

WORKING WITH FLINT TOOLS: PERSONAL EXPERIENCE MAKING A NEOLITHIC AXE HAFT

P. Harding¹

ABSTRACT

Neolithic woodworking techniques undoubtedly formed an important component of the ancient technology of the period; however few attempts have adopted a practical approach to examine the efficiency of stone tools in undertaking the task. This paper describes an attempt to replicate features of a Neolithic axe haft based on an example found at Shulishader, Lewis. It details the tool kit selected, challenges faced, and methods adopted to complete the task. The paper also considers the role of axe hafts as an integral part of the axe for Neolithic communities.

Full reference: Harding, P. 2014. Working with flint tools: personal experience making a Neolithic axe haft. *Lithics: the Journal of the Lithic Studies Society* 35: 40–53.

Keywords: Neolithic archaeology, replication, stone tools, ancient woodworking, axe hafts

INTRODUCTION

Having made stone tools for over 40 years, I realised that I had only limited practical experience using or hafting them. It seems I may not be alone; a review of the pages of *Lithics* indicates that these subjects have been featured sparingly (Hattat 1984; Clarke 1989; Mitchell 1996; Fluck 2007). The incentive to redress this and explore aspects of Neolithic woodworking technology on a personal level, using stone tools, arose from conversations during an ambitious experiment to reconstruct a half-size replica of the Bronze Age Dover boat (Parfitt 2014). The reconstruction of the vessel was undertaken by craftsmen using authentic bronze tools and necessitated that mortises be cut through cleat rails in the bottom of the vessel. This sophisticated piece of woodworking was relatively straightforward using bronze tools and the issue was raised about how easily a mortise could be cut using stone tools. Such skills were probably fundamental to prehistoric woodworkers living in an organic world and may have been resolved during the Mesolithic period as a means of hafting tranche axes.

The lack of studies that examine Neolithic woodworking techniques using stone tools may be related to the relative scarcity of preserved wooden remains in Britain. Posts and cleaved planks, some of which were modified by open mortises, as well as hurdles woven from coppiced woodland stems, have

been recorded (Coles *et al* 1973; Coles & Orme 1977). Traces of more sophisticated wooden artefacts have also been documented including axe hafts (Taylor 1998), bows (Clark 1963), bowls (Coles *et al* 1973; Taylor 1998), and domestic utensils (Coles *et al* 1973) that demonstrate the role of woodworking on a day-to-day basis. Analysis of waste products (i.e. chips: Taylor 1998 & 2011) and observations of tool signatures preserved in the surface of excavated timbers have also been exploited to study stone-tool use in prehistoric woodworking (Taylor 2011). The paucity of data in Britain stands in contrast to the wealth of material from mainland Europe, including Spain (Palomo *et al* 2013), France (Pétrequin & Pétrequin 1988), Switzerland (Boisaubert *et al.* 1974) and Germany (Tegel *et al.* 2012) where well-preserved wooden structures and artefacts have been recovered and studied. This abundance has also generated numerous programmes of experimental work, including a number, printed in German, on the use and hafting of axes and adzes in prehistoric woodworking, but not necessarily describing their manufacture (Meier 1990; Holsten & Martens 1991; Weiner & Pawlik 1995).

AXE HAFTS

Axe hafts constitute one of the most easily recognisable forms of organic, prehistoric artefacts. They provide stronger evidence to show how the head was mounted and used than the symmetry or asymmetry of the head

¹Wessex Archaeology, Portway House, Old Sarum Park, Salisbury, SP4 6EB; p.harding@wessexarch.co.uk

itself. Versteeg & Rostain (1999) listed two methods by which Amerindians of South America attached the axe head to the haft: 1) 'hafting by inclusion', in which the axe head was inserted in a mortise, optionally supplemented by binding or glue; and 2) 'non-inclusion hafting' where the axe head was glued or tied to the haft. Prehistoric axe hafts are known both on mainland Europe (Harding & Young 1979; Hafner & Suter 2003) and in Britain and Ireland where at least ten Neolithic examples have been recorded (Evans 1897: 152; Taylor 1998: table 21). This relatively limited corpus of discoveries in Britain were all made so that the blade was 'hafted by inclusion', mounted parallel to the haft as an axe with none apparently mounted transversely as adzes are supposed to be. No evidence survives to suggest that supplementary binding or adhesives were employed. Axe hafts and adze hafts, also 'hafted by inclusion', are relatively plentiful on the European mainland with ten adze hafts being found at La Draga, Spain alone (Palomo *et al* 2013).

An axe haft was therefore considered to be an appropriate candidate for testing the effectiveness of stone tools. Specific choice of design was based on an example (Fig. 1A) from Shulishader, Lewis (Sheridan 1992). This haft, radiocarbon dated to 3500–2890 cal BC (OxA-3537 4470±95 BP at 95% confidence) was found with its polished stone axe head of Antrim porcellanite still in the socket. The haft survived for a total length of 480 mm and had been made from a log at least 160 mm in diameter, and thought possibly to be hawthorn, that had been cleaved lengthways. The housing for the axe head was formed by a steep sided rebate at the top with an angled rebate on the bottom. These slots thinned the wood to a thickness of approximately 40 mm, through which the central mortise was cut. The mortise was also especially well preserved and showed that considerable care and attention had been expended to ensure that the axe head fitted precisely into the socket. The axe head was fitted asymmetrically to the haft, with the front edge of the axe fitting snugly against the face of the lower rebate below the mortise socket. This asymmetrical pattern has been noted on hafted axes from Denmark where the axe heads were set at an angle of 80° to the haft, possibly to compensate for an angled swing of

the axe and ensure correct impact against the tree (Becker 1945).

