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Field Trials in Neolithic Woodworking – (Re)Learning to Use Early Neolithic Stone Adzes

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Excavations of several Early Neolithic wells with excellent preservation of the wooden lining in the past years have made clear that Stone Age woodworking already attained a very high

level of perfection. This poses the question how it was possible to execute this type of work with the means available at that time. To find an answer we started an ongoing series of experiments with replicas of Neolithic stone and bone tools, to understand prehistoric craftsmanship, integrating all available archaeological evidence. Besides flawless tools, the key to success lies in rediscovering the way to handle them and a serious amount of experience.

> What initially started as a quite spontaneous action to answer a basic set of questions developed into an ongoing series of experiments with a much broader scope which have resulted in a large body of data. After four field experiments we can conclude that it is perfectly feasible to fell even large hardwood trees with copies of Early Neolithic adzes, as well as other Neolithic stone tools.

Dedicated to Hugo Windl, on the occasion of his 70th birthday.

Early Neolithic polished stone tools

As the Neolithic was first defined in 1865, it was done without any regards to agriculture, sedentarism, pottery and all other innovations, now known to be associated with the Neolithic transition, but on the basis of the occurrence of polished stone tools (Lubbock 1865, 3). In many ways the polished stone axe or adze is indeed emblematic for this new way of life, which was introduced to Central Europe in the middle of the sixth millennium BC. It was a prerequisite for the clearing of the land to create fields and settlements. In many aspects, including the felling of the trees for the construction of the first permanent architecture and the production of agricultural tools, the Stone Age is a Wood Age. The first farmers, inhabiting the fertile loess-soils in Central Europe, were the carriers of the Linear Pottery Culture (LPC), more commonly designated as LBK for the acronym of the German *Linearbandkeramik* (for an older but still valid overview in English: Modderman 1988). Apart from the eponymous pottery, decorated with curves and spirals, they introduced diverse crops, domestic animals, timber-built longhouses and polished stone tools to the region. Such tools are of a typical shape with a very pronounced asymmetrical section, characterized by a domed upper side and a flat bottom with a distinct bevel towards the cutting edge (See Figure 1). This shape, as well as hafting traces and use-wear, is clearly indicating that they were hafted as adzes with the cutting edge perpendicular to the handle instead of parallel as in axes. There are two general forms: a flat, mostly broad blade, known in the older literature as *Flachhacke* or flat hoe, and a higher, often narrower variety, formerly known as *Schuhleistenkeil* or shoe-last celt. According to the most recent classification (Ramminger 2007) four types are distinguished, based on the absolute width of the blade in combination with the height-breadth-ratio. A respective index is calculated by dividing the thickness of the blade by its breadth, multiplied by 100.

The most common type (type two) is the flat blade with a height-breadth-index (HBI) of less than 50, which means that the breadth is more than two times the height. In contrast to type two the medium high blades of type three have a breadth between one and two times the height (HBI between 50 and 100). The high, mostly quite narrow (between 30 and 40 mm) adzes of type four have a height that exceeds its width (index >100). Type one blades are characterized by a width of less than 20 mm. Although it is not a classifying characteristic, nearly all type one blades have a HBI larger than 50, mostly even around 100. As these narrow blades are mostly quite short, often less than 50 mm, they look like miniatures of type three or four blades and are often regarded as children's toys or non-functional amulets. Four more or less clearly delineated clusters can be recognised, if for larger series of adzes the height-breadth-index is plotted against the absolute breadth in a diagram (See Figure 2). This supports the validity of the classification and it can be assumed that the four types have had different specialised functions.

Towards the end of the LBK, around 5000 BC, the first perforated tools appear. Initially they retain the form of 'shoe-last' adzes, but becoming broader with a more rectangular cross-section resulting in the well-known broad wedges ('*Breitkeil*') of the Rössen Culture during the Middle Neolithic (See Figure 3). The perforations in these frequently very heavy axes are remarkably small, often not more than 15 mm in diameter. They are always drilled parallel to the cutting edge, suggesting more axe-like handling (Raemaekers et al. 2011). In Central Europe the use of genuine axes hafted with the cutting edge parallel to the handle starts to appear only in the fifth millennium and becomes the dominant heavy woodworking tool with the emergence of the Michelsberg culture in western Central Europe in the second half of the fifth millennium. At the same time we see the development of polished flint axes in Northern Europe with the emergence of the Funnel Beaker Culture.

