TOOL INDUSTRIES OF THE EUROPEAN PALEOLITHIC: INSIGHTS INTO HOMINID EVOLUTION AND SHIFTS IN ARCHAEOLOGICAL THEORY AND PRACTICE FROM THE JAMES B. BULLITT COLLECTION

by
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ABSTRACT

From early archaeological excavation in the nineteenth and twentieth centuries to modern conceptions of Paleolithic stone tool evolution, radiometric dating techniques and studies of paleoenvironment have revolutionized the study of relationships and divisions between these different lithic industries. In addition, there has been a shift from the formal to the functional approach when categorizing lithic industries through time. This project aims to examine how lithic industries in France changed through the Paleolithic and early Neolithic using a curated sample from Dr. James B. Bullitt's contribution to the North Carolina Archaeological Collection. Early and contemporary archaeological literature about early stone tools are compared and connected to broad theoretical shifts in the field since the 1800s. Because many artifacts in the Collection are used as teaching aids, it is hoped that this project provides insight into the value of the Collection to the study of about Paleolithic hominid evolution.

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I would first like to thank my advisor and thesis committee chair Dr. Davis: without his diligent guidance and investment of time, this project truly would not have been possible. Furthermore, the James B. Bullitt Collection and larger North Carolina Archeological Collection would not be in the incredibly organized and accessible state they are today without Dr. Davis' tireless work. I would also like to thank Dr. Steponaitis for both helpful input and incredible enthusiasm regarding the utility of this thesis project for teaching purposes and advice on integrating artifact analyses. And, I wish to thank Dr. Tomášková for input and particular expertise on the theoretical debates surrounding Paleolithic archaeology. I reiterate special thanks to my entire committee, all of whom were incredibly supportive, excited, and most of all challenged me to think critically and engage with the discipline in a productive way.

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CHAPTER 1
INTRODUCTION

Understanding hominid evolution through the Paleolithic era has been one of the highest priorities in archaeology since the discipline's early conception (van Andel et al. 2003; Bennett 1943; Binford 1985; Breuil 1913). Some of the most rapid and significant changes in the history of human evolution occurred during the Paleolithic, and thus understanding these changes in a spatial, temporal, and behavioral context is of paramount importance to the discipline (Bordes 1961a: 803). Within the past three decades, modern archaeology has revolutionized the study of Paleolithic hominid evolution by drawing upon techniques from the fields of paleoclimatology and isotope geochemistry to reevaluate the spatiotemporal placement of archaeological sites and understand them in the broader context of their paleoenvironment (van Andel et al. 2003: 31-33). In doing so, we now know much more about the lives of our ancestors, their culture, subsistence strategies, and interbreeding between hominid species.

One of the central themes of this project is to examine how the study of Paleolithic archaeology in France has changed from archaeological excavations in the nineteenth and early twentieth centuries to modern conceptions of stone tool evolution. Artifacts from 10 French sites, 511 in total, were chosen for study from the James B. Bullitt Collection, part of the UNC Research Laboratories of Archaeology's (RLA) North Carolina Archaeological Collection. In order to make connections with broader theoretical shifts within the field of archaeology, early and modern archaeological literature on stone tool evolution at these sites was compared with the artifacts present in the Bullitt Collection. The sites are discussed in Marine Isotope Stage (MIS) chronological order within divisions of the Lower, Middle, Upper Paleolithic, and Neolithic eras to clarify the linkages between important developments in hominid evolution and how these developments have been studied throughout the history of archaeology as a discipline.

The Bullitt Collection comprises 1,765 artifacts from important Paleolithic and Neolithic archaeological sites in Europe (Appendix A). These artifacts were brought to North Carolina by Dr. James B. Bullitt, a professor of histology and pathology at UNC School of Medicine from 1913–1947. He was also an amateur archaeologist with a great interest in the Paleolithic and briefly served as director of the RLA in its early days, as well as being a member of the North Carolina Archeological Society. Dr. Bullitt took an extended trip to Europe from December 3, 1928 to August 5, 1929 during a sabbatical from UNC School of Medicine. As detailed in his travel journal, Dr. Bullitt interacted with members of the Prehistoric Society of England, several influential scholars in French archaeology like Abbé Henri Breuil, and a well-connected and independently wealthy couple, Mr. and Mrs. Harper Kelley (Bullitt 1928–1929).

While virtually unheard of today, in the early 1900s it was still very assessible for wealthy, high-status individuals like Dr. Bullitt to obtain artifacts from archaeological sites, museums, and even private collections. The Bullitt Collection is therefore a representative collection, meaning that the artifacts were gifted to or purchased by Dr. Bullitt from private collectors, excavators, professors, and museums (Bullitt 1928–1929). Therefore, the artifacts are not associated with their archaeological context, so many of the sites represented in the Collection contain a mixture of artifacts from different excavation levels and cultural periods. The localities Dr. Bullitt visited during the late 1920s were already some of the most important and high-profile excavation projects in France, and were predominantly located in either open gravel pits or rock shelters along river terraces (Bullitt 1928–1929).

During the late nineteenth and early twentieth centuries, French archaeologists were primarily concerned with categorizing the lithic industries of Europe based on their morphological appearance and relative stratigraphic position (Antoine et al. 2015: 340-41). There was little consideration of the ecological or archaeological evidence surrounding the artifacts, despite the fact that many were found alongside hominid skeletal remains, faunal remains, and even cave art in the case of Upper Paleolithic and Neolithic sites (Bennett 1943: 208). The work of French archaeologist Abbé Henri Breuil, famous for his stratigraphic and typological categorization of Upper Paleolithic lithics and art, is an example of the formal approach to studying lithics. His volumes are filled with countless detailed sketches of the artifacts he unearthed during his long career (Breuil 1913; Smith 1962: 202). However, by the 1940s, archaeologists began to critique these early theoretical frameworks and demand a more broad and all-encompassing discussion of the behavioral implications of Paleolithic artifacts (Bennett 1943: 208-210).

As processual archaeology began to take root in the latter half of the twentieth century, important figures like Lewis Binford offered an alternative to the formal approach of archaeological interpretation. Binford (1962: 223-224) argued the study of artifact morphology could be expanded in ways that would shed light on processes in culture, migration, and lifeways of past people. Through several publications in the 1970s, Binford and another prominent archaeologist, François Bordes, engaged in a dialogue regarding the interpretation of morphologically categorized Paleolithic tools (Binford 1973; Bordes 1961b; Bordes and de Sonneville-Bordes 1970). Specifically, while they agreed upon what constituted the different tool categories, they disagreed on how to interpret different frequencies of these tools in a given assemblage. Binford held the position that tool use, the actual activities being performed with the tools, contributed most to the frequency of a tool type in an assemblage (Binford 1973; Tomáŝková 2005: 82). Bordes, however, concluded that frequency variation in an artifact assemblage can instead be explained by a diversity of groups with different cultural adaptations creating tools to fit those behavioral needs (Bordes 1961b; Tomáŝková 2005: 82).

In the 1980s, French archaeologists made a contribution to this debate by introducing the concept of the *chaîne opératoire*, a term that refers to focusing on the different stages of tool production rather than just the morphology and use of the final product (Sellet 1993: 106). Borrowed originally from cultural anthropology and conceptualized by André Leroi-Gourhan (Bar-Yosef and Van Peer 2009: 104), the *chaîne opératoire* considers raw material procurement, tool production, tool use, and discard to be steps in an adaptive cultural response to the needs of a particular group (Sellet 1993: 110). However, critics of the concept argue it is too subjective since identifying the intentions and goals of prehistoric flintknappers, including the desired end products of lithic sequences, is impossible (Bar-Yosef and Van Peer 2009: 108).

In contemporary archaeological research, those artifact-centered approaches are placed in dialogue with an understanding of climate and ecological environment through isotopic analysis and radiometric dating, giving archaeologists a more complete picture of prehistoric ecology. For the Paleolithic in particular, this is of extreme importance. We now know the rapidly changing environment in Paleolithic Europe had enormous consequences for settlement distribution (Olsen 1989: 296-298), hunting strategies (Bordes 1961a: 809), and may have even affected species admixture in the case of *Homo sapiens* and *Homo neanderthalensis* (Stewart and Stringer 2012: 1319-1321). Therefore, it is difficult to claim an understanding of the lithic industries of the Paleolithic without understanding their significance to culture and environment. This is the basis for the modern functional approach to archaeological interpretation.

In recent years, new techniques for radiometrically dating Paleolithic sites have allowed for a better understanding of the succession of tool industries and hominid species that once inhabited these areas (Antoine et al. 2015; Antoine et al. 2016; Schwarcz and Grün 1988). In France, the lithic material available for dating is best suited for Electron Spin Resonance (ESR) and Thermoluminescence (TL) dating. Additionally, Upper Paleolithic and Neolithic sites are young enough in age for accurate radiocarbon dating (Bourrillon et al. 2018; Pétillon 2016). Many recent chronostratigraphic studies use ESR dating of igneous rocks or archaeological materials like tooth enamel (Grün and Stringer 1991). ESR dating is particularly useful because of its wide variety of applications, ranging from precipitated materials such as carbonates to igneous minerals that have been heated or recrystallized.

Tooth enamel is common in many archaeological sites and consists of more than 96% of the mineral hydroxyapatite (Grün and Stringer 1991: 155). Because hydroxyapatite records the radioactivity of the sample and its environment from the time the tooth was buried, this allows the enamel to be used as a dosimeter. Hydroxyapatite has two different energy states where its electrons exist: the valence band, called the ground state, and the conduction band, known as excited state (Grün and Stringer 1991: 155). When a tooth is formed, all electrons are in the ground state, but due to radioactivity, electrons are then transferred to the excited state (Grün and Stringer 1991: 155–156). However, hydroxyapatite has impurities that trap these electrons at intermediate energy levels. Peaks in the ESR signal are proportional to the number of traps in a mineral, the dose rate of radioactivity, and most importantly to the time of irradiation, which gives the age (Grün and Stringer 1991: 156). Like ESR dating, TL dating of burned flint also measures accumulated radiation dose. However, TL dating is specific to crystalline materials that have been heated to well above Earth surface temperatures, which consequently have reactivity that emits a weak but detectable light signal (Frouin et al. 2017: 36).

Archaeologists and paleoclimatologists use Marine Isotope Stages (MIS) to define chronostratigraphic layers in rock. These stages are based upon eustatic sea-level and global climate conditions that are common and detectable in stratigraphic sequences, usually through analysis of stable oxygen isotope ratios and fossil assemblages (Skinner and Shackleton 2005: 571–72). This thesis considers the entire time span of hominid settlement in France from the Lower Paleolithic site of Abbeville (Antoine et al. 2015: 95) to the Neolithic site of Grand Pressigny (Figure 1), and across a varied geographic distribution (Figure 2) (Linton 2014: 235-236). The Paleolithic is a period of prehistory that is characterized by stone tool production by hominid species, and roughly spans the Pleistocene epoch of geologic time (MIS 2–MIS 104) (Ehlers and Gibbard 2007: 17). According to the International Committee on Stratigraphy, which regularly updates and publishes the International Chronostratigraphic Chart, the Pleistocene epoch is 2.58 Ma–11.7 ka, and the Holocene epoch is 11.7 ka –present (International Chronostratigraphic Chart 2019). However, it should be noted that in Europe, the earliest occupations have only been dated to the Lower Paleolithic site of Abbeville at 600 ± 90 ka (MIS 15) (Antoine et al. 2015: 93). Additionally, the Neolithic spans most of the Holocene epoch (MIS 1) until the advent of metalworking just a few thousand years before present (Linton 2014: 235-236).

