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Neolithic bone shovels of Britain: replication and reflection of a neglected artefact type

Charli Mansfield

Abstract

The earliest industrial monuments in Britain are the Neolithic flint mines, dating to around 4000 BCE. These mining shafts, which tunnel deep into chalk geologies, evidence the extremes that ancient Britons were willing to resort to in order to obtain valuable raw materials. Numerous scholars, marvelling at the excavation processes and hand tools used to aid the extraction of flint, have studied the flint-mining industry. Recognition of a toolset including antler picks, scapula shovels and possibly woven baskets has led to multiple experiments into artefact replication and testing, with the least emphasis on the scapula shovel. This article explores the results of an experiment designed to bridge the gaps in the understanding of the scapula shovel, as well as active and future research aims, in an attempt to bring this neglected artefact type out of its current obscurity.

Keywords: Neolithic, scapula, shovel, tool, flint-mining, prehistoric, excavation, industry, experimental, Britain

Introduction

Prehistoric societies impacted the natural landscape in a lasting way. This is demonstrated in the form of bank and ditch monuments, burial mounds and even pitted landscapes that are the remnants of vast ancient mining operations.

Field archaeologists have the opportunity to excavate many of these places. One of the prominent questions at the forefront of the excavators' minds concerns the methods used to produce these results. To be more precise, and more accurately reflect the thoughts of the field archaeologist who physically re-excavates the structural features, the real question concerns which tools were used and how effective they were in comparison to modern technologies.

Ancient technologies have been well studied globally, with significant interest in lithic technologies, as well as in bone and antler implements. In Britain much research has been conducted on tools used in Neolithic flint mines, with a particular focus on antler picks. This tool type has been recognised, with much experimentation on the use of these implements and their efficacy on loosening or breaking up chalk and other substrates. However, within the Neolithic flint-mining context in Britain, only a limited amount of research has been undertaken regarding the displacement of the loose materials and the tools involved in this phase of the mining process.

Standard modern manual excavation relies on three standard components – a pick, a shovel and a barrow/basket/bucket. A pick or implement is required to loosen the compacted sediment, a shovel to displace the loose material and a barrow, basket or bucket to transport the loose material from the initial location to a set distance away from the concavity being excavated.

As previously mentioned, antler picks have been the subject of study (Jewell 1963, 50–8; Clutton-Brock 1984; Worley and Serjeantson 2014). Some work has also been conducted on reconstructing baskets as a means of moving loose material (Jewell 1963, 50–8). The least studied element of this process would appear to be the shovel element. The artefact type that can be attributed to this lesser studied step of the excavation process would be the scapula shovel. This article further disseminates the results of a project completed as part of a Masters degree in experimental archaeology at the University of Exeter in 2019. The project was designed to expand on the work of previous scholars, manufacturing and testing the efficacy of cattle scapulae when utilised as digging implements and, more precisely, as hafted implements. The article also highlights how this earlier study provides a platform for ongoing experimentation and immersive learning regarding this tool type, conducted by Archaeology South-East (ASE) for the Institute of Archaeology as part of the Archaeo-Tech (Archaeology and Technology in Society) course at Butser Ancient Farm.

Previous forays into the simulation of ancient digging methods have occurred throughout the twentieth century in Britain. However, few of these recorded experiments have directly tested or manufactured the scapulae as hafted tools.

The following hypotheses were tested: To what extent can it be shown that cattle scapulae were implemented as hafted tools during Neolithic flint-mining in Britain? And what level of engineering was employed in their manufacture?

Recognition of bone shovels

Research investigating the specifics of cattle scapulae contextualised as digging implements has been acknowledged by past scholars (Curwen 1926; St. George Gray 1934; Jewell 1963; Evans and Limbrey 1974; Serjeantson and Gardiner 1995). It has been widely accepted that the majority of ancient tools could have been manufactured from wood. However, the survival rate of wooden implements is rarer than that of the bone counterparts, particularly in Britain.

After excavations conducted by Édouard Lartet and Henry Christy in the Dordogne in 1863, where hard animal substances such as bone and horn were discovered, there was the epiphany that artefacts made of these materials played a large part in the industrial activities of early man (Breuil 1938, 56). The limestone matrices of sites such as this played an important role in the preservation of these types of organic materials (Breuil 1938, 56).

