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A View from a Cave: Cueva Negra del Estrecho del Río Quípar (Caravaca de la Cruz, Murcia, Southeastern Spain). Reflections on Fire, Technological Diversity, Environmental Exploitation, and Palaeoanthropological Approaches.

Cueva Negra del Estrecho del Río Quípar overlooking the Río Quípar, a Río Segura tributary, is an upland rock-shelter 75 km north of the Mediterranean coast and 110 km west of the Segura river-mouth. It contains undisturbed sediment 5 m deep assigned by magnetostratigraphy to >0.78 Ma (Matuyama magnetochron). Optically stimulated sediment luminescence dating implies ≥ 0.5 Ma and mammalian biochronology (notably, of Arvicolid rodents) indicates >0.7- <1 Ma. Remains include an "Acheulian" limestone "hand-axe," and small chert, limestone or quartzite artifacts, knapped on site, often by bipolar reduction or repetitive centripetal flaking of small discoidal cores. Secondarily-flaked ("retouched") artifacts include small irregular chert fragments, resembling chert at an adjacent conglomerate outcrop according to laser-ablation inductively-coupled plasma mass-spectrometry of 19 lanthanide elements, though some chert may have been obtained from up to 30 km away. Faunal remains and pollen are compatible with mild (plausibly MIS-21), damp, fluvio-lacustrine environments. Evidence of fire in a deep, sealed layer includes thermally-altered, lustreless and shattered chert, and both charred and white calcined fragments of bone. Taphonomical analysis and electron microscopy of bone fragments attribute discolouration to burning, not to post-depositional mineral staining. Sediment geochemistry and thin-section micromorphology have been undertaken. FTIRS, TL and ESR analysis of chert and bone imply firing temperatures of about 500°C at least. Drawing on findings from Cueva Negra, the purpose of this paper is to offer an interpretation of Palaeolithic activity from the perspective of hominin cognitive versatility, techno-manual dexterity, and palaeoeconomic extractive behaviour in long-vanished Western European palaeoecological and palaeobiogeographical contexts.

KEY WORDS: *Cueva Negra del Estrecho del Río Quípar, Palaeolithic, Modes A-I, late Early Pleistocene, fire, environment, cognitive versatility.*

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1. Introduction, some methodological considerations, and background studies

1.1 Introduction

Cueva Negra del Estrecho del Río Quípar is a large rock-shelter that lies at 740 m above sea level in a north-facing cliff of Upper Miocene bioclastic calcarenite at the outlet of the Quípar gorge (*estrecho*), 10 km south of Caravaca de la Cruz, Murcia (lat. 38.03679 or 38° 02' 5.8" N; long. -1.88494 or 1° 53' 5.8" W). Systematic excavation began in 1990 of the 5 m depth of Pleistocene sediment lying on bed-rock. It has provided an abundant assemblage of Palaeolithic artifacts (Figures 1-6), mainly of small size, of chert and other raw materials (Walker et al., 2013), which shows noteworthy coherence throughout the stratigraphical sequence and includes flakes removed by repetitive centripetal striking of small preferential cores (Mode F: Shea, 2013), several worked fragments and flakes (Shea's Modes C, D, G), including some with steeply knapped edges, keeled or stubby forms, pieces with fine, sometimes surprisingly elongated delicate tips or spurs, a single (Mode E1) bifacially-flaked limestone "hand-axe," as well as bipolar cores (Mode B) and hammerstones (Mode A). There is no chert in the rock walls of the cave; most chert came from a nearby conglomerate outcrop 0.8 km east of the site, though some may have been obtained up to 30 km away from the site according to comparative trace-element analyses by laser-ablation inductively-coupled plasma mass-spectrometry (Zack et al., 2013).

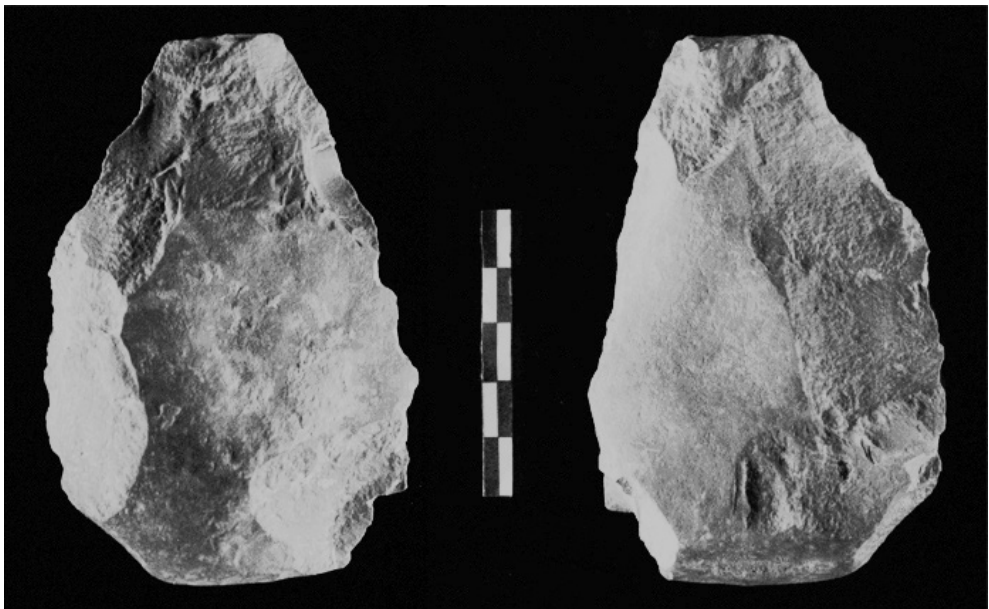
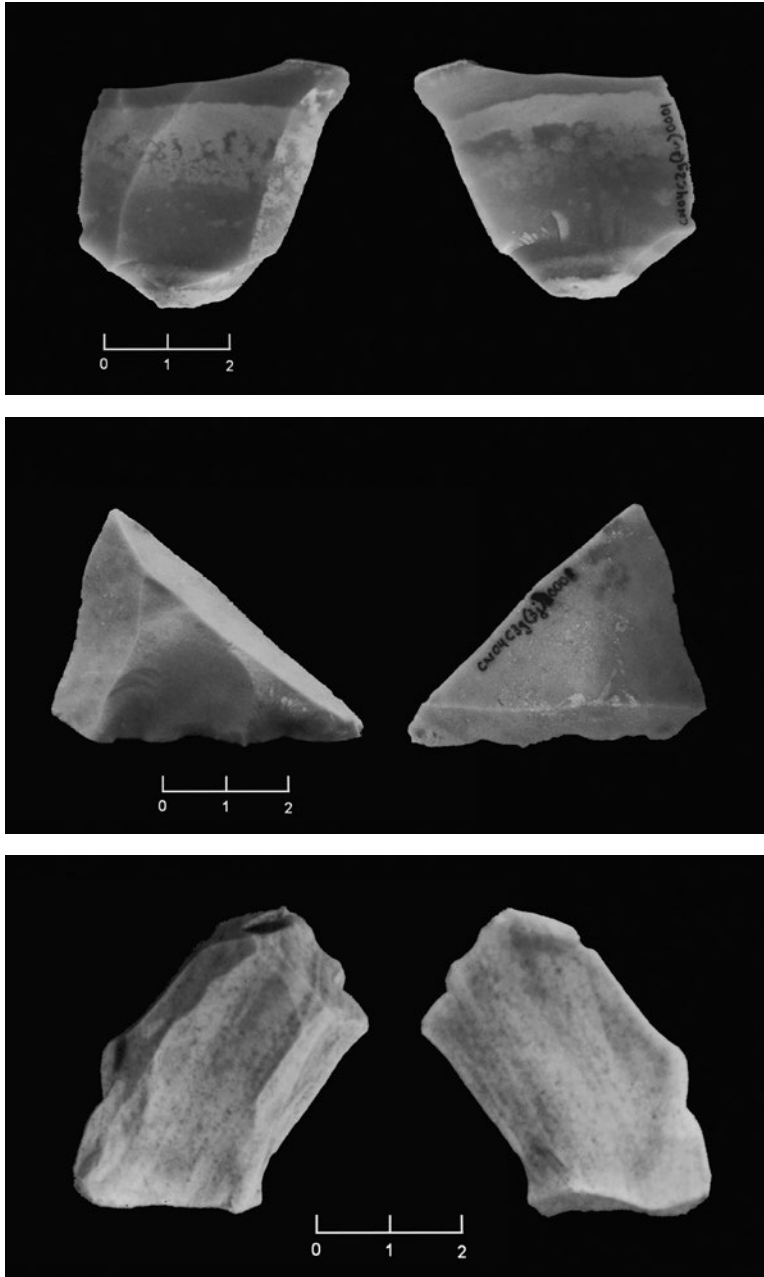


Figure 1. Cueva Negra del Estrecho del Río Quípar: Mode E1 artifact ("hand-axe") on limestone cobble. Scale in centimetres.



Figures 2a, 2b, 2c. Cueva del Estrecho del Río Quípar: chert flakes struck off Mode F cores that previously had undergone flaking. Scales in centrimetres.

Figures 3a, 3b. Cueva del Estrecho del Río Quípar: Mode F cores. Scales in centimetres.

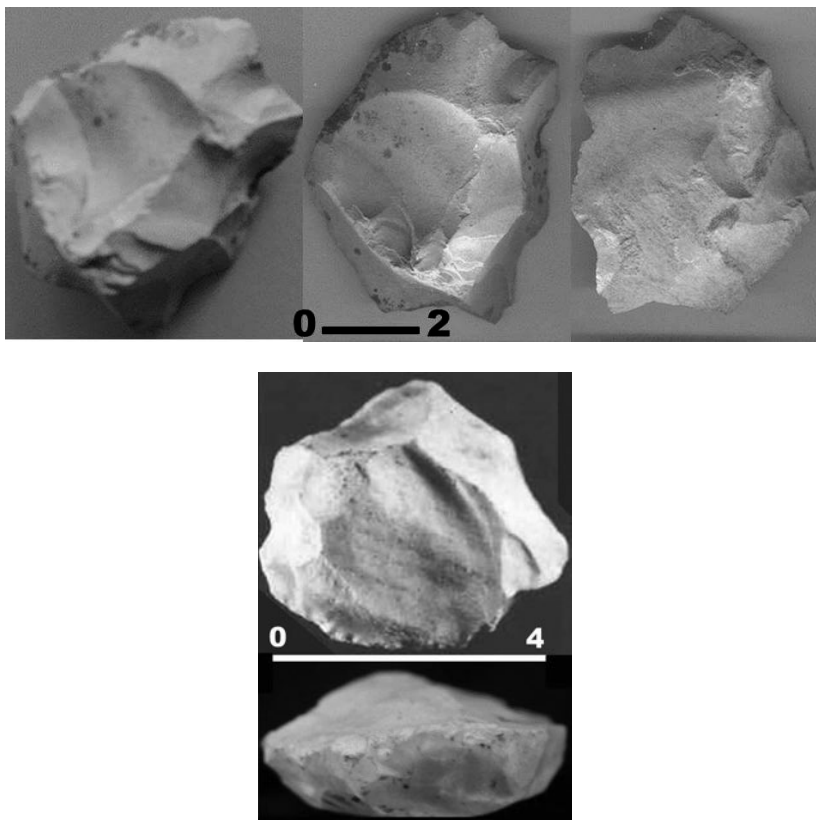


Figure 3a. Cueva del Estrecho del Río Quípar: Mode F limestone core (cf. “preferential” core), found on surface beside cave mouth. Scale in centimetres.

Figure 3b. Cueva del Estrecho del Río Quípar: Mode F chert core (cf. “preferential core”), found on surface of conglomerate outcrop (“quarry site”) 0.8 km E of cave. Scale in centimetres.

Figures 4a-4m. Cueva del Estrecho del Río Quípar: Mode C, NHC non-hierarchical core artifacts (including cores that are flake fragments). Scales in centimetres.

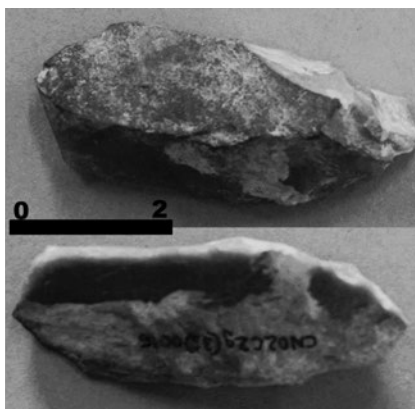
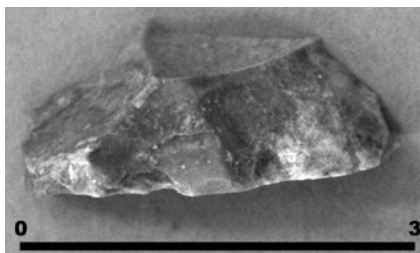


Figure 4a. Cueva del Estrecho del Río Quípar: Mode C NHC “scraper” on flake-fragment chert core (cf. “thumb-nail scraper”), though plausibly it could be a by-product of anvil-supported knapping of a small core itself derived from a flake fragment. Scale in centimetres.

Figure 4b. Cueva del Estrecho del Río Quípar: Mode C (C-2) NHC notched chert artifact (cf. “Tayac point”) on flake core. Scale in centimetres.

Figure 4c. Cueva del Estrecho del Río Quípar: Mode C (C-2) Keeled plano-convex chert artifact (cf. proto-“limace,” “Tayac point,” convergent “scraper”). Scale in centimetres.

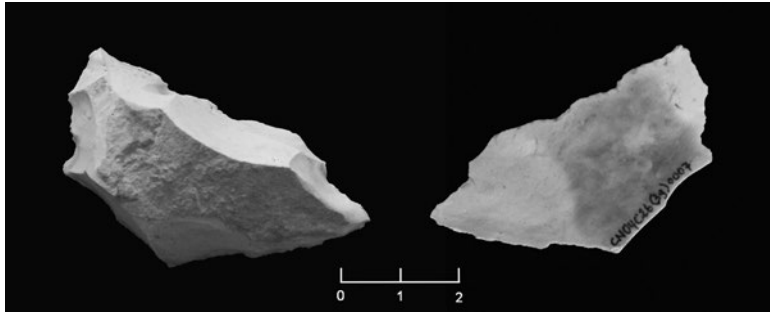


Figure 4d. Cueva del Estrecho del Río Quípar: Mode C (C-2) Keeled plano-convex chert artifact (cf. proto-“limace,” “Tayac point,” convergent “scraper”). Scale in centimetres.

Figure 4e. Cueva del Estrecho del Río Quípar: Mode C (C-2) Keeled plano-convex chert artifact (cf. proto-“limace,” “Tayac point,” convergent “scraper”). Scale in centimetres.

Figure 4f. Cueva del Estrecho del Río Quípar: Mode C (C-2) stubby flake modified by large flake-removals forming a point that bears scars of very small unidirectional flake-removals (cf. “awl”). Scale in centimetres.

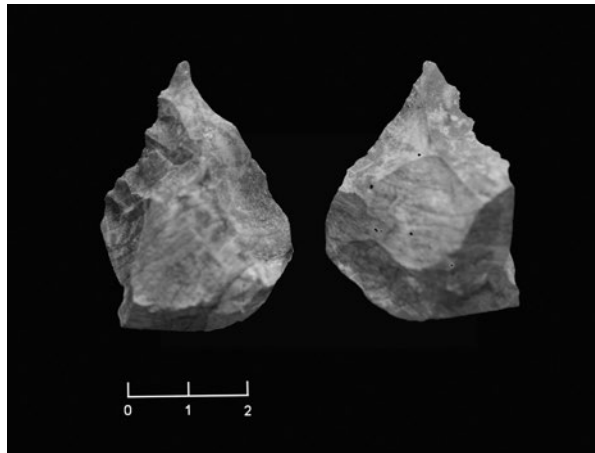
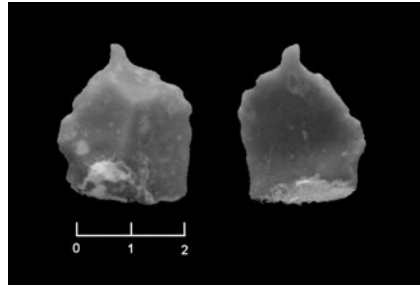


Figure 4g. Cueva Negra del Estrecho del Río Quípar: Mode C (C-2) thick flake modified by flake-removals forming a point (cf. “awl”). Scale in centimetres.

Figure 4h. Cueva Negra del Estrecho del Río Quípar: Mode C (C-2). Stubby flake modified forming a point. Scale in centimetres.

Figure 4i. Cueva Negra del Estrecho del Río Quípar: Mode C (C-2). Core modified forming a point. Scale in centimetres.

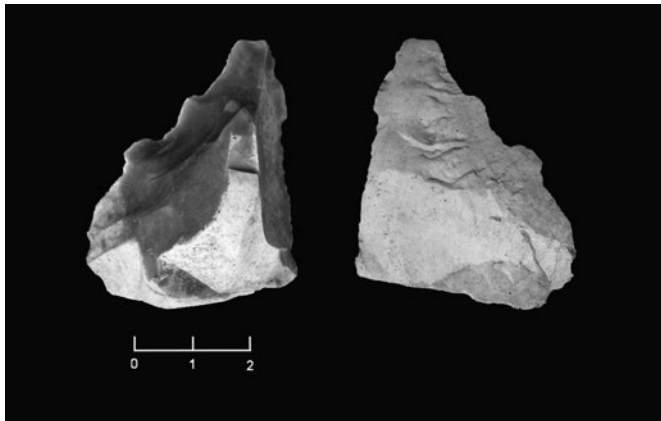
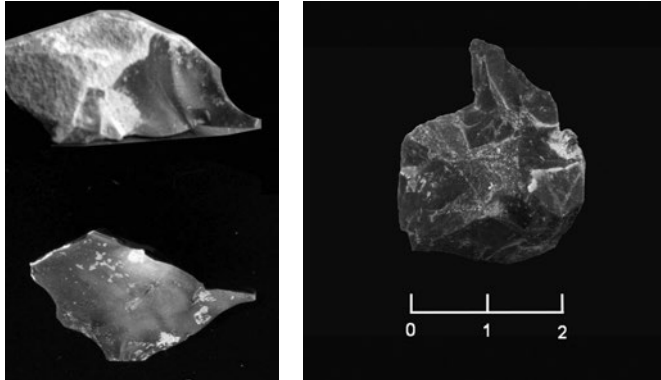
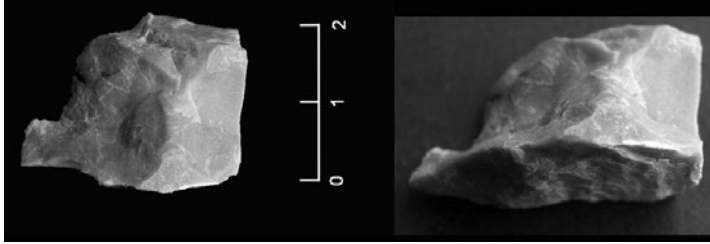


Figure 4j. Cueva Negra del Estrecho del Río Quípar: Mode C (C-2). Core modified forming a spurred point. Scale in centimetres.