James Zachos' (2001: 688) meta-analysis of oxygen isotope fractionation from marine sediment cores is one of the most frequently cited figures in the field of paleoclimatology. This study, and several others which used stable isotopes from marine microorganisms as a proxy for global temperature, shows that the Pleistocene and Holocene were relatively cool climate periods

Geologic Time Unit	Marine Isotope Stage (MIS)	Geologic Age (ka)	Cultural Period	Archaeological Site	Tool Industry & (Hominid Species)	Chronostratigraphic References
Holocene	1	3.5	Neolithic	Grand Pressigny	Neolithic (*H. sapiens*)	(Linton 2014: 235-36)
			Mesolithic			
Pleistocene	2	11.7	Upper Paleolithic			
		14		La Madeleine	Magdalenian *(H. sapiens)*	(Petillon 2016: 110)
		19		La Roche	Solutrean *(H. sapiens)*	(Olsen 1989: 298)
		22		Labatut	Gravettian *(H. sapiens)*	(von Petzinger and Nowell 2011)
		28		Blanchard	Aurignacian *(H. sapiens)*	(Bourrillon et al. 2016: 60)
	3	33.4 ± 0.35				
		39.7 ± 2.4	Middle Paleolithic	Le Moustier	Mousterian *(H. neanderthalensis)*	(Mellars and Grün 1991: 274)
		47 ± 4.1		La Quina	Mousterian *(H. neanderthalensis)*	(Frouin et al. 2017: 41)
	4	55				
		63				(Haslam et al. 2017)
	5					
	6	130	Lower Paleolithic			
	7					
		215 ± 15		La Micoque	Early Mousterian *(H. neanderthalensis)*	(Schwarcz and Grün 1988: 295)
	8					
		288 ± 10				
	9					
	10					
	11	400		St. Acheul Amiens	Acheulean *(H. heidelbergensis)*	(Antoine et al. 2016: 236)
	12	424				
	13					
	14	533		Abbeville	Abbevillian *(H. heidelbergensis)*	(Antoine et al. 2015: 95-96)
	15					
		600 ± 90				

(International Chronostratigraphic Chart 2019)

Figure 1. Temporal distribution of sites included in this study in relation to cultural periods, geologic epochs, and Marine Isotope Stages. Geologic age dates were obtained radiometrically in chronostratigraphic studies and are referenced in the far-right column.

in Earth's history, with several major glaciation events (Skinner and Shackleton 2005: 571-573; Zachos 2001: 688). In the Upper and Middle Paleolithic, there were large-scale glacial maxima from 27–16 ka in MIS 2, from 66–59 ka in MIS 4 (van Andel et al. 2003: 31), and through MIS 6

(Ehlers and Gibbard 2007: 12). During the Lower Paleolithic, there is evidence of extensive glaciation in MIS 10 and MIS 12 (Ehlers and Gibbard 2007: 9-12). These glacial and interglacial periods contributed to distinctive settlement distributions, and the subsistence strategies associated with them are important to understanding how hominids evolved in Europe (van Andel et al. 2003: 31; Bordes 1961a: 803-804). For example, Banks et al. (2013: 39-40) hypothesize in their statistical analysis of Aurignacian split-based antler points that climate pressure from glaciations caused hominids to exploit different ecological niches and settle in more temperate areas. Thus, understanding how these climate cycles correlate to cultural and biological characteristics in the archaeological record can reveal evolutionary changes in the hominid lineage. By examining the early and modern literature about the 10 chosen sites from the Bullitt Collection, this thesis will link two main inquiries: theoretical shifts in the history of archaeology as a discipline and a synthesis of important human evolutionary changes through the lithic industries of the Paleolithic era. Because many artifacts in the Bullitt Collection are used as teaching aids, including 51 out of the 511 artifacts examined in this project, it is hoped that this two-fold analysis will provide deeper insight into the value of the Collection to the study of Paleolithic archaeology.

Methods

Artifacts from 10 French sites, 511 in total, were chosen for study from the James B. Bullitt Collection, which comprises 1,765 artifacts from important Paleolithic and Neolithic archaeological sites in Europe (Appendix A). The sites were chosen to represent a wide temporal distribution of early cultural material from the Lower Paleolithic through the Neolithic periods and an even mixture of type sites and non-type sites. The artifacts were digitally

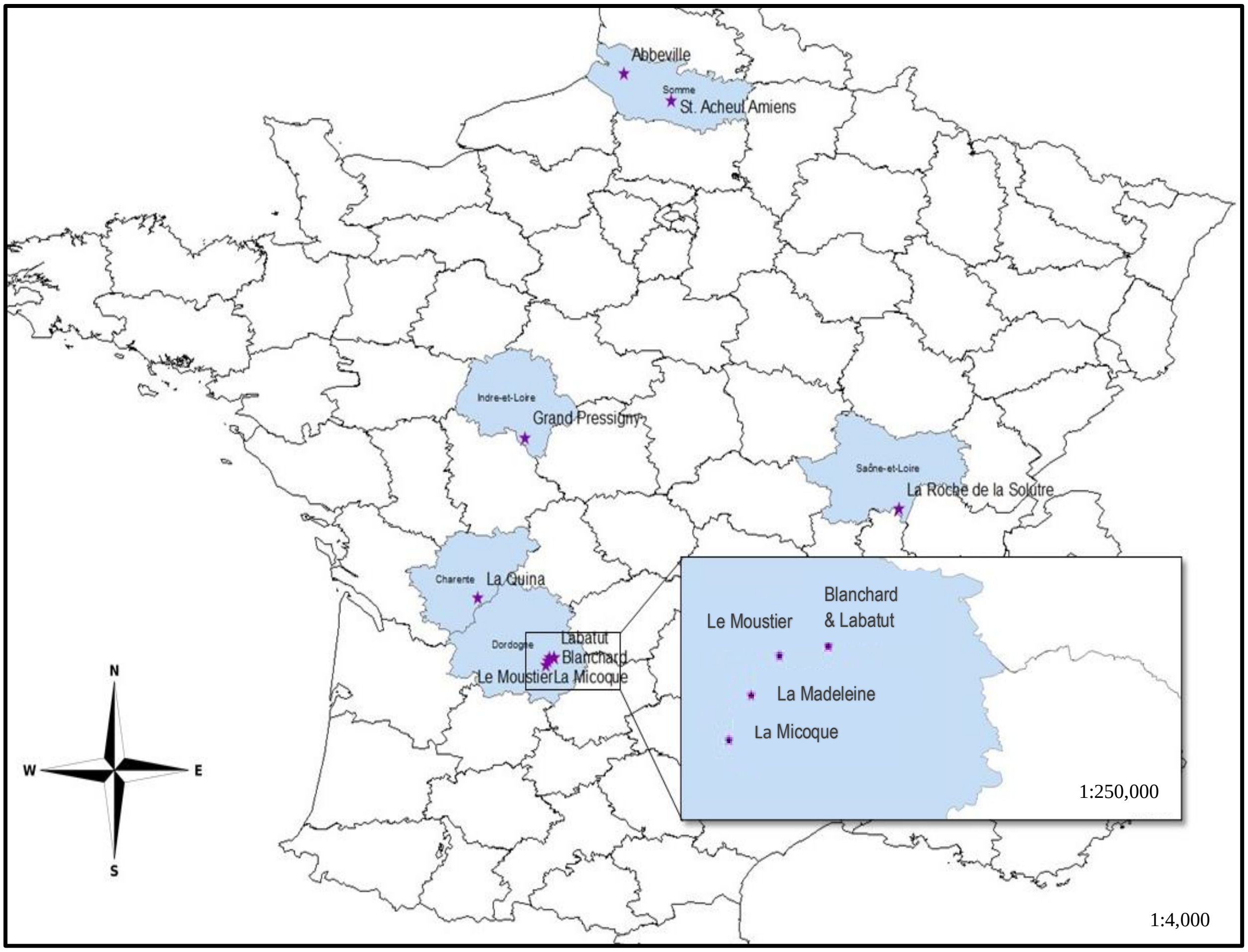

Figure 2. Locations of the sites included in this study on a political map of modern-day France.

photographed on two sides, measured tip-to-tip on the longest length, and notes on formal type and lithic material were documented for all selected artifacts (Appendix B). Photographs of these artifacts are available in the Carolina Digital Repository and are searchable by RLA catalog number (cdr.lib.unc.edu).

In order to make connections with theoretical shifts within the field of archaeology, early and modern archaeological literature on stone tool evolution at these sites was evaluated against the artifacts present in the Bullitt Collection. The 10 chosen sites are discussed in chronological order and within divisions of the Lower, Middle, Upper Paleolithic, and Neolithic eras.

Throughout this thesis, annotated images of artifacts from the Collection are included to illustrate important evolutionary trends, elucidate connections in tool morphology between sites, and emphasize comparisons between what is present in the Collection and the literature.

CHAPTER 2
THE LOWER PALEOLITHIC PERIOD

Dating back to the first human habitation in Europe, the Lower Paleolithic is a cultural period defined by the production of some of the earliest stone tools; most notably, the Abbevillian and Acheulean industries. The type site localities of these industries are located in modern-day France at Abbeville and St. Acheul Amiens. Also included is a discussion of the site La Micoque, an Early Mousterian site in the Dordogne department of France, which has recently undergone extensive stratigraphic revision (Falguères et al. 1997; Schwarcz and Grün 1988). While the hominid fossil record is relatively sparse during this time, by studying these lithic industries, we can begin to understand how the first human ancestors on the European continent lived during glacial and interglacial climate conditions.

Abbeville

The Lower Paleolithic site of Abbeville is located in the Somme department of northern France and is the type site for the Abbevillian stone tool industry (Figure 2). It is a series of gravel pits and stepped river terraces clustered around the modern-day municipality of Abbeville, of which the lower stratigraphic levels have been dated to 600 ± 90 ka in MIS 15 (Antoine et al. 2015: 93). The lithology of the area is characterized by Cretaceous chalk bedrock, which contains an abundance of flint nodules that were modified by prehistoric hominids to fashion stone tools. This abundance of material for flintknapping may account for the relatively large number of Paleolithic sites in the Somme River basin (Antoine et al. 2015: 78-79).

Archaeological information about Abbevillian sites in the Somme basin was first published by Jacques Boucher de Perthes in 1847 (Antoine et al. 2015: 78), though the term "Abbevillian" was not adopted until much later by Abbé Henri Breuil in several publications from the 1930s (Antoine et al. 2016: 339; Howell 2009: 95). Boucher de Perthes' papers included descriptions of handaxes found in the lower levels of several gravel pits in the Abbeville area (Sackett 2014: 6-7). His early reports were published during the infancy of Paleolithic archaeology as a discipline, and his work did not gain traction for several years as this was a time when the concept of evolution was not widely accepted. However, when the stratigraphy of his excavated gravel pits was later investigated and confirmed by British geologists beginning in 1859, the presence of *in situ* handaxes and other lithic artifacts made an undeniable case for the importance of the Somme basin, and France in general, for the study of human ancestors (Sackett 2014: 8-10). When Dr. Bullitt visited the Abbeville area in 1929, he described in his journal several visits to Abbevillian gravel pits and the excavation activities that took place:

> Nearly all the workmen have learned to pick out of the gravel masses those flints that have some appearance of having been chipped by man… [t]hey got two good sized bags full in the course of the day (Bullitt 1928–1929: 173).

Excavators were trained to look for typological clues that would indicate the artifacts were from before the Neolithic period. Collectors in the region, according to Bullitt, based this categorization on the original work of Boucher de Perthes (Bullitt 1928–1929: 176).

Morphologically, most Abbevillian tools are classified as bifacial handaxes (Figure 3), along with some flakes that are by-products of the handaxe making process. The Bullitt Collection contains 31 total artifacts from Abbeville, the majority of which are diagnostic Abbevillian handaxes, as well as 5 flakes (Appendix B). The flakes themselves are not a

Figure 3. Large bifacial handaxe, sides 1 (top) and 2 (bottom), from Abbeville. Note that compared to the more intricate Acheulean handaxe in Figure 4, there are relatively few flakes removed from the bifacial edges. James B. Bullitt Collection, RLA catalog no. 518a2. Scale in centimeters.

production type, but were functionally used as points in a similar way as is seen in subsequent industries (de la Torre 2016: 2-3). Handaxes are thought to have been multi-purpose, serving as scrapers, cutters, cleavers, and more (Posnansky 1959: 42). A study of 118 handaxes from British and French Lower Paleolithic times, including Abbevillian and Acheulean handaxes, also found evidence of handedness in the creation of the bifaces (Posnansky 1959: 43). This was based on asymmetry in the development of bifacial edges, and a non-central median ridge, both of which indicate preferential knapping by one hand to strike the core and create the sharply flaked biface (Posnansky 1959: 43-44).

Abbevillian tools are generally regarded as the origin point of tool use in European hominid evolution (Bordes and Thibault 1977: 116; Howell 2009: 93). They represent a ‘next step’ from the Oldowan industry in east Africa, which is reflected in the similarity of the simple structure of their cores (Howell 2009: 93-94). There is some debate about whether Abbevillian tools should be classified as an early sub-phase of the Acheulean tradition, based on the morphology of the bifacial handaxes in the two industries, instead of as a separate category (de la Torre 2016: 3). However, the link between Oldowan and Abbevillian tools is important in the framework of understanding the migration and subsequent evolution of hominids out of east Africa (de la Torre 2016: 5). In contrast, grouping Abbevillian tools as a sub-phase of the Acheulean industry seems to place greater emphasis on morphology and typological categorization, rather than what these tools imply about behavior, speciation, and population change over time.

Abbevillian sites represent the earliest reaches of European prehistoric archaeology, and therefore contain important information about how hominid habitation and behavior first evolved on the European continent (Antoine et al. 2015: 77). Combining carbonate stratigraphy with mammalian and molluscan fossil assemblages for relative dates, and Electron Spin Resonance (ESR) dating for absolute dates, recent research has established that habitation of these sites by *Homo heidelbergensis* occurred during an interglacial period (Antoine et al. 2015: 95). More specifically, the “large mammal assemblage [at Abbeville] indicates a forested landscape including some meadow and marshy zones, which developed under a definitely temperate and wet climate” (Antoine et al. 2015: 95). ESR dating of fluvial quartz grains, magnetostratigraphy, and Uranium-series (U-series) dating have contributed to the establishment of firm dates for the Somme River terrace system, including the lower levels containing both Abbevillian material and the large mammal fossil assemblages discussed above (Antoine et al. 2007: 2707). The ESR dates obtained from the earliest Abbevillian sequences are 600 ± 90 ka, in MIS 15 (Antoine et al. 2007: 2707). This large body of work present surrounding the Somme fluvial terrace system and its stratigraphy has remarkably excellent agreement on the dates of early hominid settlement in France, and there is not a significant difference between the dating methods discussed above (Antoine et al. 2007; Antoine et al. 2015; Turq et al. 2010).