Archaeological evidence

Although the Early Neolithic polished stone tools have long been seen as parts of primitive ploughs or hoes for tilling the earth, it is now widely accepted that these are specialised woodworking tools with a wide range of uses. However, it is often questioned whether an adze can be used for felling trees. Even a specialist like Modderman (1988, 106) writes "I doubt whether trees were ever felled with LPC adzes. There are, after all, other methods of doing this", leaving open to the imagination of the reader which methods these could be and in which way the enormous amounts of wood that were necessary for the construction of the well-known longhouses had been harvested. The amount required has been estimated at a staggering 52 solid cubic metres with a total length of 1200 metres (Luley 1992, 64). Generally, reconstructing the use of LBK adzes is severely hindered by two circumstances: firstly no complete adze, consisting of a stone blade still lashed to its wooden handle, has been found yet and secondly there is only a very restricted amount of timber known from the Early Neolithic on which the toolmarks can be studied. In both cases, the sparse evidence comes from the few LBK-wells found in the last decades in waterlogged conditions under the groundwater level, where parts of the wooden lining and some organic finds werepreserved (Tegel et al. 2012). These constructions made clear that woodworking in the LBK had already reached a very high level of perfection, with sophisticated carpentry joints and the ability to fell trees with a diameter of over a meter and the successive cleaving of the trunks, as well as trimming and dressing of the thus produced timbers. Currently the best available evidence for woodworking comes from the well found in Altscherbitz near Leipzig in Eastern Germany, which has been dated dendrochronologically to around the end of the 51st century BC (Tegel et al. 2012). This well was blocklifted from the archaeological excavation and subsequently excavated under laboratory conditions, using sophisticated methods like complete 3D-recording and documentation of the finds using a laser scanner. On several timbers from the lining, toolmarks produced by at least two different tools can clearly be distinguished (See Figure 4). The sides were partially dressed using a tool, very probably a flat bladed adze of type two, with a cutting edge of at least 50 mm wide, whereas the split timber was trimmed to length using a much narrower and higher blade, leaving marks with a width of less than 20 mm, which would suggest the use of a tool with a blade of type one.

From the same well comes the best evidence for the hafting of LBK adzes (Elburg 2008). In a layer a few decimetres above the level of complete organic preservation a stone blade of type two was found with, in the adjoining sediment, the imprint of a decayed wooden handle still visible. This find allowed the identification of two wooden objects from other Early Neolithic wells as hafts of adzes. All three handles are of a unique common morphology, for which no archaeological or ethnographic parallels are known. Whereas the head of the haft on which the blade is attached in all known haftings of stone adzes always forms an acute angle with the handle as in modern steel adzes, in this case the angle is obtuse, between 95 and 115° (See Figure 5). As all three known LBK-hafts, as well as a possible discarded rough-out from the well from Altscherbitz, show this peculiarity, it seems that this was the (or at least a) customary way to haft the flat blades of type two.

Experimental archaeology and ethnography

Work involving stone axes goes back to the very beginnings of experimental archaeology in the 1870s with the work of Frederik Sehested in Denmark, which consisted of building a log-cabin using flint tools (Steensberg 1986, 149-151). Later work also focussed on the felling of trees using either original blades (Jørgensen1985; Potratz 1941) or modern replicas (Choulot et al. 1997; Holsten and Martens 1991; Meier 1990). In all cases, however, parallel hafted axes were used. Hardly any experimental work involving adzes had been carried out or at least been published in full. Moreover, respective articles never contain much information about the handling of the tools or a critical review of the work-flow (Böhm and Pleyer 1990; Weiner 1986). The few reports found on the Internet (such as Albrecht w.y.) are not really usable as a reference, as they have been carried out on thin softwood trees.

Although stone axes and adzes have been used well into the 20th century particularlyin Oceania, many aspects of their use are still poorly understood and have been insufficiently documented in ethnological context. The ethnographic literature is full of descriptions of stone and shell adzes from Oceania, particularly New Guinea, but hardly anything is published on the use of the tools in felling trees (e.g. Hinderling 1949; Blackwood 1950). Mostly only a few photos are shown and longish descriptions are given of the manufacture of the blades and their hafting. Only one author provides a more precise account of the actual utilisation, but the tool used is a crossover between a stone axe and an adze, with the blade set in an angle of approx. 30° to the handle (Steensberg 1980; 1986). On the other hand, the work of Pétrequin and Pétrequin (1993 especially Figure 313) demonstrates that it is possible to fell large hardwood trees using a stone adze. The main question remaining is if these findings can be directly applied to the European Early Neolithic.

Against this background, username ‘rolfpeter’ started a discussion in the fall of 2010, on the mostly experimental archaeology oriented internet forum 'archaeoforum.de', by asking if there was anything known about how large trees were felled in the Early Neolithic, when only adzes had been available. Quickly the conclusion was reached that hardly anything was known and a field trial with reconstructed LBK-adzes was urgently needed. An ample number of the forum's members volunteered for such an action. Based on the scant information available, the first set of questions was quite basic:

- Can large hardwood trees like oaks with a diameter of 50 centimetres and more be felled using stone adzes?
- How were these tools hafted?
- Which cutting techniques are employed?
- How can the thoroughly documented toolmarks on the original timbers from the LBK-wells be replicated experimentally?