Figure 4k. Cueva Negra del Estrecho del Río Quípar: Mode C (C-2). Core modified forming a spurred point. Scale in centimetres.

Figure 4l. Cueva Negra del Estrecho del Río Quípar: Mode C (C-2). Core modified forming a spurred point. Scale in centimetres.

Figure 4m. Cueva Negra del Estrecho del Río Quípar: Mode C (C-2). Core modified forming a point. Scale in centimetres.

Figures 5a-5s. Cueva Negra del Estrecho del Río Quípar: Mode D chert flakes showing secondary knapping (“retouch”). Scale in centimetres.

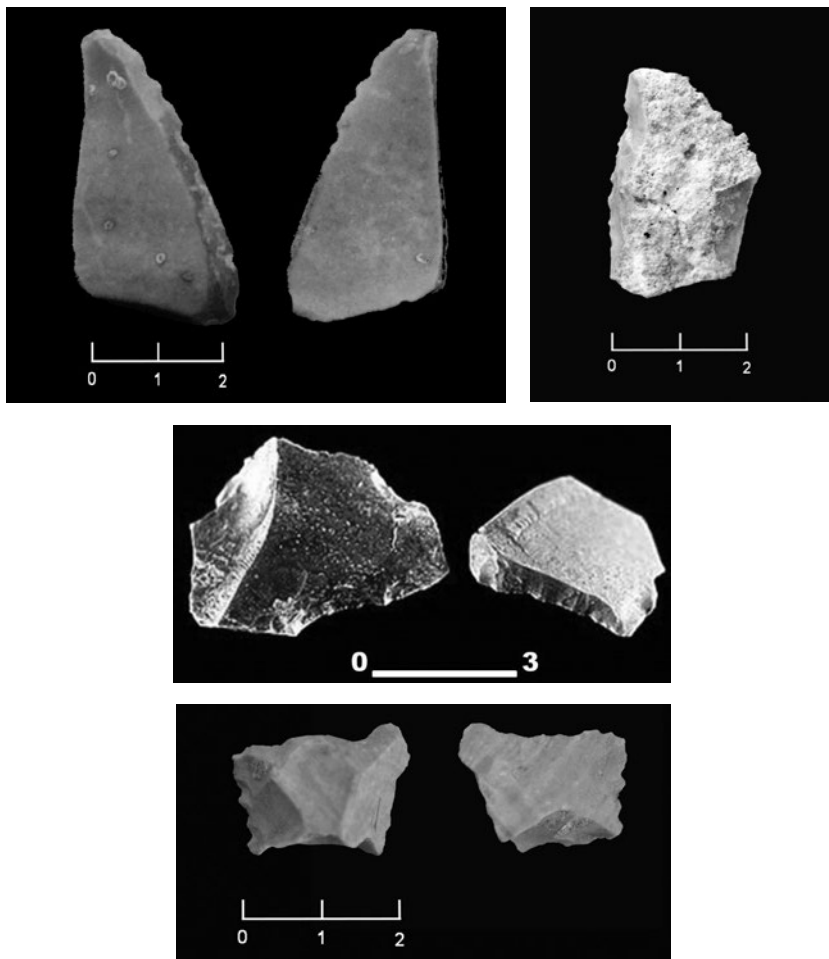


Figure 5a. Cueva Negra del Estrecho del Río Quípar: Mode D (D1) chert flake with abrupt secondary knapping (“retouch”) of one edge. Scale in centimetres.

Figure 5b. Cueva Negra del Estrecho del Río Quípar: Mode D (D1) chert flake with abrupt secondary knapping (“retouch”) of one edge. Scale in centimetres.

Figure 5c. Cueva Negra del Estrecho del Río Quípar: Mode D (D1) flakes of chert and limestone with abrupt secondary knapping (“retouch”) of one edge. Scale in centimetres.

Figure 5d. Cueva Negra del Estrecho del Río Quípar: Mode D (D1) chert flake fragment with secondary knapping (“retouch”) of dentate edge. Scale in centimetres.

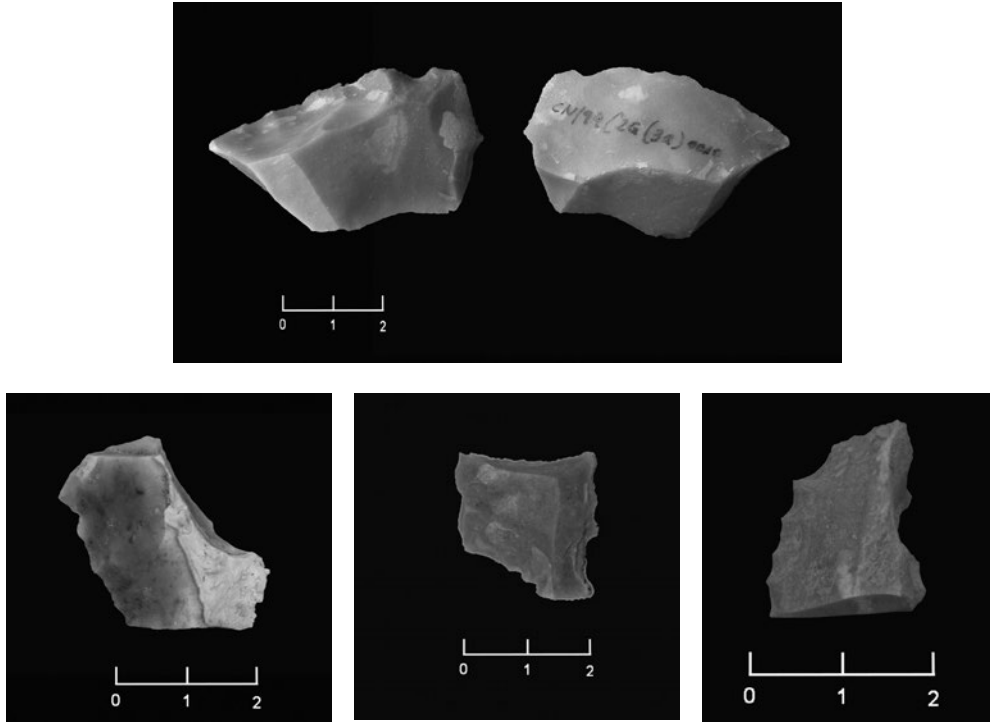


Figure 5e. Cueva Negra del Estrecho del Río Quípar: Mode D (D1) chert flake with steep secondary knapping (“retouch”) of one edge. Scale in centimetres.

Figure 5f. Cueva Negra del Estrecho del Río Quípar: Mode D (D1) chert flake with steep secondary knapping (“retouch”) of one edge. Scale in centimetres.

Figure 5g. Cueva Negra del Estrecho del Río Quípar: Mode D (D1) chert flake with steep secondary knapping (“retouch”) of edges. Scale in centimetres.

Figure 5h. Cueva Negra del Estrecho del Río Quípar: Mode D (D1) chert flake with steep secondary knapping (“retouch”) of edges. Scale in centimetres.

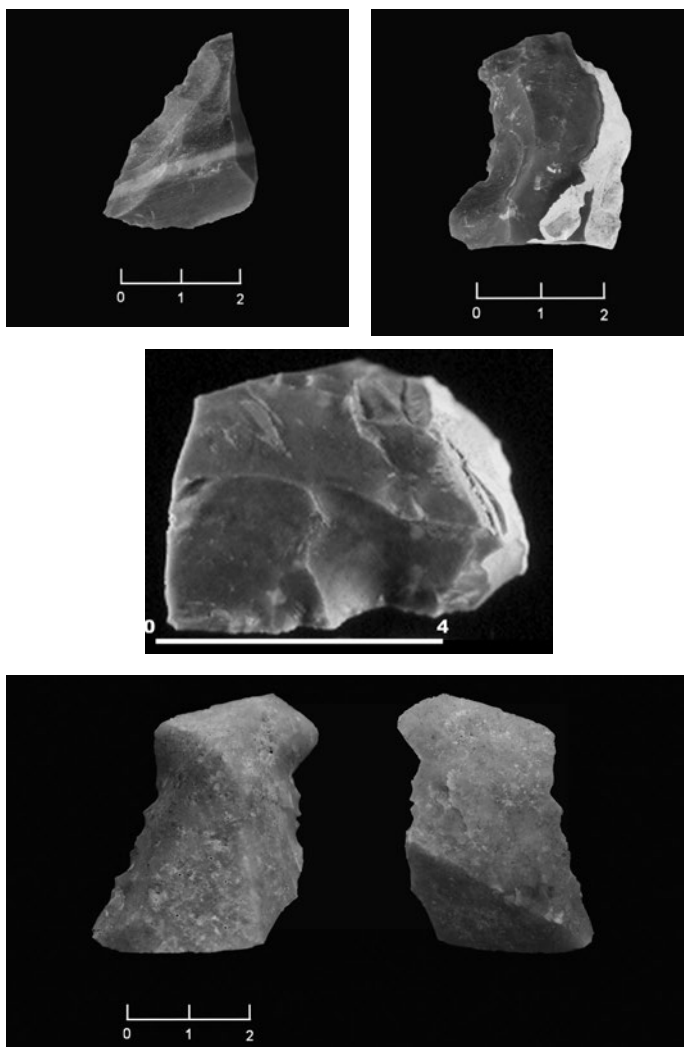


Figure 5i. Cueva Negra del Estrecho del Río Quípar: Mode D (D1) chert flake with secondary knapping (“retouch”) of an edge. Scale in centimetres.

Figure 5j. Cueva Negra del Estrecho del Río Quípar: Mode D (D1) chert flake with steep secondary knapping (“retouch”) of one edge. Scale in centimetres.

Figure 5k. Cueva Negra del Estrecho del Río Quípar: Mode D (D1) chert flake with an invasively flaked (“retouched”) edge. Scale in centimetres.

Figure 5l. Cueva Negra del Estrecho del Río Quípar: Mode D (D1) chert flake with secondary knapping (“retouch”) of one edge. Scale in centimetres.

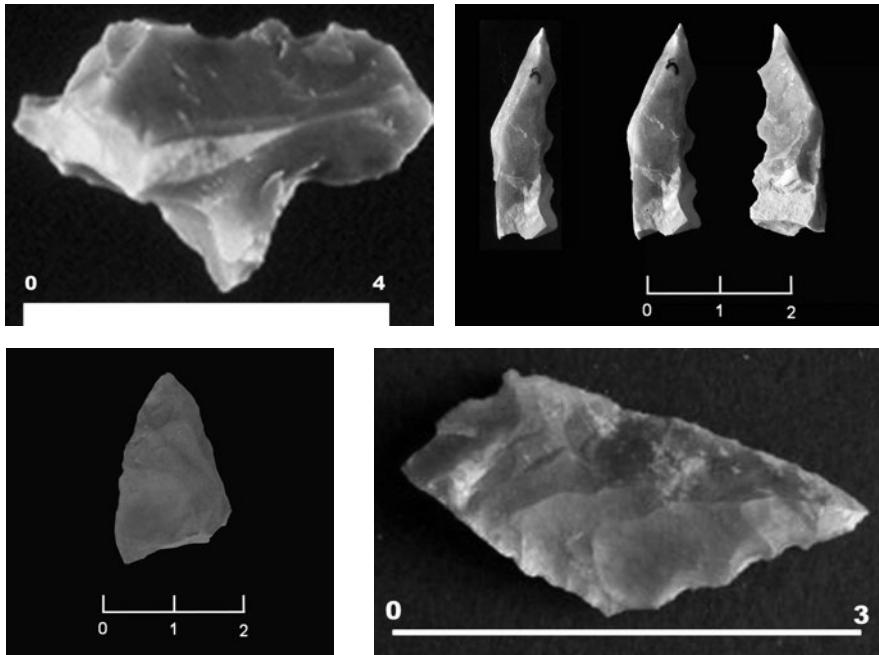


Figure 5m. Cueva Negra del Estrecho del Río Quípar: Mode D (D1) chert flake with secondary knapping and notching. Scale in centimetres.

Figure 5n. Cueva Negra del Estrecho del Río Quípar: Mode D (D1) pointed chert flake with a knapped (“retouched”) edge. Scale in centimetres.

Figure 5o. Cueva Negra del Estrecho del Río Quípar: Mode D (D5 ?) pointed chert flake with knapped (“retouched”) edge. Scale in centimetres.

Figure 5p. Cueva Negra del Estrecho del Río Quípar: Mode D (D7 ?) pointed chert flake with invasive and stepped or scalar flake scars. Scale in centimetres.

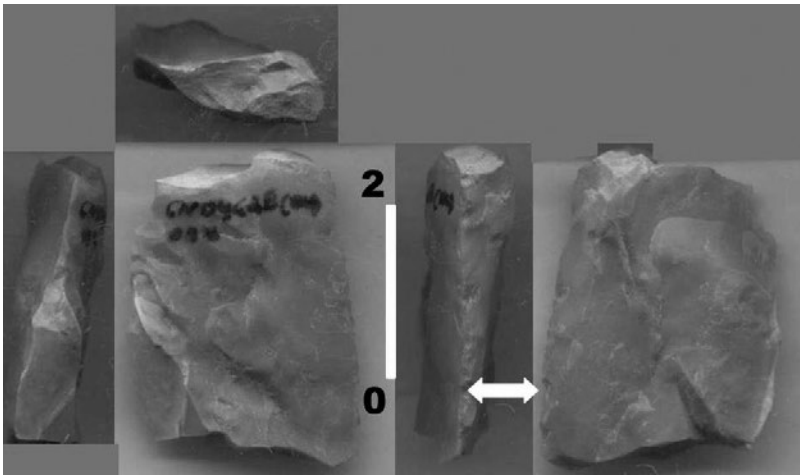
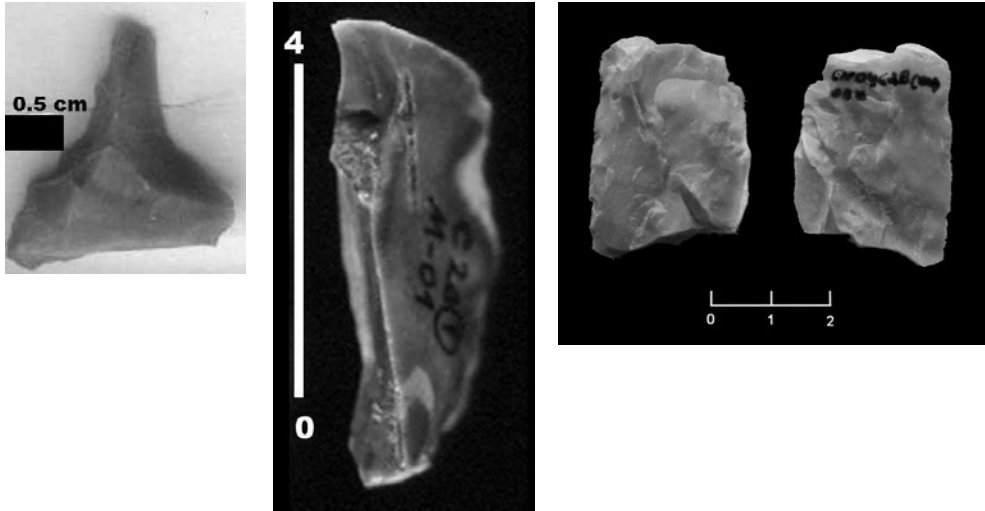


Figure 5q. Cueva Negra del Estrecho del Río Quípar: Mode D pointed chert flake. Scale in centimetres.

Figure 5r. Cueva Negra del Estrecho del Río Quípar: Mode D (D3 ?) burin on chert flake. Scale in centimetres.

Figure 5s-1. Bottom: Cueva Negra del Estrecho del Río Quípar: Sub-cuboidal flat chert flake or fragment with edge damage or perhaps secondary working (white arrows). Scale in centimetres.

Figure 5s-2. Top right: Cueva Negra del Estrecho del Río Quípar: Same piece as 5s-1 (alternative photograph). Scale in centimetres.

1.2 *Some methodological considerations*

Shea's timely revision of Palaeolithic Modes (Shea, 2013, and forthcoming 2016) is in line with the use of modal methodology in archaeology that owes much to Irving Rouse (Rouse, 1960; cf. Rouse, 1939) who deployed it in the service of differential diagnosis of ceramic types by attribute discrimination. Rouse's empirical methodology was based on procedural and conceptual "modes," defined in terms of determinant attributes, for subsequent polythetical analysis of "types" that could be historical (diachronical) or simply descriptive. Following a lecture tour in the USA, Grahame Clark pressed selective modal aspects (mainly procedural-diachronical) into the service, not of ceramics in the ten-thousand years of late world prehistory, but, instead, of a conjectural new outline of cumulative homotaxial evolutionary progress in Palaeolithic technology in the western half of the Old World (Clark, 1969, 1970). His Modes 1-5 (Clark, 1969, p. 31) or 1-6 (Clark, 1970, pp. 74-79) were not analytical procedures for determining Palaeolithic taxonomy, instead, they were fundamentally a quasi-dialectical teaching device to help first-year undergraduates to get to grips with two million years during which, at first glance, nothing very much seemed to have happened. It left untouched time-honoured perceptions of "*named stone tool industries, NASTIES*" (Shea, 2014). Far from finding Clark's Modes helpful, most archaeologists who analyze finds from Palaeolithic excavations have eschewed them by and large, drawing attention to incongruities and other drawbacks that undermine their usefulness for classifying excavated finds. Notwithstanding Clark's averral that none of his Modes should be regarded as the prerogative handiwork of particular hominid species, some palaeoanthropologists have proposed otherwise (eliding conceptual Mode into conjectures about cultural and thence mental templates that evolved in particular human palaeospecies such as *Homo erectus* and Neanderthals). "*A simple minded approach to the study of very early artifacts*" was proposed at Koobi Fora (Isaac et al., 1981) for distinguishing between unmodified stones carried to a site from elsewhere (manuports) and modified stone objects separated according to mutually exclusive "*macro-distinctions*" of "*flaked pieces*" (which include not only "*raw lumps of stone from which flakes (sic) have been detached,*" but also "*flakes or fragments which have had flakes struck off them, after their separation from a parent block,*" e.g. cores, choppers), "*detached pieces*" (flakes, fragments), and "*pounded and battered pieces*" (hammerstones, anvils, battered cobbles). Wider use of such a fundamentally modal analysis in Palaeolithic archaeology has been slow in coming and therefore Shea's proposals are a welcome redress.

