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ABSTRACT

Acheulean in the Rif Mountains

Bifaces and other stone tools from the open air sites of Ammorene I and Ammorene II
M. Deva Jebb-Albaba

This report summarizes the results of surface collections conducted from 1998 through 2007 by the Kommission für Archäologie Außereuropäischer Kulturen des Deutschen Archäologischen Instituts and the Institut National des Sciences de l'Archéologie et du Patrimoine at Ammorene I and Ammorene II. The heavily disturbed sites are located within eight kilometers of the Mediterranean Sea, near Nador, and have lithic raw material sources located less than three kilometers away, which were utilized by the inhabitants at both sites. Lithic analysis reveals that over 50% of the modified pieces collected from each assemblage are *proto-bifaces* or *bifaces*. Middle and Late Acheulean artifacts are present at each site although, techno-morphologically, the assemblage at Ammorene II may slightly predate Ammorene I's lithic collection. Given the limited number of such rich Lower Paleolithic sites in North Africa, coupled with the fact that these sites are even more of a rarity for northeastern Morocco, the research presented here aids in furthering our knowledge of the Maghrebian Paleolithic.

KEYWORDS

Handaxe, Acheulean, Lower Paleolithic, lithic industry, Maghreb, Rif Mountains

Acheulean in the Rif Mountains

Bifaces and other stone tools from the open air sites of Ammorene I and Ammorene II

I. Introduction

¹ In 1994, the Kommission für Archäologie Außereuropäischer Kulturen des Deutschen Archäologischen Instituts (KAAK, Bonn) joined with the Institut National des Sciences de l'Archéologie et du Patrimoine (INSAP, Rabat) to begin a partnership in archaeology determined to better illuminate the archaeological past of northern Morocco. The newly formed cooperation's project was dubbed, "Préhistoire et Protohistoire du Rif Oriental du Maroc."

² The most intensive and extensive surveys were carried out at the onset of the Rif Oriental program, with nearly 9,000 km² covered in 1995 and 1996. It soon became clear that many sites representing the Lower Paleolithic through proto-historical periods were scattered across this landscape. On the downside, it was recognized that based on their preservation, or rather lack thereof, only a handful of these sites would be suitable for further investigation. The main problem affecting the archaeological preservation of the area is the region is marked by increasing soil loss through deflation and surface erosion due to the reduction of vegetation from farming, herding, and deforestation. These intense disturbances cause heavy erosion to the settlement layers and lead to the dispersal of artifacts at all open air sites, leaving little in situ. Ultimately, for the KAAK-INSAP project, this meant the majority of archaeologically sound sites discovered were located in caves or rock shelters. Ifri el-Baroud, Ifri n'Ammar, and Hassi Ouenzga are just a few of these well-preserved and rich rock shelter/cave sites that were discovered in the course of the cooperation (see Linstädter 2004; Moser 2003; Nami 2007; Nami – Moser 2010). By 2006, upon completion of surveying the greater part of the designated Rif project area, the program came to an end.

³ The open air sites of Ammorene I and Ammorene II were first discovered in 1998 by the KAAK-INSAP team. They are located at the northernmost boundaries of the research area, in 'badland-like' formations less than eight kilometers south of the Mediterranean shoreline (Fig. 1). The sites boast a unique assortment of Paleolithic tools and associated debitage comprising one of Morocco's richest Lower Paleolithic surface collections. Over 100 lithics were collected at each unexcavated site, of which roughly one-quarter are bifacial in nature.

4 Unfortunately, however, there is no information available about the system of collecting stone tools during the survey period. The Ammorene sites were discovered by way of simply being within the general survey area, in an exposed stretch near the coast, accessible by car. GPS data may have been collected but it is unavailable at the time of this publication. Collections made on site happened over a number of years by various archaeologists visiting the site and did not follow traditional methods such as using transects or grids to keep collections thorough and random.

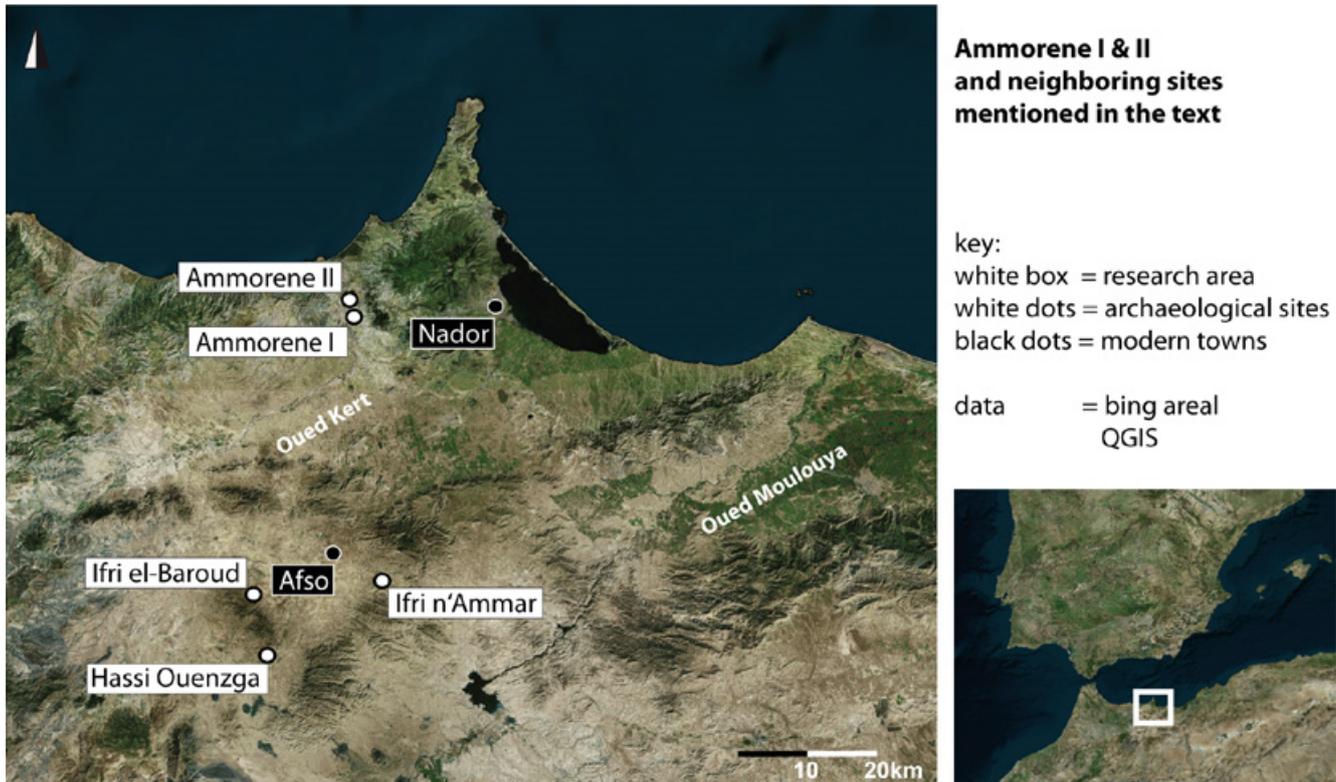


Fig. 1: Detail of the “Préhistoire et Protohistoire du Rif Oriental du Maroc” region of research with key sites marked

a. Research problems with the Acheulean of North Africa

5 Careful, thoughtful excavations, meticulous collection methods, and thorough data analysis at Paleolithic archaeological sites using multi-disciplinary approaches have only truly become standardized and universally implemented in the tail-end of the last century of North African archaeological campaigns. Although these intense investigative measures are fully embraced today by the archaeological community of, or working in, Morocco – until fairly recently they persisted as problems at a handful of sites.

6 Based on the cumulative age estimates established from lithostratigraphy, biostratigraphy, absolute dating (OSL, ESR), paleomagnetism, and aminochronology, the biological and chronostratigraphic framework for prehistoric North Africa is fairly firm, especially along the Atlantic coast of Morocco. Archaeologists such as Raynal, Geraads, and Sbihi-Alaoui believe that it can even be compared to the East African framework, although they note that it “needs refining, and could indeed be improved, in particular for the Lower Pleistocene” (Raynal et al. 2001: 66). Progress in acquiring accurate dates from stratified sites in Morocco is progressing and, amazingly, revealing record-breaking data for both human behavior markers (shell beads from Taforalt; Bouzouggar et al. 2007) and *Homo sapien* origins (hominin remains at Jebel Irhoud; Hublin et al. 2017; Richter et al. 2017).

7 While shifts in greater accuracy are occurring in later periods, presently, there are little to no thoroughly documented Lower Paleolithic sites that are located in Morocco away from the Atlantic coastline. Sites such as the Ammorenes in the Rif Mountains

or the small Acheulean collection found at Igdi, in the Anti-Atlas Mountains (Beilharz et al. 2002), are rarely found and perhaps even more rarely published (i.e. Oued Ar-Rabt, in Oujda; Sala et al. 2011). While the Ammorene sites were briefly mentioned in a *Forschungen zur Allgemeinen und Vergleichenden Archäologie* publication (Eiwanger 2004), this is the first comprehensive account of these prehistoric sites and their unique content. This research, although limited, certainly serves as a positive addition to the fragmented prehistoric record of the Maghreb and offers new insights into the lifeways of Lower Paleolithic peoples along the Mediterranean coast of Morocco.

II. Overview of the research area

8 The layout of the Rif Mountains and their environs serve as an intriguing draw to archaeologists seeking landscapes that may have appeared favorable to prehistoric settlers. Specifically, in the northern part of KAAK-INSAP's research area, a wide range of ecozones of various altitudes and composition are present with the lofty Rif range dividing into smaller mountain chains of varying heights. A myriad of wadis flow through here and into the Mediterranean Sea creating broad trough-like valleys and supplying the richly populated towns with largely perennial water sources (specifically, the Wadi Kert). At the southern portion of the KAAK-INSAP research area the Wadi Meloullou and the Wadi Moulouya serve to satiate the needs of both agriculture and the inhabitants. The surveyed area reached its boundaries to the east at the delta of the Wadi Moulouya near to the Kibdani hills.

9 On a larger scale, geophysically speaking, Africa and Europe move about four millimeters closer every year. The exact position and boundary between the African and Eurasian plates is unknown but it is located near the Gibraltar Arc - the area surrounding the Alboran Sea, directly between Iberia and Africa (Fig. 2, left). This Arc is made up of the Beltic Cordillera in southern Spain and extends southwards to include the Rif Cordillera of northern Morocco (Ibañez 2008). The Beltic Cordillera run along the Mediterranean from Gibraltar up to the Gulf of Valencia, and the Rif Mountains extend east-southeast from the northern-most part of Morocco and fade in elevation down into the Moulouya plain. In its entirety, the Gibraltar Arc is being compressed in a NW-SE direction with smaller left-lateral strike-slip faults helping to move it. The strike-slip faults that are located in northern Morocco are actually moving the majority of the Rif Mountains further southwards.

10 In addition to geographically being a part of the Gibraltar Arc, the Rif Mountains also are geologically tied to this region. The Rif is geomorphologically more similar to the Beltic Mountains than with the three other mountain ranges that run through Morocco (the Middle Atlas, High Atlas and Anti-Atlas). Conglomerates, limestones, sandstones and sands (that are more or less rich with shelly remains), and clays are the four main Pliocene deposits found comprising the southern Rif Mountains (Zouhri 2004).

11 Like the composition of the land, the climate of northern Morocco shares greater similarities to Mediterranean Europe than to the rest of Morocco. It is typically characterized as *Mediterranean* in nature, meaning the amount of rainfall in fall, winter, and spring for the area parallels that of other geographic locales that have coastlines along the Mediterranean (Fig. 2, right). The Rif region and its adjacent coastline are specifically semiarid to humid, with aridity increasing closer to sea-level, and the further south or east one migrates.

12 The percentage of dry years has been increasing over the last two decades, which makes the Moroccan ecosystem more fragile. Nevertheless, the coastal regions along the Rif can experience long and traumatic periods of rain in the winter, followed by complete drought in the summer. These long winter rains saturate soils and cause huge depletion of nutrients and soils. This is easily seen in the Rif Mountains and their



Fig. 2: Left: A January 2002 SRTM satellite image showing the vegetation of northern Morocco and southern Spain, with the Gibraltar Arc highlighted. Right: The boundaries for the Mediterranean vegetation in northern Morocco and Spain

foothills, which are mainly composed of erodible rocks, such as sandstones and conglomerates. After rainfalls, the steep Rif slopes induce gravity-connected runoff which in turn leads to the large transport of material (and therefore, simultaneously, land degradation), contributing to the silting of waterworks below. The erosion in the Rif is particularly acute, occurring at nearly 500 mm in depth for the humid massifs, and is not seen in the same extreme at any other mountain range in Morocco (Laouina et al. 2002).

III. The sites: Ammorene I and Ammorene II

13 The sites of Ammorene I and Ammorene II acquired their names after the small concentration of farmsteads in the area that are cumulatively denoted on maps as *l' Ammorene* (loosely meaning “my place”), these farmsteads are part of the rolling coastal hills that make up the hamlet of Infantaras (which, coincidentally, translates to “trace” or “evidence”).

a. Ammorene I

14 Ammorene I was discovered in April 1998, during a systematic survey of the neighboring Zeghanghane and Sammar environs. While only a handful of lithic artifacts were collected at the site that field season, further collections were made periodically during the years following, and more intensively in 2004, 2005, and 2006. In 2005, a Neolithic artifact concentration was also found at the far southwestern end of Ammorene I but only a few pieces were collected. This material was not yet reviewed and therefore will not be discussed herein.

