June 2013

"The Origins of Recycling: A Paleolithic Perspective"

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A. Defining Paleolithic recycling and reusing - New data presentation

A1. Lithics

Recycling in the Haua Fteah sequence of North Africa. *Peter Hiscock, School of Archaeology and Anthropology, The Australian National University, Canberra, Australia.*

A study of recycling in the Middle, Upper, and Epi-Palaeolithic phases of the Libyan sequence of Haua Fteah reveals chronological change in the rates of recycling. A long-term trend from high rates of recycling to negligible rates represents a fundamental shift in the structure of technological systems. This shift defines important reorganizations in technology and perhaps cognitive frameworks, although the timing of the trends is surprising. The paper will argue that recycling rates can be used as a powerful measure of behavioural organization and ancient conceptions.

The recycling of cores and handaxes during the Middle Paleolithic in Western Europe. *Claud, E., Thiébaut, C., Mourre, V., Brenet, M., Chargée d'opération et de recherche Tracéologue, INRAP GSO Aquitaine; and PACEA, UMR 5199, Université de Bordeaux, TALENCE* , France.

In several Middle and Late Paleolithic assemblages in Western Europe, cores and handaxes with percussion zones that are not related to their usual mode of functioning have been described. We observed them on artefacts of several sites that we were studing in Southwestern France: Saint-Césaire (Charente), Jonzac (Charente-Maritime), Combe Brune 2 and Cantalouette (Dordogne). To determine the origin(s) of these traces, we used experimental cores and handaxes as percussion tools on different materials. The use wear produced during percussion on stone materials closely resemble those observed on archaeological objects. Though the use of these pieces as hammerstones or retouchers is difficult to firmly demonstrate, this is the most probable hypothesis. The characteristics of the traces observed are similar to those observed on classic hammerstones. While the recycling of handaxes and cores into hammerstones, sometimes followed by their reuse, depending on their original function, is infrequently observed in Middle Paleolithic assemblages, it appears to be a recurrent characteristic that is independent of environmental constraints or economic or technical contexts.

A second life: recycling production waste during Middle Palaeolithic in Southern Italy. The lithic assemblage of layer L at Cavallo Cave (Lecce, South Apulia). *Francesca Romagnoli. Università degli Studi di Firenze, Italy; Universitat Rovira i Virgili, Àrea de Prehistòria, Tarragona, Spain.*

Cavallo Cave is located on the rocky coast of Uluzzo Bay, near Nardò, around 90 Km south of the town of Taranto, Apulia, SE Italy. The site preserves a long stratigraphic sequence comprising about 7 m of archaeological deposits directly based on a marine interglacial beach conglomerate (layer O - OIS 5) (Sarti et al., 2012). The archaeological

sequence is dominated by Middle Palaeolithic layers (layers N-F) and represents an important reference for this period in Southern Italy (Palma di Cesnola, 2001). After a first excavation on a reduced surface directed by Arturo Palma di Cesnola between 1963-1966 (Palma di Cesnola, 1963, 1964, 1965a, 1965b, 1966), the Musterian sequence was excavated between 1986 and 2008 under the scientific direction of Lucia Sarti (Sarti et al., 1998-2000). Along this sequence, technical breaks show changes in the production methods and economic organization lithic industries (Carmignani, 2010; Romagnoli, 2012). Layer L is characterized by the production of microlithic tools, the lack of evidence of Levallois methods and the manufacturing of retouched tools of valves of *Callista chione*, a big marine bivalve (Romagnoli, 2012). In this layer one may recognize a widespread technical transformation of production waste. The secondary modification of technical characters permits to insert again the artefacts in the use phase of the "*chaîne opératoire*". This technical behaviour is attested both in the lithic production and manufacturing sequence of tools made of mollusc shells. One may see a temporal segmentation between the production of the blank and the retouch, as for double patina tools, or radical functionality changes in some technical objects, as for cores on which Neanderthal men shaped out a cutting edge. The time gap and the radical transformation of an artefact give evidence of recycling (Baker, 2007; Vaquero, 2008, 2011). Recycling is well documented for objects of local raw material. Therefore these communities show a deep knowledge of the potentiality of available resources and a capacity of choosing favourable technical solutions allowing for high speed of realization and low energetic cost. Recycling seems to be a technical behaviour that contributes to the cultural definition of these Neanderthal communities.

Recycling in the ancient Middle Paleolithic of the Cantabrian Region. *Lazuén, T. & González-Urquijo. Prehistory Institute (IIIPC) of the University of Cantabria, Spain and PACEA, Université de Bordeaux1-CNRS, France.*

