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BRIEF COMMUNICATION

Experiments on digging pits in pit zone alignments

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Iron Age pit zone alignments are a relatively newly recognized type of system and research has focused primarily on why the pits were dug. There are numerous proposals, although the general perception of them as a kind of defence system has not changed since it was put forward by Eriksen and Rindel in 2001. But an experimental archaeological approach is, as of yet, untested, and by asking the 'how' before the 'why' the enigmatic tracts of thousands of pit-holes can be analysed from a new angle. Thus, in this article, the focus moves from the collective pit zone alignments to each individual pit-hole and the process involved in digging same. Systematic studies of spades, attempts to reconstruct double-spades, experiments digging pit-holes and the construction and use of parts of pit zone alignments helps make it probable that the inhabitants of a village from the pre-Roman Iron Age would have been able to dig a stretch of 100 metres by 4 metres of a pit zone alignment, broadly equivalent to seven holes, in 1 day. The experiments also made it clear that the pit zone alignment did not constitute an obstacle to sheep or cattle, and that they only, under exceptional circumstances, were an obstacle to people. But most significant was the insight gained into the process of digging the holes in terms of the organization of work, which undoubtedly lay behind the excavation work

Keywords: experimental archaeology; holes; pit zone alignments; double-spades; pre-Roman Iron Age

Introduction

Experimental archaeology is a scientific method that can be used to make plausible past work processes. You could say that experimental archaeology links objects to contexts and thus populates that context, which the objects were an original part of – it rethinks a person into the material by reflecting on praxis and interpretation. Experimental archaeology has a long tradition in Denmark: in the 1870s N.F.B. Sehested conducted experiments by drilling in stone (Sehested 1884, p. 26ff.) and the civil engineer, R. Thomsen, conducted a series of internationally recognized experiments extracting iron from bog iron ore in the 1960s (Thomsen 1964, Lyngstrøm 2015). Many Danish archaeologists use those methods in their research today (Lyngstrøm 1995, Sørensen 2006, Ravn 2014) and the University of Copenhagen has taught experimental archaeology as part of its archaeology course since 1990 (Lyngstrøm 2011, p. 135ff.).

To substantiate the contemporary work processes in the construction of the pit zone alignment, we investigated how the holes were dug and the tools used, how long it took and how the tools were handled and their relation to the excavated soil. We reflected on whether or not there were differences in how different people dug and how work to dig so many holes could be organized. Only then did we take the next step and try to interpret why the pit zone alignment was constructed. Is the pit zone alignment a real barrier to people and animals – and can a pit zone alignment provide tactical advantages for an army, as that found at Hjortspring Mose is thought to express? The questions were many, but for the experiment it was the pit-hole itself that was the starting point.

Pit zone alignments

Holes in the soil are the basis for a substantial part of archaeological knowledge. It is therefore strange that archaeologists know so little about how the pit-holes were dug in practical terms: what tools were used to dig them and what considerations people had for the digging work. The pit zone alignment is the ultimate object of study when pit-holes and the digging of holes are to be examined, as it is a long tract with several thousand holes (Figure 1). Often each hole has a diameter of about 30 cm, but the size can vary between both different tracts and different areas of the same tract (Mauritsen 2010, p. 267), and despite the pit-hole's perimeter typically being a circle, some polygonal pit-holes have also been found (Eriksen and Rindel 2001, p. 17). Each hole was originally between 30 and 40 cm deep (Steen 2005, p. 17), and there also appears to be a degree of similarity between the holes within the same tract, particularly in certain areas of the same tract (Figure 2). Moreover, although the profile of the pit-holes can show some variation, most often they are cylindrical. Tracts with identical holes are interpreted as being dug concurrently and certain areas with very similar

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Figure 1. Many pit zone alignment are between 3 and 4 metres wide, equivalent to seven or nine pit-holes. Here at Liseborg close to Viborg the pit zone alignment was 3.8 metres. Photo: Viborg Museum.