St. Acheul Amiens

St. Acheul, the type site for the Acheulean tool industry, is located just a few kilometers from Abbeville near the municipality of Amiens (Figure 2) (Antoine at al. 2016: 337). Several Acheulean sites are clustered around Amiens, ranging in age from MIS 12 to MIS 9 (Antoine and Limondin-Lozouet 2004: 62). Using ESR dating of quartz grains, St. Acheul has been placed in MIS 11, between 424–400 ka (Antoine et al. 2016: 236). The Acheulean was first defined by Gabriel de Mortillet in 1873, who was a pioneering figure in the concept of the type site for defining a set of diagnostic characteristics for a lithic industry (Mortillet 1873: 432-434; de la Torre 2016: 2). Like Abbevillian tools, most Acheulean tools are handaxes, with some unifacial scrapers and flakes also common (Antoine and Limondin-Lozouet 2004: 62-63). The Bullitt Collection contains 15 artifacts from St. Acheul, the majority of which are Acheulean handaxes, as well as 4 flakes (Appendix B). Reflected in the Bullitt Collection's handaxes is an important marker of advancement from Abbevillian handaxes: smaller and more numerous flakes, indicating a higher degree of precision in knapping the bifacial edges (Figure 4).

Figure 4. Large bifacial handaxe, sides 1 (top) and 2 (bottom), from St. Acheul Amiens. As compared to the Abbevillian handaxe in Figure 3, note the smaller and more numerous flakes removed from the bifacial edges. James B. Bullitt Collection, RLA catalog no. 515a1. Scale in centimeters.

Similar to Abbevillian tools, the source flint for Acheulean cores in France is mostly nodular chert commonly found within the Cretaceous limestone and chalk bedrock (Antoine and Limondin-Lozouet 2004: 63). However, Acheulean tools represent an advancement from Abbevillian tools in terms of the technique involved in biface production and the type of blank used. In addition to the use of prepared cores, some Acheulean handaxes instead come from large flakes as their blanks, which is a technique not usually seen in earlier Abbevillian lithics

(Lamotte and Tuffreau 2016: 63). As seen with the Bullitt Collection Acheulean handaxes, the shape of the smaller flakes struck off to create the bifacial cutting edge generally narrows and lengthens through time in the archeological record, indicating a higher degree of precision in flintknapping that has been confirmed through modern experimentation (Lamotte and Tuffreau 2016: 64-65).

Like at Abbeville, the work of Boucher de Perthes and Breuil is central to our modern understanding of the stratigraphic and paleoenvironmental relationships at St. Acheul. These early researchers correctly interpreted the sequence of deepening fluvial deposits as interglacial in nature using only relative dating techniques (Antoine at al. 2016: 338-340). Victor Commont, who lived most of his life in the municipality of Amiens, was responsible for much of the published work on the site of St. Acheul since the first discovery of *in situ* handaxes in 1854, around the time of Boucher de Perthes' work in the area (Tuffreau 2009: 116-117). Commont recognized four distinct river terraces and was able to accurately interpret the cyclic deposition of fluvial floodplain sediment and glacial till, which correlate to rising and falling sea level between glacial cycles (Tuffreau 2009: 118).

In the past two decades, several studies combining modern radiometric dating techniques and biostratigraphy using both molluscan and microfossil assemblages have determined the temporal placement of the St. Acheul terraces (Antoine et al. 2007; Antoine et al. 2016; Antoine and Limondin-Lozouet 2004). For example, in conjunction with an expanded paleoenvironmental interpretation of the St. Acheul beds, Antoine and Limondin-Lozouet (2004: 43) used ESR dating of fluvial quartz grains to determine an age of 403 ± 73 ka for the lower levels of St. Acheul, which falls within MIS 11. To confirm these findings, they examined the assemblage of molluscan fossils present in these layers and biostratigraphically correlated the layers to the Garenne Formation, a known geologic reference unit in the area for Marine Isotope Stages (Antoine and Limondin-Lozouet 2004: 43-45). Like at Abbeville, the St. Acheul fossil assemblage overwhelmingly contains mollusks that lived in warm, temperate environments. The key detail, however, is that many of the taxa are known to have lived in shaded grassland environments, indicating the likelihood of heavy forestation in the Somme River basin during times of Acheulean production (Antoine and Limondin-Lozouet 2004: 48). While the hominid fossil record is very sparse during this time, later sites that were also created during interglacial times shed light on how settlement patterns, hunting strategies, and behavior were affected by similar climate conditions.

La Micoque

La Micoque, located in the Dordogne department near the town of Les Eyzies, is considered to be an Early Mousterian site (Figure 2). It is thought to contain a representative assemblage of the Acheulean-Mousterian transition and is thus critically linked to accelerated changes in hominid evolution during this period (Turq et al. 2010: 390). Unlike the previously discussed sites of Abbeville and St. Acheul Amiens, which have historically well-established stratigraphy and a relative wealth of recent radiometric dates, there are only two published papers on U-series and ESR dating at La Micoque (Falguères et al. 1997; Schwarcz and Grün 1988). The most recent excavations there took place in 1969 by Henri Laville and Jean-Phillippe Rigaud, with a brief visit and examination the same year by François Bordes (Schwarcz and Grün 1988: 293-294). Findings on the lithic artifacts from those excavations have still not been published, so current research is more focused on stratigraphy and paleontological context (Turq et al. 2010: 390).

Denis Peyrony, first excavating between 1929 and 1932, originally defined 14 stratigraphic levels that were used in subsequent research through the mid-twentieth century (Falguères et al. 1997: 538). Very recently, there have been stratigraphic revisions of these 14 beds at La Micoque (Schwarcz and Grün 1988: 294), and new subdivisions of the original strata now yield 75 layers within the original lettered A–N framework (Falguères et al. 1997: 537). The lower and the middle units are now interpreted as two separate fluvial terraces, with Peyrony's A–N beds making up the middle unit, and the upper unit corresponds to Holocene-age unconsolidated sediment (Falguères et al. 1997: 537).

Schwarcz and Grün (1988) and Falguères et al. (1997) have published the only two studies which use radiometric dating at La Micoque. They appear to have reached agreement on the absolute dates of layer L, which were first obtained using the ESR method by Schwarcz and Grün (1988). Falguères et al. (1997) later published radiometric dates for layers in the entire middle unit, and they further validated these data by using both ESR and U-series dating. The material for both publications was obtained from dentine in horse teeth found in the most recent excavations of La Micoque. More importantly, the findings of Schwarcz and Grün (1988: 295) were also consistent with other literature on the hypothesized cultural boundary between the Acheulean and Early Mousterian: the lower boundary of layer L was 287 ± 11 ka in MIS 8. Just slightly earlier in time, Falguères et al. (1997: 543) found the lower boundary of layer L to be around 291 ± 44 ka from the U-series method and 291 ± 29 from ESR.

The "absence of cleavers, the presence of bifacial shaping, and a trifacial concept of production and/or shaping" are present in La Micoque and typical of the industry (Turq et al. 2010: 390). This is quite different from the discoidal or Levallois techniques employed at later Mousterian sites, which will be discussed in detail in the Middle Paleolithic section. The Bullitt

Collection contains 16 artifacts from La Micoque, 9 of which are diagnostic bifacial and trifacial scrapers, 5 of which are flakes, and just 2 handaxes (Appendix B). The unique trifacial scraper (Figure 5) is seen across many European Early Mousterian sites and is an important diagnostic feature of the Early Mousterian (Turq et al. 2010: 390).

Unlike Abbeville and St. Acheul Amiens, La Micoque is not a type site, and is an example of the enormous variability in lithic techniques that began to appear at the transition into the Middle Paleolithic period (Kozłowski 2014: 350). In terms of evidence for the Acheulean-Mousterian transition, La Micoque is a critical site for understanding not only a transition between these two industries, but the beginning of the transition to the Middle Paleolithic from the Lower Paleolithic. The Middle Paleolithic industries, especially the Mousterian, are extremely diverse in flake and blade technologies (Turq et al. 2013: 651). As *Homo neanderthalensis* came on the scene and quickly settled much of the European continent, the pace of cultural evolution began to accelerate, bringing new lithic technology, hunting strategies, and even artistic expression along with it (Turq et al. 2013: 652).

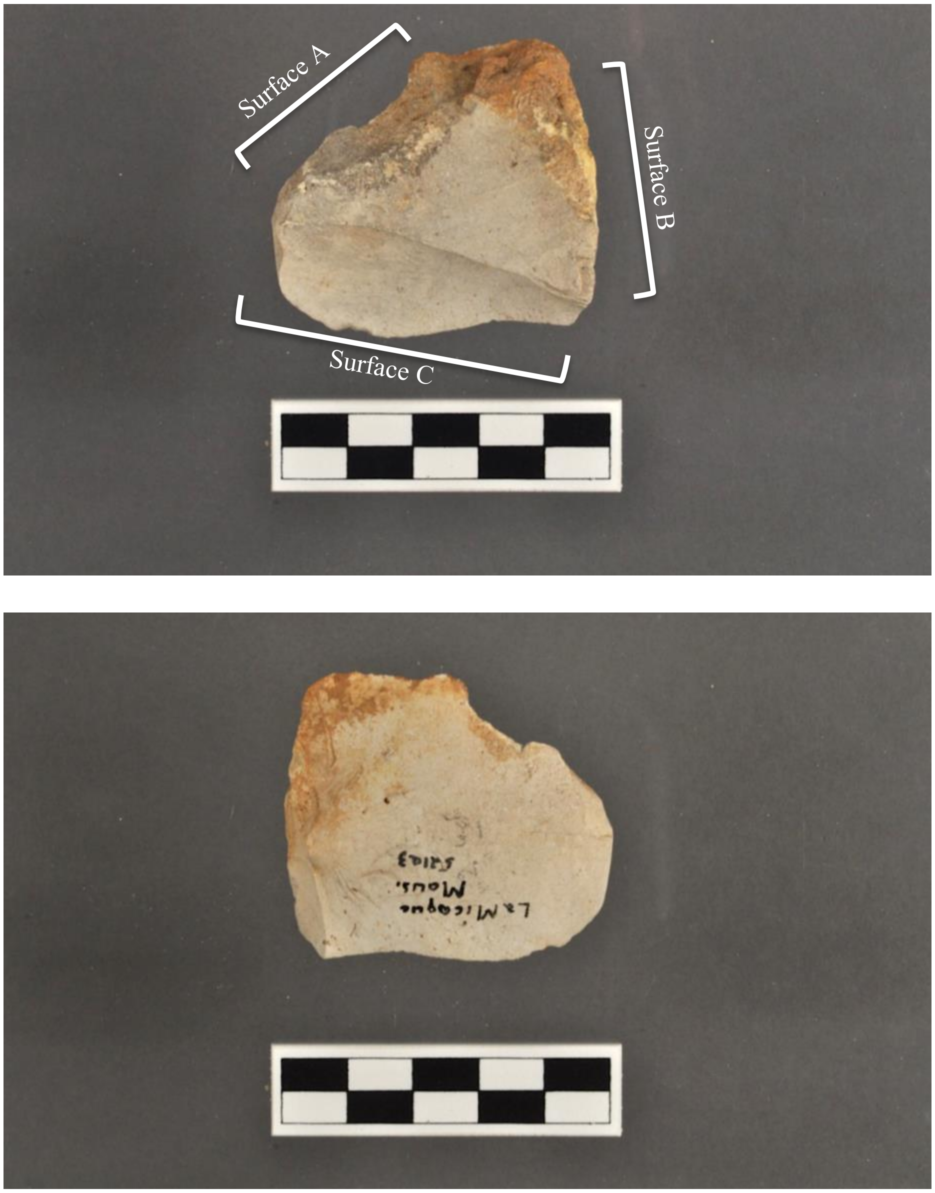

Figure 5. Trifacial scraper, sides 1 (top) and 2 (bottom), from La Micoque. The three worked faces are annotated on side 1. James B. Bullitt Collection, RLA catalog no. 521a3. Scale in centimeters.

CHAPTER 3
THE MIDDLE PALEOLITHIC PERIOD

Through the Middle Paleolithic, the archaeological record generally becomes less sparse, and the amount of preserved skeletal material increases in comparison to the Lower Paleolithic (Frouin et al. 2017: 34). Middle Paleolithic tools are extremely varied in character and reflect diversification in behavior and climate adaptation of *Homo neanderthalensis*. Retouching, indicative of tool reuse, becomes an important evaluative marker of the period and is present through the varied phases of the Mousterian tradition. Through the sites of La Quina and Le Moustier, this section explores how evidence of European hominid evolution is visible in the succession of Mousterian of Acheulean Tradition, Typical, Discoid-Denticulate, and Quina Mousterian lithics.

La Quina

La Quina, the type locality of the Quina Mousterian tradition, is often hailed as important for seeing changes in human behavior through the Middle Paleolithic; in particular, the lifestyle and hunting strategies of *Homo neanderthalensis*. Located in the Charente department of France (Figure 2), the site extends for nearly 300 m along a limestone cliff overlooking the Voultron River (Frouin et al. 2017: 31). La Quina is known for its exceptional preservation of human remains, including an almost entirely complete adult Neanderthal skeleton and material from at least 52 other individuals (Frouin et al. 2017: 34). Skeletal remains, both of hominids and other mammalian fauna, reveal important insights into the interactions between archaic hominids and their environment, and how this was mediated by stone tools.