With this in mind, the discovery of many bone implements – spanning all periods – from excavations globally can come as no surprise. The survival rates of shovel artefacts worldwide can be ranked as stone shovels occurring most frequently, bone shovels appearing occasionally (Curwen 1926; Serjeantson and Gardiner 1995; Xie 2018) and wooden shovels emerging as the rarest form (Xie 2018, 77).

The infrequent appearance of bone shovels within the archaeological record does not necessarily indicate the absence of these shovels' use within prehistoric societies; it could be more accurate to infer that few examples have survived the inevitable degradation that the passing of time permits. Another fundamental factor affecting the quantity of scapula shovels presently acknowledged may be the failure to identify the altered bone implements correctly upon discovery. With very little information about this artefact type published or accessible, there are probably many examples lost among recovered assemblages, a situation that ultimately skews their accurate quantitative representation within the archaeological record.

Prior research and experiments

Much emphasis on ancient mining technologies has fallen on antler picks (Barber et al. 1999, 1), due to the survival rate and/or recognition of the antler pick being significantly higher. The majority of information about the Neolithic scapula shovels in Britain was collated by E. Cecil Curwen's (1926) succinct article 'On the use of scapulae as shovels'. This article listed an inventory of the known ox scapula shovels across Europe, with a more detailed focus on Britain. From Curwen's work, it is evident that the scapula shovel was an implement recognised to have a period of use extending beyond the Neolithic, into at least the Early Iron Age. He hypothesised that despite the diminished volume of shovel implements recorded, it was still likely to have been a widely used and ultimately useful tool-type (Curwen 1926, 141). Building on this theory, Curwen delved deeper, investigating linguistics, finding the origin of the word 'scapula' could be dismantled in a way that implies the bone was named after its use as a shovel. In essence, the suffix 'ula' indicates an implement or utensil of some description, while 'scap' can be traced back to the ancient Greek word σκάπτω (*skapto*), which translates as 'I dig', as well as the Italian verb *scavare* meaning 'to dig' (Curwen 1926, 142).

In Britain, the first tangible evidence of scapula shovel experimentation was that of General Pitt Rivers. Following excavations at Cissbury, Pitt Rivers was inspired by observations made by a colleague, Ernest Willett, regarding the modification and use-wear present on the scapula artefacts discovered at the site (Willett 1880, 345; Jewell 1963, 15). Pitt Rivers obtained three modern cattle scapulae, removed the acromions on each and tested them in a chalk substrate as unhafted implements. He concluded that they were no quicker than using just hands to move loosened sediment (Jewell 1963, 15; Shepherd 1980; Steppan 2001, 88). Experimenting further with one of the modified bones, Pitt Rivers trialled hafting the scapula to a wooden handle with the aid of two-ply plant cordage and pitch. While acknowledging that this tool was highly effective, he could not confirm conclusively the evidence of modifications upon the archaeological examples (Jewell 1963, 16). That of Pitt Rivers is the only known experiment prior to the 2019 experimentation relayed in this article that simulates the efficacy of scapulae shovels as hafted tools in accordance with the British archaeological record.

The next documented scapula shovel experiment in Britain can be seen in the Overton Down experiment (Jewell 1963). Within the parameters of the main project, an additional research aim was implemented, where a segment of the experimental earthwork would be worked with ‘primitive tools’ (Jewell 1963, 50). A direct comparison to modern digging techniques was devised, with an antler pick as a mattock, scapulae as shovels and woven baskets as buckets.

The antler picks were considered successful. However, the scapulae were only considered useful when used in a scraping fashion as a means of pushing loosened chalk into the woven baskets – not a particularly time-efficient technique. The scapulae were included in acknowledgement of the presence of these tools within the archaeological record. There were inconsistencies with the design of this element of the experiment in that a variety of scapulae were provided – cattle, horse and elephant. It was agreed that the elephant scapula was not fit for the experiment, but the horse scapulae were still deemed suitable, despite horse domestication in Britain being uncommon until the Late Bronze Age. Ultimately the horse scapulae were favoured by all of the excavators (Jewell 1963, 52).

Radiocarbon dating indicates that horses were present in Early Mesolithic Britain, but became scarce. This created a hiatus in the archaeological representation, with horse remains reappearing in the

Late Neolithic/Early Bronze Age in the form of a skull found at Grimes Graves (Bendrey 2010, 11).