The production and use of lithic tools in some phases of the ancient Middle Paleolithic-mainly OIS 5 and 4- of Cantabrian Region (Atlantic northern coastal Iberia) is characterized by extended appeal to very small flakes, sometimes less than 3 cm. size. This type of production is a not very well known strategy, even if rather spread in Europe from OIS 5 onwards (Moncel, 2003; González-Urquijo *et al.*, 2005; Dibble y McPherron, 2006; Villaverde *et al*., 2008). Part of these blanks comes from specific exploitations of small Levallois, discoid or Kombewa cores. Other part is resharpening flakes obtained on thicker flake tools, usually sidescrapers. In this ambivalent behavior, these blanks are both tools and recycled tools as cores (Bourguignon, 2004). One of the best means to recognize the purposeful nature of resharpening flakes as tools is the presence of retouch on them (Meignen, 1988; Bourguignon, 1997; Jaubert, 2001; Soressi, 2004; González-Urquijo *et al*, 2005 y 2006). But really we have very scarce data in this type of tools to understand their management and use (cf. Barkai et al., 2010). In this work, we analyze these behaviors on some key assemblages from this region and period. The study is focused in the understanding of the set production-management-use, and relies on a functional analysis on a sample of resharpening flakes from 16 and 18 levels at Cueva Morín and the inferior level of Axlor. Results show a high degree of variability in these behaviors. Tools from recycling sometimes take part in the same type of tasks than the stub/matrix tools, but sometimes they are used in completely different tasks. The later suggest important spatiotemporal breaks in the *chaînes operatoires* and rather elaborate managements for these, at first glance, simple tools.

Rubish or raw material? Recycling performances through the Iberian Middle Paleolithic. *Felipe Cuartero. Universidad Autónoma de Madrid, Spain.*

Keywords: Reuse, Recycle, *Ramification*, Middle Palaeolithic, Iberian Peninsula

Paleolithic assemblages with intense lithic recycling behaviors usually offer a complex record. The initial stages of *chaîne opératorie* can be even completely erased. The comprehension of recycling processes, as well as its

structuration and definition fulfills information on economic performances. These behaviors are analyzed in diachronic terms through the Middle Palaeolithic of the Iberian Peninsula.

The recycling of flint throughout the Lower and Middle Paleolithic sequence of Tabun Cave, Israel.
Ron Shimelmitz. Zinman Institute of Archaeology, University of Haifa, Israel.

Tabun cave provides an opportunity to examine transformations in the way hominins recycle flint items along a sequence of ca. 500 kyr from the Lower Paleolithic to the Middle Paleolithic. The studied sequence includes 16 m of archaeological layers and is composed of results from Jelinek's excavations and Ronen's excavations which sampled different parts of the section of Tabun. The recycling of flint will be mainly examined by three aspects: (1) The presence of items with patinated surfaces on the dorsal face, indicating the reuse of old flint items. (2) The phenomenon of 'handaxes with a preferential flake scar', indicating the recycling of handaxes as cores, and (3) cores-on-flakes. The changes in their frequencies and characteristics along the sequence will be presented through a study of 20 assemblages from the sequence, spanning from the cave's base to Tabun layer C. The correlation between these three aspects along the sequence will be examined as well. The implications of the observed patterns on the cultural changes occurring along the Lower and Middle Paleolithic periods and the use of the cave and the landscape will be discussed.

Use and re-use: knapped flakes from the Mode 1 sites of Barranco Leon and Fuente Nueva 3 (Orce, Andalucia, Spain). *Deborah Barsky, Robert Sala, Isidro Toro-Moyano et al. Area de Prehistoria, Universitat Rovira i Virgili (URV), Tarragona, Spain and IPHES, Institut Català de Paleoecologia Humana i Evolució Social, Tarragona, Spain.*

The presence of flaked flakes at the Mode 1 sites of Barranco León and Fuente Nueva 3 (1,3 – 1,2 Ma, respectively) poses the problematic of the use and re-use of flakes as cores for obtaining small cutting tools. The two stone tools assemblages are composed of heavy-duty percussion tools in limestone and small cores and flakes knapped from flint. Both of these raw materials are of local origin. The limestone implements include pebbles that were simply used and/or modified. The flint material is of much smaller size. Most of it was collected as plates or blocks from nearby secondary deposits. The presence of numerous flakes displaying opposite ventral surfaces translates their origin from previous flakes, transformed into cores. Furthermore, the average flake size at both sites is very small- only 2 cm. In spite of the intense exploitation of the flint cores it is possible to recognize that at least some of them were knapped from bigger flakes. Since none of these, larger flake supports are present at the sites it is likely that they were produced elsewhere- and then reduced. What can this behavioural choice tell us about early hominin behaviour at Orce: on the one hand re-use of supports and, on the other hand, realization of a two-step operative scheme involving acquisition of a transportable support at the raw material source that could then be further reduced; at least to some extent on site. The latter poses questions of hominin mobility during the earliest periods of European Mode 1.

Lithic recycling at late Acheulian Revadim, Israel: Preliminary observation. *Agam, A., O marder and Ran Barkai. Tel-Aviv University and Ben-Gurion University, Israel.*

The multi-layered Lower Paleolithic Acheulian site of Revadim provides a rare opportunity to study patterns of continuity and change within the lithic assemblages of the Late Lower Paleolithic period in the Levant. This open-air site was excavated to a large extent (ca. 250 sq.m.) and yielded a wealth of lithic and faunal remains (e.g. Marder et al. 2011; Rabinovitz et al. 2011). The rich lithic assemblages are typical of the Late Acheulian in the Levant, including Handaxes but mostly dominated by flake-production and flake-tools (Buller-Malinovski et al. 2012; Marder et al. 2006; Solodenko 2010). In this paper we shall present the results of technological studies conducted recently and aimed at the understanding of the character and scale of lithic recycling in a late Acheulian lithic assemblage from the Levant. We will show here that several recycling trajectories were practiced at the site of Revadim, among which are the recycling of Handaxes into cores, the production of small flakes from cores-on-flakes and more. Our results shade

new light on lithic recycling in the Lower Paleolithic Acheulian and provide an opportunity for comparisons with this phenomenon during later cultural complex in the Levant and beyond.

