI, which is 0.5 meter thick, and is distinguished by zones of very dark, loose soil, suggestive of burning (unit VI = layer and spits 6a through 6i). (Unit "VII" is in reality no more than soil from the interstices of the fractured bedrock of the cave floor, albeit containing small mammal bones; originally designated layer 6j, this soil was later renamed 7a.) Finds highlighted in this article come from units II, III and IV.

The sedimentary fill of units II, III and IV is an incompletely consolidated litharenite, containing elements of breccia, forming a conglomeratic sandstone. It contains angular and subangular mineral components that come from erosion of the Miocene biocalcarenite rock in which the rock-shelter was formed, viz. calcite, 75–90%, with quartz, 10–25% (according to semi-quantitative X-ray diffraction analysis: M. A. Mancheño Jiménez). Inclusions abound of bioclastic fragments of both coral and marine shell, which likewise have their origin in the biocalcarenite roof and walls of the rockshelter. Optical inspection reveals a varying proportion (5–10%) of allochthonous particles of the size of fine silt, involving three separate minerals: plagioclase, polycrystalline quartz aggregates, and isolated quartz crystals. The isolated quartz crystals show the property of undulating extinction when inspected with polarized light through the crossed Nicol prisms of the petrological microscope, which distinguishes them completely from quartz derived from the biocalcarenite walls and roof of Cueva Negra. However, as we have mentioned in previous publications, the particles often have rounded surfaces indicative of transport to the site, and the presence of microscopical pitting points to weathering, suggestive of prior aeolian deposition of loess-size particles in lakes or swamps that may sometimes have spread in backwaters encroaching on the cave when the Quípar flood-plain stood at the same level as Cueva Negra. Some allo- chthonous particles may have been redeposited following fluviatile erosion upstream, where there is a whitish sandstone outcrop near La Encarnación which is made up of carbonates and quartz (5–10%), including polycrystalline quartz aggregates, quartz crystals showing ondulatory extinction, and crystals of plagioclase, tourmaline and zircon; the outcrop may well be a Plio-Pleistocene lacustrine formation.

Fluvio-lacustrine sedimentation in Cueva Negra itself seems to have taken place under relatively settled conditions, away from the more turbulent currents, and was doubtless intermittent. A low level of fluviatile transport, by and large, is indicated by absence of lenses of sorted river gravels in the rock-shelter fill, and by the sharpness of the edges of Paleolithic artifacts and knapping spalls, which are unrolled and have not been worn down by riverine-induced movement. As suggested earlier, the bright gray zone in unit III seems to reflect an episode of ponding, perhaps provoked by Middle Pleistocene tectonic activity which raised up the opposite side of the valley and may have induced falls of rock seen in unit III. Paradoxically, granulometrical analysis demonstrates that a dearth of soil particles > 2 mm in size differentiates the gray sediment from the beige-yellow-orange sediment. Semi-quantitative X-ray diffraction analysis carried out by one of us (M. A. Mancheño Jiménez) indicates that proportions of calcite, 80–90%, to quartz, 10–20%, in the bright gray zone are quite similar to proportions of calcite, 75–85%, and quartz, 15–25%, in the beige-yellow-orange sediments, though the greatest energy involved in the sedimentary process should therefore correspond to those beige-yellow-orange sediments which have the highest proportion of quartz, i.e., 25%. It appears that fluctuations took place in the extent to which quartz originating outside the rock-shelter was added to the sediment inside. Nevertheless, sporadical presence of rolled, fine gravel, in the uppermost parts both of the bright gray zone in unit III and of unit IV, requires additional explanation in order to be reconciled with the aforementioned hypothesis about fluctuations in fluvio-lacustrine activity and sedimentation. An accommodative conjecture might be that rolled, fine gravel was, very occasionally, washed into the cave, under exceptional circumstances, and incorporated into the surfaces of underlying sediment, especially if these were to have become slightly eroded or softened; calcretions also might have formed during or following such episodes.

BIOCHRONOLOGY AT CUEVA NEGRA

To date, units V and VI have been excavated only in a single meter square (the test-pit, meter square C2a: Fig. 1:3, Fig. 3:2–3), as has the greatest part of the depth of unit IV. Consequently, finds mentioned in this article come mainly from units II and III. Their biochronology is given by teeth of fossil voles, arvicolid rodents, which are well distributed both horizontally and vertically throughout units II and III, in particular species that had become extinct in western Europe by mid-Middle Pleistocene times, namely, *Allophaiomys chalinei*, *Mimomys savini*, *Arvicola* cf. *deucalion* and *Pliomys episcopalis*, as well as two other descendants of *Allophaiomys*, namely *Microtus brecciensis brecciensis* and *Terricola (Pitymys) huescarensis huescarensis* (Fig. 4). Other extinct rodents include the hamster, *Allocricetus bursae*, and the wood mouse, *Apodemus flavicollis*, cf. *A.* aff. *mystacinus* (rock mouse). Lagomorphs include the pika, *Prolagus calpensis*, as well as *Lepus* and *Oryctolagus*, and among the insectivores there is the hedgehog, *Erinaceus*, and an indeterminate shrew (Soricidae). Extinct large mammals include *Stephanorhinus* (*Dicerorhinus*) *hemitoechus*, a very large cervid, probably *Megaloceros* (*Megaceros*) *giganteus*, *Bison* sp. and *Macaca* cf. *sylvanus* (the last three taxa lingered on into the earlier Upper Pleistocene in Spain), as well as an indeterminate elephantid mandibular ramus fragment. There are several examples of large mammalian genera that are represented in Spain today, over sixty species of birds, and abundant chelonid (tortoise) remains (for faunal lists see Walker, 2001, Walker, Gibert, *et al.*, 2004, Walker, Gibert Clols *et al.*, 2004).

Extinct arvicolid rodents (voles) underpin the biostratigraphy of the western and central European Middle Pleistocene. About half-a-million years ago (0.5 m.y.a.), *Mimomys savini*, whose molar teeth had roots, was eventually replaced by *Arvicola*, whose molar teeth never form roots, with the appearance of *A. terrestris cantiana* marking the Biharian-Toringian biostratigraphical boundary (Roebroeks and van Kolfschoten, 1995, and refs.) and, in France, the Montièrien-Estèvien boundary (Chaline, 1974, 1977, 1985). That the transition began only after the Mutayama-Brunhes boundary (at 0.78 m.y.a.) has been demonstrated at the Spanish site of the Gran Dolina at Atapuerca (Cuenca Bescós *et al.*, 1998, 2001). *M. savini* became extinct in mid-Middle Pleistocene times.

Of particular interest at Cueva Negra is the association of *Mimomys savini*, *Arvicola* cf. *deucalion*, *Pliomys episcopalis*, *Allophaiomys chalinei*, and two species often regarded as descen-

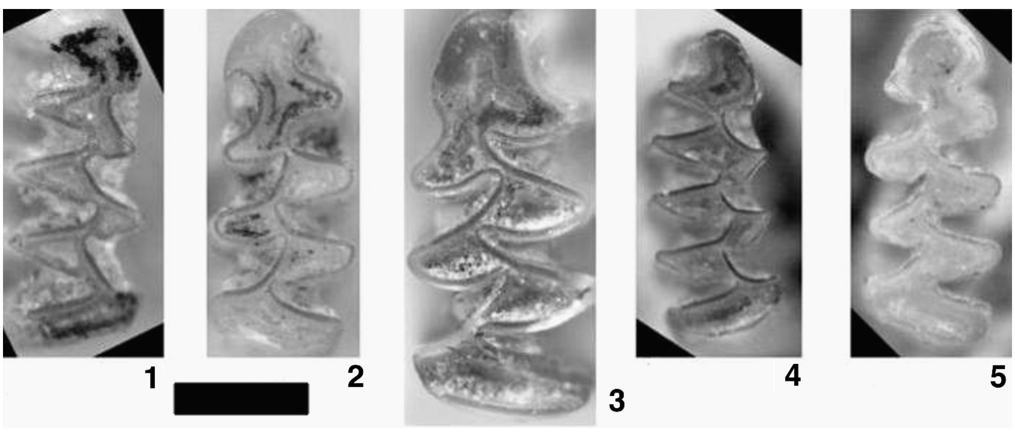

Fig. 4. Rodent lower first molars from Cueva Negra (photographed by Antonio López Jiménez): 1 – *Allophaiomys*, 2 – *Arvicola*, 3 – *Mimomys*, 4 – *Terricola* (*Pitymys*), 5 – *Pliomys*. Scale = 10 mm

dants of *Allophaiomys*, namely *Microtus brecciensis brecciensis* and *Terricola (Pitymys) huescarensis huescarensis*. We owe a special debt of gratitude to Dr. Antonio Ruiz Bustos of Granada University who kindly inspected our collection of arvicolid molar teeth and helped one of us (A. López Jiménez) with identifications; moreover, his enamel-unit methodology was found most helpful (Ruiz Bustos, 1987, 1988, 1995, 1996, 1999, 2002, 2005). Dr. Ruiz Bustos regards at least one of our Cueva Negra teeth as being more appropriately assigned to a *Euphaiomys*, a taxon for which good arguments (Ruiz Bustos, 1988) favour its demarcation from the arvicolid *Allaphaiomys* at generic or at least sub-generic level and its consideration as precursor of *Microtus* and *Terricola*.

Cueva Negra has provided large, rhizodont molars of *M. savini* that have an imposing anteroconid complex with a characteristically long bell-shaped termination. Of 28 teeth identified as *M. savini* six first molars gave a mean length of 3.45 mm and mean breadth of 1.38 mm, one had two well-formed roots and four had incipient roots, suggesting their late development, and perhaps pointing to a late stage in mimomyd evolution. By contrast, the 41 arhizodont first molars present among 97 teeth of *Arvicola* barely attain a mean length of 3 mm and some are only 1 mm long. They recall the small molars of the Lower Pleistocene *A. deucalion*, whereas by later Quaternary times they underwent a considerable increase in size to reach that of the modern western European water vole, *A. sapidus*. Another archaic rodent at Cueva Negra is represented by three lower first molar teeth of *Allophaiomys chalinei*, interestingly in the presence of what are often regarded as two closely-related species descended from that genus, namely *Microtus brecciensis brecciensis* and *Terricola (Pitymys) huescarensis huescarensis* (which some paleontologists argue could be classified together in a taxon of *Iberomys* as *I. brecciensis brecciensis* and *I. huescarensis huescarensis*: cf. Cuenca Bescós *et al.*, 1998 and refs.). At Cueva Negra there are 15 first molars among 34 teeth of *M. brecciensis* and eight among 18 teeth of *P. huescarensis*. The association demonstrates the Middle Pleistocene age of Cueva Negra. It is further supported by presence of a lower first molar of the vole *Pliomys episcopalis*, somewhat larger than *P. episcopalis* from the Lower Pleistocene TD-6 bed in the Atapuerca Gran Dolina. This species disappears from western and central European faunas after the Biharian-Toringian boundary. It may be remarked also that large molar teeth of the wood mouse, *Apodemus*, at Cueva Negra invite comparisons both with those of the rock mouse, *A.* aff. *mystacinus*, at the Middle Pleistocene site of Huéscar 1 which is 75 kilometers from our site, and with the wood mouse, *A. flavicollis* recognized at Atapuerca (Gil, 1990); at Cueva Negra we have identified 14 first lower molars, ten second molars and three third molars, as well as five maxillary teeth. Finally, 98 teeth of the pika, *Prolagus calpensis*, testify to some very large specimens; this is interesting because, to the best of our knowledge, the pika has not been recorded hitherto from inland Middle Pleistocene sites in Spain but, instead, at sites in mild environments nearer to the coast.

THE MIDDLE PLEISTOCENE QUÍPAR VALLEY AROUND CUEVA NEGRA

The River Quípar is an important tributary of the River Segura. It rises in the mountains that separate Murcia from Andalusia and flows roughly northeastwards for 65 km, falling 500 m in altitude, to join the River Segura, which drains into the Mediterranean Sea. The headwaters of the Quípar lie in a broad, shallow, upland valley, known as the Rambla de Tarragoya (or Tarragolla), the floor of which falls from 900 to 800 m above sea level along a distance of 20 km until it reaches the Quípar gorge at La Encarnación de Caravaca, where the River Quípar falls by a further 100 m over the next 2 km. The Rambla de Tarragoya follows a fault that is parallel to the principal Cadiz-Alicante and Crevillente Faults (aligned north 60–65° east), in relation to which earth tremors, reaching grade 4 on the Richter scale, have been recorded in our region, where tectonic activity continues unabated. There is noteworthy incidence, and very likely neotectonic reactivation, of Triassic evaporitic diapirs, which may well have affected folding of overlying Tertiary rocks in the Rambla de Tarragoya that attain a 30° dip in places (Ibargüen and Rodríguez Estrella, 1996). In the Miocene Messinian biocalcarenite within which Cueva Negra lies, vertical

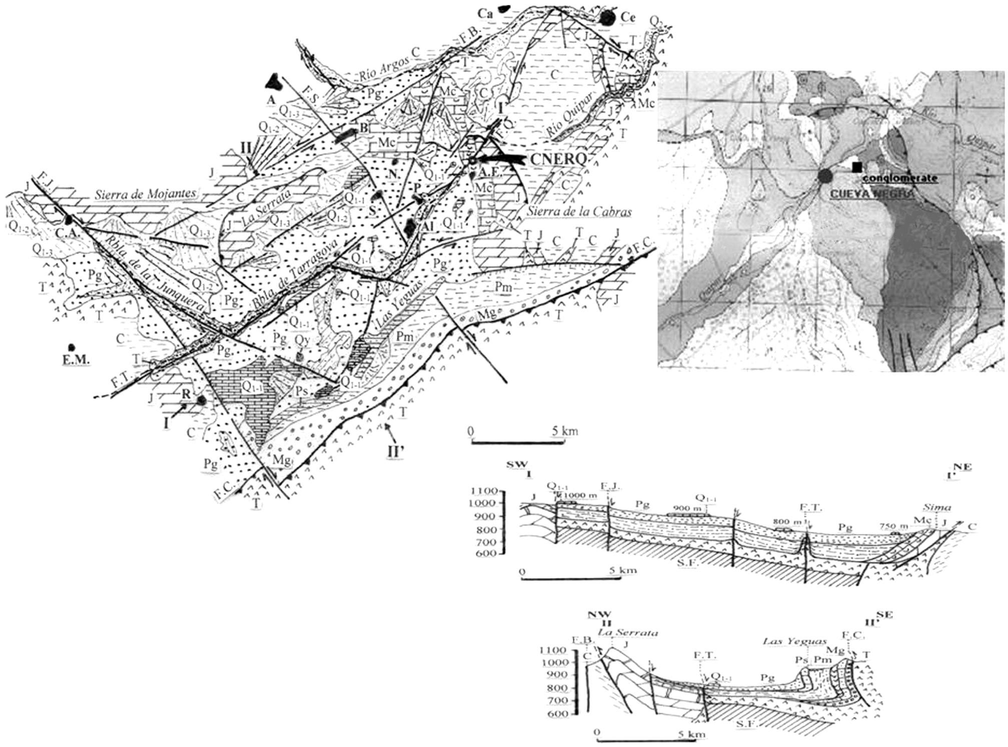

Fig. 5. Geological map and sections of the valley of the Upper Quípar/Rambla de Tarragoya (Tarragolla): 1 (top left) – geological map of the valley of the Upper Quípar/Rambla de Tarragoya (Tarragolla); 2 (top right) – enlargement to show the immediate vicinity of Cueva Negra and a conglomerate outcrop where a surface find was made of a discoidal core of chert (Fig. 6); 3 (bottom) – geological sections across the valley of the Upper Quípar/Rambla de Tarragoya (Tarragolla). (Courtesy of Tomás Rodríguez-Estrella)

halokinetic activity induced a normal fault (Quípar Fault) that has determined the course of the Río Quípar through the gorge (the Estrecho del Quípar) near La Encarnación. In late Lower or early Middle Pleistocene times, neotectonic reactivation of diapiric vertical dislocation may well have played a part in both establishing the inverse fault that defines the course of the River Quípar in front of Cueva Negra, and, subsequently, inducing uplift, relative to the watercourse. This first affected the northwestern flank (left bank) of the valley and was probably responsible for the change of course of the Quípar that ceased to drain northwards towards Caravaca, such that nowadays it turns eastwards just north of Cueva Negra. The Quípar Fault in the gorge underwent inversion in late Middle or Upper Pleistocene times, in consequence of which there was uplift of the southeastern flank affecting the hillside in which Cueva Negra lies at the outlet of the gorge. That explains how the early Middle Pleistocene fluvio-lacustrine sedimentary fill of the rockshelter came to be preserved high and dry above the river, well out of the way of later Middle or Upper Pleistocene fluviatile erosion.

