The little things in life

Investigating the past one micrometre at a time

ABOVE En garde! What looks at first sight like a photograph of fencers is instead two specialists in ancient sword-fighting techniques (left: Jaap Hogendoorn, right: Casper van Dijk). They are testing different combat situations with replica bronze swords, in order to determine what traces such fighting leaves on the weapons.

How much can we say about how ancient artefacts were really used? Countless easily missed clues are available to those willing to look a little closer. **Matilda Siebrecht** reveals a world of microscopic possibilities.

As an archaeologist, I am often both quizzed and congratulated in a predictable fashion when I reveal my profession. Here are some popular responses:

1. 'Do you like dinosaurs then?'
2. 'That's so cool - I always wanted to be an archaeologist!'
3. 'What's the most interesting thing you've ever dug up?'

Dinosaurs are, of course, a little early for a discipline devoted to humanity and its extended family. The second point is more positive; I agree that our subject is definitely very cool, and appreciate the enthusiasm it generates. It is, though, the third question that I feel particularly passionate about. Admittedly, the origins of archaeological research lay in digging up the buried remains of past civilisations. Scholars and adventurers such as Heinrich Schliemann, who famously took credit for discovering the lost city of Troy in 1872, based interpretations or classifications of past cultures on settlement structures and objects discovered during excavations, which were conducted with varying degrees of methodological rigour.

RIGHT Valerio Gentile, PhD student at Leiden University, analysing the microwear traces visible on the edge of a replica bronze sword. This approach suggests that many 'sacrificed' weapons from the European Bronze Age had indeed been used in real combat.

Nevertheless, as with other scientific disciplines, archaeology has progressed since those trail-blazing 19th-century days. While excavation remains an essential part of our research, many other specialisms dedicated to specific archaeological materials or certain forms of analysis have grown up over the decades. The upshot is that some archaeologists, including me, only participate in a few digs during the course of our work. Such specialists have demonstrated time and again that you do not need to be wielding a trowel on site to make spectacular discoveries. One way to illustrate this is by considering my own area of interest: microwear analysis.

This involves the microscopic observation of tiny marks, known as microwear traces, which occur on archaeological objects and can be used to tell the story of how these objects were made and used. A recent article in *CWA* 87 illustrated this nicely, when Eric Poehler used the various types of wear marks created by the passage of many vehicles over decades to reconstruct traffic flow in Pompeii. In that case, one cart wheel running over a stone kerb would not have had much effect, but when hundreds do it the kerb begins to wear down. By assessing the implications of varying examples of vehicle induced wear, it was possible to determine that traffic in Pompeii drove on the right. Now imagine similar processes playing out at a microscopic level, and involving a range of striations, polish, and grooves. Such signs of wear can show how an object was made, used, and handled. It is the job of microwear analysts to deduce meaning from these minute marks.

Sacrificing swords

One example of this method in action is a PhD project currently being conducted by Valerio Gentile at Leiden University in the Netherlands, which aims to investigate the curious phenomenon of weapons being 'sacrificed' – that is deliberately deposited, sometimes in a broken state – in watery places such as rivers and lakes in the European Bronze Age (approximately 2200-800 BC). In order to answer his research questions, Valerio has been conducting experiments using replica bronze swords, closely based on originals from that era. These replicas are being put through their paces in simulated combat: Valerio is working closely with experts in ancient sword-fighting techniques, and together they have tested various scenarios where fighting could cause microwear traces to be inflicted, such as tiny notches on the blade. By comparing this damage with that apparent on genuine ancient swords, it becomes possible for Valerio to identify whether the latter were also used in combat.

ABOVE A replica perforated stone axe, which was used in wood-cutting experiments by Amber Roy, PhD student at Newcastle University, in order to determine how similar stone axes could have been used in the Bronze Age.

The results so far suggest that this was indeed the case, indicating that 'sacrificed' swords had most likely been actively used for fighting before their watery deposition. This further implies that commemorating combat or war was probably the main theme prompting this ritual activity. 'Our relationship with warfare and the way we make sense of it are very relevant topics nowadays', Valerio observed. 'The European Bronze Age with its peculiar rituals is possibly the first time in which common ideas about warfare develop across the whole continent, and these might lie at the root of modern approaches to making sense of violence.'

So why are studies like this so important? Traditionally, archaeological objects have been classified according to typology, meaning that early research focused primarily on their shape and form. This helped to achieve what was often foremost in researchers' minds: dating the buildings they were discovering. Interpretations made about the so-called 'biography' or working life of an object were generally based on hypothetical assumptions. However, by looking closer – much closer – at exactly how an object was made or used, it is possible to gain a deeper understanding of not only the object itself, but also the people who interacted with it.

