University of Southampton

Faculty of Arts and Humanities

Archaeology

A GIS analysis of spatial patterning in the Lower and Middle Palaeolithic findspots recorded in the Benjamin Harrison archive at Maidstone Museum and selected museums elsewhere.

by

Patricia Jones

MSc. MA

https://orcid.org/0009-0003-4061-5587

Thesis for the degree of Master of Philosophy

January 2024

Abstract

Faculty of Arts and Humanities

Archaeology

Thesis for the degree of Master of Philosophy

A GIS analysis of spatial patterning in the Lower and Middle Palaeolithic findspots recorded in the Benjamin Harrison archive at Maidstone Museum and selected museums elsewhere.

by Patricia Jones

Palaeolithic study in the Weald is sporadic and piecemeal, with many researchers using antiquarian collector's data from museums that are uncurated and poorly understood. One of the major collections for this area is that of Benjamin Harrison from Ightham in Kent, whose archive is predominately stored in Maidstone Museum. This study combines Antiquarian archives with the power of Geographic Information Systems (GIS) to see if there are spatial patterns in the data of Harrison, which could inform future research and provide insight into possible locations that Palaeolithic artefacts may be found.

The first level of analysis was of the artefacts themselves. Harrison's artefacts at Maidstone Museum were firstly curated into a useable database, cross- referencing where possible his lithic artefacts with his written logbooks, sketches and notebooks. A secondary database was created with those artefacts that could be spatially located using annotations from the artefact only. This formed the basis of the study.

GIS was then used to look for patterns in the data using six main areas of analysis, geological analysis, proximity to waterways, analysis of abrasion, slope analysis and landuse, and average nearest neighbour analysis.

The outcome of this analysis was that the two most likely location for Palaeolithic artefacts in the Wealden area of Kent are on the Lower Greensand and on gravels. Lower Palaeolithic artefacts were more prevalent near to waterways, and especially at interfluves, and Middle Palaeolithic artefacts were found further away from the rivers and streams. The artefacts presented as clustered rather than in a random pattern, which was most likely partly due to collection bias, but could also be a product of the geology having an effect upon the positioning of the artefacts. It is possible that that some of the findspots could be due to hominin discard. The artefacts that are fresh or even slightly rolled may not have moved far from their place of deposition.

Table of Contents

Table of Tables

Table of Figures

Research Thesis: Declaration of Authorship

Print name: Patricia Jones

Title of thesis: **A GIS analysis of spatial patterning in the Lower and Middle Palaeolithic findspots recorded in the Benjamin Harrison archive at Maidstone Museum and selected museums elsewhere**

I declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;

2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;

3. Where I have consulted the published work of others, this is always clearly attributed;

4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;

5. I have acknowledged all main sources of help;

6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;

7. None of this work has been published before submission

Signature: .....

Date: 16th January 2024

Acknowledgements

I would like to thank Doctor John McNabb, my supervisor at Southampton University, for his knowledge and support. You did not despair when all the personal disasters occurred and just kept me on track.

Also thank you to Angela Muthana who is the fount of all knowledge with regards to Benjamin Harrison and helped with the curation of the artefacts and in interpreting Harrison's writing, and to the rest of Maidstone Museum's staff who helped me to find all of the archive data and allowed me to study it for many hours.

Janet Bailey for her editing and office prowess and for being resilient in the face of adversity at the end and Lisa Fisher who read and provided feedback on the thesis and encouraged me to continue when I wanted to give up.

Finally, Mark Jones who didn't make me live in a shed in the garden until I finished after all and who spent many holidays watching me studying in the most beautiful places in the world.

Chapter 1: Introduction

The Palaeolithic period in Britain is currently thought to span from around 850 or 950 000 – 10 000 BP. It is divided into three stages, the Lower, Middle and Upper Palaeolithic.

> *'Natural Pleistocene geological deposits provide the basic evidence of, and context for, the Palaeolithic world. They contain the artefacts that reflect early human presence, and faunal and palaeo-environmental remains that allow reconstruction of wildlife, vegetation, climate and local landscape' (Wenban-Smith et al., 2010, p.5).*

During the Anglian and subsequent glaciations many of the sites and findspots of Palaeolithic Britain were scoured away by ice sheets. A large number of the Palaeolithic sites and findspots that have been discovered are in the south of England, which was undisturbed by these ice sheets. The maximum southern extent of the ice sheets was London, although much of the landscape of Southern England was periglacial (areas where freeze/thaw processes occur during periods of extreme cold).

Traditionally it is thought that Lower Palaeolithic material is most prevalent near to waterways and within or on fluvial gravel surfaces near to interfluves or meanders of rivers. As much of interglacial Britain had extensive tree cover during this time, rivers would provide pathways through the landscape and attract game for hunting (Ashton *et al.,* 2005, p. 54). The Middle Palaeolithic is often associated with higher ground, caves and rock shelters. This may be because often these sites are found close to raw material sources as proposed by Turq (1988, 1989), while allowing views over the landscape to spot the presence of prey on the valley sides and the lower ground below (Scott-Jackson, 2000). This thesis will cover the Lower and Middle Palaeolithic periods only (Approximately 850 or 950 000– 35 000 BP) and will be based in Kent, England.

1.1 The Lower and Middle Palaeolithic in Britain

The Lower and Middle Palaeolithic is situated in the Middle Pleistocene series of the Quaternary system. It is thought that Humans migrated between Britain and mainland Europe at least nine times during the oscillating temperatures of successive ice ages, finally beginning permanent settlement after the last ice age, about 12 000 years ago (De Groote et *al*., 2017).

The Lower Palaeolithic is the earliest period of human occupation in Britain. Pettitt and White (2012) considered the Lower Palaeolithic period as spanning from the Cromerian Interglacial (Marine Isotope stage (MIS 13)) to the advent of persistent use of Levallois technology around 300ka BP. A revised date for the end of the Acheulian cultural tradition, which is associated with the Lower Palaeolithic, is now

predicted to have been between 141 to 130 thousand years ago (kya) based on recent modelling, thus providing evidence of a cultural overlap between this and the Middle Palaeolithic (Key *et al.*, 2021). Current evidence of Human occupation in Britain during this period begins with footprints discovered at Happisburgh Site 3 (Norfolk) dated to between circa 1 million and 0.78 million years ago. These footprints are evidence of the oldest occupation of Britain discovered thus far (Ashton et *al.*, 2014; Key et *al*., 2022). Measurements of stature and foot size fall within the range of ***Homo antecessor*** when compared to fossil remains from Atapuerca, Spain. Humanly made flint artefacts have also been discovered in Happisburgh (Ashton, 2014). At Pakefield in Suffolk flint artefacts have been discovered dating to approximately 700 thousand years ago (Parfitt et *al*., 2005).

Fordwich (Kent, UK) is a site at which 330 bifaces were found in 1920 during quarrying, followed by 251 artefacts discovered in-situ in subsequent excavations. It reveals the presence of Acheulean hominins in what is now southeast Britain during MIS 15, a period dating to approximately 620 000 - 560 000 years ago (Key *et al*., 2022).

The earliest site in Britain to produce hominin fossil evidence alongside numerous flint artefacts is at **Boxgrove,** West Sussex, where a tibia and two lower incisors were discovered. These fossils were identified as originating from **Homo heidelbergensis**. Also present at Boxgrove were many handaxes and knapping scatters, along with faunal evidence of animals, mammals, birds and vegetation that were extant at that time, which gives us a huge insight into the area in the pre- Anglian glaciation period (MIS 13).

The sites mentioned above are all Lower Palaeolithic sites from the pre-Anglian period. Lower Palaeolithic material can grade into the Middle Palaeolithic, so the following are some post-Anglian sites leading towards the Middle Palaeolithic and Neanderthal occupation.

Swanscombe in Kent, UK had evidence of human occupation during the Hoxnian Interglacial, MIS 11, based on the fossil hominin remains known as the Swanscombe skull. The skull, which was discovered as three separate pieces, was discovered over a period of time and shows some Neanderthal-type features, suggesting that physical evolution from **Homo heidelbergensis** towards Neanderthals had already begun (Wenban-Smith et *al.,* 2010).

Pontnewydd Cave, Denbighshire Wales, dated to 225 000 years ago further produced human fossils. Teeth of early **Homo neanderthalensis** were discovered in the cave, probably in a secondary context after being washed into the cave by external forces. Flint tools and animal remains were also found there (De Groote et *al*., 2017).

Figure 1. Distribution of the main Palaeolithic archaeological sites of the British Isles, including (but not limited to) sites mentioned in the text (De Groote et al., 2017).

La Cotte de St Brelade, Jersey is a later Middle Palaeolithic site at which in 1910 and 1911, thirteen permanent fully erupted teeth were found on a ledge behind a hearth in a Mousterian occupation level. Those that were found to be human teeth had affinities to both **Homo neanderthalensis** and **Homo sapiens,** pointing toward a possible shared Neanderthal and modern human ancestry (McBurney et *al.,* 1971; Stringer et.al., 1984; Bates et.al., 2013; Compton, et *al.,* 2021).

Later evidence for Neanderthals was discovered at **Lynford quarry**, Norfolk, where extensive evidence has been found for Mousterian tools associated with eleven woolly mammoths. It is thought the larger bones were transported from the site as none were found there during excavation (De Groote, et *al*., 2017). These sites mentioned give a broad overview of the period, whilst other Palaeolithic sites can be seen in Figure 1 (above).

Figure 2. Location of the wider area around the study area of Ightham, Kent and its environs: Location maps derived from: - © OpenStreetMap contributors and available under the Open Database License.

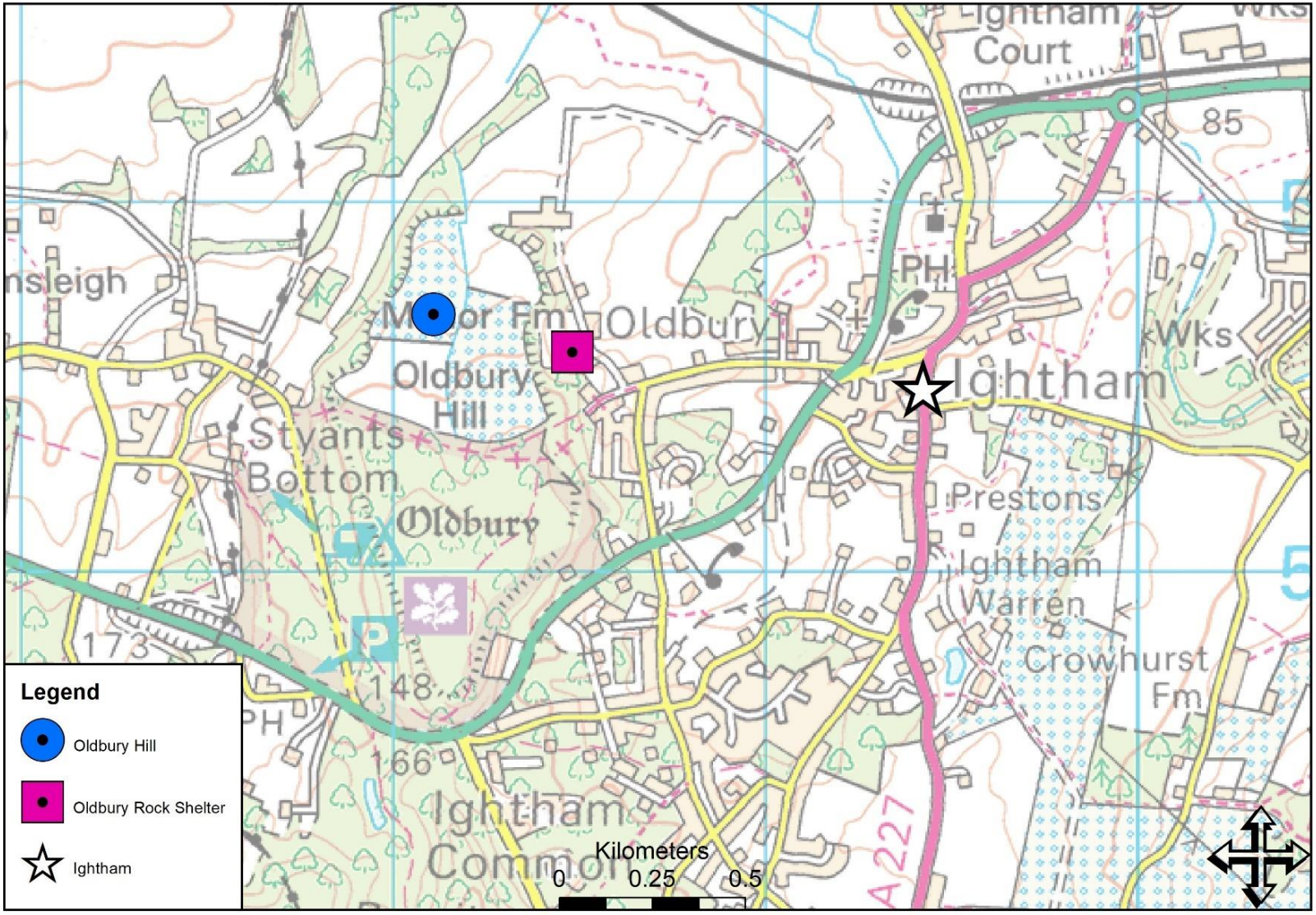


Figure 3. The study area of Ightham, Kent in the southeast of England. Location maps derived from: -© OpenStreetMap contributors and available under the Open Database License.

The possibility of studying patterns of this nature using surface finds presents itself in the Wealden area of Southern England (Figure 2), and particularly around the area near to Ightham and Oldbury Camp (Figure 3) where these landscape types are all present and large numbers of artefacts collected by Antiquarians are available to study.

Kent and the Weald has been the basis for this thesis for a number of reasons. The important area of the Lower Greensand and Gault, as described below (Figure 6), has drawn me to this area for the study of the Palaeolithic. My interest in the area developed further when I visited Swanscombe and Ebbsfleet in Kent, which are important Palaeolithic sites. Work on re-evaluation of artefacts from Ebbsfleet (Scott et al., 2010) from the British Museum had some similarities to a study I did for my MA (Master of Arts degree) in Archaeology at the University of Sussex. This was based on the artefacts from the South Downs in Sussex in the Western Weald, collected by an antiquarian called Reverend Shaw. Shaw was a collector of Palaeolithic artefacts and displayed them in a museum in his home. The relationship of these artefacts to their surroundings was an integral part of the study and were compared to those found at Slindon and Boxgrove, both in West Sussex. Shaw had many similarities to Benjamin Harrison (see Figure 4), an antiquarian from the Ightham area of Kent, who collected artefacts that were visible on the distribution maps of Palaeolithic artefacts that I had used in my MA. It was obvious that Harrison's was a notable collection, originating from the similar landscape and geology setting of the Wealden downland to the collection of Reverend Shaw. During my search for a PhD subject, I spoke to Doctor John McNabb of Southampton University and the subject of the Harrison Collection came up as an important archive, which needed further interpretation. After some discussion, I finally decided to work on the Harrison archive at Maidstone Museum for my PhD thesis. Due to personal circumstances and after considerable work on the archive, I reconsidered and changed to an MPhil.

Benjamin Harrison (Figure 4) lived and worked in the village of Ightham in Kent. He was a prolific antiquarian collector in the nineteenth and early twentieth centuries. He owned a grocers shop in the village and progressed from being a humble grocer, to having his archaeological and geological work considered by the Geological Society. He not only amassed an extensive collection of physical artefacts, but he produced a logbook of his finds, sketched each of them and mapped them. Most of this archive he donated to Maidstone Museum, although some are in the British Museum, with a few in various regional museums. Other artefacts he gave away to his peers, friends and family. Indeed, some of them he sent to his brother in Australia.

The aim of this research was to curate Harrison's artefacts in Maidstone museum into a useable archive, and to use this as a database to perform a spatial investigation in his area of collection. This involved many months, indeed years of work, as the museum is some distance away.

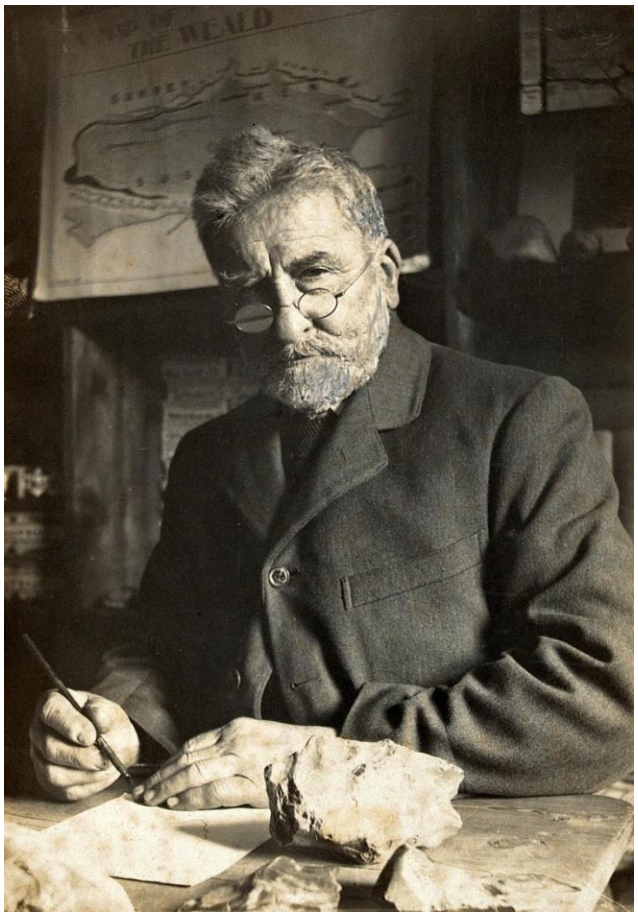


Figure 4. Benjamin Harrison, antiquarian and Palaeolithic Archaeologist: Photograph by Wallace Chisholm, Wellcome Collection 12872i.

The museum staff of Maidstone Museum assisted me in this venture, particularly Angela Muthana who is an expert in all things relating to Benjamin Harrison and is one of the few people who can actually read his writing. My thesis involved working through the artefacts one at a time to attempt to give them some provenance based on the written records and on the annotations on the artefacts in Harrison's collection. I will expand upon this process in Chapter 3.

Researchers study many aspects of the Palaeolithic period, but good data are one of the most important aspects of research. Many researchers must dip in and out of an archive due to time restraints, sometimes resulting in partial, inaccurate or incomplete data. Reliance on interpretation made many years ago when not all the information may have been available can also affect the accuracy of the results. A major issue with this is that some of the archives do not have associated written material to help us to interpret the artefacts that are stored in the museum stores, which leaves us to attempt to work out where they came from and what the original collectors' thoughts were about their artefact collections. When archives do incorporate written material, it can be difficult to understand the thoughts and methodologies of the author, along with trying to decipher difficult writing, decaying and damaged material and numerous other associated issues. Because of constant deposition into

museums of the archives from many commercial and voluntary excavations, along with donations and bequeathments, the artefacts can remain uncurated for some considerable time. Shortage of professional staff and volunteers can further impact these problems. These uncurated artefacts may be incorporated into research, scientific papers, and university theses; although once the archives are thoroughly curated, the outcome can be completely different.

Another aspect of multidisciplinary studies of the Palaeolithic is that much of the spatial analysis that can be applied today was not available in the past, or researchers may not always have been proficient in its use. This meant that spatial patterning of the data would have been much more difficult.

> *"So much of the evidence for the Palaeolithic occupation of this country was obtained in the nineteenth and early twentieth centuries that … the author must be something of a bibliophile and re-evaluator of hitherto unconsidered trifles". (Callow 1981: 239-240).*

This quote was used in the dissertation of Hosfield (1998) to describe the difficulties in investigating the Lower and Middle Palaeolithic in Britain and (amongst other things) reconstructing the collection behaviours, ideas and bias of Antiquarian collectors. There is no written evidence from the period to help us to understand the Palaeolithic period as there is in historical times; therefore, we have to use clues from geology, the landscape of the study area and the collections and research of both antiquarians and modern Prehistorians. Museums are our friend in this quest and there are endless collections of artefacts, notebooks, maps and even oral history passed on, particularly about antiquarians. In this research, an attempt is made to identify patterns in the archives of a great Antiquarian, Benjamin Harrison. In a similar manner as Hosfield (1998) in the investigations used for his PhD, I will use Geographical Information Systems (GIS) for much of the analysis. This is because there is a spatial aspect to all of the data.

There are many possible avenues of research to establish whether spatial patterning is present in these archives and the spatial analysis can take many forms. In this study, I will base it on the geology and topography of the area, for example the relationship of the artefacts' findspots to the local fluvial hydrology, the soliflucted gravels and their relationship to the superficial geology of the study area. The investigation will also be based on the proximity to waterways and patterning of the artefacts by period with regard to this proximity. Abrasion, slope and land use analysis may add to the information that could assist with this investigation.

There is a strong association of Lower Palaeolithic artefact locations with ancient water sources (i.e., fluvial or lacustrine). Whereas many (but certainly not all) Middle Palaeolithic sites are cave or high ground locations – often with valley systems behind them that could represent micro- climate refugia (McNabb, personal communication, 20th February 2021).

Chapter 2: Historical Background

2.1 Discoveries of 'Deep Time' in the 19th Century

In the early Victorian period, most people believed that God created all animals and humans approximately 6000 years ago in 4004 BC. This belief originated from Genesis in the Bible and was the time-frame of creation, worked out by Archbishop James Usher (McNabb, 2012: 19) using information from the Bible. This was the Mosaic Chronology and specified a once-only creation of all flora and fauna. No evolutionary ideas were tolerated (Gamble, 2021).

At this time there were a number of theories, which claimed to explain the existence of the flora and fauna in the context of Christianity, to name but a few, Diluvialism, Catastrophism, Creationism and Uniformitarianism. Early Victorians were tied to religious beliefs and to the idea that change was driven by progress:

> *'People and their scientific passion were enmeshed in the social, economic and political worlds of the nineteenth century' (Gamble 2021:4).*

Some creationists, known as Mosaic or Scriptural Geologists, believed that all life was created by God over a six-day period. They also believe in Noah's flood, brought about by God to wipe out all life on earth, apart from the relatives of Noah and two of every animal, with the idea that these godly people would repopulate the earth. There are modern creationists that still believe in this theory.

Catastrophists believed that geological strata were sequentially deposited over a long period but thought that they were formed as a result of catastrophic events such as volcanos, floods and tsunamis. They thought that only these violent events could account for the folding of rock strata that could be seen at that time (NCSE, 1983). Although Uniformitarians agreed that the earth was very old and that sediments were deposited over a long period, they believed that these changes could come about by gradual sustained processes rather than just violent events (NCSE, 1983). Sometimes these were adapted to the Day-Age theory as more discoveries were made, in which they believed that the days of creation corresponded to geological eras. Others adopted Gap-Theory, that most geological strata were deposited between the original creation specified in Genesis 1:1 and the subsequent events in Genesis (NCSE, 1983). Diluvialists believed a recent worldwide flood was behind the deposition of superficial sedimentary deposits and of river valleys (NCSE, 1983).

The Reverend William Buckland, Theologian, Geologist and Dean of Westminster, believed that geology supported Noah's flood. He also believed that there were several earlier deluges, each terminating a previous creation by God, after which both new and previous species appeared (McNabb, 2012: 20). He wrote in his book Reliquiae Diluvianae (1823):

'Thus far I have produced … incontrovertible body of facts, to show that the whole earth has been subject to a recent and universal inundation' (Buckland, 1823: p. 224).

Buckland was most famed for his discoveries at the Kirkdale Hyena cave in 1821, where he examined the bones of extinct animals and attributed them to inundation (Buckland, 1822), and for his misinterpretation of the Upper Palaeolithic burial at Paviland Cave as being of Roman origin. He did convert to the theories of glacial and fluvial deposition in the late 1830s even though it was not tied to the Bible (Roe, 1981).

Another believer in the great floods was George Cuvier, a French Naturalist and Zoologist in the early nineteenth century. He was considered the founding father of comparative anatomy and Paleontology and he established that extinction was a fact (University of California, Berkeley, N.D.). Buckland says that:

'M. Cuvier, in his Essay on the Theory of the Earth, expresses his conviction, that if there be any one fact thoroughly established by geological investigations, it is that of the low antiquity of the present state of the surface of the earth, and the circumstance of its having been overwhelmed at no very distant period by the waters of a transient deluge' (Buckland, 1823: 225).

Both were convinced that humans did not exist before this great inundation (Buckland, 1823: 231). The only way to bring about a change from these beliefs was to find evidence of humans in association with geology (Gamble, 2021: 2).

Charles Lyell, an eminent geologist and Professor at Kings College in the early 1800s, published a book, 'Principles of Geology' in three volumes from 1830 – 1833. This demonstrated conclusively that the earth must be millions of years old, and that the earth's current state is the result of the same forces still acting upon it today (Lyell, 1830-33). His work proved the concept of 'Deep time' but did not include humans (Gamble, 2021). Many of the principal players in the discoveries of 1859 agreed with Babbage on the 'Geological law of superposition', which stated:

'the order of succession of strata indicates the order of their antiquity, the lowest levels being the oldest' (Babbage 1859 - 60:67).

Geologists at the time thought that the geological timescale consisted of Primary, Secondary and Tertiary periods. Primary they associated with the forming and cooling of the earth, the development of the earth's crust and the formations of the oceans and land masses, and finally the appearance of vegetation, molluscs and fish. Secondary was the age of Dinosaurs, with the emergence of terrestrial

and marine reptiles. Tertiary saw mammals emerge, with some realization that small mammals could also be present in the Secondary period (McNabb, 2012: 5). Lyell renamed these periods as Eocene, Miocene and Pliocene. Lyell coined the term Pleistocene and applied it to his Newer Pliocene Epoch, but it was later designated to the post-Pliocene period as it remains today (McNabb, 2012: 5). The Victorians called the period involved in this work' The Drift Period', later referred to as the Pleistocene. The Quaternary Period was added, and it incorporated the Pleistocene and the Holocene, the latter being the current Epoch (Figure 5).

> *'The Quaternary is traditionally considered to be the interval of oscillating climatic extremes (glacial and interglacial episodes) that was initiated at about 2.6 Ma, therefore encompasses the Holocene and Pleistocene epochs' (Head and Gibbard, 2015).*

It was also believed by many, particularly Prestwich, that there had only been one Glaciation. He never changed his opinion, although it was later thought that there were four cold periods, with three warm periods separating them (Gamble, 2021: 234). The discovery that data could be used from ice cores in Greenland to discover the oscillations between warm and cold periods (Gamble, 2021: 236) extended the numbers of oscillations to those that we see today (Table 1).

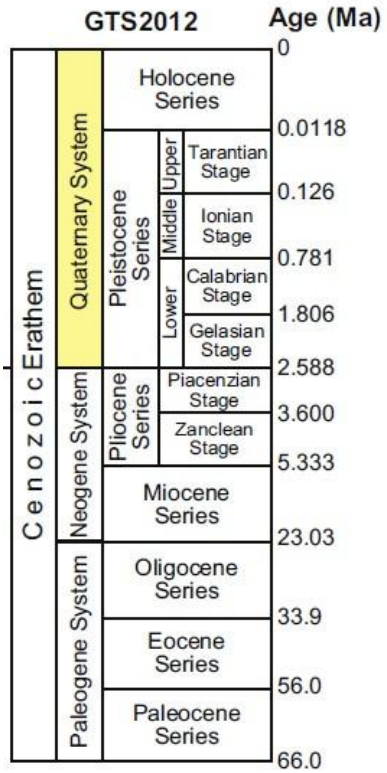


Figure 5. Quaternary chronostratigraphy summary (Pillans and Gibbard, 2012: 981). The Pleistocene Epoch has three further divisions, Early, Middle and Late Pleistocene (Table 1).

The change in thinking about the antiquity of humans could have been pioneered by The Reverand John MacEnery (1797–1841) when he excavated at Kents Cavern in Torquay in the 1820s, and found a clear association between extinct animals and stone tools. Because of the beliefs of the time as mentioned above, and particularly the influential Buckland, the evidence was dismissed and he later retracted his beliefs. Therefore, the discovery of the proof required to demonstrate the antiquity of humans was delayed until 1859, which was the defining year for the changes of thinking of the antiquity of humans and their evolution. This bought humans and geology together. This change was driven firstly by discoveries at Amiens in France followed by Charles Darwin's publication of The Origins of the Species. The first important endeavor of 1859 began when Joseph Prestwich and John Evans found proof that humans existed before around 6000 years ago at Amiens, France (Gamble, 2021: 2).

Prestwich was a wine importer with an interest in geology. He travelled with his business around Britain, France and Belgium, which gave him the opportunity to further his geological studies (Proceedings Royal College, 1896). He spoke fluent French and used these opportunities to visit gravel pits and railway cuttings where he studied geological sections (Gamble, 2021: 11-12). He noticed in 1859 that the drift, gravels and sands believed to have originated from rivers and ice, mantled old rocks like the Chalk in both England and France (Gamble, 2021: 30).

John Evans ran Dickinson's paper mills at Abbots Langley in Hertfordshire and was a numismatist and Antiquarian. Prestwich and Evans met whilst travelling on a train to London in 1854, in order to bear witness as geologists for opposite sides of a dispute about the ownership of London's water supply (Gamble, 2021: 6-7). This was the beginning of their association as geologists and their endeavor to explore the antiquity of humans. Evans and Prestwich operated free from theories and dealt only in what they considered fact, considering the six thousand years of the Mosaic theory 'simple bad geology' (Gamble, 2021: 32).

Prestwich was friends with the Scottish Biologist, Palaeontologist and Geologist, Hugh Falconer. After finding fossil animals while working in Pakistan in 1855, Falconer became interested in human antiquity and evolution. Falconer was involved in excavations at Windmill Hill Cavern, Brixham, Devon, which were supervised by William Pengelly. He found flint tools associated with Ice Age animals in deep fissures. Robert Godwin-Austin, a member of the Brixham committee, believed that this association was proof of the age of humans. Prestwich, who was the treasurer, did not believe that the proof was conclusive (Gamble, 2021: 15).

It was due to their friendship that Falconer told Prestwich about the discoveries in the quarries and gravel pits of France by Boucher De Perthes, a French Antiquary who devoted himself to the pursuit of his scientific passions. Although he had local support, Boucher de Perthes had had none outside of his

locality for his work (Gamble, 2021: 20). Falconer had visited Boucher de Perthes the year before and after seeing his extensive collection, he strongly advised Prestwich to do the same. Boucher de Perthes and his contemporaries had found many stone tools and Falconer thought that what he saw there would settle the speculation;

> *'regarding the remote antiquity of these industrial objects and their association with animals now extinct'. (Gamble, 2021: 59).*

It was as a result of this information from Falconer that Prestwich and Evans found themselves in Abbeville on 27th April 1859. There, Prestwich and Evans met Boucher de Perthes and François Marcotte, curator of the Abbeville Museum, in order to explore the working quarries and gravel beds of Abbeville (Gamble, 2021: 47). It was whilst at the home of Boucher de Perthes that a telegram arrived with the news that the proof that they were looking for had been found in a pit outside Saint-Acheul in Amiens (Gamble, 2021: 62). Prestwich, Evans and Boucher de Perthes set off to Amiens and were met by Architect and Antiquarian Charles Pinscard, who arranged for maps of the drift across the valley; transport to the site; photographs of the flint implements buried in the gravel as well as scientific witnesses (Gamble, 2021: 67). The implement in question was an axe, which had been found by workers who were called Terrassiers, and it was still *in-situ*. Prestwich measured its location and found it to be 11 feet from the surface in coarse unsorted gravel and 4 feet 6 above the bottom of the pit. Prestwich said:

> *'I carefully examined the specimen, and saw no reason to doubt that it was in its natural position, for the gravel is generally so loose that a blow with a pick disturbs and brings it down for some way around' (Prestwich, 1860: 291-2).*

Extinct animal bones were found at the same level. This in-situ evidence was the proof they needed that humans existed in 'deep geological time' (Gamble, 2021: 72-75).

After the death of Buckland in 1856 and during the time that Prestwich and Evans reported upon the evidence from the Somme, Prestwich paid tribute to MacEnery's findings at Kents Cavern (see page 29) in his Transactions paper (Prestwich, J., 1860; Gamble, 2021: 87).

After the finds at Amiens, Evans chanced upon some similar artefacts displayed in a glass case at the Society of Antiquities. After searching the archives, he found that they were attributed to a Suffolk Landowner named John Frere (1740–1807), who had sent them to the Society in 1797 (Gamble, 2021: 88). They had been found stratified in gravels along with extinct animal bones at Hoxne in Suffolk. He intimated that they were found in a primary context within deep Pleistocene deposits. His ideas and interpretations were ignored which was a sign of the thinking at that time (Roe, 1981). These artefacts were now to act as a comparison and an independent test to those found at Amiens. Evans referred to the finds as made by 'an antiquary unfettered by geological theories', as well as by a respected fellow of

both the Royal Society and the Society of Antiquaries (Gamble, 2021: 90).

The second occurrence of 1859 was the publication of Darwin's book 'On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life'. Darwin explains species living on Earth evolved by natural means from earlier ancestors, by evolution and not as explained in the biblical texts. He argued that 'natural selection' was how species change and become adapted. Darwin explains natural selection as:

> *'preservation of favourable variations and the rejection of injurious variations' and this is how some creatures survive and evolve (van Wyhe Ed., 2002).*

In 'The Origins' he did not include humans in his explanation as the subject was too contentious, as previously published articles on this subject had been ridiculed by members of the scientific community. He did specify in 'The Origins' that if his work were accepted 'light would be thrown on the origins of man and his history' (Darwin, 1871). He later published 'The Descent of Man and Selection in Relation to Sex' in 1871.

2.2 Benjamin Harrison - Antiquarian

The network of Scientists that bought about the ideas and changes mentioned eventually encompassed a wider network of antiquarians involved in the collection of artefacts and the study of the geology of the Palaeolithic period. Such an antiquarian was Benjamin Harrison (1837–1921), whose archaeological archive is the basis for this research. He lived in Ightham, Kent, which is 25 miles southeast of London on the road from Sevenoaks to Maidstone. He was born in 1837 and spent most of his life (82 years) in the house and shop where he became the proprietor, following in the footsteps of his father and grandfather. Harrison's mother shared his interests and encouraged him to read widely and to follow those varied interests (Harrison, 1928: 28). Edward Harrison was his son and also shared his interests, with many of his own archaeological finds archived in Maidstone Museum. Benjamin Harrison wrote many journals and notes about his life, which Edward collated into a book called 'Harrison of Ightham' (Harrison, 1928). As there are few sources of information about Benjamin Harrison's life, this has become the principal source for this chapter.

One of Benjamin Harrison's interests was in geology. He lived in the Weald in Kent, which included the North Downs. These areas are very important to this study and are described below and in more depth in Chapter 3, to enhance the understanding of Harrison's area of investigation.

The Wealden area, which is in Kent, Sussex, Hampshire and Surrey, is part of the Wealden-Artois anticline. In Kent it is found between the chalk escarpments of the North and South Downs (Figure 6,

Figure 12). Tectonic forces formed the Weald some 20 million years ago, burying and deforming 300 to 420 million years old sedimentary rocks (Radioactive Waste Management, 2018). Younger sedimentary bedrocks were deposited and are found at the surface. After uplift occurred, the younger sedimentary rocks eroded and exposed the older rocks (Radioactive Waste Management, 2018), (Figure 6).

The name Weald means woodland or Forest (Mills, 2003). The Wealden area is important in the study of the Palaeolithic as a number of finds of this period have been discovered in this area, particularly on the Lower Greensand (Figure 6, Figure 11).

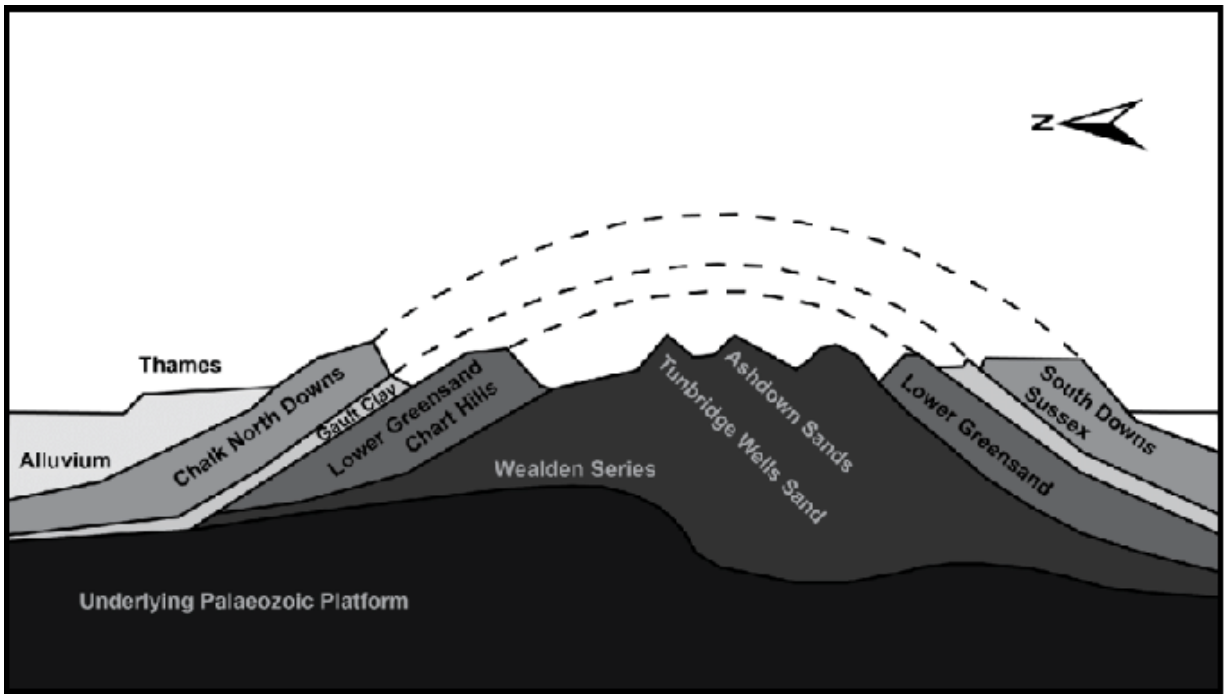


Figure 6. Simplified section through the geology of the Weald , with vertical axis exaggerated (Johnson, Matthew, 2024).

These earlier cretaceous deposits which outcrop at ground surface within the Wealden ring of late Cretaceous chalk hills (Wenban-Smith *et al*., 2010), are of particular importance in the discovery of Palaeolithic artefacts. Particular examples of sites discovered on these deposits are Beedings, West Sussex (Pope 2007; Pope et. *al.,* 2013; Jacobi, 2007), Woods Hills, West Sussex (Pope et. *al*., 2015) and Oldbury Hill in Kent (Cook & Jacobi, 1998). The closest parallels to the Beedings material can be found in the assemblage from Oldbury, (Cook & Jacobi, 1998), which should be noted is also located on Lower Greensand geology on the edge of a prominent anticlinal hill of the Folkestone Beds (Pope *et al*., 2015). Further examples of Palaeolithic archaeology have been found on the Lower Greensand ridge between Hassocks and Ditchling, with the discovery of a small group of relatively small, cordate artefacts, produced using soft hammer percussion. All of these artefacts are suggestive of the Late Middle

Palaeolithic (Pope *et al.*, 2015).

Benjamin Harrison was interested in the Wealden area and was encouraged in his interest in Geology by his brother Tom and his Schoolmaster Stephen Constable. He had access to Lyell's' book 'Elements of Geology' (Lyell, 1839) when Tom borrowed it from Constable. This was an important publication in the sequence of historical events mentioned earlier in this chapter, which aroused Harrison's curiosity (Harrison, 1928, 32). When later introducing Joseph Prestwich to the Drift Bed that capped the Water Parting (interfluve) between the Shode and the Leybourne streams on the Gault (Figure 6, Figure 11) at Park Farm, Harrison later told Prestwich:

> *'… here [at his nearby school] was my introduction to Gault fossils… when I was troubled to account for this drift' (*Harrison, 1928: 34).

His early interest led him to speculate on the derivation of these gravels (Harrison, 1928: 34). During a school outing he visited a bed of river drift (gravel) at Aylesford on the River Medway. This encouraged his interest further and during a walk in the valley of the Shode stream near the chapel at Dunks Green he found '*a vast spread of flint, Oldbury stone, ironstone and chert'*. He had discovered gravels that were transported downstream and may contain '*relics of man*'. (Harrison, 1928: 35). He further expanded his knowledge by investigating any exposures of the drift that he could. Harrison examined several excavations in the area, including;

- The construction of a railway which exposed a section of river drift near to Greatness, Sevenoaks (Harrison, 1928: 52)
- A deep section of drift, nine feet thick, near the road from Seal to Sevenoaks (Harrison, 1928: 52)
- A waterworks excavation on Matthews Farm (Robsacks) at Stone Street, where he found several flakes and a 'celt' (Neolithic polished stone axe) fragment (Harrison, 1928: 70)
- A railway cutting at Child's Bridge in Seal, where he saw a thick bed of drift

Although he worked in the shop from the age of 14, he would take advantage of early mornings, Sundays, and eventually Bank Holidays and early closing days, when they came into force in 1871 (Harrison, 1928: 71), to pursue his interest in walking, natural history, geology and archaeology. He had a multi-disciplinary outlook (Harrison, 1928: 1-44), and related his interests to each other (Harrison, 1928: 46; 77; 84). He was very familiar with his surroundings and '*walked over nearly every square yard of the locality and he was familiar with hill and vale, road, lane, by- way and path, woodland and field*'

(Harrison, 1928: 1). His archaeological investigation covered all of his chosen area, and all of this helped to minimise collection bias. This is because he did not only collect from particular areas because he knew that he would find artefacts there, meaning that he had a good sample from a number of landuse types.

His introduction to flint implements came after a visit to a curiosity shop in Maidstone when he was there on business. At this shop he saw and handled 'several polished flint Celts'. He transferred this knowledge to his exploration around Ivy Hatch, close to Rose Wood, where he associated them with a Neolithic settlement and workshop he had previously discovered there. He also trained agricultural workers on the land to recognise implements. (Harrison, 1928: 47). He paid a small amount to the field labourers for collecting the artefacts and bringing them to him. An acquaintance of Harrisons called James Buckingham Bevington, who described himself as an armchair geologist, offered to pay large sums for the finds the workers bought in to encourage them to bring more implements to Harrison (Harrison, 1928: 82). This worked and Harrison experienced an increase in the numbers of artefacts he received. Many of these artefacts went to Bevington, but not before Harrison had listed and sketched them.

His interest in the Palaeolithic period began after 1863, when he read in the 'Geologist' (a short- lived magazine 1858-1864) and elsewhere about the discoveries of *in-situ* Palaeolithic implements by Boucher de Perthes in the Valley of the Somme (1843:1844) (Editor, T., 1860, Editor, 1861). He met Joseph Prestwich in August 1879. Harrison questioned Prestwich about the position of the high-level implement-bearing gravels of the Somme. When describing these findspots to Harrison, Prestwich compared the level of those gravels above the River Somme to the level of the railway station above the River Darent near to his home in Shoreham, Kent (Harrison, 1928: 84). Harrison realised that some of the Palaeoliths that he had found were in gravels that were higher than their associated streams when compared to the height of the railway station above the River Darent. The greater relative height indicated greater antiquity; therefore, some of his collection could be older than those from the gravels of the Somme.

> *'The realization of this fact and its implications was the foundation of his more important discoveries, and, metaphorically speaking, it was from Shoreham railway station that he climbed to higher levels and proved the occurrence of Palaeolithic and Eolithic implements in the gravels of the high Chalk Plateau'* (Harrison, 1928: 84).

Harrison used his knowledge and the new insights on the antiquity of man, which he gained from these discoveries, to look at how this might relate to his own 'area of interest'. When speaking of Neolithic

implements, he knew that they were found on a land surface similar to that of today, but because of their antiquity that Palaeoliths would typically originate from a much deeper context, and therefore be more difficult to locate. He knew that:

> *'it was necessary to search for them in the gravels brought down in the beds of rivers, and representing the washings of ancient surfaces' (Harrison, 1928: 46).*

He reasoned that the local gravel beds resembled those of the Valley of the Somme and began looking in the gravels of the Shode stream in Ightham. He found his first Palaeolithic implement in a gravel pit at either Furze Field or Heron Shaw in 1863 (Harrison, 1928: 46), and his second Palaeolithic implement in the same year at the head of the Buley Valley at 500ft OD, which was above the level of any existing watercourse.

Figure 7. Palaeolithic implement from Rose Wood , No. 6 in Harrison's logbook

These implements encouraged him to begin a Palaeolithic collection and although he gave both of these implements away, they became the basis for his Palaeolithic archive used in this study. Indeed, the Rose Wood specimen (Figure 7) became one of the first entries in a numbered logbook and in sketchbooks of his collection (Harrison, 1928: 46).

Harrison concentrated his efforts around Oldbury Camp and its environs during the year of 1870 and visited the rock shelter there on many occasions. The area around Oldbury Hill included Rose Wood, Ivy Hatch, Tyler's Knoll, Knights Ground, Fishponds and Styant's Bottom. He appeared to collect all artefact types from these areas and again this helped to reduce collection bias (Harrison, 1928: 65). Collection

bias can occur when only particular artefact types are collected (through preference or lack of knowledge) and only from particular areas (due to access issues or preference). He also visited Oldbury in the summer of August 1871, at which time he examined the Rock Shelter. On the slope below the cave Harrison found several white, decomposed flint implements. These he thought to be older than those from the Neolithic. He also found further white flint implements on Oldbury Glebe land and below the rocks at Oldbury warren which he classified as the 'rock shelter series', concluding that they belonged to a race of cave dwellers who lived there (Harrison, 1928: 69). He considered that these implements may be older than the Neoliths, but received no confirmation of this from his peers at the time. In 1874, he wrote to Dr John Evans saying that he was convinced that Oldbury Hill was a stronghold, saying that:

> *'every plot of land bought into cultivation discloses something interesting'.*

Edward Harrison (Harrison, 1928: 75), mentioned that:

> *'as the greater part of the land is still woodland there are no doubt many relics still undiscovered'.*

Considering the numbers of artefacts found there by Benjamin Harrison this could amount to many thousands of pieces.

During the year of 1878, William Davies, a geologist from the British Museum who was spending his holidays in Ightham, backed up Harrison's thoughts on the antiquity of the artefacts he found at Oldbury. Upon seeing Harrison's artefacts, he declared that they were Palaeoliths – products of the older Stone Age. (Harrison, 1928: 81). Worthington George Smith, an antiquarian and friend of Harrison who was working on the area around the river Lea in Hertfordshire and also in Dunstable, viewed the artefacts and thought that the artefacts could not be Palaeolithic as they were not ochreous (Harrison, 1928: 81). Confused by the conflicting views, Harrison went to Sir John Lubbock, Banker, Politician, Biologist and Archaeologist. Lubbock was also part of the inner circle of scientists in the 19th century that included Prestwich, Evans, Falconer and even Charles Darwin. Lubbock confirmed that some of the artefacts were indeed Palaeolithic. This further encouraged Harrison towards the study of the Palaeolithic period (Harrison, 1928: 81).

Around the year 1878 his focus began to change gradually to the Palaeolithic implements found in river gravels. One of his most enlightening moments came in 1880 when he found a Palaeolith in gravels on High Field at the head of the gorge above the Shode. He reasoned that the Palaeolith was in ancient river gravels and had been carried to its position by a stream high above the present stream, giving man a greater antiquity than the very old gravels (Harrison, 1928: 87).