A Pliocene–Pleistocene stratigraphical sequence is much in evidence in the Rambla de Tarragoya (or Tarragolla), upstream from Cueva Negra (Fig. 2, Fig. 5). It consists, from below upwards, of, first, yellowish marls, silts, darker marls with bioturbation, and whitish marly limestone (with freshwater gastropods and widespread signs of burrowing), followed by ubiquitous polygenic conglomerate comprising well-rounded, often near-spherical, gravel, pale sand, and red clay, all which is overlaid unconformably by micritic freshwater limestone, sealed by a glacis cemented by calcium carbonate. Preliminary field-work suggests that the fluvio-lacustrine sediments might represent two, or perhaps even three, separate Pliocene–Pleistocene erosion cycles; the sequence calls to mind the better-known Pliocene–Pleistocene fluvio-lacustrine deposits of the Guadix-Baza depression in Granada, and especially those of its northernmost sector near Orce, which lie on the opposite (southern) side of the Quípar watershed. There may have been two lakes in the Rambla de Tarragoya, one above the village of Almudema, where a gravel bank could have separated it from another lake downstream which extended to the head of the Quípar gorge. By late Lower Pleistocene times, this lake may well have been reduced to a vestige behind the head of the gorge. Tectonic instability around the inverse fault that defines the course of the Quípar, where it descends through the gorge, undoubtedly played a part in capture and drainage of the lake above it. This process involved erosion that eliminated most, but not all, of the former lake shore above the gorge to the south, and the two Paleolithic core-tools excavated at Cueva Negra (see below) could have been made on limestone cobbles extracted from a vestigial conglomerate outcrop (with a yellow-orange matrix) corresponding to that shore, barely 0.5 km south of the cave. Slightly further to the South there are other conglomerate outcrops, which are relicts of ancient lake shores (e.g., near the hermit chapel at Singla). Cobbles in them are almost entirely of limestone; many are small and spherical, making convenient hard hammerstones, albeit with a tendency to break open during use. Upstream, by contrast, Miocene conglomerate outcrops contain detritus in the form of cobbles of chert, quartzite, marble and limestone. The limestone cobbles, in particular, must have come, originally, from eroded Jurassic Lower Middle Lias beds in mountains which reach 1,500 m above sea level and form a backdrop to the Quípar valley and Rambla de Tarragoya (Sierra de Mojantes, La Serrata, Sierra de Pinar Negro, Siete Peñones – the last-mentioned a mere 7 km from Cueva Negra).

This is a timely reminder of the great extent of continental uplift since marine Neogene formations were laid down when the Tethys Sea stretched over this region in the Miocene and still encroached on it in the Lower Pliocene. Freshwater limestones outcrop at about 750 m above sea level at Arrabal de La Encarnación, barely one kilometer upstream from Cueva Negra, whereas further upstream (i.e., to the South-West) they outcrop at altitudes of 900 and even 1,100 m (e.g., on Cerro Madroño). That 350 m vertical difference implies considerable neotectonic disruption of the ancient Pliocene–Peistocene lake bed. It was brought about by movements normal to the Tarragoya Fault, along which the valley is aligned. Those transverse NW–SE movements, furthermore, led to depression of eastern flanks with respect to western ones. Structurally-speaking, the Tarragoya Fault itself seems to be a result of leftward tearing or shearing in subsidiary relation to the important Crevillente Fault. This has influenced marked asymmetry of later sedimentary processes in the Rambla de Tarragoya, the southern part of which presents more Miocene and Pliocene outcrops than does its northern part. Moreover, in the southern part, tectonic fracturing has raised the External or Frontal Sub-Baetic that underlies the Middle Sub-Baetic, according to geophysical findings. The Tarragoya basin is best regarded as a hybrid between a graben and a sheared rift, sharing the characteristics of the rhomboidal outline of a rhomb-graben which has step-wise normal faults across its western rim, with overthrusts and rightward shearing faults aligned north 140° East such as the Junquera and Singla Faults (the Crevillente Fault itself is characterized by prominent northward overthrusts). It appears that neotectonic forces along a roughly N–S direction were more intense in the southern than in the northern part of the Tarragoya basin, and especially so in the western rather than eastern part, as is indicated by presence of overthrusts with steeply-inclined strata, folds that are directed northwards in the southern part of the basin but not in the northern part, and unconformities that are most marked toward the West.

Today, the Tarragoya basin is flanked by mountain hillsides formed of Jurassic limestones, Cretaceous marls and marly limestones, Triassic clays with gypsums, and Miocene (Messinian) calcarenites, conglomerates and gypsums. Upstream, in the southernmost part of the basin, the Miocene beds are followed unconformably by about 100 meters of Lower Pliocene sediments (namely, yellow marls and silts, followed by darker marls with bioturbation and whitish marly limestone containing freshwater gastropods,such as *Cyclostoma draparnandi* MATHERON and *Melanopsis* aff. *kleini* KURR, which is often nodular and shows widespread signs of burrowing; above which there may be up to 50 m of Upper Pliocene sandstones (recorded in the Sierra de las Yeguas, though disappearing laterally). Throughout the basin, those are followed unconformably by 80–100 m of Upper Pliocene polygenic conglomerate containing well-rounded cobbles, pale sands, and red clays, though lacking fossils owing to their fluviatile nature. Those are followed unconformably by freshwater micritic limestone which may attain a depth of 50 m in places (e.g., Cerro Madroños), giving way laterally in places to gypsums associated with chert (Q_y in Fig. 5); these Upper Pliocene, or maybe even early Pleistocene, sediments are frequently covered by a glacis characterized by calcitic concretion or encrustation.

Given that Pliocene–Pleistocene fluvio-lacustrine deposits outcrop at altitudes that fall from 1,100 to 750 meters above sea level over the length of the Tarragoya basin, the fundamental point to bear in mind is that neotectonic activity, *after* their Upper Pliocene–early Pleistocene deposition, has played an extraordinary part in affecting the relative altitudes today of outcrops of Pliocene and early Quaternary sediments upstream *above* Cueva Negra. Therefore it is well worth asking how far it has affected Pleistocene land-forms *at* Cueva Negra itself and *below* it downstream.

It seems clear that Middle Pleistocene tectonic activity caused a major change in the course of the River Quípar below the gorge in which Cueva Negra lies. Previously the river had flowed northwards from the gorge, to join the River Argos at an extensive lake where the town of Caravaca de la Cruz now stands (González Hernández *et al.*, 1997). In the gorge the river follows an inverse fault. Onset of the Middle Pleistocene broadly coincided with a change in the direction of predominant geodynamic activity in the Murcian region, which came to involve compression along a north–west to south–east axis, and brought about a significant increase in relief along inverse faults which cross that axis (Martínez Díaz and Hernández Enrile, 1992). In the vicinity of Cueva Negra, this neotectonic activity first brought about uplift of the western flank (left bank) of the valley of the River Quípar, which, by the end of the Middle Pleistocene, had become diverted eastwards, less than two kilometers north of the cave, and, later on still, uplift took place on the eastern flank (right bank) of the gorge, lifting up the geological strata in which Cueva Negra lies. Uplift of the western flank of the valley, and blockage of the Quípar's northward course, undoubtedly led to new lakes forming, particularly one where the river was undergoing diversion to its modern course, less than two kilometers north of Cueva Negra.

An extensive outcrop of conglomerate 800 meters east–north-east of the cave is a remnant of the southern shore of this lake (Fig. 2 and Fig. 5.2). The outcrop is about 100 m across, and contains cobbles of chert, marble, quartzite, and limestone, presumably derived from a vanished Miocene conglomerate nearby that would have been formed by marine erosion of Jurassic beds of the Lias and Dogger series, exposed in cliffs washed by the Tethys Sea. In previous publications, it was claimed that the visible conglomerate was itself such a Miocene coastal formation, but further geological fieldwork (by T. Rodríguez Estrella) has shown that to be wrong, and that the considerable height of the conglomerate above the river is due to neotectonic uplift of its right flank. From the standpoint of Paleolithic archaeology, this revision has no practical consequences, as the formation must have been very near to the present outcrop indeed. This is because the beach contained complete Pectinid and Ostroid shells from the Tethys Sea, which later on were redeposited intact in the Quaternary conglomerate, together with rounded cobbles – up to the size of a Rugby football – of chert, marble, quartzite, limestone, and other rock-forming minerals, all of which had been eroded by the Miocene sea from Jurassic beds that can be seen everywhere in escarpments of nearby mountains. The overthrust presence of the Lias and Dogger, with respect to nearby Cretaceous and early Tertiary rocks, is an instance of that overthrusting of the Sub-Baetic Jurassic, with respect to both pre-Neogene and Neogene rocks, which is widespread throughout the Pre-Baetic Zone, and which began in the mid-Tertiary orog-

Fig. 6. Discoidal chert core: 1 – upper surface showing scar from removal of last flake; 2 –side view to show peripheral preparation; 3 – lower surface

eny. Plausibly, neotectonic movement, immediately upslope, behind the outcrop, precipitated the erosion and later redeposition of a (presumably) Miocene conglomerate formation. The Quaternary conglomerate outcrop filled (and covered to a depth of over 10 m) an earlier water course that carried a stream down to a former Pliocene–Pleistocene lake, and to which a paleochannel stands testimony. The conglomerate represents a fluviatile gravel spread toward the lakeside. The gravel was an outcome of redeposition, downslope, under conditions of considerable energy; it lies in a gray matrix, the cementation of which by calcium carbonate might have been brought about by a rise in the level of water in the lake or sheet-wash from adjacent Jurassic limestone. Nick-point gully erosion caused local exposure of the conglomerate, probably during later Middle, or even Upper, Pleistocene times. We have picked up a Levalloisian discoidal core of chert here, among other examples of knapping (Fig. 6). The two Paleolithic core-tools excavated at Cueva Negra (see below) could have been made on limestone cobbles from the conglomerate, as could most of the knapped chert, marble, quartzite and limestone artifacts excavated at Cueva Negra, and most of the fractured cobbles excavated there could easily have come from the outcrop.

A lake where the new, eastward course of the River Quípar was evolving, would have been within easy walking distance from Cueva Negra. The immediate vicinity of the rock-shelter would have afforded excellent views downstream, taking in an erstwhile lake there. Even closer watch over this lake could have been kept from the conglomerate outcrop, with its thousands of handy chert, marble, quartzite, and limestone cobbles. It would have offered a grandstand view over the wetlands to its north and the fauna that was attracted to them. Presence of wetlands within the immediate territory of exploitation around Cueva Negra can be inferred from catchment findings excavated at the site, particularly the avian and mammalian fauna, and paleopalynological data. Without going into details, it is enough to mention that there were several species of wildfowl (*Tadorna*, *Anas*, *Netta*, *Aythya*, etc.), among which were diving ducks that require deep water, in addition to small wading birds like the little stint (*Calidris minuta*) and sandpiper (*Tringa hypoleu-*

cos), as well as voles and water rats which testify to damp surroundings. Pollen analysis undertaken by one of us (J. S. Carrión García) indicates a range of trees that includes mesothermophilous shrubs, thermophilous taxa such as *Olea*, *Pistacia* and *Phillyrea*, and species which doubtless behaved as phreatophytes, such as a deciduous oak (probably gall oak, *Quercus faginea*; acorns are a nutritional requirement for jays and wood-pigeons, both of which were also present at the site), hazel (*Corylus avellana*), birch (*Betula celtiberica*), ash (*Fraxinus angustifolia*), *maple (Acer granatense)*, elm (*Ulmus*), willow (*Salix*), and *Typha*; there are also pines (including the cluster pine, *P. pinaster*), pistacchio (*Pistacia lentiscus*), yew (*Taxus baccata*), arbutus or "strawberry tree" (*Arbutus unedo*), rock-rose (*Cistus*), wild olive (*Olea europea*), juniper (*Juniperus*), *Phillyrea*, and heather (*Erica arborea*), thus there are indicators of both thermophilous Mediterranean taxa and also of steppe vegetation which is confirmed by pollen of the association Poaceae-*Artemisia*-*Ephedra*-Chenopodiaceae, sometimes with Asteraceae, (for full information, see Carrión Garcíá *et al.*, 2003; Walker 2001; Walker, Gibert, Eastham, *et al.*, 2003; Walker, Gibert Clos, *et al.*, 1998).