Artifacts from La Quina comprise a significant portion of the Bullitt Collection, representing 131 lithic and 98 osseous artifacts out of 1,765 total in the Collection (Appendix B). During his travels in 1929, Dr. Bullitt spent some time personally participating in excavations at La Quina. It is apparent that research at the site was regarded as extremely important by French archaeologists at the time, both for the preservation of hominid remains and the abundant and varied tools:

> La Quina is a wonderfully rich Mousterian station, early, middle and late stages… Both flints and fauna are abundant, unbelievably so. We found quantities of chips, inferior pieces, and many excellent ones, not to mention large numbers of pieces of bone. Nearly every bone shows some marks of the flint knives in disarticulating or defleshing them… (Bullitt 1928–1929: 238-239).

The importance of the site for investigating Neanderthal technology and lifeways likely explains why Dr. Bullitt chose to include so many artifacts from La Quina in the Collection.

The Quina Mousterian is a subclass of the Mousterian tradition that is predominantly characterized by a specialized side scraper and very few denticulate tools or handaxes (Bordes 1961a: 804). These scrapers were made from thick flakes and have a convex scraping edge. Retouching, indicative of tool reuse, is first seen in significant amounts during the Middle Paleolithic at sites like La Quina and Le Moustier (Hiscock et al. 2009: 237). According to Bordes (1961a: 805), who was an integral figure in reimagining Denis Peyrony's original Mousterian classification scheme, Quina tools "have a special type of retouch, like the overlapping scales of a fish," which makes them easily recognizable (Figure 6). This type of retouch is visible on many of the scrapers in the La Quina portion of the Bullitt Collection. The intelligence and cultural complexity that this implies is remarkable and coincides with other

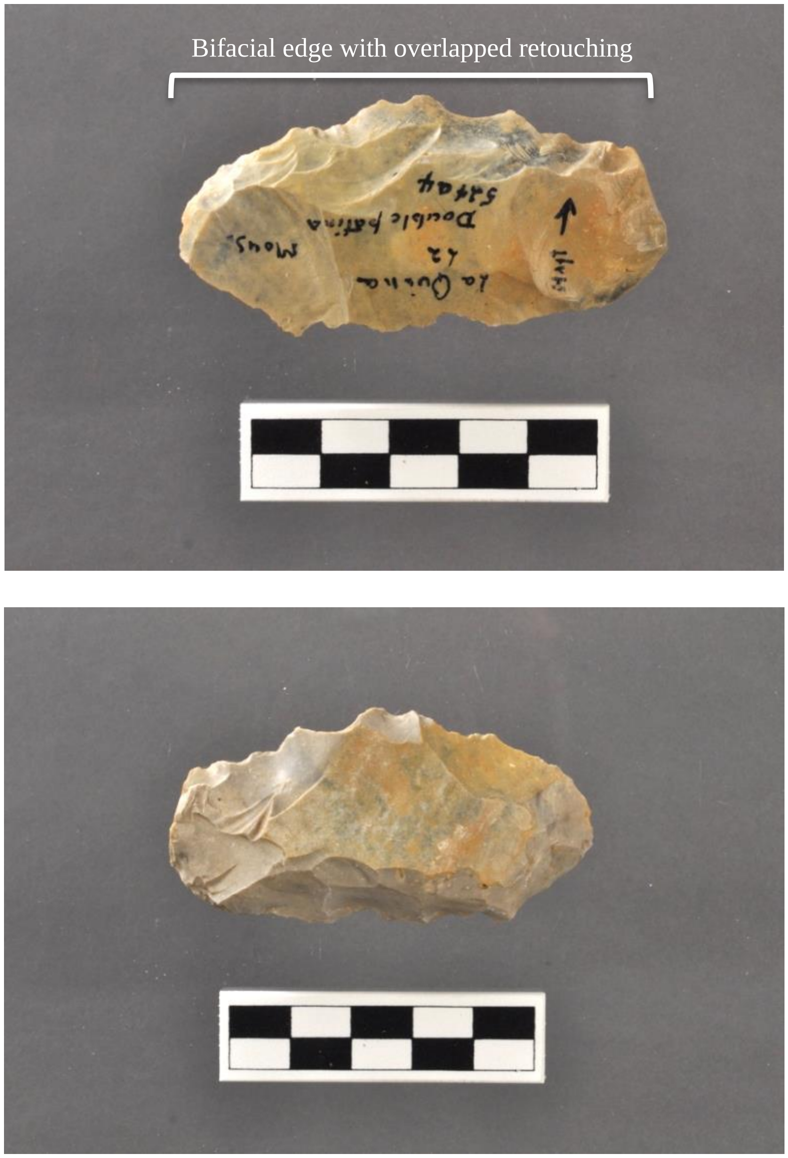

Figure 6. Thick scraper from La Quina, sides 1 (top) and 2 (bottom), with some overlapped retouching. James B. Bullitt Collection, RLA catalog no. 524a4. Scale in centimeters.

evolutionarily advanced behaviors displayed by *Homo neanderthalensis*, like active hunting and deliberate burial of the dead (Hiscock et al. 2009: 237).

TL dating studies at La Quina using burned flints have previously established the dates of tool use in the upper stratigraphic layers, which are primarily characterized by Discoid-Denticulate and Typical Mousterian implements (Frouin et al. 2017: 34). Frouin et al. (2017: 37) used two different forms of luminescence dating to establish the chronology of the lower part of the La Quina sequence, where the Quina Mousterian artifacts are located. Coarse grains of quartz were dated with optically stimulated luminescence technique, and polymineral fine grains were dated with infrared and post-infrared stimulated luminescence signals (Frouin et al. 2017: 37). The TL dates for the lower Quina Mousterian layers were 63–55 ka, from late MIS 4 into early MIS 3 (Frouin et al. 2017: 41). The upper layers were younger, spanning from 55 ka until the end of evidence for human habitation at La Quina around 40 ka, in MIS 3 (Frouin et al. 2017: 41-42).

These data are in agreement with other studies that used either TL dating of burned flints or radiocarbon dates (Frouin et al. 2017: 44). Like other sites containing Quina Mousterian artifacts, the primary faunal remains found at La Quina from the MIS 4–3 time period are horses, bison, and fewer reindeer, which correlates with the moderate, temperate climate of an interglacial period (Chase et al. 1994: 293). The presence of large, fully adult fauna and no evidence of a higher concentration of cut marks on the skulls and distal limbs, as there would be on scavenged remains, indicate that Neanderthals were likely hunting their prey during this time (Chase et al. 1994: 288).

Le Moustier

Le Moustier, a rock shelter located in the Dordogne department of France (Figure 2), is the type site of the Mousterian industry, and thus provides valuable insight into the lifestyle and hunting strategies of *Homo neanderthalensis*. In a temporal sense, Le Moustier is generally regarded as the last site before the transition to the Upper Paleolithic, so it has received consistent attention since its discovery (Gravina and Discamps 2015: 83). However, there has been a newfound interest in the past two decades as scholars have re-examined this transitional site using new radiometric and stratigraphic analyses. While Mousterian tools have only been associated with Neanderthal remains, refining the temporal placement and stratigraphy of this site is still particularly important since the upper layers of the Le Moustier sequence coincide with the time of likely interbreeding between *Homo neanderthalensis* and *Homo sapiens*.

Denis Peyrony excavated at Le Moustier at the very beginning of the twentieth century, and until recently, his data and stratigraphic classifications were the primary framework for interpreting the archaeological material from the site (Gravina and Discamps 2015: 84). Stratigraphic layers G and H are the lowest layers in the Le Moustier sequence that contain Mousterian artifacts, and they are topped by subsequent layers I and J that contain Discoid-Denticulate Mousterian and Typical Mousterian implements, respectively. Unlike layers G and H, layers I and J contain virtually no handaxes. Peyrony originally proposed the designation Mousterian of Acheulean Tradition (MTA) for the material recovered from layers G and H due to the dominant presence of handaxes, which were especially prevalent in layer G. Thus, MTA tools represent a transitional form from the earlier Acheulean to the Early Mousterian tradition.

In the 1970s and 1980s, Bordes distinguished two variants of the MTA: MTA-A, which is characterized by bifacial handaxes together with various forms of side scrapers, and MTA-B, which contains lower frequencies of bifaces and slightly more notched and denticulate tools (Bordes 1981: 78). Gravina and Discamps (2015) evaluated Peyrony's original conclusions about layers G and H of the lower shelter at Le Moustier and compared them to Bordes' later specifications. They found that there were many Levallois points in layer G versus discoid and denticulate material in layer H, which also correlated with different faunal remains, indicating different subsistence strategies between these two layers (Gravina and Discamps 2015: 88). The more recent upper layers I and J mainly contain Discoid-Denticulate Mousterian and Typical Mousterian implements, respectively. Based on faunal remains found in the same contexts as these tools, Neanderthals who created Discoid-Denticulate Mousterian implements hunted horses as game. In contrast, Typical Mousterian tools have been primarily found with remains of red deer and wild oxen (Bordes 1961a: 809).

Levallois and Discoid-Denticulate tools are differentiated by the flaking techniques used to create them. The Bullitt Collection contains primarily Levallois blades and scrapers from Le Moustier, and no handaxes or denticulate tools are present (Appendix B). Thus, only a small selection of the extremely varied artifact assemblage at Le Moustier was sampled by Dr. Bullitt. The Discoid-Denticulate Mousterian, typical of Le Moustier layer I, is defined by the presence of disk-shaped cores used as blanks to form denticulate tools (Jaubert et al. 2011: 106). These tools are notched along their edge, with structures that appear like teeth on the flaked edge (Jaubert et al. 2011: 107). Levallois tools, associated with the Typical Mousterian assemblage in Le Moustier layer J, are created by forming a striking platform at one end of a blank and flaking off pieces around the outline of the intended shape (Figure 7) (Lycett and von Cramon-Taubadel 2013: 1509). When the striking platform is hit with a hammerstone, a large flake separates from the top of the core along the entire length of the object (Lycett and von Cramon-Taubadel 2013: 1509-1510).

Mellars and Grün (1991) published a comparative analysis of their work on ESR dating layers G and H at Le Moustier against the dates obtained through thermoluminescence (TL) dating by Valladas et al. (1982). The TL dates for Le Moustier span from 49–37 ka (Valladas et al. 1982: 453), and the ESR dates span 47.0 ± 4.1 ka to 39.7 ± 2.4 ka (Mellars and Grün 1991: 274). This places the Le Moustier sequence inside MIS 3, the interglacial time period before

Figure 7. Typical Mousterian Levallois core with striking platform (a) visible on lower left, sides 1 (top) and 2 (bottom), from Le Moustier. Surface where large flake was removed is outlined in red on side 1. James B. Bullitt Collection, RLA catalog no. 519a2. Scale in centimeters.

MIS 2. MIS 2 was characterized by the Last Glacial Maximum (LGM) and the extensive geographic dispersion of modern *Homo sapiens* (International Chronostratigraphic Chart 2019). In examining the transition to the Upper Paleolithic, the intermingling of Neanderthals and Anatomically Modern Humans becomes important and is reflected in the relationship between the hominid fossil assemblage and lithic artifacts.

CHAPTER 4
THE UPPER PALEOLITHIC PERIOD

The Upper Paleolithic was a time of tremendous environmental change and rapid diversification of lithic industries in Europe. The assemblages at Abri Blanchard and Abri Labatut, two rock shelters at the Castel-Merle archaeological site, represent earlier phases of the Upper Paleolithic. Also discussed in this section are La Roche de la Solutré and La Madeleine, the type sites of the Solutrean and Magdalenian industries that are later phases of the Upper Paleolithic period. During this time, Anatomically Modern Humans dominated the landscape, and Neanderthals disappeared from the fossil record. The onset of the Last Glacial Maximum (LGM) drove these humans to adapt to their harsh environments, leading to the behavioral and genetic diversity that is apparent in the archaeological record (Banks et al. 2013: 51). Humans during this period were highly mobile (Langlais et al. 2016: 96), and their lithic and osseous toolkits reflect a diversification in both domestic and hunting behaviors as compared to the Mousterian industry of the Neanderthals (de Sonneville-Bordes 1963: 347-348).

Blanchard

Abri Blanchard is one of several partially collapsed rock shelters at the Castel-Merle archaeological site in the Dordogne department of France (Figure 2). Like many Aurignacian sites, Abri Blanchard is famous for its well-preserved examples of early graphic expression by modern humans. First excavated from 1910–1912 by amateur archaeologist Louis Didon, the art at Abri Blanchard largely consists of depictions of mammals that were common during that time period (Bourrillon et al. 2018: 47). In 2012, new excavations by Bourrillon et al. (2018: 47) unearthed a significant find: a limestone slab decorated with Aurignacian engravings. Aurignacian graphic expression is characterized by the detailed engraving of game animals such as the now-extinct aurochs, a prehistoric wild ox once found in this area of Europe (Bourrillon et al. 2018: 56). In the case of the newly discovered limestone engraving at Abri Blanchard, the images were formed using a series of tiny chipped holes, a typical style of engraving found at many Aurignacian sites (Bourrillon et al. 2018: 57).