Later, in 1882, he dug a pit eight feet deep into an outlier of these gravels to help to prove his theories. This outlier, he said,

> *'showed some six to seven feet of trailed stuff: old chert, flint, Oldbury green and white sandstone – proving to me that it must have sloped down from the west…. Ightham will yet be a peg for geological theories to be hung on' (Harrison, 1928: 97).*

The geologist F.C.J. Spurrell, a wealthy Victorian Antiquarian best known for the discovery of the important Middle Palaeolithic sites of the 'chipping floor' at Crayford and the Ebbsfleet Valley Levallois site (Scott and Shaw, 2009), considered that the Rock Shelter implements were Palaeolithic and that they followed closely in time those from the river gravels. Spurrell suggested Harrison should look for further implements at higher levels, particularly on the dip slope running northward from the greensand ridge (Harrison, 1928: 89). Harrison had already found one implement at 500 feet and, upon searching, he found further implements at 500 feet and above. William Topley from the Geological Survey of England was also interested in these gravels and the Palaeolith found there, as he had not yet discovered gravels in this area (Harrison, 1928: 88). In 1881 Harrison discovered another Palaeolithic implement within the gravel of the railway cutting near Ightham, which was being widened from single to double track. He had selected a section of Shode gravels within the cutting and dug out *'three fourths of a Palaeolithic implement … of the older form and deep ochreous in colour'* (Harrison, 1928: 90).

It was between 1879 and 1885 that he began to concentrate on the gravels of the Shode River, a tributary of the Medway. He set about exploring further high-level gravels of the Shode at Fane Hill, Ives and Coney Hill and found many specimens. His interest in the greater age of existing gravels led him up the slopes and particularly to 'water-sheds and unwasted ridges' (Harrison, 1928: 103), looking for the oldest relics. He frequently visited areas where high-level drifts of the Shode, or an earlier stream, were present. From these areas, such as Patch Grove, Bay Shaw, High Field, Buley and other localities, he found more artefacts for his collection (Harrison, 1928: 103). He revisited Dunks Green where there were extensive works on the area of the gravels and found artefacts *in situ* in the gravels and on the surface. Then he searched the flanks of the Basted valley, which were part of the Shode system. This consisted of mostly white angular or sub-angular gravel in patches at more than 200 feet above the present level of the stream, (400 feet O.D). Harrison found gravel patches at Ightham Warren, Vyse's Field, East of Buley, Crouch, Old Soar, Cop Hall, Tebbs Farm and elsewhere, at what Harrison described as *'the terraces of the valley'* (Harrison, 1928: 91). In 1881, he also began searching for implements on the high chalk plateau and wrote the following to John Evans to inform him of his work:

'I am now working at a bed of ochreous, much abraded flint, lying in a depression on a ridge between two big chalk valleys at an elevation of 520 feet O.D' (Harrison, 1928, p. 93).

This area, which was on the chalk due south of Ightham and the 'waterparting' of the Darent and Medway, he described as 'the first home of much of the ochreous flint'. (Harrison, 1928: 91)

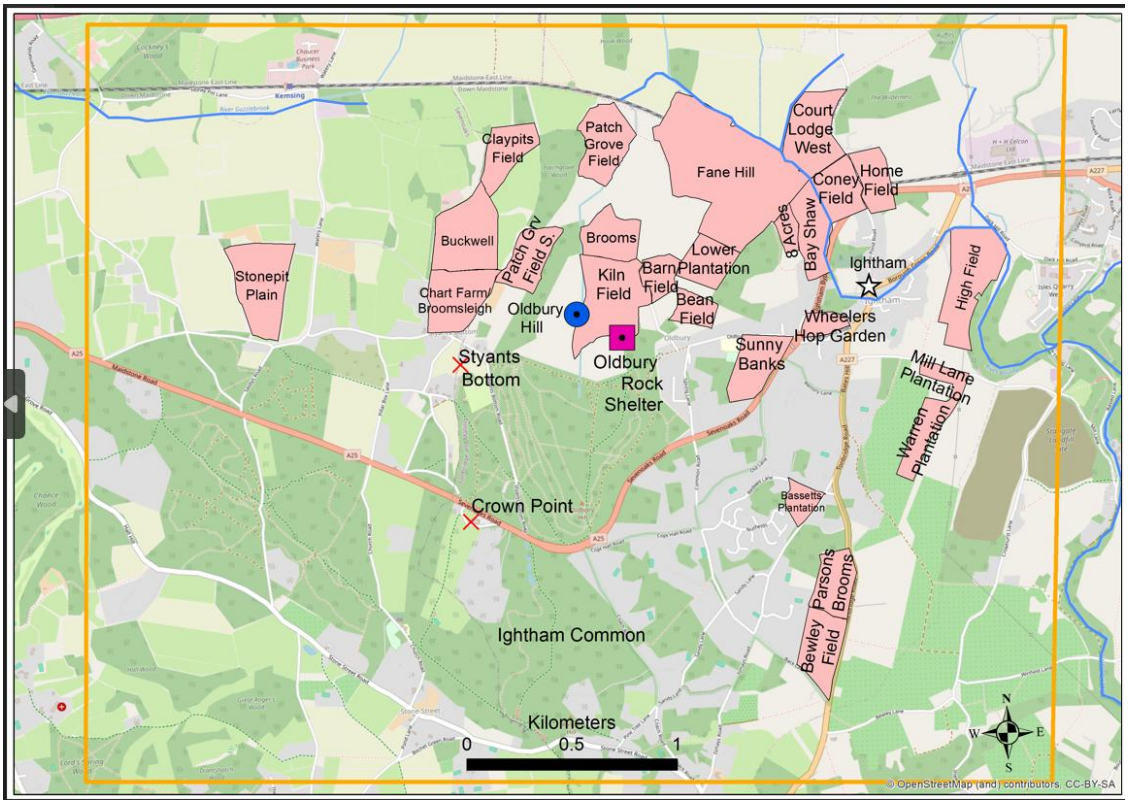


Figure 8. A map illustrating some of the areas annotated by Benjamin Harrison on his location maps. The Shode River (also known as the Bourne and the Busty) can be seen passing near to Ightham. Not all areas mentioned in this study are present due to difficulty with his writing.

He began a systematic search of the Buley valley, particularly around the 400 feet O. D. level, for which he also used his 'scouts' as he called the field workers collecting artefacts for him (Harrison, 1928: 94).

Harrison used his newfound knowledge to examine the drift of another stream, that of the upper Darent and he visited Limpsfield, Brasted and Sundridge. Around this time, Harrison began thinking about glacial geology, influenced by letters from Professor James Geikie. Geike was born in 1839 in Edinburgh and as a boy was interested in geology and natural history, much the same as Harrison. Geikie studied and went on to work for HM Geological Survey and later became Murchison Professor of Geology and Mineralogy in the University of Edinburgh. Geike was the author of Prehistoric Europe

(Geikie, 1881), which spoke of the gravels and their relationship to the Ice age, and from the time Harrison read this he was eager to collect evidence of ice-action in his area (Harrison, 1928: 97). He considered one of his finds a good example of glacial/interglacial inference. He found implement number 164 (Figure 9) on the capping of the gravel on the slopes near Oldbury Place (referred to as Sunny Banks), on the Eastern side of Oldbury Hill where he had obtained an earlier find.

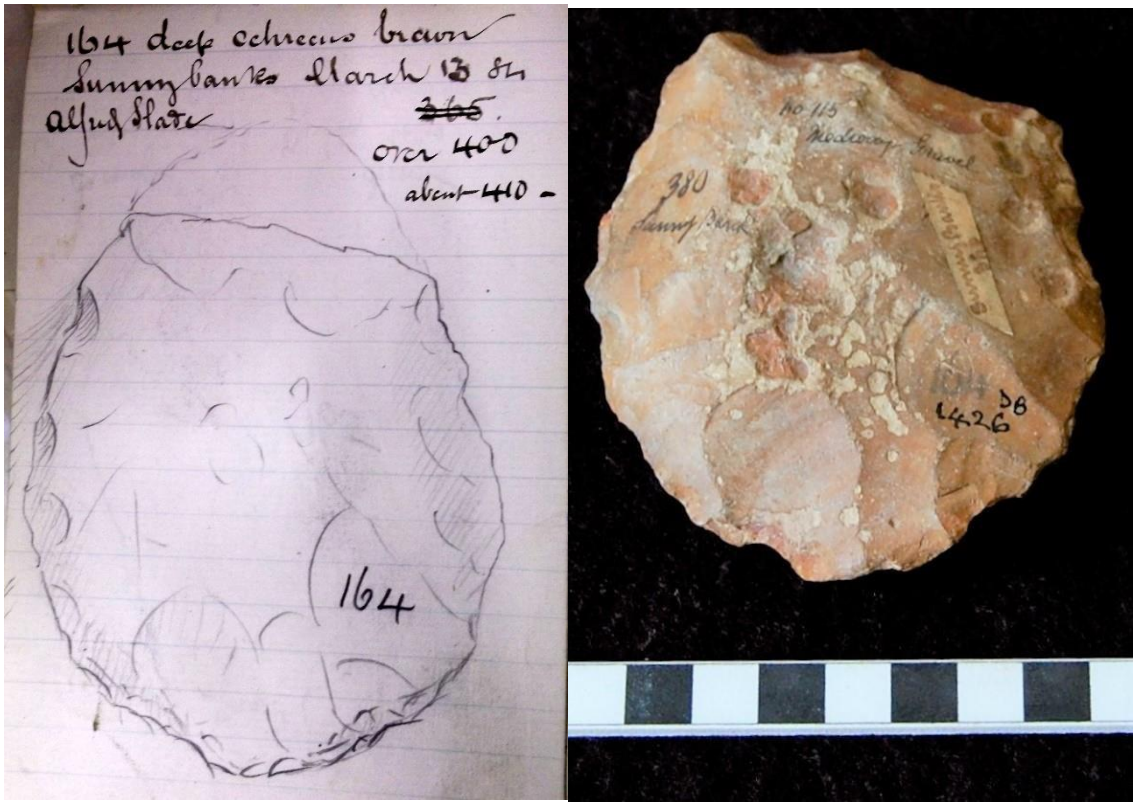


Figure 9. Implement number 164 from Benjamin Harrisons archive. (With permission of Maidstone Museum, Kent).

He regarded this gravel as glacial spread and that the position of the artefact within the gravels inferred that the implement was at least as old as the gravels, and therefore glacial or inter glacial.

In 1885 he found his first Palaeolithic find at Ash on the chalk plateau, which assigned an 'immense antiquity' to the Palaeolithic people who made them (Harrison, 1928: 110). The implement was deep orange/red in colour and found on the tertiary outlier, north of Ash Church. Prestwich concluded:

> *'The occurrence of these relics in the Plateau gravels indicated that man lived in Kent in inter-glacial or pre-glacial times' (Harrison, 1928: 117).*

Harrison's reasoning was that the oldest gravels of the Kent Plateau represented the eroded waste of the vanished uplands of the Weald (Figure 12) to the south of the chalk escarpment.

Figure 10. Benjamin Harrison visiting 'Oldbury Rock Shelter'. (Kent County Council, 2022a).

The High-level gravels became an important hunting ground for many antiquarians. When Worthington George Smith, received a letter from Geike in 1881 with reference to implements in these gravels he sent the letter on to Harrison to read. In the letter, Geikie stated:

> *'They will yet be found in such deposits and at such elevations as will cause the hairs of cautious archaeologists to rise on end. I hope other observers will take a hint from you and search for Palaeolithic implements in places which have hitherto been looked upon as barren of such relics' (Harrison, 1928: 91).*

Harrison and his fellow antiquarians scoured the land in their collection areas looking for evidence of Prehistoric humans in all different landscape types. I will use Harrison's own archive and the information used in this chapter, along with spatial analysis using GIS, to address the following research question:

> *'Is there any period specific patterning to the location of Lower Palaeolithic vs Middle Palaeolithic finds in the area around Ightham, Kent as preserved in Benjamin Harrison's artefact and document archive? Do Harrison's artefacts represent a clustered or dispersed pattern on the ground'?*

The Harrison archive is an ideal resource to answer these research questions as the artefacts are systematically recorded in maps, in the logbooks listing the artefacts and the location of their finds and in sketches annotated with information on findspots and height data.

Spatial analysis can indicate whether or not the artefacts are randomly distributed over the landscape, or if something has influenced their distribution. If the distribution is clustered (non-randomly distributed), I will attempt to interpret the patterning. Slope analysis may tell us about the movement of the artefacts. Are they in the position that they were discarded, or are they on slopes formed by solifluction or river terrace degradation/aggradation? Is this distribution a reflection of hominin behavior?

Abrasion and landuse analysis may help to build a bigger picture. The abrasion analysis is difficult due to the closing of museums during the Covid pandemic, which meant that I could not re-examine the artefacts to record levels of abrasion. At this time, I had photographed some of the archive, intending to return to photograph the remainder. Some of those photographs were of a better quality, whilst some were just lower resolution snaps of the artefacts for identification purposes only. Due to the Museum access issues, the photographs that I had taken of the artefacts had to suffice for the analysis, although these photographs were originally only intended for my records. Having recently contacted the museum to ask for admittance this was not possible, but I was offered photographs of each artefact which I hoped to integrate into the analysis wherever possible. These photographs are of variable quality and only show one face of the artefact so could not be integrated as expected.

Modern Landuse analysis from locations at the time of writing in Harrison's notes helps to ascertain the areas that Harrison was walking to collect his specimens, and whether the artefacts were in a landuse type where workers could collect the artefacts for him. It also helps to decide if bias was introduced into Harrison's collection practices by the accessibility and visibility of the type of land he was collecting from.

The locations recorded by Harrison in his logbook, sketchbooks and on the artefacts themselves are central to this analysis, which has only been made possible by the thorough curation of his archive and location of his findspots.

Chapter 3: Material and Methods: Curatorial, Spatial and Remote Condition Analysis of the Harrison Archive

The Wealden area of Kent is dominated by the Weald anticline. This is the western half of the Weald-Artois Anticline, evident in Kent, Surrey, Sussex and Eastern Hampshire. The eastern section of this anticline is in Northern France and divided by the Dover Straits. It is aligned roughly west-north-west to east-south-east. East-west orientated asymmetric periclines are superimposed on the structure (Jones, 1999), (see Figure 6: Figure 12). The anticline in the central and southern Weald was formed in response to compressive tectonic forces related to the formation of the Alps some 20 million years ago, burying and deforming older sedimentary rocks 300 to 420 million years old, (Radioactive Waste Management, 2018). These older sedimentary bedrocks are similar to rocks at the surface in Northern England and Wales.

Younger sedimentary bedrocks, including limestones, sandstones, clays and shales, and Jurassic rocks similar to those on the coast of Dorset and North Yorkshire, were deposited and are found at the surface. Some of these sedimentary bedrocks are softer and easily eroded and were deposited in the Weald Basin. The deposition stopped, resulting in an unconformity, after which the sea level rose approximately 65 to 100 million years ago and the Gault clay and chalk group were laid down (Radioactive Waste Management, 2018). The relatively flat landscape is typical of areas underlain by these sandstones, clays and limestones (British Geological Survey, 2016).

The Wealden anticline is defined by a chalk escarpment, which forms an upward-tilted rim around the dome shaped structure (anticline), within which the layers become gradually older towards the centre (Topley, 1875). After a period of uplift, these softer younger sedimentary rocks eroded, exposing the older sedimentary rocks (Radioactive Waste Management, 2018).

The geology of the Weald is described in the map in Figure 11. A cross section through the Weald is shown in Figure 12.

Figure 11. Map of bedrock and surface geology of the Weald based on British Geological survey data (2018), (Wealden Buildings Study Group, 2022) See Key below. [ ] is the approximate location of Ightham

.

The geological areas shown on the map above (Figure 11) are as follows: -

- **1. High Weald** in the centre (light green). Mostly sandstone rock with complex local outcrops. Fast-running streams have cut deep, usually heavily wooded, narrow valleys, known as ghylls
- **2. Low Weald** around the northern, western and southern edges of the High Weald (darker green). Mostly Weald clay with some soft sandstones. Characterised by small pastures, meadows, shaws and thick hedgerows
- The **Greensand Ridge,** which stretches around the north and west of the Weald (light blue and turquoise). Turquoise represents **3. Gault** and Upper Greensand formations and light blue represents the **4. Lower Greensand Group**. This includes the highest points of the Weald (Wealden Buildings Study Group, 2022)

The Wealden area was never covered by ice, it did not experience continental or lowland-scale glaciations during the last two and half million years (Radioactive Waste Management, 2018), although it would have been periglacial during much of the Pleistocene period, resulting in a tundra-like climate (Kent Geologists' Group, 2022).

The rivers and streams, which have deposited gravels relevant to the study area, include the Medway, the Darent, the Eden and the Shode (or Bourne). (The latter two are tributaries of the Medway). The Medway and the Darent cross the Weald Area of Outstanding Natural Beauty (AONB) and are both north-flowing rivers. The Medway catchment area is much more extensive than that of the Darent (Bridgland, 2003: 23):

> *'In the west-east trending vales on the Gault and Weald clay outcrops, the valley widens, and a considerable expanse of fluvial sediments have been preserved' (Bridgland, 2003: 28).*

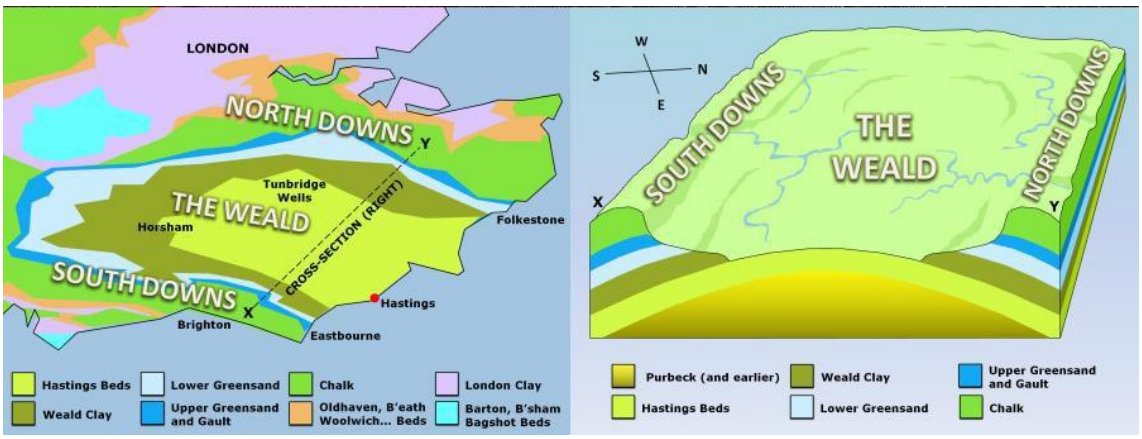


Figure 12. A cross section through the Weald shows the eroded 'dome' of the anticline, leaving the chalk of the North and South Downs on either side (Shepherd & Randell, 2022).

Superficial deposits such as river gravels, estuarine muds, solifluction deposits and Clay-with-flints are distributed over the underlying geology. These superficial deposits mostly overlay the Lower Greensand, overlaying the Hastings beds to a much smaller extent. The most extensive superficial deposits (typically of Quaternary age), are the river terrace and flood plain deposits laid down by the main rivers and tributaries formed over the last 2 to 3 million years. Topley (1875) a geologist of the Geological Society mentioned in Chapter 2, describes these superficial deposits as 'lying indiscriminately on all the older strata' but adds that the Weald clay is the formation that is mostly covered by river deposits, both modern and ancient.

The River Medway

The River Medway is believed to have been formed when the area uplifted from beneath sea level when the Weald Anticline formed during the Paleogene (Figure 5, Figure 6Figure 12), (Bridgland, 2003: 23; 45). The Medway is an ancient river that has played a significant role in drainage evolution in southeast England during the Quaternary (Bridgland, 2003: 45). It escaped glaciation and so preserves many terraces. The Medway was shortened during the Anglian glaciation when the Thames was diverted (Maddy, D. *et al.*, 2000).

The River Darent

The River Darent rises in Westerham in Kent. It runs between the greensand ridge and the chalk downs in a wide valley enclosed by deciduous scarp-top woodlands above cultivated lower slopes. The West Kent Downs lie between the Darent and the Medway. This is an area of ridges and deep dry valleys with plateaux, between which run a series of remote, enclosed dry valleys (Maidstone Borough Local Plan Examination, no date). The Darent was thought to have been beheaded by the River Medway by a process called "River capture" (Davis, 1895). It once had headwaters that drained the Central Weald,

indicated by Wealden clasts present in the gravels, which are now in the catchment area of the Medway-Eden river system (Gossling, 1937: 1940). Bridgland suggests that the Darent had been captured by a left-bank tributary of the Medway (Bridgland, 1999: 146), and the presence of Palaeoliths in the Darent at Limpsfield implies this capture occurred since the Middle Pleistocene (Bridgland, 2003: 44).

The town of Ightham is in the Wealden area between the Medway and Darent Rivers and was at the 'centre of Harrison's world'. Ightham is on the Folkestone beds of the Lower Greensand (Prestwich, 1889). North of this lies the Gault which is on the Upper Greensand and consists of clays, mudstones and siltstones (British Geological Survey, 2022b).

The North Downs incorporates much of the study area and were designated as an Area of Outstanding Natural Beauty (AONB) in July 1968; it covers 878 square km (326 square miles), is mainly within and covers 23% of the land area of the County of Kent. In Kent, the North Downs, along with part of the Greensand Ridge and Lympne Escarpment, form the Kent Downs AONB. The North Downs chalk ridge consists of the steep, south-facing scarp slope rising above the Gault clay below, with plateau tops and gentle dip slopes traversed by a number of hidden, dry valleys (Maidstone Borough Local Plan Examination, no date). The Gault clay surrounds the Weald in an arc from north-east Kent westwards through Surrey to Hampshire where it turns south and returns eastwards through West and East Sussex'. It is at its maximum in the Weald, reaching a depth of over 100 metres (British Geological Survey, 2022b).

Epoch	Age (BP)	MI Stage	Traditional stage (Britain)	Climate
Holocene	Present 10,000	1	Flandrian	Warm — full interglacial
Late Pleistocene	25,000	2	Devensian	Mainly cold; coldest in MI Stage 2 when Britain depopulated and maximum advance of Devensian ice sheets; occasional short-lived periods of relative warmth ("interstadials"), and more prolonged warmth in MI Stage 3.
	50,000	3		
	70,000	4		
	110,000	5a–d		
	125,000	5e	Ipswichian	Warm — full interglacial
Middle Pleistocene	190,000	6	Wolstonian complex	Alternating periods of cold and warmth; recently recognised that this period includes more than one glacial–interglacial cycle; changes in faunal evolution and assemblage associations through the period help distinguish its different stages.
	240,000	7		
	300,000	8		
	340,000	9		
	380,000	10		
	425,000	11	Hoxnian	Warm — full interglacial
	480,000	12	Anglian	Cold — maximum extent southward of glacial ice in Britain; may incorporate interstadials that have been confused with Cromerian complex interglacials
	620,000	13–16	Cromerian complex	Cycles of cold and warmth; still poorly understood due to obliteration of sediments by subsequent events
	780,000	17–19		
Early Pleistocene	1,800,000	20–64		Cycles of cool and warmth, but generally not sufficiently cold for glaciation in Britain

Table 1 The Quaternary and Marine Isotope Stages in Britain (Wenban-Smith et al., 2010). The Early Pleistocene was later adjusted to begin at almost 2.6 million YA, which is out of scope of this study. Generally, for MI Stages, even numbers relate to cold and odd numbers to warm stages.

The most likely artefacts found from the Palaeolithic period are lithics, anthropogenically modified in some way. These are likely in deposition areas where the artefacts were dropped or deliberately curated for future use, or have been moved by climatic events, rivers or land movement (Wenban-Smith *et al*., 2010). They are unlikely to be found with other palaeo-environmental artefacts (such as faunal remains) in the context of Harrison's collection as they were found mostly on the surface.

For this reason, the word 'site' is used as a proxy in this study, as suggested by Wenban-Smith *et al*., (2010: 14):

> '*… where one, or more, Palaeolithic artefacts have been recovered, without any necessary implication that it was a significant site of prehistoric activity'.*

The most likely place to find lithic artefacts are where river gravels are deposited or on Clay-with-flints on the higher ground of the plateau. It is difficult to characterize this type of artefact when not found in

a site that is in context, as defined by Wenban-Smith *et al.,* (2010):

> *'This is not an easy task. The vast span of time involved, the grand climatic changes, the great variety of geological processes and the impossibility of characterising areas of deposit-type in simple two-dimensional mapping all combine to make understanding of the Palaeolithic, and management of the Pleistocene resource, a much harder task'. (*Wenban-Smith *et al.,* 2010: 7*).*

Wenban-Smith *et al.* (2010) also argue that many areas mapped as head deposits could actually have a fluviatile origin. He cites Harrison's collections of artefacts from Dunk's Green as a possible example. Harrison discovered at least ten artefacts from this area; one at least came from a depth of two feet within the gravels. Unfortunately, not all of Harrison's documented artefacts have been located within his physical archive, although they are recorded in his logbook of finds.

Traditional Palaeolithic stage	Updated stage	Human species	Lithic artefacts and other material culture	MI Stage	Date (BP)	UK geo stage
Upper Palaeolithic	**Upper Palaeolithic**	Anatomically modern humans (Homo sapiens sapiens)	Dominance of blade technology and standardised tools made on blade blanks; personal adornment, cave art, bone/antler points and needles	2–3	10,000–35,000	Late Devensian
Middle Palaeolithic	**British Mousterian**	Neanderthals (Homo neanderthalensis)	The appearance of bout coupé handaxes; discoidal flake/core reduction strategies	3–5d	35,000–115,000	Early/Middle Devensian
	-	-	Britain uninhabited	5e	115,000–125,000	Ipswichian
	Lower/Middle Palaeolithic	Early pre-Neanderthals, evolving into Homo neanderthalensis	Still some handaxe-dominated sites, but growth of more standardised (Levalloisian) flake and blade production techniques (Eg. Crayford)	6–9	125,000–425,000	Hoxnian /Saalian complex
Lower Palaeolithic			Handaxe-dominated (Eg. Swanscombe; Cuxton), but appearance of more standardised flake and blade production techniques (Levalloisian); occasional industries without handaxes (Clactonian)	8–11		
	-	-	Britain uninhabited	12	425,000–480,000	Anglian
	Lower Palaeolithic	Homo cf heidelbergensis	Handaxe-dominated (Eg. Boxgrove), with occasional unstandardised flake core production techniques and simple unstandardised flake-tools; occasional unifacial flake-tool industries without handaxes (High Lodge)	13	480,000–500,000	Cromerian complex IV
		Homo ergaster	Simple flake/core industries with no standardised flake-tools (Pakefield; Happisburgh)	13–19	500,000–780,000	Cromerian complex I-III

Table 2 Revised Palaeolithic period in Britain (Wenban-Smith *et al*., 2010: 10).

I have devised a number of methodological approaches to answer the research question, describe´d as follows in this chapter. The first is artefact classification and the artefacts that form the basis of the data for this study are from the Harrison collection. They cover all periods of Prehistory and were collected by Benjamin Harrison and associates on the Kent Downs of Britain. These artefacts, along with his logbook in which he documented his finds, books containing sketches of the artefacts and manually

annotated maps, give an insight into the Palaeolithic of the area. The artefacts are mainly Palaeolithic (Table 2), with some later prehistoric examples. Only those that are Lower or Middle Palaeolithic are included in this study Table 2) as there are few diagnostic pieces from the Upper Palaeolithic and younger. The Lower Palaeolithic artefacts from Harrison's collection are generally bifacially worked handaxes. As Lower Palaeolithic handaxes can be found alongside Middle Palaeolithic artefacts in surface contexts (Wenban-Smith *et al.,* 2010), the following policy was adopted: -

- Lower Palaeolithic artefacts were identified on the basis of typological characteristics following Wymer's (1968) classification of Lower Palaeolithic handaxe types.
- Only artefacts in the collection identified as Levalloisian or Mousterian are classified as Middle Palaeolithic. These are typologically distinctive.
- Other non-diagnostic Palaeolithic artefacts, which are typologically Lower or Middle Palaeolithic, but cannot be further distinguished, are classified as Lower/Middle Palaeolithic?

Harrison's collecting activities progressed in two different directions. He continued collecting the legitimate prehistoric artefacts but diversified into collecting a new type of artefact – Eoliths, which have been described as follows:

> *'Eoliths—crude stone objects purported to be artifacts but often showing little or no convincing evidence of human workmanship'* (Ellen & Muthana, 2022).

Harrison collected Eoliths and believed them to be older than the Palaeolithic period, originating from the 'Dawn of man'. He first became acquainted with these flints at South Ash field, which was farmed by Mrs. Rogers and her sons. Mrs. Rogers was a collector of fossils and Harrison called on her to view her collections. She pointed out 'red gravel' to him in South Ash field and he began to collect eoliths from these areas (Harrison, 1928: 50).

Eoliths were the subject of major debate between the 1890's and 1920's, with antiquarians forming two sides, those who believed these were the oldest hominin tools found in Britain and those who were sure they were natural 'geofacts'. Two of the most eminent anthropologists and geologists of the time were Professor Joseph Prestwich, who believed that they were artefacts modified by these ancient peoples, and Sir John Evans who was firmly on the other side.

Harrison himself appeared to have doubts about eoliths at first. He found two flints in 1865 in a spread of ochreous gravel on Parsonage Farm. He recognized them as coming from an ancient river and

attributed the chipping to collisions with other stones. At this time he put them away, not attributing human modification to them. He only thought of them as eoliths in 1901 when he came across them and gave them a place of honour in his museum as the first two eoliths he had found on the Chalk plateau (Harrison, 1928: 55).

He found several eoliths (believed to be in 1879) on the Chalk plateau and speculated that: -

> *' these specimens, although sufficient to stimulate speculation, were not so convincing as later finds' (Harrison, 1928: 85).*

There is no reference to the context in Benjamin Harrison's notes as reported by Edward Harrison (Harrison, 1928), but he may have meant later finds of eoliths rather than comparing them to legitimate Palaeolithic artefacts. It was probably after finding eoliths of similar shape that he thought of these as a collection of humanly modified artefacts.

The following extract of a letter to Harrison shows the rejection of Eoliths as tools by Sir John Evans:

> *'Has the absolute uselessness of such flints as tools never struck you? … It requires some imagination to picture a people with special appliances for rubbing the feet, but none for the ordinary purposes of life'. Extracts from letters, Sir John Evans to B. Harrison (Harrison, 1928).*

Prestwich worked with Harrison on the eoliths and was convinced that they were the work of primitive humans. His paper 'On the Primitive Characters of the Flint Implements of the Chalk Plateau of Kent with reference to the question of their Glacial or Pre-Glacial Age' argues for the existence of eoliths or 'rude' implements and his belief is evidenced in his closing statement that states the following: -

> *'The views which have been advanced must, of course, stand or fall upon the evidence which had been bought forward; but the author had every confidence that the further investigation which is needed would confirm his facts and corroborate his opinions' (Prestwich, 1892).*

Harrison was more famous for his discovery and collection of Eoliths than for the extensive collection of what are considered genuine artefacts of the Stone Age. from a period older than the Palaeolithic implements he had already found.

Interestingly Prestwich had examined a collection of stones belonging to Boucher de Perthes when he visited Abbeville in 1859, which were essentially naturally shaped stones like Harrison's Eoliths, sorted

into similar shapes such as the heads of horse or of deer. Prestwich had dismissed Boucher de Perthes collection but believed that the Harrison's Eoliths were indeed from an ancient race of men. Eoliths are now understood to not to be humanly modified and can still be found in museums such as Maidstone, although the Eoliths will not be part of this study.

Harrison's artefacts that are available for study are mostly in Maidstone Museum in Kent, with some curated at the British Museum in London and a few at Royal Tunbridge Wells Museum in Kent. There is evidence of Harrison's artefacts in the collections of other Antiquarians as Harrison gave many of his pieces to his peers, friends and family, but these have not been included unless stated here.

The bulk of the study has taken place at Maidstone Museum, where at the beginning of the research I liaised with the Museum staff to identify Harrison's physical archive. This contained four types of evidence which I used for examining and processing the data:

1. Artefacts
2. A logbook
3. Sketches
4. Maps

The archive includes many artefacts stored loosely in large boxes with little curation. At the beginning of the investigations into the archive, I examined each artefact from these boxes, photographing them individually for identification during the research. This involved laying the artefacts from a box out individually and examining each artefact. The artefacts had a variety of numbers, written either directly onto the artefact or onto stickers attached to the artefact. Interpreting these numbers was one of the most difficult parts of the analysis and it was clear that other researchers had attempted this before. I found that the numbers on stickers were often placed there by other researchers, so I could mostly discount these numbers, although I included a few that were annotated in Harrison's distinctive handwriting.

The next set of numbers on the artefacts were not in Harrison's handwriting and did not match any of Harrison's paper archive, so I examined the museum database and found that these numbers were accession numbers annotated by the museum staff, generally in a darker ink. The remainder of the numbers on the artefacts were the ones I examined to match with Harrison's paper archive. These were mostly individual numbers, or numbers accompanied by the words Medway Gravel or Hill Gravel.

I began by looking for the numbers in Harrison's logbook. He gave the artefacts an ID number on collection and added this and other descriptive text to the log. This text included the location where the item was found, which would typically be the name of a field or area followed by the town where this location could be found. An example of this would be Bewley (Buley) Field, Ightham. As in this case, sometimes the fields/areas were spelled differently throughout the archive. The finder and the owner of the artefact were also included in the log. This was because friends and associates accompanied him on his walks and found artefacts, which they generally gave to him. Field labourers in various locations were paid to find artefacts for Harrison and so may have been included as the finder (see Chapter 2, p. 30). The owner was mostly Harrison himself but sometimes the person who accompanied him on his walks was listed as the owner, whilst he often gifted artefacts to people who may then be recorded as the owner. Finally, he recorded the level in feet at Ordnance Datum (O.D.) at which the artefact was found using contours from Ordnance survey paper maps of the period (Ordnance Survey Digimap, 1865-1872).

The artefacts located in the British Museum were either Harrisons own collection, which had been donated to the Museum, or from the Spurrell or Reid-Moir collection because they had been given to these collectors by Harrison. In this case the artefacts were identified by Harrison's annotations on the artefacts themselves. Many of the artefacts were from Oldbury Rock Shelter and were a mixture of tools and debitage.

Trying to match the numbers on the artefacts from all museums to those in Harrison's logbook was confusing as the log only had one ID number, with no reference to Medway or Hill Gravel, so there was some delay with false starts and periods of taking the wrong direction. The breakthrough came when I examined Harrison's sketchbooks alongside the artefacts and logbook.

There were seven sketchbooks in Maidstone Museum containing numbered sketches based on Harrison's logbook. These were books 1 – 4 and 7 – 9. Books 5 and 6 were missing. A further sketchbook was in the British Museum archive and was labelled by Harrison as Oldbury Rock Shelter'. I matched some of these drawings to artefacts in the British Museum and some to those at Maidstone Museum. Where this occurred the information from those matched artefacts were added to the logbook and mapped. Each drawing was annotated with the number/s, the location, sometimes the finder of the artefact and the height at which it was found. This made at least a three-point cross-validation of each artefact possible. This was achieved by using the annotated artefact itself, the drawing and the description in Harrison's logbook. In two of these sketchbooks some of the numbers on the drawings did not appear to match the numbers in Harrison's logbook. These books were entitled Book 7 Hill gravels and Book 9 Medway gravels. In most cases in sketchbooks 7 and 9 each drawing had

two numbers, the first of these either the Medway or Hill gravel number which were sequential within each type. The second number in some cases matched the numbers in the logbook and therefore could be cross-validated as previously mentioned. Some of these numbers were higher than any numbers previously allocated in Harrison's logbook, so I added them at the end of his original logbook entries in the spatial database. It is unknown if any of those artefacts with higher numbers may have duplicates in the logbook, but all reasonable checking has been done to find out. Below is an example of the Medway gravel sketchbook (number 9) and comparison photographs of the artefacts for clarification of the methodology employed in this study.

Figure 13. A photograph of an artefact (Number 368) from Harrison's archive. The artefact was located in Box number P48, Victoria Cellar, Rack 6, Bay E, Shelf 3 at Maidstone Museum (With the permission of Maidstone Museum).

This artefact (Figure 13) is annotated with the logbook number 368, the Medway gravel number 175 and the location of Patch Grove South. The measurements recorded by Maidstone Museum are length 95, width 55 and height 20 cm, which is useful as no scale is present in the photographs. See below (Figure 14), for the corresponding drawing that appears in Book 9 Medway gravels. (With the permission of Maidstone Museum).

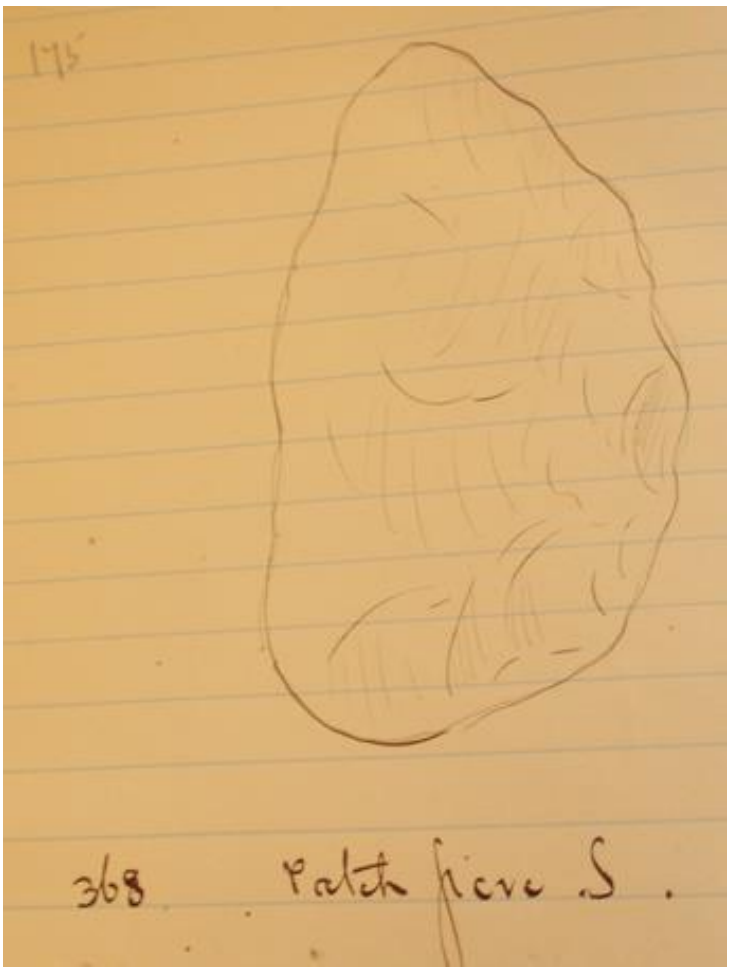


Figure 14. The drawing in Book 9 that represents the artefact photographed in Figure 13. The logbook number 368 is at the bottom and the Medway gravel number 175 is above. The location is Patch Grove South as on the artefact (With the permission of Maidstone Museum).

The artefacts annotated as Medway or Hill Gravel appeared to be grouped because they were found in particular geological areas in the study area. It was not possible to find a definitive reason why Harrison named these areas, although in the book published by his son Edward Harrison (Harrison, 1928) it states that, although he excluded this topic from his book, more information could be found in his many notebooks archived at Maidstone Museum. I have read or searched many of the transcripts from these notebooks by Angela Muthana (Maidstone Museum), but I have yet to find this information. My interpretation of this is that these were named after the geological deposit at the location at which they were found, Medway gravels deposited by the River Medway and its tributaries, Hill gravels in those gravel deposits unrelated to these river deposits. Prestwich discusses 'Hill-gravels' and describes them as being '*at Oldbury Place, Kilnfield and other places around Oldbury hill, are so much mixed up with local debris, swept down from the heights of Oldbury Hill and Ightham Common above them, that their distinctive character is obscured or lost*' (Prestwich, 1889).

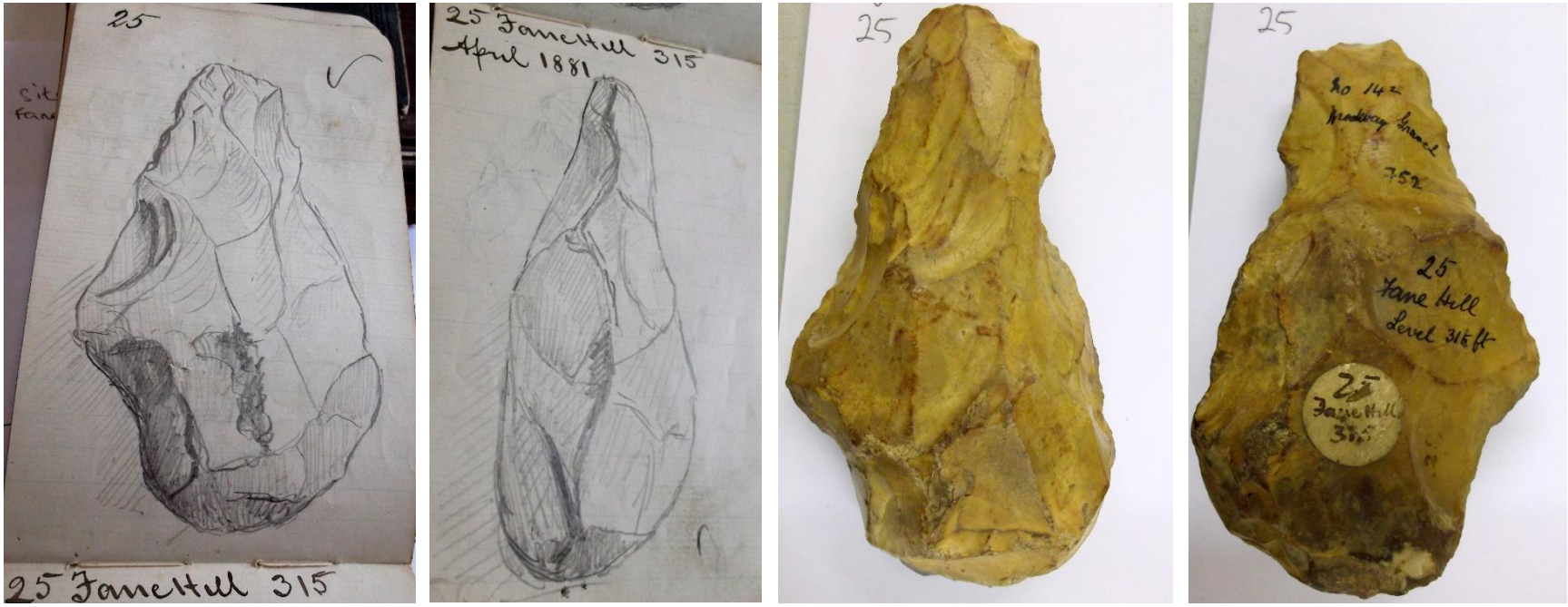
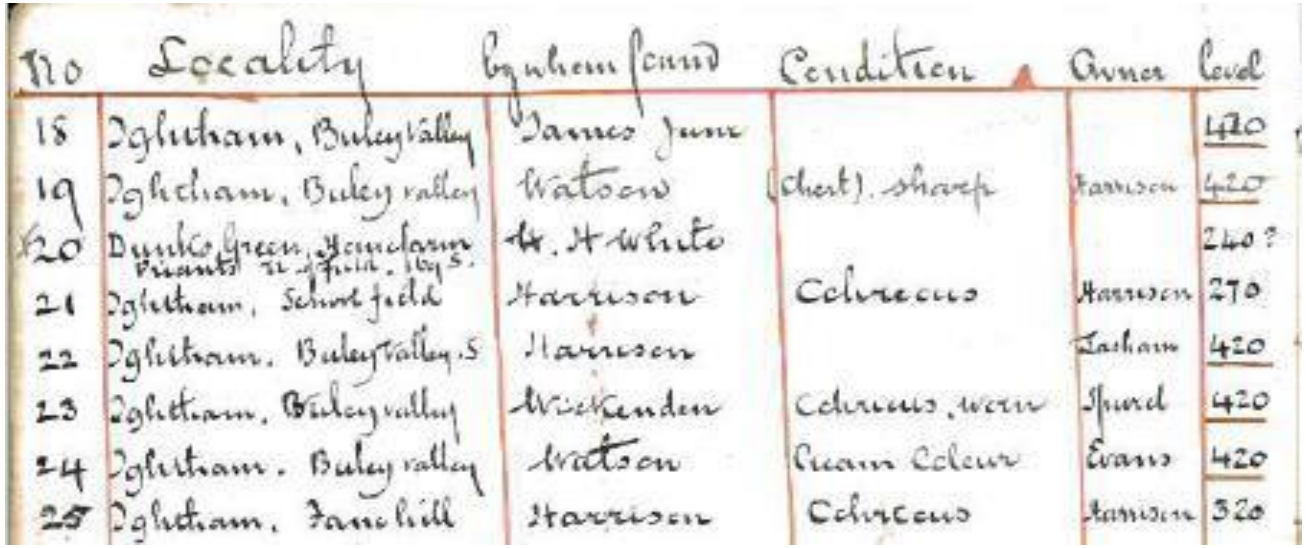


Figure 15. An example of Harrison's archive: Front and side views of artefact numbered 25 by Harrison, as drawn in Harrison's sketchbook no 1 (With the permission of Maidstone Museum). Alongside are photographs of the actual artefact with identical annotations, found in Box P22 Victoria Cellar, Rack 6, Bay E, Shelf 1. The number 315 is the O.D level and 752 is the Museum accession number. Please note that where photographs have the artefact number in the top left corner it was annotated by the author for ease of identification (With the permission of Maidstone Museum).

Figure 15 shows views of both faces of the actual artefact as found and photographed in Maidstone Museum. The annotations from the drawing and the artefact have matching Information e.g., artefact number, find location and height O. D. in feet. Also, note the Medway Gravel number on the sketch, which matches the Medway gravel number written on the artefact, and is also drawn in the Medway gravel sketchbook no. 9 (With the permission of Maidstone Museum). This information was compared with Harrison's log for artefact number 25 (Figure 16).



No	Locality	by whom found	Condition	Owner	Level
18	Ightham, Buley Valley	James June			420
19	Ightham, Buley valley	Watson	(chert). sharp	Harrison	420
20	Dunks Green, Ightham	H. H White			240?
21	Ightham, School field	Harrison	Calcareous	Harrison	270
22	Ightham. Buley valley S	Harrison		Latham	420
23	Ightham. Buley valley	Wickenden	Calcareous, worn	Hurd	420
24	Ightham. Buley valley	Watson	Cream Colour	Evans	420
25	Ightham. Fane hill	Harrison	Calcareous	Harrison	320

Figure 16. An extract from Harrison's original handwritten logbook, which lists his finds by ID number. Number 25 indicates that the artefact was found at Fane Hill, Ightham at a level of 320 OD. There were occasions when the level OD was slightly different in the logbook when compared to that on the drawing and artefact. When all other details closely matched between the artefacts, drawing and logbook this was deemed to be a match (With the permission of Maidstone Museum).

ArtefactNoFound

OBJECTID *	SHAPE *	HarrisonsArtefactNo	ArtefactLetter	MedwayGravelNo	Type_Mac	HillGravelNo	Subtype_Mac	Museum_No	MacNewPeriod	Found	POINT_X	POINT_Y
48	Point	25	<Null>	142	Handaxe	<Null>	Resharpened	752	Lower Palaeolithic	Found	558959.4556	157327.1869

0 (0 out of 159 Selected)

ArtefactNoFound

Figure 17. The entry in the GIS attribute table constructed from the data from Harrison's logbook; combined with conclusions added from the later examination of the artefacts at Maidstone Museum, along with Dr. John McNabb of Southampton University.

The next phase of the methodology was to integrate all of the data spatially, along with spatial layers to assist in the analysis. I integrated the data from the archive into a database, which I constructed and visualised as described below, and analysed in subsequent chapters using the many spatial analysis tools used in ArcMap.