The horse scapulae were selected due to the less prominent acromion when compared to the cattle scapulae (Jewell 1963, 52; Ashbee and Cornwall 1961, 130). The archaeological record was never directly consulted before this experiment was designed, as a consideration written by Jewell (1963, 52) is as follows:

> The more prominent acromion of the ox made the bone more difficult to grip firmly. In the absence of horses, it would be interesting to see whether, in ancient examples, the acromion and part of the spine had not been deliberately broken off. It is always possible that the scapula was hafted in some way to obviate this difficulty.

The next tests evident in Britain were those at Wareham, Dorset, undertaken between 1963 and 1972 (Evans and Limbrey 1974). This was another experimental earthwork project that mimicked the Overton Down project in numerous ways, including testing ancient implements. The excavators were provided with the same tool set as used at Overton Down, with the same inclusion of horse scapulae (Evans and Limbrey 1974, 173). After utilising the unmodified – and unhafted – scapulae, the excavators similarly did not favour the tools: 'The scapulae were scorned by all' (Evans and Limbrey 1974, 200).

The Wareham experimental earthwork tests were the most recently documented simulations which analysed the efficacy of Neolithic scapulae shovels in Britain prior to the 2019 research at the University of Exeter. In so doing they highlighted the necessity for new experimental research to test variables that had been repeatedly overlooked by past scholars.

Outside Britain there have been experiments focusing on different cultures and their uses of scapulae shovels, with an emphasis on their manufacture. In Baden-Württemberg, Germany, a Neolithic site comprising a complex system of ditches was discovered, with a large number of worked scapulae (Steppan 2001, 87). The scapulae had the acromion removed, as well as more severe modifications to the glenoid cavity (Steppan 2001, 87). The modifications to the glenoid cavity involved hollowing it out, so creating a socket that could have housed a haft. This modification is also present in the British archaeological record, on a scapula from the Harrow Hill flint mine (Curwen 1926).

A large contribution to the study of scapula shovels can be attributed to Liye Xie (2014; 2018; Xie et al. 2015; 2017). With work exploring the uses of the scapulae shovels across the globe, particularly focusing on those from China, Xie (2018) conducted experiments to explore the different methods of bone modification and reflect on the raw material choices made by preindustrial societies. Shovels were manufactured in accordance with archaeological examples found in proximity to the testing area. The implements were tested on a variety of soil substrates to establish functionality and efficacy (Xie et al. 2015, 71; 2017, 389). These scapula shovels seemed to be utilised mostly for agricultural purposes, as opposed to the British examples, which have only been observed in construction contexts (Xie 2014, 120). Xie (2018, 78) observed that the utilisation of scapulae as shovels was likely due to the beneficial shape of the bone, as well as the seemingly low level of know-how required to manufacture a successful implement.

Other experimentation in Europe can be seen at Flins-sur-Seine, France (Bostyn et al. 2007). Here Brocket deer scapulae were tested alongside other implements to excavate flint-mining shafts, with inconclusive comment in regard to the efficacy of the scapulae. In 2009 another experiment was conducted in Wéris, Belgium, using hafted bovine scapulae in shovel and hoe formations (Toussaint 2009). In this case, however, the replicated tools did not appear to mimic any particular example from the archaeological record. As a result the hafting formation and use-wear data created are not directly comparable to the data presented in this article.

Assessing the artefacts

Prior to the experiment design, it was important that an extensive study of the archaeological record was conducted in order to note morphological alterations, as a means to establish the *chaîne opératoire* for this artefact type. The approach adopted involved initially tracking down the artefacts mentioned within excavation reports, as well as searching museum collection databases for examples categorised as scapula shovels. Visits to three museums in the south of England were orchestrated, as well as correspondence and contributions from a museum in Scotland.

Desk-based research revealed a number of key archaeological sites with artefacts categorised as scapula shovels. From the earliest work undertaken by Pitt Rivers between 1867 and 1881 at Cissbury, continuing through to the acquisition dates for specimens from Jarlshof as late as 1968, a century's worth of material evidence was found to be scattered among museum institutions across Britain.

The Pitt Rivers Museum in Oxford held one archaeological example from Avebury, two ethnographic examples from India and an experimental replica produced by Pitt Rivers himself. All artefacts, aside from the Pitt Rivers replica, were available for study upon visitation. The specimen from Avebury (see Figure 1), as mentioned in Curwen's research (Curwen 1926, 139), was in poor condition; many post-excavation repairs had been undertaken in an attempt to preserve the artefact.