It should be mentioned here that it was too late to rectify the mistaken Upper Pleistocene age assigned to the site before an article went to press containing publication of the pollen diagram (Carrión Garcíá *et al.*, 2003): the diagram would not be out of place, however, in a late Cromerian interglacial context. Cueva Negra was probably just too far from nearby lakes for wildfowl excavated to have been carried there by predators other than humans, and, in any case, several bird bones show signs of burning, presumably by hominins. It is reasonable to infer that wildfowl and partridge imply that these birds were caught by hominins for their fat, during colder months of the year. The water vole *Arvicola sapidus* still forms part of the culinary tradition of some regions of Spain today (see Miguel Delibes' 1962 novel *Las Ratas*; cf. Blanco, 1998), as do rodents in other parts of the modern world (e.g., Malawi: reported on a BBC "From Our Own Correspondent" radio broadcast in August 2005), not to mention those taken by *Homo floresiensis* in the Upper Pleistocene (Morwood *et al.*, 2004) or the guinea pig (*Cavia porcellus*) which forms part of the traditional diet of Amerindians in Peru. It is imprudent to attribute ("unpalatable") rodent remains solely to avian predation at European Middle Pleistocene sites (pace Villa, 1983:40–41) without first having undertaken detailed comparative taphonomy of avian and mammalian, including human, consumption of rodents (an ethnoarchaeozoological task in search of an eager research student), before eliminating mammalian and human predation as more likely alternatives.

MISTAKEN ANTIQUITY AND IDENTITY

It is necessary here to explain how we went wrong in regarding the sedimentary fill of Cueva Negra as mid-Upper Pleistocene, even in those recent publications just cited; the mistake underlay our initial consideration of the Paleolithic assemblage as purely and simply Mousterian: it was a case of mistaken antiquity and identity. The explanation concerns the matter of the relative chronology of that fill to nearby fluviatile sediments. The Pleistocene sedimentary fill extends outwards from the rock-shelter, forming a narrow hanging terrace in front of its mouth. Where this terrace has been cut away by erosion in response to fluviatile rejuvenation, it can be seen lying on an eroded surface of Miocene rocks 8 m below the highest point of the fill inside the cave, where bedrock is covered by 5 m of sediment. At first sight, the vestigial hanging terrace seems to be occupying an equivalent relative position, on the eastern side (right bank) of the Quípar valley, to that of a very extensive glacis-terrace opposite Cueva Negra on the western side (left bank) of the valley, which seems to us to be the ubiquitous glacis-terrace B (gtB) that recurs throughout valleys in the Segura and Vinalopó drainage basins, where its surface lies at 35–40 m above the rivers today. Radiocarbon dating in several valleys indicated that gtB ceased to aggrade some 40,000 years ago, whereupon fluviatile rejuvenation supervened (Cuenca Payá *et al.*, 1986a; Cuenca Payá and Walker 1986a, 1995), and radiocarbon dating of a lower terrace, glacis-terrace A, seen beside rivers throughout the Segura and Vinalopó drainage basins, showed that its accumulation of 10–15 m of sedimentary alluvia and colluvia took place within a very recent time-span of 30,000–5000 BP, i.e., both during the upper pleniglacial stage of the last ice age, and well into post-glacial times when prehistoric pottery can be found in its upper part (Cuenca Payá and Walker, 1986b). Vestiges of gtA can be seen well below Cueva Negra, close to the River Quípar. Unsurprisingly, our initial working hypothesis was a minimalist one: namely, that both gtB and the sediments in Cueva Negra with Mousterian artifacts were likely to have been deposited during the earlier Upper Pleistocene, between about 120,000 and 40,000 years ago, especially during an early part of the last ice-age, perhaps 75,000–40,000 years ago. On the assumption that the surface of gtB and the rock-shelter fill belonged to about 40,000 years ago, organic samples from the excavation were submitted for radiocarbon analysis, which, however, could only detect modern contaminants. Absence of Upper Pleistocene dates led us to look more sceptically on our original assumptions.

We now recognize that our initial working hypothesis about the Cueva Negra sedimentary fill was simple-mindedly reductionist – and simply downright wrong! It is worth remarking, in mitigation, that we had been much impressed by scientific arguments (cf. Frenzel, 1973), drawing on paleopalynology in both the Old and New Worlds, which had turned upside down pre-existing, time-honored notions that major riverine aggradations usually corresponded to (warm) interglacial, marine glacio-eustatic transgressions. Instead, thick, inland, fluvio-lacustrine sediments often seem to have formed during (cold) pleniglacial stages. Cooling means that both evaporation and transpiration were reduced, so more run-off from rain and melt-water was available to sweep down over open slopes, carrying with it soil that settled in wide lake beds and vast swamps in river valleys and endorrheic basins, to which was added loess, blown from afar (so-called "*Diluvialloess*"); it comprises 5–10% of Cueva Negra sediment. Such accumulation often took place faster than the silty sediment could be removed by onward carriage downstream: i.e., lateral transport by many streams feeding a river valley, or sheet-wash into it, exceeded its longitudinal transport capacity. However, tectonic causes can lead to similar accumulation, and we have now come to recognize that they undoubtedly played a leading rôle near Cueva Negra. Given that gtA only began to form about 30,000 years ago, it had been inferred by us that gtB need be no older than the preceding part of the last ice age, especially given that for the top of gtB there are dates of about 40,000 BP and Paleolithic artifacts are sometimes found in relation to calcrete crusts of about that time (Cuenca Payá and Walker, 1986b; Vita-Finzi, 1976). In many parts of the Segura and Vinalopó drainage basins both terraces seem to belong to the Upper Pleistocene (Cuenca Payá and Walker, 1986b, 1995). There are known instances of multiple terraces dating from within the Upper Pleistocene in England and elsewhere (Brown, 1997:esp. 34–37 and references). Older glacis-terraces lie at roughly 70 (gtC) and 100 meters (gtD) above rivers in the Segura and Vinalopó drainage basins; their ages are unknown but there is no overwhelming reason for presuming them to be other than Middle Pleistocene, and tectonic instability with ensuing erosion is likely to have been responsible for the paucity of both continental land-forms and coastal formations from before half-a-million years ago (Cuenca Payá *et al.*, 1986a). It is not unthinkable that the glacis-terraces might owe at least as much to the fits and starts of Quaternary tectonic uplift, upstream from them, of the high mountains and intermontane valleys and plateaux, that form the watershed between Murcia and Andalusia, as to Quaternary paleoclimatic oscillation; Quaternary tectonic uplift could go far to explaining a dearth of equivalent glacis-terrace formations in high areas, such as the Rambla de Tarragoya.

Although the Cueva Negra sedimentary fill lies at about the same height above the River Quípar as those of what looks like gtB opposite the cave, and, other things being equal, might therefore be considered contemporaneous with gtB, a less parsimonious conjecture, namely, that the cave fill is *much* older than gtB, now seems to be far more likely. This conjecture gains plausibility from paleontological and Paleolithic findings at Cueva Negra. It implies that insufficient attention had been paid previously by us to the rôle played by Quaternary neotectonic activity near Cueva Negra. That has relevance for the matter of provenance and Paleolithic procurement of raw material for artifacts at Cueva Negra, as will be explained in the following argument. It was remarked above that our initial correlation of the sedimentary fill of the rockshelter with gtB has been revised, particularly with regard to the matter of chronological assignment. We stand, however, by our repeatedly published conclusion that Paleolithic folk can hardly have known about those cobbles of limestone that are exposed today where later Quaternary fluviatile rejuvenation has eroded sediments beneath the hanging terrace in front of the rockshelter, because the cobbles would have been lying several meters below the surface of the marshy Quípar flood-plain, whence swamps sporadically invaded the rock-shelter itself. On the other hand, with regard to the river today, the great differences between both the relative heights of gtA and gtB, and, most important, their former widths of spread across the valley in front of the rock-shelter, imply that, for every 10 cubic meters of gtA, there must have been 150–250 cubic meters of gtB, of which little more than 10% survives: erosion on such a massive scale seems unlikely if the requisite increase in available surface water were to have been limited to a relatively short period (such as an Upper Pleistocene interstadial). Evidently, gtB corresponds to a vastly greater accumulation of sediment than gtA which, of course, could only have begun to form once erosion, by fluviatile rejuvenation, had removed most of the gtB sediment throughout its 35 m depth, leaving but vestiges on valley slopes.

The tectonic processes outlined earlier help us to understand what probably happened. Instability around the inverse fault at and near the Quípar gorge led to drainage of the large Rambla de Tarragoya lakes, and to an enormous quantity of lacustrine sediment being redeposited downstream. Thus, longitudinal fluviatile transport, in response to tectonic movements, probably played a greater role in the formation of gtB, at and beyond the exit of the gorge, than did lateral contributions from ice age sheetwash and runoff from surrounding hillsides. Such longitudinal displacement could, indeed, have facilitated the changing course of the Quípar downstream during the Middle Pleistocene at the same time as uplift of the western flanks took place. Cueva Negra itself seems to have had a phreatic origin, as a small, vertical, karstic cylinder, formed by water welling upwards into the Miocene biocalcarenite. This may have been during the late Pliocene and Lower Pleistocene, when, below the gorge, a large lake formed before the definitive eastward course of the Quípar had been established. Regardless of precisely whenever the rock-shelter itself was first formed, the inescapable conclusion has to be drawn that its sedimentary fill and archaeological contents must obviously be later than any time when a lake below the gorge were to have sculpted the rock-shelter itself, and was probably later than the drainage of the Rambla de Tarragoya lakes. Nevertheless, they probably correspond to a Middle Pleistocene time when diversion of the Quípar induced formation of a lake just downstream from the cave. A likely consequence of the foregoing conclusions is that limestone cobbles, exposed today in the hanging terrace beneath the cave, were probably eroded from fossil shore-lines of the former upstream lakes and washed through the gorge. At its exit near the cave (and beyond) they became incorporated as colluvial gravel lenses in the riverine swamp. Here, alluvial aggradation continued to take place throughout the Middle Pleistocene, as uplift of the western flanks of the Quípar valley downstream was obstructing the northward course of the river which was becoming diverted eastwards: it now seems clear that the flood-plain here underwent very prolonged aggradation. Subsequent uplift of the western flank, in which Cueva Negra lies, facilitated erosion of the hanging terrace in front of the rock-shelter; this erosion must have commenced before gtA began to aggrade (very likely during the upper pleniglacial of the last ice-age) in the side of the valley below the cave.

To sum up, Middle Pleistocene sediments in Cueva Negra represent a fossil flood-plain that is much older than any erosion surface of gtB, whether opposite the cave, on the western side of the Quípar, or in those several localities in the Segura and Vinalopó drainage basins where it was attained some 40,000 years ago. Retraction fissures in the Cueva Negra sedimentary fill were a response to very cold and dry episodes, which probably followed the deposition of that fill, rather than accompanying it; indeed, paleopalynology implies that the sediments reflect temperate surroundings, rather than harsh pleniglacial conditions (Carrión García *et al.*, 2003). The Cueva Negra fill can be regarded as a vestigial remnant of Middle Pleistocene alluviation in the valley, protected under the roof of a rockshelter (which very likely extended further outwards than today) from removal by erosive processes, were these to have been induced by either tectonic or climatic impingement on the surrounding landscape. As an afterthought, it may be remarked that this view is by no means incompatible with a possibility that a mantle (gtB) of early Upper Pleistocene sediments might have spread over those of the Middle Pleistocene in the valley outside the cave. They could have been derived by lateral sheet-wash, induced both by neotectonic uplift and climatic changes, and they could even have backed up outside the rock-shelter against its fill within, before being removed by erosion; it remains to be seen whether excavation of the hanging terrace in front of the Cueva Negra may reveal this in the future. However, if limestone cobbles exposed there belonged to an early Upper Pleistocene aggradation, their future presence could never have been envisaged by Middle Pleistocene knappers of Paleolithic artifacts inside the rock-shelter, who must have had to wander further afield to procure raw materials for knapping.

SOURCES OF PALEOLITHIC STONE

Nearby conglomerate outcrops were probably their first choice. Cobbles of chert and poor quality flint occur at the outcrops as frangible tabular blocks, usually less than 10 cm across, which often have a noteworthy component of amorphous calcium carbonate zones or bands (because there seems to be a continuum from these to better quality flint, the inclusive word chert is used for both throughout this article and the word flint is generally avoided; cf. Luedtke, 1992). Knapping of these tabular blocks tends to cause shattering more often than removal of flakes with clear cut striking platforms and convex bulbs of percussion, and at Cueva Negra we have found many fragments and informal artifacts lacking either, some of which, nevertheless, have Mousterian-like abruptly retouched edges, in addition to retouched struck flakes. Cueva Negra has scrapers with steep and even Mousterian-like abrupt edge retouch, on chert, flint, quartzite, limestone, and even marble, scrapers with invasive retouch, denticulates, keeled pieces which sometimes suggest steep scrapers, and at least one chert graver or burin. There also seem to be many informal or expedient artifacts. It is conceivable that, also, large numbers of cobbles were broken apart away from the cave, in a search for occasional presence of better quality chert or even flint. Certainly, Cueva Negra has provided us with small nodules of chert and flint conducive to conchoidal fracturing, which no doubt allowed well-formed small flakes to be removed. There are several thin, triangular flakes, which very likely are rejuvenation flakes, removed during preparation of Levalloisian cores. Bipolar flaking can occasionally be inferred, which is unsurprising given the small size of cores. At the conglomerate outcrop 800 m E–NE of Cueva Negra, we have picked up a discoidal core of white flint (Fig. 6) which has a centrally-placed flake scar, in conformity with preferential removal of the final flake from that core (although because the core itself shows minimal preparation, it might perhaps be regarded as "proto-Levalloisian" in terms proposed by White and Ashton, 2003 and refs.), and a similar discoidal core of limestone was picked up on the ground outside Cueva Negra itself (Fig. 7:6), but as yet none has been excavated in the rock-shelter. The limestone core was prepared on what may well have been a thick flake or small facetted block, as it does not seem to have been a cobble; discoidal cores are documented on flake blanks as well as primary nodules (McBurney, 1960:133–134); however, the view that discoidal cores are both specific to the Mousterian (thus, McBurney, 1960; Bordes 1961) and also separate from other Levalloisian core-reduction procedures, is no longer held (Boëda, 1994; Boëda *et al.*, 1990; Mellars, 1996: 69–73; Villa, 1983: 201–202; White and Ashton, 2003). The limestone discoidal core underlines the significance of limestone at the site, both as providing flakes with sharp edges, perhaps for one-off use, given that retouch of limestone flakes is uncommon, and also as offering raw material that affords possibilities for both Levalloisian core-reduction and bifacial Acheulian core-tool production (see below).