The Shulishader haft also included a number of similarities to hafts (Fig. 1B) from Ehenside Tarn, Cumbria (Darbishire 1874: plate viii, fig. 3; Fig. 1C) from the base of a ditch at the early Neolithic causewayed enclosure at Etton, Cambridgeshire (Taylor 1998: fig. 161). Foremost of these features on the Shulishader haft were a series of parallel flutes, which ran for approximately 70 mm from the back of the upper rebate and extended along the upper part of the haft. Taylor (Sheridan 1992) speculated that these were decorative facets and had been made using an axe or adze. Similar flutes were present around the end of the haft from Ehenside Tarn.

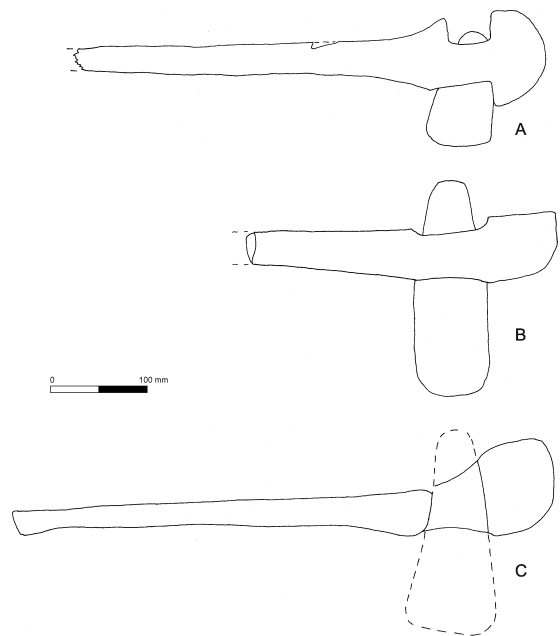


Figure 1. Neolithic axe hafts from Britain: A) Shulishader, Lewis (redrawn from Sheridan 1992); B) Ehenside Tarn, Cumbria (redrawn from Evans 1897); C) Etton, Cambridgeshire (redrawn from Pryor 1998)

TOOL KIT

The manufacture of the axe haft required a tool kit to complete a number of woodworking procedures, including cleaving, shaping, shaving and chiselling. Most importantly it demanded precision to create a mortise that mirrored the size and shape of a replica polished flint axe head that could be held in the haft without the need for additional binding. This flint axe head measured approximately 115 mm by 47 mm, which is slightly smaller

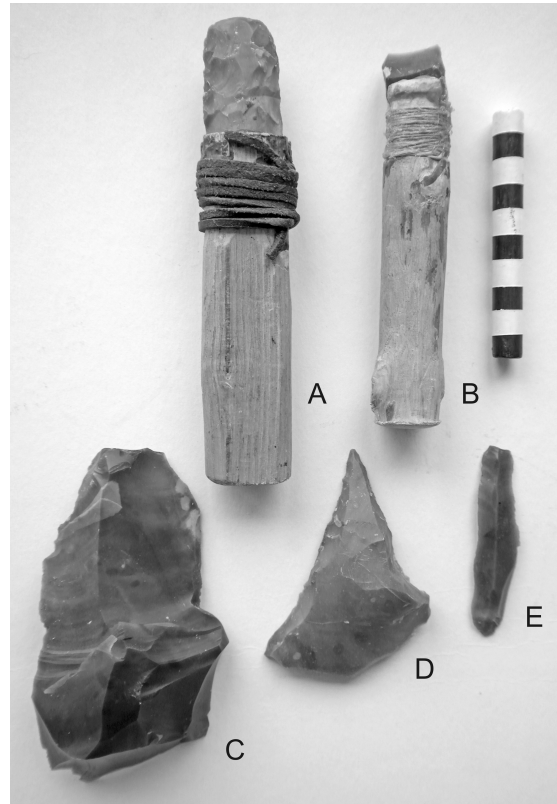


Figure 2. Tool kit: A) polished chisel; B) 'chisel' arrowhead; C) shave; D) piercer; E) snapped blade

than that found at Shulishader, and took approximately eight hours to grind, by hand, on a sandstone bench. The selection of stone tools (Fig. 2) also necessitated consideration of what tools were available to the Neolithic woodworker: wedges, axes, chisels, drill and draw knife or spokeshave, a choice that was heavily influenced by their modern equivalents, but which probably developed from stone originals.

The stone axe undoubtedly formed a principal component of the Neolithic woodworking tool kit. Blackwood (1950: plates 2 & 3) observed that, in the hands of a skilled person, high levels of precision can be achieved using only a stone bladed adze/axe. Taylor (Sheridan 1992) also considered that the stone axe was the prevalent tool that was used in the manufacture of the Shulishader axe haft. Much of the published experimental data related to stone axes has concentrated on aspects of their manufacture including flaking (Newcomer 1971; Hansen & Madsen 1983; Mandal *et al* 2004), grinding and polishing (Madsen 1984; Harding 1987). Manufacture of hafts (Harding & Young 1979) has been necessary where stone axes have been employed in studies of

their use for felling trees (Iversen 1956; Coles 1979), although few of these projects, have described in detail manufacture of the haft or used stone tools in their production. Where flint has been used very little detail or consideration of the methods used has been provided on the effectiveness/success of the work (Maigrot 2001, 2003 & 2011).