Shea's Modes are less a formal taxonomical system of reductionist analysis than an "*attribute-list*" for those "*kinds of ways of making stone tools*" that are in evidence in an assemblage (Shea, pers. comm., June 19th, 2015). When analyzing attributes of artifacts from this standpoint, of relationships between procedures and concepts, the primary focus of archaeological attention is the matter of how Palaeolithic knappers conceived manual reactions to those affordances they perceived in different stone blanks (nodules, clasts, struck flakes, fragments). Typological designation of outcomes (artifacts) is of but

secondary relevance here. Intuitive names (scraper, adze, pestle, awl, etc.) may refer to artifacts that fulfilled quite different functions. Such names may bear no relation to the concepts of whoever knapped them if those concepts were principally about procedural reactions to lithic affordances rather than about foreseeably separate forms. A cautionary example of the drawbacks to systems of lithic typology based on formal separation of artifacts by considering precise criteria or discriminants (or, for that matter, preconceived sequences) was illustrated by “paradoxical” findings from field-work undertaken among New Guinea Highlanders who knap and use stone artifacts but whose concepts about the end-products were far from always showing congruence with classification of these by Palaeolithic archaeologists (White & Thomas, 1972).

Modal appreciation is more about analysis *backwards* from the artifact *towards* the cores (“reverse engineering,” as it were) than about *forward* reconstruction of a reduction sequence, starting from initial cores (also called “blanks” or “bases”), the knapping of which leads *towards* production of artifacts (cf. Boëda, 1994; Boëda et al., 1990; Geneste, 1985). It is self-evident that the “*distinction between flake tools and cores is not always reliable. (It) breaks down... when we consider the use of a spent core as a tool blank as if it were a flake (a denticulate or scraper made on a core, for example)*” (Debénath & Dibble, 1994, p.10). Two further considerations may be borne in mind. First, there are findings by researchers at Isernia La Pineta from microscopical observations (compatible with experimental studies) that some seemingly “fashioned” cores and keeled pieces are unlikely to have been other than sources for extremely small flakes for use without modification or retouch (Crovetto, 1994; Crovetto et al., 1994; Peretto, 1994; Peretto et al., 2004). Secondly, inferences based upon reduction-sequence analyses need not be confined to reconstruction of a *chaîne opératoire* carried out from start to finish by a skilled knapper in a few minutes, because Palaeolithic secondary knapping following patination of artificially-struck flakes implies that sometimes individual sequential links in a chain of behavioural activities involved “*different actors, perhaps separated in time by many generations*” (Walker, 2009), and, moreover, re-sharpening of artifacts implies a temporal break, however short, in a chain, whilst it is also plausible that apprentices and children could have had a hand in secondary knapping, modifying, or “retouching” flakes struck off a core by a skillful knapper. A counsel of prudence is in order before deploying reduction-sequence analysis as the methodological tool of overriding choice for undertaking lithic research, let alone divining practice and purpose in Palaeolithic knapping.

Just as with Rouse’s procedural and conceptual “modes” for ceramic analysis, the inclusivity of Shea’s lithic Modes offers an advantage of admitting artifacts that often cannot be defined unequivocally from a standpoint of manual knapping techniques, particularly when raw materials are ill-suited to offering conchoidal fractures when knapped (though, of course, standard works of reference remain indispensable, e.g. Inizan et al., 1999; Odell, 2003). Far from taking a dim view of the eclectic approach to classification espoused in some hand-books of Palaeolithic typology, such as that of Debénath

and Dibble (1994), we believe firmly that avoidance of dogmatism can be extremely helpful from the standpoint of fostering mutual understanding between adepts of divergent methodological approaches, and, moreover, that a “reverse-engineering” approach is particularly helpful, as Shea’s analysis demonstrates.

Shea’s system differs in a most important way from Clark’s Modes because it eschews quasi-evolutionary progressivist conjectures (and therefore dispenses with homotaxial notions). It differs significantly from most Palaeolithic classificatory schemes because it refuses to give pride of place to the “type-fossils” which those schemes employ as key-stones for separating different archaeological cultural assemblages that not infrequently have several other lithic artefact “types” in common. Above all, the singular contribution of Shea’s modal analysis to students of human evolution is that it directs attention to human *behaviour* with stones, away from archaeological concerns about spatio-temporal differentiation and towards cognitive evolution in *Homo*. Its insights are a major palaeoanthropological contribution and represent a wholly new methodological paradigm in lithic studies. Shea’s Modes will form the basis of our primary descriptors, with retention in a secondary rôle of “*NASTIES*” and time-honoured terms.

It therefore behoves us first to reproduce Shea’s basic scheme (Shea, 2013, p. 158, Table 2), for those unacquainted with it, in Table 1 which follows:

TABLE 1. Shea’s basic scheme.

<u>Modes A–I</u>	
	<u>Mode Description and Sub-modes</u>
A	Stone percussors
B	Bipolar cores
C	Pebble cores/non-hierarchical cores
D	Retouched flakes
	D1. Retouched flake-tools
	D2. Backed/truncated flakes
	D3. Burins
	D4. Retouched microliths
E	Elongated core tools
	E1. Large cutting tools
	E2. Thinned bifaces
	E3. Bifacial core tools with retouched proximal concavities
	E4. Celts
F	Bifacial hierarchical cores (BHC)
	F1. BHC - Preferential
	F2. BHC - Recurrent
G	Unifacial hierarchical cores
	G1. Platform cores
	G2. Blade cores
H	Edge-ground tools
I	Groundstone tools

“Non-hierarchical” means that “*fracture initiation surfaces and flake release surfaces are interchangeable with one another through the course of core reduction. There is no stable hierarchy of fracture initiation and flake release surfaces*” (Shea, 2013, pp.159-160, p.159, Figure 2). Subsequently, Sub-modes have been added as follows: D5 points, awls, retouched triangular flakes; D6 tanged points, tanged pieces; D7 cores-on-flakes, scaled flakes; and D4 has been restricted to pieces below 3x1 cm in size (Shea, March 8th 2015 at [https://sites.google.com/a/stonybrook.edu/john-j-shea/Shea Lithic Modes A-I \(update\)/©John Shea; and Shea, forthcoming, *Stone Tools In Human Evolution*, Cambridge University Press, 2016](https://sites.google.com/a/stonybrook.edu/john-j-shea/Shea%20Lithic%20Modes%20A-I%20(update)/%C3%9AJohn%20Shea;and%20Shea,%20forthcoming,%20Stone%20Tools%20In%20Human%20Evolution,%20Cambridge%20University%20Press,%202016)). Sub-mode D1 shows retouch mainly at angles <90°, whereas in D2 it is at about 90°. In addition to F1 (which includes preferential “Levallois” cores) and F2 (which includes recurrent laminar “Levallois” cores), there has been added Sub-mode F3 for recurrent bifacial hierarchical cores with radial or centripetal removal (including recurrent centripetal “Levallois” discoidal cores). We are indebted to John Shea who generously corresponded with us at length about aspects of his scheme that are awaiting publication in his forthcoming book.

His scheme gives pride of place to outcomes over reduction sequences. Thus no distinction is made between whether, say, a Mode 3 “Acheulian” “hand-axe” had been made on the primary blank of a cobble/nodule or on a secondary blank of a very large struck flake: both are considered to be cores. A somewhat analogous situation appertains to those Cueva Negra artifacts that are small stubby or keeled non-hierarchical cores (NHC), many of which owe their sub-triangular cross-section and sub-pyramidal or plano-convex shape to convergent oblique flaking and/or deep notching which reduce opposite edges of a surface that may be flat, were the core to have been a piece of broken tabular chert, or slightly convex or concavo-convex were the core to have been a fragment of a thick chert flake.

Some of these artifacts were modified further by notching or non-hierarchical flaking to form a point, or even sometimes an elongated spur, though also thinner flake fragments were modified giving rise to points; indeed, there is such a gamut of overlapping pointed forms as to render pointless attempts to assign them to different varieties (e.g. “beaks,” “awls,” “borers,” “microperforators”). It should be borne in mind that comparable forms are found from early in the mid-Early Pleistocene at Olduvai (from Upper Bed I to Upper Bed II: Leakey, 1971, p. 82, Figure 44, nos. 3,4; p. 103, Figure 53, nos. 13-20; p. 195, Figure 91, nos. 1-20; p. 217, Figure 106, nos. 1-18) and elsewhere in East Africa (e.g. Gombore IB2 at Melka Kunture: Piperno et al., p. 119, Figure 10.3, nos. 7, 9: no. 7 has a striking resemblance to one from Cueva Negra shown here in Figure 4f). Similar pointed artifacts are widespread at later times and are to be found in European Middle Palaeolithic assemblages.

Keeled plano-convex forms at Cueva Negra (Figures 4b-4e) include “garden-slugs” (Fr. “*limaces*”) or keeled “Tayac points” (cf. Debénath & Dibble, 1994, p. 108, Figure 8.32, p. 109, Figure 8.36), albeit differing from typical European Middle Palaeolithic “*limaces*” mainly by absence or scarcity of secondary, scalar or stepped flake scars (“proto-

limaces” perhaps), though it should be pointed out that some accepted “*limaces*” show scant trace of either (ibidem, p. 67, Figure 5.38); indeed both “*limaces*” and “Tayac points” can be interpreted as being little more than varieties of convergent scrapers (ibidem, pp. 66, 109).

It is a moot point whether modification by additional non-hierarchical flaking is worthy to be called “retouch” in the customary sense of that word and perhaps secondary flaking or secondary knapping are more appropriate terms (cf. Barsky et al., 2013). John Shea (personal communication in correspondence of June 21st, 2015) has proposed that the keeled artifacts might be regarded as G1 platform cores notwithstanding their non-hierarchical (NHC) reduction, though also he has taken note with regard to Mode C that often “*archaeological typologies group platform cores together with pebble cores and other informal cores*” (Shea, 2013, p.168). In this regard, a useful distinction at Cueva Negra would seem to be between informal NHC cores showing unidirectional steeply flaked scars of broadly similar size and shape albeit often more numerous at one extremity (perhaps it may be called Sub-mode C1) and keeled or stubby pyramidal NHC cores bearing unidirectionally flaked scars of two different size and shape groupings that are usually separated in space on the core (perhaps it may be called Sub-mode C2), as occurs in the case of “beaks” and “awls” (for published instances, cf. Debénath & Dibble, 1994, p. 108, Figure 8.29; Piperno et al., p.119, Figure 10.3, no. 7). At first, the keeled artifacts at Cueva Negra had been dismissed as being no more than informal discarded cores but further inspection detected secondary knapping or further non-hierarchical modification that favours their interpretation as modified cores (Figures 4f-4m). The matter is raised here in the context of how analysis in terms of Modes A-1 can turn a spotlight onto the substantive traces of Palaeolithic activity, technical aptitude, manual dexterity, and, above all, cognitive versatility.

In formal traditional terms, the excavated assemblage at Cueva Negra del Estrecho del Río Quípar can be described as “Acheulo-Levalloiso-Mousteroid” from a viewpoint of purely formal archaeological technical adjectival descriptors (Walker et al., 2006a, 2013). In no way do these epithets imply notional “industries,” “technocomplexes,” technical “traditions,” or alleged “cultures.” Lest there be any lingering doubt about the way in which these adjectival descriptors here are used *sensu lato*, the descriptors will be placed between inverted commas, in order to stress that artifact forms are analogous to, but not “therefore” homologous with, those in western Europe of later Middle Pleistocene or early Upper Pleistocene assemblages to which significant numbers of characteristic artifacts offer grounds for designation of “industries” as Acheulian, Levalloisian or Mousterian, *sensu stricto*. Sporadic incidence of elements typical of these in an assemblage that mainly lacks them need imply no more than that from the stirrings of cognitive versatility and manual dexterity there arose once in a while an artifact Mode that only very much later in time or distant in space was to become widespread. Similar reasoning precludes a designation of “Oldowan” because the Cueva Negra excavation has yielded up only two or three artifacts that resemble “Oldowan” “heavy-duty” tools

(cf. Leakey, 1971, *passim*; Leakey & Roe, 1995, *passim*). They are a “hand-axe” (Figure 1) and one unidirectionally flaked chopping tool (or perhaps two). These were made on limestone, which predominates in the geology of the neighbouring mountainsides that offer abundant raw material to hand for making such limestone tools. Yet their remarkable scarcity in the otherwise “light-duty” Cueva Negra assemblage, in which, instead, small chert artifacts abound, inclines us to regard the term “Oldowan” as being less than wholly appropriate for it (perhaps a better analogy for the assemblage might be the Isernia La Pineta collection, see below).

A further explanatory comment is in order. The word “technocomplex” was invented to refer to Palaeolithic assemblages such as Gravettian, Solutrian, etc., with a geographical spread of $\leq 5,000$ km in radius (Clarke, 1968, p. 331) and a temporal one of $\leq 20,000$ years, in contrast both to far more circumscribed “culture groups” on the one hand, and, on the other, to far wider, spatio-temporally, distributed “industries” such as “Oldowan,” “Acheulian,” or “Mousterian.” Because Clarke’s principal interest was in trying to identify prehistoric social systems, he avoided discussing “industries;” in fact, the word “industry” appears only in his appended glossary (Clarke, 1968, p. 667), being defined as a *“set of single-material artefact-type assemblages from a continuous space-time area, taxonomically linked by mutual technological affinities. Frequently, a single material aspect from a technocomplex entity.”* Clarke recognized here that customary usages lack consistency; and, in like vein, with regard to such higher levels of archaeological classification, Dunnell (1971, p.158) remarked *“there is considerable confusion (both conceptual and terminological)”* – which, alas, still persists forty-five years later on. Non-comparability between “technocomplexes” and “industries” owes both to incommensurate differences in temporal scale (cf. Bailey, 1983) and also, most particularly, to the, epistemologically speaking, incommensurable difference in composition that separates any given type or class of artifacts, exclusively defined by discriminant attributes, from a group including varying numbers of artifacts belonging to several types or classes, and also, of course, from broader groupings, such as a material cultural assemblage, “tradition,” “horizon,” “technocomplex,” or “industry” (cf. Dunnell, 1971, pp. 157-160). As Dunnell (p. 159) succinctly put it: *“Types are not groups of objects, but classes whose significata consist of sets of modes, stating the necessary and sufficient conditions of membership.”*

The matter to which Shea’s Mode A-I analysis is directed, is that of identifying relationships between procedures and concepts: namely, of how Palaeolithic knappers conceived manual reactions to those affordances they perceived in different nodules, clasts, struck flakes, and fragments. Shea’s approach brings to mind the dynamic consideration of a likely fluid relationship between Levallois procedures and concepts that was inferred by van Peer (1992, pp.113-117), as against a somewhat more formal, albeit archaeologically popular, analytical approach to flaked stone (e.g. Boëda, 1994; Boëda et al., 1990; Geneste, 1985). Our predilection for Shea’s Modes A-I may well disappoint those who might have preferred us to have given pride of place to possible

spatio-temporal comparisons and contrasts, drawing on formal analytical deduction. We eschew attempting to espy quasi-historicist analogies with cultural succession in the later prehistoric record, quasi-ethnographical analogies that make phenomenological appeal to allegedly timeless understanding of material culture, or quasi-biological analogies that almost may imply phylogenetical determinism of the appearance of Palaeolithic forms.

Shea's modal scheme encompasses a range of flexible cognitive relationships between knappers and lithic affordances, which increases to at least six the four practical approaches undertaken by knappers that were highlighted at Cueva Negra in an earlier publication (Walker et al., 2013, p.150, Figure 19). It also offers a way around criticism levelled (de la Torre & Mora, 2009, p.19) against dialectical cognitive inferences drawn from geometrical analyses of selected Palaeolithic flaked artifacts. Applied to the Cueva Negra artifacts it points to the "*diversity*" and "*multiplicity*" commented upon by other students of late Matuyama assemblages in transition from Clark's "Mode 1" to "Mode 2" (Barsky, 2009; Carbonell et al., 2009).

1.3 Background studies

Magnetostratigraphy indicates that all of the Pleistocene cave sediment falls within the Matuyama magnetochron and is therefore older than 0.78 Ma (Scott & Gibert, 2009); 11 samples were taken from a 4.5 m deep excavation profile at the centre of the rock-shelter and two further samples were taken directly below the cave mouth where recent erosion had exposed sediment lying on an ancient eroded surface of Miocene biocalcaronite 8 m below the top of the sedimentary deposit in the cave (ibidem: pp. 82-83, Figures 1 & 2). The 11 bloc samples were taken in December 2006 at the only place in the excavated cutting where an uninterrupted long vertical column was available for study, which was impossible in the only 1x1 m square where bed-rock had been uncovered because of erosive damage to its profile, and impossible also towards the cave mouth because of step-wise excavation downwards from it.

Unpublished single-grain OSL analysis points to an antiquity of >0.5 Ma though signal saturation is hindering resolution; previously, the less accurate method of multiple-grain OSL analysis had suggested 0.3-0.5 Ma (Walker et al., 2006). Regrettably, an attempt to date the sediments using cosmogenic nuclide analysis produced estimates that are far in excess of the age to which the sediments reasonably can be assigned and must be rejected (Dr. Régis Braucher of Université Aix-Marseille CEREGÉ and CNRS-IRD-Collège de France CNRSUM34, personal communication by email, July 9th, 2013, who is thanked for his collaboration). Biostratigraphical analysis of micro- and macro-mammalian remains is consistent with assigning the deposits to a period of >0.7 - <1 Ma (Walker et al., 2013; see below).

The sedimentary sequence comprises near-horizontally bedded, laminated, and cross-bedded, bands or lenses of fine (silt- and sand-size) particles of litharenite, micritic limestone, and quartz, with remarkably few coarser components. Macroscopical inspection and micromorphological analysis reveal several cycles of alluvial deposits (Ange-

lucci et al., 2013, and Supplementary Data), thereby confirming that “*the Pleistocene succession at Cueva Negra is mainly an alluvial deposit, with subordinate inputs from the cave walls and roof and a scarce, though significant, anthropogenic input, in particular in the lowermost part of the sequence*” (ibidem). Furthermore, “*micromorphological observations show that most layers possess sedimentary characteristics (rather than “pedogenic microfabric”, thus Scott and Gibert, 2009, p. 84), that post-depositional processes were relatively scarce at the site, and that soil formation was limited to the single episode... (of) the buried soil on top of Sub-complex 3-1, from which we conclude that the accumulation process was fairly rapid and without major hiatuses within the individual stratigraphical complexes. The profile on top of Sub-complex 3-1 is a moderately developed alluvial soil and is related to a short phase of stabilization – its weak development may indicate that soil formation took place over a short time span, possibly in the order of 10^2 - 10^3 years. In fact, the buried soil, and the erosive surface that separates Complexes 2 and 3, are the only major evidence of discontinuity throughout the Cueva Negra succession... no significant change of sedimentary inputs has been observed in the succession, which points to the homogeneity of the sedimentary basin feeding the cave during the accumulation... (and) the sequence does not show any significant evidence of physical alteration, chemical weathering or long-term surface stabilization, except for the buried soil*” (Angelucci et al., 2013).