In their study of the association between ecological niches and Aurignacian tools, Banks et al. (2013: 39) propose that "the Aurignacian technocomplex comprises a succession of culturally distinct phases... [and between] the Proto-Aurignacian and the Early Aurignacian, [there is] a shift from single to separate reduction sequences for blade and bladelet production, and the appearance of split-based antler points." Bladelet production, usually to produce thick end scrapers, is a fundamental marker of the Aurignacian industry (Chiotti, Cretin, and Morala 2015). The Bullitt Collection contains 85 artifacts from Blanchard, and approximately half are these diagnostic blades and bladelets, while the other half are Aurignacian scrapers (Appendix B). These blades are relatively thick and sturdy, yet they are very sharp due to the careful and skilled removal of long and thin flakes, which leave behind a pronounced flake scar (Figure 8). Osseous antler points are also common in Aurignacian assemblages, and most are distinctively split-based resembling the forked tongue of a snake, though none are present in the Collection (Tartar et al. 2014: 8).

Bourrillon et al. (2018: 57-58) dated the newly discovered limestone slab at Abri Blanchard using molecular filtration and Hydroxyproline $_{14}$C methods on mammalian bones found in the same layer. Unlike the previously discussed ESR and TL dating methods,

Figure 8. Aurignacian blade from Abri Blanchard, sides 1 (top) and 2 (bottom). Note the long flake scars from very precise blade removals outlined in red on side 1. James B. Bullitt Collection, RLA catalog no. 547a1. Scale in centimeters.

molecular filtration ^{14}C dating has some significant environmental limitations. Bone collagen is vulnerable to chemical cross-linking between collagen and carbonate-rich groundwater, which commonly percolates through cave environments. To remedy this, Bourrillon et al. (2018: 58-60) also employed the Hydroxyproline ^{14}C method, which exclusively uses the amino acid Hydroxyproline, a biomarker for collagen. Dating only Hydroxyproline allowed them to exclude other contaminants. And indeed, the Hydroxyproline ^{14}C dates of 33.4 ± 0.35 ka (early MIS 2) for the slab are congruent with several Aurignacian layer dates from another Castel-Merle rock shelter, Abri Castanet (Bourrillon et al. 2018: 48).

Climate reconstruction is a relatively new theme in Paleolithic archaeology that is important for explaining and understanding human behavior and subsistence strategies. Banks et al. (2013: 47) used statistical computer models to estimate the ecological niches exploited by humans during the early Aurignacian. Because the Aurignacian is commonly associated with the time that early modern humans moved into Europe and intermingled with Neanderthals, understanding finer-scale changes throughout the industry is especially important to understanding hominid evolution in the Upper Paleolithic (Banks et al. 2013: 41). They found that between the Proto- and Early Aurignacian, there were several technological changes that occurred in conjunction with an expansion of the geographic range occupied by Upper Paleolithic humans (Banks et al. 2013: 48). During the Early Aurignacian, the climate conditions of the LGM (MIS 2) were very cold and dry, which therefore required more flexibility and cultural adaptation by human populations (Banks et al. 2013: 51).

Labatut

Abri Labatut has an artifact assemblage representative of the Gravettian industry and is located in the Dordogne department of France (Figure 2). Like Abri Blanchard, it is one of the Castel-Merle rock shelters that were part of Louis Didon's excavation projects from 1912–1913 (Simek 1986: 404). According to Didon's (1914) initial publication on the site, Abri Labatut contains three main stratigraphic levels: level 1, a thin Solutrean level at the top of the sequence; level 2, a layer predominantly containing Gravette points and Noailles burins; and level 3, the base level containing flat burins and fewer Gravette points.

Figure 9. Noailles burin from Abri Labatut, sides 1 (top) and 2 (bottom). Direction of upper flake (a) and burin spall (b) removal is shown on side 1. James B. Bullitt Collection, RLA catalog no. 555a4. Scale in centimeters.

Scholars of Upper Paleolithic archaeology sometimes evaluate the frequency of Gravette points, Noailles burins, and another type of burin, the flat burin, to assess variability between layers and correlate assemblages across sites (Delporte 1968; Laville and Rigaud 1973; de Sonneville-Bordes 1960). Burins are thought to have been sharp, chisel-like objects with multiple uses (Figures 9 and 10) (Tomáŝková 2005: 81). Take the example of Noailles burins,

Figure 10. Flat burin from Abri Labatut, sides 1 (top) and 2 (bottom). Note the much larger size and flat, more regular shape compared to the Noailles burin in Figure 9. James B. Bullitt Collection, RLA catalog no. 555a4. Scale in centimeters.

mostly present along with Gravette points in layer 2 at Abri Labatut (Didon 1914; Simek 1986). As in layer 2, Noailles burins and Gravette points are often found together in Gravettian sites across the Dordogne department. In contrast to flat burins (Figure 10), Noailles burins are often smaller in size, with an exceptionally tiny struck-off flake called a burin spall (Figure 9) (Simonet 2011: 186).

In this scheme, imagining the relative abundances of Noailles burins, flat burins, and Gravette points as a single point on a triangular ternary diagram is a useful reference for identifying Gravettian assemblages (Delporte 1968: 90; Laville and Rigaud 1973: 333). However, researchers like Denise de Sonneville-Bordes (1960) rightly caution that some typological selection and bias likely occurred during excavations in the early 1900s, so exact statistical analysis may not be possible with museum collections which are no longer *in situ*. Echoing de Sonneville-Bordes' point, the Bullitt Collection artifacts from Labatut instead include both Noailles burins, usually in Labatut level 2, and flat burins, usually in Labatut level 3, with very few Gravette points. This reflects the typological bias present in creating a representative collection, which prevents rigorous artifact analysis due to the lack of archaeological context. The Bullitt Collection contains 147 lithic artifacts from Labatut, including 39 Noailles and flat burins (Appendix B). The remaining lithics consist of 31 microliths, 16 scrapers, and 54 blades, all of which appear to be Aurignacian or early Gravettian and are not typically the focus of modern publications on Gravettian sites.

Many recent studies have turned to techniques like use-wear analysis to obtain additional data for the categorization of lithics on the basis of their function (Keeley 1974: 323-324). However, separating artifacts by both form and function together inherently increases the number of assumptions being made when constructing these categories (Binford and Sabloff 1982; Dunnell 1978; Odell 2001). Even when categorizing lithics primarily using the functional approach, it is almost impossible to escape the typological divisions set forth in the earliest publications on a particular site (Odell 2001: 48).

The majority of the osseous material at Abri Labatut is also diagnostic of the Gravettian period. It consists of antlers modified by the Groove-and-Splinter Technique (GST) (Goutas 2016: 90). GST is thought to be more precise than the Aurignacian splitting and cleavage technique, and interestingly, this technique seems to have disappeared from the archaeological record after the Gravettian period. According to Pétillon and Ducasse (2012: 436), GST was later re-introduced during the Magdalenian period, which implies that the evolution of at least some tool technologies are cyclic, rather than unidirectional, in nature. This suggests an interplay between toolmaking and the complex forces associated with climate change and settlement patterns during the cold, dry LGM period. The LGM, which dominated the climate in MIS 2, coincides with the Gravettian layers at Abri Labatut dated to 28–22 ka, immediately preceding the Solutrean industry (von Petzinger and Nowell 2011).

La Roche

La Roche de la Solutré, also known as La Roche, is located in the eastern foothills of the Massif Central in the Sâone-et-Loire department (Figure 2). La Roche is an open-air shelter within a Jurassic limestone escarpment that is geologically unique to the area (Olsen 1989: 296). However, the site is most known for its extremely well-preserved mass kill, and more generally for studying hunting strategies in the Upper Paleolithic (Olsen 1989: 297). La Roche first became famous in 1869 when Gabriel de Mortillet named the Solutrean industry of the Upper Paleolithic after the site, and the most recent excavations at La Roche were directed by Jean Combier from 1968–1976 (Combier, 1976: 111). Combier (1976) defined the 9 m deep stratigraphic sequence of La Roche, which contains Mousterian stone tools overlaid by Aurignacian, Gravettian, Solutrean, and finally, Magdalenian layers. Despite being the type site for the Solutrean industry, however, there appears to be a bias in research towards the more recent Magdalenian layers.

There is a single published radiocarbon date from La Roche sampled from the uppermost Magdalenian level, and it dates to 12.58 ± 0.25 ka (Combier 1976: 115). Based on other studies of Solutrean sequences around France, it is estimated that the Solutrean levels at La Roche probably date to around 22–19 ka in MIS 2 (Combier 1976; Olsen 1989: 298). In conjunction with the faunal remains and lithic sequence present at the site (Banks 2006: 110), it is reasonable to conclude that the Solutrean occupation of the site did indeed occur in MIS 2 at the height of the LGM period. During this glacial period, wild horses were prominent on the landscape. In her faunal analysis of the mass kill at La Roche, Olsen (1989: 323-324) concluded that humans most likely strategically trapped these horses against the limestone cliff above the site in order to kill them.

Based on morphology, the 47 Bullitt Collection artifacts from La Roche also appear to be primarily from the uppermost Magdalenian levels (Appendix B); these include Magdalenian scrapers, worked bone implements, and diagnostic thin blades (Figure 11). From the literature, the Solutrean assemblage at La Roche includes scrapers, burins, and diagnostic Solutrean bifaces, which do not appear to be present in the Collection (Banks 2004: 8). However, these bifaces are present in all of the Solutrean levels, and some are characterized by their distinctive laurel leaf appearance (Banks et al. 2009: 2854). There is extensive evidence of debitage from knapping activities, and paired with the presence of hearths and the diverse tool assemblage, it is likely camping occupations during this time were common at the site (Banks 2004: 17).

There is also an interesting controversy to note here, sometimes referred to as the “Solutrean Hypothesis” or the “Solutrean-Clovis Connection,” whereby it is posited by some

Figure 11. Magdalenian thin blade from La Roche, sides 1 (top) and 2 (bottom). Note the similarity in form between this blade and the blade in Figure 12 from La Madeleine. James B. Bullitt Collection, RLA catalog no. 531a2. Scale in centimeters.

researchers that western Europeans were responsible for the initial peopling of the Americas (Bradley and Stanford 2004). This argument is largely based on some morphological similarities between Clovis projectile points from North America and Solutrean laurel leaf bifaces (Straus et al. 2005: 508). There are three main objections to this hypothesis: first, the distance between

Europe and North America; next, the perceived difficulty of crossing the North Atlantic during the LGM; and thirdly, the greater than 5,000-year time gap between the Solutrean and Clovis cultures (Oppenheimer et al. 2014: 753). In an effort to approach this issue from a new direction, there are emerging genetic studies which try to piece together relationships between Native Americans and a hypothetical Western European founder population. The results of these very recent studies are still extremely inconclusive, and future research in this direction will likely shed more light onto this controversy (Oppenheimer et al. 2014).

La Madeleine

Abri de la Madeleine, also known as La Madeleine, is located in the Vézère River valley of the Dordogne department (Figure 2). The site is a rock shelter and represents the type locality for the Magdalenian industry. Additionally, the uppermost stratigraphic levels at La Madeleine have yielded a set of well-preserved remains from a small human child estimated to have been 2–4 years of age based on skeletal and dental markers (Bayle et al. 2009: 494). This is an especially remarkable find due to the presence of 9 *in situ* deciduous teeth, which are rarely well-preserved in prehistoric humans (Bayle et al. 2009: 493).

Abbé Henri Breuil's (1913: 205) classification of six main periods within the La Madeleine sequence was the dominant framework surrounding Magdalenian categorization for over half a century. Criticism of Breuil's organization began in the 1970s when ^{14}C dates of artifacts from other Magdalenian sites in Spain and France revealed that a larger range of tool morphologies could represent the Magdalenian period. However, this critical view soon came under criticism itself as the poor chronological resolution of the dated assemblages and results from technological approaches like use-wear analysis became better understood (Pétillon 2016:

110). Pétillon's (2016: 110) meta-analysis of ^{14}C dates from 39 different Magdalenian assemblages used data from publications, unpublished theses, and the author's own dating of various artifact collections. Unlike some researchers from other studies, Pétillon (2016: 110) specifically excluded assemblages without well-established temporal and archaeological contexts or with a small sample size. The synthesized Magdalenian dates span from approximately 19–14 ka in late MIS 2, after the peak of the LGM (Pétillon 2016: 111).

The artifact assemblage at La Madeleine is characterized by thin, sharp antler points with special selective emphasis placed on smaller size (Pétillon 2016: 112). These projectile points were shaped from blanks extracted with the Groove-and-Splinter Technique (Pétillon 2016: 116), like those from the earlier Gravettian period (Pétillon and Ducasse 2012: 436). Small, thin lithic blades are also commonly found in Magdalenian assemblages (Figure 12). Indeed, 24 of the 31 Bullitt Collection artifacts from La Madeleine are these characteristic thin blades (Appendix B). A meta-analysis of lithic raw material sourcing from 15 French sites found the maximum radius of non-local flint procurement to be as large as 250 km at some sites, indicating high mobility (Langlais et al. 2016: 96).

Magdalenian artifacts are generally thought to represent the final stages of the Upper Paleolithic assemblage across many sites, including La Roche and La Madeleine. After the Upper Paleolithic, humans entered a new cultural period, the Mesolithic, which is not represented in the Bullitt Collection. Like the Middle-Upper Paleolithic transition, which was characterized by the interactions among Anatomically Modern Humans, Neanderthals, and their harsh environments, the time between the Upper Paleolithic and Neolithic was once again a story of environmental change and cultural adaptation. Fundamentally different subsistence strategies and increasingly complex social organization define this time period, including the domestication

Figure 12. Thin blade, sides 1 (top) and 2 (bottom), from La Madeleine. Very similar in form to the Magdalenian blades from La Roche which dominate the La Roche portion of the Collection, as well. James B. Bullitt Collection, RLA catalog no. 526a4. Scale in centimeters.

of plants and animals (Linton 2014; Plisson 2002). A rapidly warming climate after the end of the LGM paved the way for increased breadth of diet and more widely distributed settlements around the globe (Pokines 2000).

