

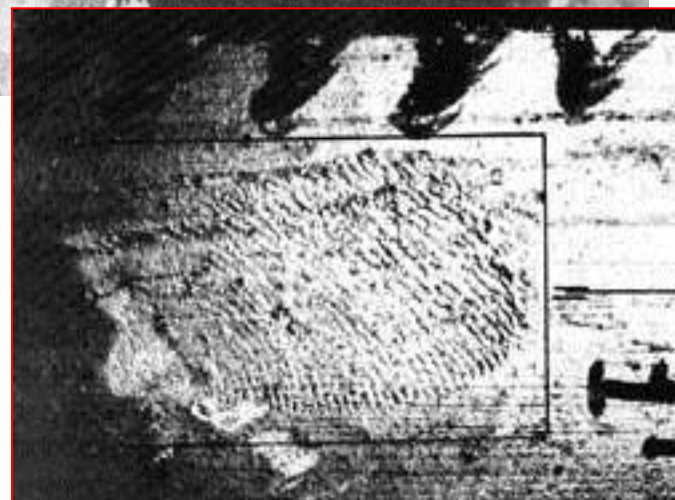
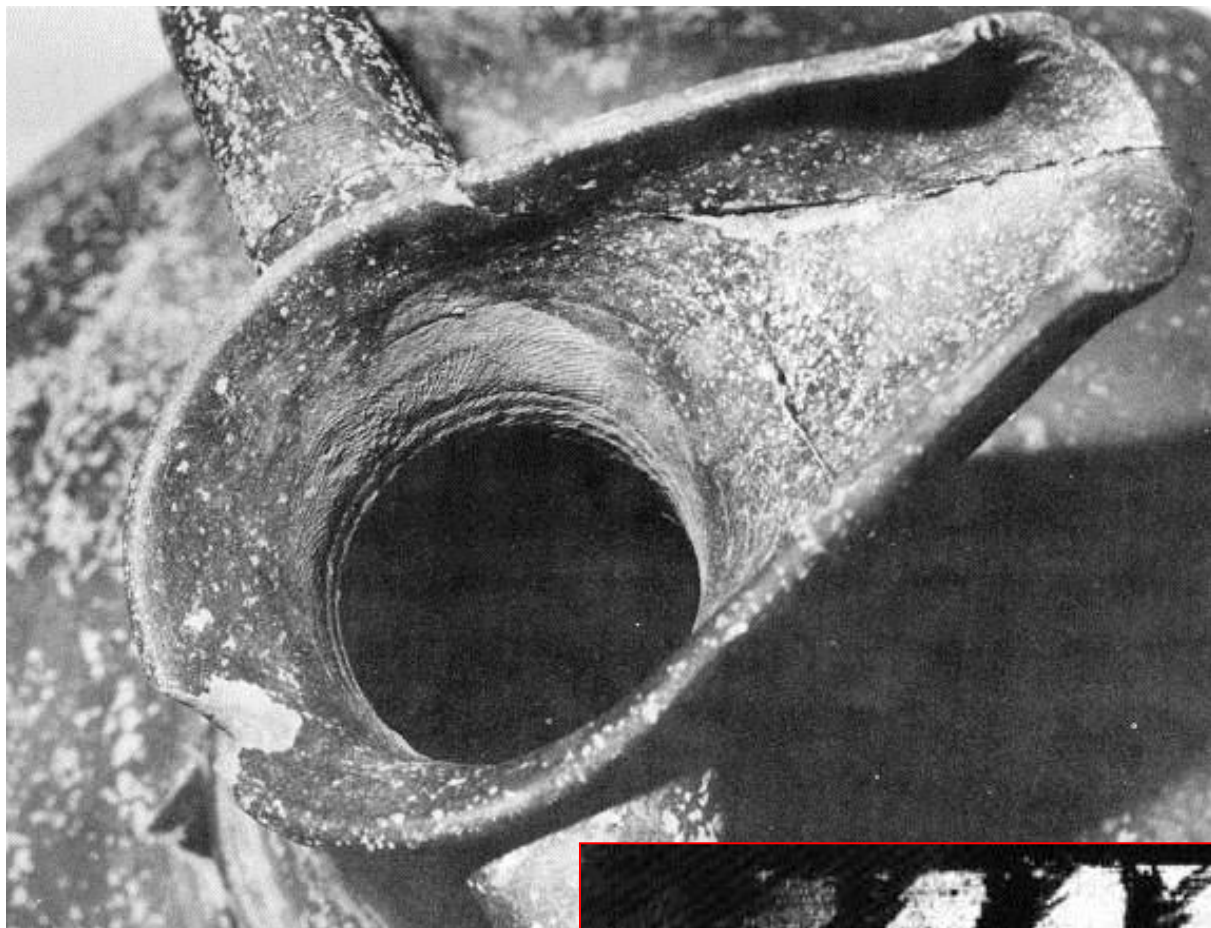
Håndverkerens kunnskapsutøvelse analysert gjennom verktøyspor i arkeologisk tømmer



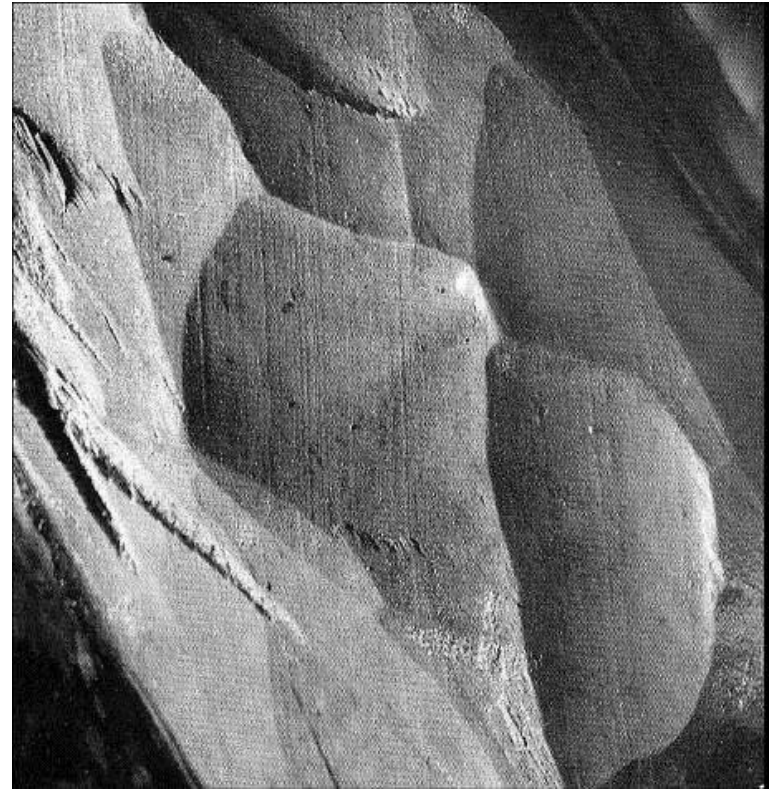
Harald Bentz Høgseth
Arkeolog dr. art/ rådgiver
Møre og Romsdal fylkeskommune

“Fingerprints” in archaeological artefacts..

Examples of signatures after craftsmen in ceramics..



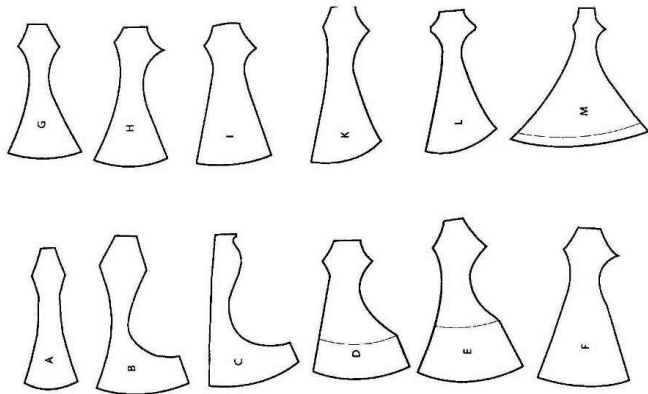
Examples of tool marks with signatures in timbers from late Iron age (left) and bronze age (right)..