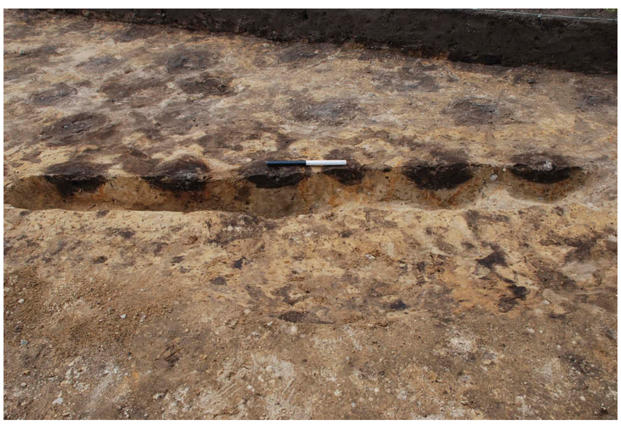

Figure 2. Each hole was originally between 30 and 40 cm deep and there appears to be a degree of similarity between the holes within the same tract, particularly in certain areas of the same tract. Photo: Viborg Museum.

holes are interpreted as being dug by the same person (Steen 2009, p. 5). In several pit zone alignments, such as at Bjødstrup, it is obvious that the holes remained open after being excavated (Olesen 2009, p. 86), and other holes may even be determined as being dug during a very dry summer, as they are below groundwater level (Mauritsen 2010, p. 264). Some pit zone alignments were supplemented by another kind of pit-hole along the edge of the tract. They are deeper and may be located in pairs. Examples include Gammelbosig (Olesen 2009, fig. 9) and Risum Østergård (Steen 2005, fig. 8) where, along the tracks, staggered holes were dug in paired sets at about 4 metres distance. Many pit zone alignments are between 3 and 4 metres, equivalent to seven or nine pit-holes (Eriksen and Rindel 2001, p. 15; Rindel 2010) and the longest pit-hole tract system so far excavated is 2.3 km long (Mauritsen 2010, p. 163). Some tracts seem to have been renewed, reinforced or rebuilt (Olesen 2009, p. 87), while others seem to have been dug only once and not touched again (Mauritsen 2010, p. 271). The course of a pit zone alignment can be quite linear like the 908 metre long tract of pit-holes at Tvis Møllevej which is 4 metres wide and in long stretches is 9 pit-holes wide (Steen 2009, p. 5). However, L-form tracts are also known such as that at Lystbaekgaard which is 3.5 metres wide with seven to nine rows of pit-holes (Eriksen and Rindel 2001, p. 16). They have also been known to encircle probable contemporaneous villages (Mauritsen 2010, p. 262). The distribution of the pit-holes in each tract rarely follows straight lines, but winds its way between each other as if they are filling a particular area of the tract (Steen 2009, fig. 79) and in several pit zone alignments there are entry points, here and there, at a width of 0.5 or 1 metre (Olesen 2009, p. 83).

In Denmark about 40 pit zone alignments have been found. Most in Jutland, probably because the preservation conditions are better here than on the islands. Pit zone alignments are difficult to date, but sherds of pottery vessels were found in some individual pit-holes (Eriksen and Mauritsen 2011, p. 163). In some cases, they were so large and plenty that it may have been an entire vessel, but most often they were individual sherds (Mauritsen 2010, p. 267). The ceramics can, in several cases, like at Lystbaekgaard (Eriksen and Rindel 2001, p. 18), be dated to the early Pre-Roman Iron Age, Beckers Period I. And on Grøntoft the course of the pit zone alignments suggests that it was constructed with consideration of tussocks (Rindel 2015, fig. 2). So although the vast majority of pit zone alignments cannot be dated, some of them, at least, belong with certainty to a time when the landscape was divided in a new way and could be an expression of this strategy (Løvschal and Holst 2015).