15 The site covers an area of roughly 15 m x 35 m (Fig. 3). These dimensions are identified based on where the lithic artifacts were collected and not upon any evidence for an actual, defined use-area or occupation space. The authentic site from which the lithics originated was most likely further up the hillside, as the pieces were located near the bottom of a series of gently sloping ravines. Ammorene I slopes slightly downwards, running north to open up in to a wide valley (Fig. 3, top). This valley is fed by the Wadi Kert and fans out to where it meets the Mediterranean Sea. Ammorene I is ideally situated less than 8 km from the Mediterranean and roughly 1.5 km from the Wadi Kert. While it cannot be assumed that the Wadi Kert was present in its current location, at its current breadth, or present at all in prehistoric times, it is highly probable that the site's close proximity to the Mediterranean meant there were numerous freshwater sources join-

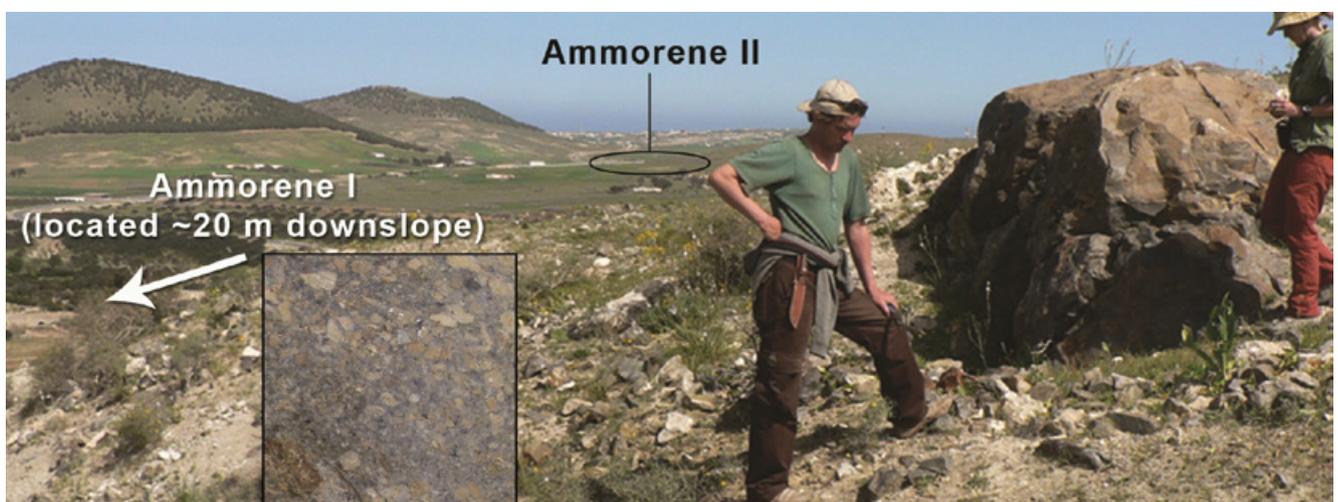


Fig. 3: Ammorene I is highlighted in red, with the yellow dot serving as a reference point in both photos to mark the same location. Top: Northwest view, looking down slope along Ammorene I's ravines. Bottom: Looking southwest across Ammorene I with seasonal natural drainage cutting through westernmost boundary of the site

ing one another in the area to flush out in to the sea. These rivers must have helped to form the present-day valley the Ammorene sites sit in and that extends directly towards the sea. Together, the freshwater and saltwater resources could easily have provided the prehistoric populations with an abundance of high quality resources.

16 Ammorene I may have also appeared attractive to early stone tool using populations because there is a fairly high grade lithic source in the site's immediate vicinity. A few meters south and upslope of Ammorene I is a large exposed volcanic outcrop of dark gray, almost glassy material that occasionally presents itself in both Ammorene assemblages (Fig. 4). The material from this outcrop is referred to as Flecked Ammorene

Fig. 4: Raw material outcrop at Ammorene I, with detail of the Flecked Ammorene Volcanic (FAV) composition. Ammorene II and the Mediterranean Sea are seen in the background



Volcanic (FAV), as its core gray-colored composition is often dappled with lighter-colored inclusions. Due to its high silicate volume, FAV has a very saccharine sheen and appears to be very sensitive to weathering, spalling easily.

17 There are also many pieces that are made of material from the nearby sources of In-Narramine, less than 3 km away, and In-Haddour Ou'Ammar, less than 1 km away. In-Narramine is a hill-like outcrop erupting with large magmatic blocks and boulders (Fig. 5). There are two slight variations of the gneissose-like raw material at this source, which were divided into Narramine Pastel Rhyolite (NPR) and Narramine Banded Trachyte (NBT). The taffy pastel range of hues found on the first magmatic type is comprised of mainly white and soft peaches and pinks. Where NPR was rapidly cooled, creating a fairly homogeneous composition, the second variant cooled more slowly allowing pockets of air to be trapped, and bands of minerals left separated. This second variant of the source material is banded with thick purple, white and bluish stripes that can be very porous in some areas. The NPR would seem more suitable for tool-making as it is not riddled with pores like the NBT. Originating from the same material, the two igneous variants are obviously also found together, gradated across single pieces. The entire hill of the In-Narramine outcrop is littered with massive flakes that are both natural spalls and man-made removals.

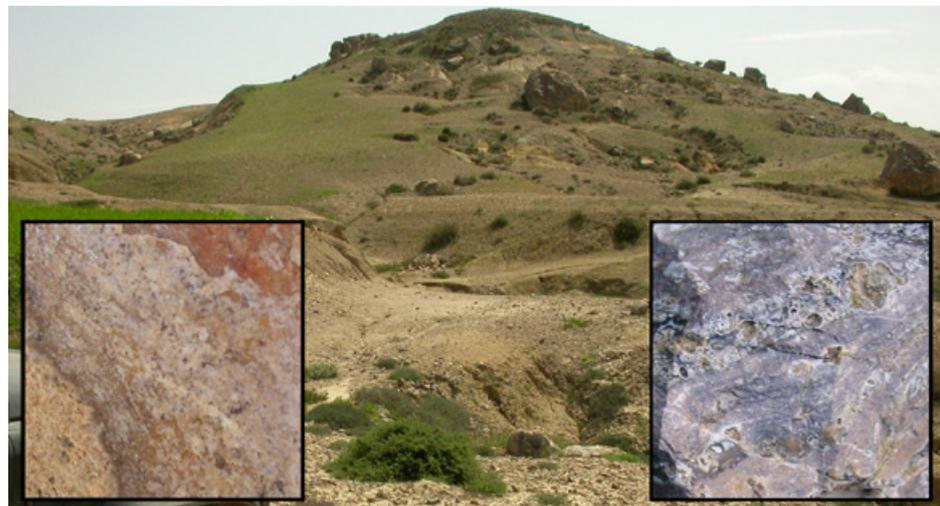


Fig. 5: In-Narramine raw material eroding out of hill, with detail of Narramine Pastel Rhyolite (NPR, left) and Narramine Banded Trachyte

18 Both of the aforementioned magmatic variants are also found at In-Haddour Ou'Ammar and as tools and debitage at Ammorene II. In-Haddour Ou'Ammar is situated closer to the Wadi Kert than In-Narramine and closely neighbors Ammorene I. Unlike the obtuse exposure of raw material at In-Narramine, the material at In-Haddour Ou'Ammar is found in a trench-like formation that was cut from the earth and uncovered by a once-flowing spring.

19 Remnants of long-since exhausted springs are also present at Ammorene I, with some historic irrigation ditches even carved into the exposed travertine on-site. In terms of the disturbances found at Ammorene I, water is the greatest factor deconstructing the site. Man-made alterations to the land exist as the second major impact to Ammorene I, with fields currently upslope of and adjacent to the site. As previously mentioned, the Rif is prone to both heavy rainfall and intensive agricultural practices, and the combination of these factors has clearly led to intense erosion in the immediate site area.

20 The 130 stone artifacts collected at Ammorene I were found strewn across the site with no defined pattern. For example, larger stones appeared downslope from smaller pieces and highly patinated pieces were mixed with seemingly freshly made bifaces. Each piece was predominantly found alone, with the nearest neighboring piece generally found over one meter away. The assemblage runs across all parts of the site

fairly evenly but is not found in the stream bed at the site's northern perimeter or near to the far southwestern portion of the area, where the Neolithic pieces were located.

b. Ammorene II

21 Discovered in 1999, one year after Ammorene I, Ammorene II is situated less than 2 km northeast of Ammorene I. The site was casually explored in 2001, 2002, and 2003, and then more intensely surveyed in 2004 and 2005. Prior to 2004, only 51 of the 137 lithic artifacts had been collected. By 2005, it became clear that the site actually contained four distinct lithic concentrations, now referred to as A, B, C, and D (Fig. 6). Unlike at Ammorene I, Ammorene II does not have a Neolithic component on-site. In all the collections made over the years, only one single cardial pottery fragment was collected (in 2004). However, there is a potential late Middle Paleolithic scatter located far upslope from Ammorene II but, like the Neolithic presence at Ammorene I, this scatter will not be further elaborated on within the discussion herein.

22 The layout of Ammorene II is similar to Ammorene I, in that the site is at the bottom of a hillside that is interlaced with ravines. The ravines are far more dramatic and extensive in their 'badland-like' undulations than those of Ammorene I. The slope of the hillside is also at a steeper incline than at Ammorene I, which in turn has led to the



majority of the artifacts being found at the bottom of the slope (and not dappled along the slope itself, as at Ammorene I).

23 The largest lithic concentrations at Ammorene II are A and B. Sixty-nine lithic artifacts were collected at Concentration A and 50 pieces from Concentration B. While Concentration B is south of Concentration A, the two concentrations are at the western-most part of the site, closest to the main road and in the midst of present-day farm fields. These two lithic scatters are each roughly extended across areas that measure over 30 m². Concentration C is further upslope from A and B; the slope is more inclined in this area and only nine lithic artifacts were collected here, as well as the large pottery fragment that was mentioned. Nine stone artifacts were also found at Concentration D, which is the northernmost of all the artifact clusters. While these four groups are clear concentrations of material, the site is presented here as a single unit because there are also several lithic artifacts scattered between the concentrations and the raw lithic material and typology present across the site is overwhelmingly shared. As a whole, the Ammorene II site boundary, encompassing all four concentrations, runs roughly 70 m north to south and 50 m west to east.

24 Due to the great expanse of the site and its location at the bottom of a gently sloping hillside, Ammorene II has consistently revealed more artifacts each year following the rainy season. In 2009 alone, 12 more lithic artifacts (including seven bifaces)

Fig. 6: Ammorene II site overview with all four lithic concentrations highlighted in red and the Mediterranean Sea beyond, at right. Part of the Middle Paleolithic scatter (highlighted yellow) is in the foreground

were found and collected on the surface at Concentration A. This is not the case at Ammorene I, where revisits during later years within the project did not yield new artifacts. In terms of location, Ammorene II is a mere five kilometers away from the Mediterranean Sea, closer than Ammorene I, and about one kilometer away from the Wadi Kert. It is also not far from the two main raw material resources in the area, with In-Narramine at about 3 km south-southwest and In-Haddour Ou'Ammar roughly 1.5 km west. Strewn across the site itself are large boulders and massive jagged chunks of NBT and NPR. They may have once been part of a concentrated outcrop that is now displaced. The gneissose material is especially concentrated at Concentrations B and C. It is likely that the inhabitants of Ammorene II utilized these boulders to gain large flake blanks for tool production, as the material is almost indiscernible in composition and quality from the raw material found at In-Narramine and In-Haddour Ou'Ammar.

25 As is the case at Ammorene I, water is the single most significant cause of damage to the original composition of Ammorene II. However, the water damage is naturally-caused, in that there exist no man-made drainages or irrigation channels that were cut into the site as seen at Ammorene I. Additionally, alluvial damage to the site is more severe at Ammorene II because the hillsides are so much steeper. Ultimately, archaeological material at Ammorene II must have moved a greater distance from the original deposition point than the lithic assemblage at Ammorene I.

c. Other utilized lithic material

26 While the majority of the material at Ammorene II could be sourced, there were still many pieces that could not be. This is especially true for Ammorene I's lithic assemblage, which contains more pieces made upon unsourced, non-local material than made from sourced material. The non-local material found at each site is mostly made from vibrantly-colored quartzites or chert/chert-like material with high sheens. These fine-grained pieces come in reds, oranges, and crisp snowy whites. It is possible that the Ammorene inhabitants found these brightly-colored stones in the gravels and terraces of the nearby Wadi Kert because similar material has been found at Wadi Moulouya and within the assemblages of the archaeological sites that neighbor the Wadi Moulouya.

27 Second to the ultra-fine-grained material recovered at both Ammorene sites are the coarser-grained basalts and limestones noted within each assemblage and still left unsourced. The basalt is generally dark gray in color and the limestones range from gray to soft hues of violet or green. There are also several pieces that look to be made on coarse granite. The prehistoric community (or communities) at the Ammorene sites, especially Ammorene I, may have travelled great distances, or even traded, to obtain such an array of material.