- The craftsman has process the timber by standing on the left side.. The leading edge of the axe has slide it's way into the timber to the right
- The craftsman has process the timber by standing on the right side..

It exist a great variety of tools from the past .. is it possible to analyze tool marks in order to find out what axe made them?

Some examples of working axes from late iron period:



Categories of axes from late iron period, Norway
(Theodor Petersen 1951)

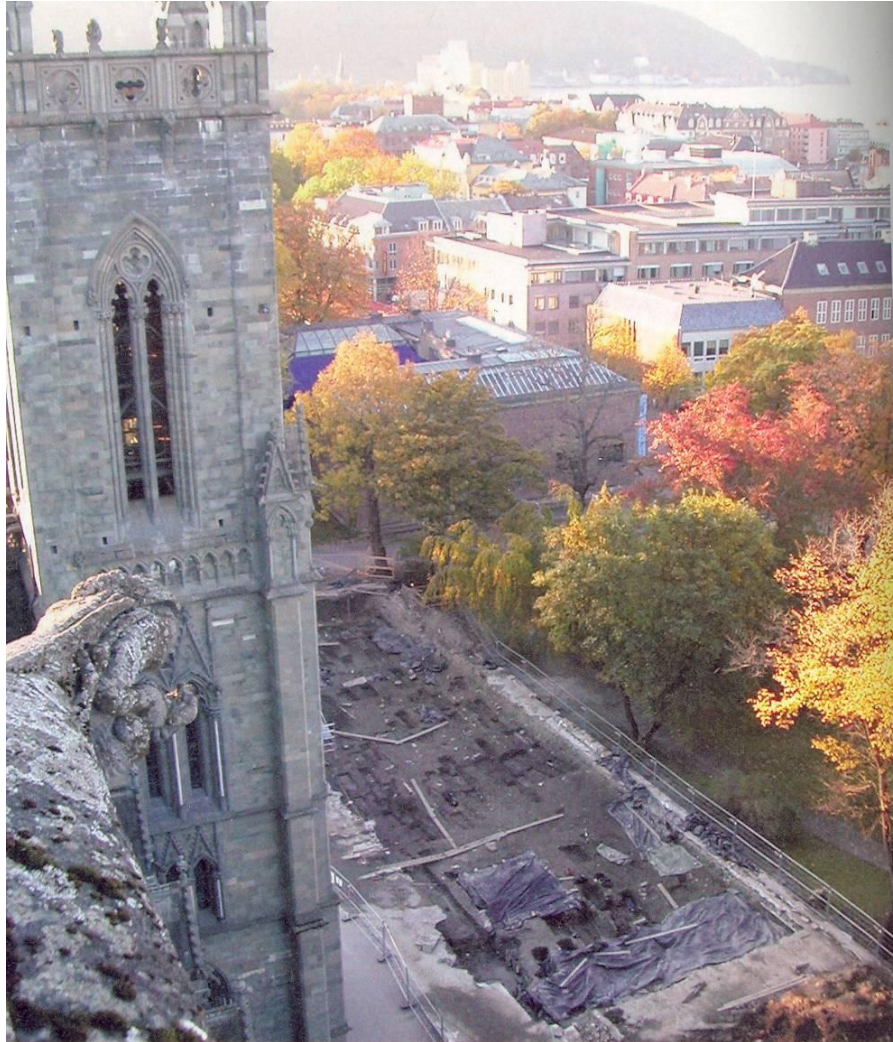


From the Bayeux tapestry

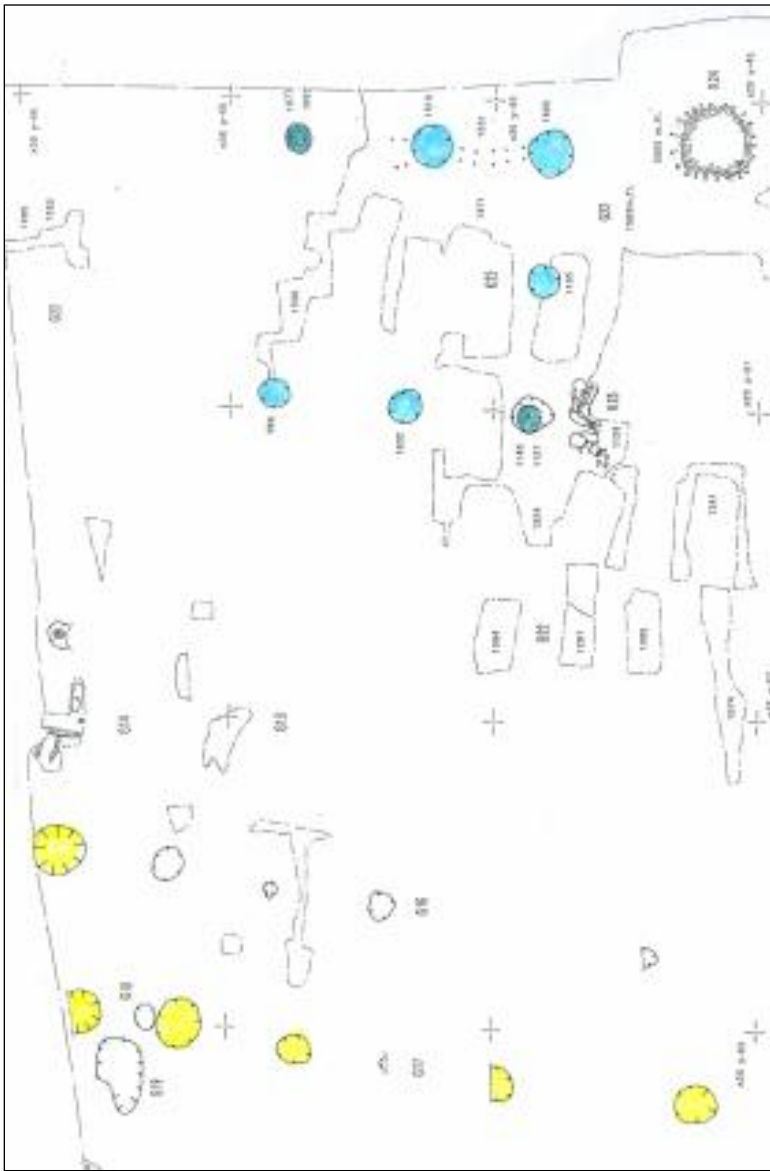


From the Oseberg grave

A examination of embodied knowledge in tool marks connected to movement patterns and traditional craftsmanship..



Wooden building remains from Nidarosdomen Cathedral in Trondheim, Norway..