A small outcrop of slightly better-quality chert lies 15 km southwest of Cueva Negra, on the far side of the watershed of the Rambla de Tarragoya, 2 km south of the hamlet of Royos de Arriba. The chert occurs in a Pliocene fluvio-lacustrine formation about 200 m across which is rich

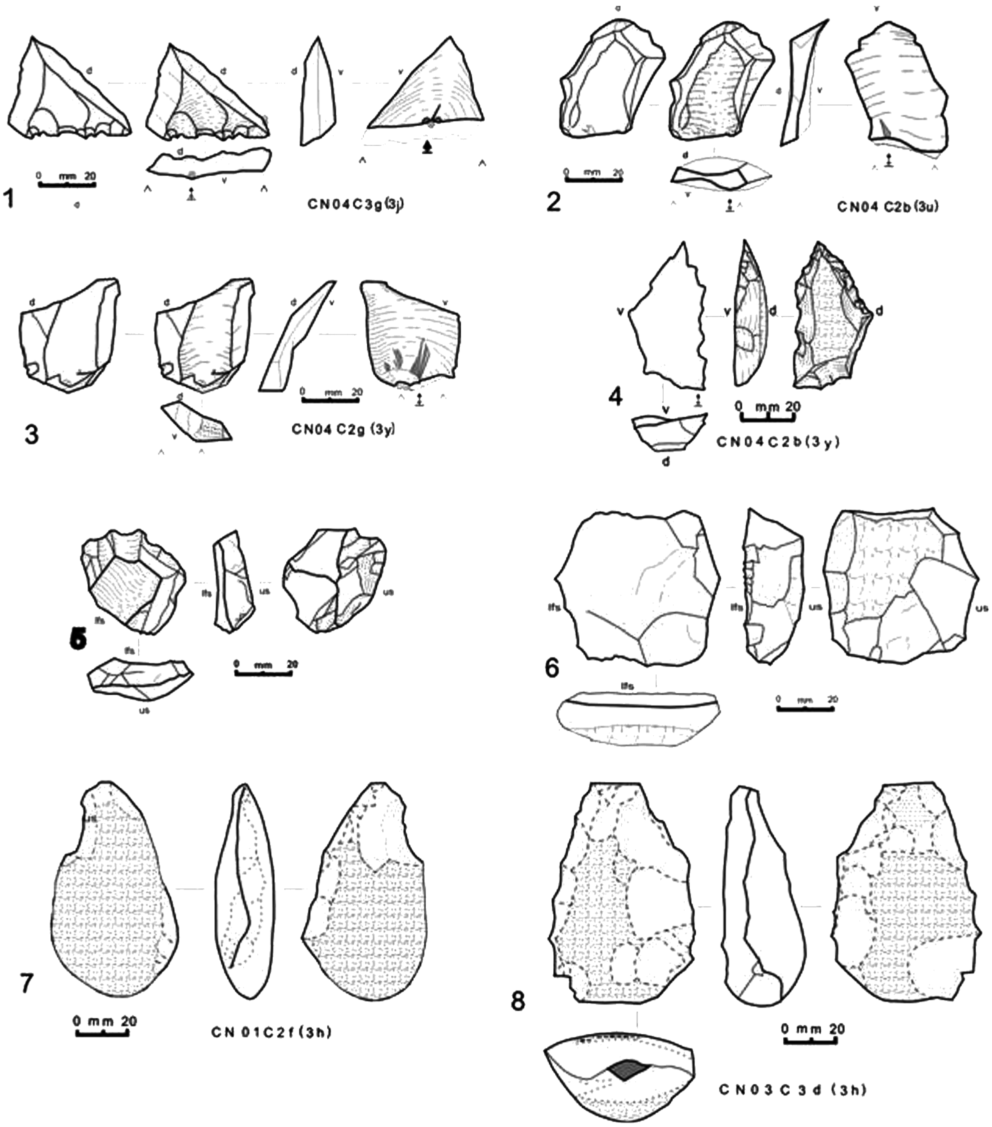

Fig. 7. Some Paleolithic artifacts: 1–3 – Levallois flakes cited in text, with identification numbers indicating excavation season (CN04 = Cueva Negra, 2004), meter-square (C3g, C2b, etc.), layer and spit in brackets, e.g., (3j), (3y), etc., and number assigned to piece from the square and spit in which it was excavated; 4 – elongated plano-convex convergent scraper or thick point with steep retouch ("protolimace"); 5 –discoidal flint core found at conglomerate outcrop 1 (see text and maps); 6 – discoidal limestone core found on surface at mouth of Cueva Negra; 7 – chopping tool with edges worked on both faces, on flat limestone cobble; 8 – hand-axe on flat limestone cobble: v = ventral surface, d = dorsal surface, lfs = last-flake scar on core, us = under surface stippling indicates cortex

in gypsum; some of this chert may well have been brought to Cueva Negra, though this cannot be confirmed. The chert occurs in masses which have frond-like outgrowths, and it may be similar to Magadi-type chert, known at Olduvai Gorge and elsewhere in the world. Luedtke (1992: 35–36) remarks that nodules of Magadi-type chert "sometimes look as if they had been squeezed from a giant tube. Many are twisted and irregular in overall shape, with spikes and lobe-shaped pro-

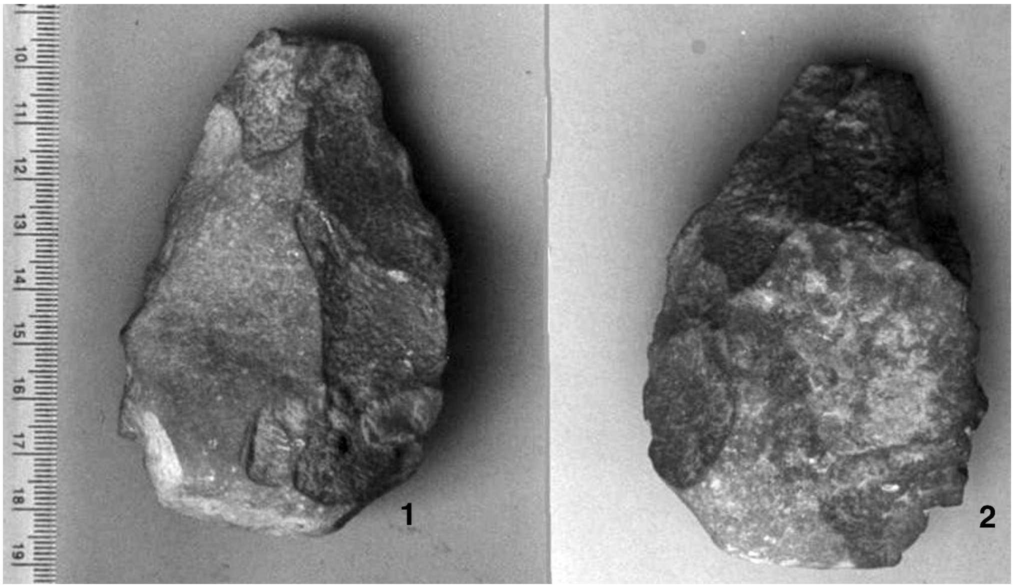

Fig. 8. Acheulian limestone hand-axe CN03C3d(3h)0095, in two views, photographed by Tina Walkling

trusions". That describes well the outcrop we have identified. Its chert is mainly pale gray in color, though with tones that range from off-white to dark, and may include bluish hues; however, it has not yet been established beyond doubt that the Cueva Negra assemblage contains chert flakes or fragments from that source and its characteristic lobular nodules are conspicuous by their absence from our excavations. Another 10 kilometers further south of that source, honey-colored chert outcrops in an area about 100 m across on the left bank of the Rambla Mayor (which feeds the River Luchena, which, in turn, drains into the River Guadalentín, the important southernmost tributary of the River Segura), though this flint is tabular and frangible. Honey-colored chert excavated at Cueva Negra could have come from the outcrop (e.g., Figure 11:8). Both outcrops lie outside the Quípar valley and would have required a hike of a few days from our site were raw material to have been retrieved in bulk. It is puzzling that a few finds have been excavated at Cueva Negra made of very good quality chert (flint). Its source is unknown, though it may imply a distance of perhaps more than 50 km, given that no outcrops of that quality are known within such a radius from the site. Mousterian scrapers excavated at the site are sporadically made of pink marble, which outcrops 10–20 kilometers downstream in the Quípar valley, near Cehegín and Bullas. Finally, we have found chert artifacts resembling those of Cueva Negra on land surfaces of the headwaters of the Rambla de Tarragoya near the hamlet of La Junquera.

ACHEULIAN AND LEVALLOISO-MOUSTERIAN AT EARLY MIDDLE PLEISTOCENE CUEVA NEGRA

Excavation campaigns in 2001, 2002, 2003, and 2004, exposed an area of hominin activity in an early depositional stage of unit II_{ii}, in the 5 cm-thick spits (3h), (3i), and (3j), in meter-squares C2c, C2f, C2i, C3a, C3d, and C3g. It presented a remarkable concentration of Paleolithic débitage and bone fragments, when compared with similar zones previously excavated elsewhere. Of particular interest was the presence in it of an Acheulian hand-axe (Fig. 7:8, Fig. 8, Fig. 9 top). Perhaps the activity area (Fig. 10, Fig. 3: 2–3) was limited to the daylight-side of the very large fallen cuboidal block that was embedded in the sediment (might it have served as a Paleolithic work-bench?). This very large rock undoubtedly distracted our atten-

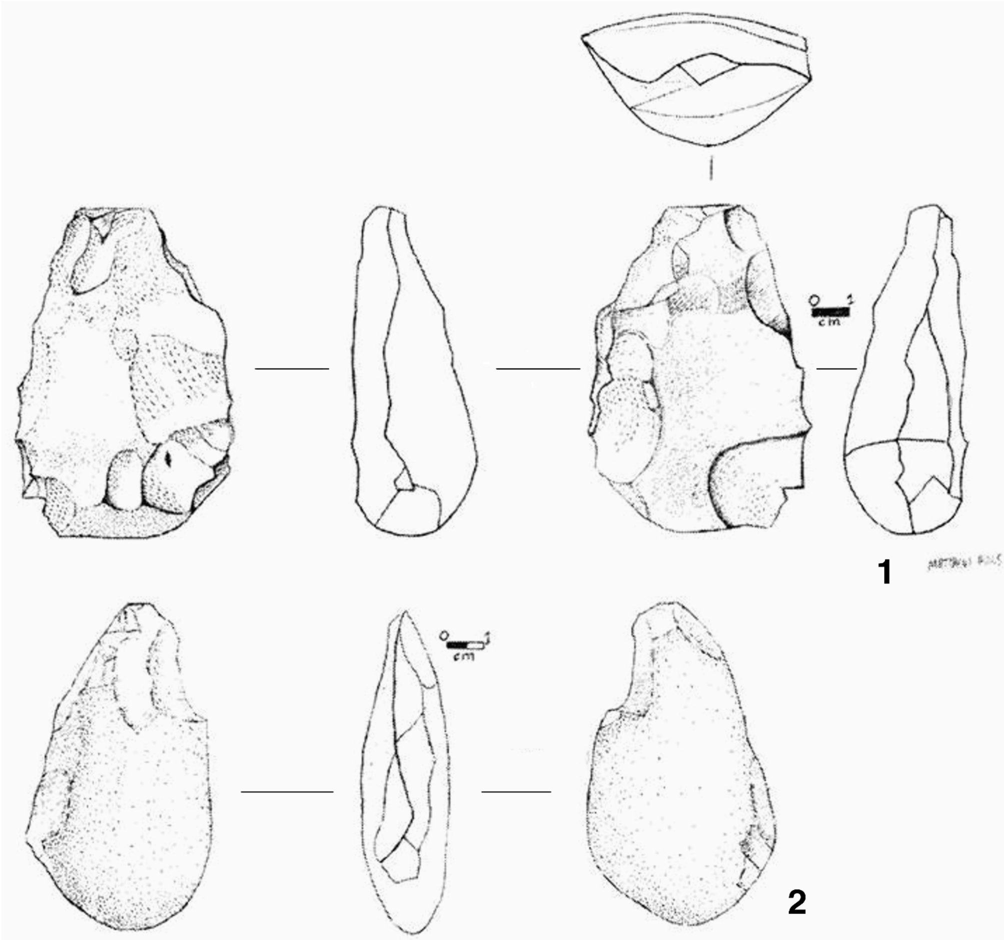

Fig. 9. Drawings of some limestone artifacts, hand-axe by Matt Hills (top) and chopping tool by M. López Martínez (bottom)

tion from recognizing any similar area behind it when that zone was under excavation in 1993. It is worth remarking, nevertheless, that behind it, in meter square C2e, albeit in a slightly deeper spit (3ñ) in the upper part of unit III, there was excavated a hominin tooth (CN-4) with typically Neanderthal osteodontometrical dimensions (Walker, Gibert, Sánchez, *et al.*, 1998:Table 4). It is a right mandibular permanent anterior premolar of a juvenile or adolescent, because the apex of its root is not fully closed. Occlusal attrition of its crown had exposed not only dentine, but also the root canal, around which secondary dentine had formed a protective areola; such exposure of the root canal by attrition of the crown is quite common in Neanderthals: it is seen at Cueva Negra also in a left maxillary permanent canine, CN-2, and a left maxillary permanent lateral incisor, CN-6 (Walker, Gibert, Sánchez, *et al.*, 1998:Table 4). The hominin remains seem to be of very early Neanderthals, which, if not *Homo neanderthalensis sensu stricto*, can be regarded as a Neanderthal forerunner or "Pre-Neanderthal", *Homo heidelbergensis* cf. *steinheimensis*, which some colleagues prefer to call simply *H. neanderthalensis*.

We do not rule out a possibility that fall of an enormous rock into the sediment nearby facilitated vertical displacement of CN-4, though be that as it may, the activity area near the base of unit II_{ii} must be regarded as roughly contemporaneous with CN-4 and certainly *cannot be earlier* than the Neanderthal CN-4 tooth. This is of significance, because all the other Neanderthal hominin finds made at the site (Walker, Gibert, Sánchez, Lombardi *et al.*, 1998:Table 4) come from layers that are *later* than the activity area; they come either from unit II_{ii}, (right humeral shaft fragment CN-8 from spit (2g), left ulnar shaft fragment CN-3, left maxillary permanent canine CN-2 and anterior permanent tooth root CN-7, all from spit (2c)), or from unit I (right maxillary permanent anterior premolar CN-5 and left maxillary permanent lateral incisor CN-6). In other words, the activity area and the Acheulian hand-axe can safely be attributed to "Pre-Neanderthals".