CHAPTER 5
THE NEOLITHIC PERIOD

Grand Pressigny

Grand Pressigny, one of the few Neolithic sites represented in the Bullitt Collection, is located in the Loire Valley of central France (Figure 2). Occupation at Grand Pressigny spans the Holocene epoch of geologic time in MIS 1 (Linton 235-236). Unlike the people of the Paleolithic, Neolithic humans domesticated plants and animals, which is reflected in their multifunctional tool assemblage. Evidence of grain and cereal processing, as well as meat cutting, is well-documented (Linton 2014; Plisson 2002). However, Grand Pressigny is most famous for being the source of a distinctive type of flint which is Upper Cretaceous in age. This flint was obtained from nodular chert contained within large limestone and chalk deposits in the area (Linton 2016: 236). The Grand Pressigny flint flakes easily and displays excellent conchoidal fracture, which makes it ideal for creating long flakes with extremely sharp edges (Figure 13). The Bullitt Collection contains 16 artifacts from Grand Pressigny, 15 of which are these long lithic blades, and 1 handaxe made from the same flint material (Appendix B).

Studies of Neolithic archaeological sites in several other countries have found artifacts made from the Grand Pressigny flint (Plisson 2002: 794). Dr. Bullitt visited the area during his travels in 1929:

> In Neolithic times an active trade in this flint began and specimens are found all over France and in Switzerland, Germany and even England. Its peculiar character identifies it, and traffic in it is the earliest evidence we have of prehistoric trade (Bullitt 1928–1929: 250).

Figure 13. Long blade, sides 1 (top) and 2 (bottom), from Grand Pressigny. Note the very defined flake scars and visible conchoidal fracture pattern that are characteristic of this excellent quality flint. James B. Bullitt Collection, RLA catalog no. 511a2. Scale in centimeters.

These artifacts, most of which are finely crafted flint daggers, were considered by archaeologists until recently to be prestige goods due to their common occurrence at burial and other ceremonial sites (Linton 2016: 236). However, they have been found discarded with evidence of heavy use in household contexts, which suggests they were also used in everyday activities (Plisson 2002: 794).

As in the Late Middle and Upper Paleolithic periods, retouching, indicative of tool reuse, is very common in the Grand Pressigny assemblage. Linton (2014) published a use-wear analysis of tools from Grand Pressigny that combined low-magnification observation for studying marks at a macroscopic scale and high magnification observation for detailed study of the polish on the objects. Linton (2014: 245) found a positive correlation between the length of the tool itself and the amount of time the tool was in use. Furthermore, cutting and longitudinal actions, such as cereal harvesting or preparation of plant fibers, were most frequently observed on the longest blades, while shorter blades that had undergone more retouching were used for less precise activities such as scraping and cutting meat (Linton 2014: 244-245).

Human occupation at Grand Pressigny spans the Holocene epoch MIS 1 (Linton 235-236). The Holocene, which continues through the present day, is a period characterized by warming after the end of the LGM. As the climate warmed, humans expanded the breadth of their diets, and with this expansion came increased variability in settlement patterns. Small mammals, birds, and fish replaced larger game like reindeer and horses (Pokines 2000). Jones (2007) examined the geographic distribution and elevation of settlements in France across the LGM-Holocene transition using geographic information systems (GIS) analysis. Site elevation variance increased in the Holocene, meaning there was a greater spread in the location of sites between the valleys and plateaus (Jones 2007: 349). By this point in human prehistory, *Homo sapiens* were the only surviving hominid species on the planet, having outcompeted or interbred with other species like *Homo neanderthalensis* to the point of their extinctions. *Homo sapiens* had spread to nearly every continent on Earth, and with their unparalleled ecological flexibility, social cooperation, and linguistic communication, the Neolithic Period would soon give way in just a few thousand more years to the Bronze Age and complex state societies.

CHAPTER 6
CONCLUSION

While it is clear that stone tool evolution was not always a linear process, there are some major trends through time that define the cultural periods within the Paleolithic and Neolithic. Dating back to the first hominid habitation in Europe, the Lower Paleolithic period was characterized by lithic production in the Abbevillian and Acheulean industries. The Lower Paleolithic assemblage was dominated by the bifacial handaxe. Over time, the size of removed flakes generally lengthened and narrowed, indicating a higher degree of precision (Lamotte and Tuffreau 2016: 64-65). Into the Middle Paleolithic, the archaeological record generally becomes richer in artifacts, and the amount of preserved hominid and mammalian skeletal material increases in comparison to the Lower Paleolithic (Frouin et al. 2017: 34). Thus, we have more data correlating Middle Paleolithic hominid species with their tool manufacture and subsistence strategies.

Middle Paleolithic tools were more varied in character than Lower Paleolithic tools and reflect a diversification in behavior and cyclic glacial and interglacial climate adaptation of *Homo neanderthalensis*. In addition to an overall greater variety of tool types, blade technology became much more sophisticated during the Mousterian, coincident with widespread evidence of retouching. This increase in tool reuse and the reduction of waste from repeated flake production hints at the intelligence required for the significant ecological adaptations. It is not yet conclusively known whether Anatomically Modern Humans ultimately outcompeted Neanderthals or assimilation by extensive interbreeding occurred between the two species.

However, the complexity of Middle Paleolithic Mousterian tools suggests, at the very least, that Neanderthals were not the brutish, unintelligent creatures they are often portrayed as.

The Upper Paleolithic period, dominated by the extreme cold of the LGM, was a time of tremendous environmental adaptation and rapid diversification of lithic industries in Europe. During the Upper Paleolithic, the onset of LGM drove *Homo sapiens* to adapt to their harsh environments, leading to the diversity that is apparent in the archaeological record today (Banks et al. 2013: 51). Highly specialized tools in the Aurignacian, Gravettian, and Magdalenian, sometimes appearing in the artifact assemblage for just a few thousand years, seem to have been developed and improved upon very rapidly. When compared to the Lower Paleolithic period, which spans hundreds of thousands of years, this pace of development is remarkably quick (Figure 1).

Humans during the recent Neolithic were highly mobile (Langlais et al. 2016: 96), and unlike their Paleolithic ancestors, Neolithic humans domesticated plants and animals, which is reflected in their tool assemblage. Thus, while the terms defining these cultural periods might be artificially imposed by modern researchers in the sense that Neanderthals had no idea they were living in the "Middle Paleolithic," they are by no means arbitrary. It can be quite useful to understand large-scale evolutionary trends within the framework of these cultural periods; though, as will be discussed, categorization of any kind by modern researchers is not without its share of implicit assumptions.

Evidently, some of the most significant behavioral changes in the history of human evolution occurred through the Paleolithic and Neolithic periods. From the first stone tools made by hominids outside of Africa to the recent domestication of plants and animals, the French archaeological record contains evidence of important adaptations to the harsh Pleistocene landscape. Within the past three decades, modern archaeology has revolutionized the study of hominid evolution by drawing from paleoclimatology and isotope geochemistry to reevaluate archaeological sites and understand them in the context of their paleoenvironment. This interdisciplinary approach builds upon decades of previous scholarship, from the early culture-history period to processual archaeology and beyond. The progression of theoretical approaches employed by archaeologists is evident in relatively new techniques from the past few decades, like use-wear analysis (Banks 2004; Keeley 1974; Linton 2014), and brand new statistical approaches from the past few years, like ecological niche analysis (Banks et al. 2013).

These newer approaches represent an attempt to diversify the analytical repertoire of archaeology in order to subvert the limited scope of pure typological categorization. However, even when categorizing lithics using the functional approach, as is the purpose of use-wear analysis, it is almost impossible to escape the typological or stratigraphic divisions set forth in the earliest publications on a particular site (Odell 2001: 48). With the exception of a few sites, such as La Micoque, extensive stratigraphic revision doesn't appear to be common in contemporary French Paleolithic archeology. Additionally, in examining characteristics of an artifact beyond its morphology, scholars tend to assume that this approach is inherently more rigorous and 'scientific' in nature (Binford and Sabloff 1982; Dunnell 1978). Dunnell (1978: 193) thus raises an important question: "how can we tell that a rigorously derived answer is also [correct] in some sense?" This is quite a difficult question to answer, as categorization of some kind is obviously needed to allow advancements in prehistoric tool-making to be observable in the archaeological record.

The consensus across the discipline seems to be that striking a balance between form and function, historical definitions and new approaches, and examining both steps of lithic production and their products is the best way to secure a comprehensive conclusion. However, finding this balance in an attempt to 'do it all' inherently increases the number of assumptions being made when conducting analyses (Binford and Sabloff 1982; Dunnell 1978; Odell 2001). I do think some sort of standardization in practice could be beneficial to the discipline, which historically has lacked this type of formal paradigm. I am not necessarily advocating for a logical positivist approach like that of 1960s processual archaeology, but rather an approach to archaeological interpretation which acknowledges the impossibility of objective analysis when archaeologists try to make sense of the behaviors of other humans (Binford and Sabloff 1982). This is also the basis of criticism of the French *chaîne opératoire*, for example, which considers the steps of tool modification and use to be an adaptive cultural response (Sellet 1993: 110). Critics of the *chaîne opératoire* argue that because it is essentially based on identifying the intentions and goals of prehistoric knappers, it is impossible for researchers to avoid projecting their own ideas about what makes for a practical and useful tool onto their analyses (Bar–Yosef and Van Peer 2009: 108).

While stable isotope analysis and radiometric dating are new techniques, geologists have been shaping theory and practice in Paleolithic archaeology from the very beginning. Early archeological research on Abbevillian and Acheulean sites in the Somme basin was published by Jacques Boucher de Perthes in 1847 (Antoine et al. 2015: 78) and Gabriel de Mortillet in 1873 (Mortillet 1873: 432-434; de la Torre 2016: 2). Boucher de Perthes' reports were published during the infancy of Paleolithic archaeology, and his work did not gain traction because the concept of evolution was considered sacrilegious in French society, including by many scientists (Sackett 2014: 8). However, beginning in 1859, the stratigraphy of his gravel pits was confirmed by British geologists. The presence of *in situ* lithic artifacts within these stratigraphic sequences made a solid case for the importance of artifacts in the study of human ancestors (Sackett 2014: 8-10). However, some researchers, even Abbé Henri Breuil from Dr. Bullitt's time, refused to confront hominid evolution as a reason for variability in tool assemblages through time. His volumes are filled with detailed sketches of the artifacts he unearthed, and almost all of his commentary is centered around classifying their formal type and morphology (Breuil 1913; Smith 1962: 202). By the 1940s, archaeologists began to demand greater evaluation of the evolutionary, cultural, and behavioral implications of Paleolithic artifacts (Bennett 1943: 208-210). In modern research, ecological environment is also an important factor. Thus, while methods in geology have transformed greatly over time, the importance of geology to the discipline of Paleolithic archeology has remained of paramount importance.

The Bullitt Collection, obtained almost a century ago, is a representative collection, meaning that the artifacts were collected from private collectors, excavators, professors, and museums without archaeological context (Bullitt 1928–1929). Three of the sites in the Collection analyzed for this thesis—Le Moustier, Labatut, and La Roche—either contain artifacts that do not represent the tool industry classically associated with that site or have clear bias towards a subset of tool types. While representative collections like the Bullitt Collection do not represent the breadth and context of archaeological material found at the sites, they have the unique advantage of showcasing the best examples of the incredible diversity in toolmaking techniques that our ancestors practiced. In fact, 51 of the 511 artifacts examined in this thesis are housed in the archaeology teaching collection at UNC Chapel Hill as exemplars of the important evolutionary milestones discussed in this thesis.

Archaeology, like the other subdisciplines of anthropology, is constantly evolving to find ever more creative and interdisciplinary ways to answer difficult interpretive questions. Yet, unlike in the other subdisciplines, archaeologists cannot communicate with their interlocutors. Therefore, we are left to decipher what we can from the tools our long-dead ancestors left behind. Thus, two main themes in this thesis—theoretical shifts in the history of Paleolithic archaeology and synthesis of important human evolutionary changes through the European Paleolithic—are intertwined. Through the examination of representative collections like the Bullitt Collection, one can observe major trends in tool manufacture which are particularly useful in education about Paleolithic archaeology.

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Appendix A. Inventory of Artifacts from the James B. Bullitt Collection.

Sites are listed alphabetically by country; those used in this study are indicated.