Polished stone chisels also feature in British Neolithic stone tool assemblages but are less common than axes. The task of making an axe haft therefore made it possible to consider whether other options were available and specifically whether a 'chisel arrowhead' (Clark 1934; Green 1980) might function in an unconventional role as a woodworking 'chisel'. Chisel arrowheads have been found with Mortlake and Fengate pottery (Middle Neolithic) from 3500 BC (Gibson 2002: 80) and within the broad date range of the axe hafts from Shulishader and Etton. The function of 'chisel arrowheads' as projectile points was established by examples that survived in their shaft (Evans 1897: fig. 344). However chisel arrowheads occur in a range of sizes; some larger examples grading imperceptibly into waisted transept tools, while Richards' (1990:

fig. 11b) 'Y' shaped tool, for which very little study has been undertaken and no function yet established. The 'chisel' arrowhead used in the manufacture of the axe haft fell within the parameters of mean length and breadth, but at the upper end of thickness, of 'chisel arrowheads' catalogued by Green (1980: table II.19). The tool blank was selected deliberately with a cutting edge that was sufficiently strong to reduce the likelihood that it would crush in use. The 'chisel arrowhead' was supplemented by a bifacially flaked chisel with a ground blade. Both tools were mounted into wooden handles.

The rotary drill, possibly used in conjunction with a sand abrasive, undoubtedly featured in the Neolithic tool kit, while hand-held piercers, of varying sizes, are well known components of many flint assemblages (Semenov 1964: fig. 25).

The role of unretouched flint blades and/or scrapers, in conjunction with grinding and abrading the wood, has also been acknowledged. Coles *et al* (1973) considered that such techniques were more likely to have been restricted to smaller objects and felt that it was unlikely that they were appropriate to work hard woods such as oak or yew. However Blackwood (1950) noted that unretouched flakes of flint or chalcedony were indispensable to supplement the polished stone adze in the production of a wooden adze haft. The tool kit was therefore completed by a large 'waste flake' with straight, relatively strong edges, which was used as a shave and by a snapped blade (Semenov 1964: fig. 51). This was adopted subsequently to produce the mortise. Snapped blades broken by flexion are a common occurrence in flint knapping, but they can also be broken deliberately, by 'voluntary fracture' (Bergman *et al* 1987; Anderson-Whymark 2011).

Consideration was also given to alternative tools, materials and techniques that may have been available to the Neolithic woodworker, but which were not made of stone. Ethnographic studies have documented the effective use of hafted animal teeth as woodworking tools (Bubberman 1972). Bone chisels/gouges, found throughout the Neolithic (Piggott 1954: 85 & 146), have also been described. Smith (1965: 128) included four examples from the upper levels of the

causewayed enclosure on Windmill Hill where they were considered to be skinning tools. Experimental studies have been conducted in Europe (Lobisser 2005) but remain relatively poorly discussed or tested in Britain.

Taylor (1998) and Tegel *et al* (2012) have both described the role that charring may have played in woodworking, similar to the technique used in antler pick manufacture, to make the material brittle and easier to work (Clutton-Brock 1984: 26). Fire provided an effective means to prepare wood in the replication of the Clacton spear point (Fluck 2007). Of more relevance to this project, Taylor (Sheridan 1992), drawing on observations of the way in which wooden bowls appeared to have been made at Etton (Taylor 1998: 154), thought it is likely that the mortise of the Shulishader haft had also been formed by charring and scraping.

TECHNIQUES

The haft manufacture involved:

- 1) roughing out and shaping the stave;
- 2) shaving;
- 3) cutting the rebates; and
- 4) creating the mortise and fitting the axe head.

The haft was made from a green oak log, approximately 0.10 m in diameter that was felled in May 2012. Throughout the early stages of the operation, the wood was kept permanently wet in a bucket of water, but during the later stages of manufacture, it was wrapped in moist paper kitchen towels and plastic bags to retain moisture. Recorded axe hafts from Britain and Ireland show that a variety of wood species were used (Taylor 1998: table 21). Rosaceous species, either hawthorn or apple, were most common although oak was employed to manufacture a haft from Ehenside Tarn, Cumbria. Axe hafts from the Swiss Lake Village sites were predominantly of ash (Harding & Young 1979).

The use of wooden wedges or stone axes to cleave roundwood radially along the grain is well understood, has been recorded at a number of Early Neolithic sites (Coles *et al* 1973; Taylor 1998: 147) and offered nothing new to this project.



Figure 3. Roughing out and shaping the haft with a polished flint axe. The image shows the distinctive fluting, the individual signatures of the blade and the resulting wood chip



Figure 4. Shaving using an unretouched flake to create the distinctive flutes

Roughing out and shaping the haft

The preliminary conversion of the cleaved stave into a suitable round shaft was achieved using a flaked axe with a ground and polished blade (Fig. 3). The process proved remarkably easy to complete and confirmed the removal of long, thin parallel ‘blade-like’ wood chips (Taylor 1998: fig. 146). Each wood chip exploited an existing arête, in much the same way that crests/ridges are exploited in the manufacture of stone blades and resulted in the creation of regular flutes. These are

reminiscent of the type described for the Shulishader haft that Taylor (Sheridan 1992) considered were probably produced using a stone axe and were intentionally decorative. Subsequent trimming created a rounder form but in each case clear traces of the blade signature were retained that corresponded to individual blows of the axe.