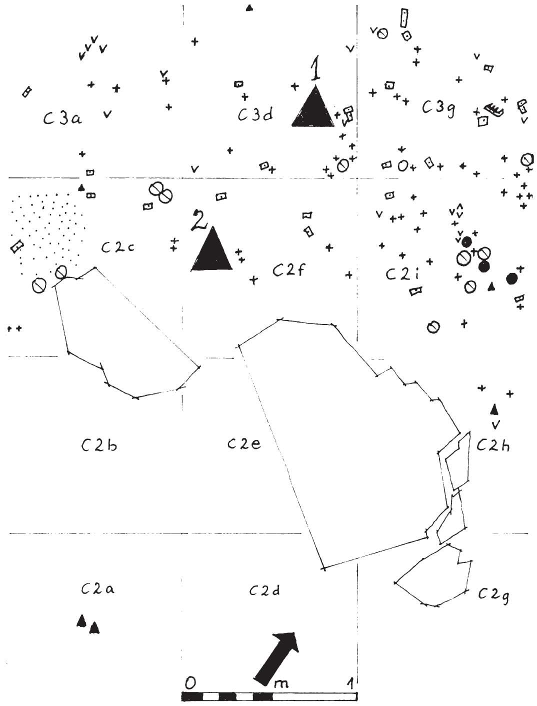

Fig. 10. Plan of activity area of layer (3h): Black triangles = limestone hand-axe and chopping tool black lozenges indicate excavated Paleolithic chert and chert artifacts cited in text and illustrated in plates and line drawings

Nearly all the Paleolithic finds from the activity area are unretouched flakes, informal artifacts, fragments, and occasionally nodules, of chert, poor quality flint, marble, or limestone, and abundant diminutive knapping spalls and chips retained on our 2 mm mesh sieve (over which all excavated sediment is washed) of which 65 occurred in spit (3i) of meter-square C2c alone. Knapping was carried out at the site, as is clear from these and similar finds in other excavated areas and levels, together with hammer-stones and possible soft-hammer antler pieces (Walker *et al.*, 1998). All the Paleolithic finds here, as elsewhere at the excavation, have fresh, unrolled edges and sharp knapping microspalls (< 2mm) have been excavated alongside larger fragments to which they can be conjoined (e.g., Figure 11:8), indicating that fluviatile activity was gentle, such that, even if the swampy flood-plain had encroached on the site from time to time, there was no churning of the sediment in the rock-shelter. Inspection at x400 using reflected light with a "Leica MZ-12" episcope reveals widespread presence of uniform micropolish, on unretouched and retouched edges alike, of flakes and fragments, doubtless owing to prolonged exposure to the sediment, with few specimens offering traces of differential use-wear analysis when their micropolishes are inspected. Cervids and wild goat are among the larger mammals of which there are bone spalls from the activity area. Cobbles of limestone are present, and at least one from the activity area was used as a hammer-stone.

Excavation in the activity area in 2003 uncovered a small Acheulian hand-axe, which had lost its tip in antiquity, in spit (3h) of meter square C3d. It presents an S-twist in horizontal cross-section. Its edges are sharp and fresh, neither rolled nor water-worn. It was made on a flat limestone cobble, on which some of the cortex is still present. This surprising find brought into new perspective one nearby that we had made in 2001, in spit (3h) of meter square C2f, of a bifacial pick-like chopping tool on a similarly flat limestone cobble, which at the time had seemed to be utterly incongruous with the rest of the Paleolithic assemblage from Cueva Negra, but now might be regarded as the beginning of bifacial knapping of an unfinished hand-axe. Its edges are similarly

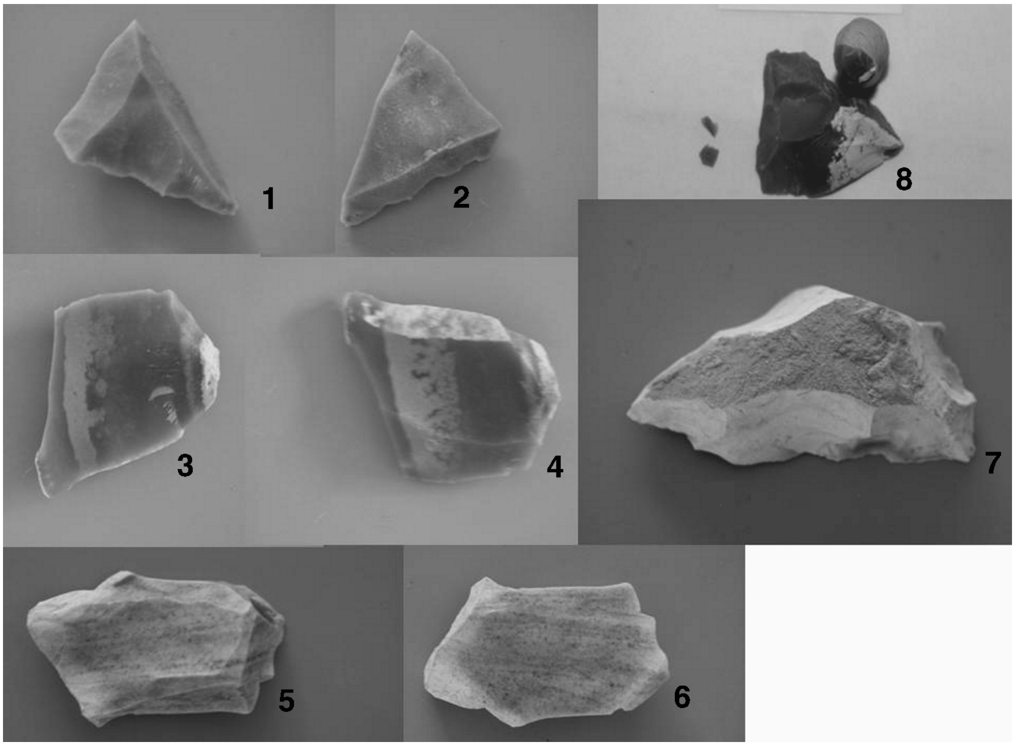

Fig. 11. Some Paleolithic flake artifacts: 1, 2 – Levallois triangular chert flake CN04C3g(3j); 3, 4 –Levallois chert flake CN04C2g(3v); 5, 6 – Levallois chert flake CN04C2b(3u); 7 – elongated planoconvex convergent scraper or thick point with steep retouch ("protolimace") CN04C2b(3y); 8 – fragment of rare, honey-colored chert about 20 mm long, excavated together in CN02C3g(3b) with three microspalls produced by knapping of the same raw material. The microspall on the plasticene ball seems to correspond to a scar on the large fragment. This small assemblage implies that at least a few detailed traces of a knapper's activity were able to survive, even if, from time to time, postdepositional reworking of sediment were to have taken place in some parts of the rockshelter

sharp and fresh (Fig. 7:7; Fig. 9 bottom). Both cobbles are of the gray-blue, micritic limestone (94% calcite, with 6% quartz which contributes to the hardness of the stones: determined by X-ray diffraction of powder and x80 optical microscopical petrography) that is characteristic of the Jurassic Lower Middle Lias. Cobbles of gray-blue limestone are present in conglomerates which lie less than one kilometer from Cueva Negra (see above, also Figs. 2, Fig. 5), though the only ones on which, as yet, we have carried out X-ray diffraction analysis are pure limestone, lacking quartz: one is composed of cryptocrystalline limestone pellets of organic faecal origin, the other has sparite cement with microscopical fossils. Whilst inspection of thin-sections with the petrological microscope might well throw more light on the comparability with these of our hand-axe and bifacial pick-like chopping tool, permission to undertake this could well be withheld lest the Paleolithic specimens suffer irreversible damage. (Two unworked cobbles excavated in the Cueva Negra sedimentary fill have been examined also by X-ray diffraction analysis and microscopical petrography: one has no quartz and is an oosparite (oolitic limestone with sparite cement), whereas the other is a dismicrite containing 10% quartz, radiolarian fragments, and filamentous planctonic fragments characteristic of the Middle Jurassic Dogger beds that can be seen in several localities in the mountains around the Rambla de Tarragoya and upper Quípar valley.)

Of singular interest are three Levalloisian flakes of good quality chert or flint, which in 2004 were excavated in unit III, in spits well below that in which the Acheulian hand-axe was found. An asymmetrical, triangular flake of gray chert or flint is an undoubted example of a centripetal flake-removal, with two dorsal crests converging on a short, single one, leading to the apex of the triangle, in the form of an inverted Y; in other words, it shows prior removal of a small triangular flake (Fig. 7:1; Fig. 11:1–2). It may be regarded as a second-order Levalloisian point, or perhaps the so-called pseudo-Levalloisian, pointed, triangular flake that is nevertheless “characteristic of particular techniques of preparing the surface of a Levalloisian flake core” (Debénath and Dibble, 1994:52: cf. Boëda *et al.*, 1990; Mellars, 1996:65–66). It came from spit (3j) of meter-square C3g. The only retouch is along the long dorsal margin of its plane striking platform, and it varies from invasive to abrupt, perhaps to assist hafting or perhaps for use as a scraper. A subsquare flake of brown-gray chert or flint, the striking platform of which was prepared with three facets (or perhaps four) of “chapeau de gendarme” type, has no retouch and ends in a step fracture which is slightly plunging; two widely separated crests on the dorsal surface delimit a flake scar corresponding to prior removal of a flake that was struck from the region of the same striking platform (Fig: 7:3; Fig. 11:3–4). Possible edge damage at the distal extremity of this piece might perhaps imply its use as a boring tool or awl. It came from spit (3v) in meter-square C2g. An oblong flake of gray-white chert or flint, with a plane striking platform, also has no retouch and again ends in a step fracture which is slightly plunging; it also has two well separated crests on the dorsal surface which delimit a flake scar corresponding to prior removal of a flake that was struck from the region of the same striking platform (Fig: 7:2; Fig. 11:5–6). It came from spit (3u) in meter-square C2b. Those three flakes are less than 6 centimeters in length. Also of interest is an elongated planoconvex convergent scraper, or thick double point (i.e., both ends are pointed), with semiabrupt or steep squamous retouch, (“protolimace”) made of chert, from spit 3y (Fig. 7:4; Fig. 11:7), of which other examples have been excavated from the site, some with scalariform semi-abrupt squamous retouch on which marginal abrupt retouch was superimposed.

A particular aim of this article is to emphasize that, in a paleontological context which points to the Biharian-Toringian biostratigraphical boundary, Levalloisian flakes occur in levels at Cueva Negra which lie below those with Acheulian bifacial preparation, hence Levalloisian core-reduction for removal of flakes and Acheulian reduction of cores into core tools were present by the mid-Middle Pleistocene. As has been already mentioned, retouched artifacts are also in evidence at the site, which include denticulates, serrated and notched forms, and even a graver or burin, as well as keeled forms among which are pieces that may well be steep-, nosed-, and end-scrapers. The limestone and poor-quality chert mean that many items are on rock fragments rather than on flakes with identifiable striking platforms and bulbs of percussion, though there are fragments and flakes which have edges with Mousterian-like abrupt retouch, and others with semi-invasive or even invasive retouch, especially along straight or convex edges. Many flakes and rock fragments might be regarded as informal artifacts, among which are several core-rejuvenation flakes and pseudo-Levalloisian, triangular, pointed flakes. Because most of these artifacts come from levels excavated above that which contained the Acheulian hand-axe, they do not serve to demonstrate precise contemporaneity with it, and a detailed account of the industry would be out of place, because those artifacts are irrelevant to the principal argument presented here, which is that there are most definitely some Levalloisian items which come from lower levels than the hand-axe, and therefore, at the very least, the two different techniques of core reduction were contemporaneous at the time of the Biharian-Toringian boundary. What is now clear is that Cueva Negra is very far from being that Upper Pleistocene Mousterian site of 50,000 years ago, which we had initially mistaken it to be for reasons given earlier. Discussion of its Acheulo-Levalloiso-Mousteroid assemblage from the mid-Middle Pleistocene is now in order, and will follow a brief discussion about the antiquity of the site.

DISCUSSION

The Biharian-Toringian biostratigraphical boundary in the western and central European Middle Pleistocene sequence, at roughly 0.5 m.y.a., is marked by replacement of the extinct rhizodont arvicolid rodent *Mimomys savini* by the arhizodont vole genus *Arvicola* (Roebroeks and van Kolfschoten, 1995, and refs.; cf. the French Montièrien-Estèvien boundary, Chaline, 1977, 1985). In Spain *Arvicola* appears for the first time in the Atapuerca Gran Dolina sequence in bed TD-10 (Cuenca Bescós *et al.*, 1998, 2001), which is later than the paleomagnetic Brunhes-Matuyama boundary of 0.78 m.y.a. defined in the deeper bed TD-8, and in Germany *A. terrestris cantiana* is present in Kärlich G; in both cases an age of about 0.5 m.y.a. seems reasonable (Roebroeks and van Kolfschoten, 1995). Roebroeks and van Kolfschoten commented on uncertainty surrounding the evolutionary relationship between *Arvicola sapidus* and *A. terrestris*; both are water voles, the former being widespread in Spain and France, whereas the latter is restricted to enclaves in northern Spain despite being widespread over much of Europe. Cueva Negra del Estrecho del Río Quípar is noteworthy because of the association of *M. savini*, *Arvicola* cf. *deucalion*, *Pliomys episcopalis*, together with both what seen to be *Allophaiomys chalinei* (three lower molars) and two other species that also most probably evolved from *Allophaiomys*, viz. *Microtus brecciensis brecciensis* and *Terricola (Pitymys) huescarensis huescarensis* (which some Spanish paleontologists argue could be classified together in a taxon of *Iberomys* as *I. brecciensis brecciensis* and *I. huescarensis huescarensis*; see Cuenca Bescós *et al.*, 1998 and refs.). The whole association strongly implies a late Biharian association and hence places Cueva Negra in the Middle Pleistocene at the transition between its early and middle stages. Such antiquity gains further support from presence of a lower first molar of *Pliomys episcopalis* (somewhat larger than *P. episcopalis* from the Lower Pleistocene TD-6 bed in the Atapuerca Gran Dolina). *P. episcopalis* disappears from western and central European faunas after the Biharian-Toringian boundary, as do the soricid insectivores, or shrews, of which one tooth is present at Cueva Negra; both taxa are lacking in assemblages later than about 0.4 m.y.a. (cf. Chaline, 1985). Large molar teeth of the wood mouse, *Apodemus*, at Cueva Negra invite comparison with those of the rock mouse, *A.* aff. *mystacinus*, at the Middle Pleistocene site of Huéscar 1 which is 75 kilometers from our site. Moreover, the pika, *Prolagus calpensis*, is represented by large specimens at Cueva Negra. This is significant because, as far as we know, the pika has not been recorded hitherto from inland Middle Pleistocene sites in Spain but, instead, at sites in mild environments nearer to the coast: from which we infer that the upland Cueva Negra deposit in the hinterland was laid down during a period of very mild climate that most likely was a late warm phase within the Cromerian interglacial complex, perhaps interglacial phase III or IV of the Cromerian sequence.