Country and Site	RLA Accession Number	Total Artifacts	Comment
France			
Abbeville	518	31	Examined for thesis
Abri Casserole	533	4	
Amiens Cagny	513	58	
Amiens de Bray	552	1	
Amiens Montieres	516	37	
Amiens Montieres-Etouvy	539	61	
Belle Assisse	537	35	
Blanchard	547	85	Examined for thesis
Brady or Boray?	550	1	
Brenoiville	553	8	
Bures	514	1	
Campiegne	504	10	
Carnac	529	1	
Carson	551	1	
Catenoy	538	16	
Caubert Somme	506	4	
Chambes	523	25	
Combe Capelle	520	34	
Copblance	498	7	
Cro-Magnon	525	4	
Dordogne Plateau	556	41	
Dunes Ambleteuse et Wimereux	559	4	
Fitz James	535	3	
Foum Tatahouine	610	2	
Garrone	501	8	
Grand Pressigny	511	16	Examined for thesis
Hedunville	557	1	
Jean Blanc	507	1	
La Foge St. Sauveur (Vienne)	601	1	
La Houssaie	615	1	
La Madeleine	526	31	Examined for thesis
La Micoque	521	16	Examined for thesis
La Quina	524	229	Examined for thesis
La Roche	531	47	Examined for thesis
La Rochette	517	32	
La Souquette	541	5	
Labatut	555	147	Examined for thesis
Laugerie Basse	530	13	
Le Moustier	519	14	Examined for thesis

Appendix A continued.

Country and Site	RLA Accession Number	Total Artifacts	Comment
France (continued)			
Le Peue	546	1	
Le Placard	542	6	
Le Roc	510	108	
Les Eyzies	534	2	
Lestrugues	503	2	
Lheure	508	1	
Lignieres	607	1	
L'Isle Adam	527	3	
Long Pre	548	1	
Maignelay	612	1	
Marceuils/Lay	614	1	
Mas d'Azil	502	5	
Meinemore	563	1	
Montersllиez	558	1	
Montieres Boutye Merchanbled	512	1	
Montmoreney Neo.	500	1	
Neuflase	549	3	
Neuville Lerrieres	499	1	
Nivernay	545	1	
Northern France	543	2	
Orleans	532	1	
Parmain	505	1	
Picardy	611	1	
Raymonden Chancelade	522	2	
Seine Inferieure	544	2	
St. Acheul Amiens	515	15	Examined for thesis
St. Riguier	554	1	
St. Romain Le Puy	608	1	
Tabaterie	536	5	
Tricot	609	1	
Tuiannay	613	1	
Unknown Sites	509	131	
Vendee	528	1	
Wacquemoulin	540	1	
England			
Barnefield Pit	567	30	
Bawbrigh	593	2	
Bulbins	565	1	
Carrow	577	2	

Appendix A continued.

Country and Site	RLA Accession Number	Total Artifacts	Comment
England (continued)			
Chivers Pit, Ramsay	568	3	
Cossey	584	5	
Cosstenay	595	1	
Cranwich	572	81	
Cringleford	574	8	
Cromer	571	29	
Drayton	591	2	
Dunbridge	566	26	
East Runton	589	2	
Easton	588	1	
Grimes Graves (Weeting)	583	6	
Harlow	592	1	
Haveringland	596	1	
Kelling	582	89	
Ketteringham	575	3	
Melton	573	1	
Mundford	587	5	
Ramsey	570	1	
Ringland	579	9	
Santon (Downham)	578	14	
Sewage (Whittingham)	576	3	
Sparham	586	1	
Swaffham	600	2	
Thetford	580	1	
Thorpe Pit	581	8	
Unknown Sites	599	62	
Weeting	598	2	
West Runton	590	2	
White House (Whitlingham)	597	7	
Whitlingham	594	1	
Wiltshire	569	1	
Belgium			
Spienne	562	5	
Switzerland			
Berne	560	2	
Canton d'Envernem	561	2	

Appendix B. Measurements and Notes on Artifacts Selected for Study.

Sites are presented in the order they are discussed in this thesis. Information is based on the RLA specimen catalog, except for individual artifact measurements and notes at the end of each site table. These are based on the author's analysis.

Each artifact was digitally photographed from two sides, and these photos are available through the Carolina Digital Repository (cdr.lib.unc.edu) by searching on the catalog number.

Abbeville (Lower Paleolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
518a1-1	Pitted Stone Ball	101.9	
518a2-1	Large Hand Axe	160.3	Teaching Collection
518a2-4	Large Hand Axe	118.8	
518a2-5	Large Hand Axe	98.9	
518a2-6	Large Hand Axe	137.4	
518a2-7	Large Hand Axe	119.2	
518a2-8	Large Hand Axe	151.0	
518a2-9	Large Hand Axe	141.8	
518a2-10	Large Hand Axe	130.0	
518a2-11	Large Hand Axe	112.9	
518a3-1	Hand Axe	117.9	Teaching Collection
518a3-2	Hand Axe	123.9	
518a3-3	Hand Axe	102.4	
518a3-4	Hand Axe	84.6	
518a3-5	Hand Axe	101.6	
518a3-6	Hand Axe	97.9	
518a4-1	Flake	70.7	
518a4-2	Flake	54.9	
518a4-3	Flake	74.6	
518a4-4	Flake	52.1	
518a4-5	Flake	47.3	
518a5-1	Large Blade	88.9	Teaching Collection
518a6-1	Celt	95.2	
518a7-1	Blade	91.2	
518a7-2	Blade	83.9	
518a7-3	Blade	64.3	

Notes:
-Large handaxes, approx. size of palm
-Handaxes dominate assemblage
-Similar material throughout handaxes (lots of natural holes/pits)
-Not much retouching or extensive flake removal from handaxes
-Blades not production type but used as points

Appendix B continued.

St. Acheul Amiens (Lower Paleolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
515a1-1	Hand Axe	117.1	Teaching Collection
515a1-2	Hand Axe	119.2	Teaching Collection
515a1-3	Hand Axe	135.6	Teaching Collection
515a2-1	Broken Hand Axe	106.5	
515a2-2	Broken Hand Axe	94.3	
515a3-1	Celt	125.0	
515a4-1	Scraper	89.7	
515a4-2	Scraper	74.5	
515a4-3	Scraper	57.3	
515a5-1	Flake	67.5	
515a5-2	Flake	62.0	
515a5-3	Flake	81.0	
515a5-4	Flake	87.5	

Notes:
-Large bifacial handaxes (departure form hammerstone use of Abbevillian)
-More flakes removed from edge than Abbevillian
-Good conchoidal fracture
-Flint very smooth, easily flakes like Grand Pressigny
-Varied materials (some flakes chalky or quartzite)
-Broken handaxes present (unique from selected sites)

Appendix B continued.

La Micoque (Lower Paleolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
521a1-1	Hand Axe	98.3	
521a1-2	Hand Axe	3.5	
521a2-1	Flake	46.2	
521a2-2	Flake	64.7	
521a2-3	Flake	40.5	
521a2-4	Flake	60.3	
521a2-5	Flake	55.2	
521a3-1	Scraper	49.4	
521a3-2	Scraper	50.8	
521a3-3	Scraper	42.7	
521a3-4	Scraper	62.2	
521a3-5	Scraper	33	
521a3-6	Scraper	44.2	
521a3-7	Scraper	53.9	
521a3-8	Scraper	50.6	
521a3-9	Scraper	50.5	

Notes:
-Some scrapers appear proto-Levallois with a large flake removed off the top
-Majority are chalky white material (fragile) and not quartzite or flint
-Lightweight due to heavy weathering of $CaCO_3$

Appendix B continued.

La Quina (Middle Paleolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
524a2-1	Large Flake	97.3	Teaching Collection
524a2-2	Large Flake	35.6	
524a2-3	Large Flake	110.1	
524a2-4	Large Flake	68.9	
524a2-5	Large Flake	96.4	
524a3	Hammerstone	76.3	
524a3	Hammerstone (burned)	119.7	
524a3	Hammerstone	76.0	
524a4-1	Blade	70.2	Teaching Collection
524a4-2	Blade	53.9	Teaching Collection
524a4-3	Blade	71.9	Teaching Collection
524a4-4	Blade	76.0	Teaching Collection
524a4-5	Blade	53.0	Teaching Collection
524a4-6	Blade	91.7	
524a4-7	Blade	61.7	
524a4-8	Blade	81.7	
524a4-9	Blade	55.9	
524a4-10	Blade	50.3	
524a4-11	Blade	74.0	
524a4-12	Blade	62.6	
524a4-13	Blade	72.3	
524a4-14	Blade	47.1	
524a4-15	Blade	55.6	
524a4-16	Blade	52.6	
524a4-17	Blade	67.5	
524a4-18	Blade	52.5	
524a4-19	Blade	59.7	
524a4-20	Blade	43.7	
524a4-21	Blade	63.4	
524a4-22	Blade	51.7	
524a4-23	Blade	62.6	
524a4-24	Blade	62.2	
524a4-25	Blade	92.9	
524a4-26	Blade	63.3	
524a4-27	Blade	64.5	
524a4-28	Blade	45.1	
524a4-29	Blade	62.3	
524a4-30	Blade	39.7	
524a4-31	Blade	47.9	
524a4-32	Blade	64.3	
524a4-33	Blade	45.8	

La Quina (Middle Paleolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
524a4-34	Blade	49.3	
524a4-35	Blade	52.6	
524a4-36	Blade	61.8	
524a4-37	Blade	56.0	
524a4-38	Blade	69.4	
524a4-39	Blade	49.6	
524a4-40	Blade	54.8	
524a4-41	Blade	67.1	
524a4-42	Blade	63.1	
524a4-43	Blade	51.2	
524a4-44	Blade	69.0	
524a4-45	Blade	62.3	
524a4-46	Blade	66.4	
524a4-47	Blade	66.8	
524a4-48	Blade	49.7	
524a4-49	Blade	54.0	
524a4-50	Blade	78.9	
524a4-51	Blade	52.3	
524a4-52	Blade	66.5	
524a4-53	Blade	54.9	
524a4-54	Blade	46.4	
524a4-55	Blade	55.5	
524a4-56	Blade	56.0	
524a4-57	Blade	49.7	
524a4-58	Blade	59.9	
524a4-59	Blade	45.4	
524a4-60	Blade	55.2	
524a4-61	Blade	48.0	
524a4-62	Blade	58.0	
524a4-63	Blade	62.5	
524a4-64	Blade	59.9	
524a4-65	Blade	61.1	
524a4-66	Blade	47.7	
524a4-67	Blade	43.7	
524a4-68	Blade	58.9	
524a4-69	Blade	51.7	
524a4-70	Blade	58.6	
524a4-71	Blade	34.2	
524a4-72	Blade	52.9	
524a4-73	Blade	44.5	
524a4-74	Blade	45.4	
524a5-1	Knife	59.2	Teaching Collection

La Quina (Middle Paleolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
524a5-2	Knife	53.4	Teaching Collection
524a6-1	Scraper	64.4	Teaching Collection
524a6-2	Scraper	60.0	Teaching Collection
524a6-3	Scraper	67.5	Teaching Collection
524a6-4	Scraper	55.0	Teaching Collection
524a6-5	Scraper	57.5	Teaching Collection
524a6-6	Scraper	54.4	Teaching Collection
524a6-7	Scraper	74.1	Teaching Collection
524a7-1	Drill	65.0	
524a7-2	Drill	51.6	
524a7-3	Drill	57.8	
524a7-4	Drill	58.4	
524a7-5	Drill	53.8	
524a8-1	Graver	77.2	Teaching Collection
524a8-2	Graver	66.5	
524a8-3	Graver	67.7	
524a8-4	Graver	35.6	
524a8-5	Graver	49.7	
524a8-6	Graver	47.6	

Notes:
-Quartzite hammerstones may be mislabeled–may just be cores
-Gravers (burins) may be mislabeled (pointy triangular prism shaped–524a8)
-Some overlapped retouching on scrapers (signals middle paleolithic)
-Scrapers are made from thick flakes w/ convex scraping edge
-Some flakes appear proto-Levallois

Appendix B continued.

Le Moustier (Middle Paleolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
519a1-1	Drill	73.0	
519a1-2	Drill	62.3	
519a2-1	Scraper	58.5	Teaching Collection
519a2-2	Scraper	51.4	
519a2-3	Scraper	37.6	
519a2-4	Scraper	32.0	
519a2-5	Scraper	48.2	
519a3-1	Blade	60.8	
519a3-2	Blade	55.7	
519a3-3	Blade	53.8	
519a3-4	Blade	44.8	
519a3-5	Blade	62.1	
519a3-6	Blade	71.1	
519a4-1	Rock	90.2	

Notes:
-Drills mislabeled–may just be cores or scrapers
-Retouched scrapers
-All typical Mousterian Levallois
-No denticulate or MTA

Appendix B continued.