The most critical point in most of such experiments, namely finding some woodland where one can legally cut down quite large oaks, was solved amazingly quickly. Via the late Werner Scharff, contact was established with the Archaeological Association Ergersheim and Surroundings and thus with the municipality of Ergersheim (district Neustadt an der Aisch-Bad Windsheim, central Franconia, Bavaria, Germany). There, a number of oaks with the desired diameter were made available. The forest where the experiments are carried out is located to the north-east of the village of Ergersheim, around 49° 32’ N/10° 21’ E and belongs to the western part of the Steigerwald Forest. It is traditionally managed, presumably continuously since the Middle Ages, as a coppice-with-standards, dominated by oak. The sections, several hectares in size, are harvested on a rotation of around 30 years. The wood is nearly exclusively used as firewood; only the very best and mature standards are milled for timber. The fieldwork takes place towards the end of the felling season in late March, as the annual plot is cleared from coppice and undergrowth with only the standards left. This is quite an ideal situation, as there is ample space to work and document and there is very little chance of the felled trees catching in the crowns of the wide-spaced standards. The trees used in the felling experiments have a diameter ranging from 25 to 55 centimetres and are aged between approx. 90 to 120 years, having been left as standards for two or three periods, which is clearly recognizable in the rhythm of wider and narrower growth rings in the wood.

Reconstructions

One of the present authors (WH) made a number of replicas of all four types of LBK adzes. Most blades were manufactured from erratic stones from the beach of the Baltic Sea, presumably a type of diabase, although a precise identification still has to be conducted. A few blades were made out of actinolite-hornblende schist from the Jizera Mountains in Eastern Bohemia (Přichystal2013, 192-195), the most widely used raw material for polished stone tools in the LBK. It is characterised by great toughness and can be ground to a very fine edge, making it one of the best raw materials for the manufacture of adze blades. Before the blades were hafted a detailed documentation was made including micro-photos of the cutting edges and high-resolution 3D-laser scans to be used as a reference for future use-wear studies.

The design of the hafts for the type three and four blades largely follows the theoretical and practical considerations of Jürgen Weiner (Weiner and Pawlik 1995). The angle between the head of the hafting and the handle was a bit under 60° (type three, Figure 5 first from the right) and 70° (type four, Figure 5 second from the right), based on publications of New Guinea haftings. In one publication (Blackwood 1950) the angles of ten haftings are listed, ranging from 46° to 76°, with an average of 62°, in another paper (Godelier and Garanger 1973) the measurements for eight adzes are given, ranging from 53° to 88°, averaging 70°. In the latter work it is explicitly stated, that there is no relation between the size and the weight of the blade and the angle of the haft. For the flat type two adzes two different forms of haftings were made, one following the 'classical' design known from ethnography and later archaeological finds (cf. Müller-Beck 1965 30-38) with an acute angle between the blade and the handle (See Figure 5 3rd and 4th from the left) as well as one based on the obtuse haftings from the bandceramic wells (see above; Figure 5 in the centre). For the very small blades of type one, copies of an original found in the well from Altscherbitz (See Figure 1, first from the right), also two alternative hafts were produced. The first one broadly follows known forms from lake-side settlements of very light adze-handles (See Figure 5, second from the left). The second one is much more massive and the blade is set, following hafting-polish on the original, with its butt in a socket in the wood, lying on a slightly protruding tongue. The heavy head of the more or less hammer-shaped hafting compensates for the lack of weight of the stone blade (See Figure 5, first from the left). All lashings were made with commercially available, probably chemically tanned, leather strips.

Fieldwork

The first field-trial was conducted in March 2011 and was a success in most respects, although according to Murphy's Law, nearly everything that could go wrongdid go wrong. For the first felling experiment, an oak with a diameter at breast height of 42 centimetres was selected. Contrary to what is mostly seen with archaeological experiments, the falling direction of the tree was controlled by cutting two opposing notches (directional notch and a back-cut slightly higher up the trunk to give a good hinge) instead of a continuous, circling groove around the circumference of the tree. This results in a pencil like point to the trunk, which gives no control over the direction the tree will fall (see Potratz 1941, Tafel 140). The main difference in cutting down a tree with an adze compared to an axe, is that all strokes are delivered overhead, which leaves the lower side of the notch looking like a brush as none of the splinters is cleanly cut off at the base (See Figure 6). A complicating factor of the use of a stone tool compared to a metal blade is the fact that the cutting has to be done in a much steeper angle, always with the grain of the wood and that the chips are removed more by cleaving than by cutting (cf. Jørgensen1985, 33; Müller-Beck 1965, 131). As only one of the authors and none of the participating volunteers had any previous experience in cutting wood with a stone adze, quite some time was required to get used to the work. This resulted in many uncontrolled strokes, which put a large strain on the tools, causing damage to the lashings which had to be rebound frequently. A more structural problem was the angle of the hafting of the type three blade, designated as the main felling tool, which at 60° was clearly too narrow. This induced a disproportional strain on the top of the blade, resulting in the breaking-off of the bevelled underside. After replacement of the blade by an identical specimen, the cutting edge broke in exactly the same manner. Thus demonstrating that the breaking-off was not the result of an invisible flaw within the stone. The first blade could be used again after regrinding and polishing, but on the second day the strain on the supporting wood of the head became too heavy, resulting in unrepairable breakage. The angle on the handle of the type four blade of 70° was adequate, but here a flaw in the wood of the handle resulted in a cross fracture, which could be provisionally repaired with the aid of very modern epoxy glue. A replacement haft, made from freshly cut wood was of no use, as it broke after just a few strokes. All in all it took well over eight hours, spread over three days, to fell the tree, leaving only very little time for the planned processing of the wood like cleaving, trimming and dressing (cf. Weiner and Lehmann 1998). The only other tools employed were the small type one adzes. The blade hafted in the heavy, hammer-like handle turned out to be extremely effective for debranching and trimming, leaving marks closely resembling those on the original planking of the wells.