Shaving

The initial process of roughing out and shaping the haft confirmed that regular flutes could be produced as by-products of manufacture. This

stage of production also provided an opportunity to examine alternative options of tool use and test the effectiveness of a large unretouched blade/flake as a stone equivalent of a shave or draw knife. The process (Fig. 4), whereby the haft was clamped firmly in a modern workbench, seemed to work better when pushing the shave away. The operation created similar *arêtes* and 'blade-like' wood chips to those produced by a stone axe. Several embryonic pushes were required to open the shaving, but once the flint had engaged with the grain of the wood, the shaving was removed smoothly in a continuous flowing stroke. The removal of long wood shavings created a similar, clear, regular pattern of parallel flutes, which lacked only the traces of individual axe blows. The technique seems to be within the possibilities of Neolithic technology, provided that a means of clamping the wood was available; a 'horse' as used by traditional woodworkers is entirely organic and rots away leaving no trace.

Cutting the rebates

The rebates at the top and bottom of the haft were cut using the 'chisel arrowhead', which was tested successfully in two preliminary trials. In these trials, a square mortise was cut in slabs of green oak 25 mm and 45 mm thick respectively. Each mortise was cut from

one side before the timber was turned over and the task repeated on the reverse side, creating a classic 'hour-glass' perforation.

The rebates on the haft were made by cutting a small 'V' shaped slot with the 'chisel arrowhead' across the wood grain (Fig. 5) at both ends of the rebate. The potential benefits were provided by the sharp tranchet edge, which, although not as robust as the polished chisel, cut through the green oak more efficiently. The sharp blade could be positioned accurately at the point at which the wood needed to be cut. Provided the chisel was used at a relatively low angle the blade remained undamaged. This angle of blow was similar to that normally used with a polished flint axe and allowed the blade to exploit the natural grain of the wood. The central slab of wood (Taylor 1998: fig. 148) was then broken out (Fig. 6) with the polished chisel, the blade being more robust. This technique is similar to 'log notching' by which a round timber can be squared-up by cutting notches and removing the intervening slabs of wood. The wood chips produced are characterised by one or two chamfered ends, according to whether the entire slab is removed complete. The process was repeated to achieve the required depth and produced a rebate with slightly angled ends. The base of the rebate was also refined using the 'chisel arrowhead'.



Figure 5. Cutting the rebates employing the 'chisel' arrowhead. Note one slot has already been cut to the left



Figure 6. Breaking out the central wedge with the polished chisel

Creating the mortise and fitting the axe head

This created the biggest challenge, requiring a made-to-fit aperture to accommodate the tapering lenticular cross section of the axe. An initial attempt was made to produce the relatively small mortise using fire, as speculated by Taylor (Sheridan 1992) for the Shulishader haft, but this process proved to be painstaking, ineffective and unsuccessful. There was an inordinate time needed to control the ember, encourage it to stay alight in the green wood and within the confined space of the mortise. It also offered little opportunity by which the shape of the mortise could be controlled to accommodate the axe head. To some degree these unsatisfactory results may have been due to inexperience of the technology. The use of a small 'chisel arrowhead', similar to that used to manufacture the rebates in the haft, was similarly unsuccessful, creating a square, rather than oval mortise hole. Use of a bow drill, wooden spindle and abrasive sand was also abandoned as being ineffective.

The most successful results were obtained using the hand held piercer (Fig. 7) that was manufactured with a tapering square-sectioned point. This was used to create a round, hourglass shaped perforation through the wood that could be expanded using the cutting edge of a flint blade/flake. This process, which was

achieved using the end of a snapped blade (Fig. 8), was by far the most efficient and precise. The snapped blade provided a tool with sufficient length to penetrate the depth of the mortise and a square sectioned profile perpendicular to the axis of the blade that offered attributes of strength and relative sharpness. These characteristics are similar to those found along the edge of a burin facet, which is parallel to the blade axis but also provides an effective scraping edge. The snapped blade showed no visible traces of use and remained totally indistinguishable from one that has broken accidentally during manufacture. The butt of the axe was blackened before being inserted into the mortise to isolate areas that needed to be removed to accommodate the axe head. The areas of contact could then be pared away in a controlled fashion using the snapped blade to push away the protruding areas of wood. This method of shaping the mortise using stone tools proved to be only marginally less efficient than using metal chisels. The snapped blade was also used subsequently to produce more right-angled edges to the rebates.

The body of the completed haft (Fig. 9) was also smoothed using the edge of a blade, although the surface created by the stone axe was by no means untidy. The finished haft was hung up to dry naturally, minimising the chance of cracking.



Figure 7. Creating the mortise using a piercer to form the initial perforation. Note the wood shavings created in the process

DISCUSSION

This small project set out to explore and document the manufacture of an axe haft, based on British Neolithic examples, using only retouched and unretouched stone tools. The challenge was undertaken by someone more adept at making stone tools than using them. One of the initial conclusions was that the task was made easier by the use of green wood. In this state, all the tools performed efficiently and better than might have been expected. It is highly likely that prehistoric craftsmen had a comprehensive knowledge of species and the working properties of individual woods. However the apparent benefits of green woodworking should not be taken for granted; craftsmen in Irian-Jaya allowed the wood to dry for several months before it was used (Versteeg & Rostain 1999).

Fluting, which is a distinctive feature on some Neolithic hafts, was produced, as anticipated, using a polished flint axe although similar results were obtained using a large flake as a shave. Whether these features were intentionally decorative (Sheridan 1992), or by-products of manufacture, as produced in this exercise, or a combination of both, remains unresolved.