Modes of flint recycling at Qesem Cave, Israel: Report on work-in-progress. *Parush-Glikman, Y., Assaf, E., Gopher, A. and R. Barkai. Tel-Aviv University.*

Qesem Cave is a Middle Pleistocene site in Israel dated to 420,000-200,000 kya and assigned to the Acheulo-Yabrudian Cultural Complex (AYCC) of the late Lower Paleolithic. The cave reveals a rich and well-preserved array of lithic and faunal remains as well as human teeth. The AYCC is a unique, local cultural entity clearly differing from the preceding Acheulian and the proceeding Mousterian. It shows a suite of innovative behaviors including: the habitual use of fire; hearth-centered activities and functionally distinct activity areas; sophisticated raw material acquisition; intensive and systematic blade production employing an efficient, innovative, and thoughtful technology ; a noticeable presence of 'ahead of their time' Quina scrapers; and intensive flint recycling activities. In this paper we would like to present a new classification system developed for the study of lithic recycling at Cave. During the last two years five lithic assemblages from two different contexts were analyzed (a total of over 60,000 artefacts) with a focus on lithic recycling. We have found out that recycling behaviour was underestimated at Qesem Cave, and a careful technological analysis was able to identify hundreds of recycled items and reconstruct several recycling modes at Qesem Cave, including a specific trajectory of producing blades and knives from recycled flakes. Our new observation provide a more coherent view of lithic recycling in the AYCC that migh be applied to the study of lithic recycling at other Plaeolithic contexts.

Intra-site recycling variability at Qesem Cave, Israel: New evidence from an Amudian and Yabrudian assemblages. *Parush-Glikman, Y., Assaf, E. Gopher, A. and R. Barkai. Tel-Aviv University.*

In this paper we will present new results regarding lithic recycling at two distinct lithic assemblages from Qesem Cave - A Yabrudian and an Amudian assemblages from a specific context within the cave. The two assemblages were retrieved from the same location within the cave - underneath a rock shelf at the northern part of Qesem Cave, are earlier than 300kyr and exhibit clear stratigraphic relations, as te Yabrudian horizon is on top of the Amudian and thus at this part of the cave and in this stratigraphic unit the Yabrudian is later than the Amudian. We will present the general characteristics of the two assemblages and will focus on the similarities and differences in lithic recycling between the two "industries". An attempt will be made to use the results in order to discuss the role of lithic recycling within each assemblage and shed some more light of Acheulo-Ybrudian lithic variability.

Simple recycling or the evidence of a deliberate and systematic manufacture of small-sized debitage? A perspective from Hummal and its eponymous industry (Central Syria).

Dorota Wojtczak Université Nice Sophia Antipolis, SJA3 - CEPAM- UMR 7264 CNRS, Nice, France and University of Basel, IPAS, Basel, Switzerland.

The excavation of the spring at Hummal, located in the region of El Kowm (Central Syria) is a reference site for the interior Levant Palaeolithic due to its archaeological sequence of deposits from the Lower to Upper Paleolithic. This proposed paper presents some principal data on the Hummalian culture, originating from the systematic excavation of *in situ* archeological layers between 2003 and 2010. The primary Hummalian reduction strategies mainly target large-sized blades, although the significance degree of reuse in the on-site production is a remarkable feature that needs to be considered. The regular practices of recycling and secondary use are documented by the appearance of; numerous cores on flake, the reuse of patinated blanks for shaping new tools, production of the bladelets on broken blanks and debris, recycling the Yabrudian

scrapers as a core and shaping exhausted cores for tool use. The main focus here will be on the presence of numerous cores-burin and truncated faceted pieces which, in our opinion, are not just evidence of the recycling of the raw material but rather the remnants of a deliberate manufacture of small implements. These end products, namely bladelets and small flakes, represent desired components supplementary to the repertoire of various implements recovered from Hummalian layers and could suggest easily portable implements. In this the Hummalian industry perhaps escapes its label of a singly large-sized blade production and additionally shows significant trends for systematic production of various small-sized debitage blank types.

Recycling older objects - The Aurignacian at Hayonim cave. *Anna Belfer-Cohen and Ofer Bar-Yosef. Institute of Archaeology, The Hebrew University of Jerusalem, Israel and the Departemnt of Archaeology, Harvard University, USA.*

The recycling of Middle Palaeolithic Mousterian (not later than 50,000 years ago) pieces collected by the Aurignacian hunters -gatherers who camped at Hayonim cave, much later, around 30 Ka BP, may indicate either time constrains for obtaining good quality hard rocks for making a sufficient number of stone tools, or perhaps less familiarity of the environment, hinting that this was an ephemeral, short-stay station. Moreoever, is it possible that we are facing new comers to the area, either of this particular group or of the Levantine Aurignacians senso stricto.