The Harrison archive is extensive but non-spatial. In the context of this archive, this means that all of the data are recorded manually in Harrison's original paper-based archives, without any co-ordinates to locate the data on a map. I needed to give Harrison's archive a spatial element in order to visualise and interrogate the data. From the data recorded, the only elements that could be utilised to transform the data spatially was height data and area field names. The best option to facilitate this approach was to add the data included in Harrison's log, supplemented with data extracted from the study of the rest of Harrison's archive, to a GIS (Geographic Information System), where I used it to plot and further analyse the data spatially as described in this chapter. The software used was ArcMap from ESRI UK, which was founded as the Environmental Systems Research Institute. When researching the software, ArcGIS offered to:

> *'Connect the seemingly disconnected with the most comprehensive set of analytical methods and spatial algorithms available. Use location as the connective thread to uncover hidden patterns, improve predictive modelling'. (ESRI, 2021a)*

This enabled the most extensive investigation of Harrison's data possible. Initially I constructed an Excel table by manually typing in the details from Harrison's paper logbook and the accession database provided by Maidstone Museum, then added this to ArcGIS as a stand-alone csv table Figure 17. This was the work-in-progress table, which included all of Harrison's data from the log (Figure 16). This now consisted of the following fields:

- Artefact numbers
- Artefact letters where duplicate numbers occurred
- Whether the artefact had been found in Maidstone or The British Museum
- Harrison's notes from the log
- The museum box number
- The museum Accession Number
- The museums measurements of each artefact
- A copy of the annotation in Harrison's sketchbook for each artefact
- The sketchbook number in which the drawing and annotation can be found
- The annotations written on each artefact

- My interpretation of the period from which each artefact originated
- The artefact type (for example 'handaxe')
- The artefact sub-type (for example broken, resharpened, twisted)

The integrative nature of GIS allows secondary spatial data like Harrison's artefacts to relate and interact with primary remote sensing imagery (Conolly and Lake, 2006). To facilitate this, I added a Digital Elevation Model (DEM) to the GIS. I also added contours and historical mapping which were downloaded from Edina's Digimap web site (Edina, 2016a, 2016b).

A (DEM) records height above sea level for a set of cells arranged in a regular grid or raster. Each cell can be queried to receive an elevation value, or a null value if data is absent (Conolly and Lake, 2006). These are continuous data (a space over which some attribute varies, usually smoothly and continuously (Burrough and McDonnell 1998; Couclelis, 1992, cited in Conolly and Lake, 2006: 4), which organizes information by predetermined locations in space. Conolly and Lake (2006) argue that continuous data fits closely with the absolute concept of space. This concept views space as a container of all material objects, which exists independently of any objects that might fill it (Harvey 1969, cited in Conolly and Lake, 2006: 3).

I downloaded The DEM as individual tiles, which roughly covered the area drawn in grid squares on Harrison's paper map. The dataset consists of a grid of height values at 5m horizontal intervals, which are calculated at the centre of the pixel. This data enables you to add a third dimension to other datasets in your GIS or perform analysis. The DEM was produced more recently than Harrison's data, which was originally perceived as a possible problem, since the positioning of Ordnance Survey data has been amended since Harrison's time. I researched this and the information from Ordnance Surveys webpage about Datum Height Differences (Ordnance Survey, n.d.) indicated that the contours on the modern map would be approximately 1 to 1.5 metres different from the historical map. As Harrison's height data was generally recorded in 10 metre OD intervals this difference would not be too significant. The tiles needed to be combined into one map coverage for further analysis and I mosaicked them into a continuous layer using the tool 'Mosaic to new raster' in the Data Management toolbox in ArcMap. This is a geoprocessing tool that merges multiple rasters that have the same number of bands and pixel depths. The resulting raster was saved in a TIFF format and then loaded into the Table of Contents in the GIS.

The Contour data used for this study was Terrain 5 data, downloaded from Edina (2016) Digimap (© Crown copyright and database rights 2020 Ordnance Survey (100025252)).

I downloaded historical mapping of the area as tiles from Digimap, which covered the extent of Harrison's total area of interest (Ordnance Survey Digimap, 1865-1872). A digitised layer was then created based on annotations in Harrison's map books. This layer included outlines of Harrison's fields/areas of interest referred to in his artefact logs and sketchbooks. I added this layer to the Table of Contents of the GIS and displayed it on top of the historical mapping.

The next step was to create a spatially enabled table called Artefact.No. This was only possible in two dimensions as the artefacts were predominately surface finds. To do this I used the Editor extension in ArcMap to plot the artefacts individually on the map as follows. In a vector data structure, coordinate pairs represent all objects. In this case, a point represented each artefact using a pair of coordinates, recorded in a list (attribute table) and given an identification number by the system. I created an empty feature class (a 'container' for the data) and then edited it to add the new points and create an attribute table. I used the original artefact number from Harrison's log as primary key or unique identifier for each point. There were no co-ordinates in Harrison's notes, as he located his finds by Field/Area name and height data derived from Ordnance Survey maps. As a result, I plotted the artefacts by locating the Field/Area and the height Harrison specified and placed the point on the relevant contour line within the field boundary. This was reasonably accurate as most contours only crossed a field once. Harrison's map books had dots representing artefacts, and although no identifaction numbers were present, they gave some indication of location along the contours. The result of this is that the find-spot is not exact, but for the purposes of this study is sufficient to locate the artefacts to a specific geological and topographical location. Each artefact described in the log was plotted using this method, whether it had been found in the Museum or not, providing that the locational data within the log was specific enough to follow the methodology above. I filtered the database to show those that had been found and exported these as a new database called Artefact No. Found. I also added to this spatial database the period that the artefact originated from (e.g., Lower Palaeolithic, Lower/Middle Palaeolithic? Middle Palaeolithic (Levallois), Middle Palaeolithic Mousterian? Later Palaeolithic or Indeterminate).

To populate the new spatial table with all of the data from Harrison's log, I performed a spatial join in ArcGIS. This used the unique identifiers of each table (the artefact numbers from Harrison's log) to attach all of Harrison's artefact data from his non-spatial csv table to each artefact in the new spatial table, thereby replicating Harrison's log spatially.

There were artefacts present in the museums that I could not locate to the logs/notebooks of Harrison but were annotated with a findspot and/or a height written directly onto the artefact. I

plotted these artefacts onto the map in a second spatial table (Artefacts by Museum No.). I achieved this in the same way as those described above, using the Museum accession number as the unique identifier instead of Harrison's artefact number. These could be duplicates of some of Harrison's log entries this table will only be used as a separate database for additional information.

The Landuse of the findspot of each of the artefacts found in the museum was required for further analysis. I obtained this by adding a new field to the Artefact No. Found attribute table and examining the attribute data for each artefact for clues as to the landuse of the findspot area. This was achieved by using the notes from the artefact, notes from the sketchbook which featured the artefact drawing, the original annotated maps of Harrison's and an Ordnance survey map from the period in question as Harrison's maps can sometimes be obscured by his annotations. Once the Landuse field was populated, I obtained a summary of the numbers of artefacts per land use type by right clicking on the field in the attribute table and clicking summarise. This produced a summary table as shown in Chapter 4, Table 6. Using the same methodology, I added a field called Abrasion to the 'Artefact No. Found table' in ArcMap and populated using the data obtained from the Abrasion analysis methodology described in Chapters 3 and 4.

Slope data was downloaded from the Worldpop website at Southampton University Finally, I added the following to the GIS:

- Slope data, which was downloaded from the Worldpop website at Southampton University and the slope analysis is described in Chapter 4
- Superficial geological data (e.g., 'drift sediments or non-bedrock sediments), geological layers downloaded from The British Geological Survey (2018). This layer was added to the map as a grouped layer below the Contours.
- A paper map produced by Joseph Prestwich (Prestwich, 1889), scanned and added to the GIS as a jpg. It was then georeferenced to the historical map using ArcMap.

Georeferencing a map;

> "*in order to use it as a background for visualising landscapes can facilitate the interpretation of other spatial data layers. A visual reference to enable contextual detail to be qualitatively assessed can provide profound insight into the spatial relationships between archaeological data and landscape features"* (Conolly and Lake, 2006).

Georeferencing is a mathematical transformation of one set of coordinates to another and for

Prestwich's map involved locating landmarks (such as junctions or bends of roads or rivers and streams) on the historical map and assigning the same co-ordinates to that location on Prestwich's map. Prestwich's map contained a wealth of information, personally identified as he walked over the land near to his home. It included the areas of Drift gravel where Harrison's artefacts were found and also the extent of the various river basins and waterways. The map was annotated with letters, which represented sites as mentioned in Harrisons Map. Once all of the layers were added to the Table of Contents in ArcMap, the GIS was used to describe the position of the artefacts in the study area by various parameters.

Harrison's map archive consisted of a Key Map (Figure 18) and a number of larger scale map books (an example can be seen in Figure 21 and Figure 22). The Key Map had two circles of approximately six miles diameter (Figure 18, Figure 19 and Figure 20), which marked his collection area. The circle in Figure 19 was centred on West Malling, near to Malling House in Kent. The second circle (Figure 20), the most prolific area, was centred on his house in Ightham. The Key map was also annotated with a numbered grid as shown in Figure 18, Figure 19 and Figure 20. The numbers on the grid covered a group of map squares annotated with letters a to f, each of which covered a page in a related large-scale map book (an example can be seen in Figure 21 and Figure 22). Harrison made map books using these larger scale map squares (Figure 21). Each map book had numbers that matched the grid squares on the Key Map, which meant the overlapping areas on the pages of the large-scale map books were easy to locate. He also annotated the maps (Figure 22) with some of the individual local field names and areas as referred to in his logbook and sketches, which made it easier to locate his artefacts on the map. There are many annotations made by Harrison on most of his maps, although often difficult to read. This map includes the area of Fane Hill on which many of his artefacts drawn, but unfortunately, he does not often add the ID numbers for identification (With the permission of Maidstone Museum).

Figure 18, Figure 19, Figure 20, Figure 21 and Figure 22 below: A series of maps illustrating those produced by Harrison and used by the author to locate names of fields and areas and to help with the placing of artefacts in the GIS produced.

Figure 18. The full extent of Harrison's key map, with grid squares and circles of interest annotated.

Figure 19. Harrison's circle of interest centred on West Malling and the grid squares on the Key map.

Figure 20. Harrison's circle of interest centred on Ightham and the grid squares on the Key map.

Figure 21. Example of Harrison's map book of individual maps. Top of page, the cover of the map book 29 D - F, 30 D - F and 31 D - F. Within this map book, each number and letter represent a page referring to the grid (Figure 18, Figure 19 and Figure 20).

Figure 22. A close-up of Figure 21, Harrison's Map page no 29f

Figure 23. Photographs of Harrison's artefact no 15 , classified as a MiddlePalaeolithic/ Mousterian? handaxe from Basted Valley, Ightham. Found at 310 feet on a piped surface (Harrison's logbook). The measurements in cm are L 88, W 65 and H 10 cm, as recorded in Maidstone Museum's database, indicate a small handaxe. Visually it has a very low maximum width, but it is damaged which could affect the measurements.

I curated the artefacts individually into bags on which I annotated the ID number, the finds location from Harrison's logbook, and the museum accession number for ease of later research. I personally examined each of the artefacts and assigned a period from which they had most likely originated based on discussion with Dr. John McNabb, using the policy adopted in this chapter (page 45) and with the methodology as follows. I did not measure the artefacts before losing museum access, so I used the measurements from the Museum accession register. The Middle Palaeolithic/Mousterian were all small handaxes and were assigned to this period based on the cordiform and sub-triangular form of classic Mousterian/Neanderthal handaxes, with very low positions of maximum width. No boute coupe handaxes were present. Only one of the five Mousterian handaxes found in the museum was assigned Palaeolithic/Mousterian, whilst the remaining four were assigned Palaeolithic/Mousterian? because there was a strong probability that these were from the Middle Palaeolithic and most likely Mousterian based on the criteria mentioned above. Three of the five Palaeolithic/Mousterian/? were located near to Oldbury Hill and the others were found approximately half a mile to one mile from this location. Artefacts were classified as Middle Palaeolithic/Levallois if the Levallois technique was present either on cores or on end products (elongated/laminar, pointed, flake) based on the diagnostic signs of Levallois preparation of the preferential surfaces.

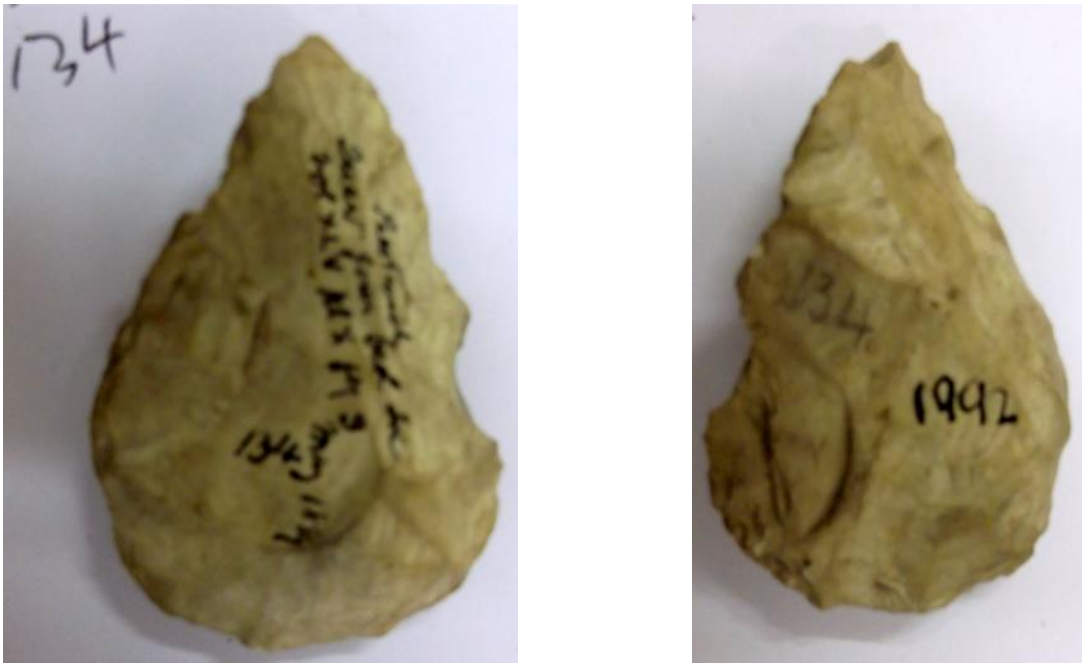


Figure 24. Photographs of Harrison's artefact number 134, with evidence of Levallois technique (with the permission of Maidstone Museum). This artefact was found at Oldbury West at 410 feet OD, in a field between Patch Grove and Brooms (Figure 8). The measurements are L 57, W 38 and D 12 cm. It is described as white, sharp and is twisted. It is featured in Prestwich Quarterly Journal of the Geological Society, Volume XLV,.Plate X, Figure 3, 3rd May 1889.

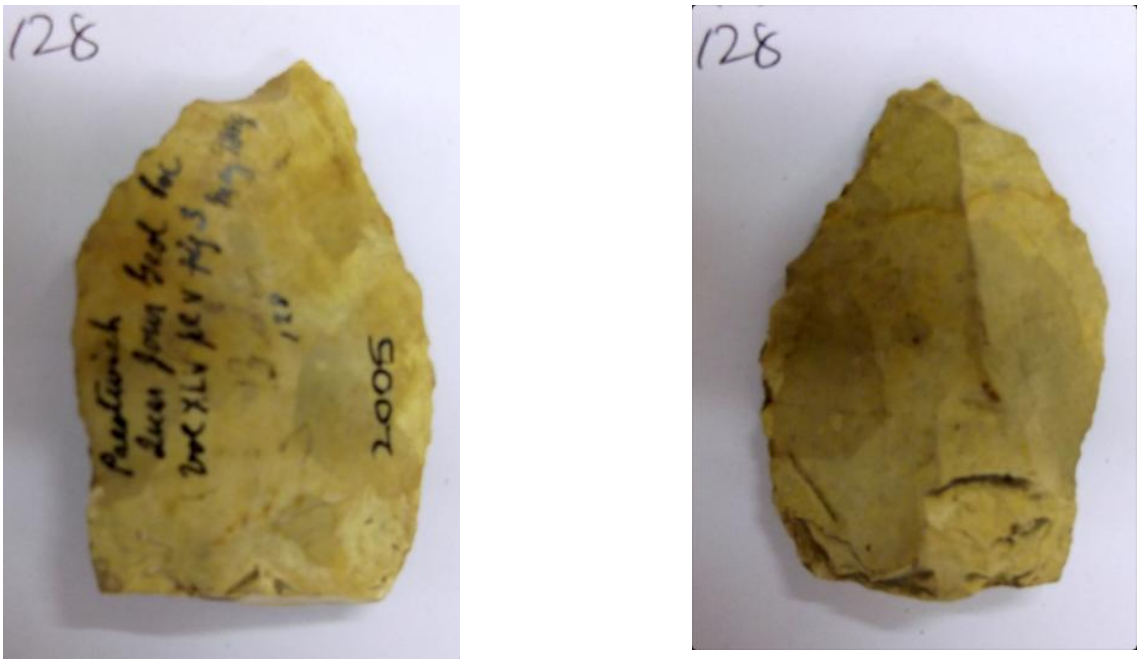


Figure 25. Photographs of Harrison's artefact number 128, classified as Indeterminate. This means that it is unknown from which period this artefact originated (with the permission of Maidstone Museum).

Figure 26. A Lower Palaeolithic handaxe described as ‘ochreous’ and number 151 in Harrison’s log. Found 20 feet deep at the base of Medway gravels in Aylesford. This artefact does not have an accurate location, level or Museum number. It has been mapped in the Museum number database (with a 0 as the museum number) in the general Aylesford area (with the permission of Maidstone Museum).

Figure 27 Photographs of a Lower Palaeolithic handaxe, white with a small patch of cortex on the dorsal face . Found at Fane Hill at a level of 375 feet. The artefact is Number 350 in Harrison’s log and museum number 765, and stored in box P22 Victoria Cellar, Rack 6, Bay E, Shelf 1. Measured at Maidstone Museum as Length 155 Width 70 Height 38 cm (with the permission of Maidstone Museum).

Those artefacts classified as Lower Palaeolithic in the archive are primarily handaxes. They have been identified as Lower Palaeolithic following the general typology devised by John Wymer (1968), although his more detailed types of Acheulean handaxes identified by letters has not been used here.

Artefact Abrasion

The final methodological approach was artefacts abrasion classification, using the data collected. This approach provided a tool to assist in the interpretation of the artefact. Each of the artefacts in the study has differential levels of abrasion depending upon their journey to their final findspot. Possible causes of abrasion could be that they are water-rolled, abraded by movement down-slope or by periglacial action, buried in a fine-grained matrix and so in mint condition and many more reasons. In the study area, the most likely action was abrasion due to water action or solifluction movement during periods of freeze-thaw action.

The artefacts that have been identified in the museum were examined for levels of abrasion. This had to be by photographs of the artefacts as Maidstone Museum has been closed to researchers for more than two years due to the Covid Pandemic and subsequent staff shortages and work backlogs. Therefore, it was not possible to access the premises to re-examine the artefacts in person. In hindsight, artefact abrasion data would have been added to the list of data collection when the original curation exercise took place. Due to the volume of work undertaken at that time, the limited time spent in the Museum at each visit and the cost of accommodation and travel this would not have been possible for my original data collection. The methodology I used for evaluating artefact abrasion is as follows.

- 1 – Mint, very sharp and with no abrasion or pitting of the edges and arêtes between scars
- 2 – Fresh, showing some signs of abrasion but is still sharp and fresh
- 3 – Slightly Rolled, Edges and ridges between flake scars have started to get rounded through abrasion
- 4 – Rolled, edges and arêtes are very rounded and possibly pitted

This methodology follows Wymer (1968), which was also utilized by McNabb (2012). It was utilised here with some caveats due to the use of photographs. These were as follow:

- The photographs consist of both professional photographs, taken with a 35 mm digital camera mounted on a fixed tripod with lighting from the top left and a scalebar, and of

photographs taken with a camera phone for identification purposes. The latter were only used when deemed clear enough to make a decision on the abrasion. Further photographs were provided by Maidstone Museum by email, although only one surface has been photographed.

- Not all of the artefacts were photographed and so a sample of approximately half of the artefacts found at the museum were analysed
- In the final analysis Mint and Fresh were combined as it was not feasible to judge this level of accuracy from many of the photographs
- Slightly Rolled and Rolled were analysed separately but inevitably some overlap is possible in the circumstances
- It is not always possible to identify differential patination without consistent photographs of both faces, but if all professionally photographed this could be an extra layer of analysis

I added the resulting data to a table in excel and loaded into ArcMap as a layer. Using this method of assessing abrasion can be difficult due to the clarity some of the images. It would always be advised to use professional photographs, but in the absence of access to the artefacts it can be a useful tool when combined with other analysis. I would only advise using this in a more general capacity for locating spatial patterning and not for in-depth studies of artefacts. For instance, if tools are deemed to be fresh or slightly rolled this can be useful for assessing movement of artefacts, whilst rolled artefacts are more likely to be redeposited.

Chapter 4: The Harrison Archive in its Spatial Context

Benjamin Harrison's archive is extensive and in chapter three, I outlined methods of adding the varied data to GIS to make spatial layers. It is essential to use a Geographic information system (GIS) to add a spatial element to Harrison's data. It can help to visualise where the artefacts were found, their relationship to each other and the geology and topography of his collection area. The advantages of GIS are its ability to find spatial patterns in these data, applying a consistent repetitive algorithm to avoid many hours of manual pattern recognition. Indeed, GIS has been described as:

> *'The most powerful technological tool to be applied to archaeology since the invention of radiocarbon dating' (Westcott and Brandon, 2000, Abstract).*

Much work has been undertaken combining GIS and archaeology, however, as there is progression in the technology and increased accessibility of open data, so the opportunities for analysis improve. GIS is uniquely placed to answer my research question:

Conolly and Lake (2006) describe the basic tasks of a GIS as data acquisition, spatial data management, database management, data visualisation and spatial analysis, while Jones (1997) groups them into five tasks (Figure 28). These tasks, when integrated, are broadly the basis for the study of the Harrison archive to *help 'in terms of understanding spatial and even space-time relationships between natural and anthropogenic phenomena*' (Couclelis, 1999, cited in Conolly and Lake, 2006: 11). Nearly every element of this flow chart has been used in the analysis and each methodology used is explained in Chapters 3 and 4.

Before using the GIS for analysis of the archive, and once the layers had been loaded in (described in Chapter 3), I added a graphic (a large rectangle) to the study area, which incorporated all of the find spots of Harrison's artefacts. This rectangle was in a British National Grid Projected Co-ordinate system with a Transverse Mercator projection and a linear unit in metres.

Firstly, in this chapter I will discuss the artefact data presented spatially and what can be seen, followed by spatial analysis using tools from ArcMap to see if further patterns emerge.

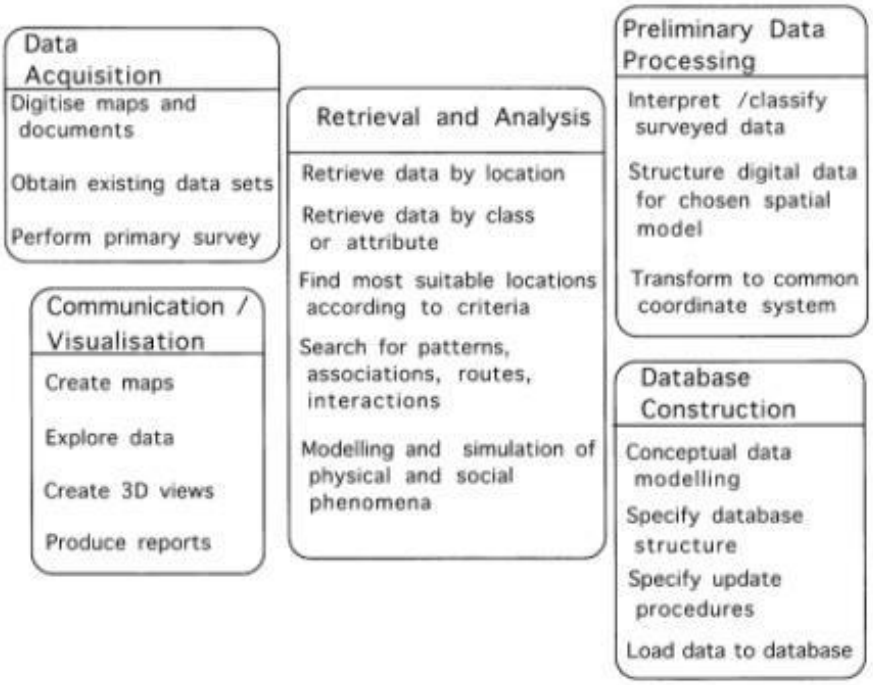


Figure 28 The five main groups of tasks performed by GIS (Jones, 1997: 7).

I used the Digital Elevation Model as a backdrop to show the position of the artefacts in comparison to the elevation of the area. The two circles of interest within which Harrison mainly worked are shown in the maps in Chapter 3 (Figure 18,Figure 19,Figure 29, Figure 31, Figure 32, Figure 33,Figure 36,Figure 37 and Figure 42), but the circles do not contain all of the artefacts in the data mapped from the Museum Number, so the rectangular graphic described in Chapter 4, page 70, (shown in Figure 29,Figure 31, Figure 33, Figure 36, Figure 37, Figure 42) encompasses all of the artefacts mapped from the Harrison collection.

The symbols for the artefacts obscure each other at the 1:130 000 resolution of the map in Figure 29, Figure 31, Figure 36, Figure 37, 43 but this resolution map is necessary in order to indicate the position in the wider area of most of Harrison's identified artefacts. It also shows the artefacts in the context of the landscape in which they are found. The map in Figure 30 at a resolution of 1:20 000 features a close-up view of the main cluster of artefacts from Figure 29. This is for further clarity of the locations at which each artefact was found by period.

It is already noticeable that there is a division between the Lower and Middle Palaeolithic artefact locations (Figure 30), with Lower Palaeolithic artefacts located closer to waterways than those of the Middle Palaeolithic. It may also be pertinent that those artefacts classified as Lower/Middle Palaeolithic? are clustering near to those classified as either Lower Palaeolithic or Middle

Palaeolithic. If the hypothesis in Tobler's first law of geography holds true, that "*everything is related to everything else, but near things are more related than distant things*" (Tobler, 1969), it may be possible to reclassify these artefacts based on the location in the landscape in which they were found. However, Tobler's law is a hypothesis to work to, but analysis will hopefully prove this theory in this case. For example, there is a large cluster of Lower Palaeolithic artefacts near to the waterway in the same location as a cluster of Lower/Middle Palaeolithic? artefacts (Figure 30). Smaller numbers of the Lower/Middle Palaeolithic? artefacts are evident around the Middle Palaeolithic artefacts at some distance from the river, which may indicate these are more likely to be Middle Palaeolithic.

In Figure 31 and Figure 32, the artefacts only classified by Museum number are visualized. There are artefacts present on the plateau, and when seen in close-up ((highlighted by the small yellow and white boxes inserted into Figure 31 and Figure 32), they are all classified as either Indeterminate, Later Prehistoric, Lower/Middle Palaeolithic? or Middle Palaeolithic. Following Tobler's hypothesis above, the Lower/Middle Palaeolithic? artefacts on the plateau are more likely to be Middle Palaeolithic.

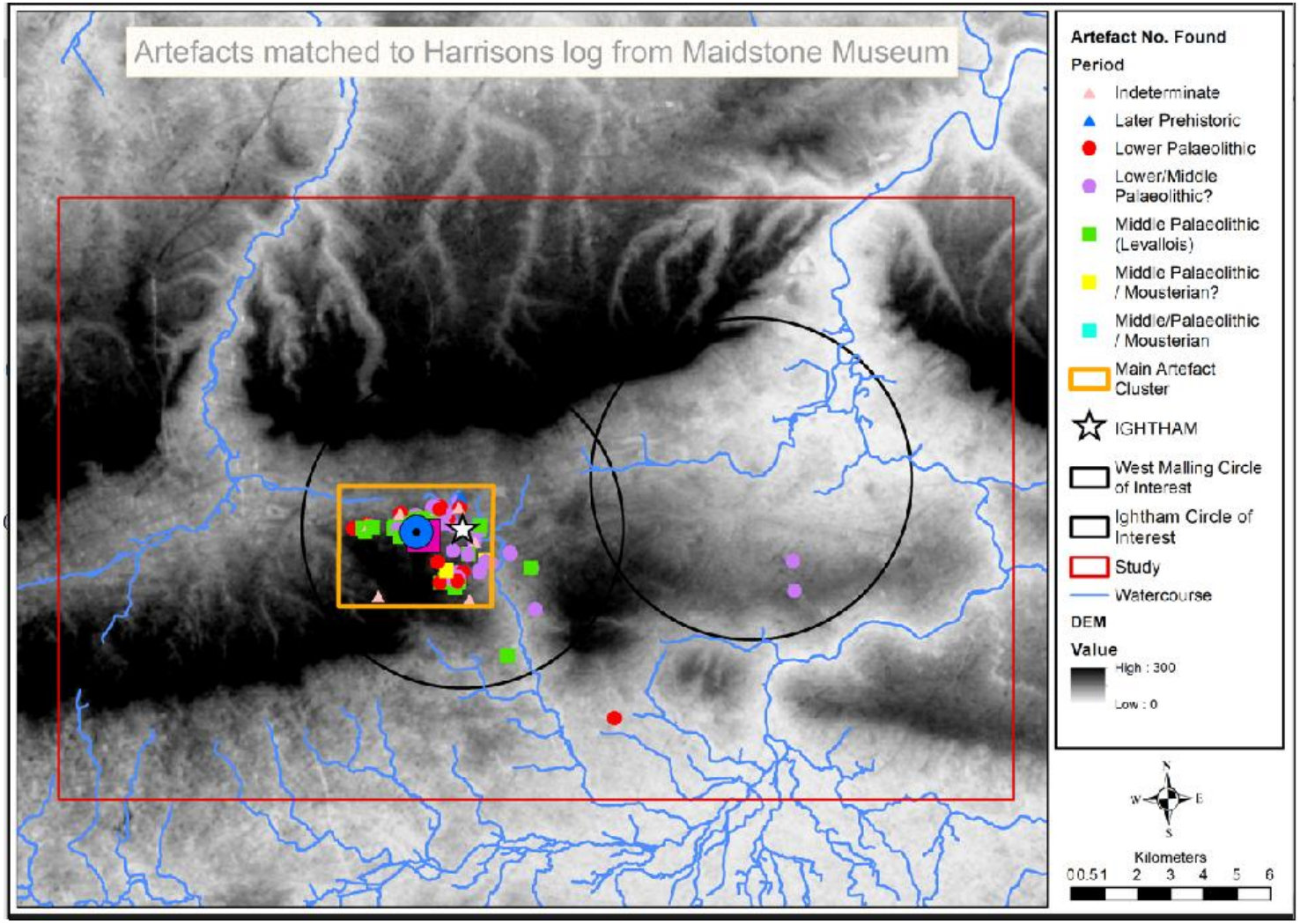


Figure 29. A Digital Elevation Model (DEM) of the study area, Harrison's own circles of interest from his maps, a graphic (rectangle) describing the coverage of Harrison's artefacts that were matched to Harrison's log (ASTGM2_N51E000_DEM, 2018) and the watercourses of the area (OS Open Rivers 2016 © Crown copyright). See Figure 30 for zoomed in main clusters of artefacts.

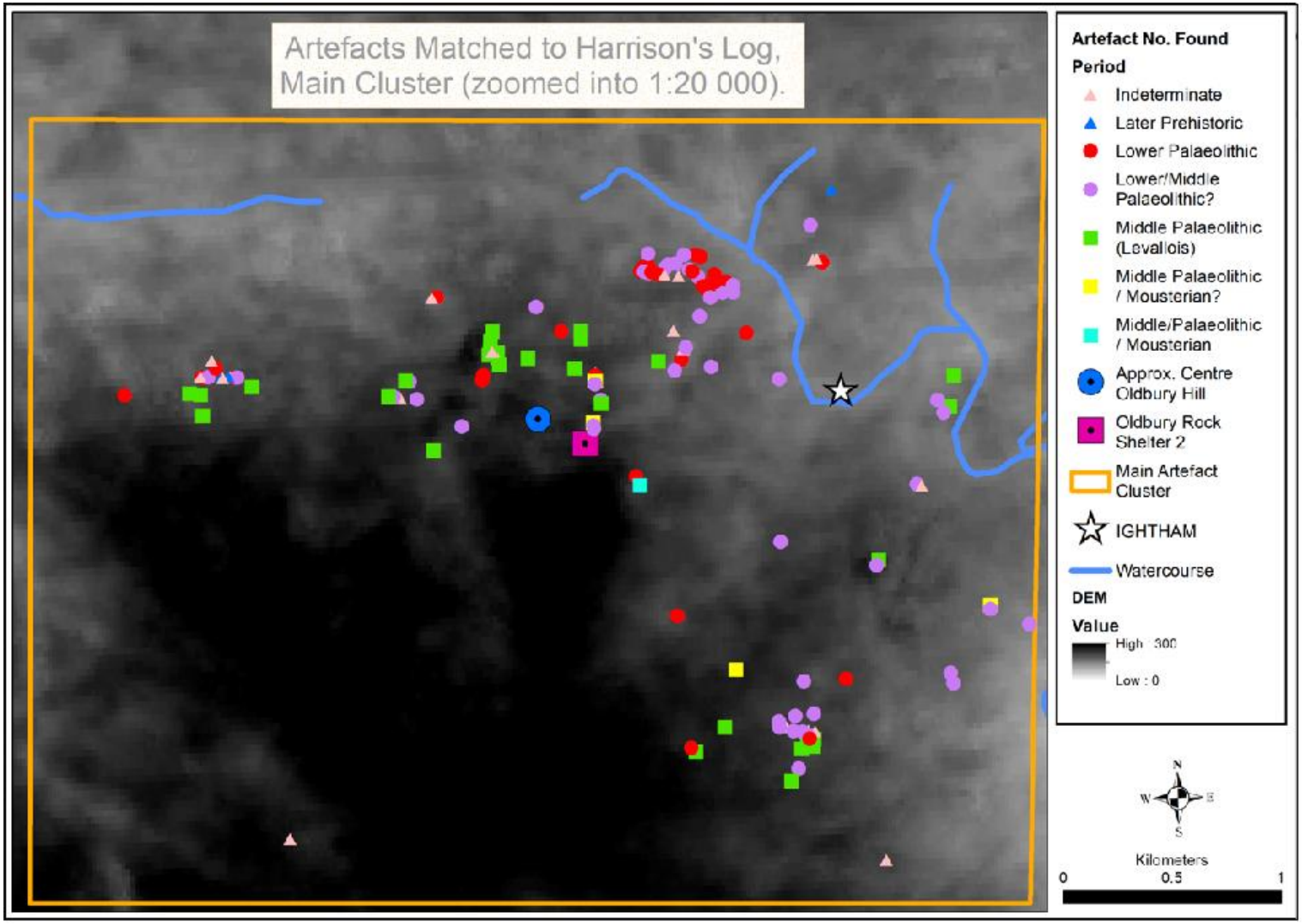


Figure 30 Zoomed into 1:20 000, the main cluster of artefacts from Figure 29 is denoted by the orange box. (Copyright ASTGM2_N51E000_DEM, 2018 and OS Open Rivers 2016 © Crown copyright throughout thesis).

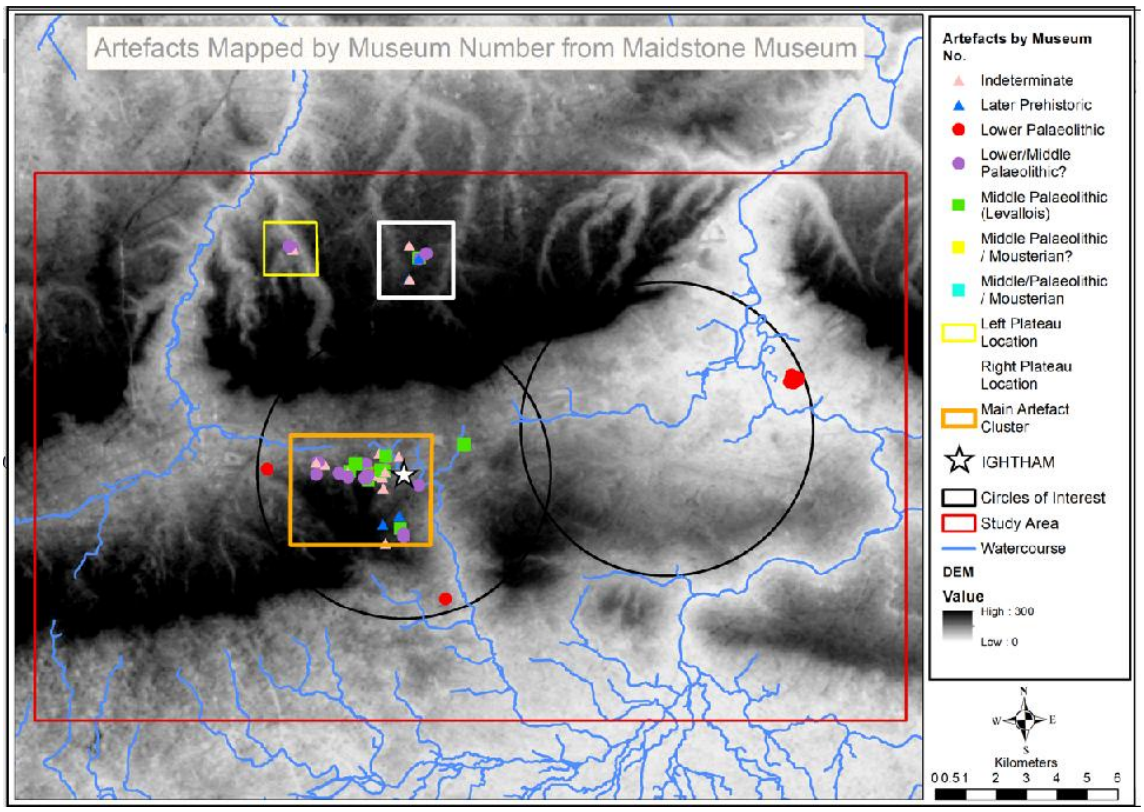


Figure 31 Harrison's artefacts that were mapped by Museum Number

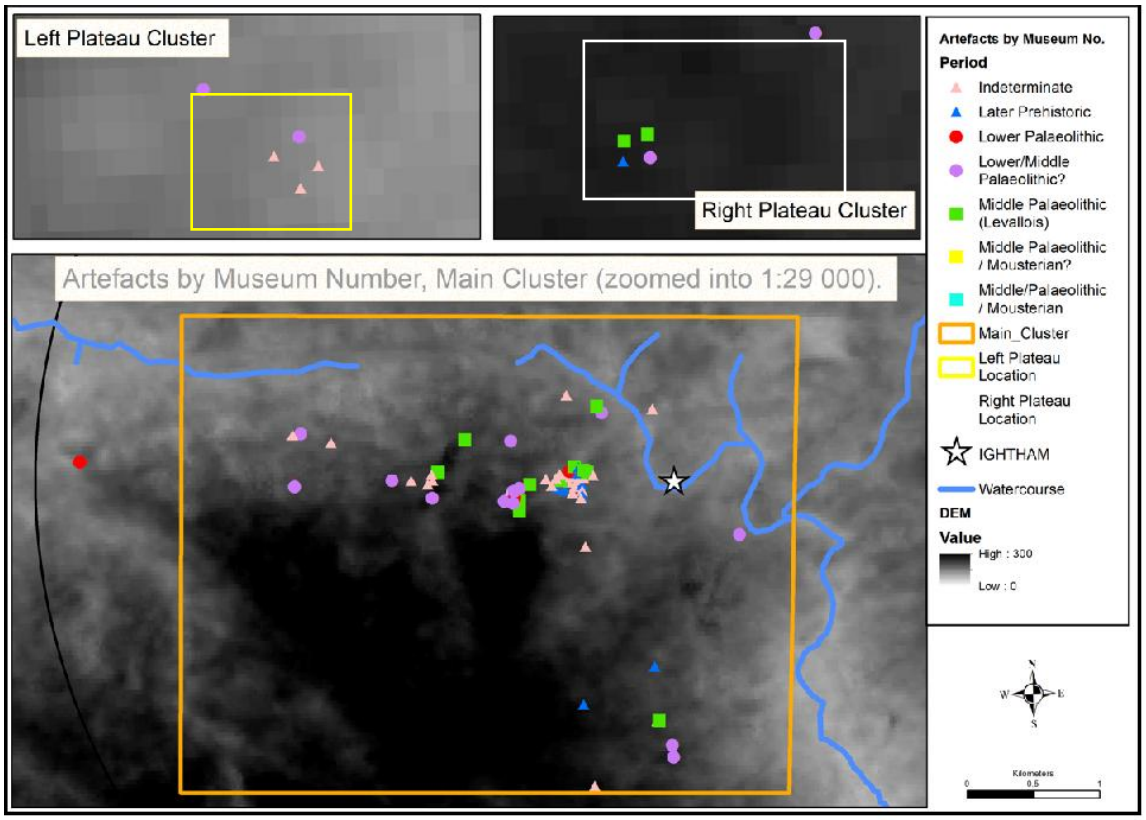


Figure 32 The orange box represents the main cluster of artefacts from Figure 31 at a resolution of 1:29 000. The top boxes are close-up versions of the artefacts in the yellow and white squares in Figure 31.

Artefact Analysis

There are 534 artefacts of Harrison's that have been either recorded in his logbook or found in the museum but not recorded in the log. His log in Maidstone Museum contained 446 records. Additionally, 88 artefacts have been found in the museum which are not on this list. This may be because they have been recorded in a different logbook which has not been found. These extra lithics have been identified using Harrison's sketchbooks and the annotations on the artefacts.

Additionally, Harrison used a numbering system for those artefacts found on Medway gravels and those found on Hill gravels (see Chapter 3). These he drew in sketch-book numbers 8 and 9 for Medway gravels and book number 7 for Hill gravels. The gravels were based on his interpretation of the geology that he encountered as he collected the artefacts. Some of these artefacts were allocated a number in Harrison's logbook and were annotated with both the logbook number and the hill or Medway gravel number in the sketchbooks. In this case the log number has been used as the main ID where available.

Gravels are a very important indicator of possible findspots for artefacts and are extensive in the study area. These gravels are often found along the paths of rivers (see Figure 37Figure 38) for mapping of buffered watercourses in the study area), indicating their previous extents and floodplains. Harrison's archive mentions gravels which are described as Hill gravels and Medway gravels. Analysis of the information provided by these gravels are described below.

Hill Gravels

There were 63 artefacts recorded as originating from Hill gravel, as specified in Harrison's sketch-book number 7.

- Of these, 52 (83%) artefacts were matched to artefacts in the museum, either to Harrison's log, or to Harrison's physical artefacts annotated with Harrison's writing. It is possible that the latter have a counterpart in Harrison's log but have not been identified as such.

- There were 38 out of these 52 Hill gravel artefacts that were physically matched to artefacts in the museum and identified for period, which ranged from Lower Palaeolithic to later Prehistoric.

- From the 38 artefacts specified above, the Palaeolithic artefacts relevant to this study are Lower/Middle Palaeolithic? with 10 artefacts, Middle Palaeolithic with 9 artefacts and Lower

Palaeolithic with 6 artefacts.

- There were 14 out of the 52 artefacts recorded in Harrison's log that were not found in the museum and therefore the period could not be ascertained.

Therefore, the period of artefact (where known) which is most likely to be found on Hill gravels (where collection took place) were those categorized as Lower/Middle Palaeolithic? and those categorized as Middle Palaeolithic. Therefore, referring again to Tobler's First Law of Geography (Chapter 3 and 4), those artefacts classified as Lower/Middle Palaeolithic? that were found on Hill Gravel are more likely to be Middle Palaeolithic.

- The height OD (Ordnance Datum) at which these 52 artefacts were recorded ranged from 365m to 520m OD, with 27 of the 52 artefacts recorded most prevalent between 400m and 430m OD.

- There were 14 Hill Gravel artefacts that had no height recorded, either in the sketchbook, logbook or on the artefact.

The areas of Hill Gravel that were identified by Harrison were mostly at Seal Chart/Chart Farm, with a few at Patch Grove.

Medway gravels

There were 172 artefacts in the Museum, which were recorded in Harrison's log as being collected from areas of Medway Gravel. These artefacts were all found in the Museum archive and identified by cross-matching with the paper archive.

- Out of these 172 artefacts, 102 had height data recorded, which were in the range 225ft O.D. to 435ft O.D.

- The heights at which these artefacts were most prevalent were 340ft, 415ft and 420ft O.D. with 11 artefacts (11%) each. There were 10 artefacts at 320ft O.D. This gives a range of 320ft to 420ft O.D which experiences the highest concentration of artefacts.

- There were 84 of these artefacts that were mapped using height and location data.

The periods of the recorded artefacts range from Lower Palaeolithic to Later Prehistoric.

- The artefacts relevant to this study that were most prolific were those that were classified as Lower/Middle Palaeolithic? with 78 artefacts, and those classified as Lower Palaeolithic

with 38 artefacts.

- There were 29 artefacts which were not recorded as being from the Medway gravel or the Hill gravel. Most of these were at 340m OD or 420m OD. More of these were Lower/Middle Palaeolithic? but the numbers are very low.

Prestwich's map of gravels of unspecified type.

Joseph Prestwich along with Harrison pinpointed all areas of gravel whilst walking around the area, although they did not specify which type of gravels (e.g., Hill or Medway gravels). They were located around the waterways and on the higher areas of Clay-with-flints. They annotated Prestwich's drift map with these patches of gravel. I digitized the gravel patches on the Drift Map, which can be seen below (Figure 33).

The gravels on the Clay-with-flints were important as Harrison had begun to find legitimate Palaeolithic implements at the higher levels, (as opposed to the contentious Eoliths), as confirmed by the following note in Harrison's archive, volume 4 of his notebooks (Harrison, 1887 – 1889). An extract, presumably from a letter from Sir John Evans to Benjamin Harrison in which he says:

> *'You are making out a most interesting case and the discovery of so many implements at such high levels and so far from any important stream opens up a wide field for speculation* (Harrison, 1887 – 1889).

I have overlain Harrison's artefacts onto Prestwich's Drift map: the artefacts that had been found and matched to Harrison's log and those that could only be identified by accession number were analysed separately. The former, mapped in Figure 34, had a third of its artefacts (55 out of 159) located within the patches of gravel area on the Drift map. Table 3 displays the numbers of artefacts of the relevant periods located within Prestwich's gravel patches.

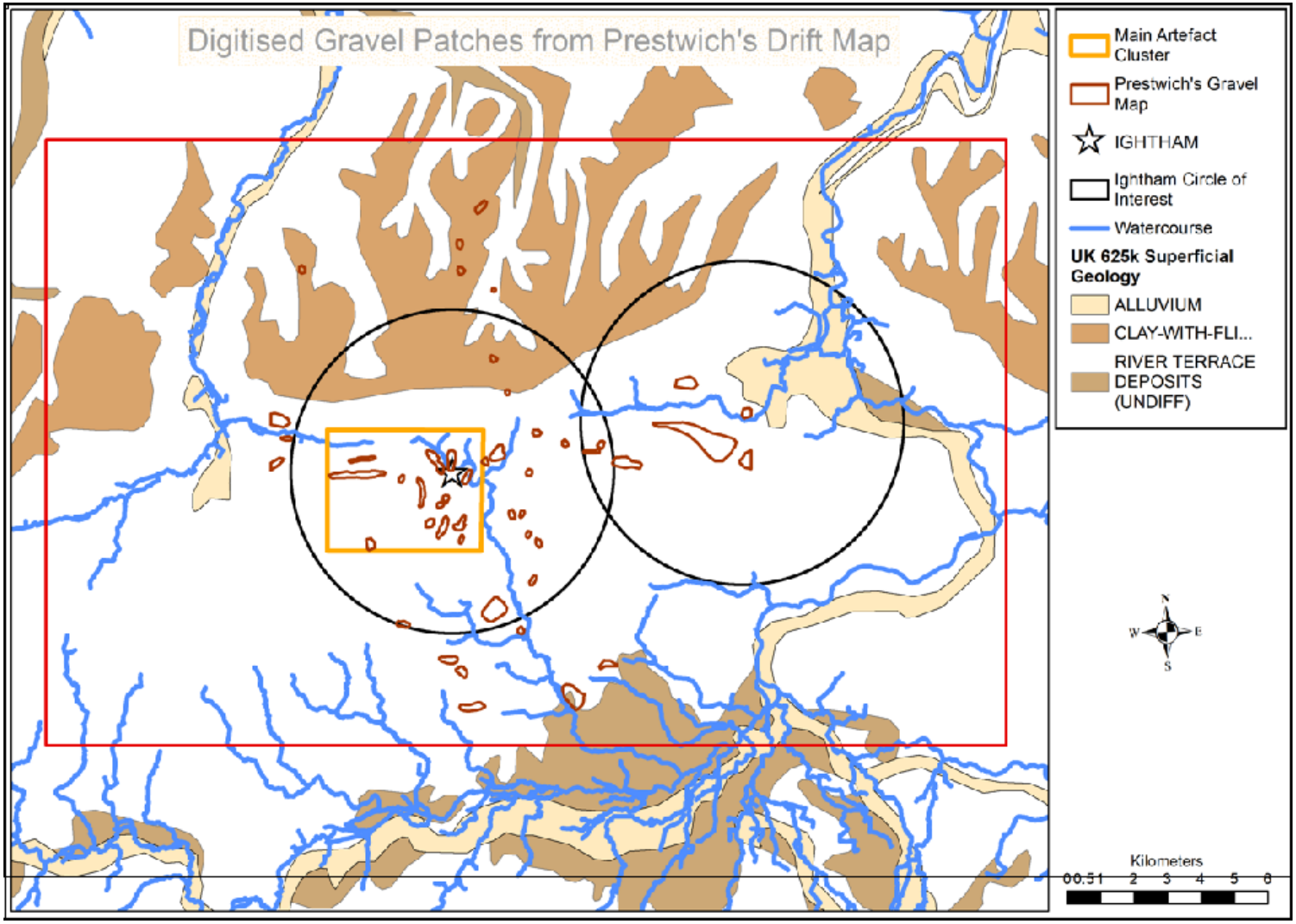


Figure 33 Areas of Gravel of unspecified type from Prestwich's Drift Map, digitised here to show the location in relation to waterways and Clay-with-flints (Prestwich, 1889). The orange box denotes the location of the main area of artefacts shown in more detail in Figure 34.