Documentation of the whole process was carried out by photo and film, and for the recording of the development of the felling notches, a reflectorless total-station was used. Although the data collected with this instrument were usable, the measurements were taking too long, causing extended forced breaks in the work. In combination with the unskilled workers, the very tiring overhead work and flawed tools, this taught us a very thorough lesson of how not to fell a tree with stone adzes and provided ample suggestions how things could and should be improved the next time.

The following year several aspects of the toolkit were optimized. The heavy blades were set in handles with an angle between 70 and 80°, the lashings being made with rawhide, resulting in a tighter yet slightly elastic binding, but the most important factor was the familiarisation with the unusual tools. This time a massive oak with a diameter of 55 cm and thus a cross-section of approx. 0.24 m^2 was felled in less than five hours, which is a remarkable improvement compared to the eight hours for 0.14 m^2 in the previous year. Parallel to this work, a comparable tree was cut with a copy of a Roman steel axe, which took a bit more than one hour to fell. This agrees well with the figure given for a similar test carried out in New Guinea by Papuas skilled in the handling of stone adzes as well as steel tools (Godelier and Garanger 1973). The major difference was that on our tree cut with stone adzes, up to three persons had been working simultaneously, whereas the steel axe was swung by only one man used to such work. This gives an interesting insight into how much learning and experience matters. For more reference material, a thinner tree was felled with a parallel hafted flint axe. Here the notch was clearly lower on the trunk, just above the point where the root wood started and was less wide as compared to those produced with the adzes, thus giving a larger yield of timber.

Much time was devoted to finer woodworking during the 2012 season of experiments. To this end a large oak was felled some days before with a chainsaw. This gave the wood time to develop first drying cracks, showing where it could best be split. These initial cracks were widened with antler wedges. For the splitting itself, large hardwood wedges, as commonly found in Neolithic lake-side settlements (see De Capitani et al. 2002), but also from the LBK-well from Erkelenz-Kückhoven (pers. comm. J. Weiner), and large wooden mallets were used. The resulting long planks were cut to length using the heavy-hafted miniature adze-blade, resulting in identical forms and toolmarks as found on the ends of the original timbers (See Figure 4). The aim was to reproduce the basal frame from the Altscherbitz well, consisting of four timbers connected with tusked mortice-and-tenon joints and one layer of logs with interlocking recesses, as in log cabin construction, and similar to how the rest of the wooden lining is constructed (Tegel et al. 2012, figs. 4 and 5). Several tools were tested for the cutting of the recesses. For this work all adzes performed poorly as it is nearly impossible to work against the grain of the wood with the relatively blunt edges of stone tools. The depth up to which can be worked is limited by the length of the blade protruding from the haft. Best results were obtained with bone chisels.

The toolmarks which occurred on the worked wood are identical to the traces which had been found on the mortices and the cogged joints of the wood lining of the Altscherbitz well. This strongly suggests that bone chisels had been used for carpentering. Next to stone and antler, bone is one of the most important materials for crafting tools in the Neolithic. For all their simplicity, the different forms of bone tools are sophisticated devices, fully adapted to their tasks, resulting in very little variation during the whole span of the Neolithic. For example, nearly identical massive bone chisels have been found in the LBK settlement of Müddersheim (ca. 5200-5000 calBC, Schietzel 1965 Taf. 15) and in the settlement of Sipplingen-Osthafen of the Horgen Culture (2925-2855 denBC, Probst in prep.). Both chisels are made of the metatarsal of an animal the size of a cow. In spite of the high number of bone tools, they are still underestimated within the archaeological research. By the Ergersheim Experiments we are able to prove, that bone tools are much more durable than anyone thought before. For example in 2012 we started to work with a bone chisel made of a moose metatarsal. Because of the sub-zero temperatures in 2013 two cracks appeared at the side, but it didn't break. Thus, in 2014 we could continue to work with this tool. Over that weekend, part of the edge cracked apart, but it is still good to handle and work with (See Figure 7). Until now it has lasted about 32 hours of work, including 15 working hours with the two cracks at the side. In 2015 we will still keep on working with that moose chisel and hope it will finally break apart irreparably. Without freezing temperatures in 2013 the moose chisel probably would have lasted at least twice or three times longer.