A2. Bone and Ivory

Recycling bones in the Middle Pleistocene: the early cases of Gran Dolina TD10-1 (Spain), Bolomor Cave (Spain) and Qesem Cave (Israel). *Jordi Rosell, Ruth Blasco et. al. Area de Prehistoria, Universitat Rovira i Virgili (URV), Tarragona, Spain and IPHES, Institut Català de Paleoecologia Humana i Evolució Social, Tarragona, Spain.*

Archaeologists have used different kinds of data to identify recycling. Most approaches to recycling are based on lithic artifact attributes, and especially on surface alterations, that suggest a period of discard between different activity events. But, recycling can be also approached by means of faunal remains from bone damage. The bone breakage processes generate a high number of small and large-sized fragments, which are usually discarded. However, some of these rejected elements can show suitable morphological characteristics to be used for different purposes. On this basis, it is necessary to distinguish between the use of bone raw material from pre-existent carcasses of elephants (and other large animals) and recycling of fragments resulting from the extraction of marrow contained in bones. In the first case, bones are considered as raw material similar to lithic industry. In the second one, bones are not fractured with a technological purpose, but they are selected to be used in a subsequent process. Here we present some early cases of recycled bones from the Middle Pleistocene sites of Gran Dolina TD10-1 and Bolomor Cave in Spain and Qesem Cave in Israel. The studied elements seem to have been part of a previous faunal processing sequence (with nutritional objective) and later, they seem to have been selected among rejected items to be used or modified intentionally. These fragments are dated to MIS 9 and show bone damage produced by use (retouched and unmodified soft hammers) or present configured forms (bone artifacts). With this study, we try to provide data on the recycling activities on faunal remains in the Middle Pleistocene and discuss on the origin of this behaviour.

Rotten Ivory as raw material source in the Aurignacian. *Leif Steguweit. University of Erlangen-Nuremberg, Germany*

Human manipulations on rotten mammoth tasks can be documented in the archaeological record from the Early Aurignacian with continuous traditions in the Gravettian/ Pavlovian. Investigations on ivory cylinders from the late

Aurignacian site of Alberndorf (Lower Austria) and the Pavlovian sites of Předmostí Ia, Pavlov and Dolní Věstonice (Moravia) display several typical breakage patterns (Steguweit 2005; Steguweit & Trnka 2008). Carving a concave ring through the outer part before breaking the tusk leaves a smaller inner cylinder stump only in case of a significant decomposition process. Comparing evidence is given by experiments with recent elephant ivory which can serve for a better understanding of fresh *vs.* rotten material. A significant decomposition is necessary as well for the production of so called "ivory shuffles", known from Gravettian/Pavlovian sites like Abri I (Bavaria), Předmostí and Pavlov. A second aspect is the use of rotten ivory for several Aurignacian and Gravettian art objects. The use of curved ivory plates – showing the concave inner side caused by rotting – is visible for instance on some of the Vogelherd figurines as well as on some of the flat figurines and personal ornaments from Pavlov and Dolní Věstonice. The probable use of rotten ivory will be discussed also for the lion man from Hohlenstein (Baden-Württemberg). Experiments concerning the manipulation of ivory by soaking can provide for the costs of different working strategies (Steguweit 2010).

In the Elephant, Everything is Good. Carcass Use and Re-use at Castel di Guido (Italy). *Giovanni Boschian & Daniela Saccà, Dipartimento di Biologia, Università di Pisa. Pisa, Italy, and Dipartimento di Civiltà e Forme del Sapere, Università di Pisa Pisa, Italy.*

Castel di Guido is a Middle Pleistocene site where intentionally fragmented bones of large mammals were found together with Acheulean biface industry. All the tools and bones lie associated on a single surface. The tool assemblage includes bifaces made up of various stone types and of elephant bone, associated with flint tools on pebbles and flakes. Following a first interpretation of the evidence, elephants, horses, aurochs and few other species were killed and butchered on site, or partly brought to the site to be butchered after having been killed elsewhere; the bones were intentionally fractured for marrow extraction and left to "season" before being used as raw material for biface production. Castel di Guido is primarily the result of anthropic processes, deriving from peculiar behavioural aspects of the Lower Palaeolithic groups that frequented the site, which was probably a sort of seep where animals and humans gathered for water and other subsistence purposes. The carcasses of various taxa were exploited for food, and the elephant ones also for raw material in bone tool production, including bifaces. Large bones of other taxa were also sometimes exploited to produce poorly elaborated tools. This peculiar choice of raw material was mostly due to the limited availability of good quality flint (or other hard rocks) in the Castel di Guido area. Several stone and some bone tools show clear evidence of recycling, like subsequent knapping or refashioning phases put into evidence by different wear of the surfaces; these characteristics point to long continuity of use of the site for similar purposes, which is in accordance with the very different preservation of the remains that were partly reworked by short-range fluvial processes. These aspects indicate that the bones of large taxa, mostly elephant, were part of a complex subsistence system characterised by an extremely fuzzy boundary between hunting and scavenging. This system was based on the recycling – or better transfunctionalisation – of the carcasses, which were exploited for food consumption (meat and possibly marrow), and later for raw material procurement over a long time of permanence and availability on the surface of the site.