House K23



Staves in house K23





Rinsing the end surface which turned down in the clay



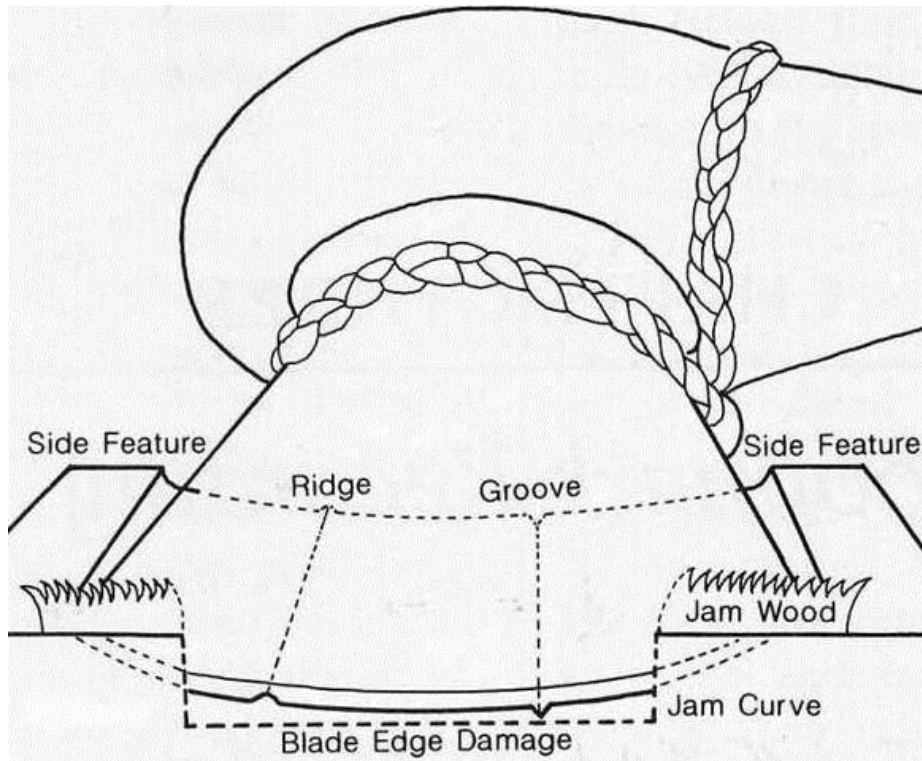
Rinsed surface with series of sharp tool marks

Starting point for the research:

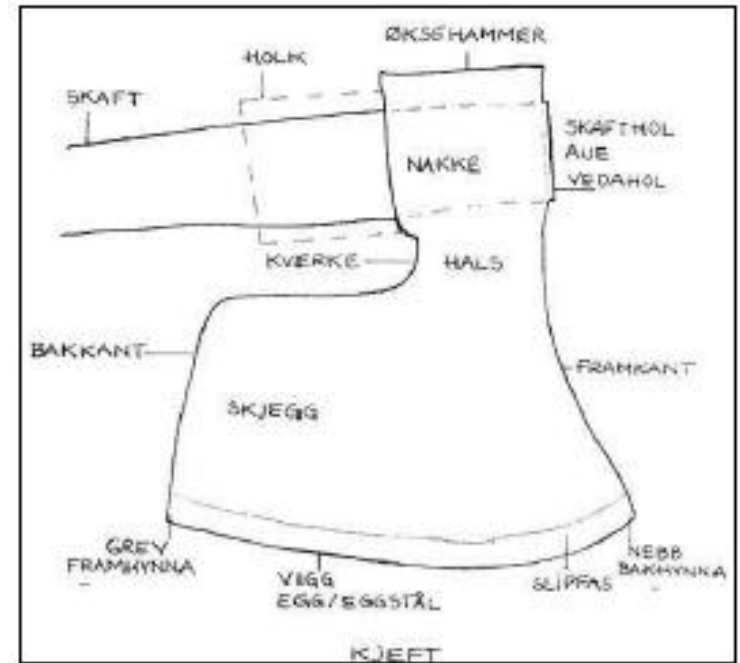
1. What kind of axe made them?
2. Is it possible to study and understand the craftsmen movements pattern, rhythm etc. based on the connection between series of tool marks in archaeological timbers and traditional craftsmen working procedures through experimental investigations?
3. If yes, will it be possible to understand the relation between craftsman, tool and material?

To answer the questions we first have to investigate how the axe actually imprint tool marks in timbers?

Some concepts related to tool marks and axes:

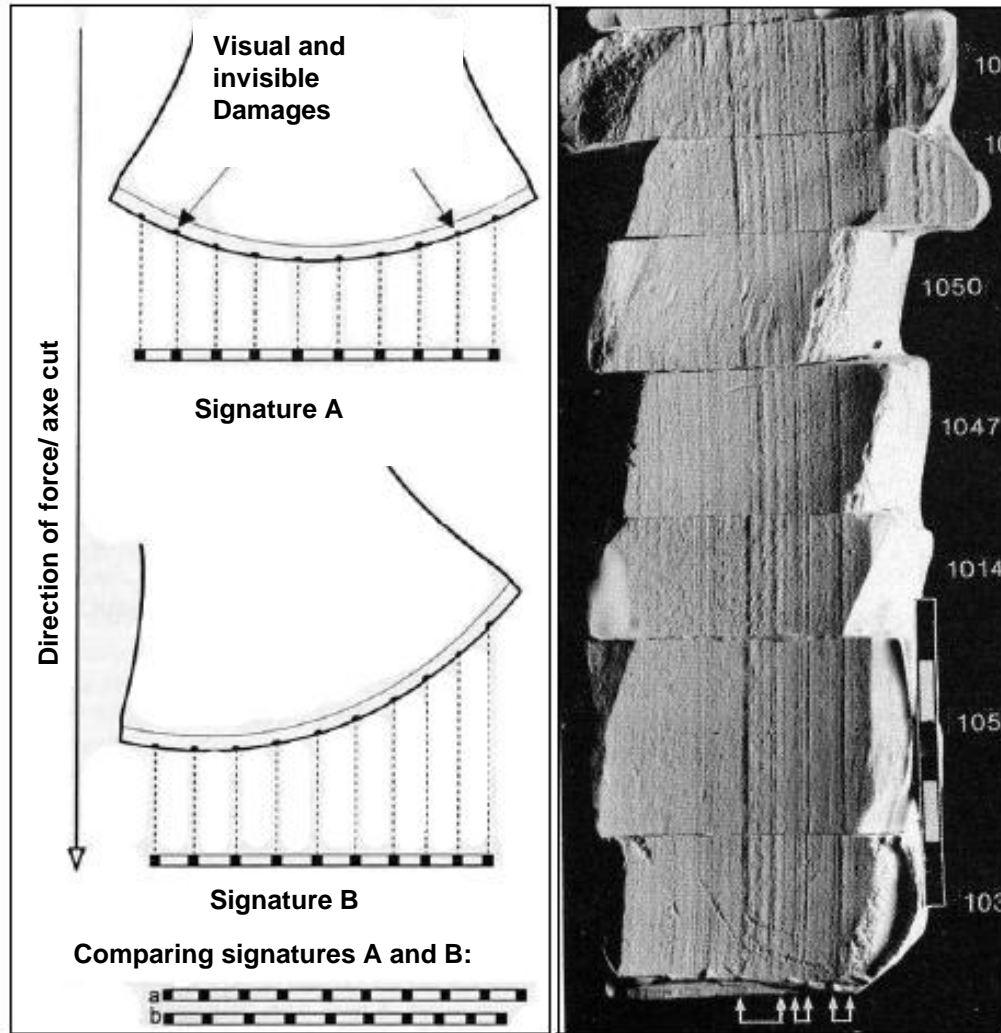


How the blade edge in general works its way into the timber. The blade edge always leaves specific patterns, called signatures, in the timbers, like our fingerprints. It does not need to be a clear “damage” in the edge..

