Understanding Lithic Recycling at the Late Lower Palaeolithic Qesem Cave, Israel

A functional and chemical investigation of small flakes

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To my Family

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Preface

The present work deals with two important topics that mainly characterise the Middle Pleistocene contexts: the practice of recycling old discarded flakes to be used as core for the production of new objects by means of recycling on one hand, and the production of flakes and tools of small dimension on the other. Both these subjects have not gained sufficient attention by the scientific community for many years due to methodological issues, preventing a detailed knowledge of these two phenomena. The possibility to study these lithic strategies, from a functional point of view, at a unique, well preserved and investigated site such as Qesem Cave, will allow us to enrich and stimulate the debate regarding the discussion on the theorisation of the recycling concept in the Palaeolithic and the comprehension of the functional role of small tools in the Lower Palaeolithic assemblages. Investigating the use of small flakes produced by means of recycling can provide significant insights into the strategies adopted by human groups towards raw material procurement, mobility patterns, use and intensity of utilisation of lithic resources, along with the study of artefacts' use/life-history, knapping trajectories, and human cognitive abilities in general.

This monograph is the revised, updated and corrected version of my PhD dissertation *The recycling phenomenon during the Late Lower Palaeolithic. The case study of Qesem Cave, Israel*, submitted to the 'Sapienza' University of Rome, Italy.

After an intensive period of three years, and one year later my doctorate degree, the publication of this work is the finishing touch of my PhD student career. It has been a period of intense learning for me, not only in the scientific domain, but also on a personal level. I would like to reflect on the people who have supported and helped me so much throughout this period because I achieve this goal also thanks to them.

I would first like to thank Ran Barkai and Avi Gopher for according me the possibility to study the Qesem Cave materials and be part of the Qesem Cave project. Even if physically far, they always have been present to dispel my doubts and uncertainty. I really thank them for making me feel part of their research group and for always welcoming me with enthusiasm during all my stays in Israel.

I am extremely grateful to my supervisor Cristina Lemorini to whom I owe all my knowledge in the field of use-wear analysis and experimental archaeology. Since the time of my Master's thesis, she has always been a mentor for me and her role in my scientific formation as a researcher has been fundamental. Her constant presence, never invasive, along with her positive influence have helped me to overcome the difficulties that this study has sometimes brought.

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I would also like to thank the following: all my colleagues from the 'LTFAPA' laboratory of Sapienza, Rome, and in particular Andrea Zupancich, with whom I have shared the Israeli experience, thanks for being always available when I needed your precious help; Jacopo Tirillò for generously sharing his knowledge on SEM-EDX working principles; Roxane Rocca, Daniele Aureli, Laurence Bourguignon, Amèlie Da Costa for inviting me to be part of the project concerning small tool production and use which proved a productive interchange of research ideas; all the Israeli colleagues at Tel Aviv University and in particular Yoni Parush for being my reference point in answering all my questions on the Qesem Cave site; Ruth Blasco and Jordi Resell for their stimulating discussion on the Qesem Cave data; Giovanni Morra for being

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Chapter 1

Introduction

For many years, recycling was only considered a contemporary manifestation, linked to the economic and ecological politics of industrialised societies. However, archaeological and historical records testify that this practice was firmly adopted by many past societies, as well as traditional hunter-gatherer groups (e.g. Amick 2007; Binford 1977; Gould 1968; Kelly 1964).

The discussion concerning the phenomenon of recycling in prehistory has recently attracted the attention of researchers. But since the theoretical foundations set by Michael B. Schiffer (1972; 1976; 1977; Schiffer *et al.* 1981) regarding the role of recycling, especially within Palaeolithic lithic assemblages, progress in this field has been rather limited. Moreover, the difficulty in recognising evidence of recycling behaviours in archaeological assemblages discouraged the dissemination of studies in this field (Odell 1996).

The renewed interest in Palaeolithic recycling in recent years has resulted in publications concerning the production sequences of lithic recycling and the archaeological criteria to identify it (Amick 2007; contributions in Barkai *et al.* 2015; Hiscock 2009; Thiébaut *et al.* 2010; Vaquero *et al.* 2012). Archaeologists are now aware of the fact that the study of recycling has enormous potential, providing significant insights on the strategies adopted by human groups in terms of the procurement of raw materials, mobility patterns, use and intensity of utilisation of lithic resources, along with the study of artefact use, life-history, knapping trajectories, and human cognitive abilities in general.

Moreover, studying recycling procedures helps to define the temporal nature of the archaeological assemblages, formed by a succession of depositional events (Vaquero *et al.* 2012). Like archaeological palimpsests, artefacts too may show different cycles of use or manufacturing events. The recycling of previously abandoned blanks for tool production is one of the best examples of temporal dynamics in the stories of artefacts (Vaquero *et al.* 2012).

This present work focuses on the study of selected recycling aspects in the late Lower Palaeolithic, 420–200 kya Qesem Cave, located by the Mediterranean coast near Tel Aviv, Israel. The cave consists of a deep (*c.* 11 m) series of sediments bearing finds of the Acheulo-Yabrudian Cultural Complex (AYCC) (Barkai *et al.* 2009; Barkai and Gopher 2011; Falguères *et al.* 2016; Mercier *et al.* 2013).