The production of the relatively small mortise posed the greatest technological challenge; the solution proved to be relatively simple and underlined the efficiency and potential value of something as simple as a snapped blade, an object that might conventionally be included as no more than a by-product of debitage (waste). These implements, like all the unretouched flakes and blades used in the work, showed no visible traces of use or edge damage to the cutting edge. Micro-wear analysis did not form part of the project, nevertheless the results of micro-wear analysis and low-power use-wear techniques (Grace 1992; Anderson-Whymark 2013) have also confirmed the extensive use of unretouched stone artefacts in prehistoric activity.

The replication underlined the adaptability of stone tools and confirmed that they may not always have been used in the way we expect them to have been. A 'chisel arrowhead' conventionally regarded as a projectile point functioned well when used as a chisel. In isolation this does not constitute conclusive proof that all chisel arrowheads were used as chisels, but merely offers an alternative workable option about how some larger examples might have performed and the use to which they were put. Most importantly, it

warns against complacency that accepted function as assigned to stone tools is always correct. It underlines the contribution that experiment and replication can make to improve and expand understanding of stone tool function (see, e.g., Barton & Bergman 1982; Bergman & Newcomer 1983).

The process of creating the haft generated considerable appreciation of the prehistoric examples on which it was based. Neolithic axe hafts that have been recorded from Britain and Ireland share features of common design; a wooden haft with a through mortise into which the axe head was inserted. The hafts from Shulishader, Ehenside Tarn and Etton all incorporate rebates to a greater or lesser degree at the top, base, or both, of the mortise. This process effectively thinned the staves of these hafts to a central band approximately 40–50 mm thick through which the mortise was cut. The design was also repeated in an account of a haft from Glamorgan (Savory 1971), the upper surface of which was recessed around the socket but which rose again at the end of the haft in a similar fashion to the Ehenside Tarn haft. A poorly described and illustrated haft from Bogancloch Aberdeen was also slightly ‘waisted’ around the axe head (Curle 1925). One explanation for this recurring

feature may lie with the fact that by reducing the thickness of the stave, it became easier to produce the mortise. This compromise retained a greater mass of wood where it was most needed, both in front of and behind the axe head, thereby reducing the likelihood of the haft splitting longitudinally, a flaw that accounted for the demise of the Etton haft. The British corpus currently includes no known examples of composite hafts with elaborate bindings, as described in ethnographic studies (Blackwood 1950) or of antler sleeves (Maigrot 2011), known on the European mainland, which plug into a stub mortise. Nevertheless it would be unwise to assume that all hafts in Britain were constructed in the same way, or did share a common design or function. In parts of New Guinea methods of hafting and binding varied significantly. Phillips (1979) noted strong contrasts between the relatively rudimentary hafting of axes designed for work, similar to those from Neolithic Britain, and the elaborate embellishments afforded to the hafts of ceremonial axes. Similarly Sillitoe (1988) described how variations in haft design provided a signature of individual groups within separate areas.



Figure 8. Reconstruction of the snapped blade as used to enlarge and form the mortise. Shown in use on the outside of the wood to demonstrate the efficiency of the tool more clearly



Figure 9 .The finished axe head and haft

Axe heads were undoubtedly practical implements and, in this role, could not have functioned without a haft. Blackwood (1950), referencing axe-using communities in New Guinea, observed that axes formed an integral part of everyday life for most males in the community. She noted that each individual would have been capable and indeed did manufacture their own axe hafts. Some were of more superior quality and more finely finished than others, where the bark was left in place. Nevertheless most craftsmen did at least fashion the haft to fit their grip. Similar trends may well have also existed in prehistoric Britain, where variations in individual skill, degrees of perfectionism or the ultimate function of the axe determined the quality of the end product. Irrespective of these individualities, the production of a haft necessitated production of a mortise that precisely reflected the shape of the axe head; one being useless without the other.

In this purely practical sense, the haft may be seen as being no more than a means of providing leverage for the axe head. However few stone tools have been imbued with as many variations of value, use or symbolism as axe heads, making it possible for some to function without a haft. Pétrequin & Pétrequin

(2011: 335) stressed the importance of understanding the *meanings* in order to understand the *social* role of the axe within a community. That axe heads were multifunctional objects, endowed with prestige, symbolism and power as well as their practical role and as objects of exchange was noted by 19th century antiquaries (Evans 1897: 55). However just as the axe head is regarded as an object of great symbolism, prestige and power, it is possible that the haft itself, and its manufacture, also acquired a symbolic and spiritual role; a stone axe is depicted with its haft carved in the decorated menhir at Table des Marchand, Brittany.

The role of axes, both hafted and unhafted, as objects of significance and meaning is reinforced by evidence that they featured in acts of deliberate deposition. A sufficiently large number of axe heads have been found, some in waterlogged deposits where preservation of hafts would be guaranteed. Those from the Sweet Track, Somerset (Coles *et al* 1974; Coles & Orme 1979) included not only a highly flaked flint example, in mint condition, but also one of jadeitite, an exotic raw material from the Alps, which was possibly already an heirloom at the time of its deposition. Sheridan (1992) speculated that the

deposition of the Shulishader axe head, which showed no signs of use, and its haft, may have been similarly deliberate; an amalgam of Parker Pearson's (2012: 6) life, as represented by wood, and death, by stone. While this argument may be idle speculation, it may have some merit; the axe head of the hafted Ehenside Tarn axe was also undamaged and probably deliberately deposited. Understanding the processes involving the haft from the causewayed enclosure at Etton is more speculative, although objects, including axes or axe fragments were frequently deposited in pits and ditches in a number of such monuments (Wheeler 1943: 166; Saville 2008: table 10.53). It is perhaps just as likely that the haft from Etton was merely discarded as being broken and escaped the understandable view that it was only good for firewood. Nevertheless it is an intriguing possibility that many axe heads from excavated pits and ditches, where no organic material survives, were originally buried with their haft.