Blanchard (Upper Paleolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
547a1-1	Snub Nose Scraper	46.7	Teaching Collection
547a1-2	Snub Nose Scraper	70.9	
547a1-3	Snub Nose Scraper	58.5	
547a1-4	Snub Nose Scraper	54.6	
547a1-5	Snub Nose Scraper	41.9	
547a1-6	Snub Nose Scraper	32.5	
547a1-7	Snub Nose Scraper	53.2	
547a1-8	Snub Nose Scraper	41.4	
547a1-9	Snub Nose Scraper	58.1	
547a1-10	Snub Nose Scraper	50.1	
547a1-11	Snub Nose Scraper	62.5	
547a1-12	Snub Nose Scraper	61.4	
547a1-13	Snub Nose Scraper	54.2	
547a1-14	Snub Nose Scraper	65.4	
547a1-15	Snub Nose Scraper	53.3	
547a1-16	Snub Nose Scraper	45.5	
547a1-17	Snub Nose Scraper	26.8	
547a2-1	Large Blade	87.7	
547a2-2	Large Blade	75.4	
547a2-3	Large Blade	71.2	
547a2-4	Large Blade	87.1	
547a3-1	Core	60.4	
547a3-2	Core	69.7	
547a3-3	Core	62.1	
547a3-4	Core	43.3	
547a3-5	Core	53.4	
547a3-6	Core	49.8	
547a3-7	Core	50.3	
547a3-8	Core	54.9	
547a4-1	Graver	65.7	
547a4-2	Graver	53.2	
547a4-3	Graver	53.3	
547a4-4	Graver	44.3	
547a5-1	Large Flake	85.6	
547a6-1	Blade	49.8	
547a6-2	Blade	43.5	
547a6-3	Blade	35.6	
547a6-4	Blade	41.3	
547a6-5	Blade	45.3	
547a6-6	Blade	59.3	
547a6-7	Blade	37.0	

Blanchard (Upper Paleolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
547a6-8	Blade	43.1	
547a6-9	Blade	60.4	
547a6-10	Blade	40.4	
547a6-11	Blade	69.4	
547a6-12	Blade	30.6	
547a6-13	Blade	32.3	
547a6-14	Blade	39.2	
547a7-1	Thin Blade	56.1	
547a7-2	Thin Blade	70.1	
547a7-3	Thin Blade	53.4	
547a7-4	Thin Blade	50.5	
547a7-5	Thin Blade	77.2	
547a7-6	Thin Blade	59.7	
547a7-7	Thin Blade	55.7	
547a7-8	Thin Blade	67.8	
547a7-9	Thin Blade	32.6	
547a7-10	Thin Blade	69.0	
547a9-1	Thin Blade	82.7	
547a9-2	Thin Blade	56.1	
547a9-3	Thin Blade	55.5	
547a10-1	Snub Nose Scraper	49.8	Teaching Collection
547a10-2	Snub Nose Scraper	66.0	
547a11-1	Scraper	79.0	

Notes:
-Good flint with excellent conchoidal fracture
-Very long and thin, likely takes considerable skill
-No broken pieces–selection bias probably
-True gravers/burins
-Dominantly blades/bladelets (over half) and rest Aurignacian scrapers
-In this case, collection represents Aurignacian well
-No diagnostic GST antler points

Appendix B continued.

Labatut (Upper Paleolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
555a2-1	Microlith	31.2	Teaching Collection
555a2-2	Microlith	34.4	Teaching Collection
555a2-3	Microlith	33.0	
555a2-4	Microlith	29.7	
555a2-5	Microlith	22.5	
555a2-6	Microlith	50.2	
555a2-7	Microlith	28.5	
555a2-8	Microlith	38.6	
555a2-9	Microlith	28.1	
555a2-10	Microlith	36.9	
555a2-11	Microlith	55.0	
555a2-12	Microlith	36.0	
555a2-13	Microlith	35.9	
555a2-14	Microlith	33.3	
555a2-15	Microlith	35.1	
555a2-16	Microlith	34.1	
555a2-17	Microlith	16.2	
555a2-18	Microlith	41.4	
555a2-19	Microlith	41.6	
555a2-20	Microlith	29.2	
555a2-21	Microlith	51.3	
555a2-22	Microlith	33.0	
555a2-23	Microlith	20.8	
555a2-24	Microlith	19.4	
555a2-25	Microlith	28.5	
555a2-26	Microlith	23.2	
555a2-27	Microlith	33.0	
555a2-28	Microlith	38.7	
555a2-29	Microlith	18.5	
555a2-30	Microlith	25.7	
555a2-31	Microlith	29.8	
555a3-1	Small Blade	55.6	
555a3-2	Small Blade	50.9	
555a4-1	Graver	40.0	Teaching Collection
555a4-2	Graver	50.3	Teaching Collection
555a4-3	Graver	45.0	
555a4-4	Graver	52.3	
555a4-5	Graver	43.4	
555a4-6	Graver	47.3	
555a4-7	Graver	81.7	
555a4-8	Graver	50.8	

Labatut (Upper Paleolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
555a4-9	Graver	51.9	
555a4-10	Graver	38.3	
555a4-11	Graver	64.6	
555a4-12	Graver	52.3	
555a4-13	Graver	53.5	
555a4-14	Graver	38.4	
555a4-15	Graver	70.0	
555a4-16	Graver	44.7	
555a4-17	Graver	73.1	
555a4-18	Graver	54.2	
555a4-19	Graver	52.6	
555a4-20	Graver	48.7	
555a4-21	Graver	48.6	
555a4-22	Graver	52.2	
555a4-23	Graver	92.1	
555a4-24	Graver	71.7	
555a4-25	Graver	72.6	
555a4-26	Graver	64.0	
555a4-27	Graver	64.5	
555a4-28	Graver	60.2	
555a4-29	Graver	57.9	
555a4-30	Graver	48.2	
555a4-31	Graver	37.6	
555a4-32	Graver	35.6	
555a4-33	Graver	44.4	
555a4-34	Graver	53.3	
555a4-35	Graver	43.8	
555a4-36	Graver	45.6	
555a4-37	Graver	28.9	
555a4-38	Graver	66.5	
555a4-39	Graver	44.3	
555a5-1	Scraper	68.9	
555a5-2	Scraper	69.7	
555a5-3	Scraper	60.1	
555a6-1	Snub Nose Scraper	72.4	
555a6-2	Snub Nose Scraper	65.2	
555a6-3	Snub Nose Scraper	59.8	
555a6-4	Snub Nose Scraper	73.8	
555a6-5	Snub Nose Scraper	61.5	
555a6-6	Snub Nose Scraper	56.2	
555a6-7	Snub Nose Scraper	71.4	
555a6-8	Snub Nose Scraper	59.2	

Labatut (Upper Paleolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
555a6-9	Snub Nose Scraper	63.7	
555a6-10	Snub Nose Scraper	54.7	
555a6-11	Snub Nose Scraper	57.8	
555a6-12	Snub Nose Scraper	72.5	
555a6-13	Snub Nose Scraper	19.8	
555a7-1	Blade	119.9	Teaching Collection
555a7-2	Blade	71.6	Teaching Collection
555a7-3	Blade	101.5	Teaching Collection
555a7-4	Blade	61.1	Teaching Collection
555a7-5	Blade	97.3	
555a7-6	Blade	89.8	
555a7-7	Blade	105.9	
555a7-8	Blade	86.2	
555a7-9	Blade	70.4	
555a7-10	Blade	123.2	
555a7-11	Blade	41.6	
555a7-12	Blade	69.4	
555a7-13	Blade	65.6	
555a7-14	Blade	37.3	
555a7-15	Blade	72.5	
555a7-16	Blade	63.9	
555a7-17	Blade	69.4	
555a7-18	Blade	30.7	
555a7-19	Blade	103.2	
555a7-20	Blade	77.5	
555a7-21	Blade	85.1	
555a7-22	Blade	102.7	
555a7-23	Blade	76.4	
555a7-24	Blade	48.6	
555a7-25	Blade	41.7	
555a7-26	Blade	51	
555a7-27	Blade	55.5	
555a7-28	Blade	73.7	
555a7-29	Blade	70.5	
555a7-30	Blade	51.2	
555a7-31	Blade	42.7	
555a7-32	Blade	32.6	
555a7-33	Blade	54.7	
555a7-34	Blade	27.7	
555a7-35	Blade	24.4	
555a8-1	Large Blade	92.3	Teaching Collection
555a8-2	Large Blade	94.8	

Labatut (Upper Paleolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
555a8-3	Large Blade	114	
555a8-4	Large Blade	83.6	
555a8-5	Large Blade	81.3	
555a8-6	Large Blade	73.2	
555a8-7	Large Blade	97.1	
555a8-8	Large Blade	58.3	
555a8-9	Large Blade	78.9	
555a8-10	Large Blade	50.7	
555a8-11	Large Blade	66.4	
555a8-12	Large Blade	101.3	
555a8-13	Large Blade	77.4	
555a8-14	Large Blade	90.4	
555a8-15	Large Blade	71.8	
555a8-16	Large Blade	111.7	
555a8-17	Large Blade	84.2	
555a8-18	Large Blade	91.3	
555a8-19	Large Blade	83.5	
555a9-1	Core	109.2	

Notes:
- -Noailles and flat burins
- -No Gravette points
- -Also some very thin Magdalenian-looking microliths
- -Emphasizes cautionary point about examining representative collections
- -No diagnostic GST antler points

Appendix B continued.

La Roche (Upper Paleolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
531a1-2	Microlith	48.9	
531a2-1	Blade	49.2	Teaching Collection
531a2-6	Blade (In Matrix)	88.7	
531a2-7	Blade	119.5	
531a2-8	Blade	98.7	
531a2-9	Blade	108.2	
531a2-10	Blade	76.7	
531a2-11	Blade	89.2	
531a2-12	Blade	88.7	
531a2-13	Blade	63.3	
531a2-14	Blade	110.5	
531a2-15	Blade	52.9	
531a2-16	Blade	61.1	
531a2-17	Blade	77.5	
531a2-18	Blade	96.1	
531a2-19	Blade	61.2	
531a2-20	Blade	75.2	
531a2-21	Blade	63.9	
531a2-22	Blade	77.1	
531a2-23	Blade	76	
531a2-24	Blade	64.1	
531a2-25	Blade	51.4	
531a2-26	Blade	66.4	
531a2-27	Blade	67.9	
531a3-1	Scraper	66.7	
531a3-2	Scraper	67.8	
531a3-3	Scraper	57.5	
531a4-1	Graver	58.5	
531a5-1	Needle	35.9	
531a5-2	Needle	31.3	
531a6-1	Bone Core	56.1	
531a7-1	Fish Hook	36.6	
531a8-1	Worked Bone	37.9	
531a8-2	Worked Bone	18.9	
531a8-3	Worked Bone	36.9	
531a8-4	Worked Bone	38.3	
531a8-5	Worked Bone	49.3	
531a8-6	Worked Bone	63.8	
531a9-1	Worked Shell	20.4	
531a10-1	Bone Harpoon	34.3	
531a11-1	Long Blade	77.4	

La Roche (Upper Paleolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
531a11-2	Long Blade	84.3	

Notes:
- -Flint tools (finely worked thin blades)
- -Transitional between Mousterian and Magdalenian?
- -Bone needles
- -Blades similar to La Madeleine
- -Very thin blades like Magdalenian
- -Not seeing any Solutrean bifaces here

Appendix B continued.

La Madeleine (Upper Paleolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
526a2-1	Core	66.5	Teaching Collection
526a2-2	Core	54.7	Teaching Collection
526a2-3	Core	67.6	Teaching Collection
526a3-1	Graver	69.7	
526a3-2	Graver	45.3	
526a4-1	Microlith	32.5	Teaching Collection
526a4-2	Microlith	24.2	Teaching Collection
526a4-3	Microlith	34.6	
526a4-4	Microlith	18.4	
526a4-5	Microlith	44.8	
526a4-6	Microlith	46.9	
526a4-7	Microlith	45.1	
526a4-8	Microlith	40.8	
526a5-1	Blade	86.1	Teaching Collection
526a5-2	Blade	67.1	Teaching Collection
526a5-3	Blade	87.6	Teaching Collection
526a5-4	Blade	48.0	
526a5-5	Blade	75.6	
526a5-6	Blade	77.4	
526a5-7	Blade	51.2	
526a5-8	Blade	64.9	
526a5-9	Blade	39.2	
526a5-10	Blade	29.8	
526a5-11	Blade	74.2	
526a5-12	Blade	48.7	
526a5-13	Blade	55.1	
526a5-14	Blade	62.1	
526a5-15	Blade	46.1	
526a5-16	Blade	41.9	
526a6-1	Scraper	42.3	

Notes:
- -Blade technology
- -Small, thin, sharp
- -Very different than Mousterian
- -No diagnostic GST antler points
- -Very typical long, thin Magdalenian blade

Appendix B continued.

Grand Pressigny (Neolithic Period)

Catalog no.	Description	Maximum Length (mm)	Status
511a1-1	Very Large Core (Hammer)	136.3	511a1-1
511a1-2	Very Large Core (Hammer)	160.2	511a1-2
511a2-1	Long Blade	125.0	511a2-1
511a2-2	Long Blade	133.6	511a2-2
511a2-3	Long Blade	70.1	511a2-3
511a3-1	Extremely Large Core	> 30 cm	511a3-1
511a3-2	Extremely Large Core	> 30 cm	511a3-2
511a3-3	Extremely Large Core	> 30 cm	511a3-3
511a4-1	Blade	81.9	511a4-1
511a4-2	Blade	86.5	511a4-2
511a4-3	Blade	10.6	511a4-3
511a4-4	Blade	105.8	511a4-4
511a5	Hand Axe	158.3	511a5
511a6-1	Flake	72.8	511a6-1
511a6-2	Flake	59.7	511a6-2
511a6-3	Flake	79.3	511a6-3

Notes:

-Easy to see why this flint was traded so much: it has amazing conchoidal fracture and super sharp edges

-No large flint knives traditionally thought to be ceremonial/trade objects

-Huge cores over 30cm long from giant flint nodules

-Found in Cretaceous age limestone (65Ma)

-Very thin but wide, sturdy, sharp blades

-Clearly advanced technique from Upper Paleolithic