Most surprising were the results of the trials with the obtuse-hafted flat-broad blades. As no parallels are known for such tools, their function and handling was a complete mystery. Several suggestions were made ranging from a specialised tool for overhead work, a kind of plane that was used in a shoving manner, throwing axe or, inevitably, an Early Neolithic golf club. All methods of use, be it for cutting the recesses or use as a plane were very ineffective and can be performed much more effectively with other types of tools. Finding an answer required quite some rethinking. As the hafting was for a flat-broad blade found in a well where the timbers showed toolmarks most probably left by such a blade, it must clearly have been used for surface work. Trying to find the most effortless way to handle such a tool and bringing the blade in a position in which it could have left such marks, we laid a split plank on the ground, stood astride over it and swung the tool between our legs (See Figure 8). This worked remarkably well with the cutting edge grazing the surface, removing thin slivers of wood, not unlike the shavings produced by a plane and leaving a clean surface with very shallow toolmarks perfectly replicating those on the Neolithic planks. Within the team the tool is colloquially known as the '115', after the obtuse angle between the handle and the blade, but should functionally be called a planing adze. Judging by the large number of type two adze blades found in LBK-settlements and the fact that all known haftings are of the obtuse variety, it can be concluded that this kind of work must have been very common during the Early Neolithic. In all we concentrated more on the work and spent less time on elaborate documentation, although the stumps and planks produced were, like the year before, transported to the laboratory and recorded with a 3D-laser-scanner to compare the toolmarks with the original timbers.

During the 2013 series of experiments we were met by freezing conditions, seriously impeding the work. As the wood froze and the bone tools became brittle from the cold, we had to discontinue the finer woodworking and concentrated on the felling. This year saw the introduction of a new piece of equipment: the Middle Neolithic broad wedge (See Figure 3). Several previous experiments had been carried out with this type of tool, with mixed outcomes. Štelcl and Malina (1970, 50-52; Taf. 31-33) successfully felled 100 trees with an average diameter of 16 cm using 'hammeraxes' as they described them. Recently an experiment on a much smaller scale was carried out in the Netherlands, which gave less convincing results (Raemaekers et al. 2011). Often these axes are seen as wedges for splitting wood, as the traditional name indicates. But as hard as we tried, it was impossible to drive the blunt edge into wood, neither by swinging nor by keeping the blade in place with the relatively thin handle and hitting the heel with a heavy wooden mallet. This matches the Dutch results (ibid.) and stands in strong contrast to our own experience using antler chisels and wooden wedges to split even very large trees. Slightly better results were obtained when using the 'wedge' to dress a beam. To this end, notches were cut at approx. 60 cm intervals in the trunk of a felled oak with a diameter of 25 cm. Subsequently the wood between the notches was removed by cleaving it tangentially. Getting an even surface would have demanded a lot of reworking as the broad head of the axe makes it impossible to split off the wood at the base of the notches, leaving deep grooves in the face of the beam. Cutting the notches showed that it should be possible to fell a tree without much problems, which was then done. As the broad wedge can be handled like a modern axe despite its blunt edge, the movements were much more familiar than the overhead cutting with an adze. After a cautious start, afraid the relatively thin handle would break under the hammering blows with a one-kilo head on solid oak, we soon drove the axe with full swing in the tree. Although it felt more like hammering than woodcutting, it was possible to keep the felling notch much narrower than with the adzes, greatly reducing the amount of wood that had to be removed (See Figure 9). Instead of producing chips, the broad wedge creates a kind of coarse sawdust as the cuttings are relatively thin and more or less disintegrate on detachment. This seems typical when cutting perpendicular to the grain of the wood with stone blades (Arnold 2003, 44). The first tree with a diameter of 25 cm fell after a bit more than an hour; a second tree with a diameter of 35 cm took nearly two hours. The thin handle made of elmwood and the perforated head easily withstood this prolonged 'tree bashing' and the cutting edge hardly showed any traces of wear.

Again all work was recorded in detail with photos and on film and the resulting stumps were laser scanned in the 3D-laboratory for later reference.

During the fieldwork in 2014 we concentrated on the documentation of the toolmarks and the development of the felling notches on the one hand and finer woodworking, predominantly using bone chisels, on the other. To compare the traces left by different tools, four oaks were cut down. On one of these, flint axes of the Northern European type, was used

(See Figure 10), another two were felled with broad wedges and one was cut down again using adzes. For the documentation of the notches we had a portable Artec EVA 3D-scanner at our disposal, provided by the Archaeological Heritage Office of Saxony in Dresden. After an initial scan of each tree before the work started, recordings of the developing notch were made at regular intervals, thus documenting the change in size and shape and the volume of material removed. After some problems due to strong sunlight, a work-flow was established which only minimally impeded the work and resulted in detailed 3D-models of all stages of the work. Also representative samples of the chips produced by the different tools were collected for later analysis and comparison with archaeological finds.