The process of making the axe haft was satisfyingly creative. To what extent these creative aspects formed a part of the Neolithic world or were driven by spiritual issues is open to question. The results, documented here, provide only an account of the work undertaken and its success. They do not profess to provide a definitive description of how certain skills were undertaken by Neolithic people but more accurately how a relatively naïve craftsman can achieve acceptable results. In addition they serve to arouse awareness of the importance of handles, not merely axe hafts but an entire range of handles for all types of flint tools. No systematic record was kept of the time taken to manufacture the haft, although collectively production probably took between 3 and 4 days. In the event this is immaterial; the work was undertaken by an individual with limited use of stone tools and a large amount of trial and error. In comparison Blackwood (1950) noted a time of four hours by a craftsman skilled in the use of a stone adze to manufacture an open socket, a less demanding task than the completion of a through mortise, and bind a stone adze blade to its haft. There is undoubtedly a need to repeat the exercise, using a thorough preliminary study of extant hafts, to test the efficiency of hafts in use, assess different types of wood, describe the

results and produce data to repeat, modify or challenge the work described here. The time is ripe to develop more individuals with the necessary craft skills, techniques, experience and inquisitiveness to determine the efficiency of the stone implements in a woodworking role.

The axe and haft were donated to Salisbury and South Wiltshire Museum at Salisbury, together with a copy of the photographic archive. The object now forms part of the public display at the Stonehenge Visitor Centre although regrettably the haft was sanded down for display, removing the finishing traces produced by stone tools.

ACKNOWLEDGEMENTS

The author wishes to thank Pat Shelley for the photographs without which this paper could not have been illustrated. Thanks are also due to Francis Pryor and Maisie Taylor for initiating this work, providing advice, discussion and comment. Francis also provided the green oak for the haft. Thanks are also given to Pippa Bradley and Jens Neuberger of Wessex Archaeology for comments, editorial assistance and translations. Inevitably thanks go to the two anonymous referees, whose comments and suggestions have greatly improved the final text.

REFERENCES

- Anderson-Whymark, H. 2011. Intentional breakage in the British Neolithic: some comments and examples. *Lithics: the Journal of the Lithic Studies Society* 32: 16–22.
- Anderson-Whymark, H. 2013. The struck flint from Area 6. In T. Allen, A. Barclay, A.-M. Cromarty, H. Anderson-Whymark, A. Parker, M. Robinson & G. Jones. *Opening the Wood, Making the Land. The Archaeology of a Middle Thames Landscape: the Eton College Rowing Course project and the Maidenhead, Windsor and Eton Flood Alleviation Scheme*: 148–178. Oxford Archaeology Thames Valley Landscapes Monograph 38, Oxford.
- Barton, R.N.E. & Bergman, C.A. 1982. Hunters at Hengistbury: some evidence from experimental archaeology. *World Archaeology* 14(2): 237–248.
- Becker, C.J. 1945. New finds of hafted Neolithic celts. *Acta Archaeologica* 16: 155–175.
- Bergman, C.A., Barton, R.N.E., Collcutt, S.N. & Morris, G. 1987. Intentional Breakage in a Late Upper Palaeolithic assemblage from