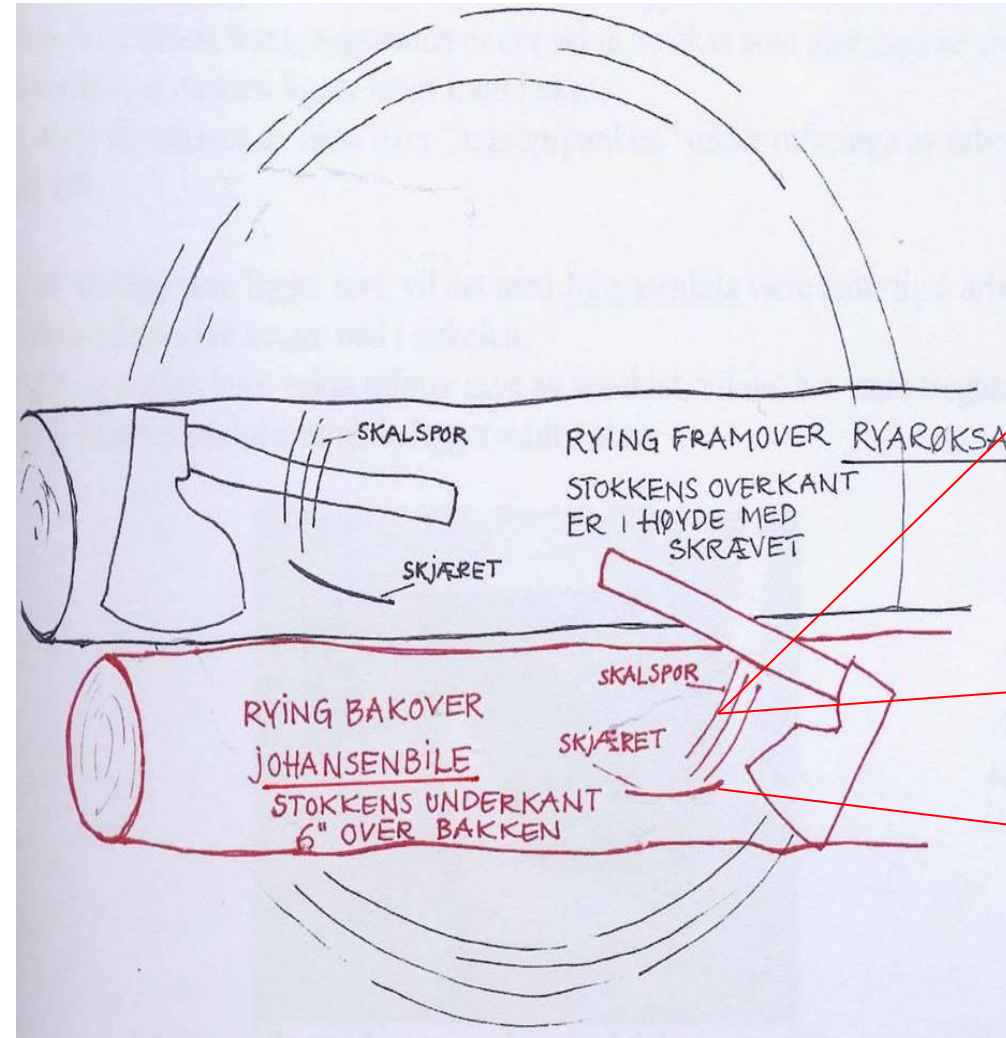
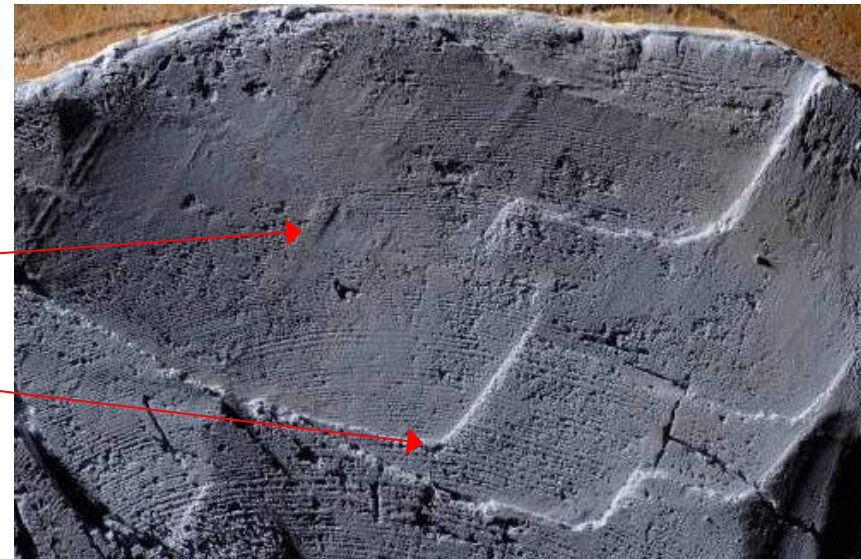
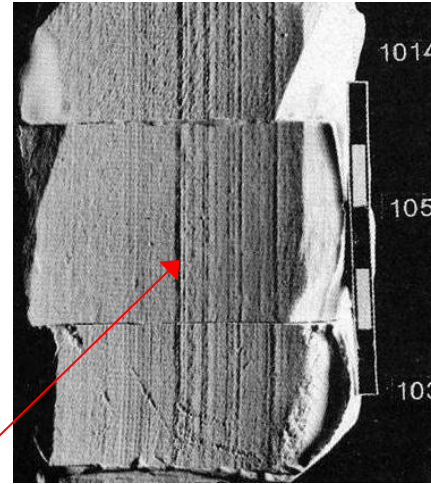


Traditional definitions on an axe (like beard, earl, cutting edge, beak, throat, neck, head, throat, eye, handle/shaft etc.) The definitions are strictly bound to the “craftsmen's dialect” which differs from area to area

How signatures lives specific patterns in toolmarks.. The possible to analyze movement patterns..



The toolmarks signatures (furrows, grooves), stopping mark and leading edge reveal the axe movements, circle curves and rotation patterns..



When reconstructing and analysing the craftsman movement patterns we both need methods based on:

- 1. Movement patterns inside the archaeological tool marks (forholdet mellom skjæret/ stoppunkt, framkant øks, skalpor, orientering/ kurve signaturer osv.)**
- 2. Reconstructing the movements by use of traditional craft methods/ techniques and tools. Compare patterns**
- 3. Invent and develop a notation system analysing details connected to motions and the relation between craftsman, tool and movement patterns**

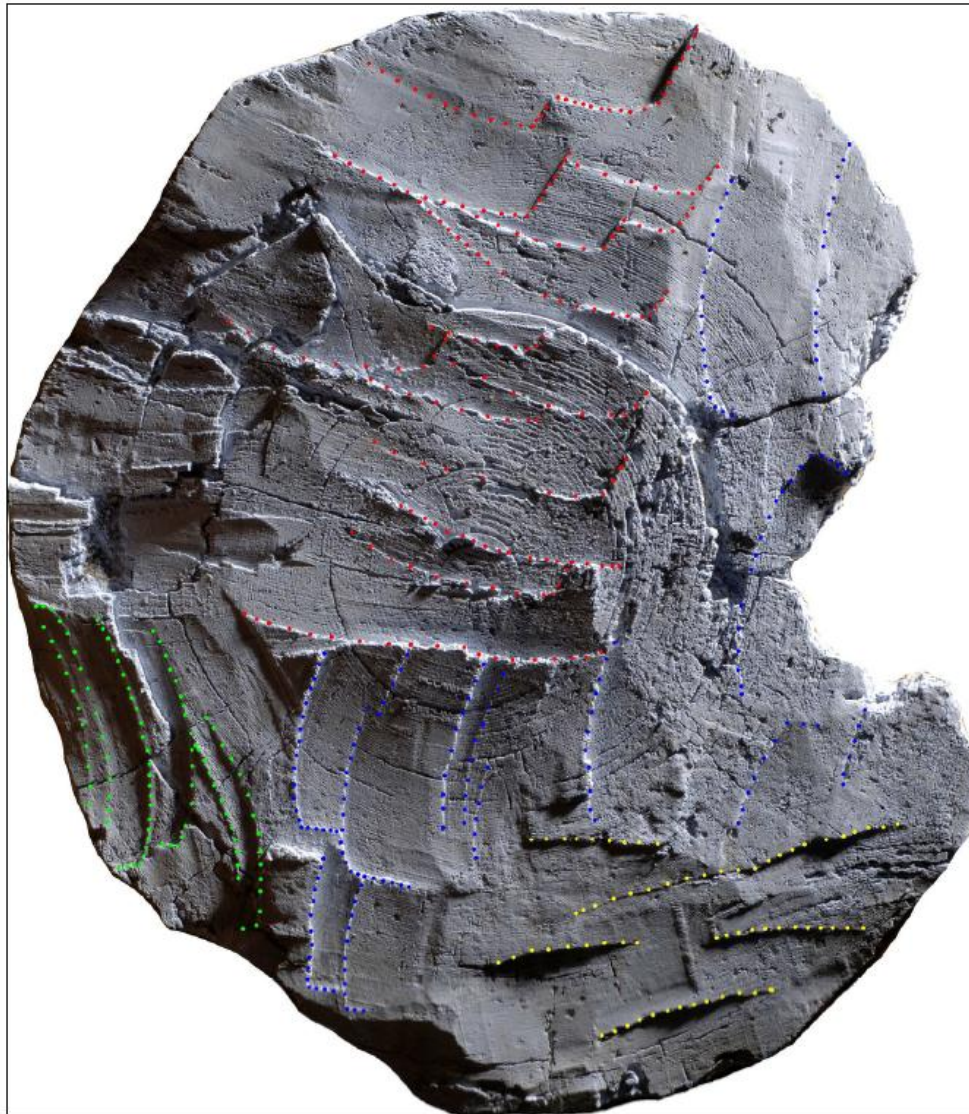
1. The study of toolmarks by using interdisciplinary methods ..