Figure 1 (A) Avebury scapula shovel (Source: Photograph by Ian R. Cartwright, Pitt Rivers Museum, University of Oxford (1926.50.3) https://www.prm.ox.ac.uk/ox-scapula-shovel-uk#listing_568976_0); (B) An unaltered modern scapula (Source: C. Mansfield, 2019)

The British Museum held 10 archaeological examples, only one of which was complete (disregarding alterations made to the bone). Seven artefacts were datable to the Neolithic period, two were datable to the Iron Age and one was of unknown provenance. These examples were recovered from Cissbury, Avebury, Skara Brae and Jarlshof. The Cissbury and Avebury artefacts are mentioned in Curwen (1926, 139). The Skara Brae specimens are traceable to Childe's (1931, 127) *Skara Brae: A Pictish village in Orkney*. The Jarlshof scapulae are referenced in Curle's (1932, 88) excavation report.

The two Iron Age examples were from Hod Hill. Neither was referred to in any accessible texts regarding the excavations, as the excavation reports focus on the Roman period of occupation of the site; any animal remains existed as statistics within faunal assemblage evaluations of the recovered materials.

Worthing Museum in Sussex is known for holding a substantial portion of the material culture recovered from the numerous flint mines in the south of England, due to the great efforts of John Pull during the early to mid-1900s. One particular specimen was traced to Worthing Museum, as referenced in the excavation report of proceedings at Harrow Hill (Curwen and Curwen 1926). Four specimens were available for study, including the referenced Harrow Hill example, of which three were archaeological. There was also a second example from Harrow Hill and a final scapula with ambiguous provenance, originating from either Cissbury, Church Hill or Blackpatch – all Neolithic flint mines that were investigated at a similar time in the early twentieth century. A consequence of this was that many objects were mistakenly filed with the same site code. Due to the scarcity of information published on bone shovels in Britain, these artefacts were not included in the flint mining displays at the museum during visitation in 2019. However, the better-known counterpart of the toolset, the antler pick, was represented by multiple examples.

The National Museums of Scotland archive in Edinburgh was contacted with a request for high-quality photographs of each scapula shovel within the store, along with accompanying dimensions. Images relating to 39 artefacts were received, all specimens discovered at Skara Brae. Of the 39 scapulae, 38 were of cattle and one of sheep. All of the specimens were fragmented or worn from heavy use.

To summarise, a total of 56 specimens were studied. Of these, two examples were ethnographic, and one was the replica created by Pitt Rivers. Of the remaining 53 scapulae, 37 specimens showed modification conducive to shovel manufacture. Of these 37 artefacts, 18 scapulae showed evidence of hafting. This equates to approximately one-third of the scapulae studied being identified as hafted tools. Of these 18 scapulae, 17 were Neolithic examples and one was an Iron Age example.

Observations of manufacture

Observations were made for each of the artefacts, regarding level of completeness, damage obtained during and after excavation (referred to as 'post-excavation') and deliberate bone modifications made during the manufacturing process (see Figure 2 for anatomical terminology).

These manufacturing modifications manifested as the removal and/or scoring of the acromion, beveling of the scapula blade, evidence of grinding on the scapula neck, adhesive residue and/or notching conducive to hafting, reshaping of the posterior border of the scapula, removal of the supraglenoid tuber and the hollowing of the glenoid fossa (see Figure 3).