Taphonomy, bone fracture, and archaeological intepretation: Human use and reuse of megafaunal bones in North America. *Landon Karr, Augustana College at Sioux Falls, U.S.A.*

Understanding the use and reuse of bones as raw materials is critical for assessing the adaptation of human groups to local environments, the cultural significance of bones, and the intimate understandings of raw materials demonstrated by early human groups. The remains of
Terminal Pleistocene megafauna in North America represent a continent-wide case study in understanding the use and reuse of bones among some of North America?s earliest inhabitants. The complex dynamics of bone fracture, bone degradation, and the effects of natural and cultural taphonomic processes present a challenge for interpreting the nature of fractured and fragmented zooarchaeological material at early sites in North America. Understanding the interaction of human groups with Terminal Pleistocene megafauna

requires innovative approaches for assessing the nature of human hunting and scavenging, the curation of bones among cultural groups, and the use of bone tools among Paleolithic peoples. The role that the environment plays in affecting the nature of
bones and their suitability for use and reuse cannot be overstated. Dramatically different rates of degradation in bones exposed to different environmental conditions suggest that the use of bones may have been temporally restricted in warmer environments. Even in cold weather environments, natural processes affect the composition and fracture characteristics of bones. Importantly, this presents an interpretive challenge for archaeologists examining fractured and fragmented zooarchaeological remains. Often, traditional markers of human modification of bones are obscured by the action of taphonomic processes. Furthermore, dramatic variation in understanding among
archaeologists has resulted in a complexities and inconsistencies of interpretation. This paper seeks to explain, describe, and resolve some of the problems inherent in assessing and understanding the use and reuse of bones as raw materials, using evidence from Terminal Pleistocene sites in North America as case studies that highlight the cultural, environmental, and interpretive differences that are manifesting in zooarchaeological assemblages.

B. Artefacts life histories, recycling and resahrpening, with an emphasis on scrapers

The role of resharpening in explaining the variation of form-shaped tools in the late Middle Paleolithic of Central and Eastern Europe. *Radu Iovita and Olaf Jöris. MONREPOS Archaeological Research Centre and Museum for Human Behavioural Evolution; Schloss Monrepos; D – 56567 Neuwied, Germany.*

The presence of bifacially-worked stone tools distinguishes the Middle Paleolithic of Central and Eastern Europe from the better-known western European Middle Paleolithic industries that are largely dominated by unifacial scraper types. These differences have led to difficulties in coherent systematics, The geographic pattern described adds furthermore to the question of regional traditions of Neandertal technologies.

We present here a review of recent data and new methods of analysis (studies of artifact life-histories and ontogenetic scaling in morphometrics), illustrating strong similarities between the resharpening strategies underlying both unifacial tools and form-shaped, so-called bifacially backed knives (*Keilmesser*). This demonstrates that regional differences in production techniques may be independent of a common Middle Paleolithic tool concept that enabled curation.
We conclude by investigating the implications of these results for understanding the variability of the Neandertal toolkit and discuss its cognitive implications.

Key-words: Artefact life-histories; Ontogenetic scaling; Morphometrics; European Late Middle Paleolithic

From Artefact Life-Histories to Understanding Land-Use Strategies - Case Studies from the Central European Middle and Upper Palaeolithic. *Olaf Jöris, Mathias Probst and Yvonne Völlmecke. MONREPOS Archaeological Research Centre and Museum for Human Behavioural Evolution; Schloss Monrepos; D – 56567 Neuwied, Germany*.

Studies of the chaîne opératoire underlying lithic inventories provide valuable information on tool production, handling, and curation. When artefacts were brought to site over larger distances, their associated chaîne opératoire is reflected in a fragmentary manner only. However, detailed studies of artefact life-histories (refits, flake scar sequence analysis) of tools made of exogenous lithic raw material allow to reconstruct the modalities of transport, shedding light on land-use strategies.

In this paper we present case studies from the Middle (Buhlen, East Eifel Volcano sites) and Upper Palaeolithic (Magdalenahöhle, Rhenish Magdalenian and Curved Backed Point [*Federmesser*] industries) of Northern Central Europe. Aside the local and regional lithic raw materials used, sites in this region are characterised by diverse spectra of easily identifiable exogenous lithic materials which facilitate the present study. Comparison of the patterns observed in these assemblages may help to better distinguish between aspects of land-use that are due to fundamental differences in behaviour and those that are situation-dependent.

Key-words: Middle and Upper Pleistocene; Exogenous lithic raw material; Chaîne opératoire; Artefact life-histories; Harris diagrams.

How much are scrapers at Nobles Pond?... A pilot study in measurement of uniface reduction. *Michael J. Shott. Dept. of Anthropology and Classical Studies, University of Akron, USA.*

Scrapers are a common retouched-tool type in Paleoindian and Paleolithic assemblages. How much their size is reduced and form is changed from first use to discard are important to know but difficult to gauge. In this pilot study, we devise several estimates of degree of reduction based on mass, volume, and length and apply them to a sample of unifacial endscrapers from the Nobles Pond Paleoindian site in Ohio, USA. In particular, we use 3D laser scanning to produce digital models of specimens, from which we measure platform area in order to predict original mass from that quantity. In our comparison of reduction estimates, even the most acceptable—a ratio of mass at discard to original mass estimated from scanned platform area derived from Clarkson and Hiscock (2011) must be qualified in important respects. The better we can estimate original size of discarded retouched tools, the better we can gauge curation and exploit the value of this theoretical concept.