'It allows you to look into the past life of an object and those who made and used it, like a physical snapshot back in time', explains Amber Roy, a PhD student at Newcastle University, England, who is currently using microwear analysis to reinterpret previous assumptions concerning the function of perforated stone axes in the Bronze Age. 'We can delve into the itineraries of objects and understand them more accurately'. An object's itinerary can reveal much about how it was perceived in past communities. For example, was an axe simply used to ▸

regularly chop wood and therefore viewed as purely a functional object, or could it have a more symbolic function that saw it used or deposited in specific ways?

Éva Halbrucker, a PhD student at Ghent University, Belgium, whose research investigates the effects of burning and other actions on the preservation of microwear traces, also emphasises how analysing them can give us detailed information not just about everyday life, but also wider social interaction and connections in the past, allowing us to appreciate how ancient groups reacted to certain situations. 'When using microwear analysis we are better able to understand the past', Éva pointed out. 'And understanding the past is crucial in order to understand and react in the future.'

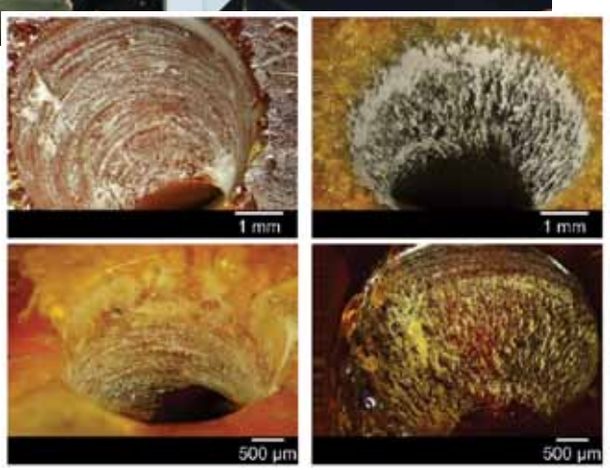
Venerable beads

Another example of a project focusing on microwear analysis, this time looking at the manufacture of prehistoric objects rather than their use, is my own study of prehistoric amber beads from the northern Netherlands. The aim is to provide a way to identify the use of metal tools in the past. Charting the development of metallurgy is an extremely important topic within archaeology, but how can we establish when a prehistoric society started using metal tools? One way, of course, is to find the tools themselves within datable stratified layers in the ground. While this may tell us when the tools were deposited in the soil, though, the durable nature of these artefacts, and the ease with which metal can be recycled, means this does not necessarily tell us when the tools first started to be used.

Enter: microwear analysis. Instead of looking at the tools themselves, we can study other objects to seek out the specific microwear traces created when metal tools are used. For example, imagine a metal drill-bit being used to create the perforation through an amber bead. The traces that the drill-bit leaves on the sides of the perforation are likely to be different from the marks left by a stone drill-bit. In order to investigate this, I conducted experiments on pieces of amber with drill-bits made from metal, stone, and antler. I then analysed the perforations of these experimental beads and made lists of microwear traces that were characteristic of the different materials.

After constructing this list of characteristic traces, I compared it with marks that I could see in the perforations of amber beads from the Neolithic (approximately 5300-2200 BC), and the Bronze Age. While some of the Bronze Age beads do display traces that could have been created using a metal drill-bit, interestingly most of them still seemed to have been crafted using non-metal tools. Sadly, none of the Neolithic beads were drilled using metal drill-bits, as discovering their presence in the period before metal technology was supposedly available would have been an exciting result! However, the results demonstrate that it is indeed possible to identify prehistoric tool materials indirectly. Even though the beads I studied have been lying in the ground for thousands of years, they still clearly preserve the microwear marks made when they were first drilled, and so can give us an insight into crafting practices in the past.

Such studies illustrate the promising potential of getting behind a microscope, and investigating past societies one micrometre at a time. ◘



ABOVE Matilda Siebrecht, PhD student at Groningen University, conducts drilling experiments on replica amber beads using drill-bits made from different materials. Microscopic images of the perforations of experimental and archaeological amber beads clearly show microwear traces (INSET). The beads on the top row are replicas, with the top left image showing a hole drilled with a flint drill-bit, while the top right example was created using an antler drill bit. The two perforations on the bottom row are Neolithic amber beads from approximately 2800 BC, and display comparable microwear traces to the replicas above.

FURTHER INFORMATION

The published article from Valerio Gentile's study ('Anatomy of a notch: An in-depth experimental investigation and interpretation of combat traces on Bronze Age swords') can be found in the *Journal of Archaeological Science* at the following address: https://www.sciencedirect.com/science/article/pii/S0305440318306800?via%3Dihub