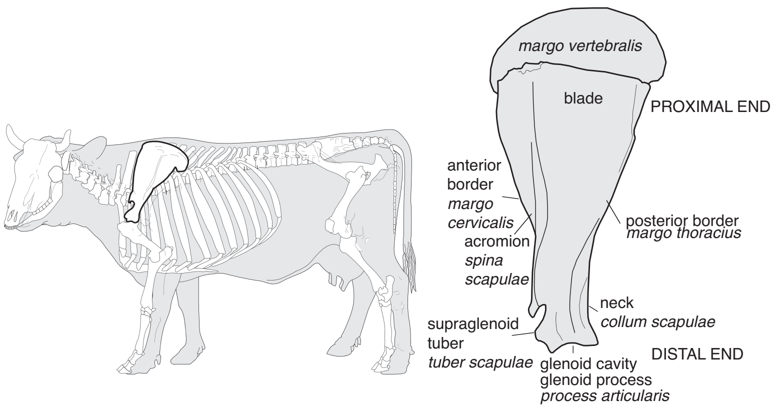
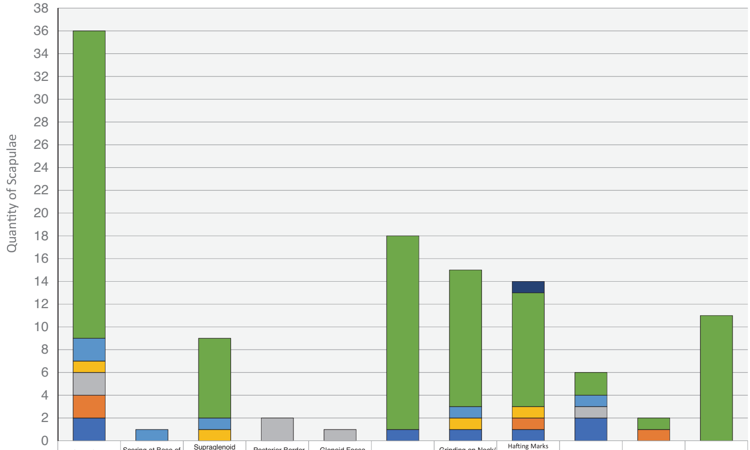


Figure 2 Diagram showing anatomical terminology regarding Bovine scapulae (Source: by F. Griffin utilising material © 1996 ArcheoZoo.org under Creative Commons licence CC BY-NC-SA 4.0)



	Acromion Removed	Scoring at Base of Acromion	Supraglenoid Tuber Removed/ Reduced	Posterior Border Reshaped	Glenoid Fossa Hollowed	Beveled Blade	Grinding on Neck/ Glenoid Cavity	Hafting Marks (Adhesive/ Notching)	Butchery Marks	No Modifications	Undiagnostic
Provenance Unknown								1			
Skara Brae	27		7			17	12	10	2	1	11
Jarlshof, Shetland	2	1	1				1		1		
Hod Hill	1		1				1	1			
Harrow Hill	2			2	1				1		
Cissbury	2							1		1	
Avebury	2					1	1	1	2		

Avebury Cissbury Harrow Hill Hod Hill Jarlshof, Shetland
Skara Brae Provenance Unknown

Figure 3 Graph showing observations of modification to a sample of 53 archaeological scapulae artefacts from four museums in Britain (Source: C. Mansfield and J. S. Hunter, 2022)

The most common alterations observed were the removal of the acromion, the reduction or removal of the supraglenoid tuberosity, grinding on the scapula neck and the beveling of the proximal edge of the scapula blade. These modifications were factored into the design of the shovels that were manufactured for the experiment.

Test shovel manufacture

Twelve shovels were designed, showcasing a variety of hafted and unhafted combinations. They featured variables, including different lashing materials, a range of handle lengths and some slight variation in bone modification. The constant control variables within the shovel design were the beveling of each blade and the conforming of the hafted tools to a standard shovel design identified as an affixed blade with its axis in line with the handle (Xie et al. 2017, 380). The supraglenoid tuber was reduced or removed on every shovel designed for the experiment, as this feature of the bone was far more pronounced on the modern cattle scapulae than was evident on the archaeological examples. One scapula remained unhafted as a comparative control factor, enabling testers to measure the efficiency of the test implements with and without the wooden handles.

It was decided that the wooden handles would be altered in order to interact effectively with the abraded neck alteration on the majority of the scapulae. This involved notching/stepping one side of the wooden rod to create a platform for the neck of the scapulae to rest, a point to which most of the force would be transferred during use. The wood chosen for this project was hazel, as it removed the necessity for a wood straightening process due to hazel growing naturally in linear rods.

With reference to a modern tool directory online (Wonkee Donkee Tools n.d.), four different shaft lengths were chosen. Aside from one unhafted blade and one socketed blade with an antler handle, all scapulae were hafted with hazel rods. The two materials chosen to bind the scapulae to the hafts were plant cordage and rawhide.