IV. Methods

28 Of the 130 lithic artifacts collected at Ammorene I, 61 are unmodified and 65 are modified (with another four that were later identified as mere ecofacts). Like Ammorene I, Ammorene II has 61 unmodified lithic pieces but its remaining 76 pieces are modified. This section seeks to explain the fundamental methods utilized in evaluating the Ammorene sites' combined 267 stone artifacts, and then discusses the unique features associated with the unmodified, modified, and other lithic types that comprise each assemblage.

29 Here, the reader must be reminded that the number and type of lithic pieces described herein are only a sampling of what was collected, rather unsystematically, from the surfaces of Ammorene I and Ammorene II over a period of several years, by different visiting archaeologists to the sites. Worth mentioning is that an archaeologist

collecting with no framework set in place may be more inclined to collect nice retouched tools or big flakes, with no attention turned to, for example, smaller debitage. Because little regard was given to a highly methodical survey and collection campaign at each of the Ammorene sites, the artifacts described below, along with their features, are not a comprehensive representation of the actual sites' contents.

a. Analysis methods

30 It is true that in establishing typologies, technologically-based or otherwise, they are often very artificial and painfully descriptive. While “classifying lithic artefacts does not constitute an end in itself,” as stated by Conard et al. (Conard et al. 2004: 13), it does serve here as the stepping stone upon which original thought is built. Inquiries into early patterns of human behavior at Ammorene I and Ammorene II can immediately be addressed with a typological-based data set.

31 Deciding on what attributes to recognize and include in a typology for lithic artifacts has been a prominent issue of debate since the 1960s with the introduction of several detailed typological systems (e.g. Bordes 2005; Roe 1964). Concerning the lithic assemblages at Ammorene I and Ammorene II, François Bordes' *Typologie du Paléolithique Ancien et Moyen* (2005) is referenced to herein. While there does exist a spare handful of other tool typologies applicable to North African assemblages they are either even more contested than Bordes' or they are only for assemblages of later periods (e.g. Tixier 1971). Bordes' system, while perhaps a bit too subjective and occupied with plan form attributes, is broad and can easily be applied to Acheulean assemblages from almost anywhere. His typology was also of specific use because it is particularly thorough concerning handaxes and tools made on flakes, both of which have a strong presence at the Ammorene sites.

32 Lithic analysis methods and typologies from Mary Leakey, William Andrefsky Jr., Nicholas Toth, and Kathy Schick were also heavily drawn upon in creating a system of analysis for the Ammorene lithic collections (Leakey 1971; Schick – Toth 1994; Andrefsky 2005).

33 Guided by these Paleolithic archaeologists, the assemblages at Ammorene I and Ammorene II, particularly the modified pieces, were assessed through the identification and typing of the following ten technological features: blank type, tool type, general modification(s), edge modification(s), direction of negatives, dorsal scars, remnant platform type, platform location, plan form, orthogonal cross-section. The tool types recognized consist of: scrapers, retouched pieces, cores, proto-bifaces, handaxes, cleavers, and picks. Unmodified lithics also were recorded, and they include Levallois flakes (prepared), flakes (including elongated flakes or blades) and chunks. When lithic artifacts were too damaged or patinated to typologically place them in a modified or unmodified category, or to recognize a distinct feature, they were recorded as “undetermined.” Finally, a few unique pieces and “intermediate” artifacts were also catalogued; the latter cannot be defined as a single tool type but instead shares clear features of two tool types.

i. General Modification(s)

34 To elaborate within the technological features category, the general modification(s) expressed in the system of attributes for each site represent those that dominate the piece as a whole. The seven general modification categories created convey the degree to which a lithic artifact's body, edges, or body and edges were worked. The first three characteristics apply to pieces that have only their bodies modified (i.e. thinning); these pieces can have 30%, 60% or up to 90% of their body altered. The fourth and fifth features describe whether the piece was only modified at its edges; these general modifications express either that up to one full edge was modified or that one full edge up

to two full edges were modified. The last two features are for pieces that have both the body and edges worked and these general modifications are simply: *partially modified (body and edge)* and *completely modified (body and edge)*. The seven characteristics were then described to address either unilaterally modified or bifacially modified artifacts. The remaining options in this attribute category are: *undetermined*, *other* and *unmodified*.

ii. Edge modification(s)

35 Whereas the previous category addresses whether or not a lithic tool's body, edge(s), or body and edges were modified, the specific edge modification(s) category communicates what type of modification was applied to the actual edges. The edge modification cited is the one that dominates the piece. At the Ammorene sites, nine simple and clear methods were recognized in trimming and shaping the stone tool edges (Fig. 7).

36 The first three edge modification noticeable on many handaxes was their crude, bifacially struck sides. In profile, the crude, or simplistic, removals create a wave ripple or zig-zag pattern. This style of edge-work can be seen when the piece is viewed upright in profile, with the lateral edges, in most cases, running parallel to the long axis. The zig-zag form arises through alternate flaking, where the striking platform is the scar bed of the preceding flake (Sampson 2006). Alternate flaking often leads to a sinuously curved edge that goes back and forth along the lateral edge but at the Ammorene sites most of the bifaces have edges that are less sinuous and arranged more as sharp, acute angles joined together. Each alternating (concave, convex, concave, and so on) acute angle is the remnant of a flake removal. A bifacially-worked edge with deeper alternating negatives suggests the use of the hard-hammer reduction technique, with the bluntness of the strike creating a more profound and larger removal than seen with the consequences of the soft-hammer technique, use-wear, or natural trampling. It cannot be assumed that the alternating edge blows were all created through implementing this technique at Ammorene I and II. It is possible that some of these edges were perhaps created when the piece was held at both ends and brought down on an anvil. These wave-like edges, seen in profile, also appear as such because they saw no secondary trimming. This form of edge modification was noted in lithic tools at both sites on single lateral edges, the first noted type of edge modification, or then on both lateral edges, the second form of edge modification recognized. The third form of biface with these simple edge reductions appears with only one edge bifacially worked and the other unilaterally reduced.

37 Following these three edge variations are another three, which are in the same style, yet more thoroughly reduced. Here, in type four of the edge modifications, is where the piece has only one edge entirely worked ventrally and dorsally. The edge is almost entirely bifacially thinned, if not fully reduced into a straight (non-zig-zagged profile), sharp edge. Additional edge trimming, beyond form reduction, was employed. An alternate option to this modification, the fifth noted, is when both edges are thoroughly bifacially trimmed, created a clean biface with significantly sharp sides all around. The sixth edge modification noted, in this highly reduced style, is where one edge is alternately struck and trimmed in detail, and the remaining edge is only unilaterally worked.

38 A seventh edge modification noted is a marrying of one crudely reduced, bifacially worked edge (zig-zagged in profile), with a thoroughly fine-tuned bifacially worked side (non-zig-zagged in profile).

39 An interesting edge modification class further documented, type eight, describes both lateral edges as flaked, but only unilaterally. However, this piece is still seen as a biface because one edge is struck in one direction, it is then flipped and struck on the new side, one edge again. To elaborate, we can imagine our piece held in plan view struck along its right edge, flipped over and struck again along the new right edge in

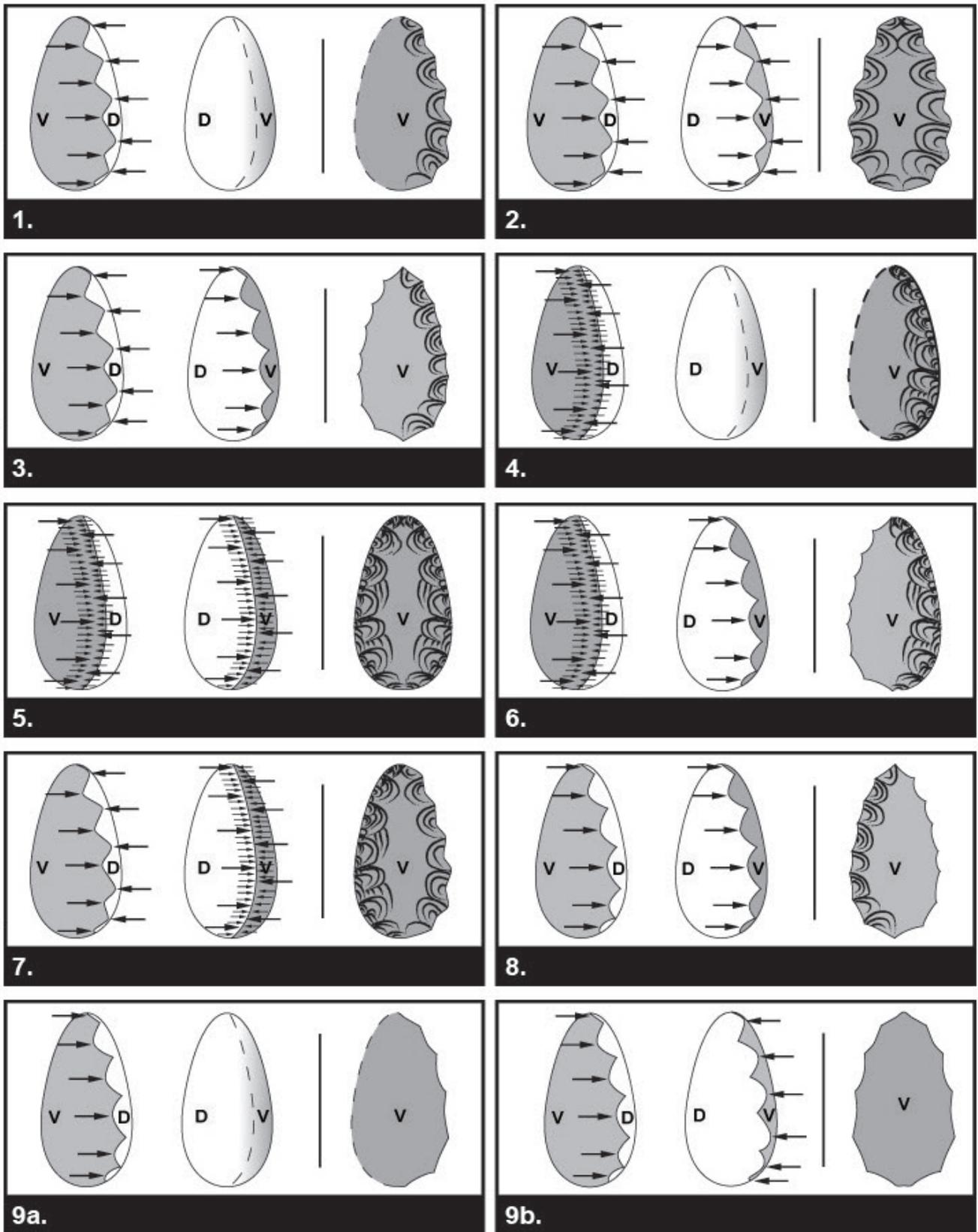


Fig. 7: Edge modifications seen on bifaces and unifaces at Ammorene I and II. 1. Crude bifacial removals along one edge, with no reduction on opposite edge. 2. Crude bifacial reduction along both lateral edges. 3. Crude bifacial removals along one edge, with removals only on one face of opposite lateral side. 4. Thorough bifacial removals along one edge, with no reduction on opposite edge. 5. Thorough bifacial reduction along both lateral edges. 6. Thorough bifacial removals along one edge, with removals only on one face of opposite lateral side. 7. Crude bifacial removals along one edge, with thorough bifacial reduction on the opposite lateral edge. 8. One lateral edge reduced (e.g. the right edge), and when piece flipped horizontally, the same edge (e.g. the right edge, again) is reduced; so opposite lateral edges worked on opposite faces. 9a. A uniface with only one edge worked. 9b. A uniface with both lateral edges reduced

this plan view. So again, ultimately, a biface was created but each edge is only worked on one surface, unifacially.

40 The final two possible edge modifications noted for the lithic artifacts at the Ammorene sites applies solely to uniface. These edge modifications describe a uniface as having only one of its two lateral edges unifacially reduced in plan view, or then both of its edges worked unifacially in plan view (Fig. 7, type 9a and 9b). The uniface were not described as *tools* in the system of attributes but were left to the *other* category due to their ambiguous characteristics that, for now in this paper, typologically leave them in a gray area.

41 After technological observations were made, the lithic artifacts were divided into whole and fragmented pieces, with complete artifacts measured for their maximum length, maximum width, maximum thickness, and weight. These sums were then employed in several indices: blank area (BA), blank volume (BV), index of size (IS), and the index of elongation (IE). However, the results from applying the various measurements of the materials in to these indices yielded no significant results and therefore will not be further elaborated upon in this paper.

42 Finally, aside from technological and metric attributes, the actual geological nature of the lithic material found in the assemblages was determined and the artifact preservation noted. The four attributes used in defining the nature of the lithic material in the Ammorene collections are limited to the geological material type, the crystalline composition, the cleavage type, and the amount of cortex (natural surface) still remaining on the lithic piece. The preservation of each lithic artifact was evaluated based on the condition of a stone artifact's body and edges as well as, when present, the type and distribution of patina upon the piece.

b. The Levallois Method

43 The Levallois Method is used here to describe a particular way of obtaining flakes of a pre-defined form from a prepared core. The core is carefully pre-shaped and prepared (thus transforming it into a *Levallois core*) in order to remove flakes of a controlled shape and thickness, known as *Levallois flakes*. The Levallois Method can then produce three lithic artifact types: the *mother* piece, or the prepared core; the *child* piece, the predetermined goal flake; and the simple thinning or reduction flake made with the goal flake in mind.