Period	Number of artefacts
Lower Palaeolithic	15
Lower/Middle Palaeolithic?	23
Middle Palaeolithic (Levallois)	9
Middle Palaeolithic/Mousterian	1
Grand Total	55

Table 3 No of artefacts which were matched to Harrison's log, recorded by periods relevant to this study, which Harrison collected from the areas of Gravel on Prestwich's Drift Map.

There were no artefacts in this dataset collected from the Clay-with-flints or the plateau. The numbers within the gravels would be higher if the co-ordinates of the artefacts were more accurate.

The latter dataset, (those identified by accession number) had just over 8.5% (9 out of 106) that overlay the gravels, which probably reflects the less accurate placing of the artefacts using my methodology specified in Chapter 3 (pp. 53-56). Four Middle to Lower Palaeolithic artefacts were collected from the Clay-with-flints, two from the Middle Palaeolithic and two Lower/Middle Palaeolithic? They all came from Ash, Ash Plain, South Ash and Turners Oak Ash. This is the area where Harrison found many of the Eoliths, although those artefacts listed here are legitimate Palaeolithic artefacts. Two Lower/Middle Palaeolithic? were recorded in the Maplescombe Valley. These were situated between 75 and 85m OD.

It is likely that the Prestwich map does not identify all of the gravels in the area and that artefacts were collected from other areas of gravel. Harrison prioritised his collection habits to areas of gravel when he discovered that more Palaeolithic artefacts were likely to be in this geology type, but he continued to collect artefacts from all landscape types.

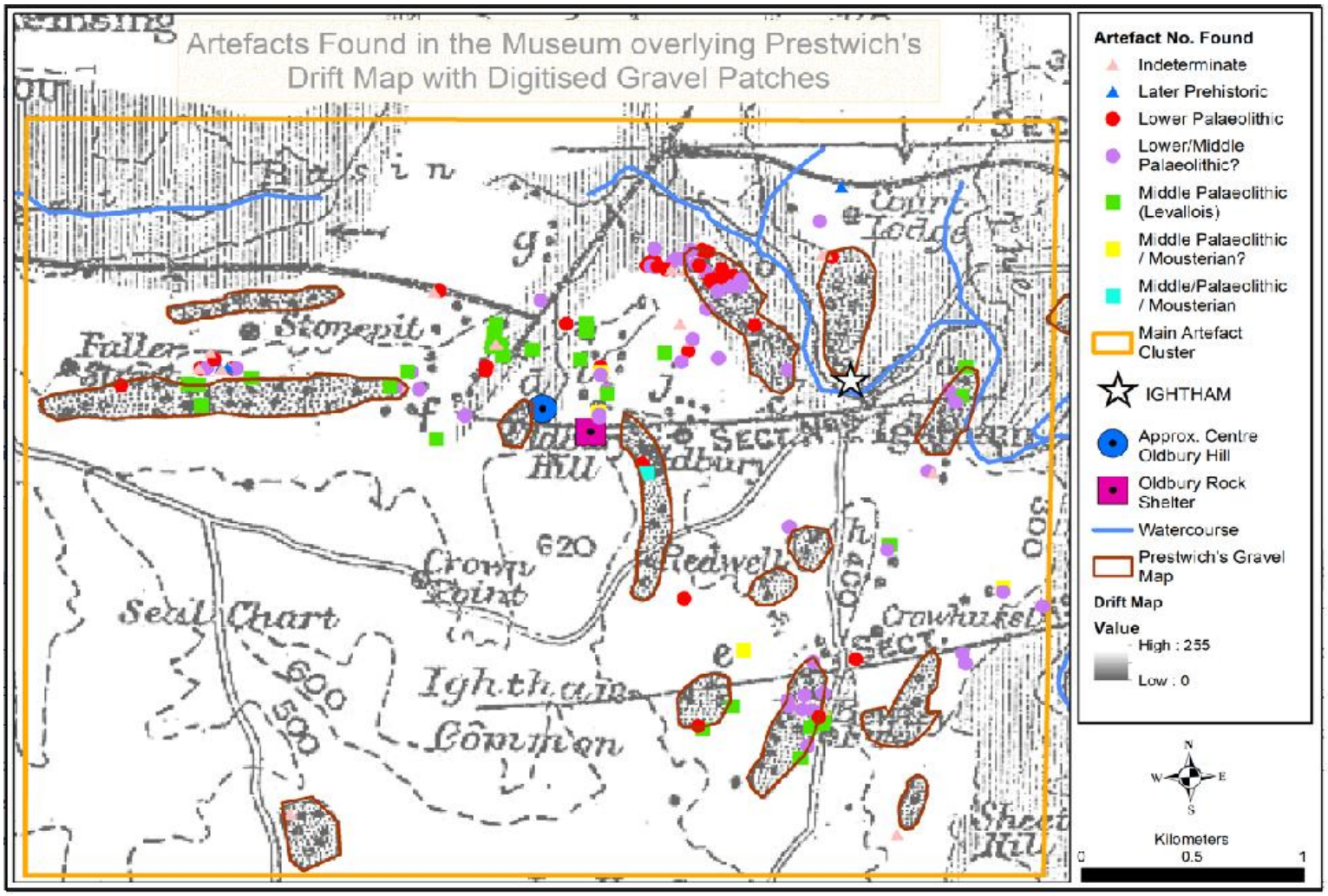


Figure 34 Prestwich's Drift Map with digitized gravels, overlain with the identified artefacts from Harrison's collection. This is to visualise the relationship between the artefacts and the gravel patches. The artefacts are placed slightly off to the north due to the methodology of assigning the co-ordinates, which is described in chapter 3. There are no artefacts on the plateau from this dataset, so this area is not shown.

Abrasion Analysis

The matched artefacts that were imported into GIS were filtered and exported as a table showing the period and the abrasion category (Table 4). Abrasion analysis could only be applied to approximately half of the validated artefacts from Harrison's archive because only those artefacts that had photographs associated were studied for artefact abrasion and it was not possible to return to the Museum during or after the Covid Pandemic to photograph the remainder of the artefacts.

Period	Fresh	Slightly Rolled	Rolled	Grand Total
Lower Palaeolithic	4	6	12	22
Lower/Middle Palaeolithic?	4	11	13	28
Middle Palaeolithic	2	9	8	19
(blank)	0	1	0	1
Grand Total	10	27	33	70

Table 4 Types of abrasion categorised by period.

From this sample, rolled artefacts are slightly more likely to be Lower/Middle Palaeolithic? (thirteen artefacts), with twelve of these artefacts classified as Lower Palaeolithic and seven artefacts classed as Middle Palaeolithic. Further analysis involved the abrasion level of the artefacts, their proximity to water and their condition. Three artefacts that were in the 0 -100m closest to water were all found at a meander above the confluence of two branches at the northern end of the Shode River.

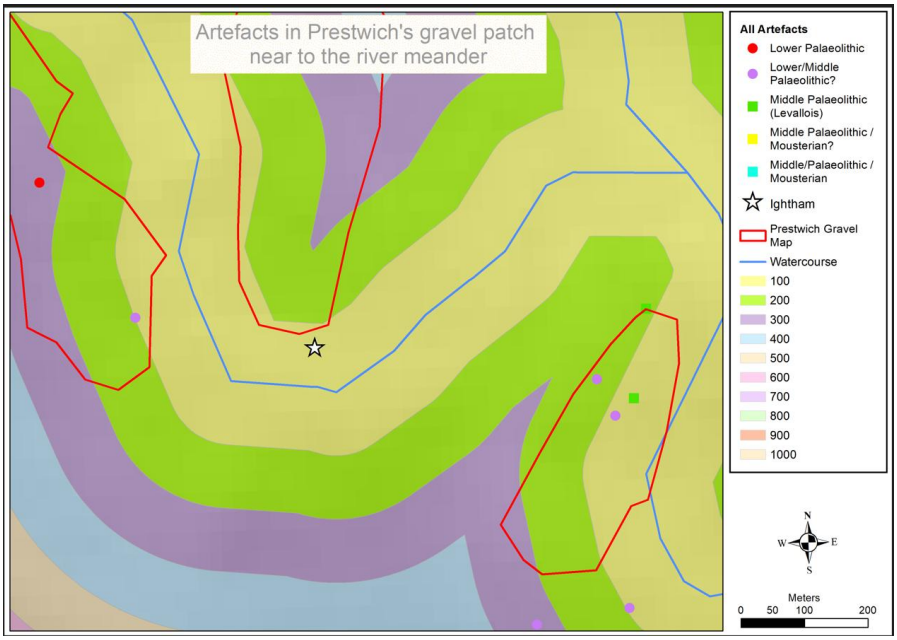


Figure 35 Artefacts near the meander of the river in the gravel spread from Prestwich's Drift Map (Table 3, Figure 33 and Figure 34). (Prestwich, 1889: Edina 2016b: Esri 2022).

	Lower Pal	Lower/Middle Pal?	Middle Pal
100 Fig. 36			
200			
300			
400			
500			
600			
700			
800			
900			
1000			

Key

Fresh

Slightly Rolled

Rolled

Table 5 Artefacts by type and abrasion level. Those in red are also broken.

There were four fresh artefacts further than 1000 metres from a waterway. Two were in Buley valley (one Lower/Middle Palaeolithic? found on Medway gravel and one Middle Palaeolithic artefact), one Lower Palaeolithic was found in Rose Wood and one Lower Palaeolithic was found at Tebbs West opposite Tyler's Knoll found on Medway Gravel.

It was noted during the analysis that there was a cluster of artefacts between 200 to 400 metres, and that these were very close to the Maidstone East railway line. It is known from the book 'Harrison of Ightham' that he regularly collected around this railway line and that artefacts were found *in-situ* in the gravels of the cuttings and on the surface there. It is feasible that some of the artefacts could have been transported there when the line was constructed but at least some of these artefacts came from these gravels (Figure 49). Approximately a quarter of these artefacts were broken:

> *'Mr. B. Harrison has found implements and portions, broken into fragments, whose parts have been barely separated from each other; while others were many inches apart: they all have clean fractures' (Spurrell, 1883: 91).*

The artefacts in Table 5 which are coloured in red are broken artefacts. If a full sample of the artefacts were available for abrasion analysis this condition analysis could be useful to identify patterns of deposition.

Land use Analysis

I determined the landuse by studying Harrison's log, sketchbooks and annotations on the artefacts themselves, and then Harrison's annotated maps to confirm this where possible. I checked Google Earth for continuity of use using the time slider which went back to 1940. When Harrison was collecting it was predominately a rural area, and most of these areas had remained undeveloped.

The most prolific land use type where Harrison collected artefacts were fields. This is probably because they were more accessible, and as he collected in all seasons of the year, the fields would not always be under crop. There were 128 artefacts found in fields. The highest percentage (37%) of these artefacts were Lower/Middle Palaeolithic? followed by Lower Palaeolithic (20%) and Middle Palaeolithic (19%). The numbers of Lower and Middle Palaeolithic artefacts found in the 'Field' land use type are broadly similar.

The next highest number of artefacts found are from plantations, with 16 artefacts. The highest number of artefacts found in this category were Lower/Middle Palaeolithic? (38%), followed by Middle Palaeolithic (25%). Lower Palaeolithic was just (13%). The most prolific artefacts found in

plantations are Middle Palaeolithic. Hop Gardens can also be described as plantations, although differentiated by Harrison. This may just be inconsistency in Harrison's administration, or there could be a reason for this. Only four artefacts were found in Hop Gardens, 50% were Middle Palaeolithic and 25% each Lower Palaeolithic and Lower/Middle Palaeolithic?

Lower/Middle Palaeolithic? artefacts cannot be specifically identified as from one period, so Middle Palaeolithic has the higher occurrence of any specific period in plantation and hop garden (combined) land use types. The reasons for this can be as follows:

- They are at a similar height
- They are at a similar distance from a waterway
- They are near to a recognised area of Middle Palaeolithic activity
- The collectors had a bias or better knowledge of these artefact types than other types or periods

The numbers of artefacts found in this land use type was quite small, only 20 in total, but may add some insight to the distribution of artefacts found.

The heights of these artefacts range between 300 and 430 feet and have no inclination towards any height. Therefore, this is unlikely to be a defining factor in their distribution.

The distance from waterways of the artefacts may have some bearing on the findspots as, with the exception of one artefact found within 100m near to a river bend, the Middle Palaeolithic artefacts found were between 600m and 1000m away from a waterway. They were found on a mixture of Medway and Hill gravels as classified by Harrison. There is a concentration of Middle Palaeolithic around Oldbury 'Rock Shelter', which is within approximately 1000m of any of the Middle Palaeolithic artefacts found in this land use type.

There were at least 11 finders of the artefacts recorded by Harrison, so it is unlikely that collection bias was an influence on the artefact type. There is some possibility that field hands paid by Harrison to collect artefacts could influence the artefact type. This may be because of differential knowledge of artefact types, so collecting only a percentage of the artefacts available, but it is assumed their knowledge only extended to whether the artefacts were worked and not typology, so it is unlikely they would all come up with the same period of artefacts fraudulently.

Landuse	**Number of Artefacts**	Lower Palaeolithic	Lower/Middle Palaeolithic?	Middle Palaeolithic
Cutting	1	1	0	0
Field	128	25	47	25
Garden	1	0	0	1
Gravel pit	1	1	0	0
Hop Garden	4	1	1	2
Piped Surface	1	0	0	1
Plantation	16	2	6	4
Railway cutting	1	1	0	0
Rock Shelter	1	0	1	0
Water Parting	1	1	0	0
Wood	4	0	2	2

Table 6 Land use analysis results of the findspots of those artefacts found within the museum's archives and matched to Harrison's log. Only those artefacts from the periods relevant to this study are included in this table.

Geological Analysis

The next step was to determine with which geological unit the artefacts were associated. The Bedrock geology was downloaded from the British Geological Survey (2018) and was clipped to the study square. The different geological strata were extracted in a GIS using a definition query, which is a way to display and analyse only certain spatial attributes from a table. Both groups of artefacts are visualised, those that have been identified in Harrison's log mapped more accurately, and those from the Harrison collection at the museum mapped by accession number. The Indeterminate and Later Palaeolithic artefacts have been removed from the mapping from this point forward as they are not relevant to this study because the former have no diagnostic properties of the Lower to Middle Palaeolithic period and the latter is after the timeframe for this work.

The geology type with most artefacts present was the Lower Greensand Group (Figure 36 and Figure 43). Of all the artefacts which were mapped by geology type (Figure 36), 383 out of 439 (87%) artefacts were from the Lower Greensand, which is a very important geological area to examine in relation to Palaeolithic archaeology. The important site of Oldbury Hill in the Study area, where predominately Middle Palaeolithic artefacts have been found on the slope near to the 'Rock Shelter', is of a similar hilltop topography to other Palaeolithic sites such as Beedings, West Sussex on the edge of the Lower Greensand scarp, and the adjacent site of Wood Hills, West Sussex. The latter included a Boute Coupe handaxe, only found in the Middle Palaeolithic. Further artefacts were found between Hassocks and Ditchling in Sussex, which are also on the Lower Greensand ridge. It is suggested that the Lower Greensand is susceptible to fissures, known locally as Gulls. These are *'deep discontinuities in competent strata that extend back from the valley crest, commonly parallel to the axis of the valley and associated with relaxation of the valley side*' (British Geological Survey, 2022a).

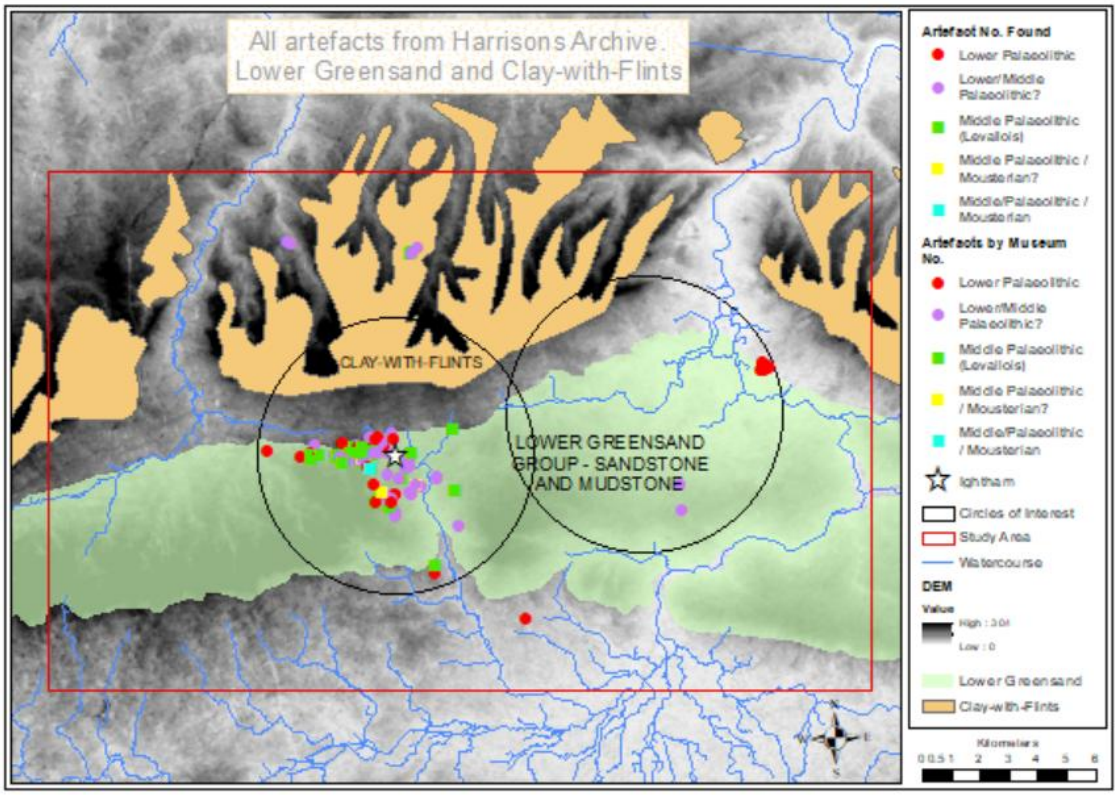


Figure 36 Artefacts found mostly on the Lower Greensand, with some artefacts found on Clay-with-flints and the plateau. (Contains British Geological Survey materials © UKRI [2018]), (ASTER, 2018).

These Gulls are not always visible on the surface and can be filled with sediment in which artefacts can be trapped, subsequently rising to the surface after human intervention such as construction, ploughing or natural erosion (Pope *et al.*, 2015: 37). This is the 'Sackung' model proposed by Simon Colcutt (2001) that cambering and gull formation can give rise to preservational environments for Palaeolithic material on the surface of hills comprised of jointed sedimentary rock (Pope et al., 2015). Benjamin Harrison discovered fissures in a quarry at Basted near Ightham and he collected faunal material and artefacts there (Harrison, 1928: 167). These artefacts are not evident amongst the identified artefacts in the Harrison archive at Maidstone Museum, although there are still many artefacts there that have not been matched to his written archive. The site was later monitored during quarrying by William Abbot and Edwin Newton (1894), who found extensive faunal material, which included fauna from the Pleistocene and Holocene. It was thought that 'the fissures acted as preservational contexts throughout the late Pleistocene and Holocene periods' (Abbott 1894; Newton 1894).

It is suggested that the artefacts at Oldbury were originally on the hilltop trapped in such a structure, and then released across the hillslopes by human or natural intervention. (ibid. p.37). The site of Beedings, West Sussex had many of these Gulls and an excavation there led by Dr

Matthew Pope discovered Palaeolithic artefacts within these structures (Pope, 2007).

A smaller but equally important number of artefacts were found on deposits mapped as Clay-with-flints. These deposits are found on the high hills and plateaux of the Southern Downland of Britain. Scott-Jackson (2005) said:

> *'Field observations suggest that particular facies of the Clay-with-flints deposits, in addition to the presence of solution features, may be implicated in the retention of Palaeolithic artefacts on these high-levels'* (Scott-Jackson, 2005).

These variable deposits, which have formed through many geomorphological processes, are described by Scott-Jackson (2005) as *'basin like' solution hollows or pipes formed from the action of Calcium carbonate solution on the underlying chalk* (Ibid). The Clay-with-flints deposits and associated Palaeolithic artefacts are retained within these deposits and sealed in until erosion, freeze-thaw or other actions on the deposit releases the artefacts.

These deposits were not in the path of glacial ice sheets or their meltwater and not generally affected by fluvial activity, although would have been affected by periglacial conditions (ibid.). The small number of these artefacts could be due to collection bias as it was outside Harrison's circle of interest, or because he was concentrating more intensely upon collecting Eoliths from these deposits. Alternatively, there may have been few patches of the deposit to produce these artefacts in accessible areas on the higher ground.

Spatial analysis tools will now be applied to the artefacts data to look for further patterning.

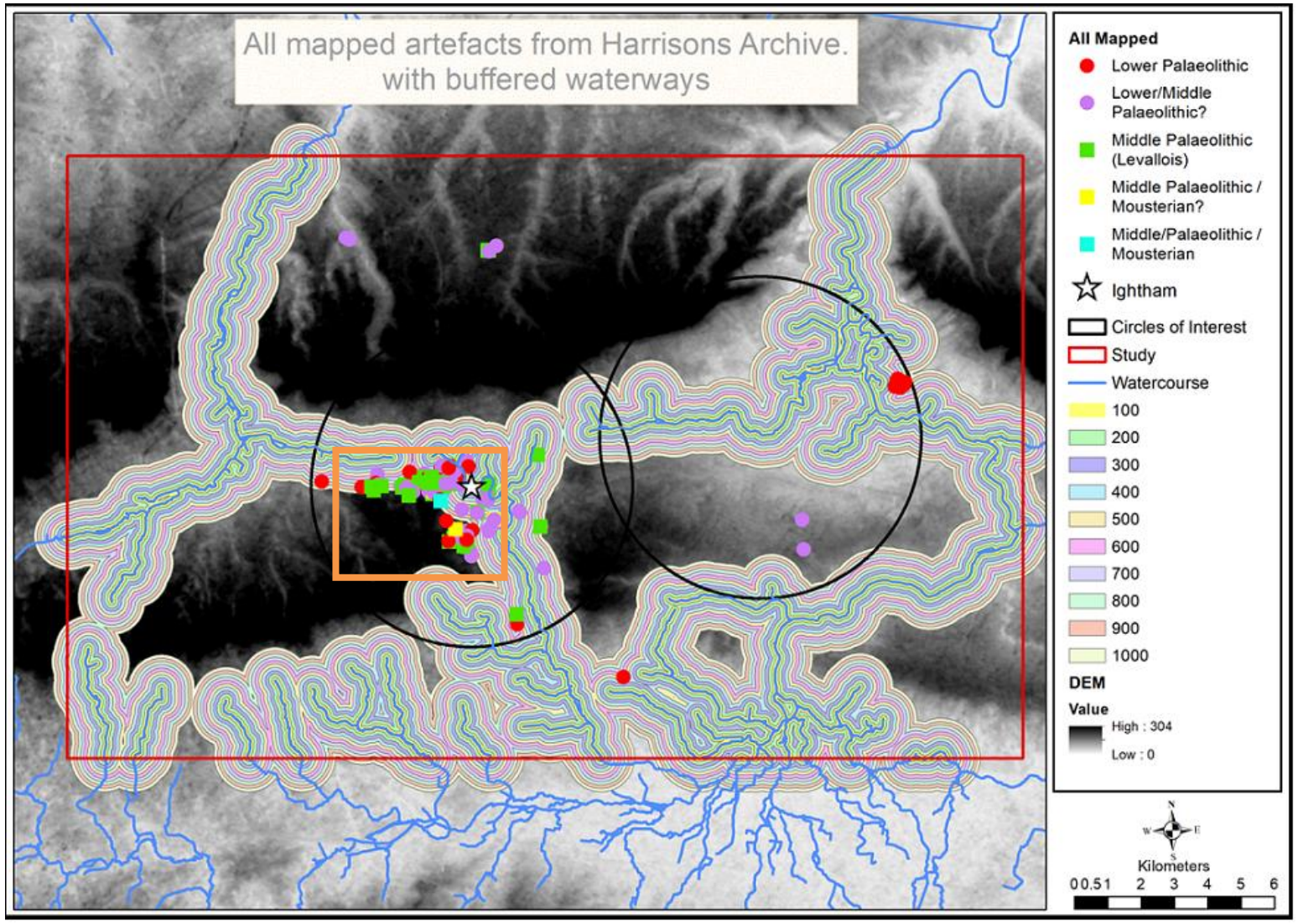


Figure 37 Multi-ring buffer of rivers in study area in 100m metre increments up to 1000m OD. The central yellow buffer represents the 100m either side of a waterway (Aster, 2018).

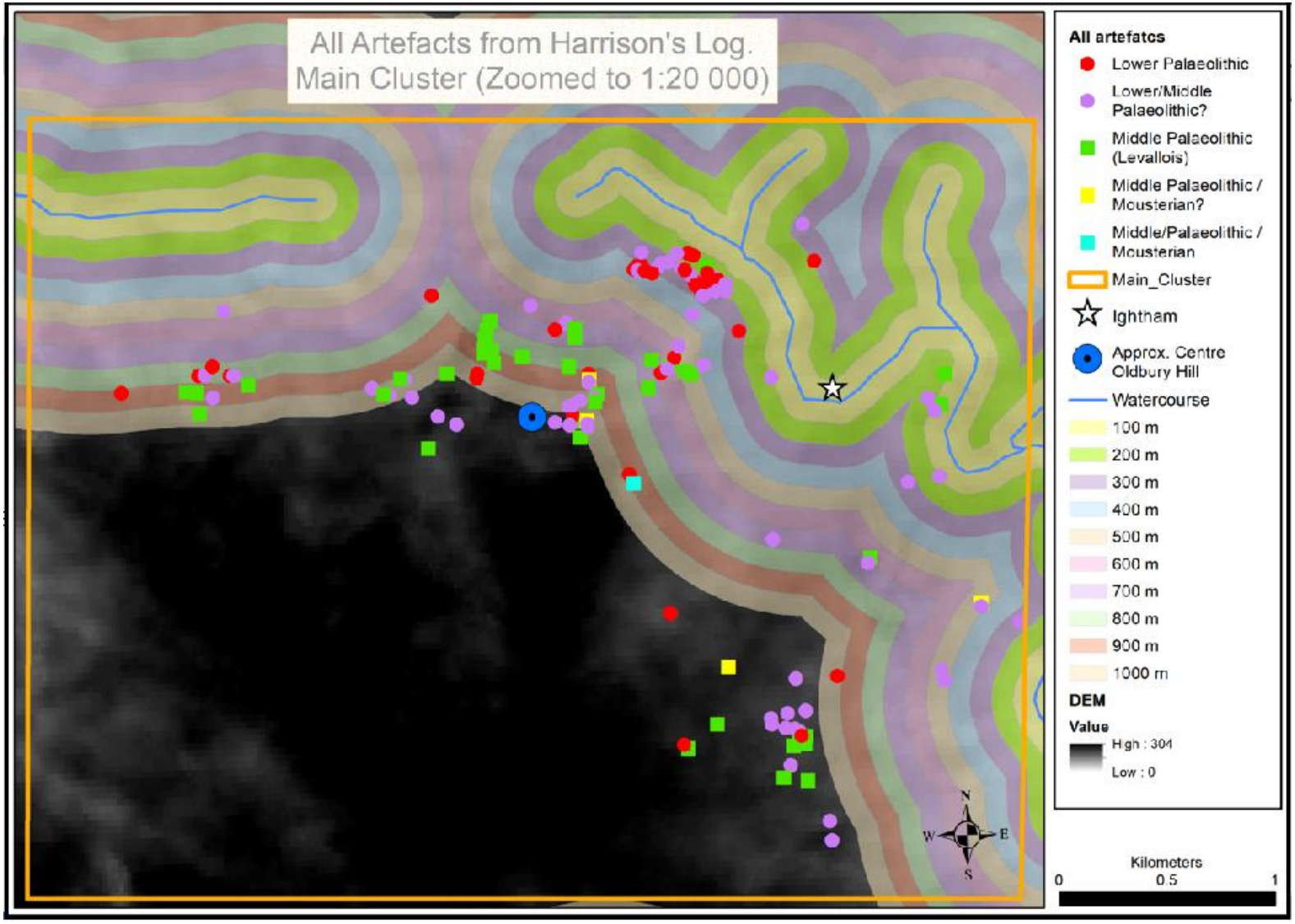


Figure 38 Zoomed in from Figure 37, multi-ring buffer of rivers in study area in 100m metre increments up to 1000m OD. The central yellow buffer represents the 100m either side of a waterway. Background is a DEM (Aster, 2018).

Buffer analysis

Rivers were a focus of activities, giving access to water, game and plants for food. They would have formed corridors for moving through the often heavily wooded landscape for hominins and would have been maintained by the movement of large animals taking advantage of these areas for accessing water and hunting other game drinking at these spots (Ashton *et al.,* 2005: 54).

The watercourses within the study square on the maps in this chapter were buffered using a multi-ring buffer (Figure 37 and Figure 38 above) to pinpoint both the elevation and distance from water at which the artefacts were found. The buffers were in increments of 100m up to and including 1000m. This was so that a finer analysis of the artefacts proximity to a water course could be included. There is a potential relationship with terraces identified in other sections of the Medway and Thames rivers.

The following analysis incorporates those artefacts found in Harrison's artefact collection and matched to the paper archive, therefore the most reliable mapped artefacts. These are listed in the order of distance band. Table 7 represent these artefacts, whilst Table 8 lists those artefacts that were not fully verified by Harrison's paper archive.

Artefacts up to 100m from a waterway

There were three artefacts found in this distance band. Two were Lower/Middle Palaeolithic? and one was a Middle Palaeolithic artefact.

Artefacts 101-200m from a waterway

There were nine artefacts found in this distance band. Four were Lower Palaeolithic, four were Lower/Middle Palaeolithic? and one was a Middle Palaeolithic artefact.

Artefacts 201m-300m from a waterway

The highest number of artefacts found were in the 201m to 300m distance band (twenty-five artefacts, 15.82% of one hundred and fifty-eight artefacts found,). Of these twenty-five artefacts, twenty (80% of artefacts from this band) were Lower/Middle Palaeolithic? or Lower Palaeolithic - (fourteen artefacts (56%) and six artefacts (24%) respectively). The remainder were three indeterminate artefacts and two Null (not yet identified). The mean height of the Lower/Middle Palaeolithic? artefacts was 325.71m OD, the lowest level being 260m and the highest 350m. There was a total absence of positively identified Middle Palaeolithic artefacts in this distance band. Seventeen out of the twenty-five artefact findspots were from Fane Hill.

Artefacts 301-400m from a waterway

There were nine artefacts found in this distance band, five were Lower Palaeolithic, and four were Lower/Middle Palaeolithic?

Artefacts 401-500m from a waterway

There were six artefacts found in this distance band, one was Lower Palaeolithic, four were Lower/Middle Palaeolithic? and one was Middle Palaeolithic.

Artefacts 501-600m from a waterway

There were five artefacts found in this distance band, one was Lower Palaeolithic, three were Lower/Middle Palaeolithic? and one was Middle Palaeolithic.

Artefacts 601-700m from a waterway

There were seven artefacts found in this distance band, three were Middle Palaeolithic, two were Lower Palaeolithic, and two were Lower/Middle Palaeolithic?

Artefacts 701m-800m from a waterway

There were fifteen (9%) of the total number of artefacts (one hundred and fifty-eight) which were found between 701 and 800m. The type most prevalent in this distance band was Middle Palaeolithic with four artefacts (27% of this band, between 400 and 430m OD). There were three each Lower Palaeolithic (between 410 and 420m OD) and Indeterminate (all at 420 m OD) (20% each of this distance band). There were two Lower/Middle Palaeolithic? (all at 420m OD), two Later Prehistoric artefacts (all at 420m OD) (13% each of this band) and one artefact (7% of this band) was Null (not yet identified). The Middle Palaeolithic artefacts began increasing in number from a distance of 700m from a waterway, whilst before this distance they were few in number.

Artefacts 801m-900m from a waterway

There were nineteen (12%) of the total number of artefacts (one hundred and fifty eight) which were found between 801 and 900m. The type most prevalent in this distance band was Middle Palaeolithic with nine artefacts (37% of this band). They were found between 380 and 430m OD. There was also three of each type (16% each of this band): Lower/Middle Palaeolithic? (between 400 and 430m OD), Lower Palaeolithic (between 400 and 420m OD), and Indeterminate (between 390 and 420m OD, and one Null (not yet identified).

Artefacts 901-1000m from a waterway

There were eighteen (11%) of the total number of artefacts (one hundred and fifty eight) which were found between 901 and 1000m. There were six Lower/Middle Palaeolithic? artefacts in this distance band (33% of this band), (between 380 and 440m OD). There were five Middle Palaeolithic (28% of this band), (between 420 and 450m OD), and three Lower Palaeolithic artefacts (17% of this band) all at 400m OD. Two of the artefacts were of Indeterminate period and two were Null (not yet identified).

Artefacts further than 1000m from a waterway

Thirty-three out of one hundred and fifty-eight (21%) artefacts were found outside of the waterways 1000m buffer zone. The Lower/Middle Palaeolithic? was represented by sixteen artefacts (49% of this distance band), which were found between 260m and 440m OD. A higher number of these were from Buley Valley. Nine (27%) were Middle Palaeolithic, of which a higher number were from Buley Field and other areas in Buley. They were found between 415m and 475m OD. There were four each (12%) of Lower Palaeolithic (between 410 and 475 OD) and indeterminate (between 415 and 520 OD artefacts).

Artefact No. Found dataset																		
	Lower Pal	% of type of artefact per buffer	Lower/Middle Palaeolithic?	% of type of artefact	Middle Palaeolithic (Levallois)	% of type of artefact per buffer	Middle Palaeolithic/ Mousterian	% of type of artefact per buffer	Indeterminate	% of type of artefact per buffer	Upper Palaeolithic	% of type of artefact per buffer	Later Prehistoric	% of type of artefact per buffer	Null	% of type of artefact per buffer	Total	% of total found artefacts per buffer distance
100m	0	0	2	66.66667	1	33.33333333	0	0	0	0	0	0	0	0	0	0	3	1.898734177
200m	4	33.3333333	4	33.33333	1	8.333333333	0	0	2	16.6666667	0	0	1	8.3333333	0	0	12	7.594936709
300m	6	24	14	56	0	0	0	0	3	12	0	0	0	0	2	8	25	15.82278481
400m	5	50	4	40	0	0	0	0	0	0	0	0	0	0	1	10	10	6.329113924
500m	1	12.5	4	50	1	12.5	1	12.5	1	12.5	0	0	0	0	0	0	8	5.063291139
600m	1	16.6666667	3	50	1	16.66666667	0	0	1	16.6666667	0	0	0	0	0	0	6	3.797468354
700m	2	22.2222222	2	22.22222	3	33.33333333	0	0	2	22.2222222	0	0	0	0	0	0	9	5.696202532
800m	3	20	2	13.33333	4	26.66666667	0	0	3	20	0	0	2	13.333333	1	6.66666667	15	9.493670886
900m	3	15.7894737	3	15.78947	7	36.84210526	2	10.5263158	3	15.7894737	0	0	0	0	1	5.26315789	19	12.02531646
1000m	3	16.6666667	6	33.33333	4	22.22222222	1	5.55555556	2	11.1111111	0	0	0	0	2	11.1111111	18	11.39240506
Outside 1000m	4	12.1212121	16	48.48485	8	24.24242424	1	3.03030303	4	12.1212121	0	0	0	0	0	0	33	20.88607595
Total	32	20.2531646	60	37.97468	30	18.98734177	5	3.16455696	21	13.2911392	0		3	1.8987342	7	4.43037975	158	100

Table 7 Top table. Results of buffer analysis between Harrison's matched artefacts and watercourses Table 8 Bottom table. Results of buffer analysis between Harrison's Artefacts mapped by Accession number and watercourses.

Artefact Museum No. Dataset																		
	Lower Palaeolithic	% of type of artefact per buffer distance	Lower/Middle Palaeolithic?	% of type of artefact per buffer	Middle Palaeolithic (Levallois)	% of type of artefact per buffer distance	Middle Palaeolithic/ Mousterian	% of type of artefact per buffer distance	Indeterminate	% of type of artefact per buffer distance	Upper Palaeolithic	% of type of artefact per buffer distance	Later Prehistoric	% of type of artefact per buffer distance	Null	% of type of artefact per buffer distance	Total	% of total found artefacts per buffer distance
100m	0	0	1	100	0	0	0	0	0	0	0	0	0	0	0	0	1	0.934579439
200m	0	0	1	25	1	25	0	0	1	25	0	0	1	25	0	0	4	3.738317757
300m	0	0	0	0	1	50	0	0	1	50	0	0	0	0	0	0	2	1.869158879
400m	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500m	2	22.2222222	1	11.11111	2	22.22222222	0	0	3	33.3333333	1	11.11111111	0	0	0	0	9	8.411214953
600m	3	20	1	6.666667	1	6.666666667	0	0	6	40	0	0	4	26.666667	0	0	15	14.01869159
700m	4	30.7692308	0	0	1	7.692307692	2	15.3846154	5	38.4615385	0	0	1	7.6923077	0	0	13	12.14953271
800m	3	37.5	0	0	1	12.5	0	0	3	37.5	0	0	1	12.5	0	0	8	7.476635514
900m	0	0	1	50	1	50	0	0	0	0	0	0	0	0	0	0	2	1.869158879
1000m	0	0	4	36.36364	0	0	2	18.1818182	3	27.2727273	0	0	2	18.181818	0	0	11	10.28037383
Outside 1000m	1	2.38095238	9	21.42857	6	14.28571429	4	9.52380952	17	40.4761905	0	0	5	11.904762	0	0	42	39.25233645
Total	13	12.1495327	18	16.82243	14	13.08411215	8	7.47663551	39	36.4485981	1	0.934579439	14	13.084112	0		107	100

Statistical Testing: Average Nearest Neighbour Analysis

I used the Average Nearest Neighbour (ANN) Tool in Arcmap to statistically test whether the mapped data is clustered or dispersed. This is an important procedure as it can tell us if these artefacts are randomly placed or if there are clusters of artefacts, which then may relate to geological or topographical occurrences in relation to the location of the artefacts.

The ANN index is calculated by measuring the difference between the centroid of each artefact and its nearest neighbour's centroid, and then averaging all of the distances measured for the group of artefacts. The random distribution (expected average distance) is based on a hypothetical random distribution with the same number of features covering the same total area. If the average distance of the artefacts is less than those of the random distribution, then the artefacts are considered clustered. If the artefacts average distance is greater than the random distribution the artefacts are considered dispersed. (Esri, 2021b).

The formula to find the Ratio (index) is as follows, where **DO** is the observed mean distance between each artefact and its nearest neighbour and **DE** is the mean distance for the random distribution, and **ANN** is Average Nearest Neighbour:

$$\mathrm{ANN} = \frac{\overline{\mathrm{D}}_0}{\mathrm{DE}}$$

If the index is less than 1 it means that the artefacts are clustered, if more than 1 it means that they are dispersed, (Esri, 2021b). The ANN tool returns five values: observed mean distance, expected mean distance, nearest neighbour index, z-score, and p-value. These can be viewed using the results window in ArcMap.

I used the ANN analysis tool in ArcMap to examine the statistical significance of the locations of those artefacts that were matched to Harrison's archive and whether they are clustered or dispersed within the study area.

The z-scores and p-values returned by the pattern analysis tools tell you whether you can reject the null hypothesis or not. The z- score represents standard deviation and can indicate the level of confidence the result is displaying. The level of confidence for a most secure result is 99%, which is the one that we would hope for in this test.

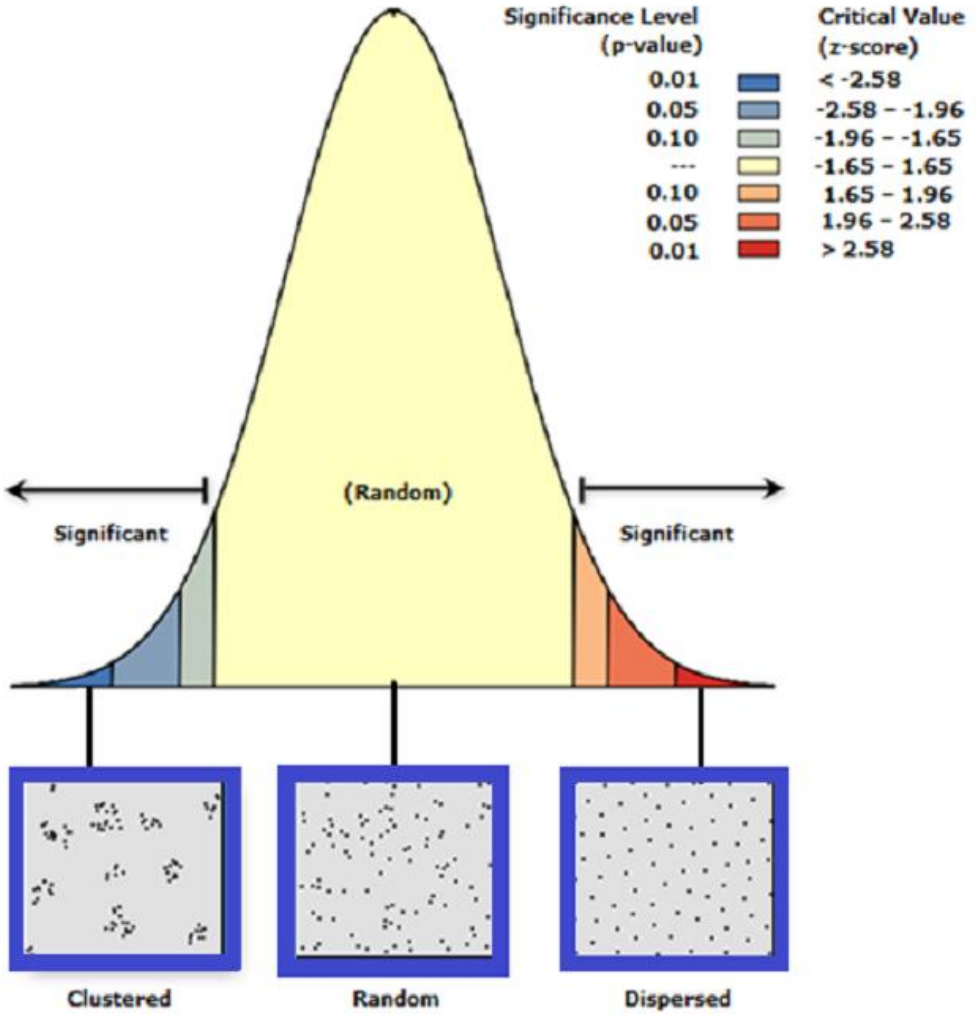


Figure 39 A visual example of how nearest neighbour analysis works using the Spatial Analysis tools in ArcMap (Esri 2021b).

The area of the boundary square artificially imposed to incorporate all of the data points was used in the ANN tool. This was recommended on the Esri tool information, as if you do not specify an area, it is impossible to compare different scores as the tool will use a boundary just incorporating the artefacts being analysed at that time. For accuracy I ran the tool without the boundary and, although the individual scores were slightly different, there is still a less than 1% likelihood that this clustered pattern could be the result of random chance.

z-score (Standard Deviations)	p-value (Probability)	Confidence level
< -1.65 or > +1.65	< 0.10	90%
< -1.96 or > +1.96	< 0.05	95%
< -2.58 or > +2.58	< 0.01	99%

Table 9 Confidence levels

The distribution of the artefacts was measured against the null hypothesis, which states that features are randomly distributed. This analysis will help to assess if the positioning of the artefacts has any spatial patterning. (Esri, 2021b)

The results of the analysis accessed from the results window (Figure 40) are as follows:

Given the z-score of -20.2711359853, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Average Nearest Neighbor Summary

Observed Mean Distance:	144.1893 Meters
Expected Mean Distance:	903.0321 Meters
Nearest Neighbor Ratio:	0.159672
z-score:	-20.271136
p-value:	0.000000

Dataset Information

Input Feature Class:	ArtefactNoFound
Distance Method:	EUCLIDEAN
Study Area:	518636951.949419

Figure 40 The report explaining the results from the ANN analysis tool in ArcMap. The data used for this analysis was the artefacts found in the Museum and matched against the paper archive.

The results of the ANN analysis on the artefacts whose positions have been verified from Harrison's archive (Figure 40) verify that the artefacts are clustered.

Next, I used the same tool with the artefacts that were in Harrison's log but not physically found in the archive table (Artefacts by Accession Number). This was because although these artefacts had not been matched to Harrison's written archive, they were plotted based on the location and height data written on the artefact. This gives us more location data which is similar to the checked and identified dataset but is just not verified with Harrison's log with the extra information it contains. The result of the analysis (Figure 41) accessed from the results window is as follows: Given the z-score of -16.8518960248, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Average Nearest Neighbor Summary	
Observed Mean Distance:	159.7168 Meters
Expected Mean Distance:	1105.9839 Meters
Nearest Neighbor Ratio:	0.144411
z-score:	-16.851896
p-value:	0.000000
Dataset Information	
Input Feature Class:	ArtefactsMuseumNo
Distance Method:	EUCLIDEAN
Study Area:	518636951.949419

Figure 41 Report of the ANN analysis on the artefacts.

This test (Figure 41) paralleled the results of the previous one, the patterning of these artefacts is not random.

Next, I ran the tool using the artefact type Lower Palaeolithic and Middle Palaeolithic respectively from the Artefact No. Found file. The results showed that the artefacts were clustered in both cases with z-scores of -8.869220 for Lower Palaeolithic and - 9.186938 for Middle Palaeolithic.

There could be several reasons that these artefacts are clustered, the following are considered by the author to be the most relevant.

1: The clustering is a product of collection bias by Harrison

2: The artefacts could have been distributed in these areas by hominins from the Palaeolithic

3: The artefacts were distributed by fluvial action, but were halted and became clustered when the waterways reached the harder Lower Greensand (Hosfield, 1998:250)

4: The artefacts could have eroded out of areas such as gulls, fissures or quarries or been brought to the surface by ploughing or construction.

Harrison collected systematically across his area of interest and had unprecedented access to areas where others were not allowed. He did also target the gravels in the areas, but it seems unlikely that the clustering is a product purely of collection bias.