Lithic recycling at Qesem Cave is fully integrated within lithic production, and consists of several recycling modes. Recycling behaviour was well planned and regularly practised by the cave's inhabitants throughout its many archaeological contexts. At least five recycling trajectories were reconstructed, including hand-axes recycled into cores, patinated flakes recycled into side scrapers, recycled side scrapers, patinated cores recycled, or reused as 'regular' cores, and small flakes and blades produced from old, discarded 'parent' flakes or blades (Parush *et al.* 2015; 2016). This latter recurrent mode of recycling, which is the focus of this work, was accomplished by selecting existing flakes/blades from a great array of blanks available in or out of the cave, and using them to produce new items. Technological analysis of these 'old and fresh' items, called cores-on-flakes, has demonstrated that a variety of blanks was selected for recycling, including flakes, primary flakes, fully patinated flakes, primary blades, naturally-backed knives (NBKs) flakes, NBK blades, blades, core-trimming element (CTE) flakes, CTE blades, tools (shaped items), scrapers, and undetermined items. These items show variability in size, length, width and weight, as well as shape, indicating no preferential selection towards specific types or shapes. The results of this production are flakes and blades knapped from 'parent' flakes and which are usually small in size and with specific and desired features.

Investigating the use of these small implements produced by means of recycling will allow the shedding of new light on the behavioural and functional significance of this practice, along with enriching and

stimulating the theoretical debate regarding two main issues: the recycling concept in the Palaeolithic; and the renewed interest of researchers in the production of small tools and their use. The recycling phenomena of Qesem Cave may significantly contribute to the debate as it is a Lower Palaeolithic site providing a large, well-preserved and diverse assemblage of recycled items and recycling products that has the potential to illustrate the roots of recycling as part of the technological history of our ancestors (Agam *et al.* 2015, 2018; Shimelmitz 2015). The comprehension of recycling procedures at Qesem Cave constitutes the starting point of this work, which is devoted to functional analyses of the products of this recycling practice.

Although the scientific literature has been recently enriched by papers discussing the technological aspects of lithic recycling, very few studies have yet taken into consideration the functional aspect linked to this particular behaviour, and, as a consequence, little is known concerning the purpose of this production (Beyries and Cattin 2015; Claud *et al.* 2010; Lemorini *et al.* 2015).

The aim of this research is, first of all, to fill this gap through a systematic study based on the use-wear and residue analysis of a large sample of 609 products of recycling coming from discarded flakes and blades from the huge span (420,000–200,000 years) of the Lower Palaeolithic site of Qesem Cave. To achieve this, the methodology applied here combines the analysis of use-wear with analyses of residues, performed by exploiting advanced microscopes capable of different magnifications. Residues were detected morphologically and chemically by applying two different techniques: Fourier Transform Infrared (FTIR) micro-spectroscopy, and Energy Dispersive X-ray Spectroscopy (EDX or EDS), while use-wear analysis was performed by applying both Low- and High-power techniques, with the use of a stereo-microscope, a metallurgical microscope, and a scanning electron microscope (SEM).

The association between use-wear traces and organic remains is a recent achievement. For many years residue analysis was a separate approach disconnected from functional interpretation (Marreiros *et al.* 2015). Although these studies have increased in recent years (Borel *et al.* 2015; Bradtmöller *et al.* 2016; Fullagar *et al.* 2006; Kononenko 2011; Lanjeans 2010; Lombard 2008; Nunziante and Lemorini 2012; Prinsloo *et al.* 2014; Rots *et al.* 2016; Wadley *et al.* 2004), comparative analysis between two different chemical techniques is an innovation. An experimental protocol was established to identify and localise the distribution of residue after the activities are carried out. The residues were microscopically observed, described, photographed, and then subjected to two spectroscopy techniques. The cross-checking of the obtained results from both analyses allowed an understanding of the quality and potential of the data provided by each technique, as well as testing to what extent the two techniques offered complementary results.

The analyses, conducted in such a systematic way across a large sample of products of recycling, will shed new light on these items and the purpose of their production. Moreover, the possibility of sampling three separate areas of the cave (the 'rock shelf', the 'central hearth' area and the area south of the hearth) provides important information and insights regarding the way the inhabitants of Qesem conceived their activity areas, and may indirectly provide information regarding social and spatial organisation and the division of space in the cave.

The studied samples originate from assemblages of both the Yabrudian and Amudian industries – two distinct components of the Acheulean-Yabrudian Cultural Complex (AYCC), to which the Qesem Cave is assigned. The AYCC, as represented by the Qesem finds, shows a significant turning point in human cultural and biological evolution as it displays a series of innovative behaviours, including, amongst other things, the habitual use of fire, hunting and sharing of game meat, use of bone retouchers for shaping flint tools, sophisticated raw material acquisition, systematic blade production and intensive flint recycling, all carried out by this innovative human community.

The AYCC is a local entity known in a limited number of caves and open-air Levantine sites and no systematic functional studies have been undertaken at these sites, specifically regarding the recycling

phenomenon. This research presents a unique opportunity to investigate, the function of the products of recycling, accompanied by an experimental programme in a well-dated and persistently occupied Late Lower Palaeolithic site. This present study will establish Qesem as a reference site for recycling studies, to the extent that it can serve as a comparative model for other sites displaying similar behaviours and habits in the Levant, as well as in Europe.

The Qesem Cave is a well-known and well-published site thanks to the contributions of many researchers who have produced a wealth of data regarding cultural and biological transformations that took place in the Levant between 420,000–200,000 years ago. The result of this research will thus be cross-checked against other studies concerning faunal remains, lithic technology, raw material procurement and more, contributing to a richer comprehension of the Qesem Cave site within the AYCC. Furthermore, its geographical position in the Levant, the crossroads between the African and European continents, makes Qesem a crucial site for understanding the dynamic evolution of early hominins.