To broaden the experience gathered with the 'broad wedge' a second copy was produced. This one was substantially larger and heavier (length 24 cm, weight 2.5 kg), made after an example of the largest and slightly more slender archaeological specimens. Due to its length and weight it was considerably harder to handle. This resulted after only a short time in an ill-directed blow, which took off a large part of the cutting edge, again demonstrating that stone tools are anything but indestructible when improperly used.

As the cold weather of the previous year rendered the work impossible, a major part of the team again concentrated on the finer woodworking. A large oak, felled a few days earlier, was split into long planks using wooden wedges. From these a copy of the basal frame of the Altscherbitz well was produced including the tusked tenon joints, showing toolmarks identical to the original.

Conclusions and perspectives

What initially started as a quite spontaneous action to answer a basic set of questions developed into an ongoing series of experiments with a much broader scope which have resulted in a large body of data. After four field experiments we can conclude that it is perfectly feasible to fell even large hardwood trees with copies of Early Neolithic adzes, as well as other Neolithic stone tools. Even so, experiments such as these have to be regarded critically, as is made clear by the use of the different types of haftings. In the absence of archaeological examples, we adapted the type of handle for the heavy adzes of types three and four to our way of working. This resulted in a functioning tool but which can't be used to prove anything about Early Neolithic woodworking. Here we have to wait for an original handle to be found before we can draw any definitive conclusions. With the idiosyncratic 115° degree haftings for the flat-broad type two adzes, it is just the other way around. Here we had possible handles without any parallels in the ethnographic or archaeological record and no idea of how they might have been used. The light, effortless movement of its use as a planing adze, replicating the original marks on the archaeological timbers, is a very strong indication that this is actually the way these tools were hafted and employed. The case for the narrow type one blades is still somewhat inconclusive. The hammer-headed hafting makes for a surprisingly efficient tool which, when used for the same kind of work as in the Early Neolithic, leaves exactly the same marks on the wood. We take this as a strong indication that blades of this type have been hafted in a similar way and it certainly proves they are functional tools and not some kind of toy or amulet.

As for the comparison of the effectiveness of the various tools and the time needed for the execution of different tasks, another caveat is in order. The reduction of time spent on the felling of comparable trees with adzes over the years, shows clearly that learning how to handle such a tool is the single most important factor. By clocking the work, you mostly measure the skill (and fitness) of the worker and little else. Although by now we are getting some practice in the use of stone woodworking tools, we can never hope to attain the proficiency of native Early Neolithic lumberjacks. This renders futile any attempts based on experiments like these to calculate the actual amount of time necessary for the construction of e.g. Neolithic houses; at the best it gives a broad indication of energy invested.

Despite these critical notes, the experiments have brought new light into the obscurity of prehistoric woodworking. For the coming years the main focus of our work will be the analysis of the large volume of data gathered. Here it is planned to do a detailed study of the experimental chips in relation to those from archaeological contexts (cf. Müller-Beck 1965 134-135), as well as a comparison of the toolmarks left by the individual tools using the 3D-scans. Another topic will be the study of ethnographic films on woodcutting to find out if evidence for the handling of stone tools similar to those used in European prehistory can be found. And of course we will continue the fieldwork as only practice makes perfect.

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Link(s)

Stone Age Timber - Ergersheim Experiments 5
Tree-felling with a stone adze

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Gallery Image

FIG 1. SET OF COPIES OF EARLY NEOLITHIC ADZE BLADES (MARKED WITH ROMAN NUMERALS) AND TWO ORIGINAL FINDS (LIGHTER COLOUR); LENGTH OF LONGEST BLADE IN THE BACK 167 MM. REPLICAS WULF HEIN, 3D-MODELS AND RENDERING THOMAS REUTER/ARCHAEOLOGICAL HERITAGE OFFICE SAXONY.