There are differing interpretations of how best to correlate marine oxygen isotope stages with the Cromerian interglacial phases II, III, and IV identified in Europe. Whereas the marine record implies that there were high interglacial sea levels in OIS 9 and 11 and lower ones in OIS 13 and 15 (Shackleton, 1987), there are several sites where those pollen records are lacking which might otherwise have indicated the relatively more open environments that were to have been anticipated during lower sea-level interglacial periods with respect to the higher sea-level ones, whilst faunal data alone seem to be very unreliable indicators of those differences (Roebroeks *et al.*, 1992). One interpretation regards the Elsterian glaciation as corresponding to OIS 10 (Roebroeks *et al.*, 1992:555, Fig. 2), which implies that the Cromerian IV interglacial corresponds to OIS 11, in which case it could be argued that very likely it was warmer than Cromerian II and III (OIS 13 and 15). An alternative interpretation is that, if the prolonged cold stage of OIS 12 corresponded to the extensive Elsterian glaciation that followed the Cromerian IV interglacial, then, Cromerian IV should correspond to OIS 13 (Gamble, 1999:430). Both of these alternative correlations were admitted as possible by Roebroeks and van Kolfschoten (1995:300–301): viz. Cromerian interglacial IV with either OIS 11 or 13, interglacial III with either OIS 13 or 15, and interglacial II with either OIS 15 or 17. Oxygen isotope stages 11, 13, 15, and 17, commenced at

0.423, 0.524, 0.62, and about 0.7 m.y.a., respectively (Aitken, 1995:274). Depending on which alternative is chosen, Cromerian III commenced just before 0.5 m.y.a. if it corresponds to OIS 13, or just before 0.6 m.y.a. if OIS 15 is the preferred option, and Cromerian IV commenced just before 0.4 m.y.a. if it corresponds to OIS 11, or just before 0.5 m.y.a. if OIS 13 is preferred. Given the uncertainty, a cautious approach is to assign Cueva Negra sedimentary units II and III to a late Cromerian interglacial, quite likely Cromerian IV.

New efforts to obtain optical sediment luminescence (OSL) dates are in progress and results are awaited from the Oxford University Physics Department's Research Laboratory for Archaeology and the History of Art (RLAHA), where Dr. Jean-Luc Schwenninger is studying new samples he has taken at the site (Fig. 1:4). Preliminary indications indicate an OSL estimate of > 0.35 m.y.a. on each of four samples currently being analyzed at Oxford, though these require confirmation (J.-L. Schwenninger, personal communication, June 26, 2006). Because it is is quite plausible that the site was invaded from time to time by meanders of a braided channel of the Middle Pleistocene river, these possibly could have afforded opportunities for a resetting of the geophysical clock, so to speak. There had been unsuccessful attempts at RLAHA by Professor Michael Tite, Dr. Ed Roads and Sara Hall to date samples by OSL that had been taken at the site by Dr. John Mitchell and Professor Derek Roe of the Oxford University "Donald Baden-Powell" Quaternary Research Centre at the Pitt-Rivers Museum. Both Dr. Schwenninger and Dr. Mitchell used the RLAHA portable gamma-ray spectrometer on site. (Samples have also been taken at the site by Dr. Krzystof Przegietka of the Instytut Fizyki of the Uniwersytet Mikołaja Kopernika at Toruń in Poland, for OSL investigation.) Fragments of heat-crazed chert submitted for thermoluminescence (TL) dating were considered to be too small for dating by Professor Tite.

Low sea-levels in OIS 12 and 16 might have permitted hominins with hand-axes from Africa to cross the Strait of Gibraltar when it was narrower than today and could have enjoyed more gentle surface currents (Rolland, 1998). Even if African hominins had done so as early as OIS 16, before accumulation of the the Cueva Negra assemblage, there are as yet no sites with evidence of Levalloiso-Mousterian operational sequences in northwestern Africa at OIS 16 or earlier. Whilst crossing of the Strait in even Lower Pleistocene times cannot entirely be ruled out of court (Gibert *et al.*, 1999), it throws no more light on the matter of how or why Levalloiso-Mousterian techniques appeared in southeastern Spain early in the Middle Pleistocene than does the more widely-held view that hominins from elsewhere in Europe had reached Spain by that time.

Archaeological excavation at Cueva Negra demonstrates that, by mid-Middle Pleistocene time, hominins there were able to use (and presumably to choose between) two alternative Paleolithic core-reduction techniques on both chert and limestone, namely, Levalloisian core-reduction for removal of flakes (whether for subsequent edge-retouch or not) and Acheulian reduction of cores into core tools (such as hand-axes). They were also able to exploit a wide range of animal resources, from birds and small mammals to large mammals; no doubt choices had to be made. In short, they were able to command a wide range of skills and practices. This does not mean they were modern humans. Unlike modern people, they may well have been minuscule, widely-separated, social units, constrained by "microenvironmental anchors" to dwell mainly in enclaves of considerable biodiversity (Walker, Gibert, Eastham *et al.*, 2004). They have been called "omnivorous specialists" (Gamble, 1993:142) and "unspecialized hunters using a broad spectrum of resources" (Villa, 1983:39). On the other hand, that does not mean they were stumbling, fumbling, bumbling, mumbling, slow-wits.

An intriguing proposal by Wynn and Coolidge (2004) is that hominins could well have possessed expert aptitudes controlled by long-term working memory (from stone-flaking to language, including survivability and reproduction in changing or strange habitats), but that their working-memory capacity remained limited (with regard to domain-free intentions or decisions) until Upper Pleistocene humans attained enhancement of working memory (enabling them to undertake rapid adjustment, to experiment and innovate, and to sustain attention by puzzling over how to try to new problems or face up to new or changing circumstances). Although genetic changes in Upper Pleistocene *Homo sapiens* were invoked by Wynn and Coolidge in order to explain how that enhancement might have occurred, it has been pointed out (Walker, 2005) that natural selection by itself could have consolidated a neuro-anatomical "exaptation" (perhaps reinforcing the neuronal circuitry, and rapidity of interchange, between the prefrontal cerebral cortex, hippocampus, thalamus, and the rest of the brain-stem, as well as the cerebellum and spinal tracts).

Selection pressure could have been brought to bear as an outcome of exponentially-increasing interactions being growing numbers of people, at some times and in some regions, though such interactions need not necessarily have taken place at the same times in all continents, and were not necessarily in a state of continual increase in any one (and perhaps hardly occurred at all in some places). The suggestion has two parts. First, Middle and Upper Pleistocene hominin and early human brain-circuitry may have offered an "exaptation" for non-linear evolution along the lines of self-organizing, or dissipative, systems. Secondly, in those Paleolithic communities that experienced greatest demographical abundance, the acceleration, in rate and frequency, of interpersonal discourse may have led to positive feedback of the aforementioned process, again in non-linear fashion with cascade effects. It is conceivable that such cascade effects may have further impinged upon the matter of which lines of future self-organization would be followed and which earlier ones would be abandonned – with natural selection acting on *both* the biological *and* behavioral planes (cf. Boyd and Richerson, 1985). Increased opportunity for interpersonal contact and discussion could have impelled consequent reflexion, on the basis of shared perception, about appropriate or inappropriate responses to be made in order simply to survive. That could well have enabled some communities, in marginal environments or unstable circumstances (Paleolithic hunters and gatherers in Eurasia and America at the last glacial maximum, perhaps), to overcome their disadvantage vis-à-vis communities in better-endowed environments or stable circumstances. Indeed, it may have sometimes (often?) been the case that diverse but *sufficient* survival strategies in uncertain environments could have been more of a spur to experimentation and innovation than were to have been, in stable ones, so-called "optimally efficient" survival strategies. "Optimally efficient" survival strategies may be cost-effective in terms of the returns gained for energy expended in their acquisition, though sometimes they can also be burdened with a long-term cost incurred by lesser pressure on them to remain flexible. This carries a hidden danger that an option of adaptive diversification may be foreclosed by rigidly restrictive, predetermined practice. Unwittingly giving such a hostage to fortune, may sometimes have been an unfortunate mortgage on unfulfilled future expectations.

Those matters are only mentioned here in order to highlight how very far removed later Upper Pleistocene communities were from that of Cueva Negra, though here the ability of hominins to survive in Middle Pleistocene Europe and adapt to scattered environments of temperate-latitude biodiversity by adopting strategies that enabled them to exploit a wide range of biological and mineral resources, and to *choose between alternative ways* of doing things, stirs us to reflect on when the first evidence for such choices can be detected earlier in the Pleistocene, especially in Africa, and what it may imply for Middle Pleistocene Europe.

Early in the East African Lower Pleistocene, at Olduvai Gorge and Peninj, there are Acheulian hand-axes and cleavers fashioned both on cobbles and on large, pre-planned flakes, and there are also some large discoidal cores bearing some resemblance to European Middle Pleistocene Levallois cores which, however, are usually of smaller size (Davidson and Noble, 1993; de la Torre *et al.*, 2003; Gowlett, 1986; Leakey, 1971; Leakey with Roe, 1995). It is worth remarking, in passing, that several European Middle Pleistocene sites also have flaked discoidal cores that were not subjected to Levalloisian flake-extraction, and that, at early sites, flakes struck off them have simple, plane striking-platforms, a few dorsal scars, and tend to be thicker than typically Levallois flakes, whereas at later sites similar Levallois flakes were struck from discoidal and Levallois cores alike (Villa, 1983:201–202). Because hand-axes were made from the African Lower Pleistocene to the Australian late Upper Pleistocene or perhaps Holocene, the word Acheulian can have no other inclusive meaning than that of presence of the index-fossil or type-fossil called a biface (hand-axe or cleaver), even if that presence was of a single example in an assemblage of other artifacts – where, however, it only serves to identify that example, without being a descriptor of the assemblage. Its use has the advantage of side-stepping imposed conjectures about *function* implicit in "hand-axe" and "cleaver". It also side-steps speculation about whether Paleolithic artifact *form*, which is explicit in the word "biface", implies some quasi-evolutionary conjecture about hominin cognogenesis.

The variety of Paleolithic techniques, recognized in the East African Lower Pleistocene, implies an element of thinking ahead, comparable to that involved in the Levallois technology of Middle Pleistocene Europe, according to Roe (personal communication). Inferences have been drawn about hominin cognition from the coexistence in the later Oldowan of *both* chopping tools *and* bifacial tools (Gowlett, 1986). Even if Oldowan chopping tools barely exceeded the cognitive capability of great apes (Wynn and McGrew, 1989), it has been argued that symmetrical hand-axes imply "spatio-temporal substitution and symmetry operations" that are more complex, cognitively-speaking, than are "the spatial concepts necessary to manufacture blades" (Wynn, 1979). They involve envisaging shapes and volumes from alternative perspectives, rotated in the mind, whilst paying attention to congruence (Wynn, 2000). Wynn regards hand-axes, in particular, as exemplifying evolution of "constellations" of behavioral plans of action that involve feature-correspondence as well as the complex cognitive skill of reversibility, which, nevertheless, could well have been learned and communicated by simply observing and copying, without need for symbolic linguistic assistance, whilst not excluding a possibility of an indexed role for some artifacts (Wynn, 1993, 1995).

Sceptical rejection of all the cognitive implications summarized above dismisses them as a "finished artifact fallacy", self-servingly reflecting archaeologists' predetermined categories – e.g. hand-axes, Levallois blanks, etc. – for defining those objects considered worthy of interest to study (Davidson, 2002; Davidson and Noble, 1993; Noble and Davidson, 1996). However, the force of this rejection rests, insecurely, on just how far individual hominins "intended", or not, to produce mainly (or only) those particular by-products of behavior which coincide with only (or mainly) those artifacts on which archaeologists confer distinctive typological names. Two separate matters have become unnecessarily intertwined here: namely, the analytical classificatory *re*cognition of taxonomists on the one hand, and whether that might or might not reflect intentional cognition in Paleolithic behavior on the other.

Taxonomy uses an eliminatory analytical methodology to separate and recognize non-identical things in exclusive fashion. This does not imply that somehow ^{14}C with atomic weight 14 is somehow "less carbon-like" than is carbon of atomic weight 12, or that *Pan paniscus* is somehow "less chimpanzee-like" than is *Pan troglodytes*. The reason is simple. It is because analytical taxonomy can only order non-identical things in terms of those similarities or differences for which a particular eliminatory methodology was designed. Atomic numbers separate carbon from silicon, and chromosomal numbers separate chimpanzees from human beings. Taxonomies help us to order non-identical things, and to infer possible structural relations between them; though these inferences may differ, depending on the methodology used – and also on the choice of non-identical things to study: this latter aspect is relevant here. Fifty years ago, specific separation of *Pan paniscus* from *P. troglodytes* was regarded more as a conjectural possibility than as being a well-defined scientific working hypothesis that had withstood attempts to falsify it. But let us beware. Molecular genetics suggests that the two species separated not much before the onset of the Quaternary. Evolution is a dynamic concept about non-identity (descent with modification via natural selection), not a static one. Would we really have recognized what seems quite likely to have evolved, were we to have gone on regarding them all, in undifferentiated fashion, as "just chimps", no more and no less? Put another way, by picking away at differences, sometimes it may just be possible to propose their separation in terms of spatio-temporal chains – but only, of course, as a working hypothesis open to refutation. That refutation may involve showing that bonobos and common chimps are but one species, or that hand-axes and Levallois blanks are all much of a muchness in a more general context of nondescript flake-production or mere rock-smashing; we shall return to this aspect later on. It is worth remarking that formal taxonomy need bear no relationship to the cognition of participants. Thus, in the New Guinea Highlands, neither knappers nor other members of their community invariably agree on how to name knapped stone artifacts, and those names by no means always correspond to exclusive taxonomical categories, as defined in terms of the formal characteristics of the artifacts knapped (White and Thomas, 1972): this shows that formal taxonomy need not imply a strong correlation between a knapper's intention with regard either to future use of artifacts or their form, nor yet how bystanders choose to name and use them. *Recognition* (archaeological taxonomy) need hardly be the same as hominin *cognition* ("mental templates"). The taxonomy of Paleolithic artifacts is able to point toward matters of interest, taking due precautions, at the much coarser-grained Pleistocene spatio-temporal level. Of course, different or alternative classificatory systems can be constructed, depending on the questions to be addressed. Questions about Paleolithic cognition have as yet to form the basis of a workable Paleolithic taxonomical system.

It is quite plausible that those artifacts which particularly have aroused the "interest" of archaeologists were outcomes of *chains of activities*, involving often more than one actor, from searching for and retrieving raw materials, to knapping processes that went beyond a single knapper's *chaîne opératoire* and extended to use (edge-damage micro-scars), and refashioning at a later time (patinated flakes were reworked sometimes at Cueva Negra). Maybe, therefore, intentionality should be interpreted less in terms of a single individual's fully self-aware intentions, and more, by reference to evolutionary biology, as results and by-products of *highly constrained* (almost deterministical) chains of complex activities that afforded tried-and-tested *adaptive value* to evolving hominin *communities* which as yet possessed only an emergent cognitive capability that was unspoken and unconscious, not yet self-aware or spoken aloud, though perhaps this itself might have been an "exaptation" that reflected the coopting of brain circuitry, which similarly may well have enabled dispersal of social groups of Plio-Pleistocene hominins (cf. Gamble, 1993:99, 111).