44 At the Ammorene sites some cores are prepared using the Levallois Method not to create blades or points but simple (and often large) flake blanks. To obtain these flakes, cores at the Ammorene sites are shaped, using Boëda's (Boëda 1994; Boëda 1995) definitions, via three main methods: the Levallois *préférentiel* method using centripetal preparation, the Levallois *récurrent* method also with centripetal preparation, and the *récurrent* method again but with unipolar preparation. All three techniques generally require a degree of platform preparation. However, due to time constraints, Levallois remnant platforms were not evaluated. Additionally, there are other Levallois core types and preparations that exist but they are either non-existent or not definitively seen in the Ammorene lithic assemblages.

45 It is important to recognize the Levallois Method when present because it existed only during a certain time-frame in explicit geographical zones. According to Biberson (Biberson 1961), Levallois technology was introduced at the start of the Middle Acheulean in the Maghreb and developed further during the Late Acheulean. The method was used extensively in the Mousterian and Aterian and then was no longer employed during the Iberomaurusian after 22 Ka (Wengler 1995). Vermeersch (Vermeersch 1995) argues that the Levallois Method ended before this and was already largely abandoned in North Africa before 40 Ka. In any case, during the Mousterian and Aterian of eastern Morocco the Levallois *récurrent* system with centripetal prepa-

ration of the cores was the flaking method most often employed; with Levallois artifacts demonstrating uni- or bi-directional preparation scars (Wengler 1995).

V. The lithic assemblages

46 The results of the lithic analysis for the two Ammorene assemblages are broken down into a discussion of the unmodified artifacts, the modified pieces and, finally, all other lithic artifacts (i.e. intermediate forms, unifaces and bolas; the ecofacts are also briefly mentioned). The modified lithic artifacts include: scrapers, retouched pieces, cores, choppers/chopping-tools, proto-bifaces, handaxes, cleavers, and picks (Fig. 8).

A. Unmodified lithic artifacts

47 Unmodified lithic artifacts (ULA) are often referred to as *debitage* and they include artifacts that are flaked or broken off of a stone blank, namely flakes, elongated flakes or blades, chunks, chips, and other such unworked detached pieces. They can have some or all of the following diagnostic features: a remnant platform, a bulb of percussion, dorsal negatives, cortex, a twisted or 's'-shaped profile, a bulbar negative, and/or a lip. Some pieces may also have evidence of use-wear.

48 There are 61 ULA that were collected at Ammorene I: ten Levallois flakes, four chunks, and 47 are simple flakes. The same number, 61 ULA, was also collected at Ammorene II: 26 from Concentration A, 27 from Concentration B, two from Concentration C, and six from Concentration D. Of the total 61 ULA from Ammorene II, eight are Levallois flakes and eight are chunks.

i. Technological features

49 *Ammorene I*: No primary flakes were collected within the ULA at this site, instead 45 tertiary pieces with no cortex present were gathered. Following the trend of a weak presence of cortex found on the collected lithics, there are only two pieces that have cortical platforms. None of the *debitage* has platforms with cleavage present. Planar platforms are seen in little over one third of the ULA assemblage, while roughly another third of the collection have simply no platforms present. Several ULA have one dorsal flake scar, while over one third have two flake scars and nearly another third has three.

<i>Lithic artifact type</i>	<i>Ammorene I no.</i>	<i>Ammorene I %</i>	<i>Ammorene II no.</i>	<i>Ammorene II %</i>
Unmodified	61	46.92	61	44.53
Levallois flakes	10	7.69	8	5.84
Flakes	47	36.15	45	32.85
Chunks	4	3.08	8	5.84
Modified	65	50.00	76	55.47
Scrapers	2	1.54	1	0.73
Retouched	4	3.08	4	2.92
Cores	9	6.92	17	12.41
Choppers/ chopping-tools	2	1.54	0	0
Proto-bifaces	11	8.46	21	15.33
Handaxes	24	18.46	14	10.22
Cleavers	3	2.31	4	2.92
Picks	0	0	1	0.73
Intermediate	7	5.38	3	2.19
Unifaces	3	2.31	10	7.3
Bolas	0	0	1	0.73
Ecofacts	4	3.08	0	0
TOTAL	130	100	137	100

Fig. 8: The complete lithic assemblages from Ammorene I and Ammorene II

50 *Ammorene II*: Slightly more of the ULA at Ammorene II have cortex present as compared to Ammorene I, this ratio is 21 pieces to 14 pieces, respectively. The type of platforms at Ammorene II and the number of each style is very similar to those reflected in the ULA of Ammorene I, except Ammorene II has two pieces with cleavage-type platforms and one that is dorsally all cortex - both of which are non-existent at Ammorene I. Ammorene I has nearly twice as many ULA with two dorsal scars as found at Ammorene II; conversely Ammorene II has nearly twice as many ULA with more than three dorsal negatives, and each site have equal amounts of ULA with three dorsal scars.

ii. Raw material and condition

51 *Ammorene I*: There are fewer collected ULA made from sourced raw material in this collection than from unsourced lithic material. Of the non-local material, the combination of chert and chert-like material account for the majority. Nearly half of the ULA have sharp edges, with only six of those pieces showing minimal signs of damage to their edges. Nearly another half of the collection shows evidence of light-use and the few remaining pieces show signs of heavy use or are completely worn. Twelve pieces in the ULA collection remain unpatinated with the majority of the collection patinated.

52 *Ammorene II*: This site is just the opposite of Ammorene I with over half of the ULA made on sourced raw lithic material, although chert and chert-like material still make up one third of the collection. Well over half of the ULA have sharp edges or sharp edges that are slightly damaged.

iii. Unique pieces and summary

53 *Ammorene I*: Within the 10 Levallois flakes at Ammorene I, six ULA are found to have been prepared using the préférentiel Levallois system with centripetal preparation. Three ULA were prepared using the récurrent Levallois system, also with centripetal preparation involved, and one récurrent Levallois flake was probably created via unipolar flaking. There are several other ULA that exhibit borderline Levallois features, and for this reason listing merely ten Levallois flakes in this assemblage is a conservative estimate.

54 In this assemblage, there is one piece who's tip may have been utilized like an awl. Unfortunately, it is not clear whether the negatives around the tip area are modern, as most of the artifact is patinated and the negatives near the tip appear unpatinated.

55 Overall, the ULA at Ammorene I do not show a high degree of technological variability or unique attributes.

56 *Ammorene II*: This assemblage contains eight Levallois flakes, five were created using the préférentiel Levallois Method with centripetal flaking. One Levallois flake was created through the récurrent Levallois system, using centripetal flaking and the last two Levallois flakes were created with the same method but by utilizing unipolar removals. One Levallois flake could be considered a cleaver, in that it has a large lateral cutting edge at its distal end but it was not formally reduced (post-removal) and for this reason was not classified as such a tool. There does appear to be some use-wear damage along the lateral "cleaver" edge and so, even if it may not be a cleaver in the traditional sense, it was most certainly a large utilized flake.

57 Another unique piece from Concentration D may be a borer, or *perçoir*, as defined using Bordes' (Bordes 2005) typology. It has a very pointed tip that is slightly curved (e.g. concavo-convex) in plan form and on its ventral face are distinct negatives that can be seen along the edge at the piece's tip.

58 There are few unique features amongst the ULA at Ammorene II, although on average the pieces have larger dimensions and more flake scars per dorsal face than can be seen in the collection from Ammorene I. Unfortunately, major inferences from such facts cannot be made because, as stated earlier, not all ULA from each site

were collected, especially from Ammorene II, and the depositional nature at each site is unknown.

B. Modified lithic artifacts

59 The lithic artifacts that are considered to be modified lithic artifacts at Ammorene I and II include: scrapers, retouched pieces, cores, choppers and chopping tools, proto-bifaces, handaxes, cleavers, and picks.

60 Out of the 130 lithic artifacts at Ammorene I, 50% of the assemblage is modified. Handaxes dominate the modified portion of the collection and are followed by proto-bifaces and cores. At Ammorene II, 76 pieces, or a bit over half of the assemblage, are modified and of these pieces proto-bifaces make up the largest portion, followed by cores, and handaxes.

B.1. Scrapers and retouched pieces

61 Tools recognized as scrapers at Ammorene I and Ammorene II include the vast array of retouched flake forms that individually can be, as stated by Bordes (Bordes 2005: 41), “un objet fait sur éclat ou lame, Levallois ou non, par retouche continue, plate ou abrupte, écaillieuse ou non, d’un ou plusieurs bords, de façon à donner un fil semi-tranchant, droit, convexe ou concave, sans encoche ni denticulation volontaire marquée.” Bordes goes on to name exactly 63 discrete types of scrapers for the Lower and Middle Paleolithic. At the Ammorene sites there appears to be such a finite number of actual scrapers that their exact type (e.g. end-scrapers, convergent side-scrapers) is left to be described for each one as it appears. The scraper types seen at the Ammorene sites include both light-duty and heavy-duty varieties.

62 Retouched pieces are less methodically worked than scrapers and are hard to classify. Bordes (Bordes 2005) grouped such lithics into his “diverses” category. They are generally flakes that are intentionally or casually retouched with the retouch limited to a short extent of one or more edges. Often the retouch is alternating, irregular or discontinuous. On some occasions it can be difficult to discern whether actual retouch was present or instead if it what appears to be retouch is simply traces of use-wear or trampling damage.

63 Scrapers and retouched pieces are discussed together below due to their limited presence at the Ammorene sites.

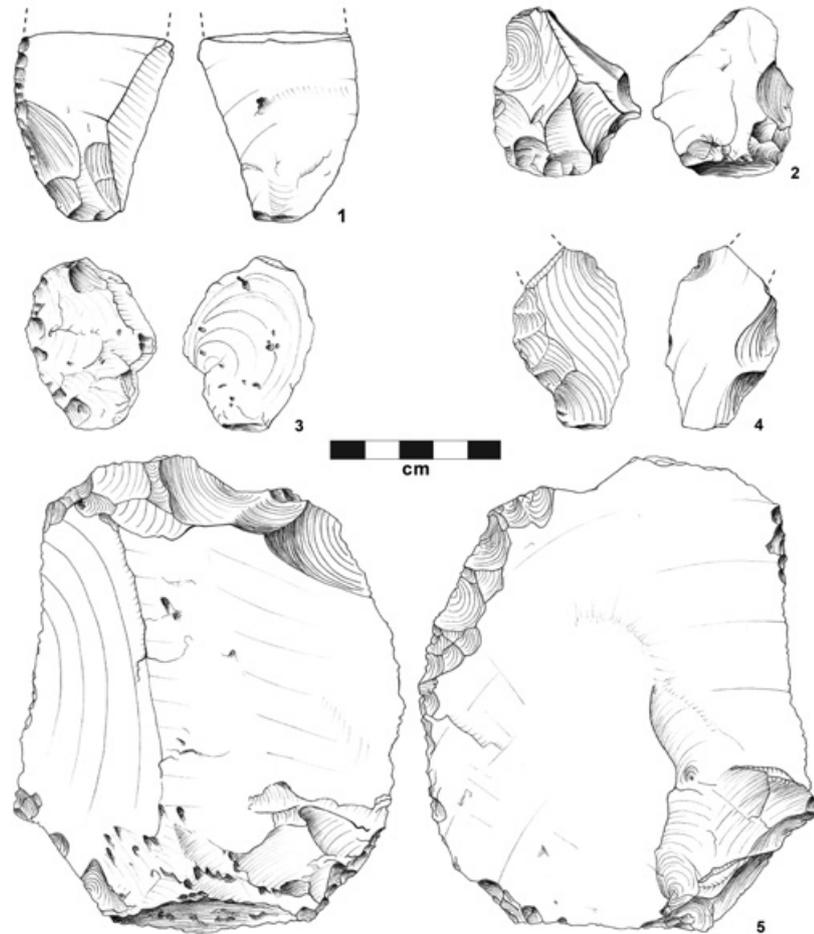
64 *Ammorene I*: There are six scrapers and assorted retouched pieces in this assemblage (Fig. 9). Two pieces are convex side-scrapers, one is an atypical backed knife and three are retouched pieces that do not directly fit into a typical tool class. Four of the pieces are made on chert or chert-like raw material and two are from one of the locally sourced materials (FAV-1, NBT-1). All of the pieces have planar striking platforms except for No. 57, which is left as undetermined.

65 *Ammorene II*: This assemblage contains one borer (No. 110), one convex side-scrapers (No. 125) and three assorted retouched pieces (Nos. 14, 26, 108). Four of the pieces are made from locally sourced material (FAV-1, NPR-2, NBT-1) and one is made from chert. Analysis of the pieces' platforms reveals two are missing theirs, one is planar, one is fractured from cleavage, and another is undetermined.

B.2. Cores

66 Andrefsky's (Andrefsky 2005: 254) definition of a core as “a nucleus or mass of rock that shows signs of detached piece removal” is accepted here to define pieces as cores within the Ammorene assemblages. Furthermore, cores have two or more facies and may be flaked in several directions and along multiple edges. In this analysis cores are also included in the technological attribute category as a blank type (the starting point for a lithic artifact) but are discussed in this section as a general tool type (the quasi-endpoint for a lithic artifact).