- Southern England. In G. de G. Sieveking & M.H. Newcomer (eds) *The Human Uses of Flint and Chert. Proceedings of the fourth international flint symposium held at Brighton Polytechnic, 10–15 April 1983*: 21–32. Cambridge University Press, Cambridge.
- Bergman, C.A. & Newcomer, M.H. 1983. Flint arrowhead breakage: examples from Ksar Akil, Lebanon. *Journal of Field Archaeology* 10: 238–243.
- Blackwood, B. 1950. *The Technology of a Modern Stone Age People in New Guinea*. Pitt Rivers Museum Occasional Papers on Technology 3. University of Oxford.
- Boisauvert, J.-L., Schifferdecker, F. & Pétrequin, P. 1974. Les villages néolithiques de Clairvaux (Jura, France) et d'Auvernier (Neuchâtel, Suisse). Problèmes d'interprétations des plans. *Bulletin de la Société Préhistorique Française* 71: 355–382.
- Bubberman, F.C. 1972. Stones span the centuries. *Mededelingen Surinaamse Musea* 9. Paramaribo.
- Clark, J.G.D. 1934. Derivative forms of the petit tranche in Britain. *The Archaeological Journal* 91: 32–58.
- Clark, J.G.D. 1963. Neolithic bows from Somerset, England, and the prehistory of archery in north-west Europe. *Proceedings of the Prehistoric Society* 29: 50–98.
- Clarke, A. 1989. The Skaill knife as a butchery tool. *Lithics: the Journal of the Lithic Studies Society* 10: 16–27.
- Clutton-Brock, J. 1984. *Excavations at Grimes Graves, Norfolk 1972–1976. Fascicule 1 Neolithic antler picks from Grimes Graves, Norfolk and Durrington Walls, Wiltshire: A biometric analysis*. British Museum Publications.
- Coles, J.M. 1979. An experiment with stone axes. In T.H. McK Clough & W.A. Cummins (eds) *Stone axe studies. Archaeological, petrological, experimental and ethnographic*. Council for British Archaeology Research Report 23: 106–107.
- Coles, J.M., Hibbert, F.A. & Orme, B.J. 1973. Prehistoric roads and tracks in Somerset: 3 The Sweet track. *Proceedings of the Prehistoric Society* 39: 256–293.
- Coles, J.M. & Orme, B.J. 1977. Neolithic hurdles from Walton Heath, Somerset. *Somerset Levels Papers* 3: 6–29.
- Coles, J.M. & Orme, B.J. 1979. The Sweet Track: Drove Site. *Somerset Levels Papers* 5: 43–64.
- Coles, J.M., Orme, B.J., Bishop, A.C. & Woolley, A.R. 1974. A jade axe from the Somerset Levels. *Antiquity* 48: 216–220.
- Curle, J. 1925. Notes on a primitive weapon or tool, fashioned by fixing a stone in a wooden shaft found in a moss at Bogancloch, Parish of Rhynie, Aberdeenshire. *Proceedings of the Society of Antiquaries of Scotland* 59: 18–20.
- Darbishire, R.D. 1874. Notes on the discoveries in Ehenside Tarn, Cumberland. *Archaeologia* 44: 273–292.
- Evans, J. 1897. *The Ancient Stone Implements, Weapons and Ornaments of Great Britain*, 2nd edition. Longmans, London.
- Fluck, H. 2007. Initial observations from experiments into the possible use of fire with stone tools in the manufacture of the Clacton point. *Lithics: the Journal of the Lithic Studies Society* 28: 15–19.
- Gibson, A. 2002. *Prehistoric Pottery in Britain and Ireland*. Tempus.
- Grace, R. 1992. Use wear analysis. In F. Healy, M. Heaton & S.J. Lobb Excavations of a Mesolithic site at Thatcham, Berkshire. *Proceedings of the Prehistoric Society* 58: 41–76.
- Green, H.S. 1980. *The flint arrowheads of the British Isles*. British Archaeological Reports 75. Oxford.
- Hafner, A. & Suter, P. 2003. Das Neolithikum in der Schweiz. www.jungsteinSITE.de, 27. November 2003. http://www.jungsteinsite.uni-kiel.de/pdf/2003_hafnersuter_text.pdf
- Harding, A. & Young, R. 1979. Reconstruction of the hafting methods and function of stone implements. In T.H. McK Clough & W.A. Cummins (eds) *Stone axe studies. Archaeological, petrological, experimental and ethnographic*. Council for British Archaeology Research Report 23: 102–105.
- Harding, P. 1987. An experiment to produce a ground flint axe. In G. de G. Sieveking & M.H. Newcomer (eds) *The Human Uses of Flint and Chert. Proceedings of the fourth international flint symposium held at Brighton Polytechnic, 10–15 April 1983*: 33–6. Cambridge University Press, Cambridge.
- Hansen, P.V. & Madsen, B. 1983. Flint axe manufacture in the Neolithic. An experimental investigation of a flint axe manufacture site at Hastrup Vænget, East Zealand. *Journal of Danish Archaeology* 2: 43–59.
- Hattat, R. 1984. An experimental hafting of a pebble hammer with hour-glass perforation. *Lithics: the Journal of the Lithic Studies Society* 5: 21–23.
- Holsten, H. & Martens, K. 1991. Die Axt im Walde. Versuche zur Holzbearbeitung mit Flint, Bronze und Stahlwerkzeugen. In M. Fansa (ed.) *Experimentelle Archäologie. Bilanz 1991*. Archäologische Mitteilungen aus Nordwestdeutschland, Beiheft 6: 231–243. Oldenburg, Isensee.