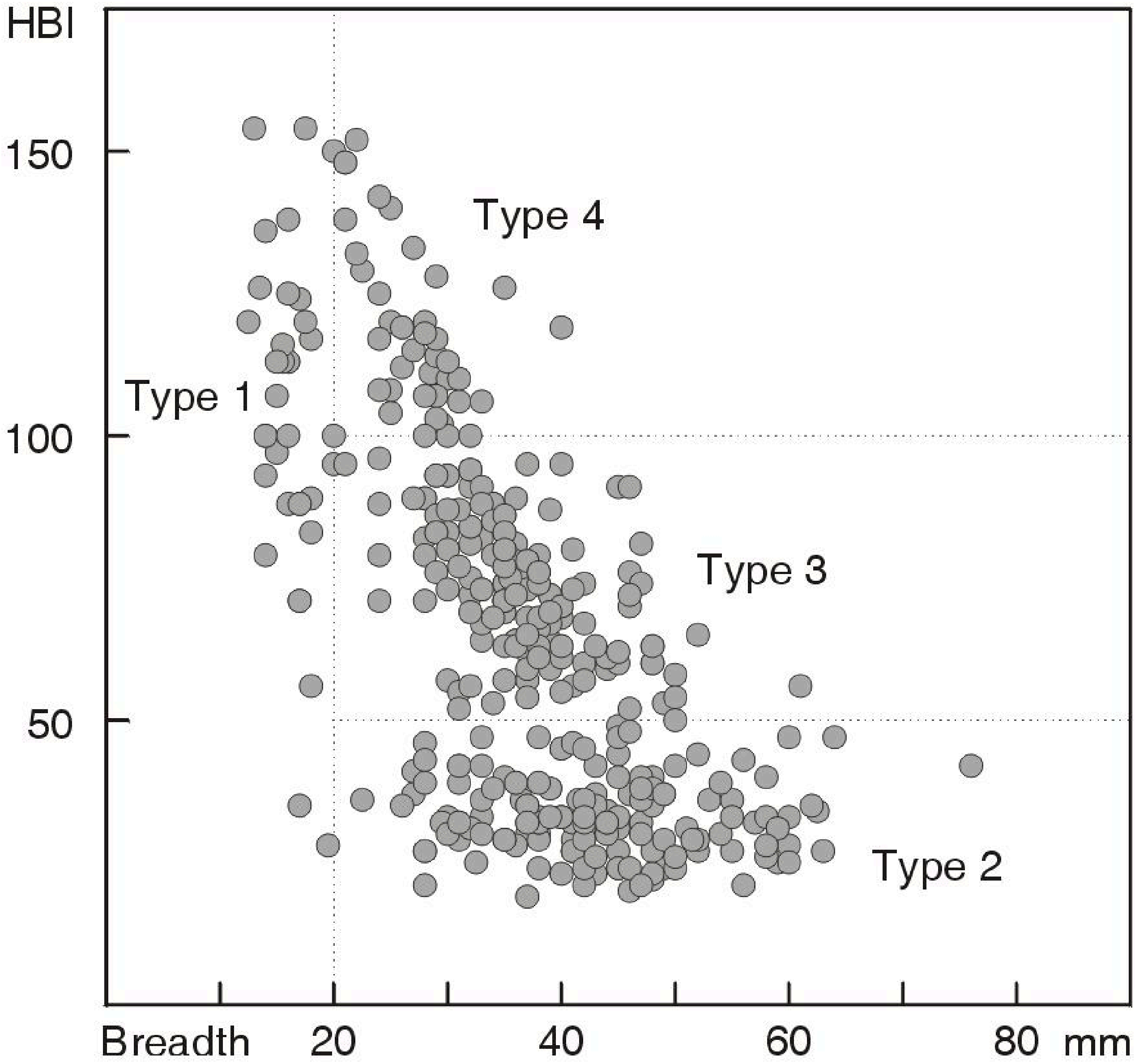

FIG 2. TYPOLOGICAL DIAGRAM FOR 390 COMPLETE BANDCERAMIC ADZE BLADES; (DATA AFTER RAMMINGER 2007, CORRECTED AND AUGMENTED). GRAPHIC RENGERT ELBURG.