Two-ply jute cordage was obtained as a coherent choice of binding material, as plant-fibre cordage utilisation is evidenced as far back as the Upper Palaeolithic at sites such as Lascaux Cave. Here a sample of fossilised cordage was discovered, suggesting the common use of plant-based cordage from approximately 15,000 BCE (Leroi-Gourhan 1982, 110). Similarly, plied sinew cordage would have been a suitable choice. However, generating the quantity of sinew cordage necessary for hafting multiple shovels would have been extremely time-consuming, and not a necessary quantifiable variable for this initial experiment.

Rawhide was selected for its characteristics – the versatility of the material and the tight lashings that can be achieved. Finding a comparative use within the archaeological record is difficult, as skin-based organics rarely survive. On the few occasions where leathers are present, chemical changes have occurred within the skins, obscuring certain aspects of the leather-making processes (Harris 2014, 11).

Birch tar pitch was used to secure and improve the endurance of the jute cordage binding on one of the test shovels, simulating the adhesive present on two of the archaeological specimens, those from Avebury and Skara Brae. The scapulae were altered first, with the acromions scored with a flint flake and removed via percussion from

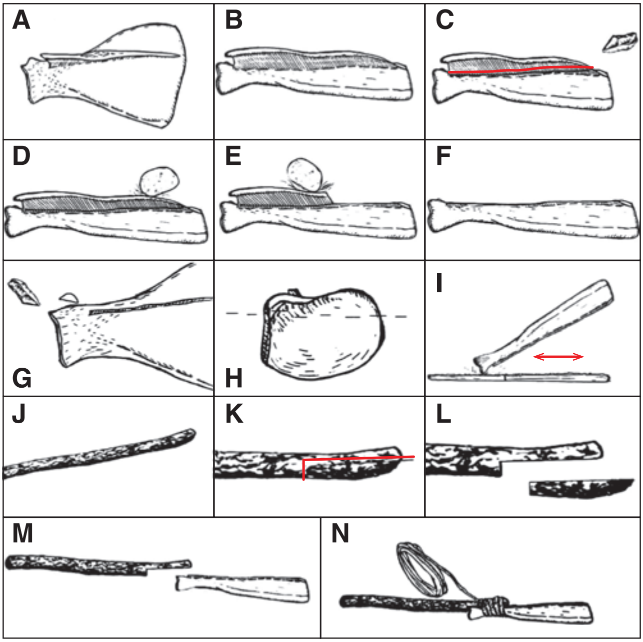


Figure 4 (A) Unaltered; (B) side aspect; (C) scoring acromion; (D) and (E) percussion with hammerstone; (F) scapula with acromion removed; (G) removal of supraglenoid tuber; (H) view of glenoid cavity; (I) abrade glenoid cavity on sandstone slab; (J), (K) and (L) create stepped platform on wooden rod/handle; (M) place two flat platforms together; (N) bind tightly with lashing material (Source: C. Mansfield, 2022)

a hammerstone (see Figures 4C–4E); any necessary grinding was then achieved with the use of a sandstone tabulate, with additional sand added for a more abrasive environment (see Figure 4I). The handles were notched, after which the two flat platforms that had been created on each shovel element were assembled and joined with the aid of the chosen lashing material (see Figures 4K–4N).

Shovel testing

With the requirement of the soil type falling to limestone-based sediments, due to the majority of the archaeological specimens being recovered from this geological substrate, the Ancient Technology Centre in Dorset was chosen as the testing site. During a prior visit to this museum, it was mentioned that this institution was situated upon chalk geology. The museum regularly utilises the chalk sediments within the cob-brick making activities that run during educational sessions held for school groups. The area referred to as the 'chalk pit' was chosen as the experiment location, comprising a concavity within the landscape, used for frequently gathering chalk. It was decided that the chalk would be broken down into a loosened material with the aid of antler picks – two small red deer antlers purchased online and two antler picks provided by the museum.

A set amount of approximately 15 litres of loosened chalk was settled on, regulated with the use of a soft bucket with litre measurements marked on the inside in 5-litre increments. The tests were carried out by three experienced excavators (J. S. Hunter, J. W. Kiernan and C. Mansfield; see Figure 5), chosen because of their natural ability to