Sedimentological Sub-complexes II, III and IV correspond, respectively, to our proposed lithostratigraphical units II_i-II_{ii}, III-IV, and V-VI (Figure 6; see Appendix 1, Figure 9). Our system of units is retained here for ease of reference to previous publications (Walker et al., 2006a, 2013).

Unfortunately, details given in synoptical tabular form (Angelucci et al., 2013, p.196, Table 1) were not reflected correctly in an accompanying diagrammatic figure (ibidem: p. 197, Figure 1) in which our former lithostratigraphical unit III (as defined in Walker et al., 2006) is depicted, erroneously, as straddling sedimentological Complex 2 and Sub-complex 3-1, whereas it should have been represented as confined to the latter

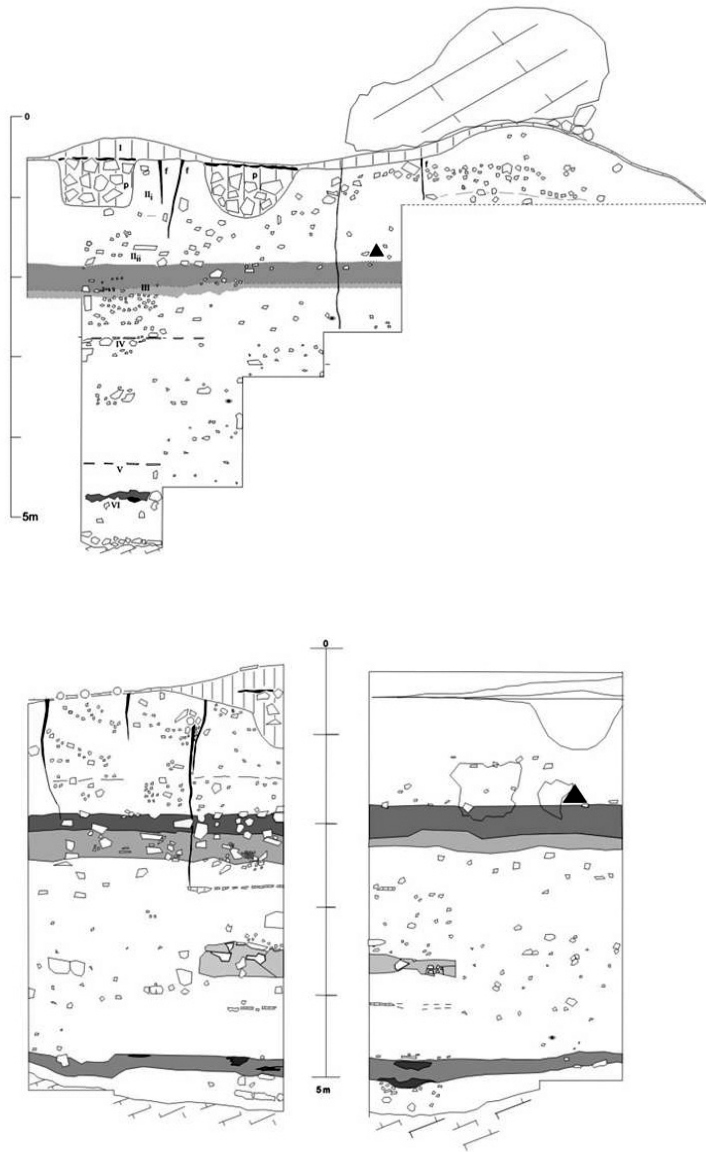


Figure. 6. Cueva Negra del Estrecho del Río Quípar: principal lithostratigraphical units defined at excavation.

Figure. 6a. Top: West profile.

Figure. 6b. Bottom left: North profile; Bottom right: South profile.

Black triangle: Mode E limestone artifact (bifacially-flaked “Acheulian” “hand-axe”).

(for the correct figure showing the sedimentological sequence, see Appendix 1, Figure 9).

Another matter seems to be related to the erosive surface of the poorly-developed buried soil at the top of Sub-complex 3-1 and concerns a gratuitous conjecture that “*the complex karst infillings... underwent two sedimentary cycles, the first during late Matuyama times (hence the reversed polarity). Following tectonic activity (described in detail by Walker et al., 2006), the cave was uplifted, and most of its sediments were removed by erosion. The cave then refilled in the Middle Pleistocene, incorporating by these times the faunal assemblage and lithic artefacts*” (Jiménez-Arenas et al., 2011). The conjecture is vitiated by absence of any substantive evidence for either “*complex karst infillings*” during late Matuyama times at the cave, or subsequent erosion of “*most of its sediments*” with later substitution by Middle Pleistocene ones.

On the other hand, Cueva Negra del Estrecho del Río Quípar is not a *tafone* (*pace* Scott & Gibert, 2009). In contrast to several, mostly barren, wind-swept, semi-ellipsoidal rock-shelters (some of which may well be *tafoni*) on the left flank (western side) of the gorge, the sub-triangular or trapezoidal rock-shelters on the right flank, including Cueva Negra and the nearby Moorish King’s Cave, had their origin in a process of phreatic endokarst spelaeogenesis affecting vertical and horizontal fracture planes which has left a few traces of faint parietal scalloping and which probably took place in relation to a major subterranean aquifer (the Sima aquifer, named after a hill called La Sima) that feeds the Quípar in the gorge and even today maintains an extension of 33.5 km². Because the deposit in the rock-shelter of fine alluvia containing bones of several species of water-fowl including diving ducks (Walker et al., 2004) points to a situation beside a marsh or lake, it is likely that the cavity originally had been formed beneath it. After emergence of Cueva Negra and exposure of its interior, perhaps owing to activity of the sinistral reverse fault that here determines the course of the Quípar, the rock-shelter was not subjected to significant ectokarst processes capable of bringing about fanciful “*complex karst infillings.*” Although sediment micromorphology shows that subaerial erosive components are less common (Angelucci et al., 2013) than alleged by Scott and Gibert (2009), the walls of some other, originally endokarst, rock-shelters on the same flank near the exit to the gorge show typically aeolian “bees-nest” alveolar pitting, and below the Moorish King’s Cave semi-ellipsoidal rock-shelters doubtless were sculpted by aeolian and subaerial processes at a time following the down-cutting by the river that exposed the cliff faces wherein they lie. Therefore aeolian and subaerial processes are unlikely to have been predominant before the Middle Pleistocene. It is plausible to conjecture that further uplift and activity of the Quípar Fault caused the altitudinal separation between the exit of the river from the gorge at 690 m asl and the Caravaca basin at 600 m asl 10 km to the north.

In 2006 chronological considerations about neotectonic activity of the Quípar Fault at the gorge were limited still to geomorphological inferences that attributed the principal land-forms nowadays between it and the Caravaca basin to changes that had begun only during the Middle Pleistocene, and in particular involved uplift of the left

flank of the Quípar valley below the exit from the gorge (González-Hernández et al., 1997), conceivably deflecting the Quípar eastwards, whereas theretofore it may well have flowed northwards to join the Río Argos in a large lake at Caravaca. Recent geological field-work around the gorge by one of us (T.R-E.) indicates that Upper Pliocene or Early Pleistocene activity of the Quípar Fault had brought about folding of the strata of a localized gentle anticline of Upper Miocene (Tortonian) marine calcarenites and marls (with periclinal closure to the south-west), such that depression of those embracing Cueva Negra was responsible for a marked dip of the beds which descend to the level of the river barely 200 m south of the cave, whereas, in front of it their base is visible in the footwall about 20 m above the river level. In short, rock-shelters, conglomerates, gravels, and other features on the left and right flanks here cannot be regarded with simple-mindedness as chronologically equivalent merely because they lie today at similar heights above the river (mistakes in that regard which afflicted Walker et al., 2006a, were corrected in Walker et al., 2013, and similar conflation probably encouraged Scott & Gibert, 2009, to interpret Cueva Negra as a *tafone*). Uplift, with halokinetic characteristics, of the western block may have played a part in separating the Quípar valley drainage from that of the Argos valley to its north. Plausibly, at the onset of the Lower Pliocene features that today are at 750 m asl probably lay at much lower altitudes above sea level, and the surrounding mountains of Jurassic limestones, such as the 1150 m high Sierra de las Cabras (overshadowing the right flank of the gorge), below which the aforementioned local post-Tortonian anticline formed, may have been little more than hills rising to 400-500 m above coastal marshland and low-lying valleys. Chert nodules occur in both Tortonian marine conglomerate (a conspicuous outcrop lies 0.8 km east of the cave at 750 m asl) and large chert blocks weighing as much as 3 kg, eroded from Jurassic beds, can be found in widespread vestiges of an erstwhile >100 m deep spread (*glacis*) of ill consolidated rolled and sub-angular gravels that are 2-3 km south of the cave lying at between 770 and 890 m asl in the Sierra de las Cabras, doubtless a consequence of Upper Pliocene and early Pleistocene erosion of the escarpments above. 1.5 km north of Cueva Negra a thin bed of freshwater limestone has been identified at an altitude similar to the base of the *glacis*.

No doubt derived from those gravels, lying 30-50 m below them and especially visible on the left side of the valley just above the gorge, where the river lies at 725 m asl, are two prominent horizontal beds of cemented gravels (sometimes covering lacustrine marl) present at similar relative heights of 5-10 m and 25-30 m above the Quípar river here and upstream in the upper reaches of the Quípar valley (also called the Rambla de Tarragoya) where the river descends from about 900 m asl 20 km west of the cave (Walker et al., 2013); these gravels contain chert nodules (Zack et al., 2013). The horizontality of the beds and the maintenance of their relative height above the river, despite a step-wise fall in their altitudes above sea level, imply a series of erstwhile semi-endorrheic hanging wetlands that were drained successively, doubtless in response to the activity of transverse faults across the Quípar-Tarragoya Fault that defines the water-course along

the centre of the valley (see Walker et al., 2006a, p. 11, Figure 5). At one locality in the Rambla de Tarragoya local dome-like warping of the cemented gravel or conglomerate beds testifies to neotectonic activity after the formation of the horizontal cemented gravels. As yet no archaeological or palaeontological finds have been detected in the ubiquitous exposures, hampering chronological inference. Prevalence of neotectonic phenomena in and around the upper Quípar warns against attempting to draw conjectural paleoecological analogies with the vast Pliocene and Early Pleistocene lake deposits in the Guadix-Baza depression, beyond the Segura watershed to the south-west. At the head of the Rambla de Tarragoya traces exist at 1050 m asl of the ancient (presumably Plio-Pleistocene) high-level spread of ill consolidated rolled and sub-angular gravels, notwithstanding absence of nearby escarpments above them, implying an origin at least 5 km away (perhaps 10-15). Activity of the important Crevillente Fault that follows the south side of the rhomb graben, which is the Rambla de Tarragoya, brought about uplift of the right flank of the valley such that Pliocene strata below it became warped into a near-vertical position with exposure of their 350 m sequence, of marly limestone, containing freshwater gastropods, sandstones, and conglomerates, at an outcrop 100 m above the river at Las Yeguas (Ibargüen-Soler & Rodríguez-Estrella, 1996; Walker et al., 2006a, p. 11, Figure 5). Parallel to the Crevillente Fault, the Quípar-Tarragoya Fault running down the centre of the valley has led to unconformity; field-work on the left bank now points to the exposed horizontal beds of cemented gravel and lacustrine marl as being much later than the aforementioned Pliocene strata (this was unclear in 2006). The earthquake of May 11th 2011, which caused nine deaths at Lorca, barely 50 km from Cueva Negra, demonstrates that the effects of neotectonic activity cannot be taken lightly. The high-level *glacis* of rolled and sub-angular gravels could have been a consequence of noteworthy Upper Pliocene tectonic activity. Only one conglomerate outcrop has been identified that may be older than the *glacis*, namely, a very small outcrop of cemented angular limestone blocks overlooking the Rambla de Tarragoya at 1200 m asl at the foot of an escarpment of Jurassic limestone in the Sierra de Mojantes.

Initial choice of Cueva Negra del Estrecho del Río Quípar for systematic excavation was influenced by its accessibility, published indications of extinct megafauna and flake artifacts earlier than the Upper Palaeolithic from cursory excavation of test pits in 1981 (Martínez-Andreu et al., 1989; San-Nicolás-del-Toro, 1982, pp. 15-16 [who called the site Cueva de Remojón]), exposed sediments of which suggested their suitability for instructing undergraduate students in techniques appropriate for recovering small palaeoecological indicators such as teeth or bone fragments of small creatures. Initially, however, unwarranted faith in geomorphological uniformitarianism underlay a mistaken conjecture that the sediments might correspond to a *glacis*-terrace at about 40 m above river level in the lower reaches of the Segura drainage basin, or perhaps a higher one there at about 70 m. Various dating methods seemed to imply that their aggradation was completed during, respectively, an early stage of the last glacial period and the preceding ice age (Cuenca-Payá & Walker, 1986; Cuenca-Payá et al., 1986), though it was

remarked that the “*paucity of continental land-forms and coastal deposits of the early Middle Pleistocene and the dislocation and dismantling of prominent Plio-Pleistocene formations implicate tectonic instability and consequent erosion between 1 m.y. and 0.5 m.y. ago*” (ibidem). The mistaken simple-minded view was bolstered by an apparent alluvial terrace on the left bank of the Quípar downstream from the cave at a similar height above the river.

After a dozen excavation campaigns at Cueva Negra, biochronological indications from the sediments were pointing towards a time no later than the onset of the Middle Pleistocene, even for the *highest* sedimentary layers in the cave (Walker et al., 2006a). Field-work, both within the cave and in the headwaters of the Quípar, has led to major revision (Walker et al., 2013) of earlier conjectures, such that the most plausible interpretation seems now to be that which attributes preservation of the sedimentary sequence inside the cave to uplift of the right flank of the gorge, in which it lies, at the *onset* of the Middle Pleistocene, no doubt owing to neotectonic activity of the Quípar Fault in front of the rock-shelter (which today lies ca. 40 m vertically above the river and less than 200 m horizontally away from it). Magnetostratigraphy indicates reverse palaeomagnetic polarity throughout the sedimentary sequence inside the cave (Scott & Gibert, 2009). Most probably the sediments were laid down during MIS 21 (0.86-0.81 Ma) in the late Matuyama sub-chron, towards the end of the Early Pleistocene. Were they to be older than that, it is not easy to see how they avoided being washed away before uplift raised them out of harm’s way. Less likely chronological possibilities might be during the first part of MIS 19 (0.79-0.76 Ma) before the magnetic reversal (0.781-0.775 Ma), or perhaps MIS 17 (0.71-0.67 Ma) were the Gioia Tauro “ δ ” geomagnetic excursion to be granted a high date ca. 0.68-0.69 Ma (rather than an alternative later one of 0.64) and equated with the Osaka Bay “Stage 17” excursion of 0.687-0.696 Ma (discussed by Laj & Channell, 2007, pp. 391-392); in either case, the time available might be regarded as rather short for the sedimentary deposit and in the latter case faunal atavisms might well have to be presumed.

Throughout the sedimentary sequence in the cave there is ample evidence of Palaeolithic activity, no doubt during dry periods or seasons. The sediments remained undisturbed save for a few small pits, 1-2 m deep, dug into them ca. 1940. Pollen from the sediments attests to mild, humid conditions with gallery woodland nearby (Carrión et al., 2003) and presence of waterfowl including diving ducks (Walker et al., 2004) is consistent with the erstwhile presence of a lake close by; it must be borne in mind that when those publications were prepared the sediments still were regarded as being no earlier than the later Middle Pleistocene.

Arvicolid Rodent taxa are similar throughout the sedimentary sequence, with no significant vertical variation. Wet-sieving over 2 mm mesh enabled recovery of very many teeth of Rodents and Insectivores. Following inspection in 2004 by Dr. Antonio Ruiz Bustos of Granada University of an initial collection of Rodent teeth that had been recovered mostly from units II and III (the lower units IV, V and VI barely had begun

to be excavated) it was clear that Early Pleistocene taxa such as *Microtus (Allophaiomys/ Victoriamys) chalinei* (widely known as *Allophaiomys chalinei*) were present and comparison with AT-TD6 was proffered (Walker et al., 2006a, p. 10) in an article published in December 2006, the same month as the arrival of Drs. Gary Scott and Lluís Gibert Beotas from the Berkeley Geochronology Center, who came to take bloc samples at Cueva Negra for their subsequent palaeomagnetical study. Thus already before their work had begun the Arvicolidae were hinting at an age for the sediments, including those of the high unit II, older than the mid-Middle Pleistocene Biharian-Toringian transition (Walker et al., 2006a,b, 2007). Lest it be surmised that Early Pleistocene taxa were acknowledged only *after* Scott and Gibert Beotas' findings had been determined in mid-2008 (*pace* Jiménez-Arenas et al., 2011; García-Aguilar et al., 2015), a reminder is in order here that suggestions already had been offered about the biochronological implications of *Allophaiomys chalinei*, *Pliomys episcopalis*, *Mimomys savini* and *Microtus (Iberomys) huescarensis* (Walker et al., 2006a), and *Microtus (Stenocranius) gregaloides* (Walker et al., 2007), suggestions corroborated subsequently by the magnetostratigraphical findings.

Latterly, the collection of Rodent teeth has grown considerably, which has enabled correction by one of us (ALJ) of some mistaken identifications, and further excavation in units IV, V and VI confirms the homogeneity of the arvicolid assemblage and the lack of vertical differentiation of its representation with regard, in particular, to units II, III and IV (units V and VI have been excavated only in a small area), see Table 2.

In Table 2 the vertical distribution shows clearly that those species which in Spain characterize the final stage of the Early Pleistocene (see below) are found in the later, upper units (II, III) as well as in deeper, earlier ones (IV, V, VI). This demonstrates that in the sedimentary sequence upper and lower units alike are late Early Pleistocene in age. It may be worth remarking that observations at both alluvial and cave sites (Hofman, 1986; Stockton, 1973) hint at a tendency for more very small archaeological items to migrate downwards than do large ones (which may even tend to migrate slightly upwards). If that be indeed so, it is unlikely that Rodent teeth in units II and III represent upward migration that has contaminated sediments very much later in age.