A widely-held conjecture is that, before the late Middle and Upper Pleistocene, hominin cognition did not resort to fully declarative, abstract planning (for which language is assumed to be a prerequisite), even though, by the onset of the Quaternary, there are traces of "preoperational" behavioral development (by reference to Jean Piaget's stages of children's psychological development, in which that stage involves mental representation and language), that was more complex than that of great apes whose rudimentary capacity for planning can nevertheless embrace strategical representation of multiple goals (cf. Parker and Milbrath, 1993). But is hominin cognitive evolution commensurable with the sequence of psychological development of modern children, let alone comparable to it? Whereas non-human anthropoids show very slow development of logical planning from a stage of physical responses characterized by rudimentary signalling, in human infants physical and logical domains of cognition develop *together* in recursive fashion very early in life, such that second-order cognition is well-established by two years old, including reversibility and substitution when playfully manipulating non-representational objects (Langer, 1986, 2000). This logicomathematical appreciation of combinativity is present in human infants *before* they can talk. Far from language being a prerequisite for such appreciation, logicomathematical cognition is almost certainly a prerequisite for acquisition of language. (In apes, even rudimentary attainment of logicomathematical cognition is barely reached by five years of age, unless there is intervention by human handlers.) Wynn's "constellations" of knowledge, which imply reversibility, underpinned the Paleolithic knapping undertaken to fashion blanks or remove and even modify flakes (Wynn, 1993). A *fuzzy* view of "mental templates" looks very like these "constellations" – *accurate* as regards my needs and wants, rather than a *precise* protocol of how to attain them.

Although Wynn's "constellations of knowledge" say little about Paleolithic language, he points out that this does not necessarily imply that stone products could never have been regarded as signifying an indexical relationship in some contexts (Wynn, 1993). It is quite possible that some circumscribed assemblages of ancient Paleolithic artifacts were products of one or very few individuals, or in other cases were products of populations (societies or communities) with particular traditions or tendencies of knapping. Some exercises in complex statistical analysis of Acheulian bifaces have pointed towards such possibilities (among many publications, the following are a representative sample of a wide range: Ashton and White, 2003; Crompton and Gowlett, 1993; Gowlett and Hounsell, 2004; Roe, 1968; White, 1998; Wynn and Tierson, 1990). Interpretation of results has invoked, variously, differences in tradition, raw material, function, or extent of reduction. Advances in rigorous multivariate statistical methodology applied to numerical taxonomy and spatial analysis have led to reconsideration of findings that had been deployed in support of some interpretations (McPherron, 1999, 2000) – though it seems quite possible that there is no single, "one-size-fits-all", interpretation. This is definitely not the place for yet another review of a very wide-ranging topic, both because some matters are still unresolved, and, more important, because several of them refer to finer-grained aspects of the hominin record than the coarse-grained matter in hand of alternative behavioral choices that were made by some hominins at the Lower-to-Middle Paleolithic transition in western Europe. How did these arise? What do they imply for cognogenesis and the evolution of hominin consciousness in the Middle Pleistocene. Did most Middle Pleistocene hominins in Africa and Europe possess similar capabilities?

As Wynn (1995) put it: "it would be difficult to overemphasize just how strange the handaxe is… it does not fit easily into our understanding of what tools are, and its makers do not fit easily into our understanding of what humans are." It is also worth bearing the matter in mind when considering Levallois cores. Although the "standard interpretation is that a core was prepared in such a way that a flake of predetermined shape could be removed… it does not seem likely that such cores represented a novelty in planning beginning at the time the Levalloisian technique is said to appear. Rather, such cores had been used for producing flakes almost from the very beginning, and continued to be so used even after knappers began to strike large flakes from them" (Noble and Davidson, 1996:200). It is time to return to the Paleolithic record.

In Israel, the Lower Pleistocene site of 'Ubeidiya in Israel, around 1.4 m.y.a., has hand-axes and cleavers in its later layers in addition to the Oldowan-like artifacts of the earlier ones (Bar-Yosef and Goren-Inbar, 1993), and at the Lower-Middle Pleistocene boundary, around 0.78 m.y.a., the site of Gesher Benot Ya'akov also has hand-axes and cleavers fashioned on large, pre-planned flakes (Goren-Inbar and Saragusti, 1996; Goren-Inbar *et al.*, 2000); similar flakes were also used to fashion cleavers found at several Spanish and southern French sites of the Middle Pleistocene, and further north in Europe hand-axes were not uncommonly made on large flakes (though in the main nodules were preferred, especially nodules of good flint), as, indeed, were cleavers occasionally (Villa, 1983:204–205 and refs). In Spain, discoidal technology is in evidence at the Lower-Middle Pleistocene boundary in the Gran Dolina at Atapuerca (Vaquero and Carbonell, 2003). Several European Middle Pleistocene sites have flaked discoidal cores that were not subjected to Levalloisian flake-extraction, and, particularly at early sites, flakes struck off them have simple, plane striking-platforms, a few dorsal scars, and tend to be thicker than typically Levallois flakes, whereas at later sites similar Levallois flakes were struck from discoidal and Levallois cores alike (Villa, 1983:201–202). What is beyond all doubt, is that there was a far more ancient African origin, in the Lower Pleistocene, both for bifacial fashioning and pre-planned removal of prepared large flakes. From the outset, both seem closely related; the cognitive processes involved must have an ancient origin indeed.

Much less ancient, however, is the preparation of small cores for removal of small, pre-planned flakes: this is the Levalloisian technique *sensu stricto*. It appears no earlier in the African Middle Pleistocene than it does in Europe. Both Levalloisian cores and blades come from site GnJh-17, nearly 0.3 m.y.a., in the Kapthurin Formation in Kenya (Cornelissen, 1992; McBrearty *et al.*, 1996; McBrearty and Brooks, 2000; Tallon, 1978), and some, indeed, come from even older beds in that Formation (e.g., K2: McBrearty *et al.*, 1996), which also contains Acheulian, Sangoan and “Fauresmith” artifacts. Some blades were struck from prismatic cores, whilst others were removed by Levalloisian reduction of tabular cores (McBrearty *et al.*, 1996), a technique known also in the European early Upper Pleistocene (cf. Mellars, 1996: 80–84). The East African Early Stone Age with Acheulian bifaces is followed by the Middle Stone Age, which is characterized by Lupemban backed flakes at the Zambian site of Twin Falls, about 0.25 m.y.a. (Barham, 2002; Barham and Smart, 1996). Middle Stone Age assemblages dating from a similar period come from Gademotta in Ethiopia and the Malewa Gorge in Kenya (McBrearty and Brooks, 2000). The period of 0.25–0.2 m.y.a. corresponds to the beginning of the Mousterian in the Levant, according to recently revised geophysical dates (Mercier and Valladas, 2003; Porat *et al.*, 2002) which are slightly later than previous estimates (Bar-Yosef, 1995 and references); it was preceded there by Acheulo-Yabrudian assemblages, some of which show evidence of Levalloisian flakes, though “…reconstruction of operational sequences has not identified a well-identified Levallois method” (Bar-Yosef, 1998).

It is improbable, to say the least, that one and the same hominin species was responsible for Levalloisian flaking over a period of a million years. A *reductio ad absurdum* of that opinion would require it to have been always *Homo sapiens*, given both that elongated points on facetted-platform flakes, bearing uncanny resemblance to Levalloiso-Mousterian forms, existed on the Indonesian island of Sulawesi at about the time of the last glacial maximum (Glover, 1981), and also that Levalloisian flakes are sometimes found in Australia (Dortch and Bordes, 1977); the same goes for hand-axes around the world, given that they also are known from Australia (McCarthy, 1976: 21, 24:Fig. 8). Much less can blades be regarded as the handiwork solely of modern humans, given both that they were being made at Liang Bua on the Indonesian island of Flores, at about the time of late glacial maximum, by *Homo floresiensis* whose expert skill and long-term working memory were not incompatible with a diminutive *erectus*-shape brain of barely 400 cubic centimeters (Brown *et al.*, 2004; Falk *et al.*, 2005; Morwood *et al.*, 2004), and that blades are known also from ancient Quaternary sites, which led Bar-Yosef and Kuhn (1999) to conclude, “...there is no direct evidence that the earliest blade industries are associated with anatomically modern fossils... the most parsimonious interpretation of current knowledge is that the pre-Upper Paleolithic blade technologies in Europe, the Near East, and Africa were produced by a variety of members of the genus *Homo*, perhaps including anatomically modern humans but certainly also including other taxa such as Neanderthals or *H. heidelbergensis*”.

In like vein, it seems that not only has Levalloisian flaking been practised by *Homo erectus/ergaster*, *H. heidelbergensis* (to the north as well as to the south of the Mediterranean Sea), Neanderthals and modern humans, but also that the overwhelming evidence that is needed, in order to implicate late Middle Pleistocene Neanderthals as the first bearers of Levalloisian techniques of core-preparation and flake-removal, from Africa to Europe, is conspicuous by its absence from the Paleolithic record of the Near East and Europe – whilst in Africa there are no Neanderthals. Were it not for clear evidence of Levalloisian flake-removal, the Cueva Negra assemblage might be regarded as just one more European Middle Pleistocene site, among many, with coexistence (or, at any rate, rough contemporaneity) between Acheulian bifacial core-reduction, and “proto-Charentian”, “pre-Mousterian”, “proto-Mousterian”, “Archaic Mousterian”, or “Mousteroid”, flake assemblages, which may include several small artifacts that would be quite in place in Mousterian assemblages, but which also contain many forms that would be considered as being “atypical” forms from the standpoint of François Bordes’ classification of Mousterian “tool-types” (Bordes, 1961a; cf. Debénath and Dibble, 1994). Terra Amata is a site with a typically wide range of forms, from hand-axe and cleaver forms (several on limestone), to scrapers, denticulates, chopping-tools, flaked pebbles and other relatively informal artifacts; thermoluminescence suggests an age of 0.25–0.2 m.y.a. (Villa, 1983). Some well-known western European Middle Pleistocene small-tool assemblages may be older than Cueva Negra (e.g. High Lodge; Baume Bonne, Caune de l’Arago) and others are perhaps not much younger (e.g., Vértesszőlős; Bilzingsleben); the English site of High Lodge cannot be later than 0.5 m.y.a., which, to put it mildly, puts a question mark over attempts to conjure up quasi-phylogenetical trajectories for stone tool-types in the European Middle Pleistocene (Ashton and McNabb, 1992). Still in England, from about 0.4 m.y.a. (OIS 11) there are Levallois-like cores at Rickson's Pit at Swanscombe, near London.

Several of the assemblages mentioned above have been compared with "Clactonian" and "Tayacian" industries, though they may contain a variable number of hand-axes or other bifacial forms (it is curious coincidence that, as at Cueva Negra, a biface at Caune de l'Arago was made on a flat cobble: de Lumley, 1971:307:Fig. 275), and Mousterian-like abrupt retouch of flake edges may occur also in some of those assemblages, though irregularity in shapes of many of them separates those assemblages from later Mousterian sites, especially those where more or less regular and repeatable flake shapes were reproduced by means of Levalloisian reduction of prepared cores (Boëda, 1994; Bordes, 1951; Inizan *et al.*, 1999: 63–68; Mellars, 1996:61–72; Van Peer, 1992), though archaeological statistical data fail to corroborate, and may, indeed, refute, a widespread popular conjecture that such shapes were somehow preconceived, or predetermined, by Paleolithic knappers (Dibble, 1989; Noble and Davidson, 1996:200–203). Although various types of these prepared cores are acknowledged (Bordes, 1980), they all permit economical use to be made of the volume of a small core, with regard to removal from it of useful small artifacts (McBurney, 1975). This property would have been particularly useful in regions lacking good quality chert, such as that around Cueva Negra where use of good quality chert for Levalloisian flakes, and limestone cobbles for Acheulian bifacial fashioning, suggests that Paleolithic knapping was not so much "driven" by the kind of stone to hand, as capable of choosing one kind of stone for one kind of knapping, and another for another.

Levalloisian artifacts come from terrace sediments of the River Somme, near Amiens in France, some of which are of penultimate interglacial and antepenultimate glacial, age (Bourdier *et al.*, 1974), whilst others are older still, corresponding to OIS 11 and 12 at Cagny-la Garenne (Boëda, 1994:7; Bordes, 1961a:17; Tuffreau and Antoine, 1995) where Acheulian and Levalloisian are found together, as they are also at Orgnac in southern France (Combier, 1976) where the Levalloisian first appears at 0.325 m.y.a. in a deep OIS 9 sequence that spans 0.35–0.28 m.y.a. acording to thorium-uranium and electron spin resonance determinations (Combier, 2005). The Levalloisian core-reduction sequence, with Mousterian retouch of flakes thus removed, was present at about 0.25 m.y.a. at Maastricht-Belvédère in The Netherlands (Roebroeks, 1988; Roebroeks *et al.*, 1992; van Kolfschoten and Roebroeks, 1985). Mousterian assemblages in France from the early Upper Pleistocene or late Middle Pleistocene do not imply presence of the Levalloisian core-reduction sequence (Bordes, 1951, 1953, 1961a, 1961b; Bordes and Bourgon, 1951), and the "Levallois Index" was designed to reflect the extent of variability of its presence or, indeed, absence from different French Mousterian assemblages. Mellars (1996) has given a timely reminder of the extraordinary wide range of Mousterian variability. It is timely, because there has been a growing tendency to presume that which it ought to be the task of archaeological inquiry to demonstrate, namely, that Mousterian artifacts cannot, or should not, be recognized unless, or until, the Levalloisian core-reduction sequence had appeared or arisen. In part, this owes to greater appreciation of how the wide variety of acknowledged Levalloisian products was achieved, involving – most important – the corresponding technical choices a knapper had to make, and a plausible conjectural inference that those may imply a knapper's conceptual framework for Levalloisian core-reduction that differed sharply from that required for other kinds of discoidal core-reduction (Boëda, 1994), though refitting of some Levalloisian products leaves open the matter of just how far a knapper's perception of what was feasible for a particular core influenced the corresponding core-reduction strategy employed (van Peer, 1992). What is important here from the standpoint of Middle Pleistocene hominin cognition is the time-depth of the Levalloisian concept, which regarded as being 400,000–500,000 years by Boëda (1994).