Fig. 9: 1. AmmI.86 convex side-scraper. 2. AmmI.93 retouched flake. 3. AmmI.94 convex sidescraper. 4. AmmI.95 atypical backed-blade. 5. AmmII.14 retouched flake. Unfortunately, remnant platforms were not detailed in the illustrations (scale: 5 cm)



i. Technological features

67 *Ammorene I*: This site has a total of nine cores, which include: five récurrent Levallois cores with centripetal flaking, three unformed cores, and one préférentiel Levallois core with centripetal flaking. Two of the récurrent Levallois cores are clearly made on flakes, with little to no removals on the ventral face; and they each appear to have had one of their edges used, as there are numerous chips and damage concentrated along one edge for each piece. Cores No. 34 and 129, not only have blank removals arranged in a largely centripetal fashion but also all had one major negative removed from their center - a prepared flake. Additionally, piece No. 26 is the only core that has an intact and identifiable remnant platform (planar).

68 *Ammorene II*: There are a total of 17 cores at this site. The majority of these pieces are from Concentration A, with one such core from Concentration B and two from Concentration C. Twelve of the 17 cores are prepared as Levallois cores. Of these 12 Levallois cores, seven are fashioned into récurrent Levallois cores with centripetal flake removals, another four are préférentiel Levallois cores also with centripetal negatives. Cores No. 12, 29, and 39 have their final central flake removed. Levallois core No. 39 also has a slightly utilized edge and resembles a proto-biface in many ways. The next five cores are very robust and largely centripetally worked, although one of No. 69's "faces" (unlike the other cores it is bifacial) is centripetally worked and the other has unidirectional flake removals. Piece No. 123 is the only core that is entirely worked unidirectionally with very long flakes removed from its body. Lastly, No. 61 is an unformed core.

69 Most of the cores (11 pieces) do not have platforms present, although two pieces have cortical platforms and one has a planar platform. The cross-sections and plan forms for the cores do not show a great deal of variety and instead are dominated by polygonal plan forms and hemi-spherical cross-sections.

ii. Raw material and condition

70 In simply observing the collections it would appear Ammorene II users continued to select largely local material, while the Ammorene I inhabitants used an extremely diverse array of material for the production of cores. However, while differences can be observed within the collections, inferences cannot be made due to the loose-natured collection methods.

71 *Ammorene II*: All but three cores are patinated at Ammorene II. Fourteen pieces have sharp edges or sharp edges with some damage present and one piece has lightly-used edges with damage present; the remaining two pieces have worn edges and worn edges that are slightly damaged.

iii. Unique pieces and summary

72 *Ammorene I*: Core No. 58 closely resembles a spheroid (or exhausted core) as it is very rotund and the negatives remaining on it are numerous and small. Piece No. 129 is the only core that has lateral retouch along one of its edges.

73 The IS shows the cores at Ammorene I to be consistently smaller than the large blanks used at Ammorene II, conversely both sites share wide blanks as their dominating IE measurement.

74 *Ammorene II*: Based on its utilized edges, No. 39 is the only core at this site with clear evidence that it was a core-tool.

75 While cores collected at Ammorene II are fashioned in high numbers from NPR and NBT, the variety of plan forms and cross-sections is far more diverse than what is seen in the same tools at Ammorene I. Derek Roe (Roe 2006: 330) notes that the “same rock types can be used to produce assemblages with quite different shape preferences.” In reviewing the collections, this is reflected at the Ammorene sites, where the wildly diverse material used at Ammorene I was used in creating far more similar plan forms than are expressed at Ammorene II.

B.3. Choppers and chopping-tools

76 These tools are made on cobbles, cores or large chunks or blocks of rock by removing flakes along a section of the material's perimeter. The trimming can be unifacial or bifacial, with multi-directional flaking of the working edges and rarely includes secondary trimming. This tool type category includes Mary Leakey's (Leakey 1971) unifacial and bifacial choppers, as well as side choppers, end choppers, end and side choppers, pointed choppers, and so forth.

77 *Ammorene I*: This site contains one chopping tool and one chopper. The former piece is large and crude, and it is hard to distinguish the patination from the cortex but the piece appears to be a possible primary flake on FAV source material. The distal end and one lateral edge on No. 33 have flake removals, with particular signs of heavy-use along the distal edge. No. 130 is made on a distinctively heavier unidentified geological material – the only such example of a lithic artifact made on this material in either collection.

78 *Ammorene II*: None present.

B.4. Proto-bifaces

79 The lithic tools collected at Ammorene I or Ammorene II considered to be proto-bifaces are directly related to the “roughouts” (e.g. Inizan et al. 1999: 154; Newcomer 1971: 85), “bifaces partiels” (Bordes 2005: 89) and “archaic handaxes” (e.g. Chavaillon

et al. 2004: 202) described in other contemporary archaeological literature. Like these pieces, proto-bifaces may still have an intact bulb of percussion and a limited number of negatives (generally less than 20); there may also be some cortex remaining and little to no body thinning. However, the lateral edges will be partially if not fully worked. In some cases, unifaces will appear similar to proto-bifaces but in this work are not counted as such because they must have some flake removal evident on both faces (either on the body or at the edges). Pieces considered to be proto-bifaces here have plan forms that are often similar if not parallel to those of handaxes or cleavers, with a defined tip (or cutting edge, for cleavers) region and a defined butt area. The butt area, in particular, may be left completely un-worked.

80 There are 11 proto-bifaces at Ammorene I, all of which were found and collected before the intense surveys that began in 2004. Ammorene II has 21 proto-bifaces, nearly twice as many of these stone tools as Ammorene I. The collection at Concentration A contained eight of the proto-bifaces, eight were found at Concentration B, three originated from Concentration C, and the last two were collected at Concentration D.

i. Technological features

81 *Ammorene I*: Over half of the proto-bifaces at Ammorene I were made on flake blanks, while two were made on cobbles and one piece was fashioned from a core (Fig. 10). Due to heavy patination two of the 11 proto-bifaces have indeterminate blank types. Additionally, two proto-bifaces from this site revealed planar remnant platforms, while one is faceted.

82 The amygdaloid to near-amygdaloid plan forms dominate, making up 45.5% of the proto-bifaces. Ovoid to near-ovoid plan forms make up slightly over a quarter of the proto-biface collection.

83 The collected proto-bifaces at Ammorene I are to some extent more modified than those at Ammorene II. In contrast to this, all the proto-bifaces at Ammorene II are worked bifacially, whereas at Ammorene I four pieces are unifacially worked.

84 In terms of the dominating edge modifications seen on the proto-bifaces at Ammorene I three pieces are unifacially worked on both lateral edges (type 9b, Fig. 7), another three have crude bifacial removals on two edges (type 2).

85 All the general modifications seen in the Ammorene I collection are centripetal with six of the 11 proto-bifaces having centripetal removals only on one face (the other face either having no removals or then sparse and irregular negatives).

86 *Ammorene II*: Over three-quarters of the proto-bifaces were made on flake blanks (Fig. 11). One piece was fashioned from an elongated flake and three were made on cobbles.

87 Six proto-bifaces have intact remnant platforms, two of which were planar and four of which were cortical. Most of the remaining proto-bifaces are missing their platforms.

88 In observing the plan forms and cross-sections of the proto-bifaces at Ammorene II it is evident that variety abounds. There were no pure ovoid or triad plan forms at Ammorene II. The percentage of amygdaloid to near-amygdaloid plan forms and near-ovoid plan forms that make up the proto-biface collection at Ammorene II almost perfectly parallels what is seen at Ammorene I with the same plan forms. Also similar to Ammorene I, although they are closely followed by other cross-section forms, is the dominance of amygdaloid to hemi-amygdaloid cross-sections at Ammorene II.

89 There is a great array of edge modifications seen in the proto-bifaces at Ammorene II. Simple bifacial edge reduction is seen on three pieces along both edges (type 2) and in three pieces solely along one edge (type 1). The bifacial edge reduction is also seen crudely along one edge of a piece, with the other edge thoroughly worked ventrally

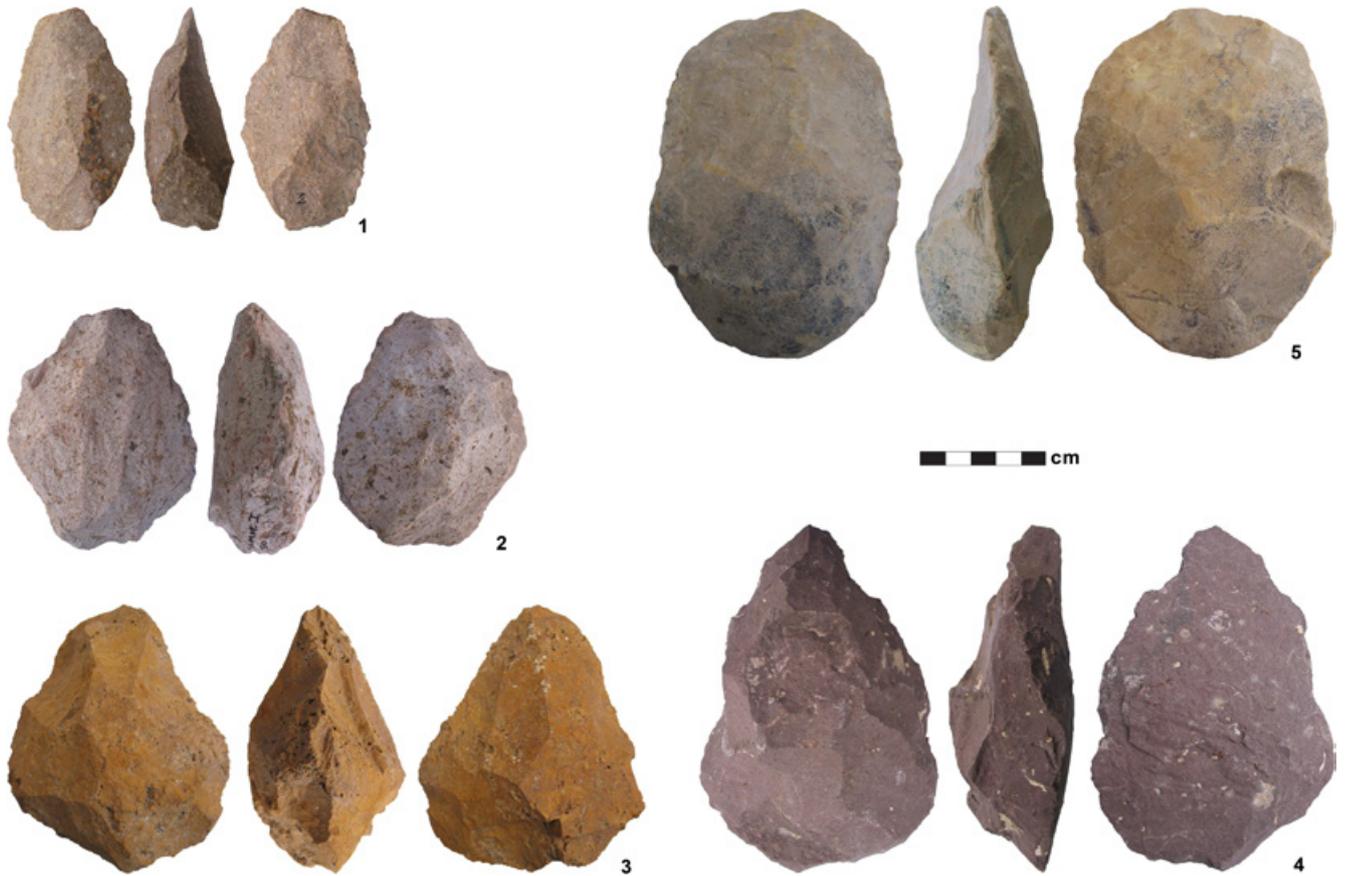


Fig. 10: 1. AmmI.2 proto-biface. 2. AmmI.50 proto-biface. 3. AmmI.9 proto-biface. 4. AmmI.15 uniface. 5. AmmI.37 proto-biface on a cobble (scale: 5 cm)

and dorsally (type 7). In three other pieces where the loose bifacial edge modification occurs again on one edge but the other edge has only unifacial reduction (type 3).

90 At Ammorene II the direction of negatives vary from piece to piece and from the ventral face to the dorsal face; there is one unidirectional proto-biface, two centripetal proto-bifaces, and the rest of the pieces have combinations of two to three, even to four (only in one case), negative removal directions.

ii. Raw material and condition

91 Over one third of the Ammorene I proto-bifaces are made on local material while the same material comprises three quarters of the same tool type at Ammorene II. Little to no fine-grained material (e.g. chalcedony, chert or chert-like stone) was used for the proto-bifaces at either site.

92 *Ammorene I*: In terms of body damage, the proto-biface collection is in very good condition at this site.

93 Six of the 11 proto-bifaces have no cortex remaining. No patination was so heavy as to obscure a proto-bifaces' surface. Aside from No. 2, all the proto-bifaces at this site reveal patination, particularly thick patination.

94 *Ammorene II*: There are more damaged and completely broken proto-bifaces in the Ammorene II collections than can be seen in Ammorene I's. While most pieces are complete, five pieces show damage to their ends.

95 Four proto-bifaces at Ammorene II have completely sharp edges and another four have worn edges. The remaining 13 pieces all show varying degrees of edge damage. Fourteen of the 21 proto-bifaces are without cortex. All but two pieces are patinated at Ammorene II.