Whereas the 2006 publication (Walker et al., 2006a) drew on scarcely fifty "*Iberomys*" teeth, less than half of which were lower first molars that hinted at a possible bimodal size distribution (supposedly representing *Iberomys huescarensis* and *I. brecciensis*, albeit unhelpfully designated, respectively, as "*Terricola (Pitymys) huescarensis*" and "*Microtus brecciensis*"), there are now almost two hundred specimens, all of which can be assigned safely to *Microtus (Iberomys) huescarensis* because the value for mean length is noticeably below that of the Middle Pleistocene *Microtus (Iberomys) brecciensis* and only trivially above mean values published for AT-TD6 and Vallparadís. Our sample also differs from *I. brecciensis* because it shows a high frequency of a short and simple anterior part of the anteroconid complex (hintonid morphotype), moderate buccolingual asymmetry, and somewhat confluent T4-T5 morphology (López-Jiménez,

TABLE 2. Taxa identified in units II-VI. The numbers refer to finds identified for each species: for Arvicolidae the numbers refer to mandibular first molars; for other Rodentia and Insectivora they refer to maxillary and mandibular molars; for *Oryctolagus* they refer to mandibular third premolars; for *Prolagus* they refer to different molars of that taxon.

Taxa identified	Excavated lithostratigraphical units				
	unit II	unit III	unit IV	unit V	unit VI
<i>Pliomys episcopalis</i>	1	9			1
<i>Mimomys savini</i>	7	17	4	1	5
<i>Microtus (Iberomys) huescarensis</i>	21	101	42	1	26
<i>Microtus (Stenocranius) gregaloides</i>		3			
<i>Microtus (Terricola) arvalidens</i>		2			
<i>Microtus (Allophaiomys/Victoriamys) chalinei</i>	40	45	49	8	13
<i>Allocrietus bursae</i>	9	3	2		
<i>Apodemus cf. Sylvaticus</i>	13	13	16	1	3
<i>Eliomys quercinus</i>	1	1	2		
<i>Crocidura sp.</i>	8	39	27	1	13
<i>Neomys sp.</i>	2	11	4		
<i>Erinaceus europaeus</i>	43	29	6		
<i>Oryctolagus cf. Giberti</i>	87	84	24	4	30
<i>Prolagus calpensis</i>	12	21	20		11

in preparation). Presence of *Microtus (Terricola) arvalidens* is indicated by differential diagnosis of the anteroconid complex of two arvicolid molars. Previous mention of specimens of “*Arvicola cf. deucalion*” reflected a particular phylogenetical interpretation (Ruiz-Bustos, 1991; Ruiz-Bustos & Sesé, 1985; Ruiz-Bustos & Pérez-López, 1992) of its morphological evolution from *Allophaiomys deucalion*, though a simpler interpretation (Cuenca-Bescós et al., 2010a) regards the latter as a precursor of *Allophaiomys chalinei* to which the arhizodont Cueva Negra specimens can be assigned without difficulty. The species present at Cueva Negra are comparable to those found elsewhere in Spain from the end of the Early Pleistocene (Agustí et al., 2010, 2014; Cuenca-Bescós et al., 1999, 2010b; Lozano-Fernández et al., 2007; Minwer-Barakat et al., 2011); see Table 3.

The biochronological implications of the Rodent remains were yet to be recognized when in 2003 a manuscript was sent for publication containing mistaken identifications of several remains (Walker et al., 2004, p. 465, Table 2) and reports of excavation campaigns conducted before 2004 contain errors (owing to tardiness of publication by the Murcian regional authorities and failure to send proofs for correction, some of those reports have much later publication dates, e.g. Walker et al., 2006c). Following the line of preliminary identifications taken by Dr. J. Estévez at the Autonomous University of Barcelona of fossils retrieved by the 1981 excavators (Martínez-Andreu et al., 1989), a precautionary principle favoured consideration of correspondences with late Middle Pleistocene taxa, until presence of clearly older taxa could no longer be ignored, on the part of collaborating palaeontologists, foremost among whom, before his death in 2007, was Dr. Josep Gibert-i-Clòs of the Institut Paleontològic “Dr. M. Crusafont” at Sabadell. Identifications have been hampered by the paucity and fragmentary nature of the excavated remains of large mammals.

Revision of the large mammalian remains is being undertaken by one of us (J.v.d.M.). A skull fragment with the bases of both antlers of a Megacerine was uncovered in 1995 in a closed situation at the top of unit II_{ii} (lying on layers 3k-3l), and together with several teeth and bones excavated at the site, it corresponds to *Megaloceros novocarthaginiensis* n. sp. from the late Early Pleistocene (ca. 1 Ma) site of Cueva Victoria near Cartagena in Murcia (van der Made, 2015a); this species is larger than *M. savini* which it resembles (cf. van der Made & Tong, 2008). *Dama* cf. *vallonnetensis* is present at both sites, likewise consistent with a late Early Pleistocene age. *Capreolus* sp. is present at Cueva Negra, as are Caprini indet. (*Hemitragus bonali*/*Capra alba*?). *Bison* sp. (*B. voigtstedtensis*?) is represented by a short and apparently backwardly orientated horn core, as occurs in *Bison voigtstedtensis* from Voigtstedt, a species that is assumed to be a descendant of *Bison menneri* and is known mainly from the final Early and early Middle Pleistocene (Fischer, 1965; Van der Made et al., in press). The horn core lay immediately underneath a huge boulder which had sealed the Pleistocene sediment of unit II_i at the cave mouth before being broken up with a pneumatic drill in 1991.

Many horse teeth have V-shaped linguaflexids or small protocones, and morphologically and metrically fit *Equus altidens*; this species appeared ca. 1.2 Ma and may have evolved into *E. petralonensis* between 0.6 and 0.4 Ma (Van der Made et al., in press). The ascending ramus of a mandible and a fragment of a tooth loph correspond to Proboscidea indet. A few loose teeth and bone fragments belong to *Ursus* sp. Rhinocerotid fossils include several mandibular fragments and teeth from units II, III and IV, and a small neurocranium with a nearby edentulous mandible were excavated within unit II_i. In earlier reports on Cueva Negra it had been presumed wrongly that those were of *Stephanorhinus hemitoechus*, however, they certainly are not; they correspond either to *S. hundsheimensis* (latest occurrence ca. 0.5 Ma: Van der Made, 2010; Van der Made & Grube, 2010) or a small *S. etruscus* (latest occurrence ca. 0.75 Ma; cf. van der Made, 2015b). A few teeth and maxillary fragments of *Macaca* sp. have been excavated. Like-

wise, *Sus scrofa*, Mustelidae, and possibly *Lynx*, have provided sporadic fragments (which is surprising given the ubiquity of wild boar near the cave today). Hyaenids are represented by a mandible with a first molar that is damaged and cannot be measured but seems to be narrow and therefore might correspond to *Crocota* (rather than one of the other hyaena species of the European Pleistocene which have wide molars: Bonifay, 1971). *Crocota* originated in Africa and was present ca. 1.4 Ma at 'Ubeidiya in Israel; its earliest recorded occurrence in Europe is in the final Early Pleistocene of Atapuerca TD4 (García & Arsuaga, 1999). If the Cueva Negra specimen belongs to *Crocota* it well may be another early European example.

The combination of temporal ranges of the large mammals points unmistakably to a final Early Pleistocene age for Cueva Negra (and certainly no later than the initial Middle Pleistocene), which is compatible with the final Early Pleistocene age suggested by palaeomagnetism (Scott & Gibert, 2009). The fauna shows noteworthy similarity to the fauna from the latest Early Pleistocene site of Cueva Victoria in Murcia (cf. Gibert & Ferràndez-Cañadell, 2014).

As already remarked, the smaller mammalian fauna is also being studied by one of us (ALJ). *Oryctolagus cf. giberti* and indeterminate Leporid remains abound, and *Prolagus calpensis* is also present. Smaller mammals include *Allocricetus bursae*, *Apodemus cf. sylvaticus*, *Erinaceus europaeus*, *Neomys*, and indeterminate Vespertilionids. Remains of over sixty bird species identified by one of us (AE) are informative (notably the Anseriformes) regarding environmental conditions (Walker et al., 2004), though large avian raptors are rare, their presence near the cave today notwithstanding. Fragments abound of *Eurotestudo (Testudo) hermanni* (Dr. X. Murélagu-Bereicua is thanked for his collaboration in classifying these).

2. Fire and Palaeolithic activity

Because detailed consideration of laboratory evidence indicating combustion in deeply-lying sediment at Cueva Negra will be presented elsewhere (Walker et al., in press), only the principal findings and results are mentioned here. Signs that combustion had affected numerous bone fragments and many Palaeolithic chert pieces was observed first in 2011 during excavation of a layer 4.5 m below the top of the Pleistocene sedimentary sequence, 6 m behind the cave mouth, and many more burnt fragments, of both bone and chert, were excavated in the same layer in 2012, 2013 and 2014; most are between 2.0 and 0.5 mm in size owing to shattering by combustion. Because Palaeolithic and palaeontological remains are plentiful in all the overlying sediments, these have to be washed on 2 mm mesh sieves, thereby imposing severe brakes on the speed of excavation and the rate at which it is able to expose the deep layer. Nevertheless, it has provided numerous charred fragments of bone, and several white calcined fragments, including some that show conjoined lengthwise long-bone spalling that is typical of circumferen-

tial shrinkage after thermal volatilization of organic components (cf. Uberlaker, 1999 [2004], pp. 35-38). Although shrinkage usually takes place at 800-900°C (ibidem) it could result from prolonged or repeated exposure at somewhat lower temperatures in the case of bones of small animals or birds. Among abundant thermally-altered lustreless chert fragments, a nodule was excavated that had been split open by heat, with several minute razor-sharp splinters still kept in place together, with a split surface showing the kind of pock-marked rippling which often accompanies the “pot-lid” fracture surfaces that can develop when chert is heated (Richter, 2007; cf. Schön, 2012, p. 104, Abb. 4). An artificially-struck flake cracked open by thermal shock was excavated with sharp conjoinable fragments still in place. Following thermal alteration, those two finds cannot have undergone displacement of more than a few centimetres. Effects of combustion on chert are variable owing to the variety and complexity of cherts; in some cherts temperatures of 250-300°C may produce changes in colour, lustre, or even cause heat damage or recrystallization of quartz, whereas in other cherts higher temperatures of up to 500°C are needed for heat damage or recrystallization, depending on the chemical and crystalline properties of both the quartz itself and impurities present in the chert, such as calcium carbonate or even water (Luedtke, 1992).

At Cueva Negra del Estrecho del Río Quípar combustion temperatures of 400-600°C are inferred from several investigations (Walker et al., in press). Thermoluminescence (TL) analysis of a fragment of excavated burnt chert demonstrates the TL peak characteristic of combustion at such temperatures. Fourier Transform infrared spectroscopical (FTIRS) analysis of bone fragments detects phosphate and hydroxyl absorptions typical of temperatures of 450-700°C. Electron spin resonance (ESR) “palaeothermometry” (Skinner et al., 2004) identifies an organic radical signal in burnt bone (as well as a manganese signal) indicating a temperature of 400-500°C. Thermally induced discolouration of bone is corroborated by taphonomical analysis combined with scanning electron microscopy (SEM) and energy-dispersive (EDX) spectroscopy which enable small isolated deposits on bone surfaces of oxides of manganese or iron to be distinguished from more widespread discolouration caused by thermal alteration. A statistically significant contrast exists between the proportion of bone fragments of small animals showing notable change in colour, consistent with exposure to heat, and the proportion of those showing less change, when samples from the deeply-lying sediment containing burnt chert and bone are compared with samples from overlying layers. Taphonomical inspection (Rhodes, 2013) of some 2,300 fragments from different stratigraphical layers found that deeply-lying sediment with burnt chert represented 97% of all the fragments showing greatest change, and that in deeply-lying sediment bones from different anatomical regions were affected in like manner, which is compatible with *in situ* exposure to high temperature (Rhodes et al., 2014, submitted for publication). Although excavation of that sediment uncovered burnt bone fragments of large mammals, the taphonomical study was orientated towards comparing and contrasting the remains of small animals only, with a view to considering their source, which is most likely to have been predation

by owls, lynxes or foxes, doubtless during periods of human absence. Humans perhaps burnt unhealthy rubbish on their return and maybe roasted foodstuff also. Detailed examination of the deeply-lying sediment revealed that “*distinct layers were observed of materials resembling ash, sometimes resting on reddened belts*” (Angelucci et al., 2013), although incontrovertible high-resolution microscopical evidence of combustion could not be detected in the thin sections on which sediment micromorphology was carried out, there was microscopical detection of charcoal in two of the layers (Walker et al., in press). Chemical and mineral investigations compared the reddened sediment with sediment lying above and below it by means of thermogravimetric analysis with mass spectrometry, granulometry (of the <2 mm fraction) using laser diffraction, and XRF and XRD studies. Presence of hydroxyapatite in the reddened sediment (2.5%) and in the sediment immediately below it (2.5%), is compatible with degradation of bone.

Evidence of fire from ancient cave sites may often seem quite convincing (James, 1989) but it is unwise to ignore much-discussed difficulties that exist behind conflicting interpretations at such important sites as Swartkrans and Zhoukoudian. For that reason, inconclusive comments in a much earlier article (Walker et al., 2006) were limited by prudence to cursory mention of bones with “*signs of burning*” excavated in higher sediments at Cueva Negra, and, in relation to a 1 m² test pit, to “*loose sediment flecked with carbon*” (albeit lacking pollen or microscopically identifiable charcoal fragments) from about 0.5 m above bed-rock, which was reached in 2004; neither its vertical profiles nor its sediment, lacking burnt chert and burnt bone, are commensurate with the sedimentary sequence of the adjacent 2.5 m² which subsequently have provided clear evidence of burnt bone and chert. Six more excavation campaigns were to pass before that adjacent area could be exposed, because of the time-consuming methodological requirement to remove overlying sediments and wash them over fine-mesh sieves. The prudent caution expressed in 2006 was inspired by a possibility that burnt material might have blown into the cave from bush fires sweeping past the cave mouth. Such an interpretation may account for traces of burnt material from 1.2 Ma sediments at the Sima del Elefante (in the Sierra de Atapuerca in northern Spain), reported as follows: “*L’abondance de micro-charbons associés à des composés organo-minéraux exogènes atteste de la récurrence d’incendies naturels dont le déclenchement semble être lié à des événements exceptionnels d’origine cosmique*” (Carbonell et al., 2010).

Roebroeks and Villa (2011) wrote, “*...heated flints in a cave site are unlikely to be the result of natural wild fires and may be considered a reliable indicator of anthropogenic fire if (i) there is no evidence of reworking of sediments, slope wash, or debris flow entering the cave; (ii) the excavator notes a localized concentration of heated flint and bones; and (iii) only a small proportion of heated flint occurs at the site. This combination of evidence suggests a good probability of localized fire,*” which is the very combination found at Cueva Negra. However, “*anthropogenic fire*” carries with it an overtone, unfortunate perhaps, that tends to direct attention to how fire was *generated* in the Palaeolithic. There is no archaeological evidence that Palaeolithic folk at Cueva

Negra knew how to ignite a fire. Striking chert with pyrite can produce hot sparks but no pyrite has been excavated at the cave, though pyrite exists in Triassic Keuper marls near Caravaca. Perishable wooden fire-saws or fire-drills have left no traces at Palaeolithic sites. Moreover, no objects are known from Early or Middle Palaeolithic sites which show signs of modification by drilling. Cognitive appreciation of the affordances of raw materials for generating fire doubtless followed from widespread recognition of the advantages of *tending* fire, possibly a consequence of the *reduction* of innate fear of fire which, plausibly, had been widespread in hominids and caused by painful burns to the skin. Evidence of fire inside an early Palaeolithic cave has implications for our understanding of cognitive evolution.

It is highly unlikely that sparks from a bush fire outside by chance set alight an accumulation of brushwood inside, and that the event resulted in a roaring blaze within causing high temperatures. In any case, bush fires rarely cause temperatures greater than 300°C (Bellomo, 1993). It must be borne in mind that a river and its swamp lay in front of the cave, where gallery woodland flourished in a damp environment, not a dry one. *“Fires may have been made in particular situations, on banks, close to both water and fuel – in the settings where they do not often occur in nature”* (Gowlett et al., 2005). Possibly at that time the cave roof extended outwards further than today (because later erosive reduction of the roof may well have taken place at the entrance); if so, the traces of fire uncovered would have lain relatively further behind the cave mouth than today. Maybe smouldering brands from nearby bush fires were carried into the cave so that fire could be *tended* where rain or wind could not put it out. No fire-pit or hearth stones have been found, hence it is likely that there was scant ability to *control* the heat of a tended fire.

The earliest plausible inferences of Palaeolithic *control* of fire relate to the mid-Middle Pleistocene and are drawn from excavated indications of the repeated use of fire in controlled or restricted spaces. At ca. 0.3 Ma a hearth was present at Qesem Cave in Israel (Shahack-Gross et al., 2014), though signs of combustion were found in deeper layers (Karkanas et al., 2007) of a stratigraphical sequence spanning 0.38-0.2 Ma; some layers contained small tools, others provided Mode E1 (“Acheulian” bifacial) artifacts. In England, various Mode E1 bifaces were excavated at Beeches Pit which is an open site dating from MIS 11, ca. 0.42-0.37 Ma (Gowlett et al., 2005; Preece et al., 2006) where the excavators uncovered features interpreted as hearths *“indicating controlled fire-use”* (Gowlett et al., 2005), as well as *“broader concentrations of burnt material... (that) may be essentially natural features stemming from forest fires”* (ibidem), aspects which are typical of the problems surrounding archaeological interpretation of charred remains at Palaeolithic sites. Nevertheless, at *“Beeches Pit, the occurrence of bones burned to grey or white... implies more intense combustion than is usual for a natural fire, which often results in only partial and superficial burning (David, 1990). However, none of the large mammal bones from Beeches Pit bear cut-marks and it is not clear whether those that were burned were done so intentionally during cooking or disposal*

of food waste, or as a fuel for the fire” (Preece et al., 2006); both issues remarked upon here apply to Cueva Negra, where barely a handful of bones show cut-marks and many are burned to grey or white.

There are no unambiguous indications that fire could be controlled at those earlier Palaeolithic sites where excavation has uncovered clear-cut evidence of combustion. Prominent among these is Gesher Benot Ya’akov in Israel which has Mode E1 bifacial implements (Alperson-Afil, 2012; Alperson-Afil & Goren-Inbar, 2010; Goren-Inbar et al., 2004) and dates from the onset of the Brunhes magnetochron that commenced ca. 0.78 Ma.

In southern Spain, a small area containing burnt bone and “*carbón*,” surrounded by five charred stones, was excavated below some 15 m of overburden at the open Solana del Zamborino site (140 km south-west of Cueva Negra del Estrecho del Río Quípar), from which there came also Mode D1 small secondarily-flaked artifacts and Mode E1 bifacially-flaked “hand-axes” (Botella et al., 1976), including a “hand-axe” (found out of context) of the cordiform shape not found in Europe before the later Middle Pleistocene. Magnetostratigraphical analysis points to an age of ca. 0.77-0.75 Ma (Scott & Gibert, 2009).