- Knowledge from the Norwegian Criminal Investigation Department
- Dental surgeon knowledge
- Optical Measuring (SINTEF)
- Motion studies (Sutton SignWrig.)
- Traditional Craftsmanship



Silicone castings..

Positive casting: manual analyses and documentation of patterns indicated that the craftsman processed the timber from four directions ..



When analyzing tool marks - and movement patterns we both needs manual methods, but also development of digital tools like optical metering systems..

That's why I applied a non-linear mapping to the values in the derivative image. Every pixel, x , in the image was converted as follows

$$f(x) = \frac{x/a}{1 + (x/a)^2}$$

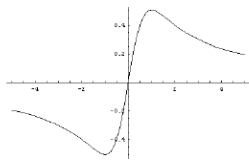


Figure 4: Contraction map function.

where a determines the extrema of the function. In practical terms one can focus on patterns of a certain detail level by choosing a value for a .

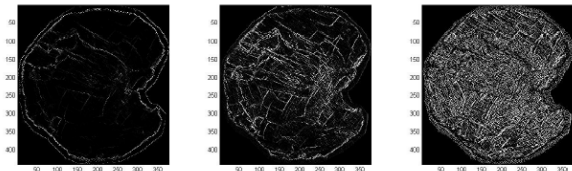
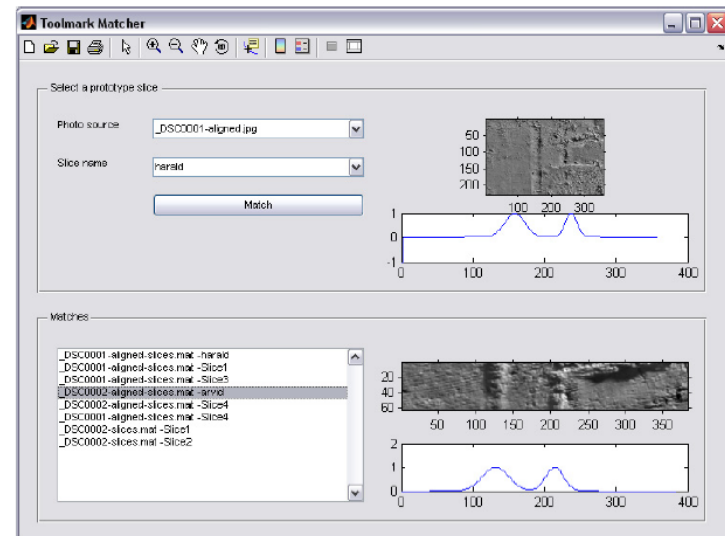
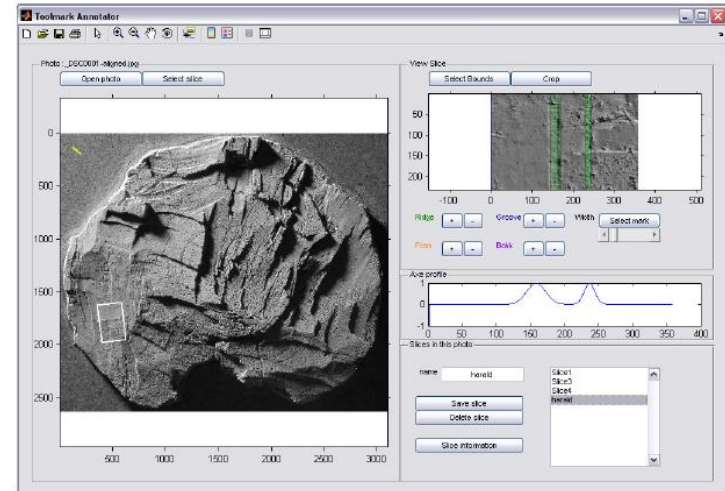
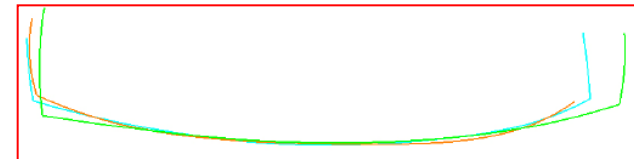
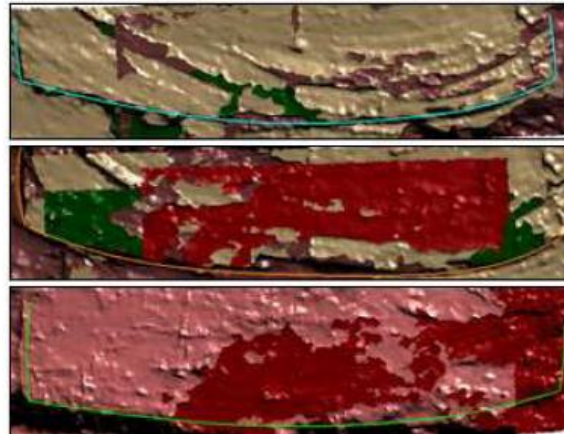
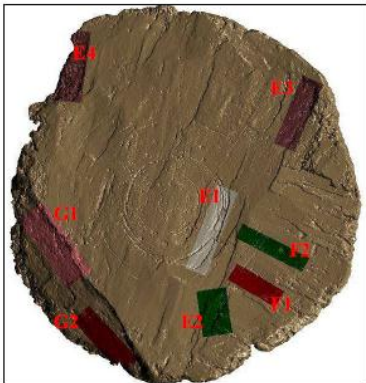
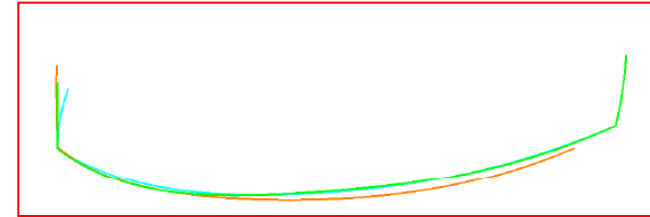
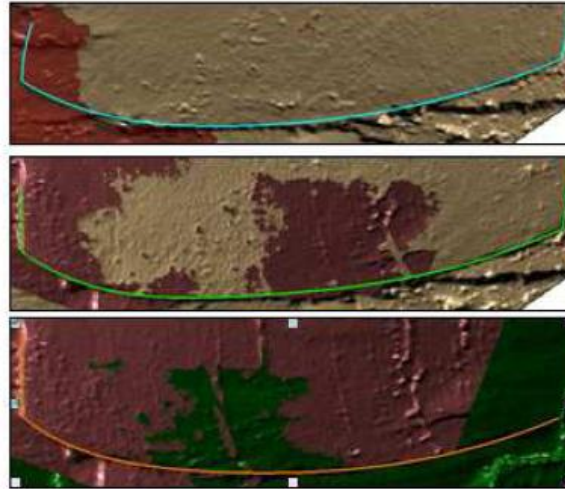
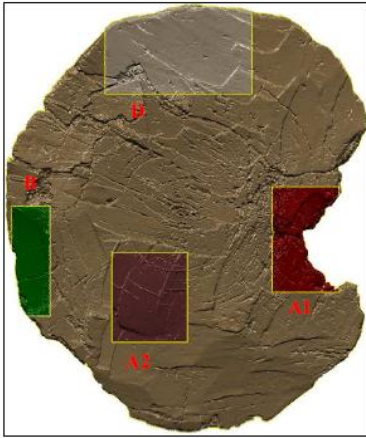