Archaeologists first became aware of the long tracts with many holes in the 1960s when they uncovered large, contiguous areas at the West Jutland settlement excavations (Becker 1971). But most pit zone alignments were found in this millennium. Pit zone alignment research is relatively new and has focused primarily on *why* the holes were dug. Here the proposals are many: perhaps they were defensive, to control the movement of peoples and animals, cattle grids, territorial markings or they marked symbolic or cosmological limits. There have also been suggestions that they were simple fences, whose purpose was to keep animals in or out of the village (Martens 2007, p. 96). The interpretations have focused particularly on the few tapered wooden sticks that were located between holes at Brændgaards Hede. The sticks were excavated southernmost, in the inner tract, furthest out in a meadow area. They are 15–20 cm long, tapered at both ends (Mauritsen 2010, p. 267 and fig. 6) and are similar to those found in the bottom of the moats at Lyngsmose and Borremose (Eriksen and Rindel 2001, p. 13). The intense focus on the sticks has helped to maintain an overall interpretation of all pit zone alignments as defence installations or as prepared battlefields with analogies drawn to Caesar's investment at Alesia (Eriksen and Rindel 2001, p. 19; Eriksen and Mauritsen 2011, p. 163) or to chevaux-de-frise (Steen 2005, p. 23f.). The 80 metre long pit zone alignment, which ran parallel to Rammedige, has further supported this interpretation (Olesen 2003).

In this article the focus moves from the function of the pit zone alignment to the individual pit-hole and the process involved in digging a pit zone alignment. Apart from a single reconstruction, the experimental archaeological approach has, so far, been untested in pit zone alignment research and by asking *how* before *why* the enigmatic tract system of thousands of pit-holes can be analysed from a new angle.

How and why?

There can be no doubt that pit zone alignments were dug in a community and that people in this community probably worked somewhat contemporaneously. Furthermore, the pit-holes were used immediately after they were dug, that is, if the purpose of the pit-holes did not lie in the excavating process itself. In the society, there must therefore have been a consensus for where and how to dig, as well as how the pit zone alignment should lie through the countryside. Maybe having taken into account certain visual landmarks (Olesen 2009, p. 85) the alignment was allowed to grow or perhaps it stuck out and was divided into sections, as several of the most linear pit zone alignments indicate (Steen 2005, p. 18f.; Mauritsen 2010, p. 163).

After reviewing the published plans of pit-holes and pit zone alignments, the experiments focused on the most linear of them and a straight line was walked and marked with sticks every fourth step (about every 4 metres) (Figure 3). Since it is common for multiple linear pit zone alignments to close watersheds between river systems (Olesen 2009, p. 85) or lie across the landscape's lines of movement, we constructed the tract across a wheel track, which thus also became a kind of opening or passage through the tract (Løvschal and Holst 2015). The excavation work began with a chain marking pit-holes, as it seems from several excavation plans that the holes along one edge – perhaps the first holes dug – were dug quite similarly, while the remaining holes can have a more individual form and distribution (Steen 2005, fig. 5).

Several different types of spades were employed for excavation work in the early Iron Age, though they had a common factor: the blades were rarely wider than 10 cm. The spade was, thus, a tool to cut and loosen the soil with – not a tool to move earth with. It is also characteristic that none of the spade forms had a ledge, so that the foot was not used for the work. Until the early Germanic Iron Age the digging must have primarily involved the muscles of the upper body. It is perhaps only in the 500 s – a time of major technological changes in general – that ledges became a feature of spades, so that, as in the Viking and Medieval Periods, the body's entire weight could be used to advantage in the digging work (Bill and Daly 2012, fig. 2).

Around the start of the Common Era, the double-spade – with a blade on each side of the handle – was relatively common (Lerche 1985, p. 210ff.) (Figure 4). The two blades not only extended the life of the tool, they also added the function which a worn blade may have. The spade was carved from one piece of wood and usually made of oak (*Quercus* sp.). A 114 cm long double-spade from Østrup near Vognsild in Northern Jutland is C14 dated to 170 BCE (Lerche 1995,

Figure 3. The experiments focused on the most linear pit zone alignments and a straight line was marked with sticks every fourth step. Photo: Henriette Lyngstrøm.