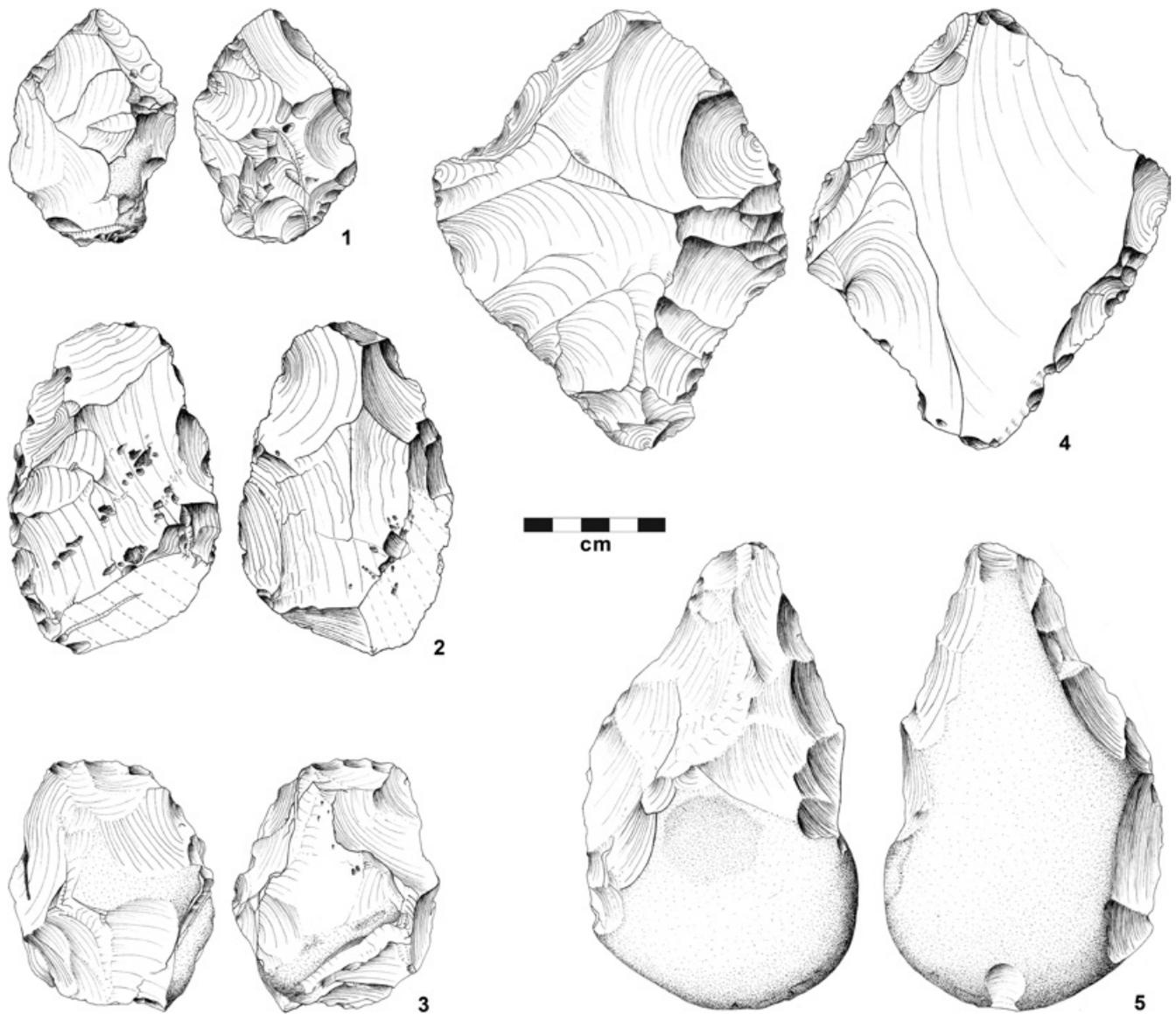


Fig. 11: 1. AmmII.3.A3 proto-biface. 2. AmmII.32.A32 proto-biface. 3. AmmII.58.A58 proto-biface on a cobble. 4. AmmII.13.A13 proto-biface. 5. AmmII.42.A42 proto-biface on a cobble (scale: 5 cm)

iii. Unique pieces and summary

96 *Ammorene I*: Proto-biface No. 9 has a very wide butt and has some features that also suggest it could be a core or a chopping-tool but the fact that it is so worked (yet not thinned), together with its plan form, strongly imply that it is a proto-biface. Proto-biface No. 50 is unique in that it has one face that was reduced in a unidirectional manner, it also appears as a small lageniform in plan view. In fact, proto-biface No. 50 along with Nos. 2 and 9 are all very petite in size and verge on being “diminutive” forms, with mean diameters of around 50 mm.

97 *Ammorene II*: Proto-biface Nos. 6 and 13 should probably be referred to as “proto-trifaces” as they are trihedral. Not only is No. 13 trihedral but it also has a square plan form with a straight, cleaver-like cutting edge. Proto-biface No. 63 also has a distal end that terminates into a fairly narrow but lateral, almost cleaver-like edge.

98 In most modified lithic categories, the pieces at Ammorene II are a great deal larger than those found at Ammorene I, this is not the case for the proto-bifaces from both sites. The Ammorene II proto-bifaces have mean dimensions that are only slightly larger than at Ammorene I but, ultimately, the differences are inconsequential.

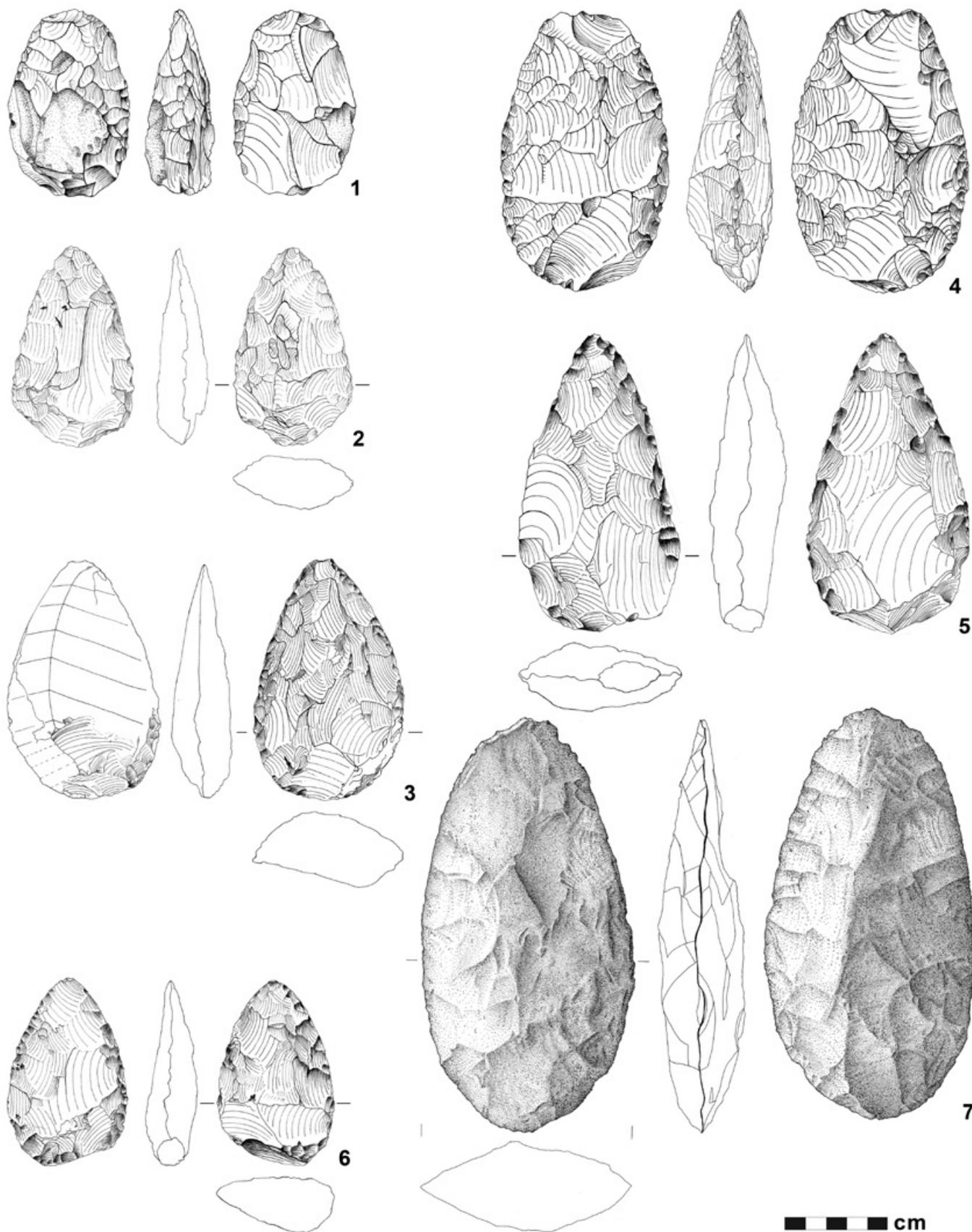


Fig. 12: AmmI.3 biface. 2. AmmI.4 biface. 3. AmmI.16 biface. 4. AmmI.32 biface. 5. AmmI.31 biface. 6. AmmI.120 biface 7. AmmI.27 biface (scale: 5 cm)

B.5. Handaxes

99 A lithic tool defined as a handaxe at Ammorene I or Ammorene II has the following physical features (features described and recognized by such members of the Paleolithic archaeology community as Ashton – McNabb 1993; Crompton – Gowlett 1993; Leakey 1971; Schick – Toth 1994; Wynn 1995):

- a long axis that usually exceeds 10 cm;
- in plan form a major plane that is bounded by the bifacial edge;
- approximate bilateral symmetry, around the major plane and generally around the cross-section/thickness plane;
- a tendency for both lateral edges to converge towards a tip, which is rounded (and rarely comes to a sharp point) with the other (butt) end more rounded and thicker;
- a lenticular cross-section is common but can in many cases have a variety of cross-sectional shapes;
- bifacially worked over most of the two faces to both thin and shape the piece.

100 Handaxes also include diminutive forms and those which have three facies (i.e. trihedral handaxes). Additionally, where proto-bifaces might represent the first stages of handaxe production (“roughing-out,” as termed by Newcomer 1971: 85) and possibly some elements of the second stage (“thinning and shaping”), handaxes, cleavers and picks include all aspects of the second stage of reduction as well as some, if not all, features of the third and final stage of reduction, known as “finishing.”

101 While the Ammorene I collection of tools has fewer proto-bifaces than Ammorene II, the reverse is true for the number of handaxes in each assemblage. With the exception of three handaxes (Nos. 119, 120, 123), nearly all of the 24 handaxes that are a part of Ammorene I's assemblage were collected before the thorough surveys that began in 2004. Ammorene II has 12 handaxes collected in 2004 or later and only two that were collected in 2003. Of the 14 handaxes from this site, five come from Concentration A, seven from Concentration B and one each from Concentrations C and D.

i. Technological features

102 *Ammorene I*: At this site the majority of handaxes are fashioned from flake blanks (Fig. 12). One handaxe is also made from an elongated flake while another comes from a core; the remaining five pieces have undetermined blank types.

103 More than half of these tools have no remnant platforms. If there are intact platforms, they are generally planar.

104 There is very little variety in the plan forms seen in the Ammorene I handaxe assemblage, with amygdaloid to near-amygdaloid plan forms prevailing. These plan forms are seen with a range of cross-sections but with amygdaloid cross-sections as the chief shape present

105 Most handaxes at Ammorene I and Ammorene II are either completely modified bifacially or at least partially modified bifacially. One exception at Ammorene II is No. 83, which is only worked bifacially along its edges. Another two pieces at Ammorene I are the only two pieces from both sites that are predominantly worked unifacially but still classified as handaxes due to the quality of the reduction.

106 The most prevalent edge modification seen in the handaxes at Ammorene I is the crude alternating strikes along two edges (type 2); this was prevalent in 13 pieces, with another three pieces having simple bifacial removals along only one edge (type 1).

107 Eighteen of the 24 handaxes at Ammorene I are modified through bifacial flaking in a centripetal direction; another five handaxes also have centripetal flake removals but they are largely concentrated on a single face.

108 *Ammorene II*: All the handaxes at this site, aside from one (undetermined), are made from flake blanks (Fig. 13).