It is unlikely that all of these artefacts are clustered due to deposition by hominins as they are mostly found in river gravels and so are redeposited. There are some artefacts that were not from river gravels such as those described by Harrison as Hill Gravels and in these places, the clustering may be due to depositions by hominins. One such area is likely to be around Oldbury rock shelter and its environs.

It is most likely that the third reason is a significant reason for clustering of artefacts as many of them are distributed around the edge of the Lower Greensand. Research in the areas of the Hampshire Basin found that large assemblages of artefacts were situated on the boundary of Tertiary/Chalk boundaries (Hosfield 1998: 250). In the case of the Kent study area, many artefacts were situated on the Gault/Lower Greensand boundary, and so it may be that when the river reaches the change in bedrock it alters its flow and therefore its ability to transport the artefacts over the new lithology bedrock.

In summary, some collection bias is inevitable given the similarity in the landuse and geology of the collection area. There is an indication that some of the data is clustered due to the effects of the local geology, as in the presence of the artefacts on river gravels and greensand. The discard of the artefacts by hominins appears to be possible in some cases as those artefacts found on the plateau and in the patches of Clay-with-flints are not close to any rivers or areas of soliflucted head gravels which may have transported them to their current location. Additionally, those artefacts that are fresh, grading into slightly rolled which have not been moved far from their deposition area may be a product of hominin activity.

Slope Analysis

Slope data was added into a GIS as described below and analysed in this chapter.

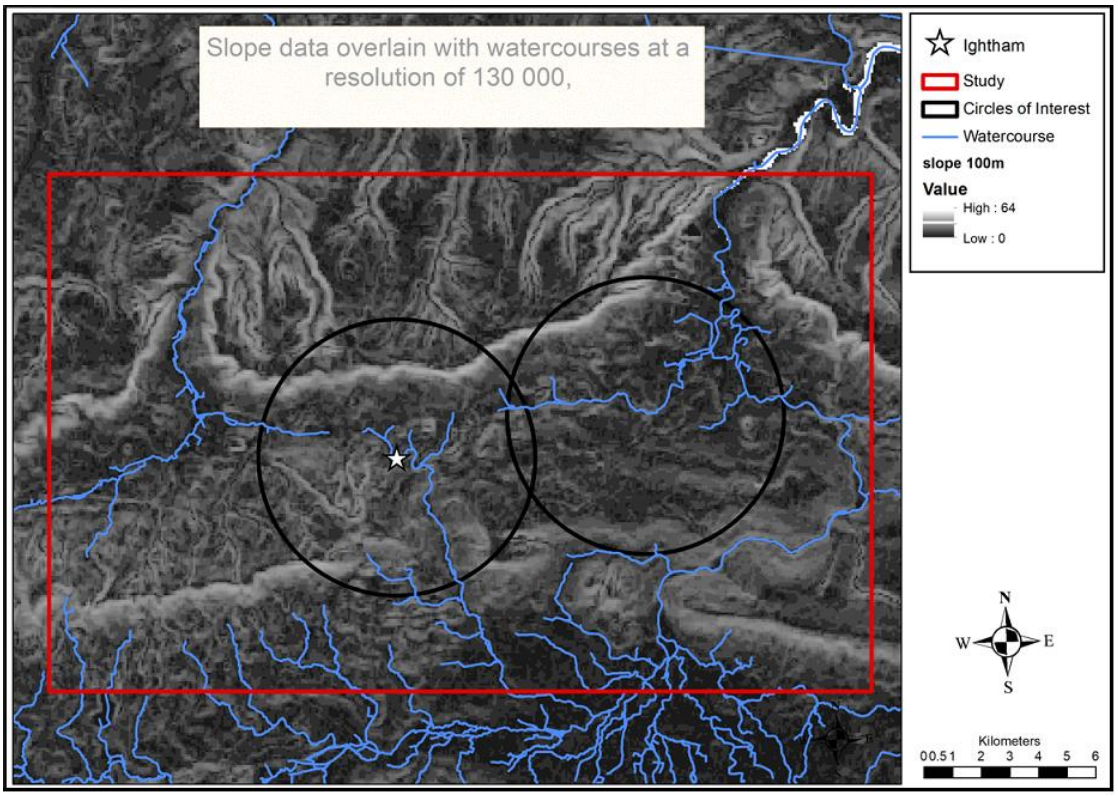


Figure 42 Slope data for the study area from Worldpop, projected to British National Grid overlain by watercourses in the study area. The areas represented by lighter colours are those of a larger slope gradient, so steeper slope. The dark centre of the white ghost lines is indicative of dry valleys (Worldpop *et al.*, 2018).

Slope data was downloaded from the Worldpop website at Southampton University at a resolution of 3 arc-seconds (approximately 100m at the equator) under the Creative Commons Licence (https://creativecommons.org/licenses/by/4.0/. The data is in Geographic Coordinate System, WGS84, which is a geographic coordinate and so will not match with the rest of the data as this is in the British National Grid coordinate system, so the slope raster was projected to UK National Grid (OSGB 1936). The data was projected using the project raster tool in ArcGIS.

The value of each grid cell represents its topographic slope (in degree) (Worldpop *et al.*, 2018) https://creativecommons.org/licenses/by/4.0/). The artefact data identified in the museum was layered over the slope raster in ArcMap. The gradient value of each cell was recorded against each artefact in the database. The slight error in placement of the artefacts due to the previously described lack of precise coordinates should not be an issue here, as the slope pixels on which they lie are generally similar to those surrounding them, as explained in Tobler's first law of geography:

'everything is related to everything else, but near things are more related than distant things' (Tobler 1970)

Measurement of slope can be problematic, particularly where rapid increase of elevation occurs such as at the edge of a cliff, as there will be very few pixels showing a high degree of slope. This is because the valley floor will be relatively flat, as will the plateau above. However, the following analysis will show if any variation of slope is shown by separating the artefacts by period to show the gradient of the land upon which these artefacts were found, and by abrasion of the artefact to see if there appears to be any significance of abrasion.

Some of the artefacts found do not have an abrasion measurement due to the fact the museum was not accessible during the Covid pandemic and so only those with clear photographs could be measured.

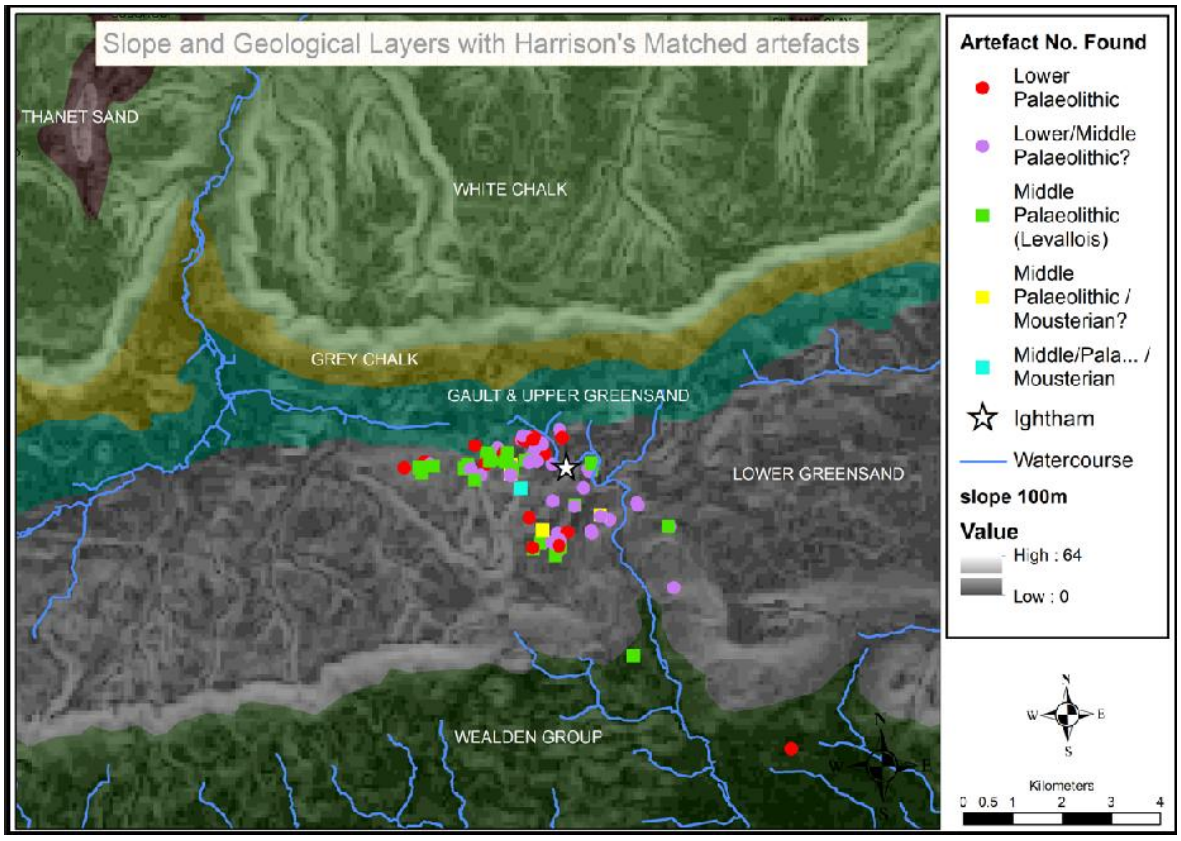


Figure 43 Bedrock geology with the slope layer draped over it. The central grey area is Lower Greensand, turquoise is the Gault and the Upper Greensand, dark green at the bottom of the map is mostly Weald clay with some soft sandstones, the lighter green at the top of the map is upper and Middle chalk overlain in places with brown Clay-with-flints. The matched artefacts from Harrison's archive are mapped and are predominately on the Gault and Upper Greensand ((Contains British Geological Survey materials © UKRI [2018])) (Worldpop *et al*., 2018).

The following table (Table 10) records the maximum gradient achieved for each period. The lower the slope gradient, the flatter the terrain; the higher the slope value, the steeper the terrain. The highest slope gradient for the study area was 20, which illustrates that the artefacts are lying on reasonably gentle slopes. The maximum gradient for the artefacts is 6 so the higher gradients mentioned above do not impact upon our study. The Middle Palaeolithic artefacts as a whole lie on marginally more gentle slopes (maximum of 5 degrees) than Lower/middle Palaeolithic? (maximum of 6 degrees), whilst Middle Palaeolithic (Levallois) has the same maximum gradient as Lower Palaeolithic.

Period	Number of Artefacts	Maximum_Gradient
Lower Palaeolithic	32	5
Lower/Middle Palaeolithic?	57	6
Middle Palaeolithic (Levallois)	30	5
Middle Palaeolithic/Mousterian?	4	4
Middle/Palaeolithic/Mousterian	1	4

Table 10 The maximum gradient for artefacts achieved for each period from the matched artefacts.

One of the reason the artefacts may have been moved from their deposition site is solifluction, which is when saturated soil moves downslope when there is no frozen ground in the moving layer (Washburn, 1979). Solifluction can occur on slope less than 1°, but it is more common on slope gradients between 5° and 20° (Walker 1986). This indicates that it is unlikely, but not impossible, that most of the artefacts have been moved by this process.

When concentrating on the Gradient in relation to abrasion and land use, the following observations were made:

Lower Palaeolithic

There were 32 out of 159 artefacts classified as Lower Palaeolithic, 10 of which had no abrasion record assigned.

- The artefacts classified as fresh in the abrasion section (four artefacts out of 32), had a gradient between 1 and 3 degrees, therefore on fairly flat terrain. Three of these artefacts were located on Medway Gravels, the fourth unknown. Three of these artefacts were found in fields and one in a wood

- The artefacts classified as slightly rolled in this category (six artefacts out of 32) had a gradient between 4 and 5 degrees. All of these artefacts were located on Medway Gravels and were found in fields
- The artefacts classified as rolled in this category (twelve artefacts out of 32) had two artefacts with a gradient of 2, three with a gradient of 3, five with a gradient of 4 and two with a gradient of 5. Eight of these were on Medway Gravel and 3 were on Hill Gravel. Those with gradients of 4 and 5 degrees were mostly from Stonepits and Fuller Street. Most of those from Stonepits were on Hill Gravel, the remaining one artefact was unknown for gravel type. All of these artefacts were found in fields.
- The remaining artefacts were classified as Null, either for period or for abrasion.

Middle Palaeolithic

There were 35 out of 159 artefacts classified as Middle Palaeolithic, 16 of which had no abrasion record assigned.

- The artefacts classified as fresh in the abrasion section (two artefacts out of 35), had a gradient between one and three degrees, therefore on fairly flat terrain. One of these artefacts was located on Medway Gravels the other was unknown. Both artefacts were Middle Palaeolithic, and both were found in fields
- The artefacts classified as slightly rolled in this category (nine artefacts out of 35) had a gradient between zero and four degrees. Five of these artefacts were located on Medway Gravels, with two located on Hill Gravels and two were unknown. All of these artefacts were Middle Palaeolithic. Eight were found in fields and one was found in a Hop Garden.
- The artefacts classified as rolled in this category (eight artefacts out of 35) had a gradient between zero and five degrees. Three of these artefacts (with gradients between 2 and 3) were located on Medway Gravels and four were located on Hill Gravels (with gradients between 0 and 5). All but one of these artefacts were classified as Middle Palaeolithic. Five of these artefacts were found in fields, two in Plantations and one in a piped surface.

Interestingly the rolled Middle Palaeolithic artefacts were found in a number of land use locations, plantations, piped surfaces and fields, where the land may have been subjected to differential types of working and also were often collected by Harrison's 'lads' collectors.

Lower/Middle Palaeolithic?

There were 57 out of 159 artefacts classified as Lower/Middle Palaeolithic? 29 of which had no abrasion record assigned.

- The artefacts classified as fresh in the abrasion section (four artefacts out of 57), had a gradient between 0 and 5 degrees. Three of these artefacts were located on Medway Gravels, the fourth unknown. Three of these artefacts were found in a field and one on a plantation.
- The artefacts classified as slightly rolled in this category (eleven artefacts out of 57) had a gradient between one and five degrees. Seven of these artefacts were located on Medway Gravels, with two located on Hill Gravels and two were unknown. The majority were found in fields, with one found in a wood and one on a plantation.
- The artefacts classified as rolled in this category (thirteen artefacts out of 57) had a gradient between 2 and 6 degrees. Ten of these artefacts (with gradients between 2 and 5) were located on Medway Gravels, none were located on Hill Gravel and three were Null.
- All of these artefacts were found in fields, except for one which was found in a Hop Garden

The preceding chapters have included artefact methodology and spatial analysis to answer the research question posed above. The artefacts and paper archive of Harrison when displayed spatially has given a new perspective to those data as described in Chapter 3. In Chapter 4, I used spatial analysis to investigate the locations of the findspots and their relationship to each other and the geography and topography of the area. Chapter 5 will look at what the patterning found in the spatial analysis reveals about the people of the Palaeolithic in the area around Ightham, Kent.

Chapter 5: Exploring patterns in the data for the Lower and Middle Palaeolithic in the Weald

Handaxes form the bulk of Harrison's collection, which is mainly because these are predominately surface finds and are not accompanied by any debitage. The Lower Palaeolithic artefacts are often larger items that may have been washed along river channels and therefore redeposited. Middle Palaeolithic artefacts trend towards Oldbury Hill, a known focus for Middle Palaeolithic artefacts, and these trends can be seen in the data from Harrison's archive. Artefacts can also be found on the Clay-with-flints deposits on the plateau. There are other artefacts besides handaxes in Harrison's archive, such as flakes collected by Harrison and deposited in the museums. Many of the flakes in his collection at the British Museum were collected from Oldbury Hill and its environs. During excavations by Harrison in 1890, he found a few Palaeolithic artefacts down-slope of the rock overhang ('rock shelter'). He then excavated below the overhang of a rock outcrop called Mount Pleasant 50 yards southeast of the rock shelter dig (Beresford, 2021). Edward Harrison (1933) commented about this excavation: -

> *'the finding of 700 tools and flakes in a space no larger than an ordinary allotment amply warrants the inference that the implements were made on the spot'.*

Benjamin Harrison excavated on the eastern face of Oldbury Hill, which commenced with help from a grant from the British Association for the Advancement of Science. In his subsequent report he suggested that this could be a workshop (Harrison, 1892; Beresford, 2021). Harrison (1933) observed that many of the finds at Oldbury Hill were unworn and white patinated. This colouring is due, not to staining but to chemical action called patination. Benjamin Harrison found that*:* -

> *'although these tools might be picked up on many fields in the Ightham district, they seemed to have some particular association with Oldbury, as they occurred there in far greater numbers than elsewhere' (Harrison, 1933).*

Flakes and other tool types from all periods of Prehistory were also present in Harrison's collection at Maidstone Museum. Unfortunately, there was not enough information attached to these artefacts to map them using the methodology used here, but they should be considered when thinking about hominin activity in this area. The data in this study has been analysed to decide if the following research question is valid:

> *'Is there any period specific patterning to the location of Lower Palaeolithic vs Middle Palaeolithic finds in the area around Ightham, Kent as preserved in Benjamin Harrison's artefact and document archive?' Do Harrison's artefacts represent a clustered or*

dispersed pattern on the ground'?

The patterning in the data supports the fact that many Lower Palaeolithic artefacts are found near to water sources and river terrace gravels. The examples later in this chapter help to validate that in the Palaeolithic period, handaxes from the Lower Palaeolithic have traditionally been found near to a water source (Wymer, 1999). Because most of Harrison's artefacts are surface finds we cannot know for sure if they were discarded near to a river or lake, but the topography of today's rivers and river gravels in relation to these artefacts points towards the presence of these Lower Palaeolithic hominins being active near to fluvial activity, as illustrated in the maps in Figure 30,Figure 34, Figure 47,Figure 38, Figure 49, and Table 7 and Table 8.

Similarly, we cannot be positive exactly how the Middle Palaeolithic artefacts in Harrison's archive were deposited near to their findspot location, but spatial analysis may give us some insight into this, using their relationship to each other and the geology and topography of the area. In the analysis of Harrison's Middle Palaeolithic artefacts and the proximity to both Oldbury Rock Shelter and to waterways, I explored the data by mapping all Middle Palaeolithic artefacts within a 1000m buffer from the Rock Shelter (Figure 44 and Figure 45). The first observation is that the Rock Shelter itself is more than 1000m from a waterway as mapped by the Ordnance Survey Open Rivers Survey (2016). As many Middle Palaeolithic artefacts have been found there it indicates that Middle Palaeolithic sites may be more likely to be in inland sites, which may include caves, rock shelters and dry valleys, than in the gravels of rivers and their floodplains. Therefore, these landscape types would be good locations to look for Middle Palaeolithic evidence.

Harrison collected some artefacts from the Clay-with-flints and the plateau (Figure 31, Figure 32,Figure 36, Figure 37). None of Harrison's matched artefacts were situated on the plateau or near to the gravels on the plateau that are annotated on Prestwich's Drift Map (Figure 33, Figure 34). However, some of the artefacts identified by museum number are evident near to these gravels and on the Clay-with-flints deposits. Therefore, the inference from these findings is that, as Palaeolithic artefacts exist on the plateau and on the Clay-with-flints superficial geology, Hominins were most likely present on the plateau during the Middle Palaeolithic period. Their utilization of the plateau was likely considering the visibility of large animal movements on the lower ground below and the proximity to raw materials in the form of the flint-bearing chalk escarpment and the nodules of flint from the Clay-with-flints deposits. Julie-Scott Jackson sums this up when she suggests:

'The hilltops and plateau edges of the Downlands were important to Palaeolithic people.

From these high places they could perhaps watch the movements of animals on both the hillsides and in the valleys below. They could also manufacture stone tools from the readily available flint or stone of a knappable quality. High-level vantage points and knappable material is a consistent, unifying feature of all the high-level occurrences on the deposit mapped as Clay-with-flints' (Scott-Jackson, 2000: 170).

Harrison's archive also contained twisted handaxes, which have been the subject of much debate over time, whether they were temporally-restricted assemblage-types (White *et al.*, 2019), or if the twisted edges were a defect uncorrected due to raw material constraints (Spurrell, 1883). In the early 20th century, Smith and Dewey (1913, 1914) regarded twisted forms from Swanscombe and Dartford as technologically advanced. White et. *al., (2019)* describes these artefacts as follows: -

'Twisted handaxes are usually ovate or cordate forms, although they are defined not by the outline shape of the tool but by the profile of the edges, which display strong (usually reversed) ogee curves on all sides'.

White (1998b) tentatively suggested that the S-twist might be a significant feature of British biface assemblages attributed to MIS 11. More recently, White et. *al.,* (2019) explained how these and other temporally-restricted assemblages have become more defined:

'A better understood chronological framework for the Middle Pleistocene of Britain has enabled archaeologists to detect a number of temporally-restricted assemblage-types, based not on 'culture historical' schemes of typological progression but on independent dating methods and secure stratigraphic frameworks, especially river-terrace sequences' (White et. al., 2019)

Harrison's matched database contained six twisted handaxes of the periods relevant to this study. One was Middle Palaeolithic (Levallois) and one Middle Palaeolithic/ Mousterian? and were located near to the Rock Shelter. The most northerly of these (see maps in Figure 45 Figure 47) is Harrison's artefact with ID number 134 (see Chapter 3, Figure 24: 64). Harrison described this artefact as 'white, sharp', whereas I have classified this artefact as slightly rolled. This example can give some insight into the difficulty in classifying abrasion from photographs of artefacts, although in the absence of access to the artefacts it helps to build a picture of how the artefacts relate to the local geology and topography. My abrasion classification which conforms to a standard set by Wymer (1968) for this artefact (I. D. number 134) could be correct, but Harrison saw the artefact in person when he decided on

the level of abrasion. The classification however is still valid for this particular study, as in both cases it means that the artefact probably hasn't moved far. The abrasion methodology may not be suitable for more in depth artefact study.

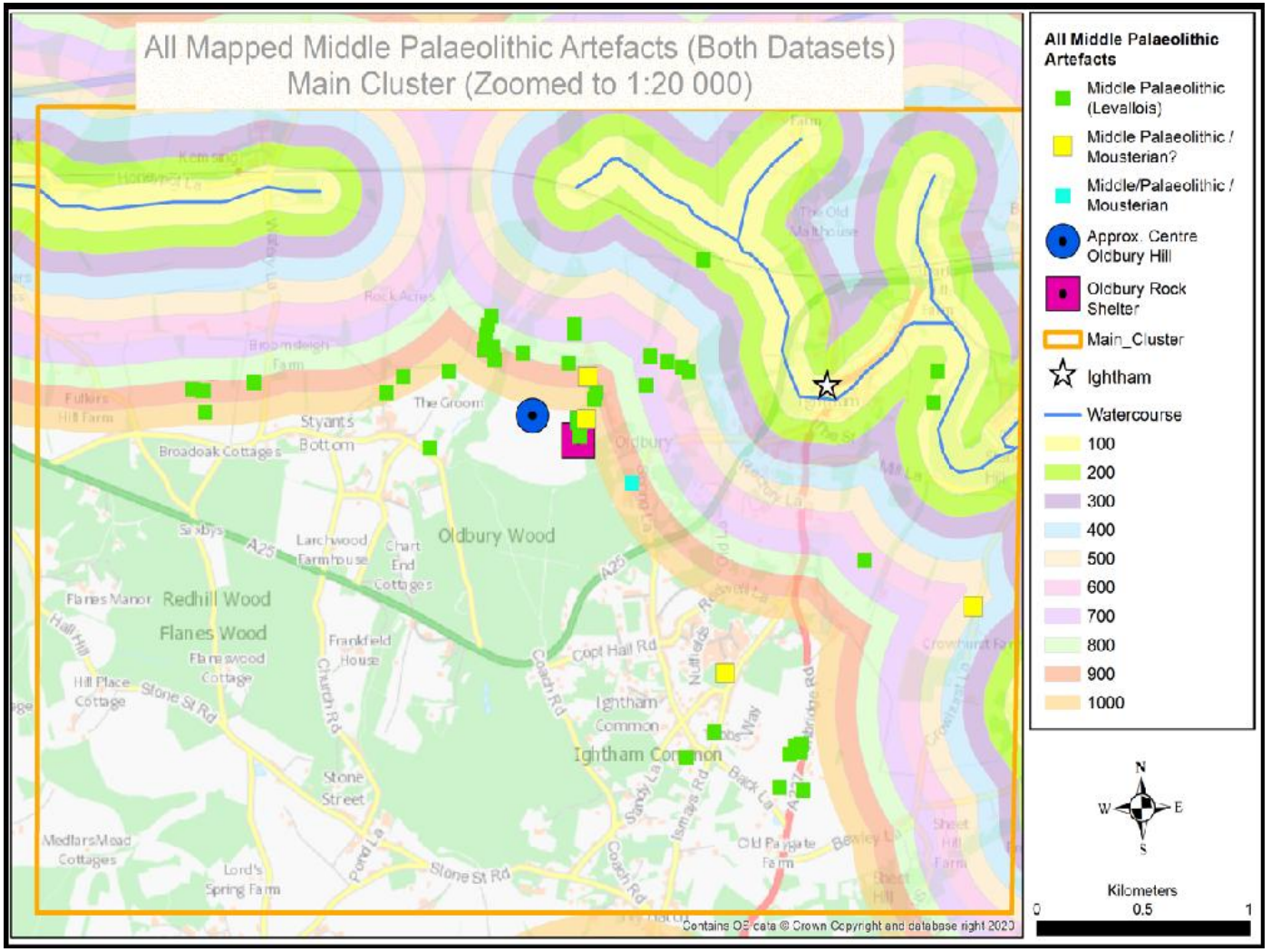


Figure 44 Image presented to show artefacts from the groups Middle Palaeolithic (Levallois), Middle Palaeolithic/Mousterian and Middle Palaeolithic/Mousterian? The artefacts are displayed on a modern map (©OpenStreetMap (and) contributors, CC-BY-SA), downloaded from Esri UK and overlain with a multi- ring buffer in 100m increments from waterways in the study area

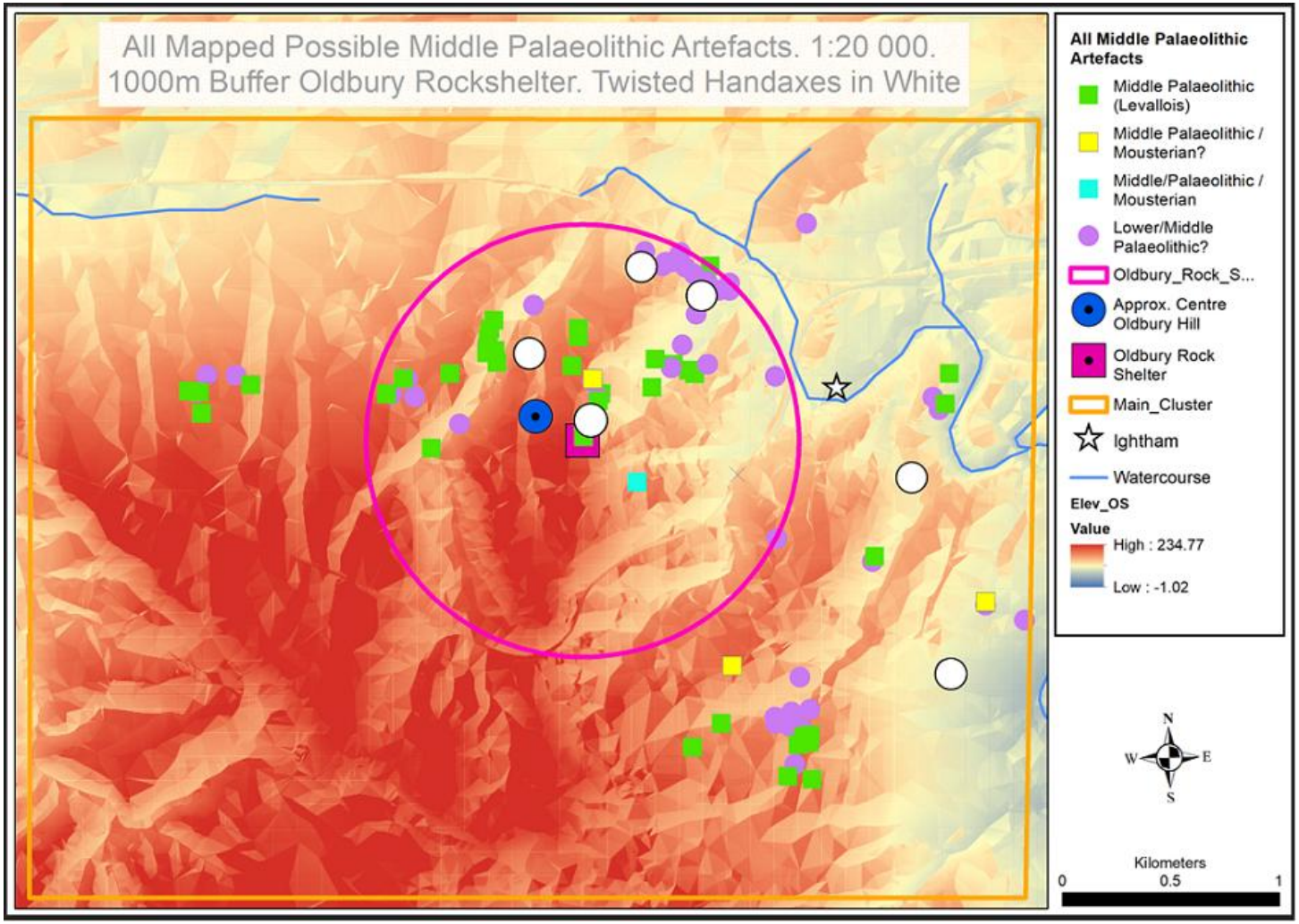


Figure 45 Oldbury Rock Shelter' with a 1000m buffer. This map visualises the distance from Oldbury Rock Shelter of all of the Middle Palaeolithic or Lower/Middle Palaeolithic? artefacts. Note most of the Middle Palaeolithic artefacts are at some distance from the watercourses buffered in Figure 44. The white circles denote twisted handaxes from the matched artefact dataset

The second of these twisted handaxes (Harrison's ID no 54), was annotated with the words 'Rock Shelter' by Harrison. The photograph in Figure 46 is the only one available at present, (courtesy of Maidstone Museum). I classified this handaxe as Middle Palaeolithic Mousterian? The museum accession register states that it is Mousterian and that it is Later Middle Palaeolithic from MIS 5 (Courtesy of Maidstone Museum), which makes the identification somewhat consistent. A further two twisted handaxes were classified as Lower/Middle Palaeolithic? and were located within the 1000 metre buffer of Oldbury Rock Shelter and within 400 metres of the watercourse (Figure 44Figure 45,Figure 47). These artefacts were associated with the cluster of Lower Palaeolithic artefacts near to the site of the railway lines at Fane Hill, described in (Figure 49, and pages 36, 100, 114, 125). As twisted handaxes are associated with the Middle Palaeolithic, MIS 11 (White, 1998b), it is possible that these two artefacts could have been transported in with materials during the work on the railway lines.

Figure 46 Twisted handaxe no 54, which I classified as Middle Palaeolithic Mousterian? (Photograph courtesy of Maidstone Museum).

An alternative scenario for these six artefacts is that all of their locations on the edge of higher ground, overlooking or adjacent to lower ground, would have been attractive to hominins. The proximity to raw materials and the opportunity to view prey on the lower ground helps to validate the theory on page 111 that the Middle Palaeolithic hominins utilised these areas as part of their hunting strategy. In Figure 47, I layered contours over the OS elevation layer to make it easier to visualize the terrain on which the twisted handaxes lie. The Abrasion Analysis (chapter 4) includes three of these artefacts, which are all classified as slightly rolled, which implies that these artefacts have not moved far from their original deposition site.

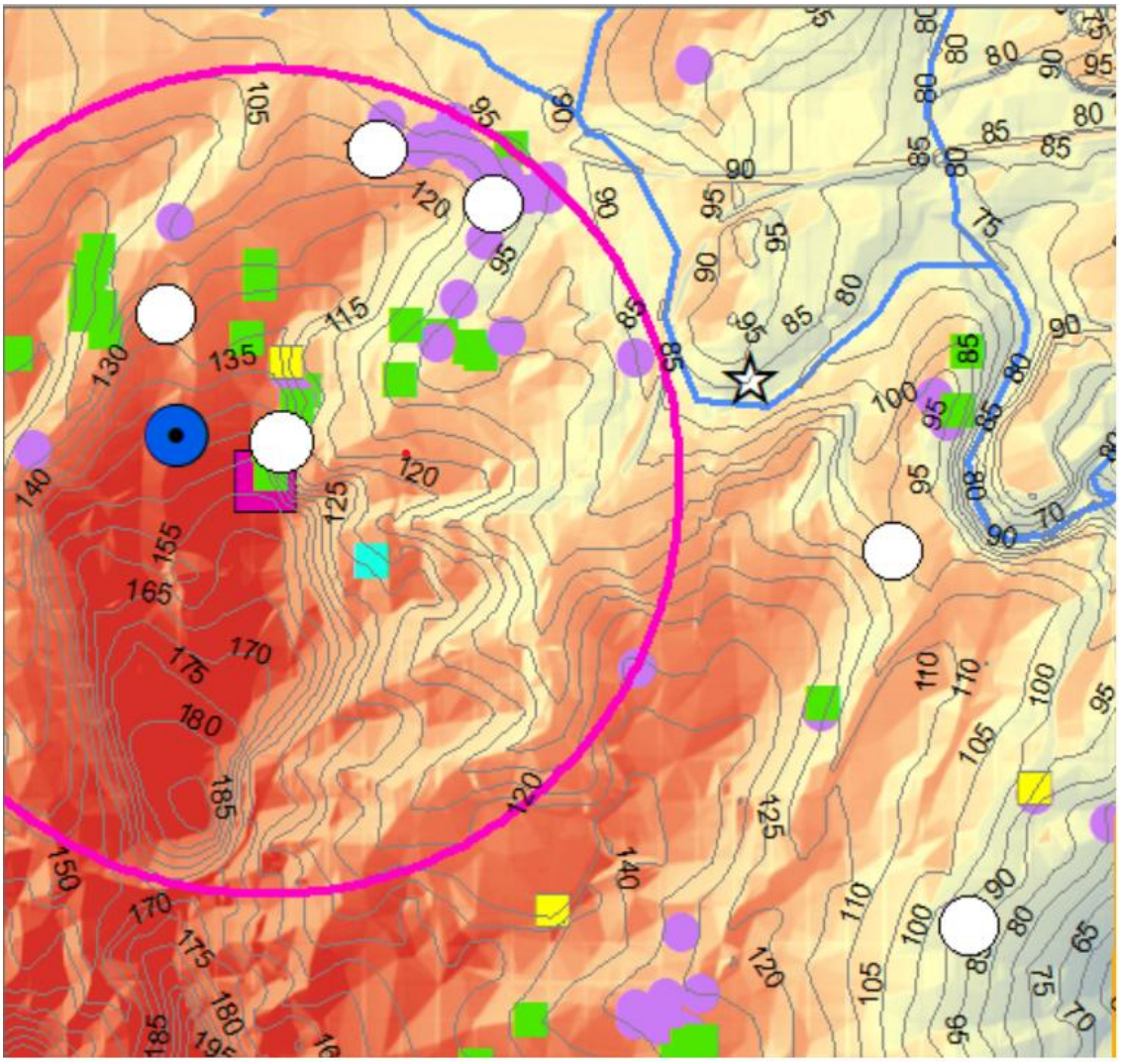


Figure 47 Location of twisted handaxes in the main cluster of artefacts mapped in Figure 45 above with 1000 metre buffer from Oldbury rock shelter, OS elevation and Terrain 5 contour data.

I mapped all of the Middle Palaeolithic artefacts with available abrasion levels from Harrison's matched database (Figure 48 below). All of the fresh artifacts are in the Southeast of the mapped area (see Figure 48 in yellow). Two of these artefacts were on a ridge of higher ground away from the river, whilst one was near to the river associated with slightly rolled artefacts. Abrasion data are a useful contribution to the analysis, although the absence of abrasion data for many of Harrison's artefacts has a detrimental effect on the analysis. The methodology of using photographs for abrasion analysis has some merits if the whole archive has good quality photographs, but it is difficult to obtain the full picture. Identifying the location where artefacts are more likely to be rolled and broken or fresh or slightly rolled could help with identifying which period the artefacts described as Lower/Middle Palaeolithic? belong to.

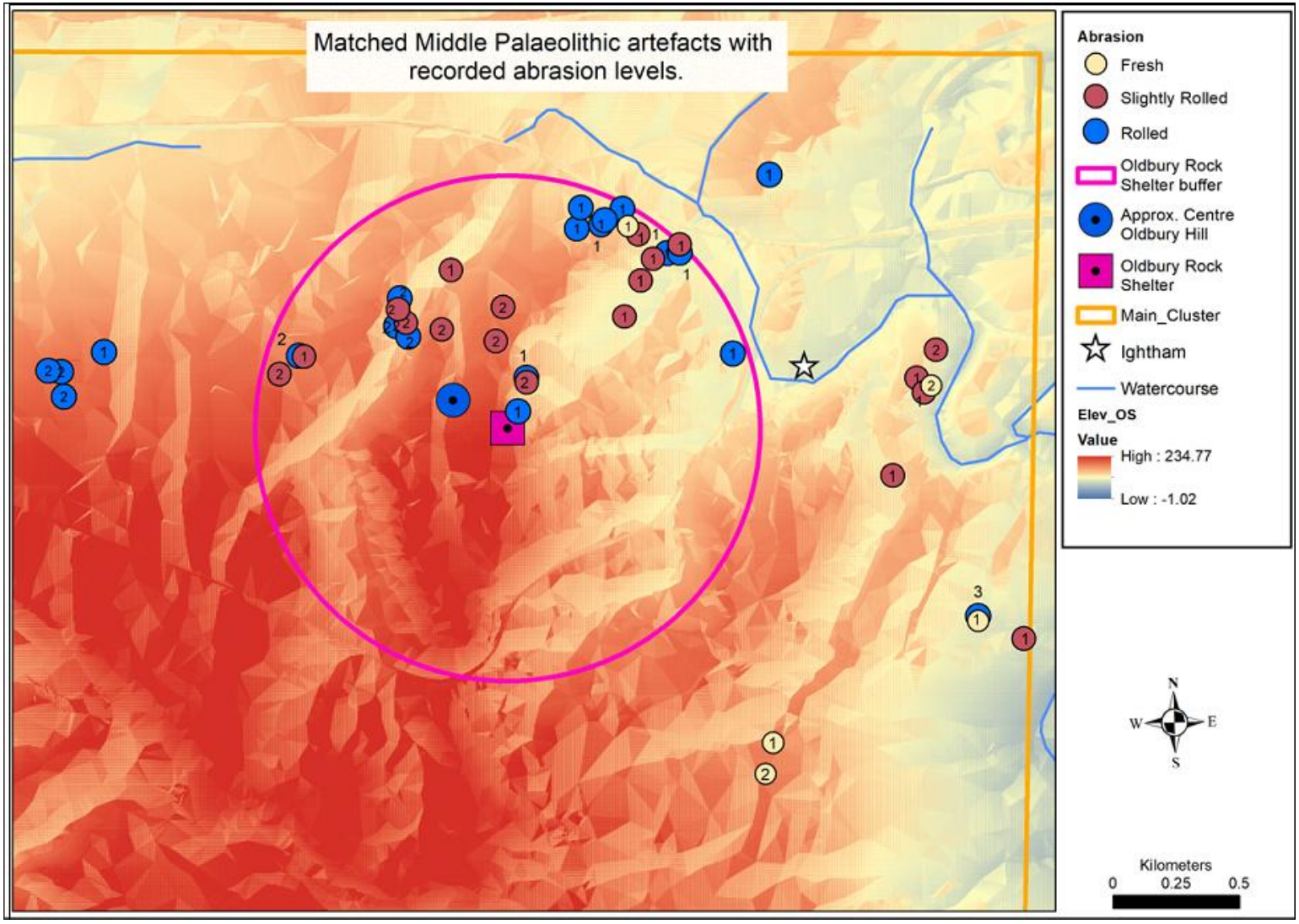


Figure 48 Abrasion levels where available of matched possible Middle Palaeolithic artefacts, including Lower/Middle Palaeolithic? Those marked with a 1 = Lower/Middle Palaeolithic? 2 =Middle Palaeolithic (Levallois), 3 = Middle Palaeolithic /Mousterian?

The second observation is that the Lower Palaeolithic artefacts in Harrison's archive are clustered near to the waterways. Hominins in the Lower Palaeolithic appeared to prefer river environments which also suggests that the theory that Lower Palaeolithic sites are more likely to be associated with waterways and lacustrine (lake) deposits holds true. Several sites in Britain indicate that the locality to rivers and inland water bodies is most likely the influencing factor to the findspots of Lower Palaeolithic artefacts, either due to redeposition by fluvial action or the attraction of river valleys and pathways provided along rivers to Palaeolithic Hominins.

The proximity of these sites to raw materials from the local geology or cobbles from river gravels would also have been attractive to Hominins, although a number of British Palaeolithic sites from fluvial environments would dispute this. Examples are at Hoxne, where the Lower Industry was recovered from a fluvial channel (White, 1998a), High Lodge assemblage C from a floodplain in overbank sediment (Ashton *et al.,* 1992) and the Industry from the Lower Loam at Swanscombe (Conway *et al.,* 1996). None of these had an obvious source of raw material (Ashton *et al*., 2005). The artefacts from Harrison's archive do have a local source of raw material, the chalk cliff of the North Downs, near Ightham, and cobbles from the watercourses near to where many of the Lower Palaeolithic artefacts were found. Many Lower Palaeolithic sites are found in Brick pits or quarries as they are often deeply buried by subsequent deposition. The following sites are examples where Palaeolithic sites are in fluvial contexts, although they are excavated sites and not surface finds: -

- Barnfield Pit is located on a fluvial terrace deposit above the south side of the River Thames, on the Boyn Hill/Orsett Heath Formation (Kent County Council, 2022). The deposits contain Palaeolithic and palaeontological evidence stretching from the end of the Anglian period, through the interglacial (MIS 11) and into the following cold period (Pettitt and White, 2012). Artefacts of the Palaeolithic industry were found in three phases comprising a Clactonian non-handaxe assemblage, Handaxes (usually small and pointed) and twisted ovate handaxes along with fragments of cranium of Homo heidelbergensis. Artefacts found at Barnfield Pit are from the first well-established occupation in the Thames Valley at the end of the Anglian glaciation (White *et al*., 2018).

- East Farm, Barnham in Suffolk is a Lower Palaeolithic site approximately 400,000 years old (Suffolk County Council, 2022), which contains a series of fluvial sediments dating to MIS 11c, the Hoxnian interglacial. It is located in a disused clay pit which

was in use around the turn of the twentieth Century. The fauna suggests habitats ranging from dense woodland to open scrub grassland, near to still or slow-moving water with a warmer climate than today (Pettitt and White, 2012). A coarse band of cobbles were the main source of raw materials for Clactonian and Acheulian assemblages found here (Ashton *et al.,* 1998; 2016). The area is dominated by cores with a few handaxes, with most of these being fluvially abraded, suggesting derived contexts after being transported by fluvial action. The raw material for the artefacts is quartzite, and Andesite, with a few flint artefacts. Only larger objects have been found, whether the result of being carried along in the rivers or as a result of collection bias is unknown (Pettitt and White, 2012).

- Waverley wood site, including Wood Farm, is in Warwickshire in the area to the south and southwest of Coventry. The site has sediments representing the upper Bytham River (Keen *et al.*, 2006). Four channels representing one river deposited sediment on its floodplain and were filled with clayey-sand and gravel, overlain by a succession of Bytham deposits and capped by MIS12 Thrussington Till (Keen *et al.*, 2006). Shotton *et al.* (1993: 295) state that '*The channel complex represents a single but fluctuating, fluvial regime*'

These sites reinforce a strong relationship to water, and to river or stream environments McNabb, *et al*., (2006). Gamble (1999) has proposed that: -

> *'resource exploitation … was dominated by encounters in the course of daily foraging, rather than through pre-planned exercises.*

In Chapter 4's Geological Analysis, the importance of the Lower Greensand geology associated with the artefacts was explored, with parallels found at Beedings in West Sussex and Wood Hills, which were both located on prominent hilltops of the Lower Greensand. The finds at Ightham were also on a stretch of the Lower Greensand ridge. In Pope *et al*. (2015: 35) it was stated that Jacobi mentioned in a discussion that a group of finds in Hassocks West Sussex were '*a useful starting point for considering the issue and possibly illustrative of preservation processes in the region'* (see Chapter 1, pp. 18-19). The point introduced in Chapter 4 discusses a possible reason for the clustering of the artefacts, that when the river reaches the change in bedrock (the Lower Greensand) it alters its flow and therefore its ability to transport the artefacts over the new lithology bedrock (Hosfield, 1998.) This would certainly explain some of the clusters around the Shode River.

Furthermore, Pope *et al*., (2015) suggests that we may consider that the Lower Greensand is susceptible to Gulls. Looking more widely, we might consider that similar near surface structures are responsible for preservation at Oldbury, offering an alternative interpretation to the site being situated originally on a slope or in a former rock shelter (ibid.). Late Neanderthal occupation at the site may have taken place on the hills surface, with their discarded artefacts subsequently captured within fissure-like structures, only to be spilled across the hillside during Late Glacial and Holocene erosion. The evidence presented from Harrison's archive of Middle Palaeolithic artefacts found on and around Oldbury Hill at least backs up the theory that we should consider the Lower Greensand geology as an area likely to preserve, at relatively shallow depths, a well-preserved archaeological signature from the Devensian (ibid.).

Gravels are the most common context for Palaeolithic artefacts (Wymer, 1995: 46), and Prestwich's Drift Map illustrates the antiquarian's knowledge regarding the location of gravels in the study area and gives an insight into their thoughts and actions. I used Prestwich's Drift map to illustrate where he found gravels and where Harrison collected a good proportion of his artefacts. Gravels may have been identified in other areas in more modern periods, but the Drift map identifies the extent of the gravel at that time. Therefore, the analysis uses this map to analyse the relationship of his artefacts to the gravels mapped at that time.

Harrison's artefacts were drawn on Prestwich's original Drift map (Figure 33 Figure 34) and it would be useful if these artefacts could be identified, but the artefact numbers were not annotated at the time. The analysis of the information available in the archive shows approximately where the artefacts should be plotted on the map, and it emerged that a third of all artefacts that I found and identified from Harrison'sarchive and plotted on the georeferenced Drift Map were within an area of gravel. The limitations of the methodology for plotting the artefacts, are stated earlier, and so it is possible that some of the artefacts plotted are near but not exactly on the original findspot. Some of the artefacts are slightly outside of the gravel patches because of this reason. The inference from this data is that Harrison did not exclusively collect from the gravels, but that the gravels were very important in the distribution of the artefacts.

It is conceivable that the artefacts were transported downriver and were caught up in the meanders and interfluves, as some of the artefacts are placed within 100m of the meander of the Shode and a much larger number were found within 200 – 400m of the meanders/interfluves).

There is another possibility that some of the artefacts found in the latter distance band could be related to the railway as described in Figure 49 and pages 36, 100, 114, 125. As many of the artefacts

were broken, it is possible that these were gravels that were brought into the area for the widening of the railway cutting or that the railway cut through the gravels, exposing these implements or bringing them to the surface through the construction itself or the building of spoil heaps from the railway excavations.