Figure 5 (A) Test-shovel lineup; (B) C. Mansfield testing unhafted scapula; (C) J. W. Kiernan testing birch tar pitch bind; (D) J. S. Hunter testing socketed antler handle (Source: Kiernan and Mansfield, 2019)

adapt to using different tools. This was an attempt to reveal the true functionality of the implements. With three personnel present, this allowed for one person to test the shovel, one to film (for later reference) and time the test and one to monitor when the bucket had reached the 15-litre marker. Each test involved testing three basic motions of the tool – scooping, scraping and pushing. Scooping refers to the standard shovel motion of using the implement to scoop up loosened material; the shovel is held in a horizontal manner and force exerted from behind. Scraping refers to the tool being held vertical to the ground, with a pulling motion moving the implement towards the user. Pushing refers to a motion usually associated with a spade, in which a downward force is exerted upon the implement, slicing into the substrate being excavated. At the completion of the task, the testers would sit for a short interview. In this they would relay their experience of each respective shovel's benefits and shortcomings. As the handle lengths varied with three set lengths (antler being the exception), each tester could contribute their thoughts on each specific handle length.

Results

In the wake of the experiment, many observations were made. When considering the experiment's design, the large number of shovels manufactured was not only to create a multitude of hafting combinations in order to produce an enriched dataset, but also to account for any breakages that may occur during the testing. This was to ensure that enough data could be generated for analysis. It was predicted that the bone matter would be the element of the tool most likely to suffer damage, particularly in the centre of the proximal end of the blade where the bone is the thinnest, as this is where the majority of the damage was present in the archaeological specimens.

However, this was not the case – the experiment revealed that the weakest point of the implement as a whole was the binding point where the bone meets the haft. With the rawhide lashings, the most prominent consideration of this binding material was the tendency of the rawhide to expand when exposed to the high moisture levels. After initially shrinking tight during application, the rehydration of the material through atmospheric moisture was detrimental to the integrity of the bind. This resulted in instability in every rawhide-bound shovel that was tested.

With the plant cordage lashings, the strength of the bind was affected by the cordage's ability to find purchase on the smooth surface of the scapulae neck. The only example of a cordage-bound shovel that remained tight throughout use was the lashing coated in birch tar pitch.

With regard to the handle material, hazel was an adequate choice, with the slight flexibility to the wood negating any breakage of the shafts. It was noted that the test shovels with more proportionate measurements in relation to the thickness of the neck of the scapula and the diameter of the hazel rods had a greater degree of stability.

The socketed shovel with the antler handle was also found to be effective, proving that wooden hafts were not the only viable materials. It also provided valuable insight into the variation of shovel constructs that could be created depending on the use of the tool, as well as the available raw materials in accordance with situational location. For example, many of the archaeological specimens were recovered from Skara Brae, where many of these northern sites lacked vegetation – a situation reflected in much of the material culture being made of either bone or antler. It is also likely that hafted scapula shovels constructed with antler handles would have been limited in regard to handle length directly related to the salvageable antler lengths available at any time.

When analysing the performance of the tools, all the testers agreed that both short and long hafts were feasible options, though the shorter handles only worked when the user was in a crouched or kneeling position. The longer handles only worked when the user was in a standing position. They were preferred by the testers, but this was probably due to the familiarity of the tool, which mimicked the manoeuvrability of a modern shovel. In relation to the Neolithic flint-mining context, the shorter handles would favour the confinement of the narrow mining shafts, where the miner would probably already be in a crouched or kneeling position.

Post-experiment reflection and research

From the experiment, a dataset was generated that can be utilised as a platform for further study and experimentation regarding this tool type.

As so little prior experimentation had been undertaken, with virtually no quantifiable data for comparison, this experiment can be considered a success in forming an initial insight into the scapula shovel as a hafted implement while mimicking observations within the archaeological record, in which further study and experimentation can be juxtaposed.

The natural progression for this experiment was to create further tools of a similar assembly that eliminate the design flaws present in the initial shovel sample set. This included a more polished application of the binding process.

A thirteenth shovel was created shortly after the initial experiment in 2019. In this instance a moose scapula was used in place of a bovine scapula, as it more accurately mimicked the dimensions of the prehistoric breed of cow. Rawhide was used for the binding, but was prepared with insight from an experienced prehistoric tanning specialist (Kamper, personal communication, 19 July 2019). This process involved a longer rehydration period, extensive pre-stretching and the rawhide being cut to thinner strips, resulting in a sturdier bind – this shovel remains structurally sound to the present date. An additional short length of wood was added to the alternate end of the shaft in a 'T' formation. This 'T' handle formation was present during the initial experiment, on the test shovel with the antler handle. This object had been modelled after an archaeological example from Harrow Hill, which had an antler handle associated upon discovery. The testers all concluded that the additional handle feature aided control, manoeuvrability and efficiency during use.