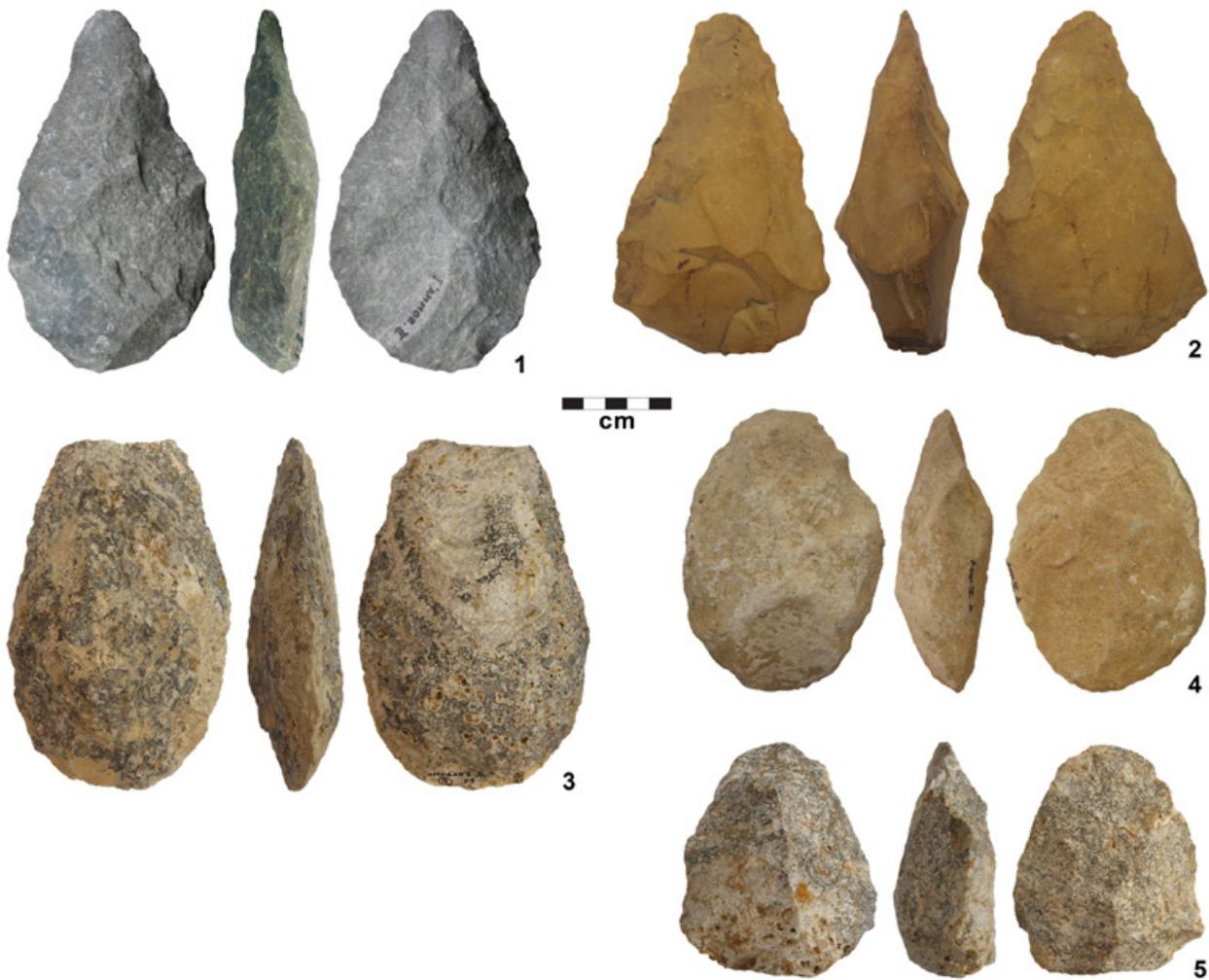


Fig. 13: 1. AmmII.27.A27 biface. 2. AmmII.70.B1 biface. 3. AmmII.78.B9 biface. 4. AmmII.130.D2 biface. 5. AmmII.80.B11 trihedral biface (scale: 5 cm)

109 Like Ammorene I's handaxe assemblage, over half of the handaxes at Ammorene II have no platforms. Two handaxes have planar platforms and one has no remnant platform as it was made on a cobble.

110 The dominant plan forms at Ammorene II are amygdaloid to near-amygdaloid and triad to near-triad. The amygdaloid to near-amygdaloid forms show the greatest diversity in their cross-sections; it seems that while their lateral edges may have been shaped in similar fashions, their bodies were not thinned in one particular style - creating an array of cross-section shapes. Spherical and/or lenticular cross-sections make up slightly more than one-quarter of the cross-section styles, closely followed by concavo-convex types.

111 Like the proto-bifaces from this site, the handaxes show an array of edge modifications within the assemblage. Four pieces have simple bifacial reduction along one of their edges, and the other edge is intensely worked bifacially (two pieces; type 7) or unifacially (type 3).

112 Thirteen of the 14 handaxes at Ammorene II are modified through bifacial flaking in a centripetal direction. The fourteenth handaxe, No. 79, is extremely unique (in terms of the direction of negatives seen in the handaxes of both Ammorene sites) in that it is the only piece that does not have centripetal negatives, instead it has uni-directional negative removals on both faces.

ii. Raw material and condition

113 The raw material trends for the handaxes at Ammorene I and Ammorene II are very similar to that of the proto-bifaces from these same two sites. At Ammorene II the dominant raw material used in handaxe production is the local NPR and NBT (there are no handaxes or proto-bifaces made from FAV at Ammorene II), whereas only one-quarter of the handaxe collection at Ammorene I is made upon the local raw material. There is a complete absence of fine-grained material for the handaxes at Ammorene II but the tool-makers at Ammorene I did make use of chert and chert-like material for some of their handaxes (although the site has only one proto-biface made from a fine-grained lithic material). As with the proto-bifaces at Ammorene I, several of the handaxes at this site were fashioned from basalt and limestone - materials which are void in the proto-biface and handaxe assemblages of Ammorene II.

114 Ammorene I: In observing the body damage present in the handaxes from this site, 18 pieces are in fact complete.

115 Three-quarters of the handaxes at this site have no cortex remaining while five pieces have 0-33% cortex present on their bodies. Except for two pieces, all handaxes from Ammorene I are patinated.

116 Ammorene II: Eight pieces are entirely complete and undamaged at Ammorene II. There is no cortex on 12 handaxes at Ammorene II; the remaining two pieces have their natural surfaces heavily obscured by patina.

iii. Unique pieces and summary

117 It is hard to say for certain whether the handaxe forms found at Ammorene I and Ammorene II were the desired outcomes of conscious or subconscious choices made by the tool-makers but current research suggests that raw material choice and reduction intensity clearly affect the frequency of form types (e.g. Ashton – McNabb 1993; McPherron 1995, 2006). Additionally, the more extensively a tool type is worked and finished the higher the chances of form overlap (Healy 1993). The variety of material found at the Ammorene sites, especially at Ammorene I, may explain why there is a varied spectrum of biface plan forms present at each site, but the amount of reduction may explain why there are similarities.

118 The bifaces highlighted in Fig. 14 include proto-bifaces, handaxes, cleavers, and picks. Even when the proto-bifaces are removed from the plan form count: the same plan forms are present; the same plan forms dominate in each collection and the arrangement of numerically most popular to numerically least popular plan forms is unchanged.

<i>Plan form shapes</i>	<i>Ammorene I no.</i>	<i>Ammorene I %</i>	<i>Ammorene II no.</i>	<i>Ammorene II %</i>
Amygdaloid or near-amydaloid	24	63.16	16	40
Ovoid or near-ovoid	8	21.05	8	20
Quadrilateral	4	10.53	6	15
Triad or near-triad	2	5.26	6	15
Polygonal	0	0	4	10
TOTAL	38	100	40	100

Fig. 14: Proto-biface and biface plan form frequencies

119 *Ammorene I*: The plan forms at Ammorene I are overwhelming “classical” Acheulean forms (Ashton – McNabb 1993: 183) - revolving around amygdaloid (which includes pointed forms) and ovoid plan form varieties. The more “non-classical” plan forms such as bulky quadrilateral shapes are hardly represented and polygons are entirely missing.

120 The similarity of plan forms may not only be attributed to the level of reduction but also to the method of reduction. Several Ammorene I handaxes, such as Nos. 4 and 27, show evidence along their edges for the successful implementation of the soft-hammer technique. The sharp, fine edges of these handaxes which have extensive small flake removals, are not present to the same extent upon handaxes at Ammorene II.

121 *Ammorene II*: Similar to other well-documented Moroccan sites, like Casablanca's S.T.I.C. Quarry and the Cave of Bears, magmatic material, high in quartz minerals, is the overwhelming material of choice at the Ammorene sites, especially for tools and within the entire Ammorene II assemblage. The large presence of fine-grained gneissose rocks, and to a lesser extent basalts and miscellaneous igneous rocks, served as important contributing factors to both assemblages' variability.

B.6. Cleavers

122 Cleavers are similar to handaxes in bifacial features, albeit without rounded or pointed tips. In line with Tixier's (Tixier 1956) definition, cleavers are recognized at Ammorene I and Ammorene II as tools made on large flakes, and are shaped by retouch along their sides, with a wide, unretouched distal cutting edge.

123 *Ammorene I*: The three bifacial cleavers (Nos. 23, 40, 118) at Ammorene I are made on flake blanks and all are complete except for No. 118 which is broken orthogonally. The quadrilateral plan form and the large-sized blank form, the latter attributed to the IS, dominate the cleaver types found at this site. The cross-sections vary from piece to piece, from quadrilateral (No. 23), to 's'-shaped (No. 40), to plano-convex (No. 118).

124 *Ammorene II*: This assemblage contains three complete cleavers (Nos. 10, 23, 64) that are all made from NPR and, in line with the IS, measure as very large blanks (Fig. 15). A fourth cleaver is broken distally (No. 40). All four pieces are part of Concentration A, weigh over 300 g and have quadrilateral plan forms (making this plan form the dominant type at both Ammorene sites). The cross-sections vary like those at Ammorene I. Piece No. 10 is perhaps the best example of a cleaver from both sites, it has a well-defined tranchet flake removed from its dorsal face, to create the thin distal, horizontal cutting edge. It also features a unique modification where the left lateral edge was worked, the piece was flipped over, and then the left lateral edge was worked on the second face (type 8). Cleaver No. 64 is distinctive in that it is pointed and trifacial (e.g. has a trihedral cross-section) at its proximal end and thins out to be bifacial and blunted at its distal end. The lateral edges of No. 64 show no damage or clear reduction attempts aside from one massive flake removal that extends almost the entire length of the piece and probably served to radically reduce the thickness of the tool's distal half.

B.7. Picks

125 Like handaxes and cleavers, picks are a third type of tool that is a subcategory of bifaces, although they are often "trifacial." Picks are defined as being fairly thick, with a pronounced dorsal ridge and with fat, often triangular, cross-sections (Wynn 1995). For picks, Toth and Schick (Schick – Toth 1994: 232) note that "there tends to be less emphasis than with handaxes on creating sharp cutting edges at the tip ends, which instead usually form thick, triangular points."

126 *Ammorene I*: None present.

127 *Ammorene II*: Piece No. 28 is the only pick at Ammorene II and originates from Concentration A (Fig. 15). The piece is fashioned from an igneous (possibly basalt) flake blank and measures 123.8 x 72.8 x 47.9 mm and weighs more than 300 g. The piece is amygdaloid in plan form but has a very distinct ridgeline on one of the faces that makes the piece slightly trihedral instead of purely bifacial. The dominant modifications to the

piece are seen in its edge reduction; more specifically, it has one lateral edge that was struck along its left side and then the piece was flipped over and again struck only on its left lateral edge (type 8). The remnant platform is not present and there is no cortex remaining on the pick. The piece is unbroken with thick patchy patina and edges that are worn but undamaged.

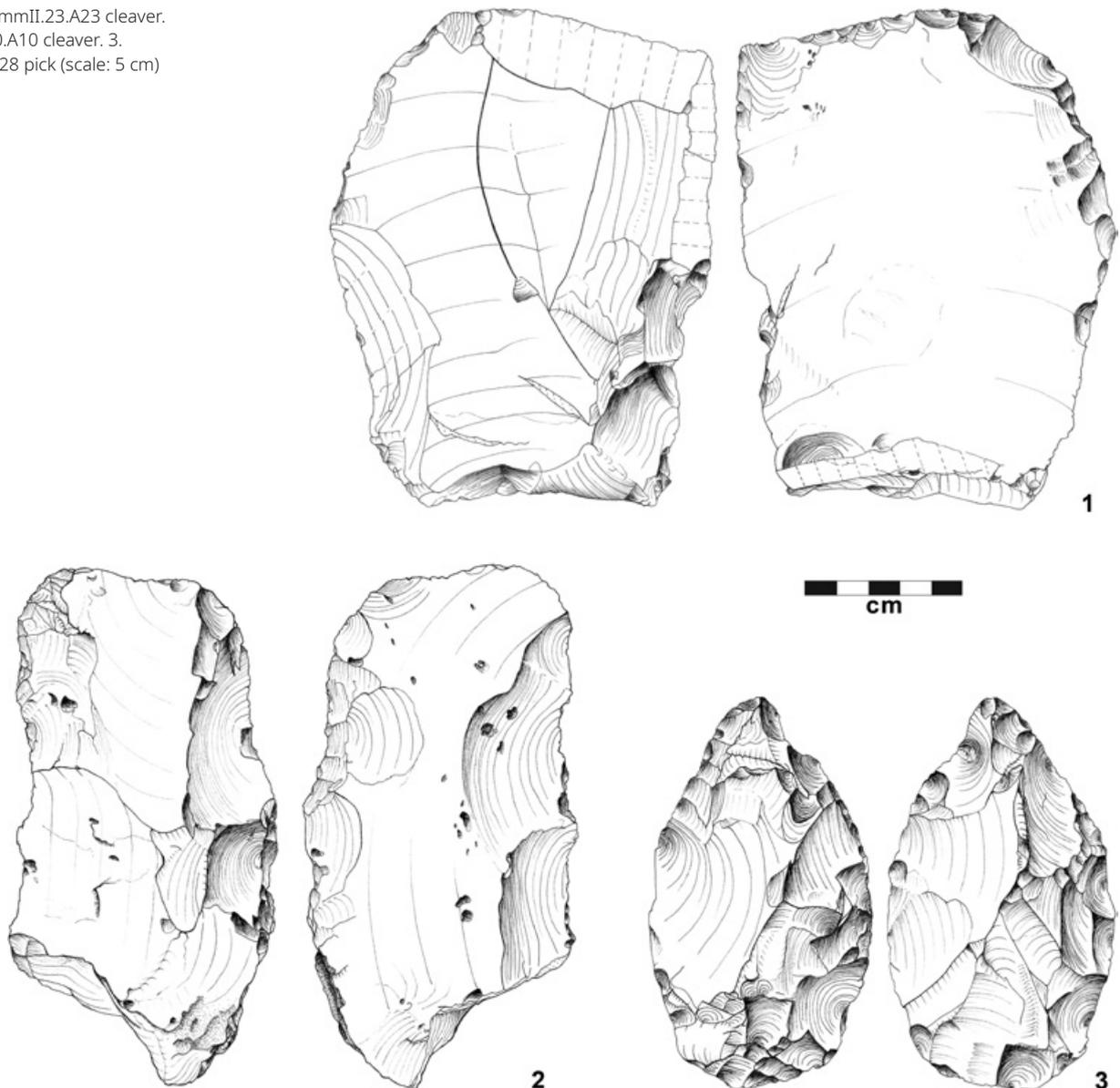
C. Other lithic artifacts

C.1. Intermediate artifacts

128 There are a number of pieces at both sites that do not clearly fit into one category or another and seem to be intermediate or “cross-over” pieces, where they illicit some characteristics that can be seen both in one lithic artifact form and in another form, e.g. core/scrapper, uniface/chopper. These pieces are clear “links” along the chaîne opératoire, or behavioral chain. As links in the behavioral chain, the intermediate lithic artifacts help delineate the sequence which transforms an unformed piece of raw material into a finished cultural product.