French Paleolithic archaeologists have long considered that different kinds of Upper Pleistocene Mousterian assemblages might reflect continuity with particular Middle Pleistocene precursors, in terms of variable presence or absence of bifacial artifacts, variable presence or absence of Levalloisian core-reduction, and variable presence or absence of different kinds of formal small tools (Bordes, 1953a, 1961a, 1973; Bordes and Bourgon, 1951; Bourgon, 1957; de Lumley, 1969, 1971, 1975, 1976). More heat than light was generated by disagreements over preferred permutations and combinations. So what are we to make of resemblance between Mousterian convex scrapers and "proto-Charentian" ones from the "Tayacian" assemblage at Caune d'Arago (de Lumley, 1971, 1975, 1976), or similar ones from the "Clactonian" assemblage at the late Cromerian site of High Lodge (Roe, 1981: 238–240)? It has been suggested that viewing Palaeolithic artifacts in their local spatiotemporal and paleoenvironmental context should take precedence over quasi-evolutionary conjecture (Ashton and McNabb, 1992). Put bluntly, consideration of likely strategies and techniques for procuring and reducing cores, or even subsequent modification of artifacts, should take precedence over comparison and contrast of artifact type-lists at different assemblages. Derek Roe (personal communication) has suggested that good flint may have predisposed to Mousterian-like retouch at High Lodge. When he visited Cueva Negra del Estrecho del Río Quípar he acknowledged that he found the poor-quality local chert very hard to knap: nevertheless, we have excavated pieces here with Mousterian-like abrupt edge-retouch, so might not this imply Middle Pleistocene perception that some unpromising edges could, indeed, be strengthened by particular kinds of edge-retouch? Might that imply expert aptitude, retained in long-term working memory as unconscious, intuitive, recognition of ever-present technical matters that impinged on daily life?

There is undoubtedly wide variety in European Middle Pleistocene assemblages of small artifacts, and some well-known ones do not look much like harbingers of the Mousterian, though they share aspects with "Tayacian" or "Clactonian" assemblages elsewhere (e.g., Vértesszőlős: Kretzoi and Dobosi, 1990; Bilzingsleben: Mania, 1995; Weber, 1986). As Gamble (1986:178) remarked, "they have little temporal ordering and resemble nothing so much as a well-stirred minestrone soup of types and techniques that coagulate into industries on the end of the taxonomist's spoon". Putting the matter another way, the whole notion of "Mousterian" may not be particularly helpful to Paleolithic archaeologists beyond serving as short-hand for labelling assemblages with abundant regular and repeatable flake shapes which may often show different particular kinds of retouch repeatedly. Levalloisian core-reduction is not a *sine qua non* of such assemblages, though at Cueva Negra it is just as ancient as are, say, the convex-flake scrapers from High Lodge. The diversity of both those Cromerian sites highlights the early expert versatility that was present in the European Middle Pleistocene stone-working, in environments, with widely differing availability of suitable raw material for knapping, which were sparsely inhabited and widely separated. Perhaps designation of some assemblages as "Mousterian" need reflect no more than growing demographical abundance and density of knappers from the late Middle Pleistocene onwards, regardless of whether the hominins were Neanderthals in some parts of the world, or, in others, more similar to modern humans, skeletally-speaking: especially, perhaps, if *all* of those were to have been descendants of *H. heidelbergensis*, whether North or South of the Mediterranean Sea. We would do well to bear in mind that it took several years of argument to banish unnecessary methodological conjectures that purported to attribute allegedly different French Mousterian variants to correspondingly different hypothetical biological communities in France during the earlier Upper Pleistocene. Scant progress can seriously be claimed to have been achieved in paleoanthropology when similarly self-justifying assertions are made about the likely correspondence of the beginnings of this or that core-reduction technique with this or that African species of *Homo*, each of whose dispersals gave the rest of the world something new. The task of Science is to separate a working hypothesis which is useful for further inquiry from what is not: to separate it from poorly-supported conjectures that are less useful, in so far as they require self-justifyingly accommodative, subsidiary, arguments, in order to take account of awkward findings. In plain Popperian terms, the job of Science is to seek out where useful working hypotheses can open up a breach in our expectations, and to follow up their leads, while, for the time being, putting on one side preoccupations with those conjectures that have been seen to lack support, or found wanting, in the universe of material phenomena they had purported to interpret, more or less rationally, hitherto.

In order to address the matter of more useful and less useful hypotheses about early Middle Pleistocene hominin behavior in Europe it is appropriate to begin with the forthright statement made two decades ago by Gamble (1986:117), "…the application of the terms lower and middle palaeolithic to European data is no longer instructive about the relative levels of technological attainment". There can be no doubt that the antiquity of the English site of High Lodge undermined "…the notion that not only should there be a European framework for understanding the Lower and Middle Palaeolithic, but that this framework should be structured within an evolutionary model" (Ashton and McNabb, 1992:165); the same authors go on to say "…the way sites have been compared often over long distances has created a false sense that patterns can be recognised, initially by using type fossils, and more recently by the creation of a type list… little heed has been taken of the effects of site use or of the supply and quality of raw material on assemblage formation" and they make an interesting comment, which may well be relevant to Cueva Negra, that "…in the absence of large flakes for chopping… other forms such as chopping tools or bifaces might be made". A similar reassessment has resulted from the French site of Cagny-La Garenne, where "…the appearance of the Levallois débitage is situated in a context of handaxe production, indicating a conceptual link between the flaking of handaxes and the emergence of the Levallois flaking methods… that stresses the artificial character of the classical break between the Lower and the Middle Palaeolithic" (Tuffreau and Antoine, 1995). The same authors highlight "…linkages between methods of handaxe production and methods of Levallois débitage. Some handaxes broken during flaking have yielded a large *éclat préférentiel*", and they illustrate a hand-axe one surface of which has a long, wide flake-scar extending from the butt towards the point (Tuffreau and Antoine, 1995:153:Fig. 6:2), described as "a negative of a removal similar to a Levallois flake" (similar observations were made by Agache, 1976:129:Fig. 50, "l'empreinte d'un éclat pseudo-Levallois"; see also Breuil and Kelley, 1956:Fig. 6).

The linkages – which also seem to have existed in the Acheulo-Levalloiso-Mousteroid assemblage at Cueva Negra – are nowadays considered to be very important. In order to understand why, it is helpful to bear in mind the distinction that was proposed between "façonnage", or fashioning of blanks, and "débitage", or pieces thus removed, in sequences of blank-reduction (Boëda *et al.*, 1990). Based on that distinction, a further consideration has since been offered, which is of fundamental importance. It is that, whereas, on the one hand, the execution of both Acheulian bifaces and Levalloisian core-reduction can be regarded as examples of *both* façonnage *and* débitage that were effected in relation to a notionally stable secant plane (slicing, as it were, across a blank or core, thereby affording a possible controlling referent during knapping), on the other hand, in the absence of a notionally stable secant plane the resulting forms may be more irregular, be they chopping tools on cores or "Clactonian" flakes, owing to a "more random, non-secant… migrating plane technology" (White and Pettitt, 1995). It is as if knapping outcomes may be imagined in relation to two perpendicular axes which form a cross, where one axis has as its opposing poles *façonnage* and *débitage* (let us say, top and bottom, respectively), and the other has as its opposing poles *presence* and *absence* of secant-plane control (let us say, right and left, respectively). The Cueva Negra assemblage contains examples of all four outcomes and thus encompasses the intersection of both axes, though with preponderance in the *débitage* and *absence* (lower left) quadrant. This is perhaps what might be expected of an early European Middle Pleistocene assemblage with much unpromising raw material on which were applied knapping techniques that produced outcomes varying both in aspect and amount.

White and Pettitt suggested that, vis-à-vis more random, migrant-plane knapping, there was gradual increase, over time, in secant-plane controlled façonnage in the reduction of blanks and cores, which necessarily produced and reproduced a limited range of débitage. They proposed that Levalloisian flake-removal was a dependent consequence of secant-plane controlled fashioning of Levalloisian cores, which developed alongside secant-plane controlled fashioning of Acheulian bifaces, rather than hundreds of thousands of years later, notwithstanding the clearly very different respective knapping sequences involved in reducing the blanks in question; in the case of hand-axes with an S-twist like the one at Cueva Negra, it was perhaps less a secant plane, in strict geometrical terms, than an unequal concavo-convex surface, as if it were a roughly horizontal ripple slicing diagonally across the longitudinal axis. White and Pettitt conjectured that "changing environments and resulting mobility strategies" may have led to variation between assemblages of débitage facies. In particular, they suggested that Levalloisian cores and flake-removal may have been better suited to mobile behavior because those allow more flexible applications than do hand-axes, whilst they nevertheless maintain that "…bifaces were transported as finished tools with limited flexibility". Their suggestion is an attempt to address why it is that "Lithic products which are made on exotic or imported materials, whilst rare… are often Levallois". This may very well be relevant to the Cueva Negra Levalloisian artifacts that are of better-quality chert than most of the chert that is available near the site. What is particularly attractive about those considerations is that they allow a unitary interpretation for the apparently heterogeneous assemblage at Cueva Negra, in which such different secant-plane products as a hand-axe and Levalloisian blanks and flakes occur together with non-secant, migrating-plane products on poor-quality chert and limestone, ranging from plane-platform flakes and fragments with edge-retouch to informal artifacts without retouch.

Given that some artifacts have abrupt Mousterian-like edge-retouch, it seems as if several aspects of the Levalloiso-Mousterian package were already present in the Acheulo-Levalloiso-Mousteroid assemblage at Cueva Negra 0.5 m.y.a. Perhaps labelling some assemblages as "Mousterian" reflects growing demographical abundance and density of knappers from the late Middle Pleistocene onwards. In those Paleolithic communities which experienced greatest demographical abundance, the acceleration, in rate and frequency, of interpersonal relations may have led to positive feedback in non-linear fashion with cascade effects, thereby further channelling those lines of future self-organization that would be followed, with abandonment of others. Perhaps one that would be followed was a growing tendency towards débitage assemblages, and towards their production governed by secant-plane techniques, perception of which could have gone hand in hand with neuro-anatomical "exaptations" in brain-circuitry favouring non-linear evolution, in self-organizing manner, in larger-brained, later Middle and early Upper Pleistocene hominins. If natural selection came into play at both biological and behavioral levels, advantages accruing from débitage assemblages such as those of the Mousterian could have permitted growing demographical abundance and density of those hominin communities in Africa, southwestern Asia and Europe.

Such hominins could well have possessed expert aptitudes controlled by long-term working memory (from stone-flaking to language, including survivability and reproduction in changing or strange habitats), even if their working-memory capacity remained limited (with regard to domain-free intentions or decisions) until mid-Upper Pleistocene humans attained enhancement of working memory (enabling them to undertake rapid adjustment, to experiment and innovate, and to sustain attention by puzzling over how to try to new problems or face up to new or changing circumstances; cf. Wynn and Coolidge, 2004). Elsewhere we have suggested that Middle and early Upper Pleistocene hominins may have flourished only in widely-separated localities privileged with biodiversity, in which rare sites with deep stratigraphy like Cueva Negra stand out as if to signal to us, or hint at, a role of a microenvironmental anchor for hominin communities that were quite limited in their ability to survive in more challenging circumstances (Walker, Gibert, Eastham, *et al.*, 2004). With regard to a particular Levalloisian knapping sequence, analyzed at the Middle Pleistocene site without hand-axes of Maastricht-Belvédère, Schlanger (1996) has argued convincingly for presence of an underlying "plan-like principle" that set out a practical objective whilst letting the knapper monitor the work in hand so as to allow transformation in a fluid yet structured "configuration of possibilities".

Coolidge and Wynn (2005) remark "Early stone-knapping techniques like Levallois… and early stone tool types such as twisted profile handaxes appeared at least 300,000 years ago and would appear to require a complexity of images held in the visuospatial sketchpad of working memory… No more complex form of stone knapping *ever* appears" (their emphasis). Although they suggest that enhancement of working memory might well have evolved first of all in a domain-free context of working memory (in the prefrontal cerebral cortex), they do not rule out a possibility that it could have occurred in an important domain-specific subsystem of memory elsewhere in the brain. Whilst preferring here the verbal (phonological) subsystem, they do not rule out the spatial (visual) subsystem and comment that "the visuospatial sketchpad may be the older of the two systems. Certainly, early stone-knapping techniques like Levallois suggest complex motor skills and procedural memory… Rossano (2003) has recently proposed that the deliberate practice required in becoming a skilled stone tool-knapper may have served as one of the original bases for consciousness… deliberate practice requires evaluation of one's own performance against a more proficient model. This self-monitoring process would require goal-setting, voluntary control over actions, and error-detection and correction. It would also require the recall from long-term memory of hierarchically-organized retrieval structures that have been previously demonstrated to be useful to the task at hand…" According to Rossano, a person's goal-orientated self-monitored striving involved in the *deliberate practice* necessary for achieving superlative proficiency – by self-application and dedication to repetitive rehearsal of those skills that have already been developed to a level of efficient competence – is closely related to development of an individual's insightful awareness and self-consciousness (which repetitively-acquired expertise by itself need not imply): thereby affording escape from that rigidity which is such a prominent characteristic of unconscious behavior (cf. Rossano, 2003:216). Expert aptitudes (efficient competence) of Middle Pleistocene hominins were, plausibly, under the control of their long-term working memory (Wynn and Coolidge, 2004). Does coexistence of alternative knapping sequences, which could and did reduce blanks in different ways in order to make different kinds of stone tools, reflect a capacity for developing innovative *behavioral choices* that imply enough insightful awareness for us to be able to infer enhancement of memory? A difficulty here, however, is that, with regard to subsistence paleoeconomy, the Cueva Negra hominins seem to have been less innovatively proficient than simply locally efficient. But was it, maybe, their range of Paleolithic artifacts, which enabled them to exploit their local environment efficiently?

Did they, so to speak, enjoy an edge over Nature in a singular microenvironment? Is it too much to wonder whether that slight edge provided beneficial circumstances within which alternative Paleolithic working edges came to be knapped? Can this be inferred from the flexibility with which hominins at Cueva Negra were able to execute the very different knapping sequences involved in the bifacial fashioning a cobble into a hand-axe on the one hand, and the Levalloisian removal of flakes from prepared blanks on the other? Perhaps the plan-like principles that set out those different practical objectives, which must have been held in mind as separate and alternative possibilities, whilst at the same time letting the knapper monitor the chosen work in hand so as to allow its transformation in a fluid yet structured configuration of possibilities according to the initial choice of objective, imply that working memory was not held in an iron grip by a single expert aptitude but, instead, could *pick and choose from very different alternatives* stored in long-term memory. Did these choices mean that alternative patterns of behavior had sometimes to be explained verbally to bystanders? Did they come back with, "What if you were to have chosen to make a hand-axe instead of a Levalloisian flake?" Would that have implied the stirrings of enhanced working memory half-a-million years ago in hominin individuals who may have been far removed from modern human ancestors? The answer eludes us.

CONCLUSION

Cueva Negra has an early Middle Pleistocene fauna, hominin remains, and a diverse Acheulo-Levalloiso-Mousteroid assemblage, which in its small way gives a foretaste of that diversity-in-unity which is present in the European early Paleolithic but which by late Middle Pleistocene times was becoming channelled towards the Mousterian.

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