Fire was present at the South African Wonderwerk Cave together with Acheulian artifacts during the Jaramillo sub-chron ca. 1.07-0.99 Ma (Berna et al., 2012). Although in Africa other late Early Pleistocene sites with evidence of combustion are known from ca. 1.5 Ma onwards (Gowlett et al., 1981; Rowlett, 2000), most are open sites where bush-fires might have been responsible (see Berna et al., 2012, who do not exclude Gesher Benot Ya’akov in that regard, versus Alperson-Afil, 2012; Richter et al., 2011). At Swartkrans cave, the evidence for combustion (Skinner et al., 2004) from Member 3, which contains Acheulian artifacts, has been the subject of uncertainty with regard to the integrity and age of the member, with dates ranging from 1.4 to 0.6 Ma (Berna et al., 2012; Herries et al., 2009), although an $^{26}\text{Al}/^{10}\text{Be}$ estimate of $0.96\pm 0.09\text{Ma}$ (Gibbon et al., 2014) and another by U-Pb of $0.83\pm 0.21\text{Ma}$ (Balter et al., 2008) seem plausible.

Acheulian artifacts are unknown at Zhoukoudian Locality 1, where six $^{26}\text{Al}/^{10}\text{Be}$ estimates of $c.0.77\pm 0.08\text{Ma}$ (Shen et al., 2009) derive from levels 7-10, which also have 17 estimates ranging from 0.35 to 0.55Ma obtained from $^{230}\text{Th}/^{234}\text{U}$, TL, ESR and fission-track methods (Goldberg et al., 2001). Layer 8 correlates with the laterally separate “quartz horizon 2” where “ash” was reported (Black et al., 1933; Pei, 1932; Teilhard & Pei, 1932). Chemical signs of combustion exist in later levels 4-6 (Zhong et al., 2013) notwithstanding micromorphological demonstration of post-depositional alteration of their sediments by diagenesis. This also took place in the deeper layers 7-10, leading to mistaken identification of “ash” features; burnt bone found slightly above them is incompatible with in situ combustion (Goldberg et al., 2001).

The denizens of Cueva Negra del Estrecho del Río Quípar may have been less afraid of fire outside than animals they saw fleeing from it. That may have induced them to meddle with fire in order to drive animals towards natural death-traps, such as swamps,

where they could be dismembered. Were foodstuffs roasted or cooked at the cave? It is impossible to say. A tended fire in a cave could serve several different purposes at the same time, such as providing warmth, roasting food, and deterring the approach of fierce animals. There are, however, physiological arguments for considering that cooking may have played a significant part in human evolution from at least 1.5 Ma, and perhaps 2.0 Ma, onwards (Rowlett, 1999, 2000; Wrangham, 2009; Wrangham & Conklin-Brittain, 2003). Wrangham (2009, pp. 88-90) wrote that archaeological “*hints from the Lower Paleolithic tell us only that... the control of fire was a possibility, not a certainty*” and that “*the inability of the archaeological evidence to tell us when humans first controlled fire directs us to biology... At some time our ancestors’ anatomy changed to accommodate a cooked diet.*” With regard to the evolution of human anatomy, given the attainment at ca. 1.6 Ma of a more-or-less modern stature by *Homo erectus/ergaster* at Nariokotome, it is by no means unthinkable that subsequent expansion of cerebral volume was facilitated, at least in part, by enhanced digestion and the absorption of nutrients which cooking afforded to pregnant women, lactating mothers, growing infants, children, and adolescents (cf. Fonseca-Azevedo & Herculano-Houzel, 2012), with noteworthy advances in cognitive versatility throughout our genus by the onset of the Middle Pleistocene. This, of course, is merely a plausible conjecture.

3. Technological diversity

Nevertheless, it is one that it would be imprudent to ignore within the context of current palaeoanthropological and Palaeolithic debates about the likelihood, or otherwise, that successive migrations from Africa during the Early Pleistocene, by different palaeospecies of *Homo*, might have been responsible for first introducing into Eurasia “Oldowan” (“Mode 1”) stone artifacts, followed subsequently by “Acheulian” (“Mode 2”) bifacially-flaked artifacts, and later on, during the Middle Pleistocene, a technology characterized by small flakes of stone neatly-knapped into various kinds of artifacts (“Mode 3”). Despite being aspects of convergent evolution, did any or all of those Palaeolithic phenomena occur independently? And what might this mean when interpreting palaeospecies of *Homo*, particularly in Eurasia?

In an attempt to address some of these questions, the rest of this paper will focus primarily on interpreting published findings from Cueva Negra del Estrecho del Río Quipar with regard to technological diversity (Walker et al., 2013; Zack et al., 2013), environmental exploitation (ibidem, cf. Walker et al., 2004, 2006a), and the palaeoanthropological path of cognitive evolution (Walker, 2009; Walker et al., 2013; Zack et al., 2013), instead of conjectures about behavioural diffusion, imported lock, stock and barrel via intercontinental dispersals of early humans. Although other specialists may choose to publish contrary opinions, we regard our own interpretation to be preferable because it is a minimalist view, grounded in evolutionary principles, without the need for recourse to

self-justifying conjectures about diffusion that are immune to attempts to falsify or refute them, and which, moreover, present spatio-temporal incompatibilities and methodological drawbacks in terms of the scalar incommensurability of data.

Hard evidence of cognitive evolution is, of course, widespread in the archaeological record of Palaeolithic technology from the Middle and Late Pleistocene. Earlier still, towards the close of the Early Pleistocene (after the Jaramillo sub-chron but before the Matuyama-Brunhes boundary), it can be detected in the Mediterranean region of the Iberian Peninsula where, in Catalonia, a Mode E1 artifact (a bifacially-flaked “Acheulian” “cleaver”) from that period has been excavated at Barranc de la Boella (Vallverdú et al., 2014), and an assemblage of small artifacts of Modes B, C, and D was uncovered at Vallparadís (Barsky et al., 2013; Duval et al., 2012; Garcia et al., 2011, 2012; Martínez et al., 2010).

Because the Cueva Negra excavation has provided both Mode E1 (a bifacially-flaked “Acheulian” “hand-axe,” Figure 1) and Modes C, B, D, and F artifacts, which include flakes produced by repetitive recurrent flaking of small cores to make small tools, the site demonstrates the ability of those who frequented it to select and carry out a variety of Palaeolithic practices, which include two identifiable, though substantially different, self-determining or self-constraining Palaeolithic sequential behavioural activities (Walker, 2009; Walker et al., 2013; Zack et al., 2013). Early human survival at latitudes higher than those of Africa placed heavy evolutionary demands on cognitive versatility and manual dexterity, as attested to by the diversity of the Cueva Negra Palaeolithic artifacts, so we need not be at all surprised that they could tend fire. Rather than trying to assign early humans in Eurasia to notional palaeospecies of *Homo*, it is more prudent to consider early co-occurrence of fire with Mode E1 (bifacially-flaked) stone artifacts from the standpoint of cognitive evolution at the close of the Early Pleistocene.

In the European context, the Palaeolithic assemblage at Cueva Negra is of considerable interest, given its late Early Pleistocene antiquity. It can be regarded as a coherent assemblage because from the standpoint of Shea’s modal analysis there are few marked differences between the lower part of the 5 m depth of sediment lying on bed-rock and the upper units. In so far as there may be differences in vertical distribution of the representation of large (L) “heavy-duty” and small (S) “light-duty” artifacts, they are in line with observations at both alluvial and cave sites of Holocene age (Hofman, 1986; Stockton, 1973), which suggest a greater tendency for small archaeological items to migrate downwards than do large ones (which may even tend to migrate slightly upwards). At the Middle Palaeolithic coastal dune site of Terra Amata (dated to ca. 0.38 Ma: de Lumley et al., 2009), vertical migration of artifacts was demonstrated by analysis of lithic conjoins to be at least as significant as horizontal displacement if not more so (Villa, 1983, pp. 65-79). The following data in Tables 4a,b,c and d from Cueva Negra refer to an excavated sample from sealed layers.

Table 4a. Volumes of Pleistocene sediment excavated by stratigraphical unit.

Table 4b. Average number of lithic elements per m³ excavated.

Note: The high value of 300 in unit 6 is due to heat-shattering of chert into minute splinters, often <5 mm long.

Unit	m ³	Unit	Ave. number per m ³
II	24.00	II	65
III	8.40	III	475
IV	9.10	IV	75
V	1.20	V	135
VI	0.55	VI	300*

Table 4c. Excavated lithic finds by rock type:

Excavated lithic finds by rock type L = large (>60 mm approx.) "heavy-duty tool" S = small (<60 mm approx.) "light-duty tool"		chert	quartz	quartzite	limestone	marble
L	Mode A (hammerstone, manuport)	1		16	17	
L	Mode A (worked core/nodule)	19			7	
L	Sub-mode C1* (unidirectional "chopping tool")				1 (???)	
S	Sub-mode C2* (stubby or keeled, with several steep flake-scars at one extremity)	15			1	
S	Sub-mode C2* (stubby keeled "beaks," "awls," and spurred "microperforators," with two kinds of NHC flake scars)	9				
S	Sub-mode C2* (NHC flake scars on extremities of keeled plano-convex forms: "proto- <i>limaces</i> " and " <i>Tayac</i> points")	2				
S	Sub-mode D1 (continuous edge "retouch": "scraper")	71	1	6	6	1
S	Sub-mode D1 ("denticulate")	5				
S	Sub-mode D1 (struck flake with notching or discontinuous irregular modification of an edge)	100		1	6	
S	Sub-mode D5 (pointed pieces)	5		1		
L	Sub-mode E1 (bifacial "hand-axe")				1	
S	Sub-mode F derivatives: flakes with dorsal scars caused by recurrent repetitive flaking before removal from a Mode F core**	6				
S	Unretouched struck flake (with striking platform/bulb of percussion)	408	1	28	71	
S	Fragments, spalls, knapping "waste"	3969	24	35	494	2

Table 4d. Excavated lithic finds by lithostratigraphical unit.

Notes:

- (1) C2* - as explained earlier in the text, a distinction is proposed between informal non-hierarchical stubby or keeled C1 cores, albeit with a tendency for flake scars to be more numerous at one extremity, and a Sub-mode C2 comprising non-hierarchical keeled plano-convex and stubby pyramidal forms characterized by two kinds of NHC flake scars, separable by size and space to such an extent that the two are not in a hierarchical relationship.
- (2) **These flakes indicate the presence of Mode F knapping in Sub-modes F1 and F3, and although they are not in the sample presented here, Sub-mode F1 cores have been found: one of limestone on the surface beside the mouth of the cave, and the other of chert at the quarry site 0.8 km E of the cave where other artifacts have been collected, all resembling those excavated in the cave.
- (3) ***It should be noted also that a “scraper” of radiolarite was excavated in unit V after this table had been drawn up. The nearest known radiolarite outcrop is over 30 km away.
- (4) ****Bipolar cores are not shown in Tables 4c and 4d, although several have been identified. Some plano-convex C2 pieces can be interpreted as bipolar cores (see text).

Excavated lithic finds by lithostratigraphical unit L = large (> 60 mm approx.) “heavy-duty tool” S = small (< 60 mm approx.) “light-duty tool”		II	III	IV	V	VI
L	Mode A (hammerstone, manuport)	15	18	1	0	0
L	Mode A (worked core/nodule)	2	17	7	0	0
L	Sub-mode C1* (unidirectional chopping tool)	1	?1?			
S	Sub-mode C1 (stubby or keeled informal NHC pieces)	3	9	2	0	20
S	Sub-mode C2* (stubby keeled “beaks,” “awls,” and spurred “microperforators,” with two kinds of NHC flake scars)	0	3	2	2	2
S	Sub-mode C2* (NHC flake-scars on extremities of keeled plano-convex forms: “proto- <i>limaces</i> ” and “ <i>Tayac</i> points”)	0	2	0	0	0
S	Sub-mode D1 (continuous edge “retouch”: “scraper”)	10	47	23	3	1
S	Sub-mode D1 (denticulate)	1	1	3	0	0
S	Sub-mode D1 (struck flake with notching or discontinuous irregular modification of an edge)	19	54	26	2	6
S	Sub-mode D5 (pointed pieces)	1	4	1	0	0
L	Sub-mode E1 (bifacial “hand-axe”)	1				
S	Sub-mode F derivatives: flakes with dorsal scars caused by recurrent repetitive flaking before removal from a Mode F core**		3	3		
S	Unretouched struck flake (with striking platform/bulb of percussion)	94	303	93	6	17
S	Fragments, spalls, knapping “waste”	1450	2265	525	146	117

Excavation at Cueva Negra has identified one Mode E1 bifacially-flaked (“Acheulian”) “hand-axe” (Figure 1; see also Walker et al., 2006a, p. 19, Figure 7.8, p. 20, Figure 8, p. 21, Figure 9.1; Walker et al., 2013, p. 141, Figure 6) and one (possibly two) Mode C (Sub-mode C1) (“Oldowan”) “chopping tool” (Walker et al., 2006a, p. 19, Figure 7.7, p. 21, Figure 9.2), all of limestone, and many small artifacts of Modes C and D (Figures 2a-c, 4a-m, 5a-s) of chert, limestone, quartzite, and in one case, radiolarite, some of which (e.g. Figures 5a-c) have Sub-mode D1 steep, abruptly knapped edges (“Mousteroid”) (see also Walker et al., 2006a; Walker et al., 2013, p. 142, Figure 8, p. 143, Figure 9). A few of them (e.g. Figures 3a-c; see also Walker et al., 2006a, p. 19, Figures 7.1-7.3, p. 23, Figures 11.1-11.6; Walker et al., 2013, p. 144, Figure 12, p. 145, Figure 13) were struck by Mode F recurrent repetitive flaking on small cores, of which one (“Levallois”) discoidal core of limestone (Figure 3a) is a surface find from beside the cave (see also Walker et al., 2006a, p. 19, Figure 7.6; Walker et al., 2013, p. 144, Figure 11), and another, of chert (Figure 3b), was found at a nearby “quarry” site of Tortonian conglomerate 0.8 km east of the cave (see also Walker et al., 2006a, p. 14, Figure 6, p. 19, Figure 7.5; Walker et al., 2013, p. 144, Figure 11), where knapped artifacts have been collected that are indistinguishable from those excavated at the cave (no other kinds have been found there).

Modes C, D, and G Unipolar and Mode B bipolar reduction are more frequent. Nevertheless, most of the chert artifacts excavated can be regarded as “expedient” or “opportunistic,” being of informal shape, as often as not on irregular fragments, rather than on flakes showing striking platforms and bulbs of percussion. The raw materials to hand at Cueva Negra were mainly frangible tabular chert nodules, blocks, or slabs, of sub-parallelepiped shape, on which knapping usually fails to elicit conchoidal fractures or to produce feathered flakes with convex bulbs of percussion. Such nodules can be described as being *fissural* (Stein, 1981, p. 537: “Fissural” [adj.], entered under “Fissure”; cf. “*fissilità*” Crovetto et al., 1994, p. 87) because when hammering does not simply shatter blocks of local chert into tiny chips and fragments, it may split them apart along fissures or *fissural* flat planes, defined by the internal structure and impurities of the chert, and thereby produce flattish, sub-rectangular laminar pieces (cf. Figure 5s; see also Walker et al., 2013, p. 147, Figure 17) that can be modified into tools, particularly by knapping a perpendicular margin steeply in order to transform it into a sub-mode D1 acute angle useful for cutting or scraping. Whereas steep retouch applied to thin, feathered flakes can prevent the risk of snapping during use, it should be remarked that well-formed, feathered flakes are uncommon at Cueva Negra. Erosion of nearby escarpments caused displacement from Jurassic rock strata of chert nodules that often were subjected to Miocene, Pliocene and Early Pleistocene rolling and battering, during processes, first of marine, and subsequently continental, erosion and redeposition in conglomerates or gravels (Walker et al., 2013).

Several small retouched or secondarily-knapped artifacts appear to fall into overlapping groups. It is worth remarking that most artifacts are very small, mainly <5-6

cm across (sometimes <3 cm). A sizeable group comprises flakes and flattish or laminar rectangular fragments (Figure 5a-s), the edges of which often bear Sub-mode D1 steep abrupt edge-modification typical of “scrapers” (Walker et al., 2013, p. 142, Figure 8). Steeply knapped edges of serrated, notched and denticulate forms are common (Figures 4f-m, 5m; see also Walker et al., p.146, Figure 16), as are pieces bearing one or two large notches, though semi-invasive flake-scars are less common (e.g. Figures 5k, 5p; see also Walker et al., 2013, p. 146, Figure 15). Steep marginal knapping is found on many pointed pieces (Figures 4b-m; see also Walker et al., 2013, p. 139, Figure 3, p.143, Figure 10, p.146, Figure 16), some of which are flattish pieces that could be interpreted as fine points and “awls” or “perforators” (Walker et al., 2013, p. 146, Figure 16), although others recall thick “Tayac points” described in several Middle and early Late Pleistocene European assemblages. Various Sub-mode C2 pieces were carefully knapped out of one end of small chunky fragments of chert (Figures 4f-m; see also Walker et al., 2013, p. 143, Figure 10), from which there emerge, incongruously and daintily, delicate tiny elongated “tips” or “spurs” (perhaps appropriate for undertaking perforation as “awls” or “borers”). There are several Sub-mode C2 (and perhaps G1) steeply keeled fragments, some of which resemble steep scrapers on short stumpy cores, and others were knapped neatly into the elongated, keeled, planoconvex shape of “garden slugs” (Fr. “*limaces*”), which might be regarded as “proto-*limaces*” or convergent “steep scrapers” (Figures 4b-e; see also Walker et al., 2006a, p. 19, Figure 7.4, p. 23, Figure 11.7; Walker et al. 2013, p. 145, Figure 14) and, where both ends are pointed, could be envisaged as thick “double points.”

The problem of bipolar cores must be approached with caution. Researchers at Isernia La Pineta provide cogent arguments that both “beaks” and “*limaces*” are merely what were left behind when cores had been reduced by bipolar knapping techniques in order to remove extremely small flakes for subsequent use as unretouched tools (Crovetto, 1994; Crovetto et al., 1994; Peretto, 1994; Peretto et al., 2004). Flakes that were the result of bipolar knapping have certainly been identified at Cueva Negra, though not quantified. This is because the quantification of bipolar elements can give conflicting results, depending upon how some keeled pieces are regarded. Put simply, might some keeled pieces (whether with notches, such as “beaks,” “awls,” spurred “microperforators,” etc., or without them, such as plano-convex proto-“*limaces*” and “Tayac points”) be cores that had been reduced by bipolar knapping in order to remove very small flakes for use? Or should they be regarded as tools of various kinds that were fashioned intentionally as such?