With these initial post-experiment adaptations proving successful, future research aims have been focused on a number of different elements. Exploring new varieties of hafting methods, with handles designed to accommodate the scapulae in different formations, is one of the short-term goals, opening up the discussion to a more diverse audience. Another short-term yet ongoing aim is to manufacture more sets of tools and put them through a rigorous functionality test. This would involve longer exposure to use-function, expanding on the brief parameters of the initial experiment in order to gauge the longevity of the tool, and possibly to provide some quantifiable use-wear data comparable to the archaeological record. This would be necessary as the experiment within this article did not create enough use-wear for analysis; the hypothesis that was tested centred on functionality, rather than on the longevity of the tools.

Some of these short-term goals will be accommodated through the collaborative relationship established with UCL Institute of Archaeology's Archaeo-Tech. The course runs at the beginning of the first semester of each academic year in partnership with Butser Ancient Farm in Hampshire. It is an immersive, experimental experience for archaeology undergraduate students, offering hands-on sessions of activities that replicate the daily activities of ancient people. Archaeo-Tech 2021 was the first season for which scapula shovel experimentation had been added to the roster. The format for the course was altered in this instance, as the Covid-19 pandemic did not allow for the usual logistical efforts of the standard sizeable gathering of students and staff alike. An online teaching strategy was adopted, with activities being demonstrated via video broadcast to the students and supplementary video footage taken to serve as teaching materials.

During the video broadcasts a scapula shovel was created with a plant cordage binding. The prior shortcomings of the cordage lashings from the initial test shovel – the lack of traction between the binding and the bone surface – was alleviated by the addition of slight abrasion/notching on the scapula neck, a feature apparent on numerous archaeological artefacts. This contributes to the short-term research aim of finessing the manufacturing process and improving our insights into the quality of the tool.

For the next few seasons of Archaeo-Tech, which aims to be orchestrated in the more traditional learning environment, less focused on distance learning (pandemic climate allowing), a methodology will be adopted in which participating students will be able to contribute their ideas on feasible shovel design when presented with the archaeological evidence, and so to create a new set of test shovels. It will also be the correct forum to start prolonged shovel testing to create the aforementioned level of use-wear required on the scapula surfaces for comprehensive comparison with archaeological examples.

Conclusions

The shovel experiments of 2019 were ultimately successful in fulfilling the aim of generating a control dataset that can be used as a benchmark during future investigations of this tool type. The experiment highlighted the simplicity of the bone modifications in accordance with the archaeological record, as little alteration was required to create a functional implement.

Between the initial set of test shovels and the two subsequent post-test versions, it is evident that the quality of tool produced can be improved when skills and/or prior knowledge are applied during the manufacturing stage. It was also evident that procuring scapulae that conform to the dimensions of the ancient cow breed would garner greater insight into the dynamics of the implement.

As mentioned, future research building on this initial dataset will expand into investigating use-wear patterns, as well as exploring a variety of hafting configurations, with the aid of the UCL students. This will further the understanding of scapula shovels and facilitate a greater engagement between ASE and the UCL Institute of Archaeology, building a connection between the academic/educational sphere of archaeology and the commercial/professional sphere. The Archaeo-Tech experience creates an environment in which staff and students from a variety of backgrounds can come together to discuss, hypothesise and experiment on numerous archaeological subject matters. In so doing, they bring new perspectives and ideas that can develop the methodologies and insights of projects. The students can contribute to active research projects, gaining skills that will aid them in their own future research and careers.

It is a great hope that the initial shovel experiment, teamed with the ongoing and future research agendas, will succeed in bringing awareness to this neglected artefact type. This may in turn result in more scapulae being identified as shovel implements upon discovery, as well as during the assessment of faunal assemblages. With accurate curation, regular presentation and continued study of scapula shovels, our understanding of ancient excavation and mining contexts will have the chance to broaden, developing a clearer picture of such a prevalent ancient industry.

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Declarations and conflicts of interest

Research ethics statement

Not applicable to this article.

Consent for publication statement

Not applicable to this article.

Conflicts of interest statement

The author declares no conflict of interest with this work. All efforts to sufficiently anonymise the author during peer review of this article have been made. The author declares no further conflicts with this article.

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