Scrapers and scrapers recycling in the Levantine Middle Paleolithic: a view from Nesher Ramle, Israel. *Yossi Zaidner. Institute of Archaeology, Hebrew University, Jerusalem; and Zinman Institute of Archaeology, University of Haifa, Israel.*

Nesher Ramle Middle Paleolithic site is located in deep karst depression that was used by the Middle Paleolithic hominins during the MIS 6 and MIS 5. During the excavations at the site an eight-meter-thick Mousterian sequence was exposed. Along the sequence a number of well defined layers and activity areas were recorded. These layers contain rich lithic and faunal assemblages. The lithic assemblages show high frequency of retouched tools, especially standardized and carefully prepared side-scrapers. The frequency of the side-scrapers at some of these levels is considerably higher than in other Levantine Middle Paleolithic sites known to date. Together with the side-scrapers, side-scraper rejuvenation flakes were found in many of these levels. In this paper we first describe the techniques and methods of the side-scraper rejuvenation, and second, discuss the criteria on basis of which side-scrapers were selected for recycling.

Scrapers in the landscape: Scraper life histories from the Late Middle Paleolithic open-air site of Ein Qashsih. *Sumner, Alexandra and Malinsky-Buller, Ariel. Department of Archaeology, Faculty of Science, University of Cape Town, South Africa and Institute of Archaeology, The Hebrew University of Jerusalem, Israel.*

Scrapers are one of the most common and ubiquitous tools ever produced. From the earliest industries up to their continued use among indigenous cultures today, the production of a scraper edge is straightforward; its function hinging on the retouch of one or more margins of a knapped flake. Research associated with scraper typology, classification and the study of underlying factors that influence the observed variation within assemblages has been the hallmark of Paleolithic research for the last 50 years. Yet given the simplicity of the method of production, at times current discourse can be unnecessarily complicated, obscuring "the obvious" via frameworks that seek to explain scraper production and use from a number of perspectives including everything from economy to cognition. Moreover, scraper studies are often accompanied with intricate analytical and statistical methods. Ultimately, scrapers studies become buried in a web of method, theory and stats that in the end often contribute comparatively little to what we know of associated human behavior (i.e. how a particular element fits within the larger frame of past adaptations).

In this paper, we apply the concept of *life histories*; the common premise being that cycles of use and rejuvenation reflect past decisions that reveal associations between raw material availability, artifact transport, patterns of mobility and the nature of occupation. Due to the extensive range of influencing factors, scraper *life histories* are circumstantial; they are a response to changes in local conditions and are therefore suited to specific questions of the immediacy of human behavior. We situate our use of *life histories* in this study from the perspective of the *paleo-landscape*. Addressing the significant role of associated landscape in such studies provides insights into temporally and spatially constrained forces that affect human behavior. The case study for this paper is the site of 'Ein Qashish, an open-air late Middle Paleolithic occurrence located in the Yizra'el Valley just east of Mt. Carmel. Applying the concept of *life histories* framed in landscape trajectories we will explore how behavioral patterns were demonstrated in scraper production, maintenance, use and discard at the site of 'Ein Qashish.

C. Understanding Paleolithic recycling: A use-wear perspective

Functional meaning of recycling at Qesem Cave, Israel: an overview of the use-wear data.
Lemorini, C. Sapienza University of Rome, Barkai R. and Gopher A., Dept. of Archaeology, Tel-Aviv University, Israel.

Lithic recycling is evident throughout the nine meters of stratigraphy at Qesem Cave, a testimony of ca. 200,000 years of human use, reuse and recycling of stone at the site. An impressive variety of technological solutions was practiced for producing new tools, mostly items with sharp edges, from old blanks. These new tools show a range of sizes and shapes that suggest different functional goals. This paper presents the results of the use-wear analysis of some of these types of tools made of recycled blanks: small flakes, adlun burins, adlun burin spalls, double bulb items and a specific type of Naturally-backed knives (NBK's). Except for the NBK's, the other categories of tools made of recycled blanks seem to have been planned especially for short cutting activities on soft material, including fleshy tissues. Indeed, the recycled NBK's, that can been defined as small seized backed knifes, seem to have been intended for other purposes. In various cases the processing of herbaceous and woody plants by cutting and scraping was identified; moreover, localized traces that suggest some sort of hafting were detected. In this last case it seems that we are dealing with less ephemeral activities than the previous ones, suggesting that recycling was a way to produce not only expedient tools but also tools intended for more structured functions. The functional study of the recycling phenomenon at Qesem Cave provides a unique opportunity to discuss the intended goals of recycled items at the cave. A combined study of the technological and functional aspects of this phenomemnon at Qesem Cave will enable a better understanding or lithic recycling at the cave and might be applicable for understanding recycling at other sites as well.

The use of handaxes shaping and (re)sharpening flakes. Functional data from the study of two Middle Paleolithic series from the sites of Chez Pinaud and Mont des Bruyères (France).
Emilie Claud. Chargée d'opération et de recherche Tracéologue, INRAP GSO Aquitaine; and PACEA, UMR 5199, Université de Bordeaux, TALENCE, France.