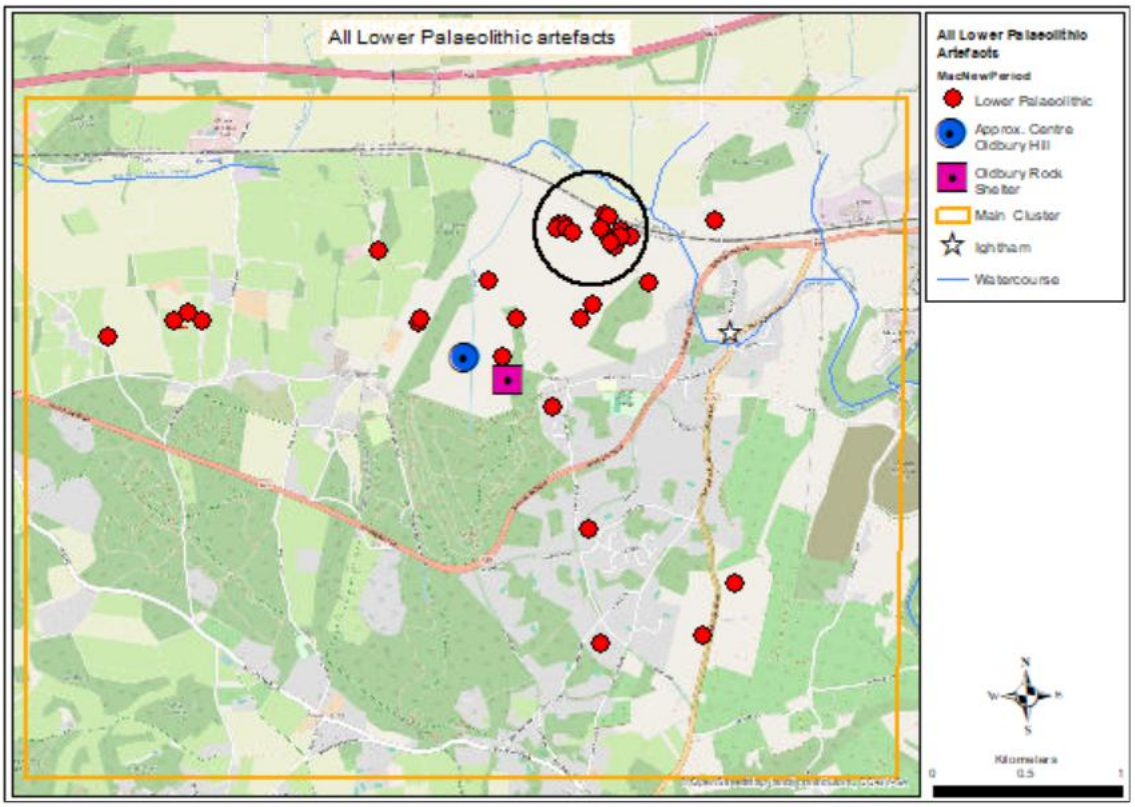


Figure 49 All mapped Lower Palaeolithic artefacts from Harrison's archive (both datasets). The cluster of artefacts near to the railway line is circled in black Described below).

Harrison (1928) described the gravels as either Hill gravels or Medway gravels and it is likely that the Medway gravels represent those deposited by the Medway's tributaries. There were a higher number of Lower/Middle Palaeolithic? artefacts from the validated database found on these gravels, followed by Lower Palaeolithic artefacts, whilst there were fewer artefacts from the Middle Palaeolithic period. The lower numbers of Middle Palaeolithic artefacts coincide with the paucity of Middle Palaeolithic artefacts nearer to waterways in the buffer analysis (Chapter 4).

Those artefacts that were identified as found on Hill gravel by Harrison were most likely those not associated with river gravels. The period of artefact relevant to this study which is most likely to be found on Hill gravels (where collection took place) were those categorized as Lower/Middle Palaeolithic? while more of the artefacts identified were those categorized as Middle Palaeolithic. There were fewer Lower Palaeolithic artefacts on these gravels.

There were more Middle Palaeolithic artefacts more than 600 metres of a waterway. They then increase incrementally within each 100 metres distance travelled from the river. They are most prevalent around 801 to 900 metres from waterways and at heights between 380 and 430m OD.

Chapter 6: Conclusion

The aim of this thesis is to answer the research question::

> *'Is there any period specific patterning to the location of Lower Palaeolithic vs Middle Palaeolithic finds in the area around Ightham, Kent as preserved in Benjamin Harrison's artefact and document archive? Do Harrison's artefacts represent a clustered or dispersed pattern on the ground'?*

It is suggested that there are two basic tasks of archaeologists:

> *The first one is to identify the spatio-temporal patterns of hominin presence and absence, i.e., getting the pattern 'right', the second one is to explain these patterns. (*Roebroeks, 2006; Blundell, 2019)

This research covers both of these tasks using Harrison's archive, which has been studied in depth in this work and the likelihood of there being spatial patterning of artefacts from Benjamin Harrison's archive (mainly handaxes of the Lower and Middle Palaeolithic periods) in his area of collection around Ightham is discussed in this chapter.

The artefacts were tested to ascertain whether they were a product of random dispersal using the Average Nearest neighbour tool in ArcMap. In both datasets, (the matched data and those mapped by accession number), the artefacts were clustered and not located as a result of random chance. Patterns in the mapped data could be mainly due to various landscape processes acting upon the artefacts original places of discard and analysis shows that likely reasons for this clustering could be for a number of reasons: disparate Pleistocene landscape preservation, random sediment exposure from quarrying and subsequent exposure of deeply buried artefacts, antiquarian collection bias, urban expansion, (Blundell, 2019) transportation by fluvial or solifluction actions, clustering in an area of obstruction, (for example the edge of the much harder greensand), distribution by Hominins, or by natural or anthropogenic erosion (such as from Gulls) exposing the artefacts to the surface . In reality, all of these reasons are likely candidates for clustering of the artefacts and are discussed below:

- Harrison did display some collection bias in limiting most of his collecting to his circles of interest, the availability of land to inspect (although he did have unprecedented access in his area), and his later concentration on gravels for collecting. Even with these limitations he displayed a remarkable knowledge of the subject and of his area and contributed an

extensive archive of Palaeolithic information for us to study

- The clustering of artefacts around rivers and their meanders, and their limitations to within the Lower Greensand suggest geological and fluvial intervention in the locations of these artefacts. It indicates a background noise of redeposited Lower Palaeolithic artefacts along river valleys

- Construction in the area of railway lines, laying water pipes and in quarry exposures have bought artefacts to the surface, with some embedded in gravels which suggests they are in-situ. Artefacts were clustered near to the railway line at Fane Hill (Figure 49). Harrison (1928) contains various notes and copies of letters from Harrison about his investigations during these interventions (Harrison (1928) pp. 89-90, 98, 131, 264 and 323)).

- Gulls in the Lower Greensand could have been exposed by ploughing or erosion and bought artefacts to the surface

Patterns in the data suggest that the findspots of the artefacts have been influenced by geological location and actions, and deposition was evident mainly in three areas of geological deposit. These are the Lower Greensand, the River Gravels and Clay-with-flints. Almost all of the artefacts were found on the Lower Greensand, with a few found on the Clay-with-flints (Figure 36 Figure 43). Blundell (2019) suggests that on the North Downs as a whole, 26.77% of the Chalk is covered by Clay-with-flints. Chalk interfluves capped with Clay-with-flints have undergone only minor erosion or deposition since the Cromerian (Blundell, 2019; Catt 1986), meaning that this geological deposit is likely to be a residue of original geological strata and artefacts within it are unlikely to have been redeposited by fluvial or solifluction actions:

> *'There is every reason to suppose that artefacts found on these upland sites are in the place where they were discarded, apart from movements in the soil and some dissolution of the underlying Chalk* (Blundell 2019: 34; Scott Jackson 2000: 893; Wymer, 1999: 16).

As Harrison's artefacts on the plateau are mostly Middle Palaeolithic, it suggests that their findspots are close to the area in which they were discarded, giving an insight into the mobility and landuse of Middle Palaeolithic people:

> *'Whilst there is no doubt that artefacts found in some lowland areas are in a derived state, surface finds in elevated locations may not be the product of derivation, but approximate markers of activity and use within the landscape' (Drinkhall, 2014)*

Hill gravels are most likely head deposits and more of Harrison's Middle Palaeolithic artefacts were found on and within this deposit. Some of these artefacts could have been redeposited by movement downslope from the plateaux, but those that are fresh or slightly rolled are unlikely to have moved far from their deposition site. Middle Palaeolithic sites are normally expected to be on hills, valleys, caves and rock shelters. The result of this analysis is that the Middle Palaeolithic artefacts from Harrison's archive follow this pattern as they are mostly found around Oldbury Hill and the higher ground in dry valleys and on Clay-with-flints on the plateau of the North Downs.

Lower Palaeolithic artefacts appear to have long been over-represented in the archaeological record due to collection bias around areas of gravels and large-scale excavation due to exposure of sediments due to quarrying and infrastructure. The enhanced availability of artefacts due to workers at these quarries and infrastructure developments procuring and selling them to antiquarians boosts the numbers of finds. This also creates bias towards handaxes as they would have been more sought after and more easily recognizable. Harrison collected both Middle Palaeolithic and Lower Palaeolithic artefacts so reducing some of that bias.

It has been suggested that changing artefact and landscape use from the Lower to the Middle Palaeolithic would have affected the quantity and distribution of artefact discard locations (Scott, 2011). The data does not seem to reflect this as the Lower and Middle Palaeolithic numbers are quite similar (Table 7 and Table 8), although the quantities of Lower/Middle Palaeolithic? artefacts could skew this if they could be further identified. However, the number of artefacts in Harrison's archive diminish from the higher numbers of Levallois compared to very few Mousterian artefacts present in Harrison's archive. This distribution reflects the way the land was utilized in each period and possibly levels of population through time. Ashton *et. al.,* 2015 suggests: -

> *An underlying pattern that relates to Lower and Early Middle Palaeolithic land-use…may reflect the changing palaeogeography of Britain from MIS 13 through to MIS 7* (Ashton *et. al.,* 2015).

Palaeogeography has been studied in relation to access to Britain and populations in Kent during the periods in which these artefacts were deposited, and the results suggest that hominins may have entered Britain from the Southern North Sea basin and spread along the river valleys, such as the Thames, the Medway and their tributaries, to colonize the study area repeatedly during temperate weather and retreating during cold stages (Ashton, *et al.* 2017: Stringer, 2006: Parfitt, et al., 2005: 2010).

From the small sample of abrasion data available there were more rolled artefacts than slightly

rolled, with a higher number being Lower Palaeolithic. As these artefact types are more prolific in the river gravels it suggests that the artefacts were moved by fluvial actions. The Lower/Middle Palaeolithic? were most prolific in both categories, which would be expected as these could be from either Palaeolithic period. There were more Middle Palaeolithic artefacts in the slightly rolled category which suggests they are less likely to have been moved from their deposition location and less likely to have been affected by fluvial action. Some of the artefacts were broken in all abrasion categories which suggests either that they were impacted by ploughing as many of them were found in fields, that they were from the gravels that were impacted by the railway construction or that they were moved in rivers or downslope from the plateux by solifluction. Abrasion analysis has indicated that there is no particular pattern in the fresh artefacts identified, other than that there were slightly more of these found near to the railway line at Fane Hill.

The gradient at which the artefacts were found suggests that many of the artefacts had not been moved downslope as their gradient was a maximum of 6 degrees see Chapter 4, Table 10. The slope analysis indicates that all of the artefacts were located on areas of minimal gradient, up to six degrees (Table 10), and it is usually higher gradients of 5 to 20 degrees that allow solifluction movement (Walker 1986). This, along with the lower Palaeolithic artefacts proximity to waterways and Middle Palaeolithic artefacts found near to dry valleys, rock shelters or Clay-with-flints deposits, indicates a landscape where hominins had all of the essential requirements for this landscape to be a place revisited over long periods of time. Water for drinking from the springs and streams, game which could be found in the clearings and interfluves around the waterways, visibility over the lower ground from the plateau, raw materials from the chalk downs and river cobbles for toolmaking may have made this a very attractive landscape during the Palaeolithic.

The artefacts in Maidstone Museum are better curated than ever before and they were matched to Harrison's paper archive, making further research possible. This study could be enhanced by further study of abrasion when the artefacts are available, and an in-depth addition to the database of those artefacts in the British Museum and other collections where Harrison's artefacts are stored.

Those artefacts described as Lower/Middle Palaeolithic? could be further studied as it may be possible to identify these artefacts, for instance those that are twisted which are more likely to be Middle Palaeolithic, rolled versus slightly rolled/fresh and the clustering of the Lower/Middle Palaeolithic? around certain artefact types that have been identified. This would facilitate further identification.

Glossary of Terms

Acheulian: A culture that emerged from Africa approximately 1.7 million years ago and named after the type-site of St Acheul in Northern France where later versions of these tools, in the case of this study handaxes, were first discovered.

Algorithms: Exact step-by-step instructions for specified actions, usually in IT

Anglian Glaciation: Glaciation in Britain in Marine Isotope Stage 12, approximately half a million years ago. It is thought to have reached to the position of the Thames, which it moved to its present location.

Anthropogenically: Those modifications and effects that are derived from human activities.

Anticline: Upward arching fold of stratified rock, descending on both sides.

Antiquarian: Collector of artefacts and knowledge form the past, often to build a collection of antiquities. In this study, it relates to such collectors from the nineteenth century.

Bifacially worked: artefact (handaxe for instance) flaked on both sides

Chert: A hard sedimentary rock composed of quartz

Clactonian: A stone tool industry found in the south of England dating to MIS 11,

Clasts: A fragment of rock broken from a larger rock

Clay-with-flints: Orange-brown and red-brown sandy clay with flint pebbles and nodules

Cranium: The bones of the skull enclosing he brain

Cretaceous period: Geological period lasting from 145–66 Million years ago

Cromerian: Early to mid-Pleistocene interglacial stage dating to approximately 0.9–0.5 Million years ago

Debitage: Waste flakes and cores produced from the manufacture of stone tools

Deciduous: Trees or shrubs that shed their leaves at the end of the growing season

Digital Elevation Model (DEM): A digital dataset that represents a continuous topographical surface

Drift: Superficial deposits which are the youngest deposits, formed during the Quaternary period

Eoliths: Natural stone 'artefacts' thought to be legitimate stone tools by antiquarians

Escarpment: A long steep slope at the end of a plateau or ridge usually formed from erosion

Fluvial processes: Associated with rivers or streams and the land deposits formed by them

Gault: Sequence of clays, siltstones and mudstones deposited during the Cretaceous period

Gelasian stage: Geological stage (approximately 2.6 to 1.8 million years ago), which is at the base of the Quaternary period

Head: Sediments formed on slopes in periglacial conditions consisting of a clay matrix with various angular rock inclusions

Holocene: The geological epoch of the last 11-1200 years from the end of the last glacial period to the present

Hominin: Group consisting of all modern and extinct human species

Homo heidelbergensis: An extinct species of hominin from the Middle Pleistocene, thought to have been a common ancestor of Neanderthals and modern humans

Interfluve: The higher area between two streams or rivers flowing in the same direction

Interglacial: A warm period between two glacial periods

Levallois: Middle Palaeolithic prepared core technology of the Mousterian industry, associated with Homo neanderthalensis in Europe

Lithic analysis: Analysis of stone tools using scientific methods

Marine Isotope Stage (MIS): Numbered stages of the Quaternary period using data from deep sea cores. Even numbers are cold stages and odd numbers are warm stages.

Mousterian: Middle Palaeolithic Industry associated with Homo neanderthalensis in Europe

Neolithic/Neoliths: period of transition to agriculture from hunter-gathering approximately 4000
– 2300 BC

Ochreous: Yellow-brown staining on flint tools

Ovate: Oval shaped handaxe

Palaeogene: The period following the Cretaceous period, dated to approximately 66 – 23 million years ago

Palaeolithic/Palaeoliths: Archaeological period and artefacts from the Pleistocene period

Patinated: A thin surface layer induced by natural or chemical reaction to rocks. Often caused by air or water reacting with the minerals in the rock

Pericline: Dome shaped stratified rocks with the oldest rock at the centre and the slopes following the direction of folding

Pixel: The smallest unit in a digital display used with other pixels to build a picture

Plateau(x): Area(s) of fairly flat high ground raised sharply above the surrounding areas

Pleistocene: The oldest epoch of the Quaternary period from 2.6 million years ago to 11700.

Quaternary: A geological period, which includes the Pleistocene and Holocene epochs

Tectonic: Relating to the way the earth is formed and it's structure

Tertiary: Period between the Cretaceous and Quaternary periods

Sedimentary: Rock formed at or near to the earth's surface

Unconformity: non-deposition surface that forms a break in the geological record

Water-shed (watershed): Drainage divide that separates adjacent drainage basins, the area where waterbodies discharge into their waterbody**.**

Bibliography

Abbott W. J. (1894) The Ossiferous Fissures in the Valley of the Shode, near Ightham, Kent. *Quarterly Journal of the Geological Society*, 1894, 50, pp. 171-181. Available at: https://www.lyellcollection.org/doi/10.1144/gsl.jgs.1894.050.01-04.16. (Accessed: 22 August 2022).

Ashton, N.M., Cook, J., Lewis, S.G. and Rose, J. (eds) (1992) *High Lodge: Excavations by G. de G. Sieveking 1962-68 and Cook 1988*. London: British Museum Press.

Ashton, N.M., Lewis, S.G. and Parfitt, S.A. (eds) (1998) *Excavations at the Lower Palaeolithic Site at East Farm, Barnham, Suffolk 1989-94*. British Museum Occasional Paper 125, London: British Museum.

Ashton, N., Lewis, S., Parfitt, S., Candy, I., Keen, D., Kemp, R., Penkman, K., Thomas, G., Whittaker, J. and White, M. J. (2005) Excavations at the Lower Palaeolithic site at Elveden, Suffolk, UK. *Proceedings of the Prehistoric Society* 71, pp. 1-61.

Ashton, N., Lewis, S., Pett, D., and Harris, C., (2013-2017) *The mapping Palaeolithic Britain Project: place, space and time.* Queen Mary University of London, School of Geography. Available at: https://www.qmul.ac.uk/geog/research/research-projects/mappingpalaeolithicbritain. (Accessed September 2022).

Ashton, N., Lewis, S.G., De Groote, I., Duffy, S.M., Bates, M., Bates, R., Hoare, P., Lewis, M., Parfitt, S. A., Peglar, S., Williams, C and Stringer, C., (2014) Hominin footprints from Early Pleistocene deposits at Happisburgh, UK. *PLoS ONE* **9.**

Ashton, N., Lewis, S.G., and Harris, C.R., (2015) The distribution of early Palaeolithic sites in Britain. *No Stone Unturned: Papers in Honour of Roger Jacobi. London: Lithic Studies Society Occasional Paper*, *9*, pp.19-30.

Ashton, N., Lewis, S.G., Parfitt, S.A., Davis, R.J. and Stringer, C. (2016) Handaxe and non-handaxe assemblages during Marine Isotope Stage 11 in northern Europe: Recent investigations at Barnham, Suffolk. Journal of Quaternary Science, 31(8), pp. 837-843.

ASTER GDEM V003 data (2000) *NASA/METI/AIST/Japan Space Systems, and U.S./Japan ASTER Science Team. ASTER global digital elevation model V003 (2018), distributed by NASA EOSDIS Land Processes DAAC*. Available at: https://lpdaac.usgs.gov/products/astgtmv003. (Accessed:

30 April 2018).

Babbage, C., (1859-60) Observations on the Discovery in Various Localities of the Remains of Human Art Mixed with the Bones of Extinct Races of Animals. *Proceedings of the Royal society of London*, 10, pp. 59-72. Available at https://royalsocietypublishing.org/doi/epdf/10.1098/rspl.1859.0020 (Accessed: 26 August 2023).

Bates, M., Pope, M., Shaw, A., Scott, B. and SCHWENNINGER, J.L. (2013) Late Neanderthal occupation in North-West Europe: rediscovery, investigation and dating of a last glacial sediment sequence at the site of La Cotte de Saint Brelade, Jersey. *Journal of Quaternary Science*, *28*(7), pp.647-652. Available at https://onlinelibrary.wiley.com/doi/full/10.1002/jqs.2669 (Accessed: 1st April 2024).

Beresford, F. (2021) The Late Middle Palaeolithic Site at Oldbury, Kent, England and a Memory of Benjamin Harrison (1837–1921). *Kent Archaeological Society Magazine*, 115: pp. 30-37

Blundell, L. (2019) *A critical evaluation of the lower-middle Palaeolithic archaeological record of the chalk uplands of northwest Europe*. Doctoral Thesis, UCL (University College London).

Bridgland, D.R. (1999) 'Weald rivers' north of the Thames: a provenance study based on gravel clast analysis. *Proceedings of the Geologists' Association*, 110(2), pp. 133-148.

Bridgland, D. R. (2003) The evolution of the River Medway, SE England, in the context of Quaternary palaeoclimate and the Palaeolithic occupation of NW Europe. *Proceedings of the Geologists' Association*, 114(1), pp. 23-48

British Geological Survey, (2018) *BGS Geology 625k - BGS Datasets*. Available at: https://www.bgs.ac.uk/datasets/bgs-geology-625k-digmapgb/. (Accessed: 10 September 2018).

British Geological Survey (2022a) *Cambering, gulls and Valley bulging* – BGS Research – Shallow geohazards. Available at: https://www.bgs.ac.uk/geology-projects/shallow-geohazards/cambering-and-valley-bulging/. (Accessed: 22 August 2022).

British Geological Survey (2022b) *Gault Formation – BGS Research – Engineering geology maps*. Available at: https://www.bgs.ac.uk/geology-projects/engineering-geology-maps/engineering- geological-studies-of-bedrock-formations/gault-formation/. (Accessed:

on 15/08/2022).

British Geological Survey (2022c) *Geology Viewer*. Available at: https://geologyviewer.bgs.ac.uk/?_ga=2.260197391.322541683.1658951774-328993958.1658951774 (Accessed: 20 July 2022).

Buckland, W., (1822) ARTICLEXVI. Account of an assemblage of fossil teeth and bones of elephant, rhinoceros, hippopotamus, bear, tiger, and hyæna, and sixteen other animals; discovered in a cave at Kirkdale, Yorkshire, in the year 1821: with a comparative view of five similar caverns in various parts of England, and others on the continent. *Philosophical Transactions of the Royal society of London*, 112, pp. 1-78. Available at https://royalsocietypublishing.org/doi/epdf/10.1098/rstl.1822.0017. (Accessed 4 August 2023).

Buckland. W., (1823) Reliquiae Diluvianae or Observations on the Organic Remains contained in Caves, Fissures, and Diluvial Gravel and on other Geological Phenomena, Attesting to the Action of an Universal Deluge. London: Murray. Available at https://wellcomecollection.org/works/k7twatkd/items?canvas=9. (Accessed 4 August 2023).

Burrough, P.A. and McDonnell, R.A. (1998) *Principles of Geographical Information Systems*. Oxford: Oxford University Press.

Callow, P. (1981) Review of The Lower and Middle Palaeolithic periods in Britain, by D Roe. *Antiquity,* 55(215), pp. 239-40. Available at: https://www.proquest.com/docview/1293739614?pqorigsite=gscholar&fromopenview=true&imgSeq=1 (Accessed: 22 August 2022).

Catt, J.A. 1986. The nature, origin and geomorphological significance of Clay-with-flints. In: G. de G. Sieveking & M.B. Hart (eds.). The scientific study of flint and chert. Proceedings of the fourth international flint 412 symposium held at Brighton Polytechninc 1-15 April 1983. Cambridge: Cambridge University Press,151-159.

Cook, J. and Jacobi. (1998) *Discoidal core technology in the Palaeolithic at Oldbury, Kent*. Oxbow Monograph: Oxbow Books.

Compton, T., Skinner, M. M., Humphrey, H., Pope, M., Bates, M. Davies, T. W., Parfitt, S. A., Plummer, W. P., Scott, B., Shaw, A., Stringer, C. The morphology of the Late Pleistocene hominin remains from the site of La Cotte de St Brelade, Jersey (Channel Islands). *Journal of*

Human Evolution, **152**, 2021. Available at https://www.sciencedirect.com/science/article/pii/S0047248420302001 (Accessed 22 May 2023).

Conolly, J. and Lake, M. (2006) *Geographical Information Systems in Archaeology.* New York: Cambridge University Press.

Conway, B., McNabb, J. and Ashton, N.M. (eds). (1996) '*Excavations at Barnfield Pit, Swanscombe,* 1968-72' (94) Occasional Paper. London: British Museum.

Couclelis, H., (1992) *People Manipulate Objects (but Cultivate Fields): Beyond the Raster-Vector debate* Available at: http://www.dpi.inpe.br/gilberto/references/couclelis_1992_objects_fields.pdf. (Accessed: 1 July 2022).

Darwin, (1871, reprinted 2013) *The Descent of Man and Selection in Relation to Sex*. Hertfordshire: Wordsworth.

Davis, W. M. (1895) The Development of Certain English Rivers. *The Geographic Journal,* 5(2), pp. 127–146.

De Groote, I., Lewis, M., Stringer, C., (2017) Prehistory of the British Isles: A Tale of Coming and Going *Bulletins et Mémoires de la Societal d anthropologie de Paris*. 30(1). Available at https://www.researchgate.net/publication/319638174_Prehistory_of_the_British_Isles_A_tale_of_coming_and_going Accessed 11 May 2023

DRINKALL, H. C. (2014) Expanding our horizons: an exploration of hominin landscape use in the Lower Palaeolithic of Britain and the question of upland home bases or lowland living sites., Durham theses, Durham University. Available at Durham E-Theses Online: http://etheses.dur.ac.uk/10660/

Editor, T. (1860) "The Evidences of the Geological Age and Human Manufacture of the Fossil Flint Implements," *The Geologist*. Cambridge University Press, 3(11), pp. 404–408. Available at: https://www.cambridge.org/core/journals/geologist/issue/FA12C1A02C0E4F83943013D6BAC8AB10 (Accessed: 03/02/2021).

Editor, The Evidences of the Geological Age and Human Manufacture of the Fossil Flint Implements (Ed.) (1861) *The Geologist*, 4(1), pp 19-31 Available at: https://www.cambridge.org/core/journals/geologist/listing (Accessed: 03/02/2021).

Edina, (2016a) *Digimap Ordnance Survey County Series 1st Edition [TIFF geospatial data]* Available at: Digimap (edina.ac.uk) (Accessed: 15 March 2016)

Edina, (2016b) *Digimap Ordnance Survey Service*. Available at: http://digimap.edina.ac.uk. (Accessed: 29 December 2016)

Ellen, R. & Muthana, A. (2022) The Kentish Eoliths of Benjamin Harrison: Their rise and fall in museum collections and what this tells us about the circumstances of their survival. *Museum* Anthropology, 45, issue 2, pp. 91 – 204.

Esri, (2021a) *ArcGIS - Discover your power with ArcGIS, Esri*. Available at: https://www.esri.com/en-us/arcgis/about-arcgis/overview. (Accessed: 9 March 2021).

Esri, (2021b) *ArcGIS Desktop: ArcMap - Average Nearest Neighbour*. Available at: https://desktop.arcgis.com/en/arcmap/latest/tools/spatial-statistics-toolbox/average-nearest- neighbor.htm (Accessed: 10 December 2021).

Esri 2022, *ArcMap*. Download available at: https://www.esri.com/en-us/arcgis/products/arcgis- desktop/resources (Accessed 5 September 2022)

Gamble, C. (1999) *The Palaeolithic Settlement of Europe.* Cambridge: Cambridge University Press.

Gamble, C. (2021), *Making Deep History: Zeal, Perseverance, and the Time Revolution of 1859.* Oxford: Oxford University Press.

Geikie, J. (1881) *Prehistoric Europe: a geological sketch*. London: E. Stanford.

Gibbard, P.L. 1995 The formation of the Strait of Dover. In R.C. Preece (ed.) *Island Britain: a Quaternary Perspective*. London: Geological Society Special Publication 96. 15-26

Gossling, F. (1937) 'Wealden pebbles in the Valley of the River Darent' *Geological Magazine,* 74(11) pp. 527–528. Available at: https://www.cambridge.org/core/journals/geological- magazine/article/wealden-pebbles-in-the-valley-of-the-river- darent/48C569CDEEDCB1E5F6CAF555B53EBD86. (Accessed: 25 July 2022).

Gossling, F. (1940) A Contribution to the Pleistocene history of the Upper Darent Valley.

Proceedings of the Geologist's Association, 51(4), pp 311-340.

Harrison, B. (1887 – 1889) *Notebook 4.* Maidstone Museum.

Harrison, B. (1892) Report of the committee appointed to carry on excavation, at Oldbury Hill near Ightham IN Report of the Sixty-First Meeting of the British Association for the Advancement of Science, Cardiff 1891 pp. 353-4.

Harrison E. R. (1928) *Harrison of Ightham.* London: Oxford University Press

Harrison, E. (1933) Oldbury Hill, Ightham. *Archaeologia Cantiana*, 45 pp. 142-161. Available at https://www.kentarchaeology.org.uk/arch-cant/vol/45/oldbury-hill-ightham. Accessed 13 January 2024

Head, M. J. and Gibbard, P. L. (2015) Formal subdivision of the Quaternary System/Period: past, present, and future. *Quaternary International*, (383), pp. 4–35. Available at: https://www.sciencedirect.com/science/article/abs/pii/S1040618215006394. (Accessed: 2February 2022).

Hosfield, R. T. (1998) *A Regional Model of Hominid Behaviour during the Middle Pleistocene*. Department of Archaeology, Doctoral Thesis. University of Southampton.

Jacobi R. M. (2007) A collection of Early Upper Palaeolithic artefacts from Beedings, near Pulborough and the context of similar finds from the British Isles", Proceedings of the Prehistoric Society 73, 229–325,
(2) (PDF) Early Upper Palaeolithic archaeology at Beedings, West Sussex: new contexts for Pleistocene archaeology. Available from: https://www.researchgate.net/publication/272715269_Early_Upper_Palaeolithic_archaeology_at_Beedings_West_Sussex_new_contexts_for_Pleistocene_archaeology [accessed Apr 24 2023].

Johnson, M. Discussion: elite sites, political landscapes and lived experience in the Later Middle Ages - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/Simplified-section-through-the-geology-of-the-Weald-with-vertical-axis-exaggerated_fig3_332167031 [accessed 16 January, 2024]

Jones, C.B. (1997) *Geographical Information Systems and Computer Cartography*. Harlow U.K, Longman. Available at:https://www.google.co.uk/books/edition/_/5Ix9AwAAQBAJ?hl=en&gbpv=1&pg=PP1&dq=jones+1 997+geographical+information+systems+and+computer+cartography. (Accessed: 3 April 2021)

Jones, K.C. (1999) On the uplift and denudation of the Weald. *Geological Society*, London, Special Publications. Available at: DOI:10.1144/GSL.SP.1999.162.01.03. Accessed on: 9 March 2022.

Keen, D. H., Hardaker, T. and Lang, A. T. O. (2006) A Lower Palaeolithic Industry from the Cromerian (MIS 13) Baginton Formation of Waverley Wood and Wood Farm Pits, Bubbenhall, Warwickshire UK. *Journal of Quaternary Science,* 21, p. 457 – 470 Available at: https://onlinelibrary.wiley.com/doi/epdf/10.1002/jqs.1047 (Accessed: 22 August 2022).

Kent County Council (2022a) *Exploring Kent's Past*: *The history of Kent's archaeology. The Kent Archaeological Society.* Available at: *https://webapps.kent.gov.uk/KCC.ExploringKentsPast.Web.Sites.Public/SingleResult.aspx?uid=Tke 1069* (Accessed: 22 August 2022)

Kent County Council (2022b) *Exploring Kent's Past: The history of Kent's archaeology, Monument details.* Available at: https://webapps.kent.gov.uk/KCC.ExploringKentsPast.Web.Sites.Public/SingleResult.aspx?uid=%2 7mwx20965%27 (Accessed: 3 April 2022).

Kent Geologists' Group (2022) *A Synopsis of Kent's Geology.* Available at: https://www.kgg.org.uk/kentgeo.html (Accessed: 31 July 2022).

Key, A.J.M., Jarić, I. and Roberts, D.L. (2021) 'Modelling the end of the Acheulean at global and continental levels suggests widespread persistence into the Middle Palaeolithic.' *Humanitarian and Social Sciences Communication,* 8(55), p.1. Available at: https://doi.org/10.1057/s41599-021- 00735-8. Accessed: 27 July 2022

Key, A., Lauer T., Pope, M., Bridgland, D. R., Noble, L., and Proffitt, T. (2022) On the earliest Acheulean in Britain: first dates and *in-situ* artefacts from the MIS 15 site of Fordwich (Kent, UK). *Royal Society Open Science* 9(6*):* Royal Society Available at: https://royalsocietypublishing.org/doi/full/10.1098/rsos.211904 (Accessed 08 May 2022).

Lyell, C., (1830-1833) *Principles of Geology, Being an Attempt to Explain the Former Changes of the Earth's Surface by Reference to Causes now in Operation*. London: Murray.

Lyell, C., (1839) *Elements of Geology: or the ancient changes of the earth and its inhabitants as illustrated by geological monuments*. Murray: London. Available at: https://wellcomecollection.org/works/g337qs54 (Accessed: 17 August 2022).

Maddy, D., Bridgland, D.R., and Green, C. P. (2000) Crustal uplift in southern England: evidence from the river terrace records. *Geomorphology*, 33(3-4), pp. 167-181. Available at: https://doi.org/10.1016/S0169-555X(99)00120-8. (Accessed: 4 August 2022).

Maidstone Borough Local Plan Examination (n.d.) Representor R19450: Kent Downs AONB Unit Year *Hearing Session 8, p8.* Available at:https://maidstone.gov.uk/ data/assets/pdf_file/0004/132979/R19450-Kent-Downs-Area-of- Outstanding-Natural-Beauty-Unit.pdf (Accessed: 25 July 2022).

Mapcarta (2023) *Ightham*. https://mapcarta.com/35532302 (Accessed 22 April 2023).

McBurney, C. B. M. and Callow, P. (1971) The Cambridge excavations at La Cotte de St Brelade, Jersey—a preliminary report. In *Proceedings of the Prehistoric Society* (Vol. 37, No. 2, pp. 167-207). Cambridge University Press.

McNabb, J., Jacobi, R. and Colcutt, S. (2006) The Palaeolithic *The Archaeology of the East Midlands An Archaeological Resource Assessment and Research Agenda, Leicester Archaeology Monographs No. 13*. Leicester: University of Leicester Archaeological Services

Mills, A. D. *Oxford Dictionary of British Place Names*. Oxford: Oxford University Press.

Newton, E. T. (1894) The vertebrate fauna collected by Mr. Lewis Abbott from the fissure near Ightham, Kent. *Quarterly Journal of the Geological Society*, 50. 188–211. Available at: https://www.semanticscholar.org/paper/The-Vertebrate-Fauna-collected-by-Mr.-Lewis-Abbott- Newton/30b70c0a39d2c330ba05faf22b62bd1955e290d1. (Accessed: 6 August 2022).

Ordnance Survey County Series 1st Edition [TIFF geospatial data] (2016) *Scale 1:10,560,Kent County, Published 1869-72, Landmark Information Group, UK.* Using: EDINA Historic Digimap Service. Available at: https://digimap.edina.ac.uk/historic (Accessed: October 2016)

Ordnance Survey (no date) *Datum Height differences, Ordnance Survey Limited [GB], 2016*. Available at: https://www.ordnancesurvey.co.uk/gps/legacy-control-information/liverpool-to- newlyn (Accessed: November 2016).

Ordnance Survey (2016) OS Terrain 5 [ASC geospatial data], Scale 1:10000, Tiles:

tq33ne,tq33se,tq34ne,tq34se,tq35ne,tq35se,tq36ne,tq36se,tq37ne,tq37se,tq38se,tq43ne,tq43n
w,tq43se,tq43sw,tq44ne,tq44nw,tq44se,tq44sw,tq45ne,tq45nw,tq45se,tq45sw,tq46ne,tq46nw,t
q46se,tq46sw,tq47ne,tq47nw,tq47se,tq47sw,tq48se,tq48sw,tq53ne,tq53nw,tq53se,tq53sw,tq54
ne,tq54nw,tq54se,tq54sw,tq55ne,tq55nw,tq55se,tq55sw,tq56ne,tq56nw,tq56se,tq56sw,tq57ne,t
q57nw,tq57se,tq57sw,tq58se,tq58sw,tq63ne,tq63nw,tq63se,tq63sw,tq64ne,tq64nw,tq64se,tq64
sw,tq65ne,tq65nw,tq65se,tq65sw,tq66ne,tq66nw,tq66se,tq66sw,tq67ne,tq67nw,tq67se,tq67sw,
tq68se,tq68sw,tq73ne,tq73nw,tq73se,tq73sw,tq74ne,tq74nw,tq74se,tq74sw,tq75ne,tq75nw,tq7
5se,tq75sw,tq76ne,tq76nw,tq76se,tq76sw,tq77ne,tq77nw,tq77se,tq77sw,tq78se,tq78sw,tq83ne,
tq83nw,tq83se,tq83sw,tq84ne,tq84nw,tq84se,tq84sw,tq85ne,tq85nw,tq85se,tq85sw,tq86ne,tq8
6nw,tq86se,tq86sw,tq87ne,tq87nw,tq87se,tq87sw,tq88se,tq88sw,tq93nw,tq93sw,tq94nw,tq94s w,tq95nw,tq95sw,tq96nw,tq96sw,tq97nw,tq97sw,tq98sw, Updated: 19 October 2016,

Ordnance Survey Open Rivers 2016 © Crown copyright

Parfitt, S. A., Barendregt, R. W., Breda, M., Candy, I., Collins, M. J., Coope, G. R., Durbidge, P., Field, M. H., Lee, J. R., Lister, A. M., Mutch, R., Penkman, K. E. H., Preece, R. C., Rose, J., Stringer, C. B., Symmons, R., Whittaker, J. E., Wymer, J. J., Stuart, A. J. (2005) The earliest record of human activity in Northern Europe: artefacts from the Cromer Forest-bed Formation at Pakefield, Suffolk, UK. *Nature* **438** pp. 1008 – 1012. Available at https://www.researchgate.net/publication/203931962_The_earliest_humans_in_Northern_Europe_artefacts_from_the_Cromer_Forest
bed_Formation_at_Pakefield_Suffolk_UK#fullTextFileContent (Accessed 11 May 2023).

Parfitt, S. A., Ashton, N. M., Lewis, S. G., Abel, R. L., Russell Coope, G., Field, M. H., Gale, R., Hoare, P. G., Larkin, N. R., Lewis, M. D., Karloukovski, V., Maher, B. A., Peglar, S. M., Preece, R. C., Whittaker, J. E., & Stringer, C. B. (2010) Early Pleistocene human occupation at the edge

of the boreal zone in northwest Europe, Nature **466** pp.229 – 233. Available at https://www.nature.com/articles/nature09117 (Accessed 16 January 2024).

Pettitt, P. and White, M. (2012) *The British Palaeolithic: Human Societies at the Edge of the Pleistocene World*. Abingdon: Routledge.

Pillans, B. and Gibbard, P. (2012) The Quaternary Period. *The Geological Time Scale*, 2, pp. 979- 1010. Available at: https://doi.org/10.1016/B978-0-444-59425-9.00030-5. (Accessed: 16 January 2022).

Pope, M. (2007) Early Upper Palaeolithic archaeology at Beedings, West Sussex: new contexts for Pleistocene archaeology. *Archaeology International*, 11

Pope, M., Dinnis, R., Mills, A., Toms, P. and Wells, C. (2013) A Middle Palaeolithic to Early Upper Palaeolithic succession from an open air site at Beedings, West Sussex. *Quaternary International* 316:14–26

Pope, M., Blundell, L., Cutler, H. and Scott, B. (2015) At the headwaters of the English Channel River: considering Late Neanderthal archaeology in the Sussex Weald. In *No Stone Unturned: Paper in Honour of Roger Jacobi*. Eds: Ashton, N., Harris, C.

Prestwich, J., (1860) On the occurrence of Flint Implements, Associated with the Remains of Animals of Extinct Species in Beds of a Late Geological Period, in France at Amiens and Abbeville, and in England at Hoxne. *Philosophical Transactions of the Royal society of London*, 150, pp. 277-317.

Prestwich, J. (1889) On the Occurrence of Palaeolithic Flint Implements in the Neighbourhood of Ightham, Kent, their Distribution and Probable Age. *Quarterly Journal of the Geological society of London*, 45, pp. 270-297.

Prestwich, J. (1892) On the Primitive Characters of the Flint Implements of the Chalk Plateau of Kent with reference to the question of their Glacial or Pre-Glacial Age. *Journal of the Anthropological Institute of Great Britain, 21, p.276.*

Radioactive Waste Management Ltd (2018) *Wealden District Regional Geology.* Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/ file/834550/Wealden_District_Regional_Geology_V1.0a.pdf. (Accessed: 31 July 2022).

Roe, D. A. (1981) *The Lower and Middle Palaeolithic Periods in Britain.* London: Routledge and Kegan.

Roebroeks, W. (2006). The human colonisation of Europe: where are we? *Journal of Quaternary Science*, 21, pp. 425–435.

Scott, B. & Shaw, A. (2009) The quiet man of Kent: the contribution of F.C.J.Spurrell to the early years of Palaeolithic archaeology. In R. Hosfield, F. Wenban-Smith & M.Pope (eds.)

Great Prehistorians: 150 Years of Palaeolithic Research, 1859 – 2009 *(Special Volume 30 of Lithics: The Journal of the Lithic Studies Society):* pp.53 – 64. Lithic Studies Society, London.

Scott, B., Ashton, N., Penkman, K. E. H., Preece, R. C. and White, M. (2010) The position and context of Middle Palaeolithic industries from the Ebbsfleet Valley, Kent, UK. *Journal of Quaternary Science*, 25(26), pp. 931–944.

Scott-Jackson, J. E. (2000) *Lower and middle Palaeolithic artefacts from deposits mapped as Clay-with-flints: a new synthesis with significant implications for the earliest occupation of Britain,* Oxbow Books, Oxbow.

Scott-Jackson, J. E. and Walkington, H. (2005) Methodological issues raised by laser particle size analysis of deposits mapped as Clay-with-flints from the Palaeolithic site of Dickett's Field, Yarnhams Farm, Hampshire, UK. *Journal of Archaeological Science, 7 pp. 969-980.*

Scott-Jackson, W.B. and Scott-Jackson, J. (2008). Alternative location modeling of a lower/middle Palaeolithic site on deposits mapped as Clay-with-flints in southern England. PADMAC Unit, Oxford

Shepherd, R. and Randell, R. (2022) *Discovering Fossils: Introducing the Palaeontology of Great Britain.* Available at: http://www.discoveringfossils.co.uk/hastings-east-sussex/ (Accessed: 19 August 2022).

Shotton, F.W., Keen, D.H., Coope, C.R., Currant, A.P, Gibbard, P. L., Aalto, M., Peglar, S.M. and Robinson. J.E. (1993) The Middle Pleistocene deposits of Waverley wood Pit, Warwickshire, England. *Journal of Quaternary Science,* 8, pp. 293-325.

Smith, R.H. & Dewey, H. (1913) Stratification at Swanscombe: report on excavation made on behalf of the British Museum and H.M. Geological Survey. *Archaeologia*, 64, 177–204 IN White, M., Ashton, N., and Bridgland, D., (2019) Twisted Handaxes in Middle Pleistocene Britain and their Implications for Regional-scale Cultural Variation and the Deep History of Acheulean Hominin Groups. *Proceedings of the Prehistoric Society 85*, 2019, pp. 61–81 © The Prehistoric Society.

Available at: https://www.cambridge.org/core/journals/archaeologia/article/ivstratification-at- swanscombe-report-on-excavations-made-on-behalf-of-the-british-museum-and-h-m-geological- survey/CE230206CBF00147700EEF3340D0DAFD. Accessed: 29 November 2020.

South East England (2003) Official tourist website for South East England https://www.visitsoutheastengland.com/places-to-visit/kent/map (Accessed 22 April 2023).

Spurrell, F.C.J. (1883) Palaeolithic implements from West Kent. *Archaeologia Cantiana,* 15(89) p. 103.Suffolk County Council (2022). *Suffolk Heritage Explorer*. Available at: https://heritage.suffolk.gov.uk/Monument/MSF7047. (Accessed: 3 April 2022).

Stringer CB. 2006.*Homo Britannicus.* Allen Lane: London.

Stringer, C.B., Hublin, J.J. and Vandermeersch, B. (1984) The origin of anatomically modern humans in Western Europe. *The origins of modern humans: a world survey of the fossil evidence*, pp.51-135.

Tobler W. (1970) "A computer movie simulating urban growth in the Detroit region". Economic Geography, 46(2) *Proceedings. International Geographical Union*. Commission on Quantitative Methods (June 1970): Taylor and Francis 234-240.

Topley, W. (1875) *The Geology of the Weald: Parts of the Counties of Kent, Surrey, Sussex and Hants:* Memoirs of the Geological Survey, England and Wales. HMSO: London.

Turq, A. (1988) Le Moustérien de type Quina du Roc de Marsal à Campangne (Dordogne): contexte stratigraphique, analyse lithologique et technologique. *Documents d'Archéologie Perigourdine (A.D.R.A.P.)* 3, 5–30.

Turq, A. (1989) Approche technologique et économique du facies Moustérien de type Quina: etude préliminaire. *Bulletin de la Société Préhistorique Française* 86, 244–56.

University of California, Berkeley, N.D. George Cuvier (1769-1832) Available at https://ucmp.berkeley.edu/history/cuvier.html. (Accessed 26 July 2023).

van Wyhe, J. ed. (2002). *The Complete Work of Charles Darwin Online* Available at http://darwin-online.org.uk/ Accessed 10 August 2023.

Walker, H. J. (1986) Periglacial environments. In: Fookes, P.G., Vaughan, P.R. (Eds.), A *Handbook of Engineering Geomorphology*. Chapman and Hall, New York, NY, pp. 82–96.

Washburn, A.L. (1979) *Geocryology*. Edward Arnold, London, 117(5), pp. 503–504.

Wealden Buildings Study Group (2022) *Geography and Geology, High Weald, Low Weald and Greensand Ridge*. Available at: https://www.wealdenbuildings.org.uk/the-weald/geography-and- geology. **(**Accessed: 4 February 2022).

Wenban-Smith, F., Bates, M., Bridgland, D., Harp, P., Pope, M. and Roberts, M. (2010, with revisions in 2017 and 2019) *South-East Research Framework: Resource Assessment and Research Agenda for the Early Palaeolithic*. Kent County Council. Available at:

https://www.kent.gov.uk/_data/assets/pdf_file/0010/98938/Early-Palaeolithic-chapter.pdf. Accessed: 02 August 2022

Wenban-Smith, F. (2022) Kent County Council: Exploring Kent's Past, Palaeolithic Kent. Available at: https://webapps.kent.gov.uk/KCC.ExploringKentsPast.Web.Sites.Public/SingleResult.aspx?uid=Tke 1067 (Accessed: 20 August 2022)

Wescott, K. and Brandon, R. (Eds.) (2000). *Practical Applications of GIS for Archaeologists: A predictive modelling toolkit*. Abstract. London: Routledge.

White, M.J. (1998a). On the significance of Acheulean biface variability in southern Britain.

Proceedings of the Prehistoric Society, 64, pp. 15–44.

White, M.J. (1998b) *Twisted ovates in the British Lower Palaeolithic. In N.M. Ashton, E Healy & P. Penin (eds*). Stone Age Archaeology: essays in honour of john Wymer, 98-104. Oxford: Oxbow

White, M.J., Bridgland, D.R., Schreve, D.C., White, T.S., and Penkman, E.H., (2018) Well-dated fluvial sequences as templates for patterns of handaxe distribution: Understanding the record of Acheulean in the Thames and its correlatives. *Quaternary International,* 480, pp. 118-131.

White, M., Ashton, N., and Bridgland, D. (2019) Twisted Handaxes in Middle Pleistocene Britain and their Implications for Regional-scale Cultural Variation and the Deep History of Acheulean Hominin Groups. *Proceedings of the Prehistoric Society 85*, 2019, pp. 61–81.

WorldPop *et al.* (2018). *Open Spatial Demographic Data and Research: Geospatial Covariate Data Layers.* (www.worldpop.org - School of Geography and Environmental Science, University of Southampton; Department of Geography and Geosciences, University of

Louisville; Departement de Geographie, Universite de Namur) and Center for International Earth Science Information Network (CIESIN), Columbia University (2018). Global High Resolution Population Denominators Project - Funded by The Bill and Melinda Gates Foundation (OPP1134076). Available at: https://hub.worldpop.org/doi/10.5258/SOTON/WP00644 (Accessed: 27 July 2022).