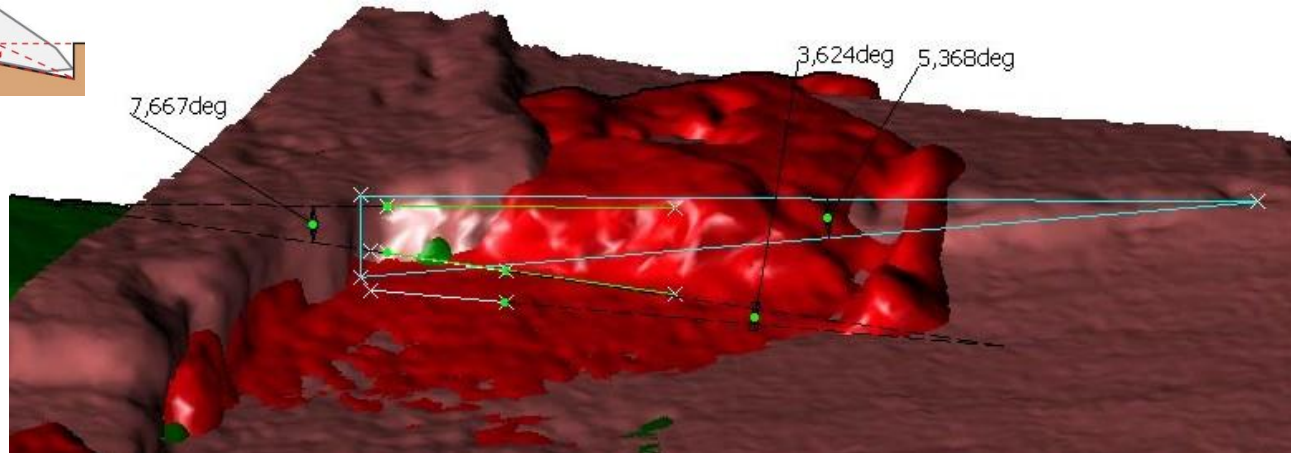
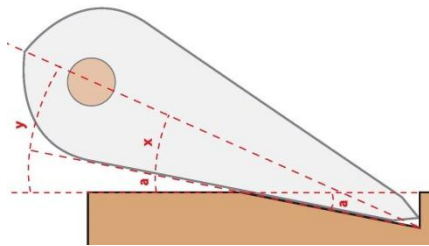
Figure 5: Derivative images after contraction mapping is applied for values $a = 200, 20$ and 2 .



Digital 3D scans from a GOM/ATOS scanner in the process analyzing and reconstruct two-dimensional axes from remnant 1077 and 1145..



Example of analyzing the cross section of the axe cutting angle..

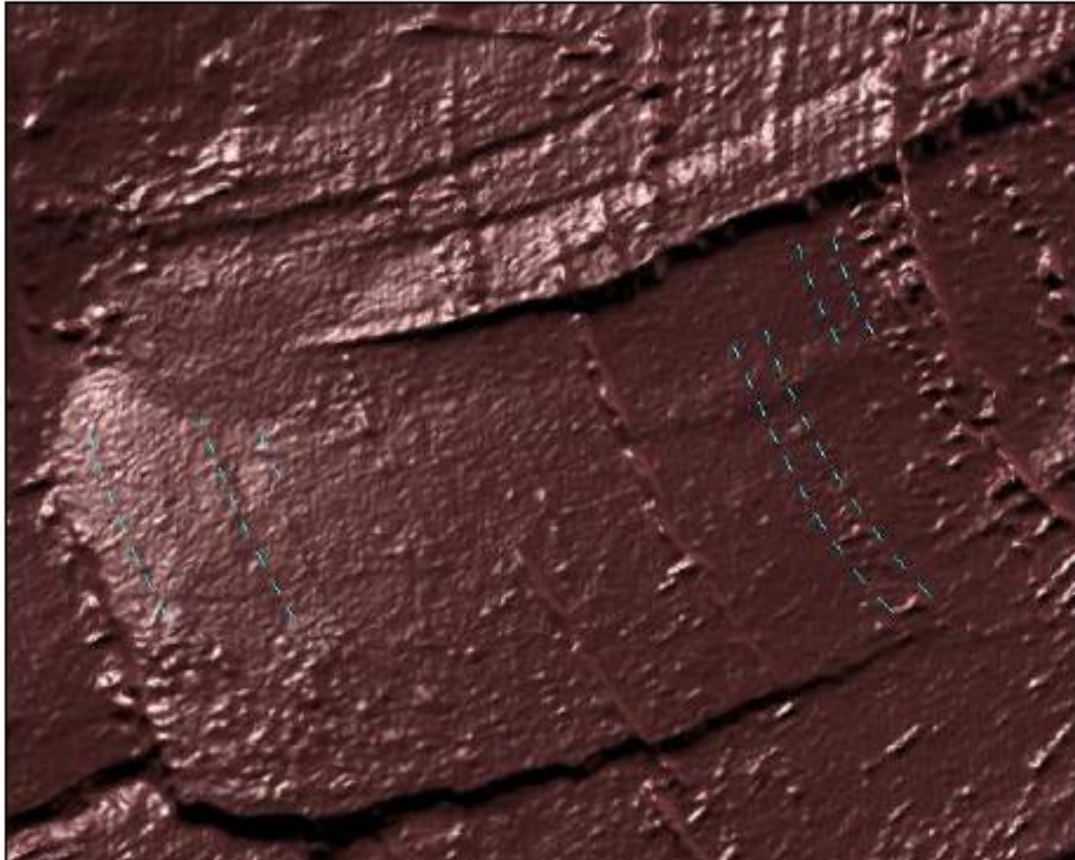


Same tool mark from cross-section. Green line indicate a horizontal line, orange the axe movement into the timber



Analysing the curve of signatures..