The aim of this communication is to present the functional results of a use-wear analysis of some handaxes shaping and (re)sharpening flakes of two Middle Palaeolithic sites. The first, called Chez Pinaud, is a rock shelter located in Southwestern France and was excavated by J. Airvaux and M. Soressi in 1998, 1999 and 2003, and then by J. Jaubert, J.-J. Hublin, M. Soressi and Sh.-P. McPherron from 2004 to 2007. The sample that was studied is from the level of Mousterian of Acheulean Tradition (MTA), dated 39 ± 3 ka. The second is an open air site located in North of France and was excavated in 2008 by P. Feray (Inrap). The lithic industry is characterized by triangular handaxes (as for "MTA with triangular handaxes" industries of Northern France). This site is a little bit older: 49,2 ± 3,34 ka.

The study of handaxes shaping and (re)sharpening flakes of these sites shows that some of them were used, even unretouched. They wear edge damage that are characteristic of cutting motion of soft to medium hard material and sometimes micro-polishes that allow me to precise that these flakes were used for butchery. Some differences were

found between the two industries about the prehension of the flakes. I tried to know what was/were the criteria(s) to use or not use a flake, and to discuss the aim(s) of "chaîne opératoire de façonnage" for these sites.

Resharpening and recycling: different conceptions of the Magdalenian tools. *Sylvie Beyries and Marie-Isabelle Cattin. Université Nice Sophia Antipolis, SJA3 - CEPAM- UMR 7264 CNRS, Nice, France.*

Most of upper Palaeolithic sites show a tendency for the tools corresponds to a single function. In this case, successive resharpening lead to a reduction of the tool, changes in morphology and in the angles of the active edges. In contradiction with this situation, tools are sometimes resharpened, reshaped and/or recycled after have been used for domestic activities, and then employed for highly specialized one. In this paper, we will show how management tools can be completely different through some examples from the European Magdalenian : in one hand Champrevert and Monruz, open sites with seasonal occupations, and in other hand The Roc-aux-Sorciers and La Marche, rock shelters sites with a long occupations and remarkable artistic activities. The status of these sites is at the center of different visions conceptions and managements of the tools.

To haft or not to haft. The contribution of hafting evidence to the understanding of tool life histories and recycling. *Veerle Rots. Chercheur qualifié FNRS, Service de Préhistoire (bât A4), University of Liège quai Roosevelt, 1B, 4000 Liège - Belgium***.**

Functional studies have largely improved insights in past tool use and site function. Aside from providing basic use evidence, such studies also contribute significantly to the understanding of tool life histories. By incorporating evidence on resharpening for instance or by identifying the prehensile mode of implements and thus distinguishing between tools that were used in the hand, and tools that were used hafted. The identification of hafted tools in an assemblage is not only important for understanding more general technological evolutions, it also significantly affects the way in which a tool is and can be used (flexibility) and a tool's life history, including its production, resharpening, retooling and discard, its potential recycling, and the location of each of these processes. Based on the results from functional studies of Palaeolithic assemblages of Northeast Africa and Europe, it will be demonstrated how the identification of hafted tools can improve the understanding of tool life histories and recycling processes.

D. The meaning and significance of Paleolithic recycling

Recycling of Material Culture during the Paleolithic and Today. *Daniel S. Amick, Department of Anthropology, Loyola University Chicago, USA.*

Archaeologists are being increasingly challenged to apply their methods and perspectives to address contemporary global concerns, such as material consumption and recycling. The archaeological investigation of recycling can contribute to understanding its behavioral causes and situational contexts because it can reveal systematic patterning in its temporal, spatial, and formal dimensions. In this paper, I review some of the evidence of lithic artifact recycling in North America and a few lessons drawn from those studies, including general patterns in lithic recycling behavior and needs to address ambiguity in the definition of recycling, compounding factors of equifinality in lithic reduction, and recognizing opportunism in recycling behavior. This evidence is also used to consider the behavioral and environmental circumstances of patterned recycling in the broader study of material culture and human behavior. It is argued that archaeological studies can offer useful contributions to such universal theories and that archaeological explanations about recycling behavior would benefit from greater integration with the larger body of historical and social science studies on this topic.

Recycling in abundance: reuse-recycling processes in the Paleolithic contexts of the central Iberian Peninsula. *Javier Baena Preysler and Irene Ortiz Nieto. Dep. Prehistory and Archaeology Universidad Autónoma de Madrid (Spain).*

The central region of the Iberian Peninsula is dominated by Mesozoic and Palaeogene sedimentary deposits in which geochemical processes provide a wide range of siliceous materials. Quaternary erosion processes expose and derived important amount of flint outcrops and blanks as well as quartz and quartzite pebbles. In this context, exploitation of raw material took place since the Middle Pleistocene, with important testimonies from Acheulian and Mousterian, documented since the XIX th century (Baena et al. 2000, Santonja and Vega 2002,), as has been located in some other geographical context (Roebroeks 1988, Sanguino et al., 1994, Fernández Péris, 1998, Moncel and Perreve 1999, Petraglia et al. 1999, Gopher and Barkai 2006, Van Peer et al. 2010). During the last 20 years, several field works has been promoted in order to study human occupations in this context with the result of finding several archaeological sites. Among them, Cañaveral, Berrocales and Ahijones, has display a huge amount of lithic testimonies under study now (Baena et al. 2010). In this paper, we present a and conceptual discussion of the terms used to understand production levels inside the assemblages (Bourguignon et al 2004) as well as an approximation to the re-use and recycling processes detected in those workshop sites/quarrying sites, that could be consider as a context of raw material abundance. This approach, is oriented by a diachronically analysis of the *Chaines operatoires*, both in Acheulian and Mousterian sites (Barkai et al. 2002). As a preliminary hypothesis, the presence of recycling or re-use inside the abundance, could be explain in terms of social or economic reasons. The changes produce during the Lower and middle paleolithic introduce important changes in social participation in the flint knapping activities and strategies that could contribute to explain its presence.