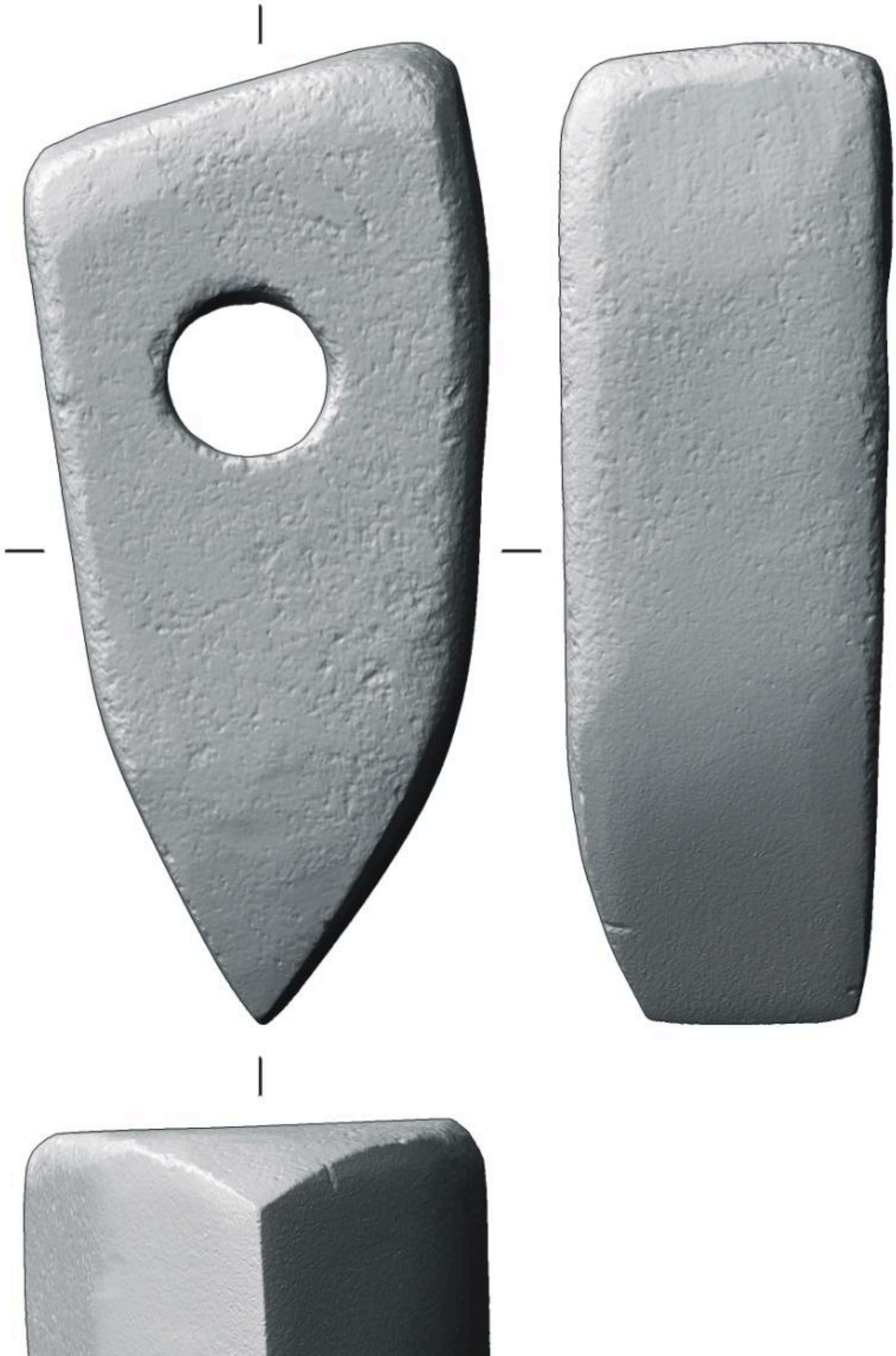

FIG 3. MODERN REPLICA OF A MIDDLE NEOLITHIC BROAD WEDGE FROM LOWER SAXONY (GERMANY); ORIGINAL LENGTH 154 MM. REPLICA WULF HEIN, 3D-MODEL AND RENDERING THOMAS REUTER/ARCHAEOLOGICAL HERITAGE OFFICE SAXONY.

FIG 4. TIMBER FROM THE WOODEN LINING OF THE EARLY NEOLITHIC WELL OF ALTSCHERBITZ (GERMANY) WITH TOOLMARKS LEFT BY TWO DIFFERENT TYPES OF ADZE.; LENGTH 157 CM. 3D-SCANS AND RENDERING THOMAS REUTER/ARCHAEOLOGICAL HERITAGE OFFICE SAXONY.

FIG 5. RANGE OF ADZES USED IN THE ERGERSHEIM EXPERIMENTS; LENGTH OF THE SHORTEST TOOL 30 CM. REPLICAS AND PHOTO WULF HEIN.

FIG 6. TYPICAL STUMP AND FELLING NOTCH PRODUCED BY THE USE OF A STONE ADZE. DIAMETER OF TREE 31 CM. PHOTO PETRA SCHWEIZER-STROBEL.

FIG 7A. CHISEL MADE OUT OF A MOOSE METATARSAL AND ITS USE FOR CUTTING A MORTICE IN AN OAKEN PLANK; SCALE IS 3 CM. REPLICA ANJA PROBST, PHOTO SEBASTIAN BÖHM.

FIG 7B. CHISEL MADE OUT OF A MOOSE METATARSAL AND ITS USE FOR CUTTING A MORTICE IN AN OAKEN PLANK; SCALE IS 3 CM. REPLICA ANJA PROBST, PHOTO SEBASTIAN BÖHM.

FIG 8. THE HANDLING OF AN OBTUSE ANGLED STONE ADZE IN SMOOTHING THE SURFACE OF A TIMBER. PHOTO RENGERT ELBURG.

FIG 9. FELLING AN OAK WITH A DIAMETER OF 37 CM USING A 'BROAD WEDGE'. PHOTO ANDREAS FRANZKOWIAK.


FIG 10. REPLICA OF A FLINT AXE OF THE NORDIC TYPE; LENGTH OF BLADE 233 MM. REPLICA KAI MARTENS, PHOTO KLEMENS NIESEN.