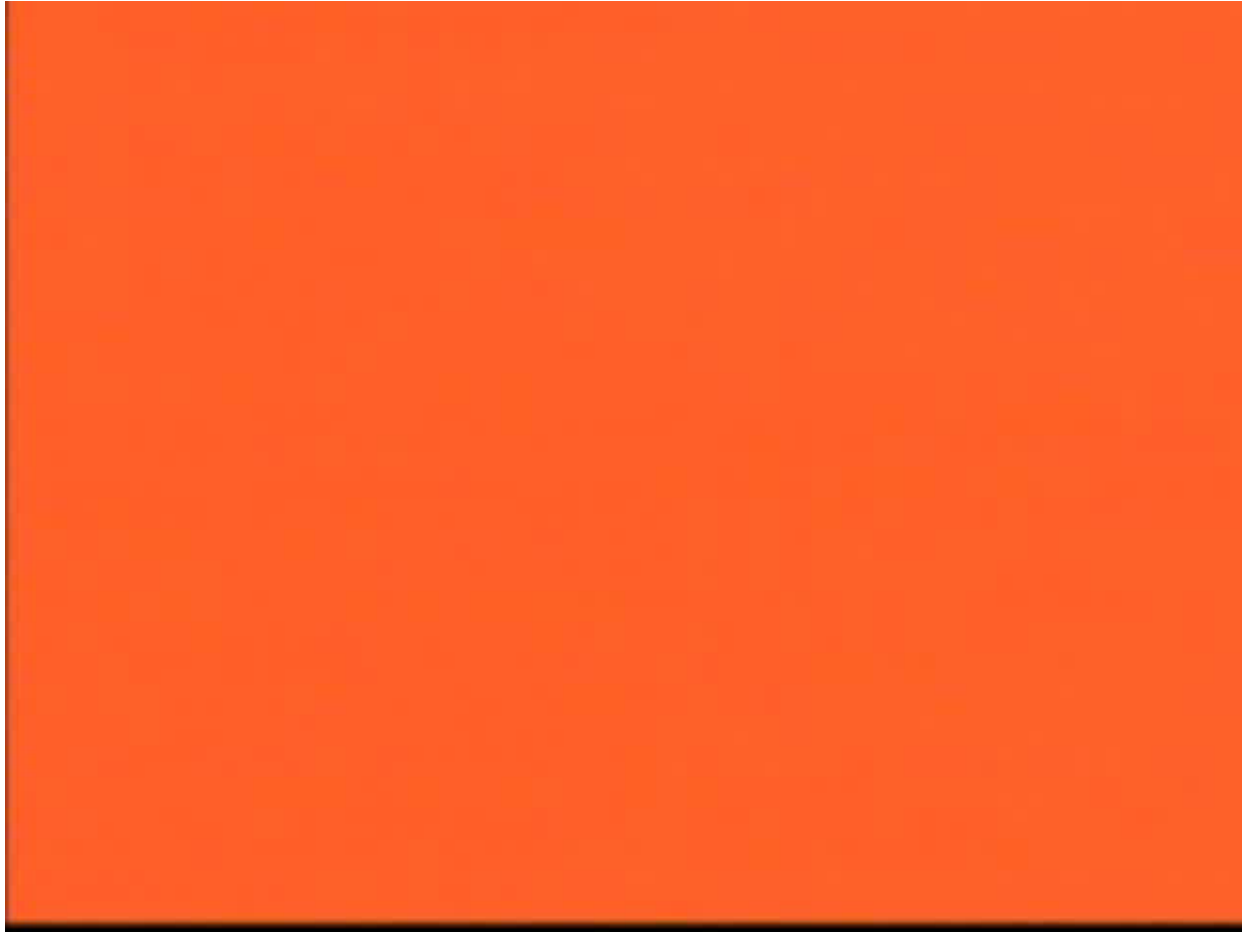
Observe the leading edge of the axe to the left and how it relates to the curve of the signatures and the stop mark ..



The overall patterns indicates that the axe leading edge stroked the timber first..

2. Reconstructing the cutting process.

A dynamic analyze of archaeological tool marks and procedures, tools, moving patterns and techniques based on traditional craftsmen knowledge (“know how”)

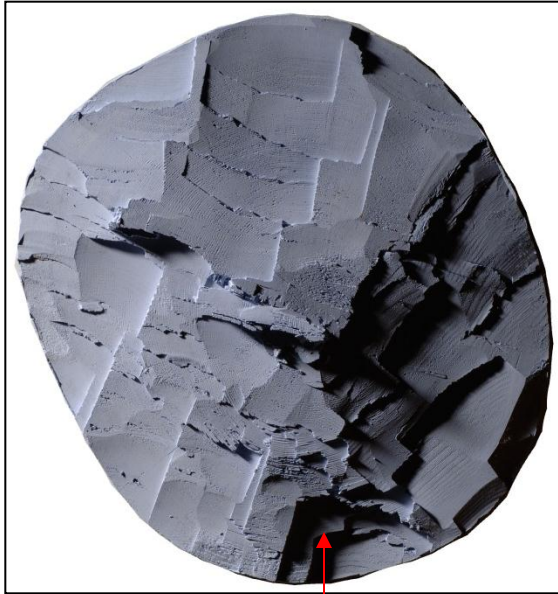


Series of tool marks after rough cutting process



Original and reconstructed timbers compared..

Rough cutting (reconstruction)



Rough cutting (original timbers)

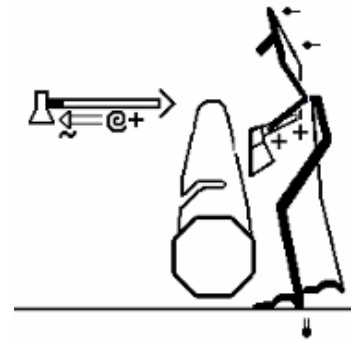
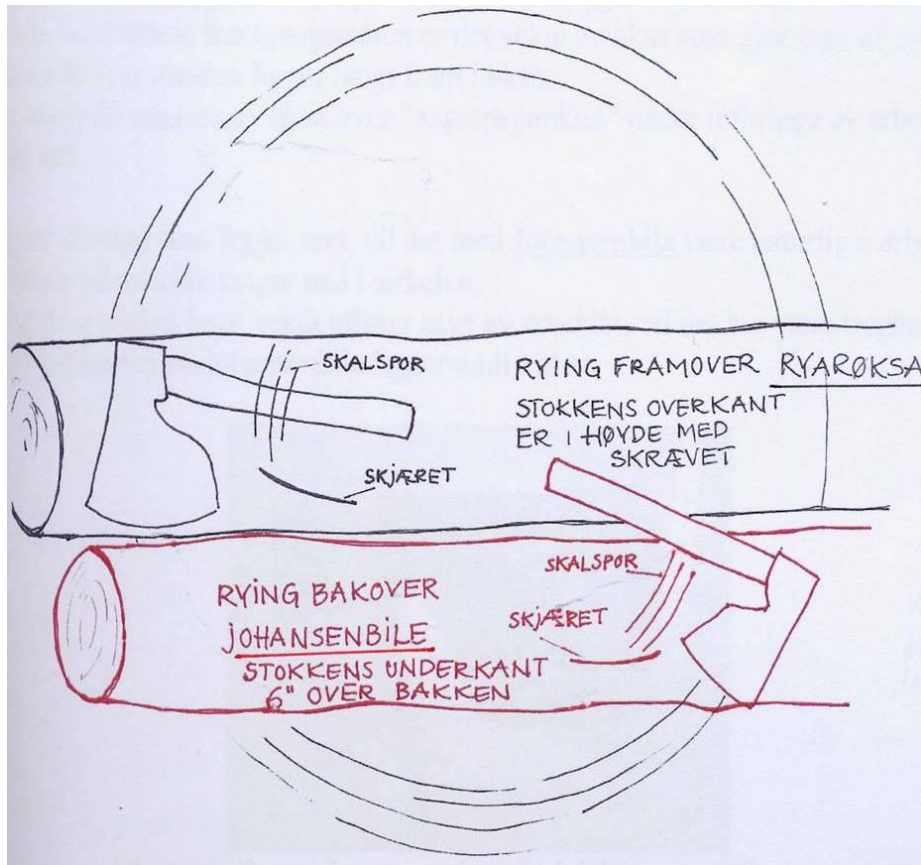


“Boløks”

See how the length between the tool marks from the reconstruction process and the original timber has the same pattern in the beginning of the cutting process, but deeper down the length became a bit longer. That means longer movements..



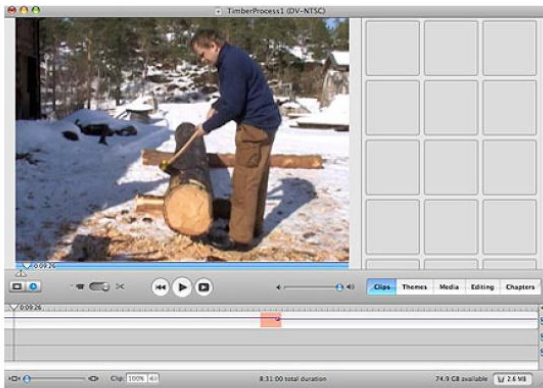
3. The connection between tool marks, tools and body movements..