Moreover, to complicate matters even further, these possibilities need not be mutually exclusive of course. As mentioned earlier, researchers at Isernia La Pineta have put forward cogent arguments in support of their interpretation of the artifacts excavated there, which has been corroborated by microscopical use-wear analysis (according to a verbal conversation with Dr. L. Longo) and experimental knapping, and we are embarking (IML) on similar studies, especially in light of microscopical analysis of Early Pleis-

tocene bipolar knapping at Bizat Ruhama in Israel (Zaidner, 2013). It should be borne in mind, however, that in several continents apparently similar lithics, widely separated by time and space, have been interpreted as implements, and occasionally microscopical use-wear analyses support such views (there is extensive literature with references to “*limaces*,” “beaks,” “awls,” and other similar artifacts, e.g., “microperforators,” from Pleistocene and Holocene lithic assemblages, not only in Europe but also in Africa, North America and South America).

Knapping spalls abound at Cueva Negra, as do split (“tested”) cobbles, lumps and fragments that had been brought to the cave from nearby sources of stone. Apart from chert, knapping was also performed on quartzite and fine-grained (including dolomitic) limestone; sometimes these bear the conchoidal scars of knapping, as do, unsurprisingly, some of the chert artifacts, among which are flakes with convex bulbs of percussion and striking platforms. Some chert flakes bear dorsal scars that testify to repetitive flaking on the core before the flakes were struck off. Occasionally, striking platforms are faceted, indicating a particular preparation of the area on the core where the flake was struck from it, and sometimes, the shapes of both small flakes and their dorsal scars show that repetitive flaking must have been carried out on the cores (Figures 2a-2c; see also Walker et al., 2006a, p. 19, Figures 7.1-7.3, p. 23, Figures 11.1-11.6; Walker et al., 2013, p. 144, Figure 12, p. 145, Figure 13).

Two small discoidal cores (Figures 3a & 3b) support the inference that such (“Levallois”) flaking was performed at times. Each bears a central concave scar which corresponds to the convex ventral bulb of the last flake to have been struck from it (the so-called “*éclat préférentiel*”): one is of limestone and was found on the surface beside the mouth of the cave (see also Walker et al., 2006a, p. 19, Figure 7.6; Walker et al., 2013, p. 144, Figure 11); the other is of chert (see also Walker et al., 2006a, p. 14, Figure 6, p. 19, Figure 7.5; Walker et al., 2013, p. 144, Figure 11) and was taken from the surface of an outcrop of a Tortonian conglomerate 0.8 km east of the cave, from which we also recovered small chert artifacts with steep abruptly knapped edges like those at the cave, from which cobbles were taken to the rock-shelter.

A Sub-mode E1 bifacially-flaked (“Acheulian”) limestone “hand-axe” (Figure 1; see also Walker et al., 2006a, p. 19, Figure 7.8, p. 20, Figure 8, p. 21, Figure 9.1; Walker et al., 2013, p. 141, Figure 6) was excavated in 2003 in a deep position (in lithostratigraphical unit II_{ii}; Walker et al., 2013) where there was also a noteworthy concentration of Palaeolithic knapping débitage and bone fragments (Walker et al., 2006a, p. 22, Figure 10). The “hand-axe” had lost its tip in antiquity and presented an S-twist in its horizontal cross-section. Its edges are sharp and fresh, neither rolled nor water-worn. It had been fashioned by removal of no more than thirty flakes from a flat limestone cobble, on which some of the cortex is still present. This unexpected find brought into perspective another, discovered in 2001 in the same level, namely, a Sub-mode C1 “pick”-like chopping tool, with sharp, fresh edges, which had involved unidirectional removal of fifteen flakes, fashioned also on a flat limestone cobble (Walker et al., 2006a, p. 19, Figure 7.7, p. 21, Figure 9.2). Initially, this

had seemed incongruous with the assemblage of small artifacts, which, in 2001, we still regarded as being of late Middle (or even early Late) Pleistocene age, because of a lack of clear-cut evidence to the contrary. However, by 2003 the extinct Arvicolid rodent species that we had begun to recognize, such as *Mimomys savini*, implied a much earlier chronology. Both cobbles alluded to previously are of grey-blue, micritic limestone (94% calcite, with 6% quartz, which contributes to the hardness of the stone, determined by X-ray diffraction (XRD) of powder and x80 optical microscopical petrography), which is characteristic of the Jurassic Lower Middle Lias. Cobbles of grey-blue limestone were incorporated in the nearby conglomerate outcrop (0.8 km east of Cueva Negra) during the Upper Miocene Tortonian phase. However, the only two cobbles from the outcrop submitted to XRD analysis are of pure limestone, lacking quartz: one is composed of cryptocrystalline limestone pellets of organic faecal origin, the other of sparite cement with microscopical fossils (Walker et al., 2006a). Two other unworked cobbles excavated at Cueva Negra were also examined by XRD analysis and microscopical petrography (ibidem): one has no quartz and is an oosparite (oolitic limestone with sparite cement), and the other is a dismicrite containing 10% quartz, radiolarian fragments, and filamentous planctonic fragments characteristic of the Middle Jurassic Dogger beds that outcrop upstream from Cueva Negra at several localities in hills around the upper Quípar valley.

In 2004, three (cf. “Levallois”) flakes, probably struck from Mode F cores, made of good quality chert, or flint, were excavated in lithostratigraphical unit III (i.e. *below* the “hand-axe” and pick-like chopping tool) (Figures 2a-2c). One is an asymmetrical, triangular flake of grey chert or flint (Figure 2b). It is a clear example of 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 (see also Walker et al., 2006a, p. 19, Figure 7.1, p. 23, Figure 11.1-2; Walker et al., 2013, p. 144, Figure 12 top, p. 145, Figure 13 top). This could be regarded as a “second-order Levalloisian point,” or perhaps a so-called “pseudo-Levalloisian” pointed, triangular flake which nevertheless is “*characteristic of particular techniques of preparing the surface of a Levalloisian flake core*” (Debénath & Dibble, 1994, p. 52; cf. Boëda et al., 1990; Mellars, 1996, pp. 65-66). Secondary knapping had taken place along the long dorsal margin of its plane striking platform, and it varies from semi-invasive to abrupt (perhaps the small scars assisted hafting). Possible edge-damage at the distal extremity of this piece perhaps implies that it was used as a boring tool or awl. Another flake is of brown-grey chert or flint and sub-square shape (Figure 2a). Its striking platform was prepared with three facets (or perhaps four). The flake shows no secondary modification and ends in a step fracture which is slightly plunging (see also Walker et al., 2006a, p. 19, Figure 7.3, p. 23, Figure 11.3-11.4; Walker et al., 2013, p. 144, Figure 12 bottom, p. 145, Figure 13 middle); two widely separated crests on the dorsal surface delimit a flake scar corresponding to the prior removal of a flake that had been struck from the region of the same striking platform. The third flake is of grey-white chert or flint and oblong shape. It has a plane striking platform (Figure 2c), shows

no secondary working, and ends in a step fracture which is slightly plunging. It 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 (see also Walker et al., 2006a, p. 19, Figure 7.2, p. 23, Figure 11.5-11.6; Walker et al., 2013, p. 145, Figure 13 bottom).

These three flakes are less than 6 cm in length. From the same unit there is an elongated, keeled, planoconvex “garden-slug” or “proto-*limace*,” made of chert, with semi-abrupt or steep squamous flake scars (other plano-convex chert pieces have been excavated at the site, some with semi-abrupt squamous flake scars on which marginal abrupt flaking was superimposed in a stepped or scalar manner). Of fundamental importance is the incontrovertible fact that, at a depth even greater than that where the Sub-mode E1 bifacially-flaked (“Acheulian”) “hand-axe” was found, these flakes are evidence of Mode F core-reduction and flake-preparation techniques (plausibly Sub-mode F1 and F3, cf. “Levallois”).

In short, it is beyond all reasonable doubt that there was broad contemporaneity, before 0.78 Ma, at Cueva Negra, of both types of core-reduction processes, namely, “*façonnage*” (fashioning artifacts on cores) and “*débitage*” (products of knapping). Furthermore, each, in turn, can be divided (Walker et al., 2013) in respect of interpreting work on cores in terms of whether or not there is plausible incidence of secant planes, which could have affected knappers’ subliminal appreciation of the differences in the volumes that were to be reduced (cf. White & Pettitt, 1995). There are both substantive and formal aspects to this consideration, which impinge on Shea’s analysis of Modes A-I as one that informs us of the knappers’ wide cognitive appreciation of the “*kinds of ways of making stone tools*” identifiable in the assemblage (Shea, pers. comm., June 19th, 2015). Only Modes H and I are unrepresented at Cueva Negra. Therefore, the aforementioned consideration is highly pertinent to the matter of cognitive evolution at the close of the Early Pleistocene in Europe. As remarked earlier, Shea’s modal scheme embraces a range of flexible cognitive relationships between knappers and lithic affordances. Its application at Cueva Negra increases to at least six the four practical approaches undertaken by knappers hitherto identified at the site (Walker et al., 2013, p. 150, Figure 19). It points to the “*diversity*” and “*multiplicity*” observed by other students of late Matuyama assemblages (Barsky, 2009; Carbonell et al., 2009).

Very few bone fragments bearing cut-marks have been excavated (for an example see Figure 7).

Two short, peduncular fragments were uncovered (each reduced distally) of the shed antlers of large cervines, as well as another shortened fragment attached to bone (Figure 8). There is a possibility that soft-hammer knapping was practised, especially in the case of stepped or scalar flake scars on diminutive chert artifacts such as that shown in Figure 5p.

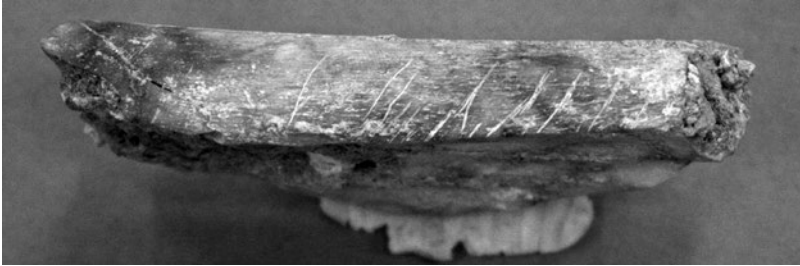


Figure 7. Bone fragment with cut-marks.

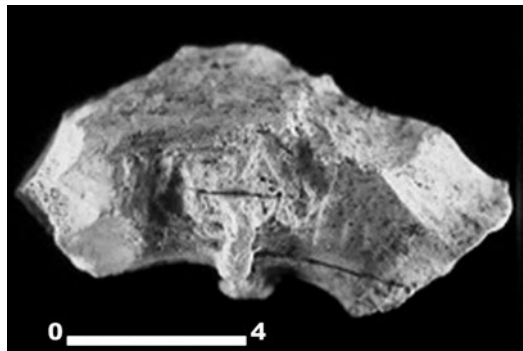


Figure 8. Fragment of antler attached to bone.

4. Environmental exploitation

Before research began at Cueva Negra, the extensive Segura drainage basin, of which the Quípar valley is a part, had received very little attention from the standpoint of research related to Palaeolithic environmental exploitation during the earlier Middle and final Early Pleistocene (0.6-0.9 Ma). The River Quípar rises about 30 km upstream from the cave and joins the Segura 40 km downstream from it. It is one of several important tributaries feeding the River Segura which drains into the Mediterranean Sea. The geomorphological and geological characteristics of the basin, and the neotectonic effects on their evolution, render imprudent presumptions of commensurability with palaeoenvironmental findings of studies performed beyond the watershed of the basin, especially those based on periods before 0.9 Ma or later than 0.6 Ma. It is more appropriate here to limit our remarks to the exploitation of resources in the Quípar valley by those who frequented Cueva Negra.

Several possible sources of chert have been investigated in an attempt to shed light on Palaeolithic interaction with the environment. Likely sources in the landscape were

sampled at distances of ≥ 30 km from the site. Trace-element fingerprints were analyzed by laser-ablation inductively-coupled plasma mass-spectrometry (ICP-MS) and comparisons were made between chert excavated at Cueva Negra and samples taken from different outcrops (Zack et al., 2013). In all, 56 chert samples were analyzed for 19 lanthanide and rare-earth trace elements, all of which produced detectable values (Sc, V, Cr, Co, Zn, Ga, Ge, Rb, Sr, Y, Zr, Nb, Cs, Ba, La, Ce, Pr, Nd, Sm). Factor analysis was used to differentiate between sources and to indicate where chert analyzed from the cave may have been obtained. Although the analysis corroborated conjectures that the chert had mainly originated from a conglomerate outcrop 0.8 km east of the cave, where chert nodules could be quarried readily (see above), the trace-element evidence also has pointed to the likelihood that some chert excavated at Cueva Negra (ca. 15% of the pieces investigated) could have been brought from sources up to 30 km away (ibidem). Subsequent field research has suggested that a considerable amount of black chert excavated at Cueva Negra probably came from an outcrop about 20 km south-west of the cave, and that a “scraper” (with secondary flaking) of radiolarite may well point to a source at an outcrop 40 km north-east of the cave. It is no surprise that most stone for knapping was obtained close to the site. This is consistent with well-known considerations about optimal foraging strategies and time-and-energy trade-offs when near-versus-distant procurement strategies are contrasted (cf. Brantingham, 2003, 2006; cf. Féblot-Augustins, 1993, 1997). It is perhaps worth remarking that, apart from the nearby conglomerate outcrop, nearly all the other outcrops of interest lie upstream from Cueva Negra, in and around the upper reaches of the Río Quípar and its headwaters (known as the Rambla de Tarragoya). A significant exception is the radiolarite outcrop, which lies downstream, at the Barranco de Vite, near to where the Río Quípar drains into the Río Segura.

Regardless of whether or not a particular relationship existed between Palaeolithic exploitation of resources in the Quípar valley and Palaeolithic utilization of Cueva Negra, which is a conjecture that cannot yet be tested, the following observations merit reflection. First, the vicinity of the site appears to have undergone considerable Pleistocene neotectonic disturbance, to such an extent that its Palaeolithic surroundings undoubtedly were different from those of today (Walker et al., 2013). Secondly, although the excavation has provided much information about the effect of the river on the cave and its surrounding swamp and nearby lake, and on the sustenance of plants, animals, and birds, it is as yet unclear what was exploited by those who knapped Palaeolithic artifacts inside the cave and who left behind traces of fire. Few fragments of animal bone have cut-marks and it is unclear what kinds of predators should be implicated. A plausible surmise is that human foragers, scavengers or hunters visited the cave sporadically, and only when the floor sediments were dry, given that these may well have been water-logged often during the spring, whilst the north-facing rock-shelter often was inhospitable in winter.

However, the excavation of a large fragment of a giant cervine (*Megaloceros*) skull with both of the antlers still attached to it would seem to imply that a large predator or scavenger had dragged the animal's head, complete with antlers, into the cave during the

cooler months of the year, given that deer antlers usually are shed in the spring. A smaller fragment of frontal bone with the proximal crown-beam of a smaller cervine (Figure 8) was excavated. Also found were a cranium and fragments of several mandibles of rhinoceros (*Stephanorhinus*), one of which displays signs of carnivorous gnawing of the ramus, and a large mandibular fragment and loph of an Elephantid. Larger mammals commonly found are of horse, cervines, caprines, bison, and even macaque, whereas the identifiable remains of large carnivores (bear, hyaena, lynx) can be counted on the fingers of one hand. By contrast, Palaeolithic artifacts are ubiquitous throughout the cave. Is it plausible that humans might have left parts of giant herbivores inside a cave which otherwise those animals would never have entered?

The singular biodiversity of the surroundings of Cueva Negra has been highlighted by palaeopalynology (Carrión et al., 2003), avian palaeontology (Walker et al., 2004, 2006), and revised mammalian palaeontological identifications (Walker et al., 2013) which supersede earlier publications that contain mistaken identifications (to a large extent owing to the very fragmentary remains of some genera and the misconception that their sedimentary context belonged to a time no earlier than the late Middle Pleistocene). Nonetheless, the botanical and zoological biodiversity implies that sediments were deposited in Cueva Negra at a time when it lay at the intersection of four biotopes: 1) lakes and rivers with temperate woodland; 2) open mixed woodland; 3) open grassland and moorland; and 4) craggy mountainsides. Pollen analyses indicate woodland stands predominantly with evergreen oaks (holm or holly oak, *Quercus ilex rotundifolia*) and deciduous white oaks (undoubtedly Portuguese oak, *Quercus faginea*), as well as pines (maritime pine, *Pinus pinaster*, and possibly also Aleppo pine, *Pinus halepensis*), yew (*Taxus baccata*, which has disappeared only recently from the Sierra del Tejo, i.e. Yew-tree Mountain, in nearby Moratalla), strawberry-tree (*Arbutus unedo*), and tree-heath (*Erica arborea*). It is particularly interesting that there is pollen of species that flourish only in damp conditions, including hazel (*Corylus avellana*), beech (*Betula celtiberica*), ash (*Fraxinus angustifolia*), maple (*Acer granatense*), elm (*Ulmus*), willow (*Salix*), and bulrush (*Typha*); nowadays the dry open landscape around Cueva Negra retains few of these species apart from on a few shaded river-banks. The presence of swamps and even lakes has been further corroborated by the excavated remains of waterfowl, namely, ruddy shelduck (*Tadorna cf. Ferruginea*), wigeon (*Anas penelope*), gadwall (*Anas cf. strepera*), common teal (*Anas crecca*), red-crested pochard (*Netta rufina*), common pochard (*Aythya farina*), ferruginous pochard (*Aythya nyroca*), and mallard (*Anas platyrhynchos*), this last being the only species of waterfowl present in the area today. Despite searching for fish remains with a field microscope in samples of excavated sediment, otoliths have not been found and only one small vertebral fragment has been observed.