Re-using in Middle Paleolithic: opportunistic recycling or integrated strategy?
Rios-Garaizar, Joseba,Consorcio CENIEH (Centro Nacional de Investigación sobre la Evolución Humana), BURGOS, and the University of Valencia, Spain and Eixea, Aleix and Villaverde, Valentín, University of Valencia,Spain.

The reuse of objects, both manufacturing byproducts as objects that have lost their original function, is a recurrent activity in the Middle Paleolithic. In principle this could be interpreted as a improvised solution to immediate needs, but a detailed analysis of these reuse processes in stone and bone objects suggests the contrary: that they are well planned strategies integrated with mobility, tool management, raw materials procurement etc.. A clear example of that are ramificiación strategies defined by Bourguignon et al. (2004). They are a common practice in Quina and Levallois assemblages that consists in the re-use of flakes and tools as cores for the production new generation tools. Recent analysis in various sites of the Iberian Peninsula (Axlor, Amalda, Quebrada), have shown that it is a common practice at the end of the Middle Paleolithic and that is the result of a planned strategy to facilitate mobility and the availability of small flint tools (Rios-Garaizar 2005, 2010, Eixea et al in press). These kind of strategies do not only apply to stone tools but have been also documented in bone industry, especially in the systematic use of bone splints, by-poducts of marrow extraction, as retouchers (Mozota 2009). The comparison with ancient Middle Paleolithic assemblages (Rios-Garaizar et al 2011, Alvarez and Arrizabalaga 2012, Sanchez-Yustos et al 2011) shows that such strategies are less frequent and tooling needs are mostly solved with the use of immediate resources (local raw materials of poorer quality). This diachronic variation seems to be related with changes in settlement systems, with changes in production strategies, and with a stronger social structure, characterized by increased activity planning and greater social control of production. This shows that Neanderthals were not static populations and that they lived crucial changes towards more complex societies.

Maintaining, recycling and anticipating: curation strategies at the end of the Pleistocene in Northwestern France - evaluating the impact of mobility patterns on lithic industries management strategies

Jérémie Jacquier (University of Rennes 1, UMR 6566 CNRS CReAAH) and Nicolas Naudinot (University of Nice-Sophia Antipolis, UMR 7264 CNRS CEPAM)

Two main strategies are available for hunter-gatherers to manage their industries: expediency and curation. In this paper we focus on two sites from Western France attributed to the end of the Paleolithic (Pleistocene-Holocene transition) and studied in a techno-functional perspective. All over Europe during this period, lithic industries exhibit standardized methods of reduction aiming for the production of flat regular and straight blades and bladelets and sometimes blades particularly long. Contrary to the Recent Azilian that preceded where expediency is obvious both in production and tool management, the organization of these Pleistocene-Holocene transition industries testifies of various curation strategies. The choice between these two extreme of a continuum is the result of several parameters. The way people move and organize his economy in the landscape is one crucial factor. In the case of these industries, curation is illustrated by several phenomena like tool maintenance, recycling of raw material and production for deferred uses. These modalities of curation are complex and need to be considered in a global perspective. The systemic approach of the lithic sub-system included petroarcheology, technology and functional analysis is thus the best tool to deal with this complexity. These analysis shows that the various curation modalities are more or less marked regarding the studied site. We consider these variations to be the result of adaptation to different socio-economic contexts.

Temporal variability of recycling at the end of the Middle Palaeolithic: the evidence from the Abric Romaní (Capellades, Spain). *Vaquero, M.; Bargalló, A.; Boldrin, M.; Chacón, M.G.; Gómez de Soler, B.; Picin, A. Area de Prehistòria, Universitat Rovira i Virgili. Institut Català de Paleoecologia Humana i Evolució Social (IPHES)*

The aim of this paper is to present a general overview of the lithic recycling identified in the Middle Palaeolithic of Abric Romaní. The archaeological layers so far excavated – spanning from 40 to 56 kyr BP – have provided significant evidence suggesting that recycling of artefacts was a behaviour fully integrated in lithic provisioning strategies. The characteristics of the Abric Romaní formation processes allow to recognize most of the different kinds of data usually considered as proxies of recycling: re-use of patinated or burned artefacts, use of a single artefact for different functions, successive knapping events on the same core, reduction of flakes as cores. In particular, the information provided by refitting and spatial analysis should be stressed. We will pay special attention to the temporal variability in recycling, by comparing the evidence found at different archaeological layers. Correlation of these temporal changes with the variability documented in other environmental and behavioural domains – subsistence strategies, raw material provisioning, knapping methods, settlements patterns, and spatial organization – will provide some clues on the factors explaining recycling. The implications of this recycling evidence for Neanderthal behaviour and cognition will be also discussed.