Figure 4. Hundred of double-spades are found in Denmark and most are about 1 or 1½ metres. In the experiments we observed how the blades were worn during the digging work and therefore had to be frequently sharpened. This spade is from the collection at Vesthimmerlands Museum. Photo: Michael Nielsen.

p. 198f.), while a spade from Blegind south of Aarhus – which is distinguished by being carved from alder (*Alnus* sp.) and by being part of an archaeological context – an Iron Age road – is C14 dated to 220 BCE (Jørgensen 1991, p. 216ff.; Lerche 1995, p. 176f.). Like all tools the double-spade has a biography with conception, manufacture, use, cleaning, sharpening, storage, recycling and disposal, but its functional context is also dynamic with a manufacturing site, a workplace, a storage place and a maintenance site; there were probably quite regular routines for cleaning and maintenance (Fél and Hofer 1974, pp. 35 and 291; Gorecki 1978, p. 186). Perhaps that is why double-spades are so frequently considered by museums as casual finds from peat-cutting between the two World Wars: the bog may have been repository of spades (Lerche 1977, p. 119).

Like all hand tools double-spades were customized to the body and fit just as closely to the individual as their shoes and clothes. Spades could be very long, almost 2 metres, but most are about half as long and in the experiments we observed how the blades were worn during the digging work and therefore had to be frequently sharpened. The current length of a double-spade is rarely the original. Some are fragmented and others are dried out. Most are worn from use and not all double-spades were made with the same length. The earth and the earth's surface are, of course, of great importance to the wear and tear on the spade. In the experiments, we dug into grass-covered, slightly rocky and very clayey moraine. Therefore, the cutting edge of the spade's blade was quickly frayed, but the majority of the pit zone alignments appear on sandy soil where the wear and tear on the spade may have been different. We worked best on our knees when we cut grass-turf with the spade's sharpest edge, loosened the soil with the dullest edge and lifted the earth out of the hole with our hands or with a large ceramic sherd. In this way a double-spade could be used for almost 10 holes before it had to be sharpened. But the experience was that double-spades – after a period of adaptation – were no more difficult to dig with than modern spades (Figure 5).

We, modern people, think it is important to know that one can dig a hole in a pit zone alignment in 6 minutes. This means that a section of four steps in length and with a total of about 35 holes could be dug at 3.6 hours. And as the spade has to be sharpened after every 10th hole, it adds an additional 22 minutes: 4 hours in total. It is also a question of whether the excavated soil is moved or perhaps spread out to blur the tract's presence. If that is done, the work will increase by at least 1 hour per section. The earth from one of the holes in the experiment weighed 11 kg, corresponding to approximately 400 kg per section. Since it is estimated that a village in pre-Roman Iron Age had between 70 and 100 people (Martens 2007, p. 96), we must assume that the inhabitants may have dug 100 metres of approximately 4 metres wide pit zone alignment in 1 day. That is 10 diggers, 1 sharpening spades, 10 pulling away soil (if that was done) and 5 responsible for the supply of food and water. Experimental archaeology is full of such examples of how long work processes take to produce results: to build a hill, grind an axe or sail a certain distance. But most often it is a completely unimportant information, partly because it is difficult – if not

Figure 5. The experience was that double-spades were no more difficult to dig with than modern spades. Photo: Henriette Lyngstrøm.

impossible – to compare a person's work in the early Iron Age with a modern person's work. But mostly because the perception of the concepts of 'time' and 'work' is quite different. In cultural history there are examples of many work processes where there is much more focus on the process than on the product: the process should not be completed as quickly as possible, but with as many people as possible, the right people or under special circumstances (Figure 6).