There are plausible conjectures that many of the bird species excavated at Cueva Negra may have been hunted or trapped by humans, particularly migratory birds that rest, feed and mate in wetlands during autumn and spring, but it is not our intent to elaborate such theories here. Suffice it to say that there are several indications that hu-

mans frequented the cave during different seasons of the year, and in this context it is probably worth mentioning that the golden plover would have been more abundant in winter, whereas the swifts, swallows, and bee-eaters would have been more plentiful in the summer (Eastham, 2005). Oddly enough, although 66 avian species have been identified among the excavated remains, very few of the larger raptors are represented (other than one or two bones of golden eagle) although nowadays several species visit the neighbourhood, including the griffon vulture, eagle owl, and goshawk (while further west the lammergeier can be seen in the mountains above the source of the Segura). Smaller birds of prey, however, are represented among the excavated remains (buzzards, kestrels, peregrine falcon, red kite, barn and little owls), though many others that visit the neighbourhood nowadays are conspicuous by their absence. Might this have been because human activity deterred them? Nevertheless, it should be borne in mind that birds of prey do not usually nest in Spanish caves, and it is unlikely that the excavated remains of larger animals owe to avian predation. Nonetheless, barn owls are known to nest in the twilight zone of caves, from Europe to southern Africa (Andrews, 1990; Brain, 1981), just as they may well have done at Qesem cave in Israel (Smith et al., 2013), and there are even reports of eagle owls nesting in caves (ibidem). Notwithstanding absence of their pellets at Cueva Negra, owls might have been responsible for depositing remains of small animals. It should not be forgotten, however, that in several cultures today humans consume many species of small mammals, reptiles, amphibians, and birds, and, of course, their eggs. With a view to identifying likely predators, taphonomical analysis is underway in an attempt to assess both the relative proportions of different identifiable bones and teeth and also the respective relative degrees of corrosion or alteration in digestive tracts of alternative possible predators. However, the possibility cannot be ruled out that various predatory species of animals and avian raptors may have deposited the remains at Cueva Negra, perhaps during different seasons of the year or during different periods that could have lasted several years.

Pride of place must be afforded to the biodiversity that existed around Cueva Negra at the time when Pleistocene sediments accumulated in the rock-shelter. It undoubtedly facilitated survival there of Palaeolithic foragers during a late Early Pleistocene interglacial period. Nevertheless, even in the present interglacial period of the Holocene, day-time temperature at the cave can fall to 0°C between mid-autumn (early November) and early spring (mid-April), night frosts are usual, and deep snow-cover is present during at least two or three weeks every winter.

5. Cueva Negra and cognitive archaeology

The Palaeolithic assemblage at Cueva Negra may be considered in the context of other assemblages from the late Early Pleistocene and onset of the Middle Pleistocene. In the Iberian Peninsula, the bifacially-flaked “Acheulian” “hand-axe” from Cueva Negra has a counterpart in a bifacially-flaked “Acheulian” schist “cleaver” and a schist trihedral “pick” from sites in the Barranc de la Boella near Tarragona, which date from the late Matuyama magnetochron shortly after the Jaramillo sub-chron, according to magnetostratigraphy and cosmogenic nuclide analysis. In particular, the Boella “cleaver” comes from unit II at the El Forn site, where unit II is dated to 0.87-1.07 Ma (Vallverdú et al., 2014), and therefore it is probably slightly older than the Cueva Negra “hand-axe”. Small flakes and knapped denticulate artifacts of chert excavated at the Barranc de la Boella sites resemble several from Cueva Negra. At the site of Vallparadís near Terrassa, determination of age by ESR, uranium-series, and magnetostratigraphy indicated 0.83 ± 0.07 Ma for an assemblage of small artifacts some prepared by bipolar core-reduction which included “*becs*,” denticulate and notched pieces, and “*a few examples of centripetal cores and débordant flakes*,” as well as larger artifacts including a chopper fashioned on a cobble (Barsky et al., 2013; Duval et al., 2012; Garcia et al., 2011, 2012; Martínez et al., 2010). This assemblage is undoubtedly comparable to that of the Cueva Negra and is similar in age.

Even earlier than the aforementioned Catalan sites are two in eastern Andalusia, near Orce in Granada, namely, Fuente Nueva 3 and Barranco León 5 (Carbonell & Rodríguez, 2006; de Lumley et al., 2009; Fajardo, 2009; Gibert et al., 1998; Martínez-Navarro et al., 1997; Oms et al., 2000; Toro-Moyano et al., 2010). Although the assemblages have been designated “Oldowan” they include several small artifacts that are not unlike those of later sites (including Cueva Negra) as can be seen by inspecting those on display at the Palacio de los Segura museum at Orce.

Whilst cognitive versatility undoubtedly can be inferred from these assemblages, it is appropriate to ask whether the application of “Oldowan” imbues the term with an elasticity that begs too many questions and implies increasingly unsatisfactory answers other than self-serving, corroborative “progressivist” interpretations of a quasi-evolutionary bent retaining a homotaxial spatio-temporal form, such as the notion of “*Mode 0? homogeneity*” followed by “*Mode 1 variability*,” giving rise to “*Mode 1 diversity*,” preparatory to a stage of “*Multiplicity*,” which includes a bifurcation into “*Mode 2*” (Barsky, 2009; Carbonell et al., 2009). It is far from clear how the notion could *ever* be tested, or refuted, in order to comply with the fundamental aim of all scientific inquiry: namely, to achieve clarity through analytical consideration of observations, or data derived from them, which can respond to working hypotheses that are potentially refutable within a finite universe of commensurable material findings under review. The epistemological foundations of scientific critical inquiry caution against the imprudence of presuming in advance that towards which our fundamental endeavour should be directed by trying to

demonstrate that it be the *least implausible* provisional working hypothesis capable of accounting for all commensurable empirical observations and data derived therefrom.

In terms of the notion, assemblages such as those from Barranc de la Boella and Cueva Negra would be assigned to the “*Multiplicity*” stage, which in Mediterranean Spain had begun by at least 0.9 Ma. These assemblages have few “heavy-duty” artifacts, in marked contrast to their abundance throughout the Olduvai sequence from “Oldowan” via “Developed Oldowan” to “Acheulian” (even were knapping strategies appropriate for producing “light-duty” artifacts to have been more widespread than some early publications implied; cf. de la Torre & Mora, 2009; Potts, 1988), yet that this cannot owe to lack of suitable raw material is shown by knapping of “heavy-duty” implements at Cueva Negra from limestone, which is the predominant rock around the site, in contrast to the paucity of chert from which most “light-duty” artifacts were knapped there.

Less similar, and therefore compatible with “multiplicity,” are some other early Spanish Palaeolithic assemblages from 1.3-0.78 Ma, such as those published from the Sierra de Atapuerca sites near Burgos of Sima del Elefante (Carbonell et al., 2008; Parés et al., 2006; Rosas et al., 2006) and Gran Dolina TD-6,8,9,10 (Carbonell et al., 1995, 1999; Mallol, 1999; Terradillos, 2010).

By contrast, the Cueva Negra assemblage shares much in common with the early Middle Pleistocene Palaeolithic collection from Isernia La Pineta, which dates from just before 0.73 Ma and continues into mid-Middle Pleistocene times (Crovetto, 1994; Crovetto et al., 1994; Peretto, 1994; Peretto et al., 2004). Despite the absence of “Acheulian” bifacial reduction and “Levalloisian” repetitive centripetal core-reduction, the Isernia La Pineta assemblage could be “*an ‘opportunistic facies’ of a cultural model which was not manifested and which could be... even that of the Acheulian*” (Crovetto et al., 1994). Researchers at Isernia who conducted knapping experiments on local chert discovered that “*it was possible to produce ‘protolevallois’ type blade forms, Acheulian type bifaces and Levallois type artifacts*” (ibidem). Moreover, in Italy centripetal flaking was reported to have occurred as early as 1.3 Ma at the Pirro Nord P13 site (Arzarello et al., 2012).

Conjectures abound. One concerns a contentious long-standing matter of whether, from beyond the Strait of Gibraltar, North Africa contributed to some early Palaeolithic industries of the Iberian Peninsula; it is unclear what kind of evidence is required in order to determine whether, or to what degree, this might have taken place, or, if it did, how it might affect interpretation of European paleoanthropology. Another conjecture is that there was a major demographical discontinuity in the early Palaeolithic of southwest Europe, supposedly as a consequence of the Early-Middle Pleistocene transition when faunal turn-overs of large herbivores are sometimes thought to have led to replacement of sparsely distributed Early Pleistocene humans using pebble tools by Middle Pleistocene immigrants wielding bifacially-flaked hand-axes and cleavers. That view is regarded with scepticism by Vallverdú et al. (2014) who concluded their account of Barranc de la Boella by remarking, “*The early European Acheulian assemblage has been*

found in areas populated by hominins during previous dispersal events with PBC (Pebble and Core) technologies. The increase in technical behavioural diversity has been found in the huge expanse of geographical, temporal and ecological territories occupied by hominins. It is thus reasonable to expect changes in land use and technical skills which, in our opinion, may be attributed to the chronology of various poorly recorded hominin dispersal events that date to before the definitive colonization of Eurasia during the Middle Pleistocene.”

Those comments chime with our choice here to present Palaeolithic activity at Cueva Negra with regard to fire, technological complexity, and environmental exploitation, that is to say, terms of *dynamical* interactions. It is pertinent to reflect on what these may imply. One implication could well be that hominins who dispersed into Eurasia before 1 Ma already had brains that allowed choices to be made between undertaking very time-consuming alternative chains of complex behaviour leading to greatly deferred rewards that were by no means predictable, let alone guaranteed. That does not mean they behaved like modern adults. Perhaps their behaviour may be envisaged as not altogether unlike that of our inquisitive, nifty, nimble and canny four-year-old children were these to be clothed in our adult-size bodies (albeit more tongue-tied than in modern kindergartens).

At any rate, they behaved differently from modern great apes. Whether in tending fire inside a cave, fashioning a cobble to make a “hand-axe,” “cleaver” or trihedral “pick” in repeatable manner, or reducing a nodule to remove flakes or fragments that could be modified into more or less repeatable forms, they were participating in behavioural chains that seem to have had self-determining or self-constraining properties in so far as choices taken in order to embark on the activity of the next link set both the scope of, and limits to, what may be undertaken thereafter. When engaging in a chain of activities, awareness of the limits that define or constrain the sequence can stimulate recursive attention being paid to previously unnoticed opportunities for exploration in earlier parts of a chain once it ceases to be seen as defining a single, exclusive, pattern of behaviour and begins to be seen as allowing alternative behaviour at will. Regarding hominin cognitive evolution in the late Early Pleistocene, where sequential chains of behaviour can be inferred from the Palaeolithic record, it is more prudent to consider it in hypothetical contexts of *evolving hominin populations*, than to attribute an entire chain, from start to finish, to one or two contemporaneous individuals.

When considering the very many millennia of the Early-Middle Pleistocene transition, sequential chains of behaviour could very well have involved multiple actors, whether together, or separated discretely in time or space. Just as with palaeobiological evolutionary interpretations of skeletal fossils, so too can behavioural chains be interpreted in terms of the palaeoethological evolution of early human groups. It is a different approach from that which assumes tacitly that separate individual stone-knappers were personally responsible for the different reduction sequences inferred from analysis of stone tools and knapping waste at a site (Walker et al., 2013).

Moreover, looked at in that way, it is possible to appreciate the cognitive relationship that may exist between secant-plane control of stone-knapping in both Mode E1 (“Acheulian”) bifacial flaking and Mode F, BHC (cf. “Levallois”), core-reduction and flake-removal (cf. White & Pettitt, 1995). The argument has a good pedigree. “Acheulian” “hand-axes” and “cleavers” existed at ca. 1.7 Ma in East Africa, followed by centripetal flake-removal ca. 1.6-1.4 Ma at Peninj where “*the cognitive processes, the technical knowledge and the manual dexterity*” are in some respects comparable to those of much later “Levallois” procedures elsewhere (de la Torre et al., 2003), and involve a “*bifacial hierarchical centripetal strategy of core exploitation... through the configuration of one of the surfaces as a subordinate plane used to exploit the principal surface,*” in such a way that the centripetal cores “*show a subordinate surface with secant flakes with respect to the edge created by both surfaces. The aim of this process is the preparation of flake extraction on the main flaking surface... aimed at obtaining pre-determined flakes*” (ibidem; cf. de la Torre & Mora, 2005).

A reasonable inference is that by ca. 1.5 Ma similar cognitive processes in *Homo* had enabled bifacial-fashioning of Mode E1 (“Acheulian”) artifacts, on the one hand, and bifacial hierarchical preparation of cores for centripetal removal of pre-determined flakes by Mode F, on the other. A minimal interpretation of the Cueva Negra assemblage, dated to ca. 0.8 Ma, is that those responsible for it could reproduce either process at will. As already remarked, considered from the standpoint of modes A-I the evidence for the presence of all but for H and I demonstrates cognitive versatility and manual dexterity.

Quite likely, there had become well established in the brains of early *Homo* the physico-chemical underpinning of some cerebral neurones appropriate for participation in neuronal circuits that can facilitate the development of both procedural memory involved in maintaining the habits of motor behaviour (e.g. riding a bicycle on the road) and the attention necessary to modify it (e.g. to apply the brake when a dog runs out in front of a cyclist), or to change to an alternative tool-using behaviour (e.g. to ride one-footed on a scooter on the pavement instead of the road) or add a supplementary one (e.g. to switch the bicycle lamp on at night).

If so-called “Mousteroid” abrupt edge knapping may well have served the dual purpose of strengthening the working edges of feathered flakes and, as seen at Cueva Negra, forming acutely-angled working edges on the perpendicular margins of small pieces, then traditional technological descriptors (“Mousterian,” “Levallois,” “Acheulian”) may be of limited applicability. They may be little more than a time-honoured short-hand way in Continental European Palaeolithic studies to label *different aspects* of a single homogeneous assemblage, and they can be replaced by Shea’s Mode A-I system without epistemological loss to the ground rules of normative scientific methodology. They cease to vie for pride of place as alternative Procrustean beds, onto the allegedly distinctive “cultural” traditions of which diverse Palaeolithic findings are racked into shape by archaeologists desirous of reducing them to, or forcing them into, rough conformity with notional patterns that are proffered as representatives of various palaeoethnological

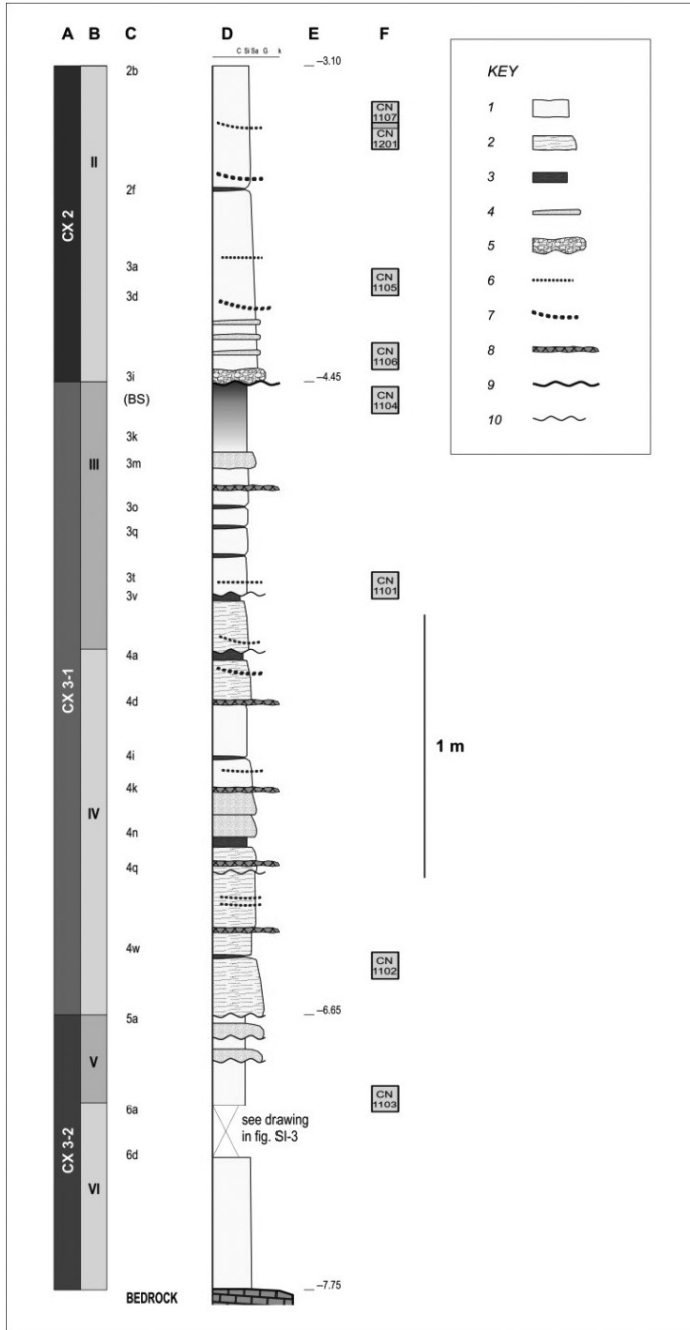
entities that smack less of objective scientific knowledge than of self-serving fanciful conjecture.

Firm neuroscientific grounds underpin an argument in favour of a “palaeoneuro-physiological” interpretation of the evolution in Early Pleistocene *Homo* of complex cerebral circuitry enabling and enhancing tactile perception, “haptic” memory, manual dexterity, and cognitive versatility, which underpin alternative or different behavioural sequences as well as the detection, and even anticipation, of errors or appropriate deviations from anticipated practices. It is fitting to interpret late Early Pleistocene-early Middle Pleistocene human Palaeolithic behaviour in the Iberian Peninsula from such a holistic minimal perspective of palaeoanthropology, rather than to ascribe the presence or absence of this or that feature of Palaeolithic assemblages to the comings and goings of nebulous communities, whether from Africa, the Near East, or anywhere else. The self-serving notion is superfluous that within the genus *Homo* during the Early Pleistocene there existed dispersed spatio-temporal homotaxial lineages characterized differentially by different technical Palaeolithic aptitudes. Such an implied antinomy is eschewed by a minimalist palaeoanthropological interpretation of Palaeolithic activity at Cueva Negra, one which favours appeals to evolutionary considerations of early human cognitive versatility, manual dexterity and technical ability.

Appendix 1

Figure 9. Revised sedimentological sequence.

Cueva Negra, simplified stratigraphical column: (A) stratigraphical subdivision (see also Angelucci et al., 2013) (key: cx = Complex or Sub-complex); (B) former lithostratigraphical units (Walker et al., 2006); (C) excavation spits (key: BS = buried soil); (D) stratigraphical column (key: C = clay; Si = silt; Sa = sand; G = granules and gravel; K = carbonate crusts or flowstones; stones are not represented in the column); (E) approximate depth below datum point, in metres; (F) stratigraphical position of soil micromorphological samples. Key: 1 = silty sand, massive or poorly laminated; 2 = silty sand with flat lamination or cross-bedding; 3 = silt or clayey silt, massive or with flat lamination; 4 = sand; 5 = gravel; 6 = stone-lines formed of fine granules; 7 = fine lenses of granules to fine gravel; 8 = calcium carbonate crusts; 9 = main erosive surface between Complex 2 and Complex 3; 10 = minor erosive surfaces.



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