129 *Ammorene I*: There are seven intermediate pieces at Ammorene I: Nos. 13, 18, 19, 63, 121, 124, and 125. The first four pieces are tool variants: a Levallois core/chopping-tool, flake/laterally retouched flake (broken proximally and distally), trihedral

Fig. 15: 1. AmmII.23.A23 cleaver.
2. AmmII.10.A10 cleaver. 3.
AmmII.28.A28 pick (scale: 5 cm)



uniface/lageniform pick, and a uniface/chopper. The remaining three pieces may not even be modified but could instead be ecofacts. Because their true nature as artifacts, specifically a uniface, exhausted core and scraper, is not wholly supported, they are placed here in the intermediate artifact category.

130 Additionally, except for two pieces, all of the pieces do not have any cortex present and the trihedral uniface/lageniform pick (No. 19) is the only piece that has a remnant platform (planar) present.

131 *Ammorene II*: Nos. 21, 81 and 85 are considered as intermediate pieces at Ammorene II. Each of these three lithic artifacts is either considered to be between a uniface or a Levallois core (No. 21), or a pick (No. 81) or merely an ULA (No. 85). The first piece originates from Concentration A and the latter two are from Concentration B. All three pieces have thick patchy patina on their surfaces, making it even more difficult to discern the nature of their modifications. The pieces also all have no cortex present and only one piece (No. 81) has a remnant platform (planar).

C.2. Unifaces

132 Unifaces are lithic artifacts that have been modified solely on one face, either on the body, the edge or a combination of both. Unifaces are generally made on flakes but can be found on chunks or cobbles.

133 *Ammorene I*: This site has three unifaces made on flakes: Nos. 39, 62 and 122. Uniface No. 39 may possibly have two bulbs of percussion and No. 62 has evidence of retouch along one edge and has a planar remnant platform. All three pieces do not have any cortex present, are patinated and are not broken.

134 *Ammorene II*: There are ten unifaces at Ammorene II: Nos. 7, 11, 20, 31, 37, 43, 66, 82, 89, and 107. All the pieces are made on flake blanks and Nos. 11 and 66 have unique plan forms, they are respectively naviform and lageniform. Five of the unifaces do not have platforms remaining, one (No. 89) has a planar platform and the remaining four unifaces have undetermined platforms. Four unifaces have no cortex remaining and one has 0-33% cortex present. In line with the massive flake sizes seen at Ammorene II, all the unifaces weigh over 300 g except for Nos. 7 and 107.

C.3. Bolas

135 *Ammorene I*: Not present.

136 *Ammorene II*: In 2005, at Concentration A of Ammorene II, it is of note to mention a unique lithic was collected, which strongly resembles a bola (Fig. 16). It is hard to confirm because it is made from a substandard variety of the NBT and it is unclear whether its poor surface texture is because it is still corticated or if it is simply heavily eroded and weathered. Details that suggest it is a true bola are what appear to



Fig. 16: Single bola from Ammorene II (Concentration A, No. 68) (scale: 5 cm)

be pecking marks across the surface of the piece and concentrated in particular areas; two to three very small sections also appear to be smoothed. The piece is near perfectly rounded at 106 x 95 x 95 mm and weighs more than 300 g. It is in very good condition - unbroken and unchipped - and is patinated with thick patchy patina.

C.4. Ecofacts

137 All lithic pieces that appeared at first glance to be manipulated by human hand were collected at both sites. Upon further inspection of the material from the Ammorene assemblages it is clear that four pieces from Ammorene I are, in fact, ecofacts: Nos. 1, 64, 74, and 115. There were no clear ecofacts found at Ammorene II. However, there are some pieces listed in the intermediate artifact category (for both sites), which are not clearly ecofacts, nor assuredly classifiable as artifacts.

VI. Discussion and conclusion

a. Relative dates

138 While obtaining definite, calibrated dates for the Ammorene sites may not be possible, it is possible to define the collections as Acheulean. To establish what part of the Acheulean these pieces belong to is, however, more challenging.

139 It must first be remarked that the collected artifacts from both Ammorene sites are unique in they appear to share technological features found in both European and African Acheulean sites. This is often the case with North African Acheulean sites (Biberson 1956). In the Ammorene assemblages we see artifacts largely manufactured from large flake blanks, similar to those in East and South Africa, instead of the more European preference for flint nodules and cobbles. The Ammorene inhabitants also exploited an array of material, employed various knapping techniques and created diverse tool forms, all of which are also largely characteristic of African Acheulean assemblages. Contrary to the aforementioned features is the fact that the biface collections from the Ammorene sites contain only a small number of cleavers which is also true for European sites, especially those which exist beyond Spain.

140 The bifaces (i.e. proto-bifaces, handaxes, cleavers, and picks) present in both Ammorene assemblages clearly place these two sites in the Lower Paleolithic as members of Acheulean industries. Even considering the tenet, now largely deemed defunct, that a collection can only be defined as Acheulean if 40% or more of the tools are bifacially worked (see Kleindienst 1961; Leakey 1971) serves to staunchly place the Ammorene I (with 58.5% bifacial tools) and Ammorene II (with 52.6% bifacial tools) assemblages within the Acheulean. Another important Acheulean industry marker that is present at both sites is the cleaver, which is a tool that is almost exclusively confined to the Acheulean and is only on very rare occasions documented in the Middle Paleolithic (Inizan et al. 1999).

141 If the Ammorene assemblages can safely be categorized as Acheulean industries, where in the spectrum of the Acheulean continuum can they be placed?

142 This is not a question we can presently definitively answer with a solid date but in considering some simple relevant markers that are extant at the Ammorene sites we can obtain an idea of where each site sits within the Acheulean.

143 *Ammorene I:*

Middle Acheulean evidence:

- The collection rarely contains or does not contain the following pieces, which are prominent in the Late Acheulean and in some cases in the Mousterian: scrapers and other fine flake tools, pieces with edge re-sharpening, blades or bladelets, denticulates,

Micoquian handaxe forms (handaxe No. 54 comes closest to resembling the Micoquian plan form), bifaces and tools from the Mousterian of Acheulean tradition.

- The bifaces have limited trimming and the majority do not reflect idealized symmetrical plan forms, both of which are strongly reflected within Late Acheulean and Mousterian assemblages.

Late Acheulean evidence:

- There are no picks in the collection.
- The Levallois Method is regularly employed.
- The bifaces are slightly smaller and more standardized in shape than those found at Ammorene II, and several (e.g. Nos. 4, 27, 120) appear to have been refined using the soft-hammer reduction technique.

¹⁴⁴ *Ammorene II:*

Middle Acheulean evidence:

- The collection rarely contains or does not contain the following pieces, which are prominent in the late Acheulean and in the Mousterian: scrapers and other fine flake tools, pieces with edge-resharpening, blades or bladelets, denticulates, Micoquian handaxe forms, bifaces and tools from the Mousterian of Acheulean Tradition.
- The bifaces have limited trimming and the majority do not reflect idealized symmetrical plan forms, both of which are strongly reflected within Late Acheulean and Mousterian assemblages.
- The site contains a pick, which is classed as a typically Early to Middle Acheulean tool (e.g. Bordes 2005; Schick – Toth 1994), although it can be seen in some Late Acheulean assemblages.

Late Acheulean evidence:

- The Levallois Method is regularly employed.
- The site contains a bola which can be seen at particular Middle and Late Acheulean sites in Africa (e.g. Chavaillon – Lavallée 1988), although it is more regular in the terminal Acheulean and into the Mousterian (Chavaillon et al. 1979; Bordes 2005).

¹⁴⁵ Comparing the lithic collections from the Ammorene sites to those assemblages belonging to vast and well-documented sites in East Africa, such as Melka-Kunturé (Ethiopia) does not help in placing the Ammorene sites chronologically. In describing cultural markers that were present for each period at Melka-Kunturé, Chavaillon et al. (Chavaillon et al. 1979: 108) characterize the Middle Acheulean as having more diversified tools than from the previous periods with an increase in the number of handaxes, cleavers and end-scrapers. By the Late Acheulean a “new factor” is introduced at the site, the choice of site-location, independent of raw material sources. The authors go on to describe this period at Melka-Kunturé as having cleavers and handaxes outnumbering the remaining tools and which have “forms standardized to the point of monotony... New types, such as small bifacial pieces and bolas appear.” In the Final Acheulean, the Levallois technique appears and the number of cleavers and handaxes decreases, with an increase in small bifacial pieces.

¹⁴⁶ The Ammorene sites appear to have features that are present in the Middle Acheulean and the Final Acheulean at Melka-Kunturé; they do not seem to have been selected independently of their proximity to raw material sources as was the case for Late Acheulean sites at Melka-Kunturé, nor do they express “monotonous” form standardization in their tools.

¹⁴⁷ A more helpful site to observe technological trends and compare the Ammorene sites with is, of course, Sidi Abderrahmane in Morocco. At the base of Sidi Abderrahmane's Tyrrhenian deposits (ca. 260,000 years ago) in the Cave of Bears, Arambourg and Biberson (Biberson 1956: 475-476) described an assemblage of very large, worked flakes, with hard-hammer removals and some retouch as belonging to a Proto-Levallois Middle Acheulean. As one slowly progresses up through the layers in the Cave of Bears

the soft-hammer technique becomes employed alongside the hard-hammer technique and the bifaces become thinner, flatter, the edges more straight, and the forms more regular. These latter tools are what seem very similar to those at the Ammorene sites, especially when Arambourg and Biberson carry on in their description of the assemblage:

“With bifaces are associated unifacial tools on large flakes whose workmanship testifies to the abandonment of the Proto-Levallois technique... with smooth striking platform... Cleavers become rarer when specialized tools like the side-scraper (still often bifacial) make their appearance. One finds here a Middle Acheulean still little refined, but which becomes perfected in the upper levels, to terminate in an evolved Acheulean horizon...”

148 The content of this late Middle Acheulean or early “evolved” Acheulean which is described sounds very similar to what is contained in the collections of Ammorene I and II.

b. Site usage

149 The preeminent factor(s) that drove prehistoric people to select Ammorene I and Ammorene II for use, and the type and duration of this use, remains ambiguous. It does seem fairly clear that the proximity to freshwater resources, the ocean and suitable local lithic raw material were significant motivators, if not the decisive agents, in selecting these sites.

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ZUSAMMENFASSUNG

Acheulean in the Rif Mountains

Bifaces and other stone tools from the open air sites of Ammorene I and Ammorene II
M. Deva Jebb-Albaba

Dieses Paper fasst die Ergebnisse der Surveyfunde zusammen, die von 1998 bis 2007 von der Kommission für Archäologie Außereuropäischer Kulturen des Deutschen Archäologischen Instituts und des Institut National des Sciences de l'Archéologie et du Patrimoine in Ammorene I und Ammorene II durchgeführt wurden. Die stark gestörten Fundstellen liegen in 8 km Entfernung zum Mittelmeer, in der Nähe von Nador. Sie verfügen über lithische Rohstoffquellen, die weniger als 3 km entfernt sind und von den Bewohnern beider Fundstätten genutzt wurden. Die lithische Analyse zeigt, dass über 50% der modifizierten Stücke, die von jeder Assemblage gesammelt wurden, *proto-biface* oder *biface* sind. Artefakte aus den Mittel- und Spätacheuléen sind an jeder Fundstelle vorhanden, obwohl die Assemblagen bei Ammorene II technisch-morphologisch etwas älter als die Lithologische Sammlung von Ammorene I zu sein scheint. Angesichts der begrenzten Anzahl solch reicher Fundstätten des unteren Paläolithikums in Nordafrika und der Tatsache, dass diese Fundstätten für den Nordosten Marokkos noch seltener sind, trägt die hier vorgestellte Forschung dazu bei, unsere Kenntnisse über das Paläolithikum des Maghreb zu vertiefen.

SCHLAGWORTE

Faustkeil, Acheuléen, Jungpaläolithikum, Steinindustrie, Maghreb, Rif-Gebirge

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