- Iversen, J. 1956. Forest clearance in the Stone Age. *Scientific American* 194: 36–41.
- Lobisser, W. 2005. Zum Nachbau eines linearbandkeramischen Brunnenkastens mit Werkzeugen aus Holz, Stein und Knochen. In M. Fansa (ed.) *Von der Altsteinzeit über „Ötzi“ bis zum Mittelalter. Ausgewählte Beiträge zur Experimentellen Archäologie in Europa von 1990–2003. Experimentelle Archäologie in Europa, Sonderband 1*: 241–254. Oldenburg, Isensee.
- Madsen, B. 1984. Flint axe manufacture in the Neolithic: Experiments with grinding and polishing of thin-butted axes. *Journal of Danish Archaeology* 3: 47–62.
- Maigrot, Y. 2001. Le débitage du bois de cerf au Néolithique final à Chalain et Clairvaux (Jura, France). Approche expérimentale. In L. Bourguignon, I. Ortega & M.C. Frère-Sautot (eds) *Préhistoire et approche expérimentale*: 165–172. Montagnac, Monique Mergoil.
- Maigrot, Y. 2003. Etude technologique et fonctionnelle de l' outillage en matières dures animales, la station 4 de Chalain (Néolithique final, Jura, France). Thèse de Doctorat, Paris, Université de Paris I.
- Maigrot, Y. 2011. Neolithic polished stone axes and hafting systems: Technical use and social function at the Neolithic lakeside settlements of Chalain and Clairvaux. In V. Davis & M. Edmonds (eds) *Stone Axe Studies III*: 281–294. Oxbow, Oxford.
- Mandal, S., O'Sullivan, A., Byrnes, E., Weddle, D. & Weddle, J. 2004. Archaeological experiments in the production of stone axeheads. In E.A. Walker, F.F. Wenban-Smith & F. Healy (eds) *Lithics in Action*: 116–123. Oxbow, Oxford.
- Meier, M. 1990. Das Arbeiten mit neolithischen Felsgesteinbeilen. In M. Fansa (ed.) *Experimentelle Archäologie in Deutschland. Archäologische Mitteilungen aus Nordwestdeutschland, Beiheft 4*: 273–278. Oldenburg, Isensee.
- Mitchell, J. 1996. Studying biface butchery at Boxgrove: Roe deer butchery with replica handaxes. *Lithics: the Journal of the Lithic Studies Society* 16: 64–69.
- Newcomer, M.H. 1971. Some quantitative experiments in hand axe manufacture. *World Archaeology* 3: 85–94.
- Palomo, A., Pique, R., Terradas, X., Lopez, O., Clemente, I. & Gibaja, J.F. 2013. Woodworking technology in the early neolithic site of La Draga (Banyoles, Spain). In P.C. Anderson, C. Cheval & A. Durand (eds) *Regards croisés sur les outils liés au travail des végétaux. An Interdisciplinary Focus on Plant-working Tools. XXXIII Rencontres Internationales d'Archéologie et d'Histoire d'Antibes*: 383–396. APDCA, Antibes.
- Parfitt, K. 2014. A land archaeologist goes to sea. *Current Archaeology* 24(11): 44–45.
- Parker Pearson, M. 2012. *Stonehenge. Exploring the greatest Stonehenge mystery*. Simon and Schuster, London.
- Pétrequin, P. & Pétrequin, A.-M. 1988. *Le Néolithique des lacs. Préhistoire des lacs de Chalain et de Clairvaux (4000–2000 av. J.-C.)*. Paris.
- Pétrequin, P. & Pétrequin, A.-M. 2011. The twentieth-century polished stone axeheads of New Guinea: why study them? In V. Davis & M. Edmonds (eds) *Stone Axe Studies III*: 333–349. Oxbow, Oxford.
- Phillips, P. 1979. Stone axes in ethnographic situations: some examples from New Guinea and the Solomon Islands. In T.H. McK Clough & W.A. Cummins (eds) *Stone axe studies. Archaeological, petrological, experimental and ethnographic*. Council for British Archaeology Research Report 23: 108–112.
- Piggott, S. 1954. *The Neolithic Cultures of the British Isles*. Cambridge.
- Richards, J. 1990. *The Stonehenge Environs Project*. English Heritage Archaeological Report 16. Historic Buildings and Monuments Commission for England, London.
- Saville, A. 2008. The flint and chert artefacts. In R. Mercer & F. Healy *Hambledon Hill, Dorset, England. Excavation and survey of a Neolithic monument complex and its surrounding landscape*: 648–743. English Heritage Archaeological Reports.
- Savory, H.N. 1971. A Neolithic Stone Axe and Wooden Handle from Port Talbot. *Antiquaries Journal* 51(2): 296–297.
- Semenov, S.A. 1964. *Prehistoric Technology. An experimental study of the oldest tools and artefacts from traces of manufacture and wear. Translated, and with a preface by M.W. Thompson*. Adams and Dart, Bath.
- Sheridan, A. 1992. Scottish stone axeheads: some new work and recent discoveries. In N.M. Sharples & A. Sheridan (eds) *Vessels for the ancestors: essays on the Neolithic of Britain and Ireland in honour of Audrey Henshall*: 194–212. Edinburgh.
- Sillitoe, P. 1988. *Made in Niugini. Technology in the Highlands of Papua New Guinea*. British Museum Publications, London.
- Smith, I.F. 1965. *Windmill Hill and Avebury. Excavations by Alexander Keiller 1925–1939*. Clarendon Press, Oxford.
- Taylor, M. 1998. Wood and bark from the enclosure ditch. In F. Pryor *Etton*.

- Excavations at a Neolithic causewayed enclosure near Maxey, Cambridgeshire, 1982–7*: 115–160. English Heritage Archaeological Report 18.
- Taylor, M. 2011. Woodworking at the Long Barrow. In J. Harding & F. Healy (eds) *The Raunds Project. A Neolithic and Bronze Age Landscape in Northamptonshire. Volume 2 Supplementary Studies*: 405–413. English Heritage CD.
- Tegel, W., Elburg, R., Hakelberg, D., Stäuble, H. & Büntgen, U. 2012. Early Neolithic water wells reveal the world's oldest wood architecture. *PLoS ONE* 7(12): e51374. doi:10.1371/journal.pone.0051374.
- Versteeg, A.H. & Rostain, S. 1999. A hafted Amerindian stone axe recovered from the Suriname River. *Mededelingen Surinaams Museum* 55.
- Wheeler, R.E.M. 1943. *Maiden Castle, Dorset*. Reports of the Research Committee of the Society of Antiquaries of London 12. Oxford University Press, Oxford.
- Weiner, J. & Pawlik, A. 1995. Neues zu einer alten Frage. Beobachtungen und Überlegungen zur Befestigung altneolithischer Dechselklingen und zur Rekonstruktion bandkeramischer Querbeiholme. In M. Fansa (ed.) *Experimentelle Archäologie. Bilanz 1994*. Archäologische Mitteilungen aus Nordwestdeutschland, Beiheft 8: 111–144. Oldenburg, Isensee.