However, one issue did make sense to examine in relation to pit zone alignments: were the pits a real obstacle for animals and people? First we used a flock of sheep that repeatedly moved undisturbed over the pits. Sometimes they used the rut – other times they found foothold with ease between the pits (Figure 7). Cattle also seemed to find a relatively easy path between the pits. Future experiments will show if horses do the same and if it is possible to pull a wagon over the pit-holes. But we must conclude that pit zone alignments cannot have served as effectively as cattle grids. Next, we examined whether the pit zone alignment could be a real barrier for people. A group of people attacked and defended in various formations. Our experience was that a group of civilians who do not know each other beforehand, can remarkably quickly learn to master simple attack formations, if they are instructed professionally. And by attacking in close formation – covered with shields, the size of those found in Hjortspring – the people in the rear ranks look down and thus see the pit-holes (Figure 8). The result was that the pit zone alignment can give defenders a moderate advantage if it is placed so that attackers have to fight uphill. But a very long line requires many defenders, even if fighting is carried out differently from how we imagine today.

Figure 6. It is possible to dig a hole in a pit zone alignment in 6 minutes. This means that a section of four steps in length and with a total of about 35 holes could be dug at 3.6 hours. Photo: Henriette Lyngstrøm.

Figure 7. A flock of sheep repeatedly moved undisturbed over the pit-holes. Sometimes they used the rut – other times they found foothold with ease between the pit-holes. Photo: Henriette Lyngstrøm.

Figure 8. By attacking in close formation and covered with shields the people in the rear ranks look down and, thus, see the pit-holes. Photo: Michael Nielsen.

Results

The pit zone alignments still represent an archaeological feature type whose actual purpose is an open question and we do not know why the many pit-holes were dug. Maybe it was a strategy early Iron Age man chose when he divided the landscape and claimed his ownership to land – or maybe the purpose was the process of digging. But the experiments strongly indicate that the pit zone alignments were not used for cattle grids, nor did it work effectively as obstacles to people besides from under exceptional circumstances and only future experimental work will show the consequences if the soil is left between the pit-holes or if wooden sticks as found at Brændgårds Hede, Lyngsmose and Borremose are added.

The experiments made it probable that the people of a village from the early Iron Age may have dug a stretch 100 metres by 4 metres of a pit zone alignment in 1 day. And more importantly: we, through the process of digging the pit-holes, understood a little more of the work organization behind the process through the marking out of the line, digging the first chain of pit-holes and digging divided in sections. As the diggers had to work somewhat contemporaneously they clearly benefited from the section division with room enough to dig in they own pace and 'style', not unlike the organization of work seen on group level in the building of the Bronze Age mounds (Holst and Rasmussen 2012, p. 231ff.). The tool was the spade, prepared in advance and continuously sharpened. In such a scenario one can imagine about 10 diggers with 10 spades kneeling section by section. Beside each digger lay a skin, which they lifted the earth onto and between the sections children scurried, pulling away soil, pit-hole by pit-hole. The diggers had the chance to stretch their legs and get a sip of water every 9th or 10th hole, when they carried their spade to the person sharpening, who sat a little away with his axe.

How much wear and tear there was on the spade depended on the soil, but 5 cm per blade per section would not be unrealistic. At the same time, it was obvious that part of the process concerning laying out the tract and marking the holes to be dug differs from the rest of excavation work, thus it may have been shared between several actors: many diggers and earth-luggers, one or a few sharpeners and other persons responsible for the logistics of water, food and other necessities, which were especially necessary when digging the linear pit zone alignments that were apparently far from the contemporary settlements. In this scenario, it is not unrealistic to imagine that the people who performed the first part of the process had other skills or powers than those who performed the second part. It is not necessary that both working parties worked at the same pace or directly and consecutively. And one can also imagine that the first part was ritualized on a higher level or was imposed on more jurisdictions, than the later one and perhaps therefore took longer and had actors that we are unable to see in the archaeological material. They may have been participants in processions or ceremonies. By examining *how* the pit-holes were dug, we took a little step closer to understanding the organization of the work and the complex diversity to which the enigmatic tracts with thousands of pit-holes bear witness.

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