Wymer, J. (1968) *Lower Palaeolithic archaeology in Britain as represented by the Thames Valley.* London, Baker.

Wymer, J. J. (1999) *The Lower Palaeolithic Occupation of Britain*. Wessex Archaeology and English Heritage, London.

Appendices

The photographs for this study can be found in the appendix below. Those photographs with a black background and a scale were taken by a professional photographer as described in Chapter 3, p. 70. I placed the artefacts and scale bars for the photographs, which could have been more carefully in hindsight. The numbers on this group of photographs represents Harrison's ID number above and the accession number below. Where there were no ID numbers available the top number represents Medway Gravel and is proceeded by an M.

Those photographs without a black background were taken with a camera phone and the number displayed top left is Harrison's ID number.

Below these photographs are those artefacts which could not be utilised in the study due to lack of information, for instance no ID numbers, no location, no height data


M196
1579


M196
1579


M160
1450


6
1611


6
1611

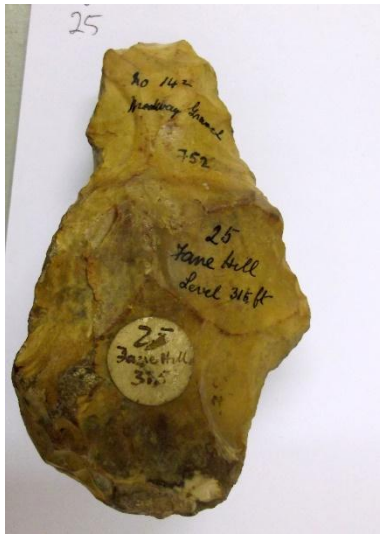

15
1673


15
Bastid
valley

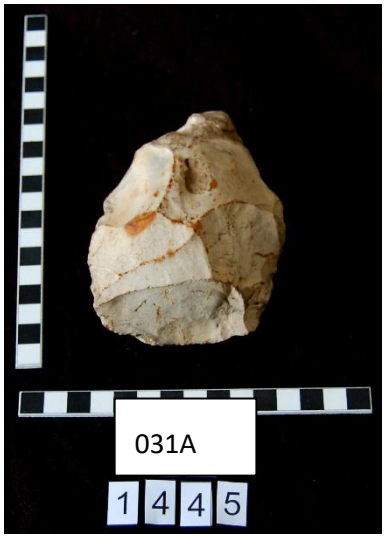

22
1386


22
1386


25


25
25
Jane Hill
Level 31 ft

31
1610

31
1610

031A
1445

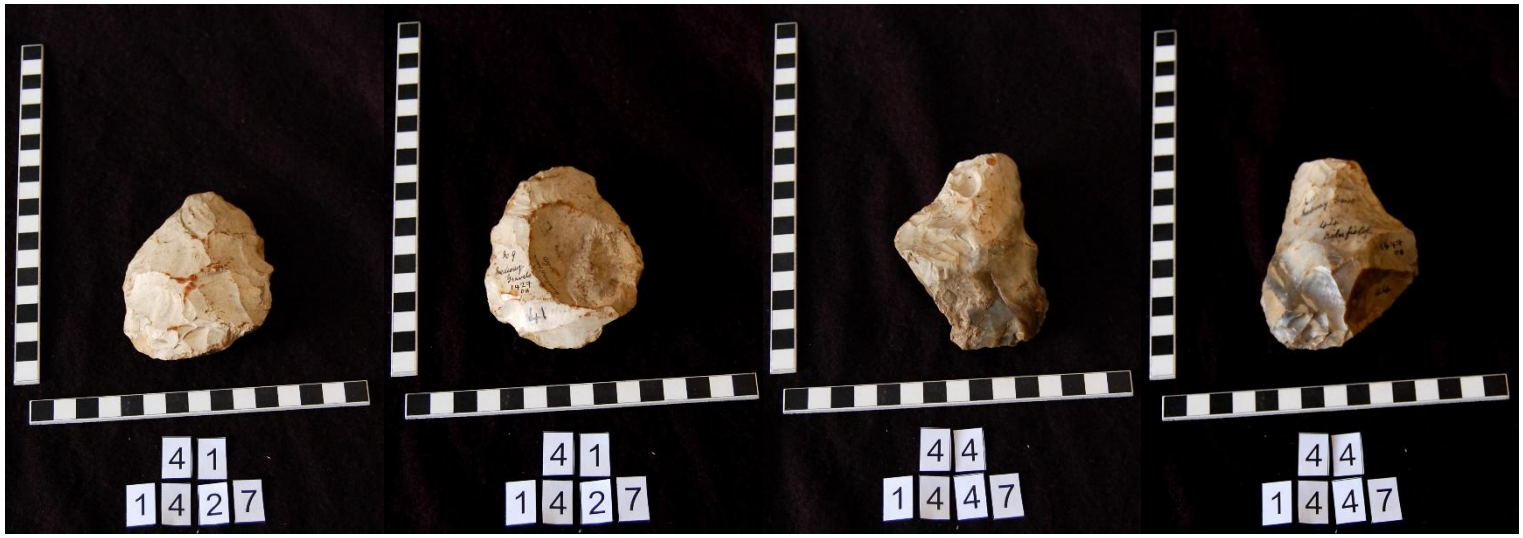
31A
1445

33
1612

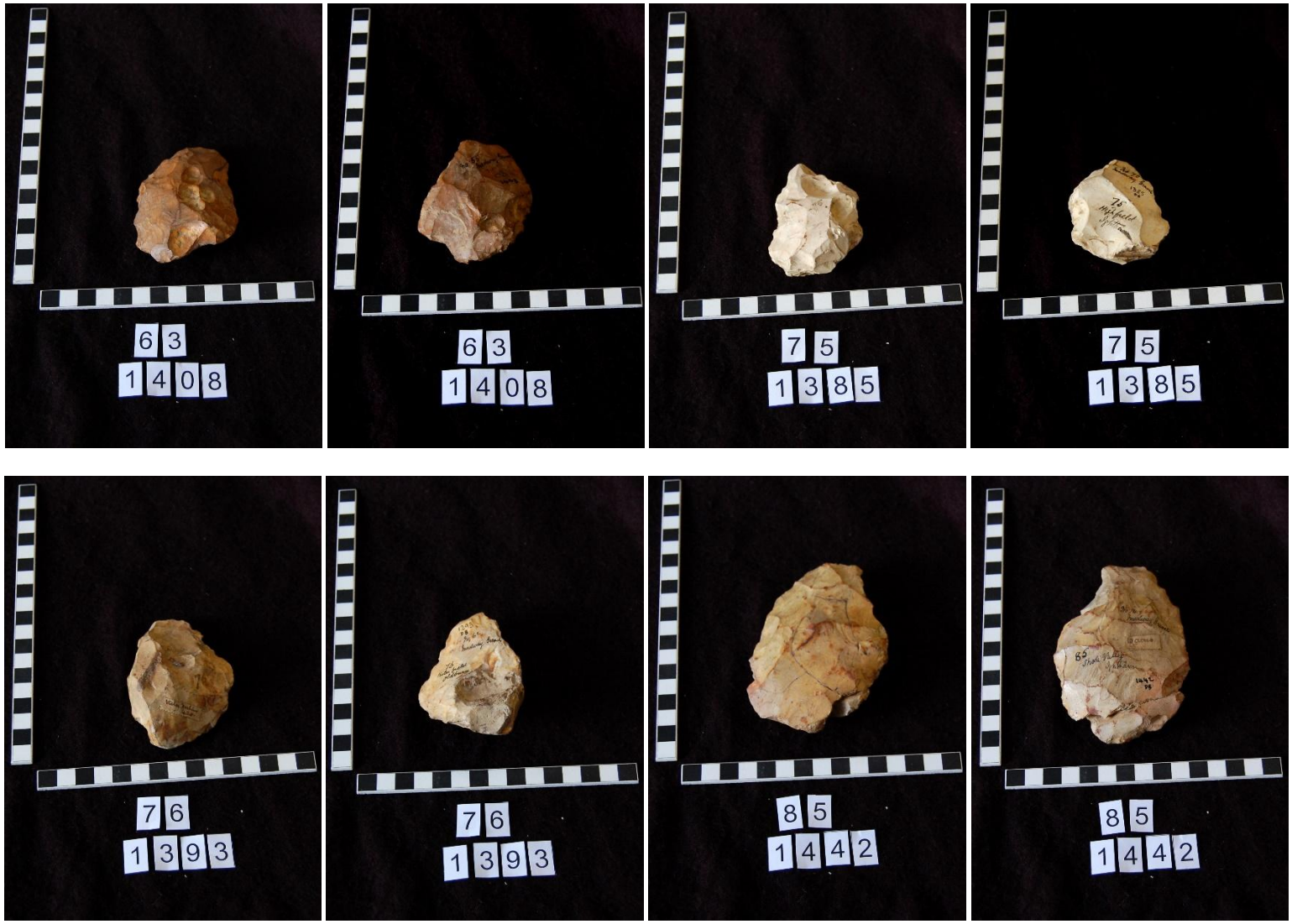
33
1612

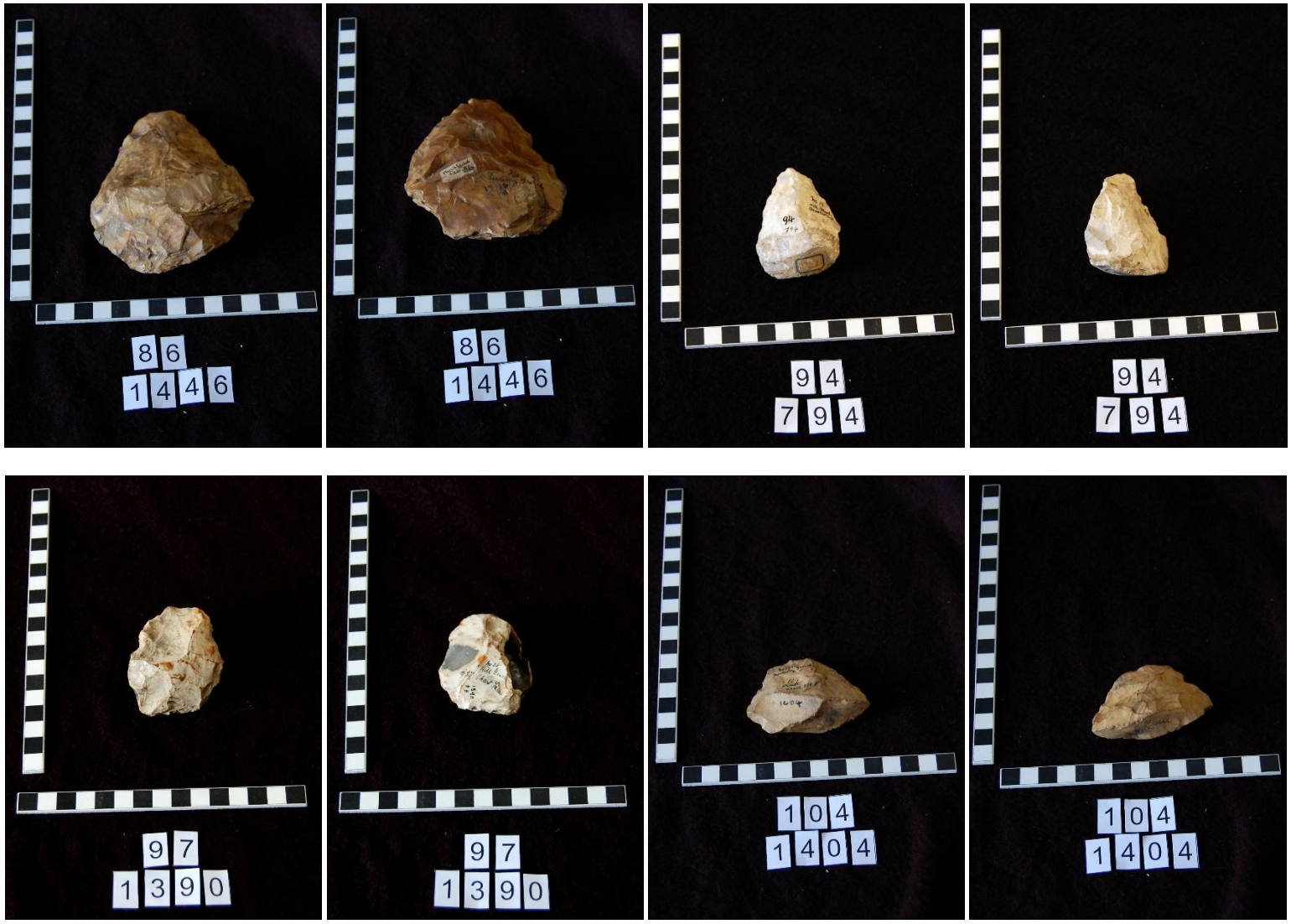
38
1495

38
1495

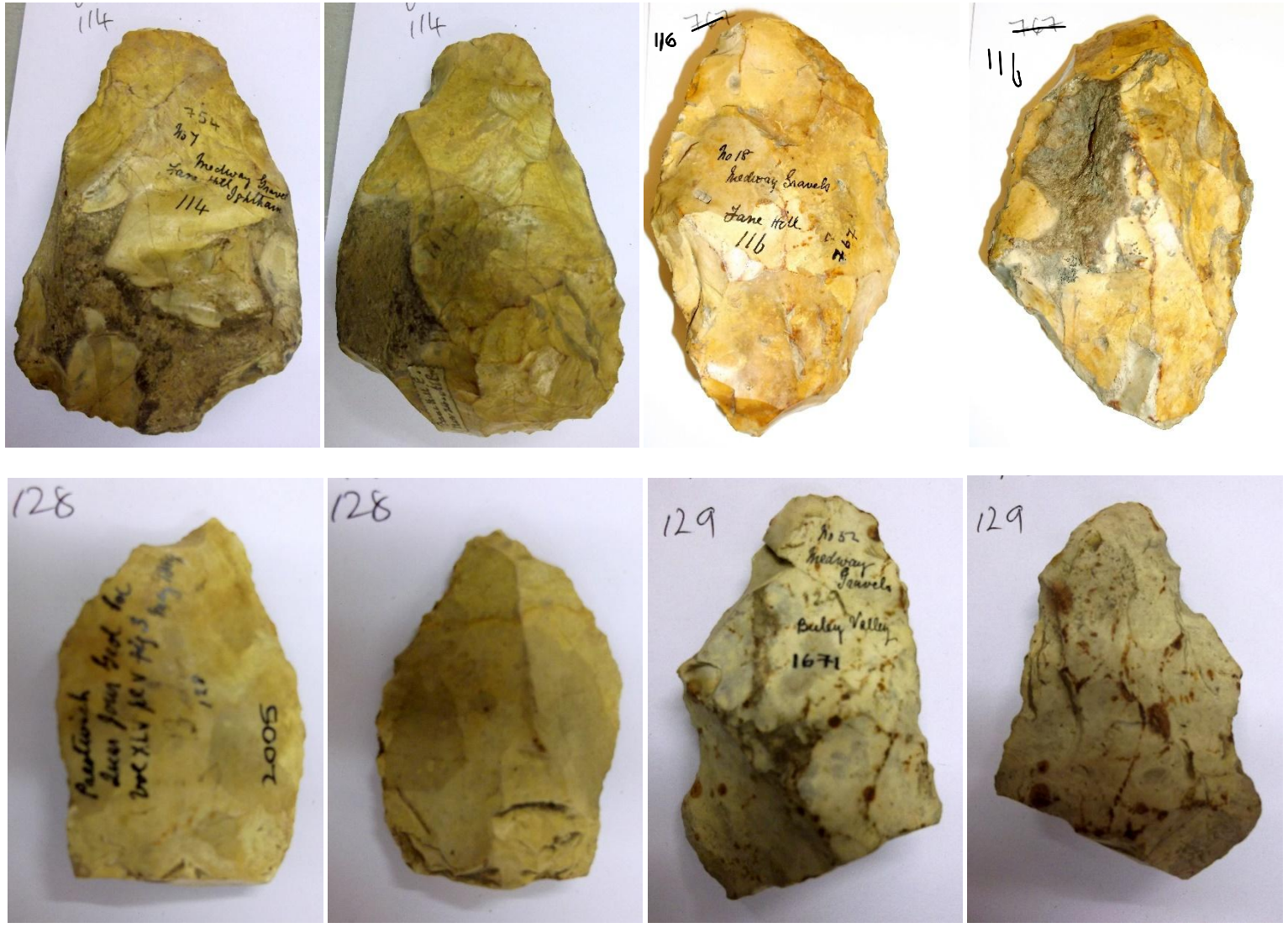

41 1427
41 1427
44 1447
44 1447

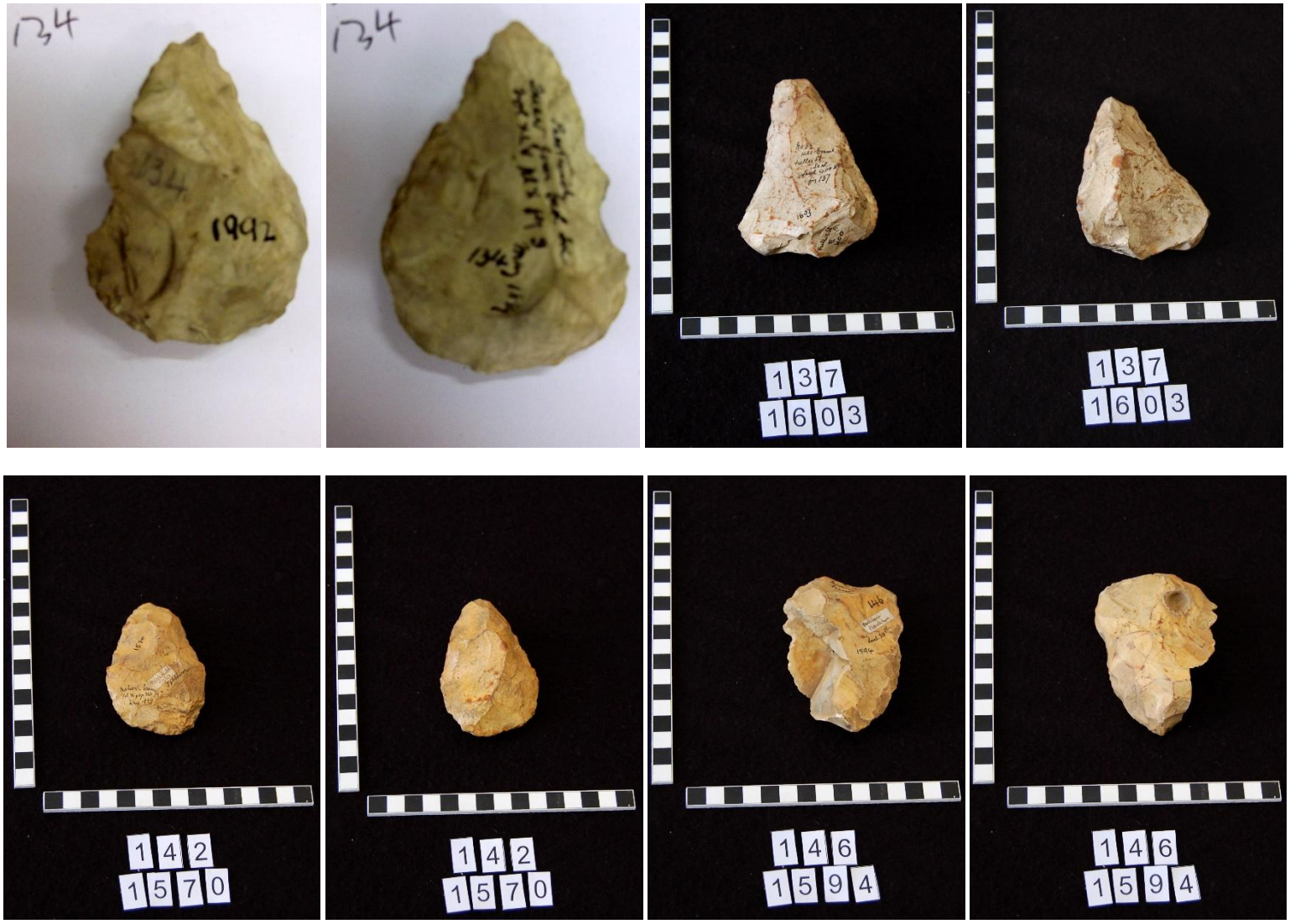

50 1588
50 1588
55 1574
55 1574

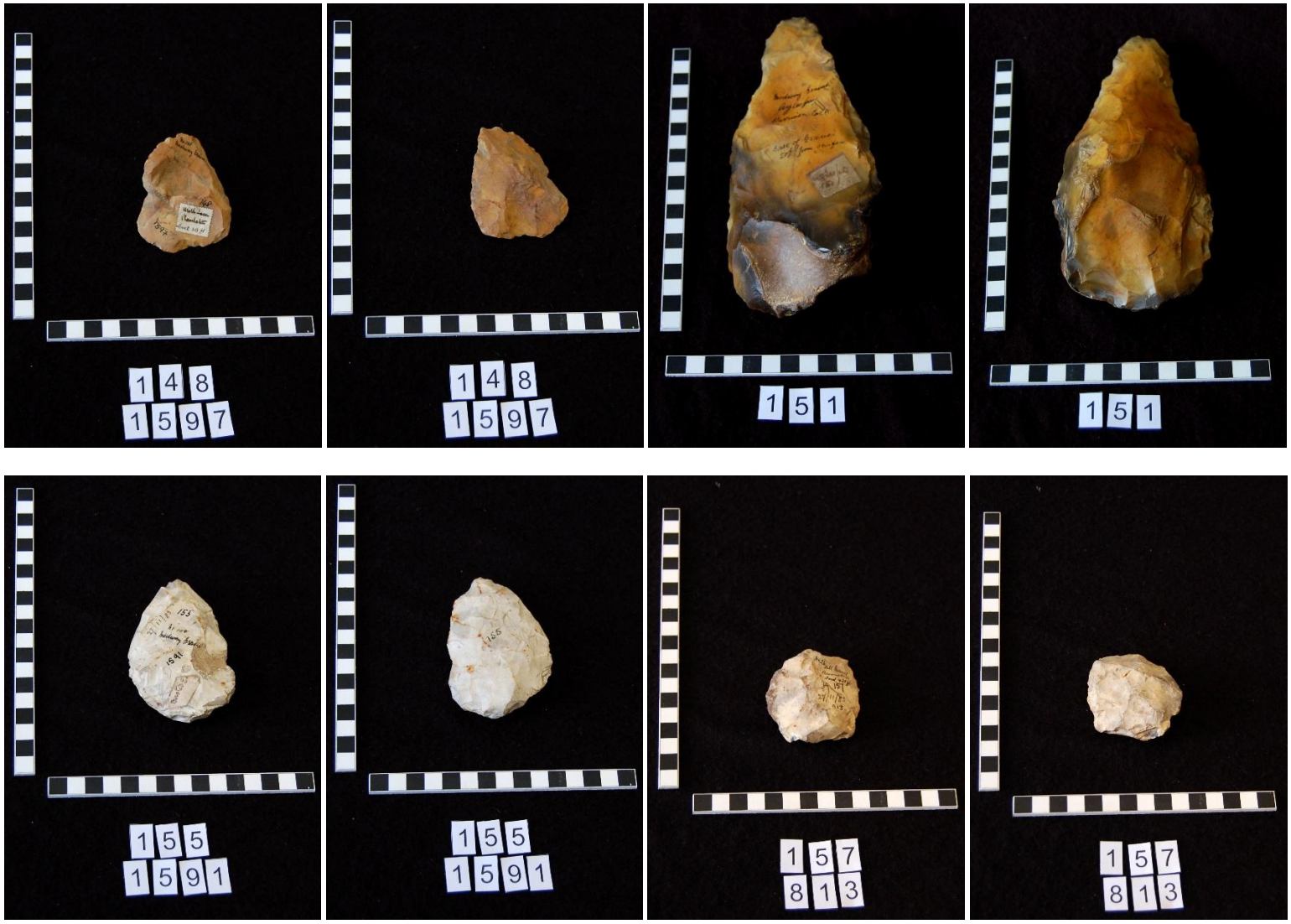

63
1408
63
1408
75
1385
75
1385
76
1393
76
1393
85
1442
85
1442

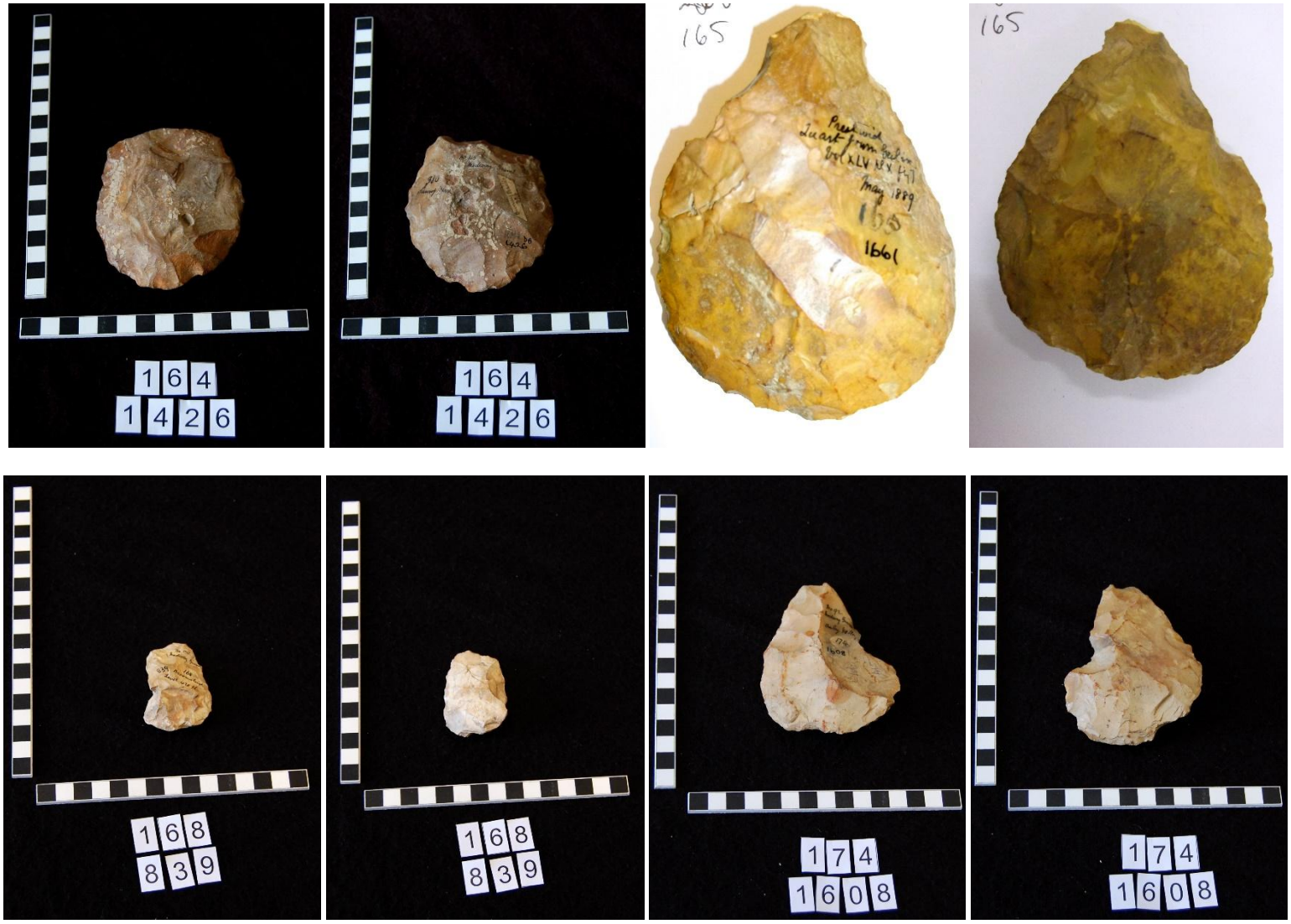

86
1446
86
1446
94
794
94
794
97
1390
97
1390
104
1404
104
1404

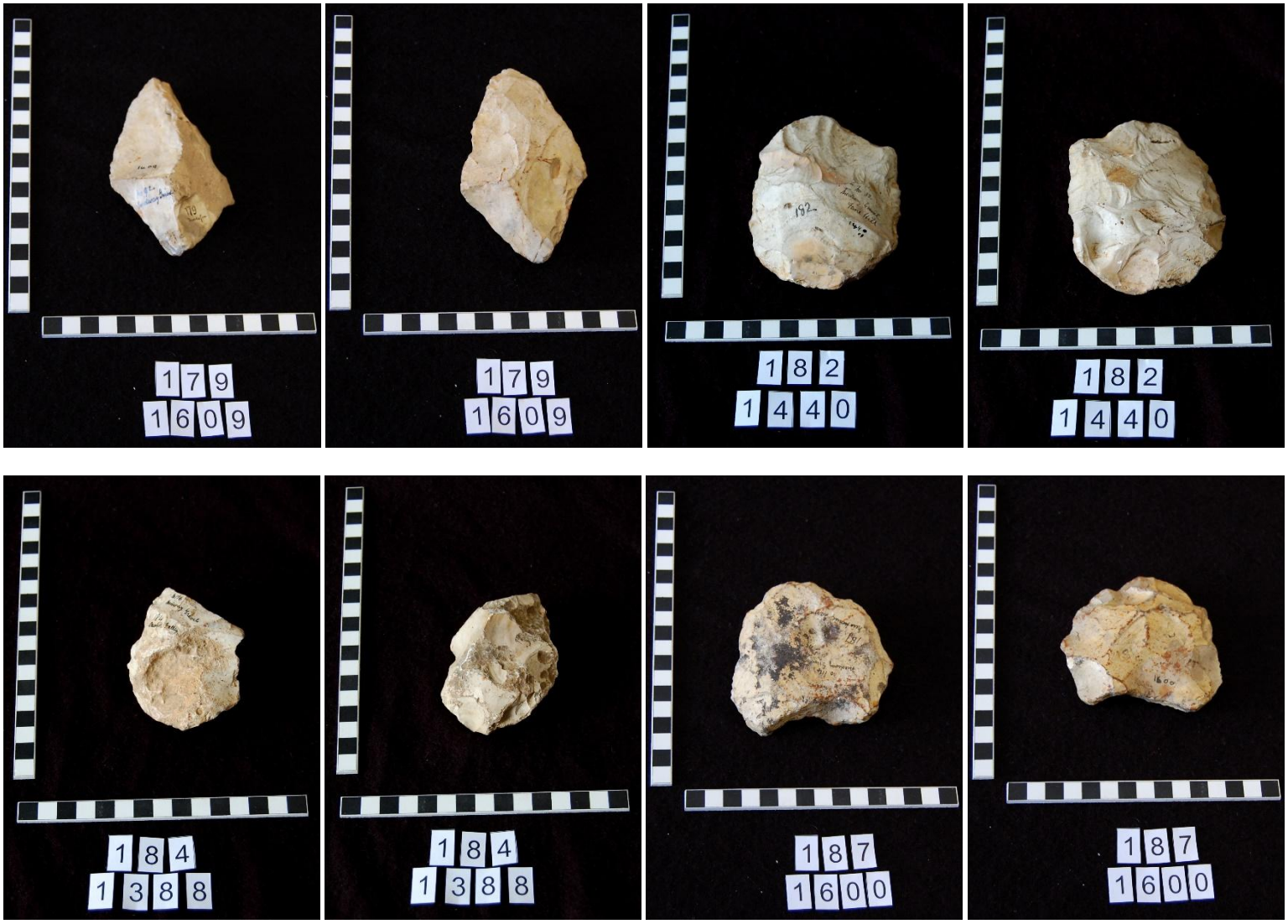
Your text here

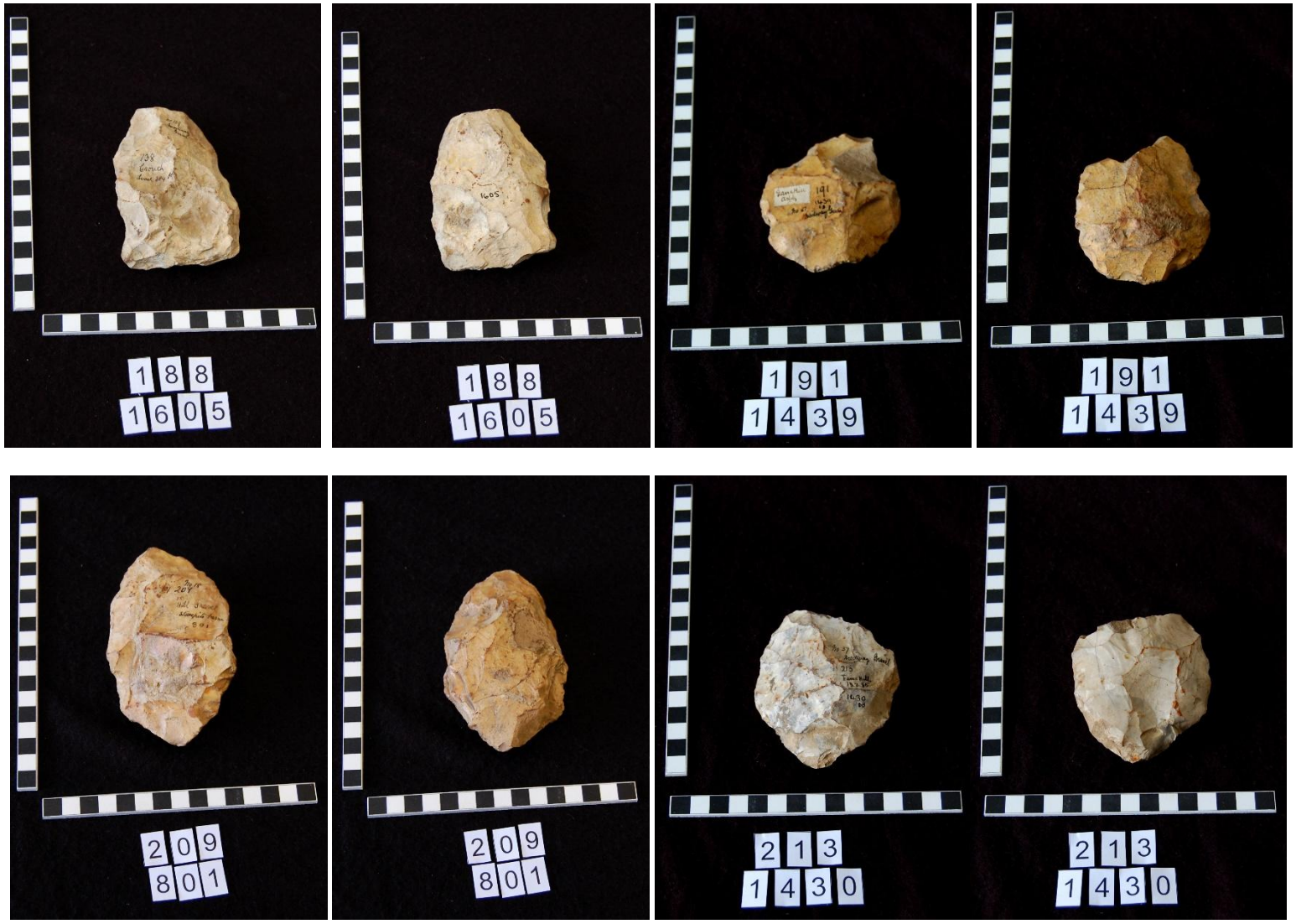


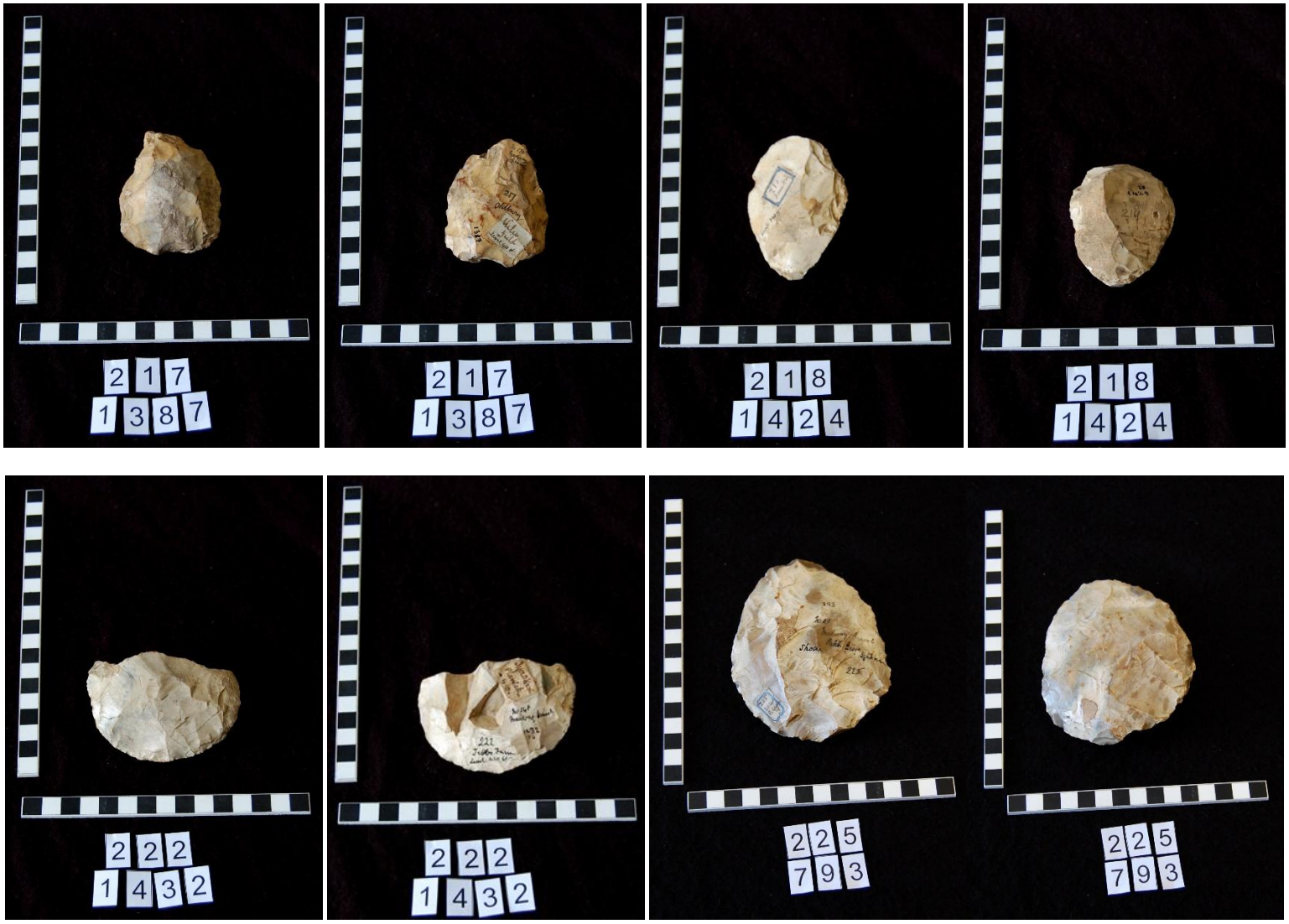

134
1992
134
137
1603
137
1603
142
1570
142
1570
146
1594
146
1594


148
1597
148
1597
151
151
155
1591
155
1591
157
813
157
813

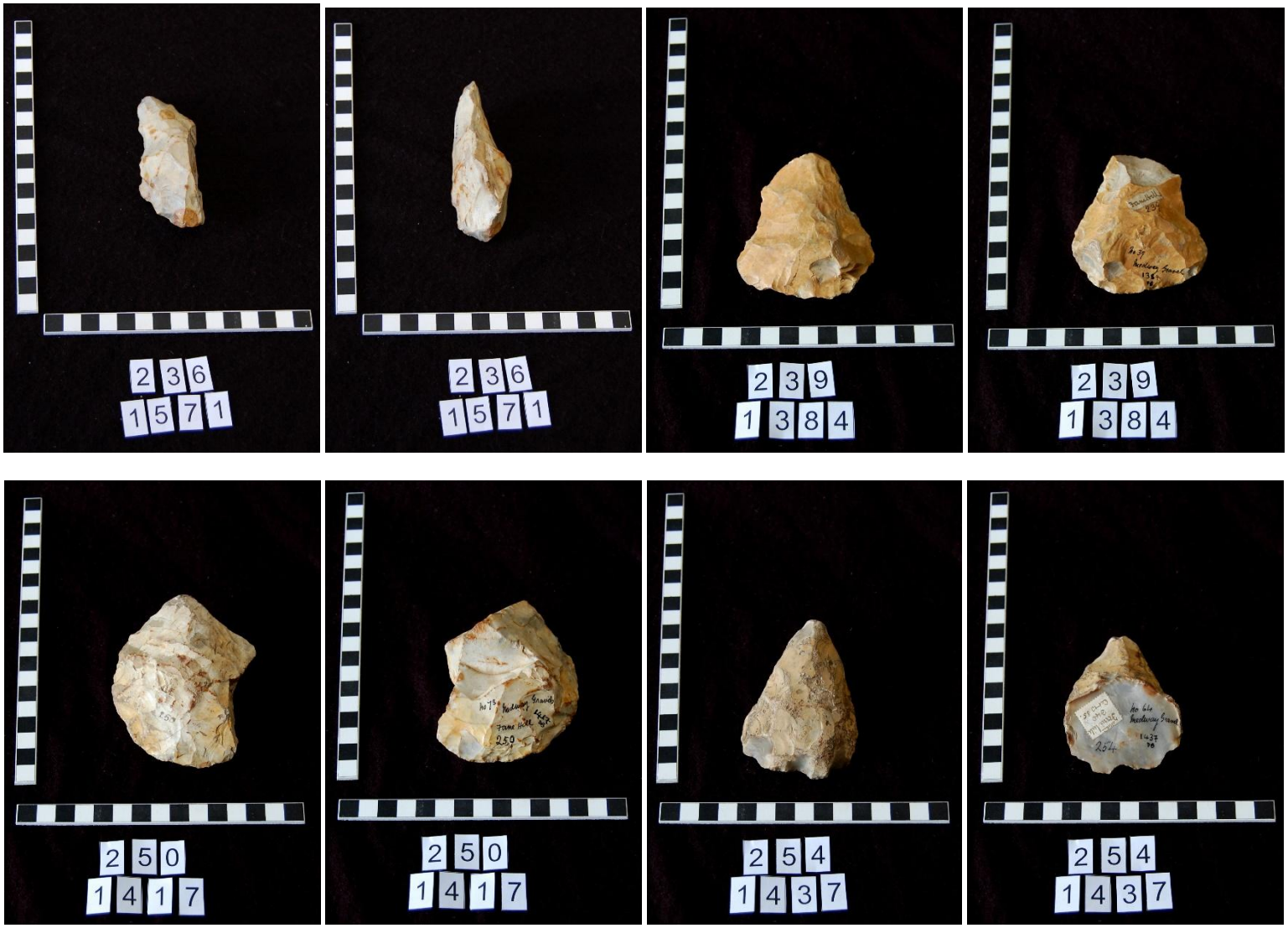

1 6 4
1 4 2 6
1 6 4
1 4 2 6
165
165
1 6 8
8 3 9
1 6 8
8 3 9
1 7 4
1 6 0 8
1 7 4
1 6 0 8

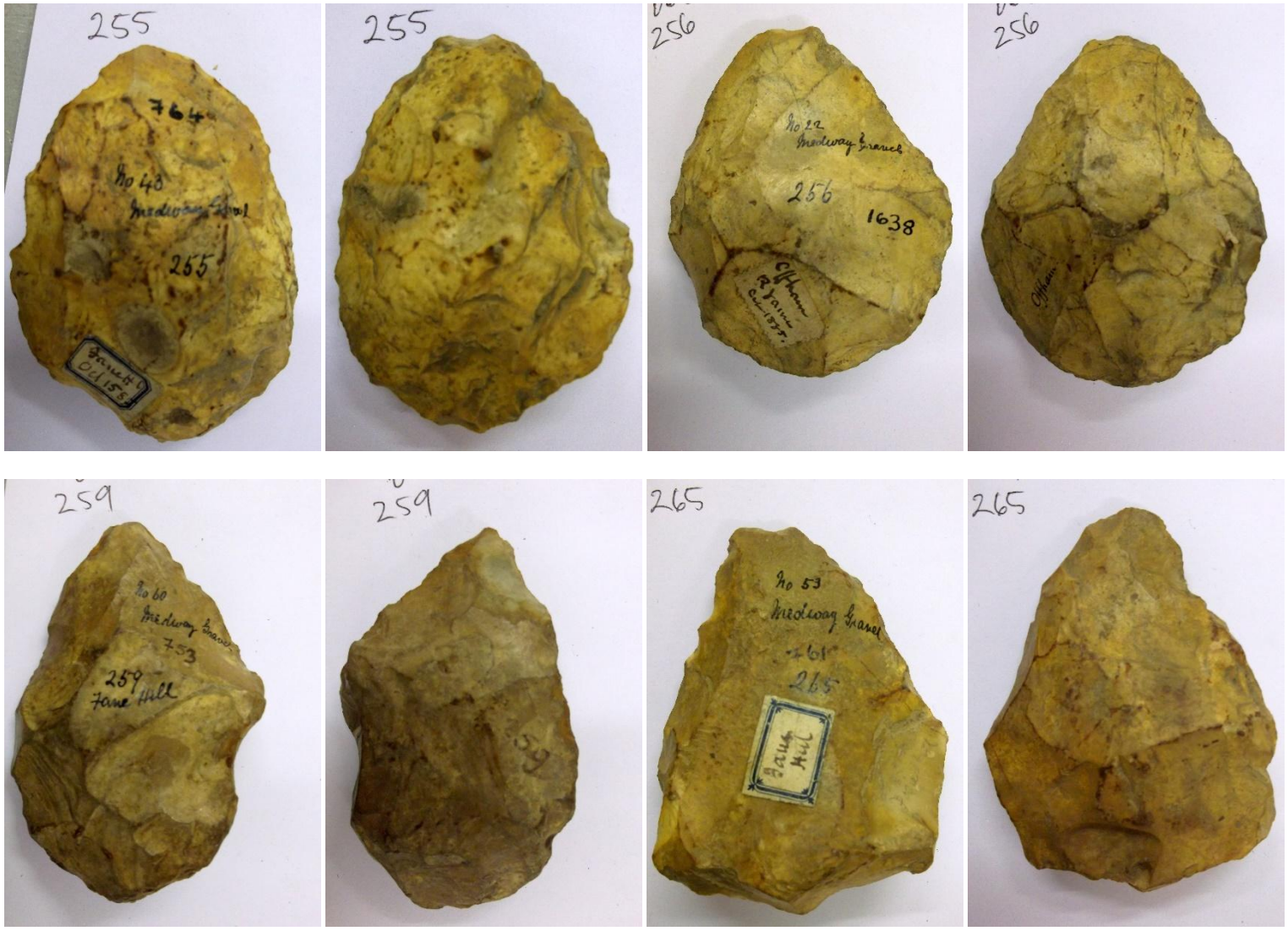

179
1609
179
1609
182
1440
182
1440
184
1388
184
1388
187
1600
187
1600


188
1605
188
1605
191
1439
191
1439
209
801
209
801
213
1430
213
1430

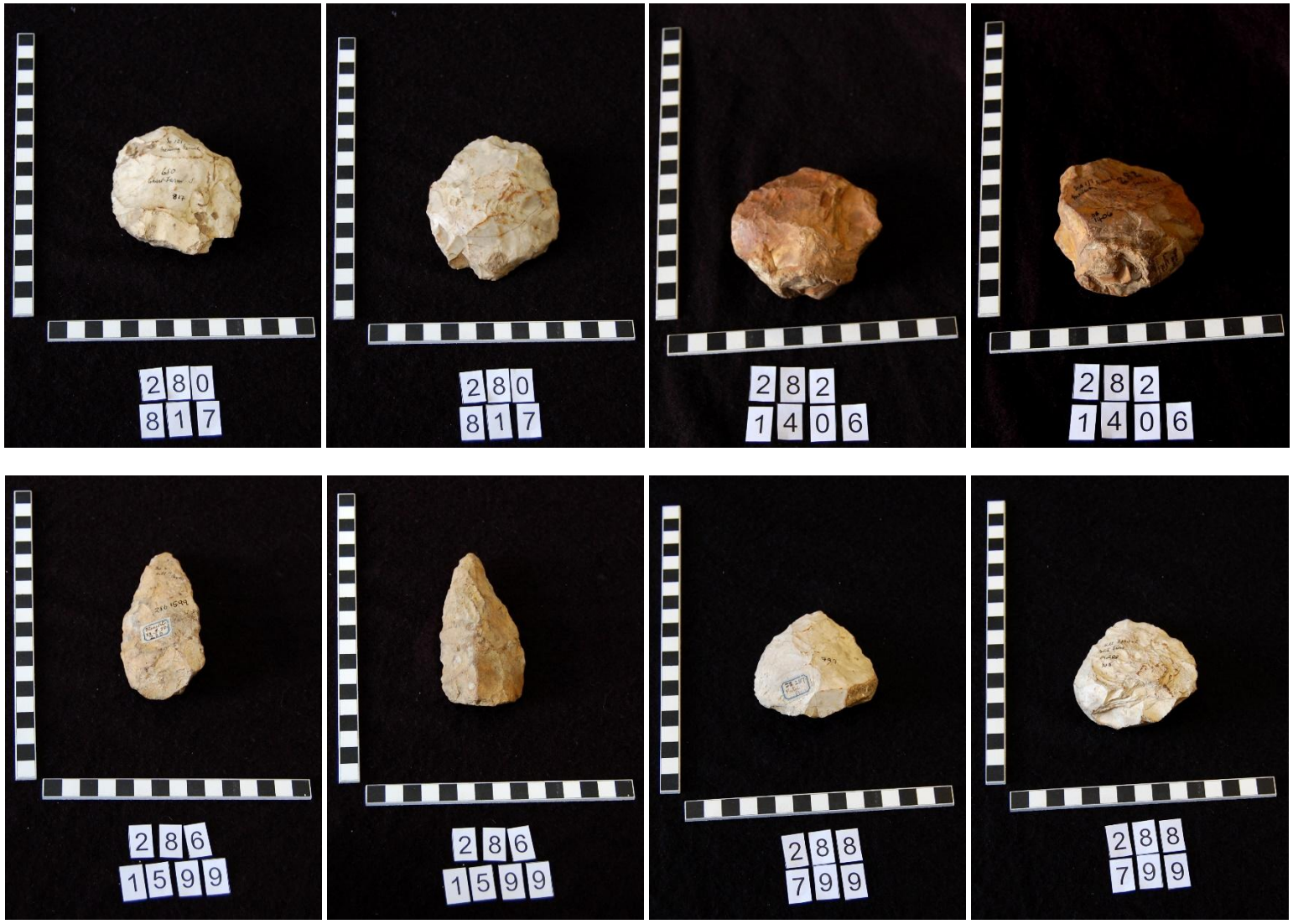

2 1 7
1 3 8 7
2 1 7
1 3 8 7
2 1 8
1 4 2 4
2 1 8
1 4 2 4
2 2 2
1 4 3 2
2 2 2
1 4 3 2
2 2 5
7 9 3
2 2 5
7 9 3


228
228
2 2 9
1 6 1 3
2 2 9
1 6 1 3
2 3 1
8 1 2
2 3 1
8 1 2
2 3 5
1 4 3 5
2 3 5
1 4 3 5


2 3 6
1 5 7 1
2 3 6
1 5 7 1
2 3 9
1 3 8 4
2 3 9
1 3 8 4
2 5 0
1 4 1 7
2 5 0
1 4 1 7
2 5 4
1 4 3 7
2 5 4
1 4 3 7

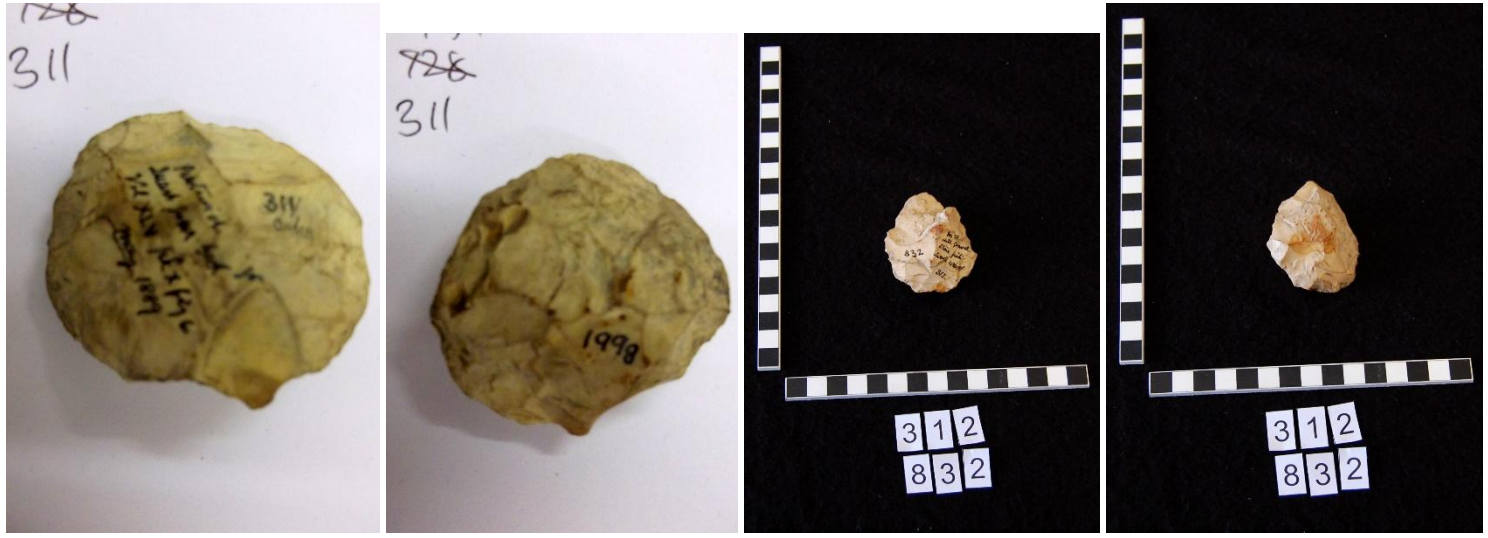

255
764
No 48
Medway Gravel
255
255
256
No 22
Medway Gravels
256
1638
256
259
No 60
Medway Gravels
753
259
Jane Hill
259
259
265
No 53
Medway Gravel
261
265
265

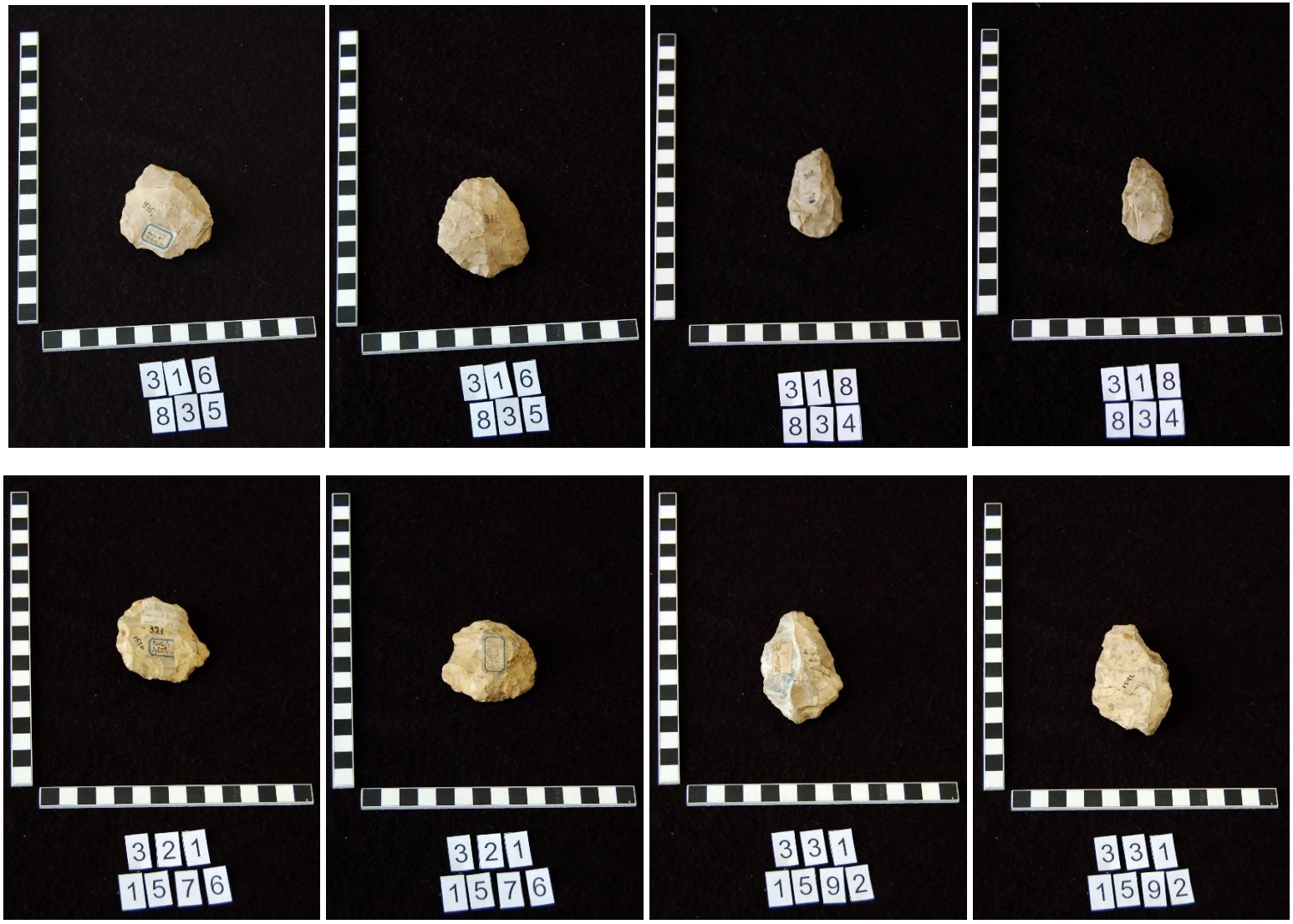

266
1412
266
1412
267
1449
267
1449
268
846
268
846
269
269


280
817
280
817
282
1406
282
1406
286
1599
286
1599
288
799
288
799

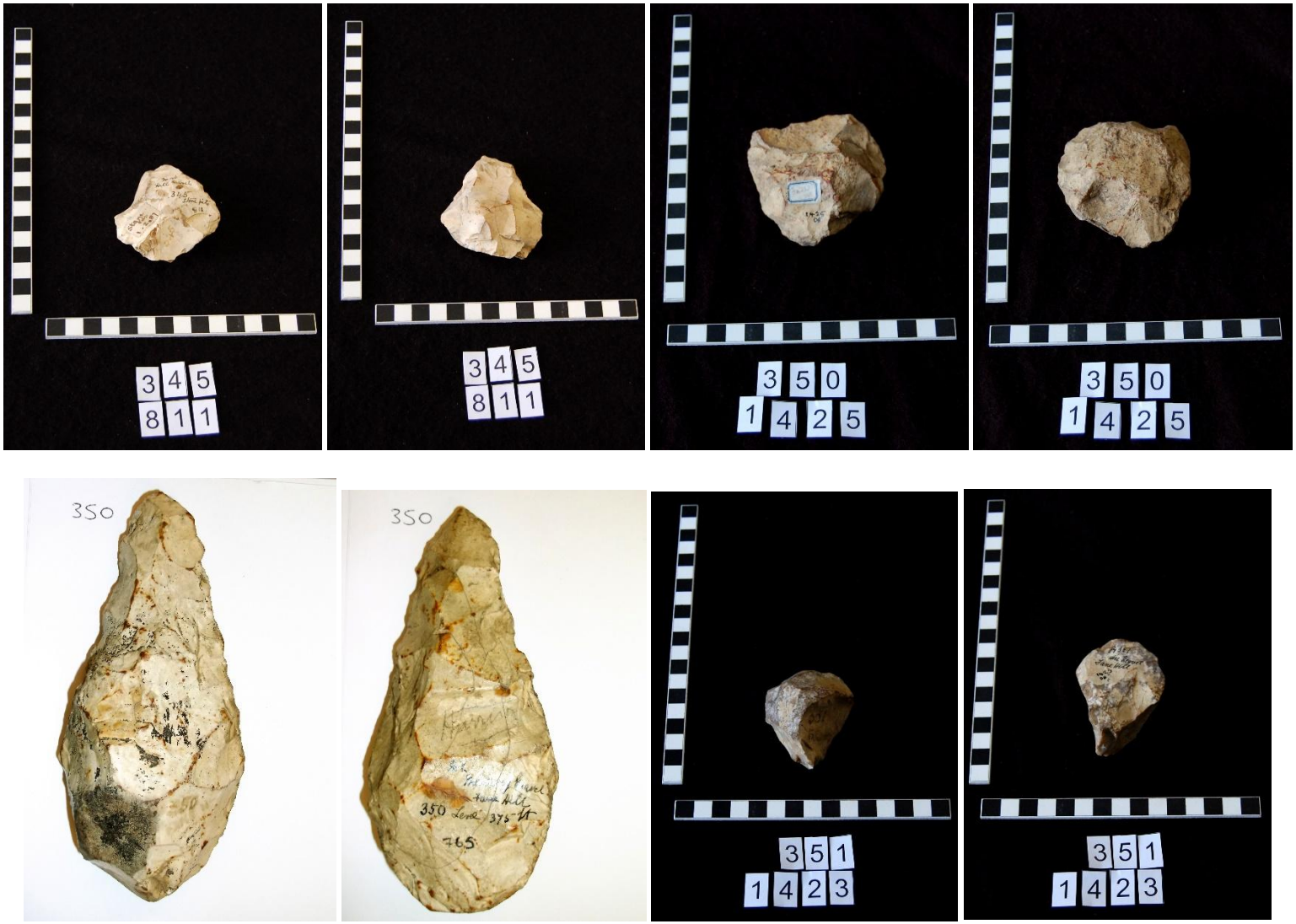

290
798
290
798
+5
+29
293
Stone pcs
+5
+29
293
1663
293
294
1089
294
301
1575
301
1575


303
1683
309
844
309
844

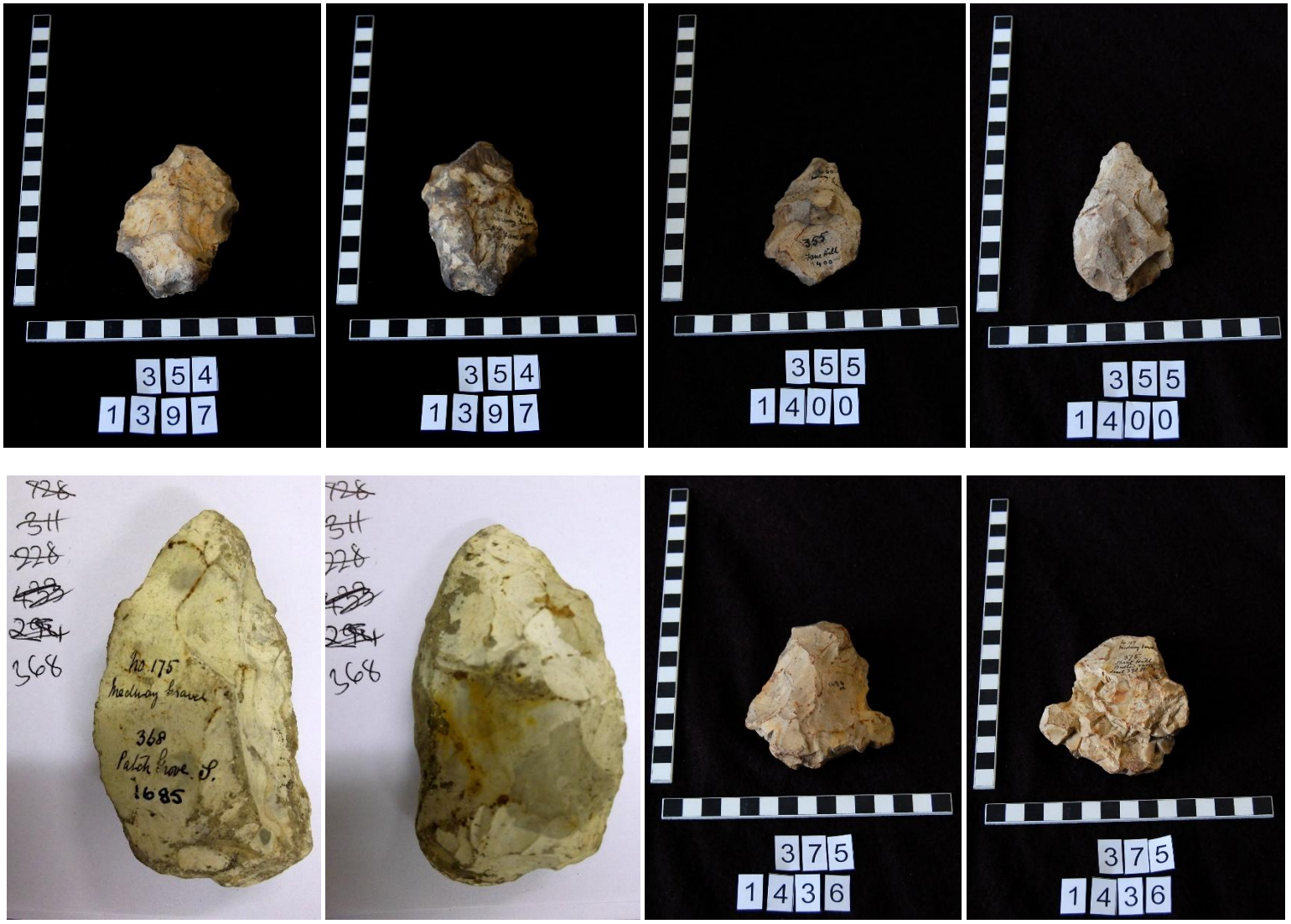

311
311
1998
312
832
312
832


3 1 6
8 3 5
3 1 6
8 3 5
3 1 8
8 3 4
3 1 8
8 3 4
3 2 1
1 5 7 6
3 2 1
1 5 7 6
3 3 1
1 5 9 2
3 3 1
1 5 9 2

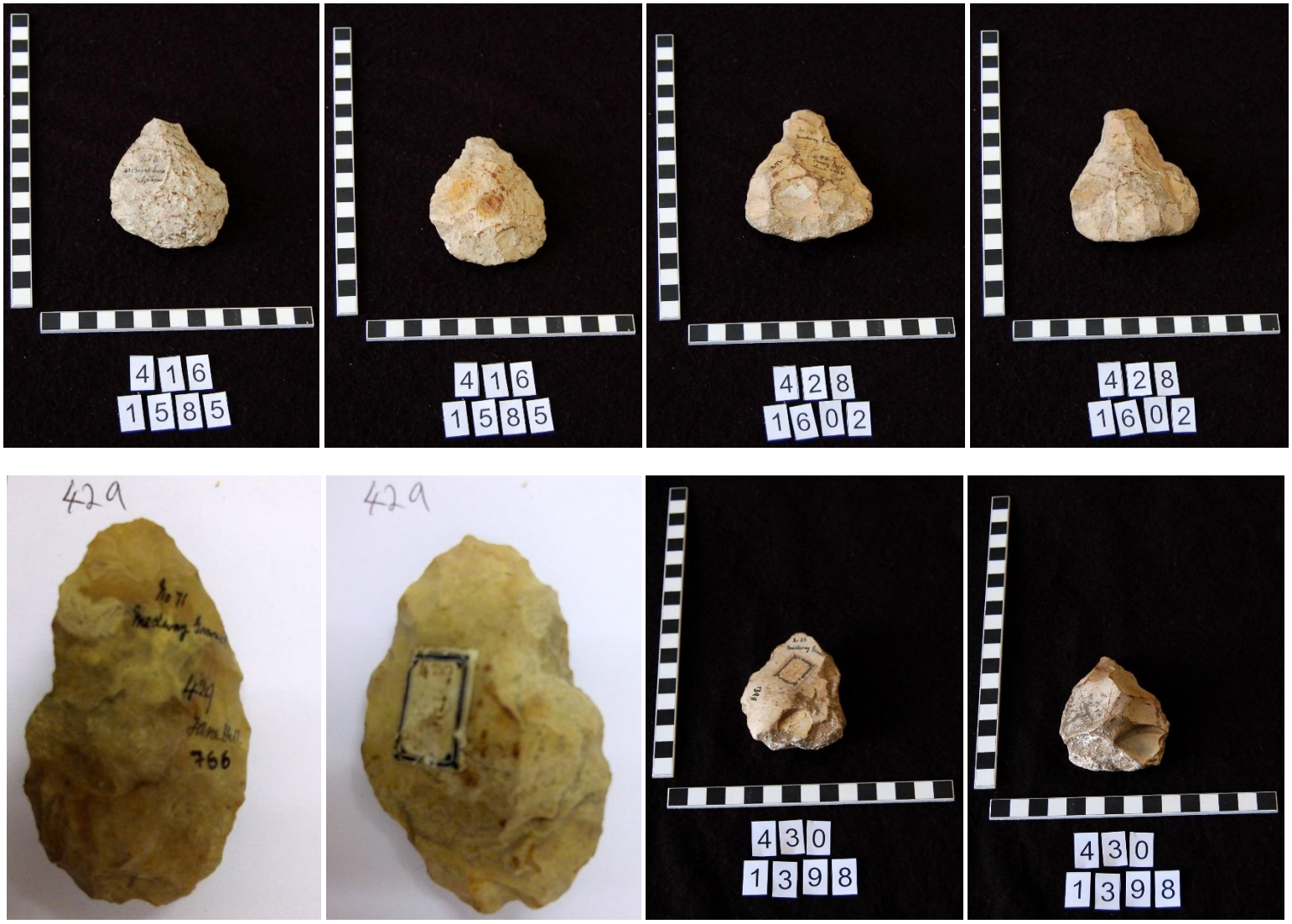

334
334
335
840
335
840
338
1392
338
1394
341
759
341

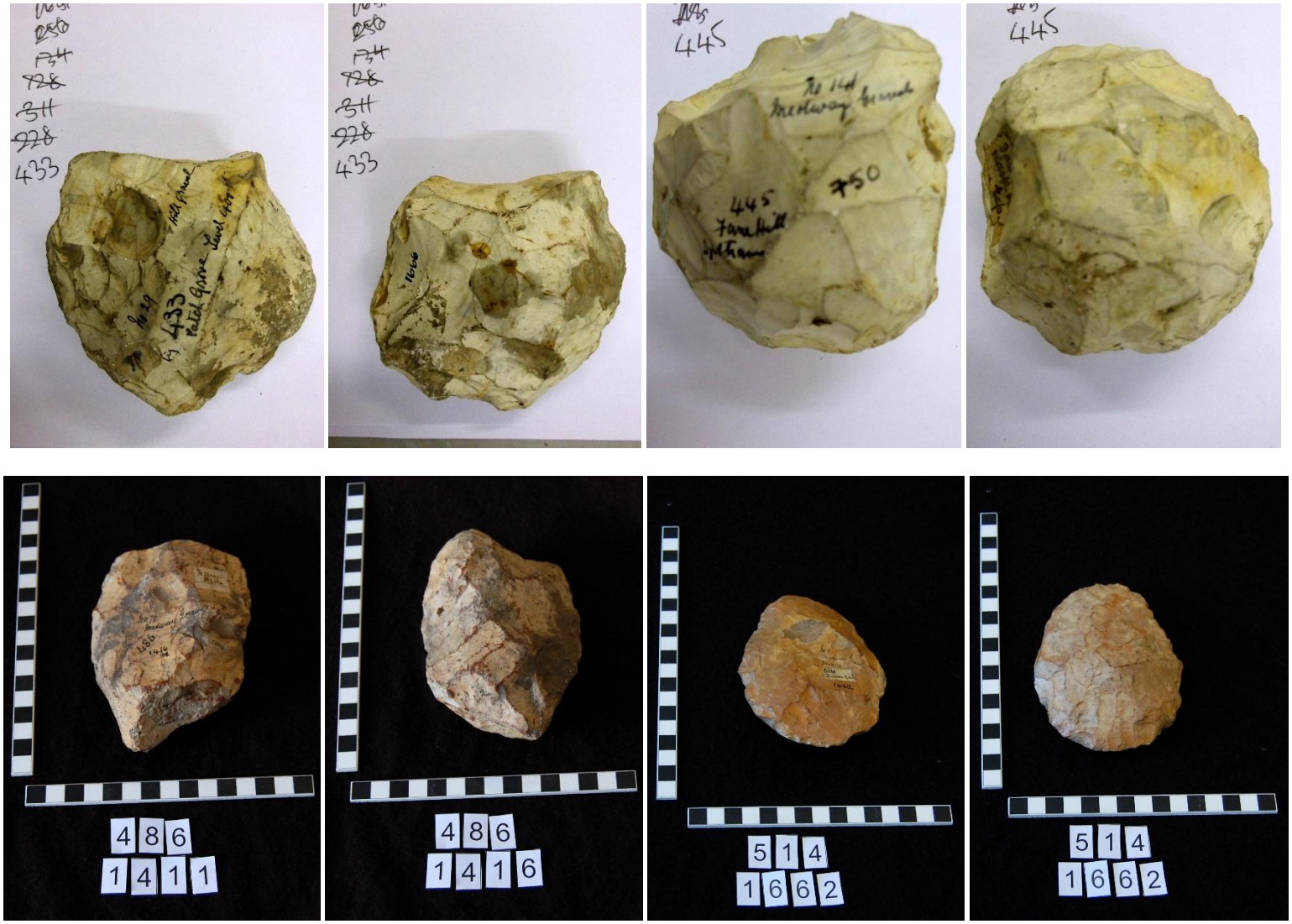


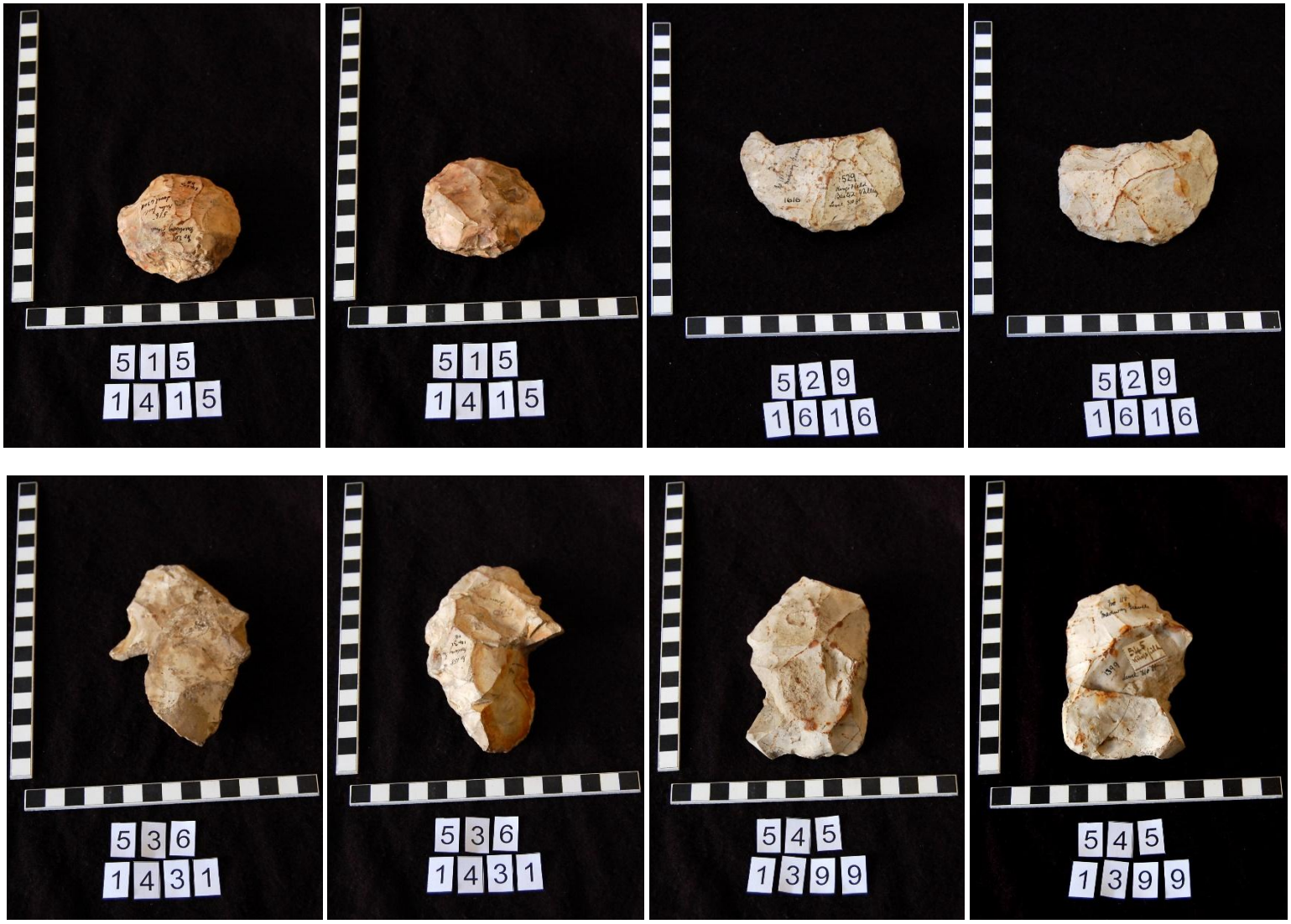
There are two artefacts annotated with ID no 350. The first two will be called 350a as Harrison duplicated his numbers.

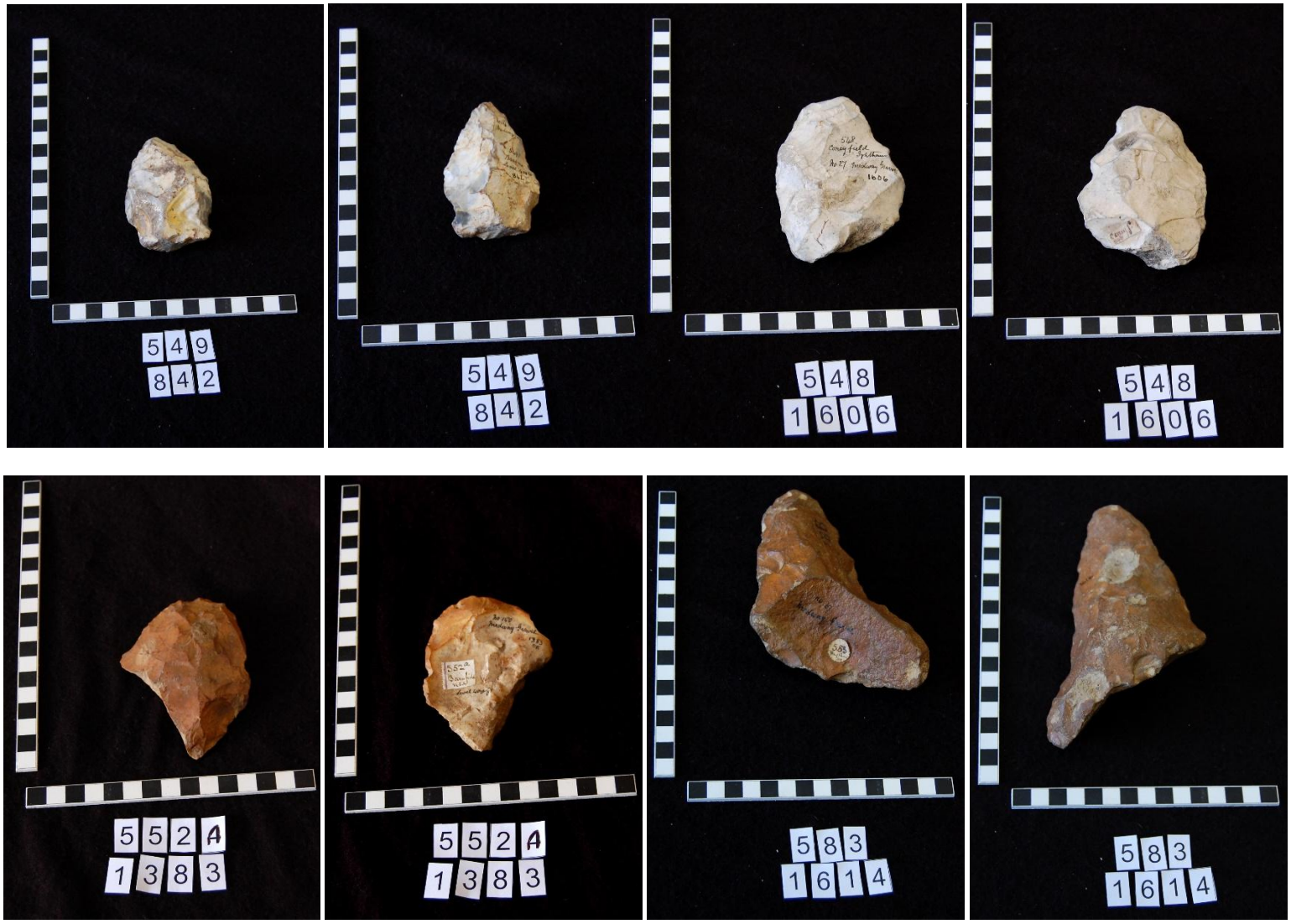

3 5 4
1 3 9 7
3 5 4
1 3 9 7
3 5 5
1 4 0 0
3 5 5
1 4 0 0
No. 175
Medway Gravel
368
Patch Grove S.
1685
3 7 5
1 4 3 6
3 7 5
1 4 3 6

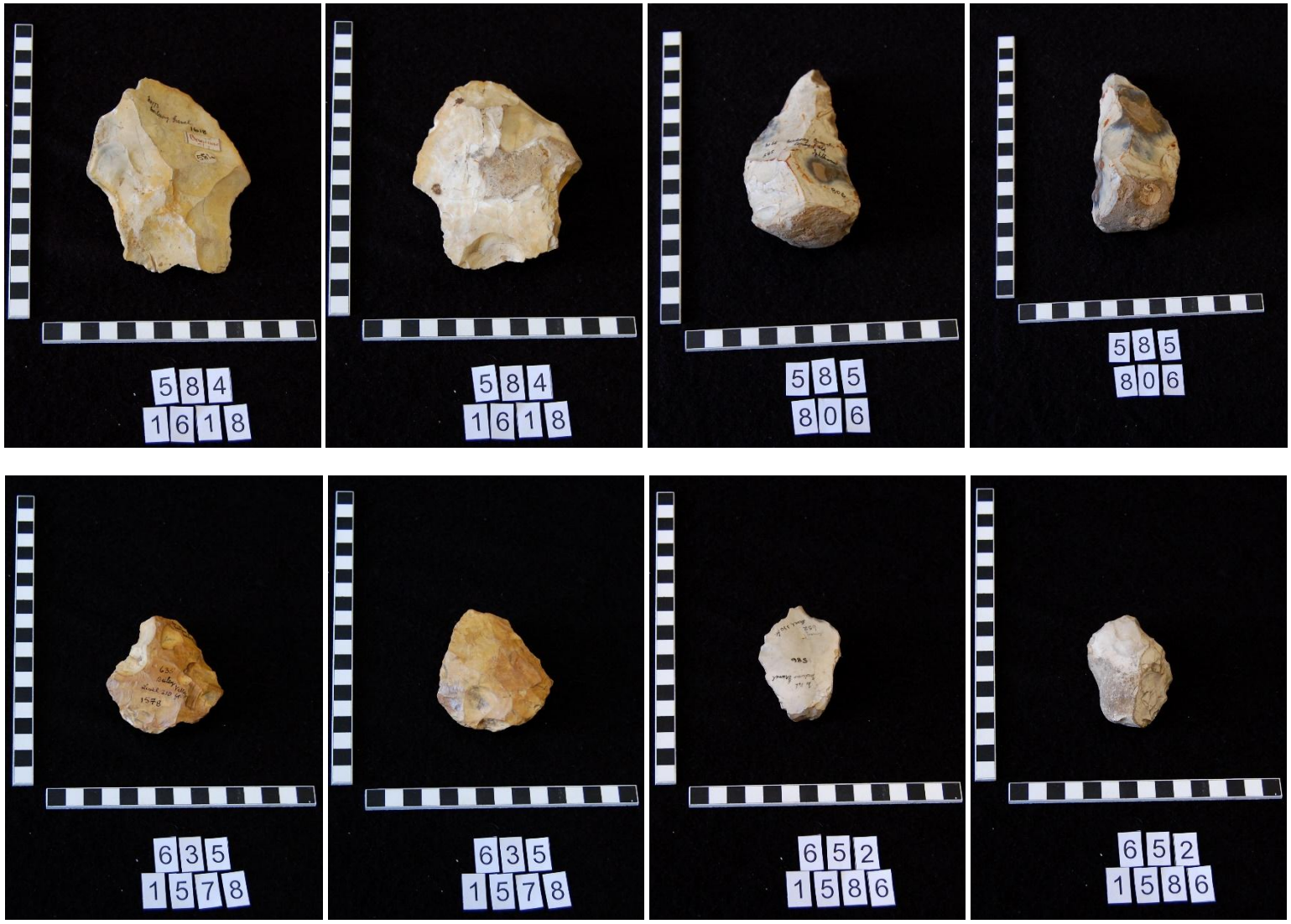

386
1403
386
1403
389
389
391
1413
391
1413
394
1598
394
1598

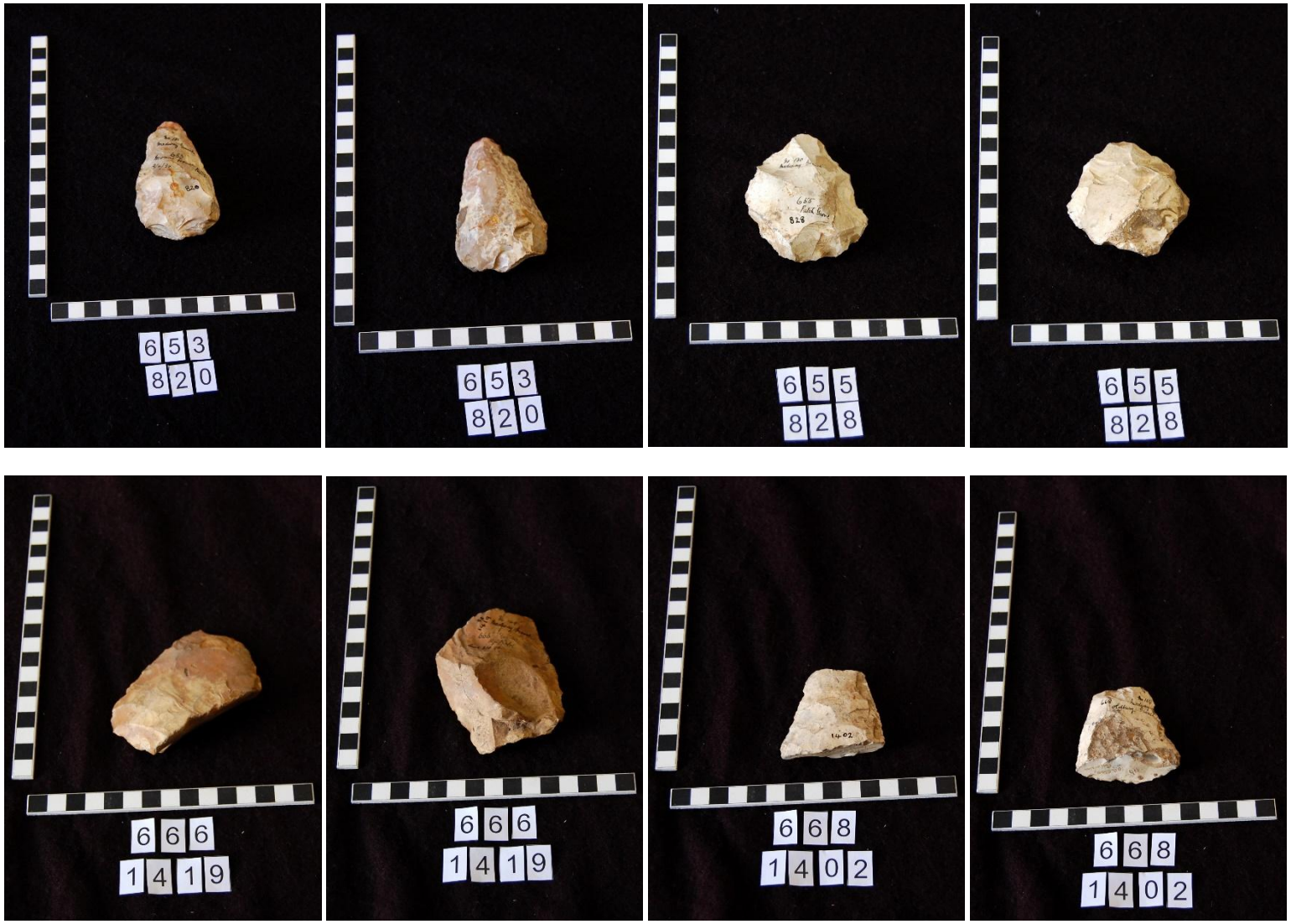

4 1 6
1 5 8 5
4 1 6
1 5 8 5
4 2 8
1 6 0 2
4 2 8
1 6 0 2
429
429
4 3 0
1 3 9 8
4 3 0
1 3 9 8


433
445
750
445
486
1411
486
1416
514
1662
514
1662

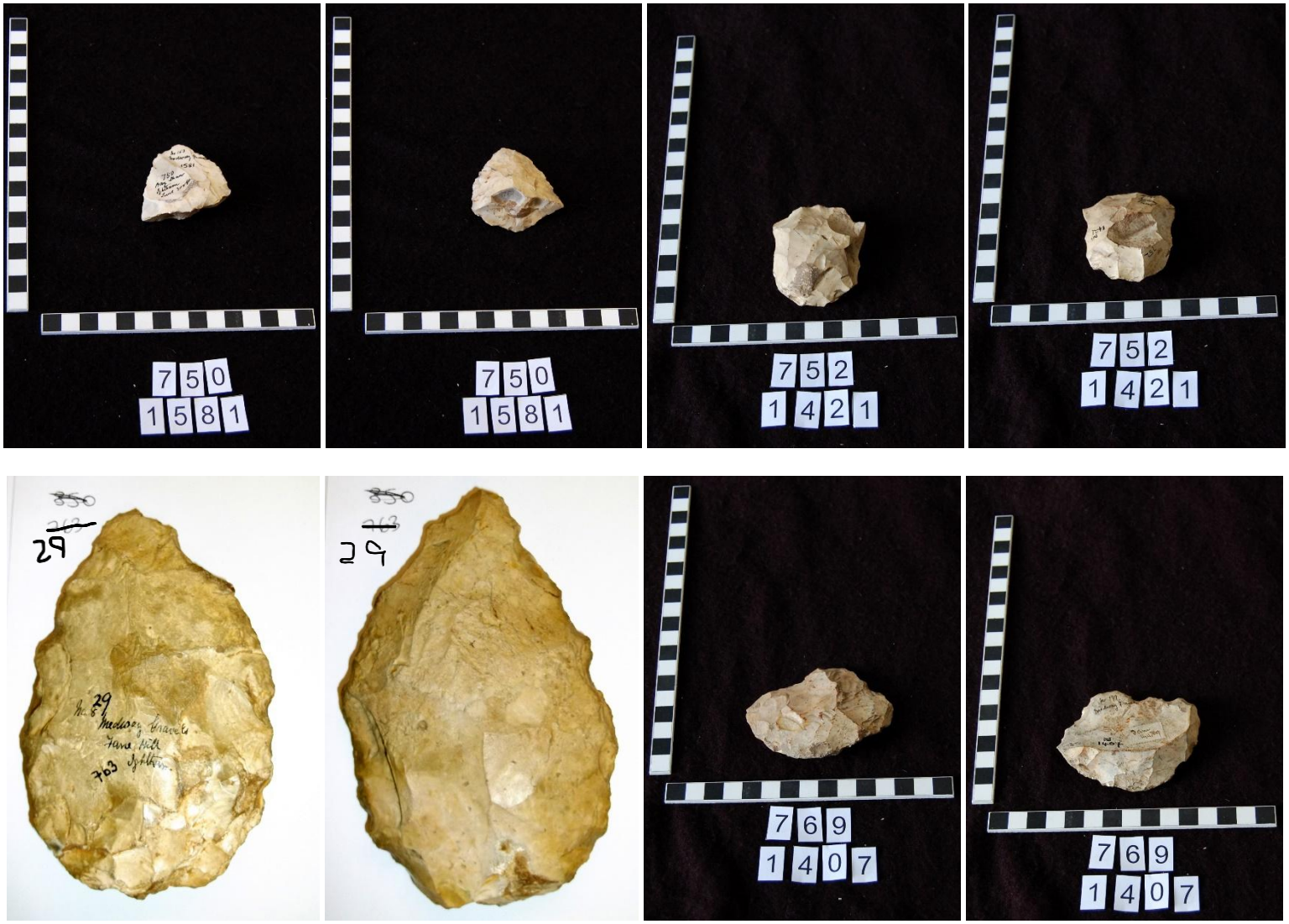

5 1 5
1 4 1 5
5 1 5
1 4 1 5
5 2 9
1 6 1 6
5 2 9
1 6 1 6
5 3 6
1 4 3 1
5 3 6
1 4 3 1
5 4 5
1 3 9 9
5 4 5
1 3 9 9

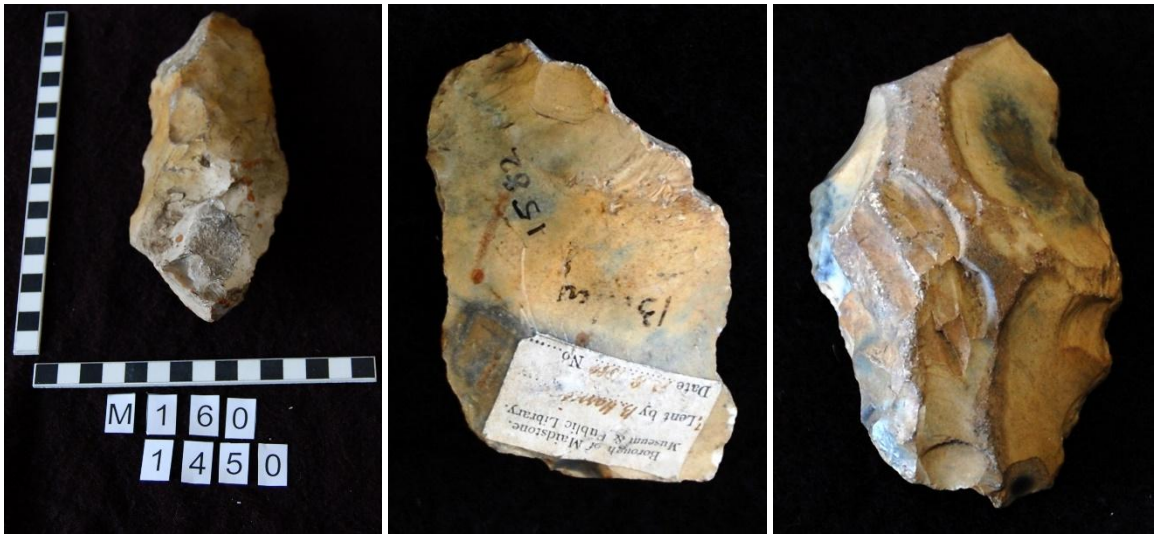

549
842
549
842
548
1606
548
1606
552A
1383
552A
1383
583
1614
583
1614


584
1618
584
1618
585
806
585
806
635
1578
635
1578
652
1586
652
1586


653
820
653
820
655
828
655
828
666
1419
666
1419
668
1402
668
1402


669
1438
669
1438
679
1434
679
1434
709
1444
709
1444
709A
1418
709A
1418


750
1581
750
1581
752
1421
752
1421
769
1407
769
1407



Accession number 1582

The artefacts below were in Harrison's collection but could not be utilised due to lack of information.