The invention and development of a notation system analysing details related to craftsman, tool and motions

Part 1: Writing Major Counts

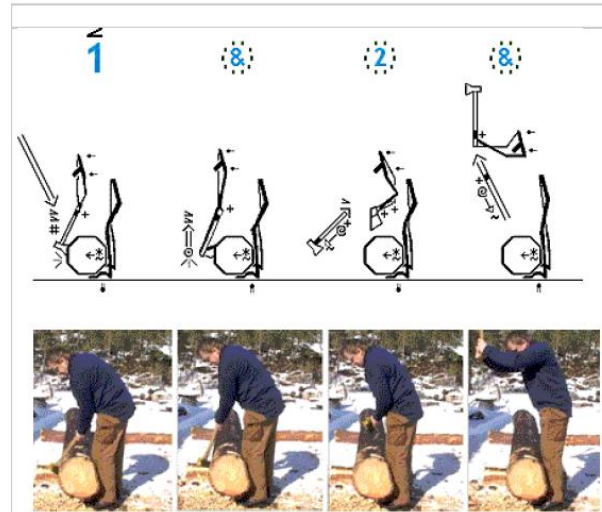
1. Open iMovie.
2. Drag the Timber Process 1 Video onto the iMovie Window.
3. The video loads into iMovie:



4. Then watch and listen to the video several times.
5. What is the focus of the movement? What is the purpose?
6. The focus, or purpose, is to cut wood.
7. So the moment the axe reaches the wood, (marked by the loud sound the axe makes hitting the wood) is the focus of the movement and it repeats and repeats.

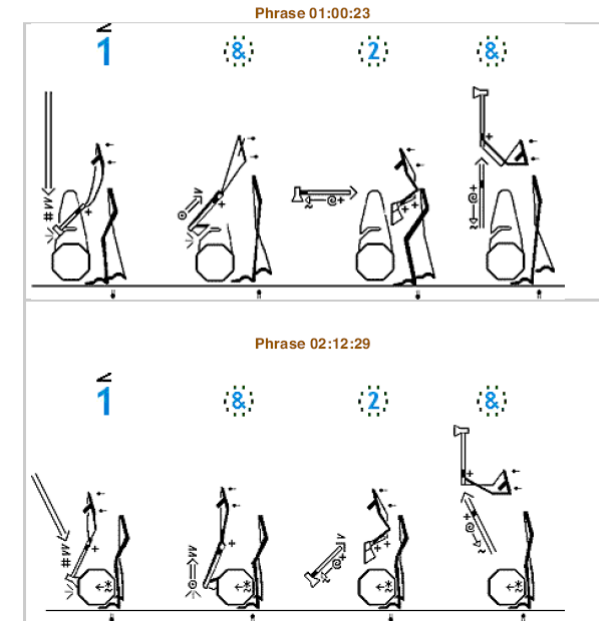
Part 5: Comparing Two Movement Phrases

Here is a second phrase, Phrase 02:12:29

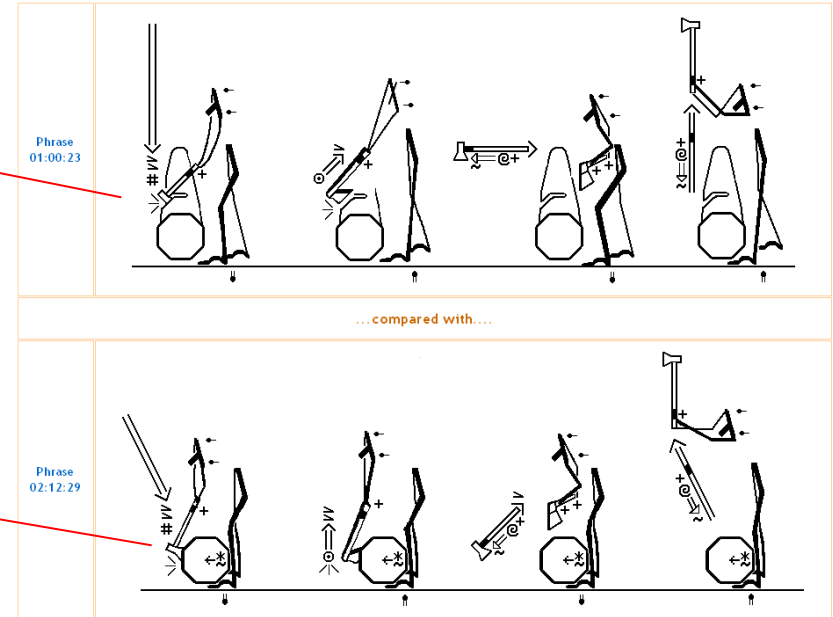
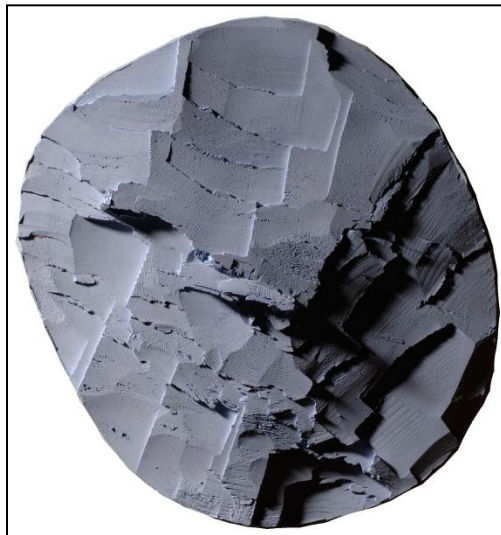
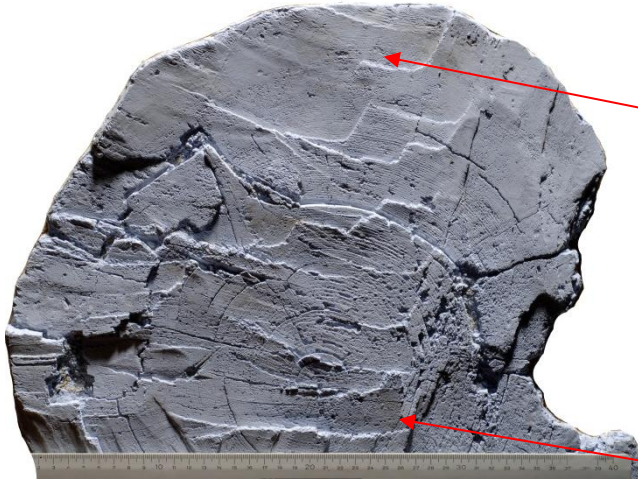


Comparing Phrase 01:00:23 with Phrase 02:12:29

As the cut in the log gets deeper, as time goes by, the timberman moves his feet forward, pressing his lower legs and feet against the log, and bends forward and down deeper, over the log, to reach the other side of the log with the axe. This changes the writing considerably. Notice in Phrase 02:12:29 below, the figure has the feet under the log, the shins pressing against the log, the upper body is bent lower and over the log, and the movement arrows are at different angles.

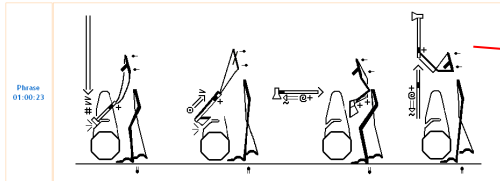


Changes in procedures, movements, rhythm etc. affect the tool marks..

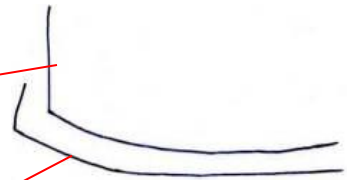
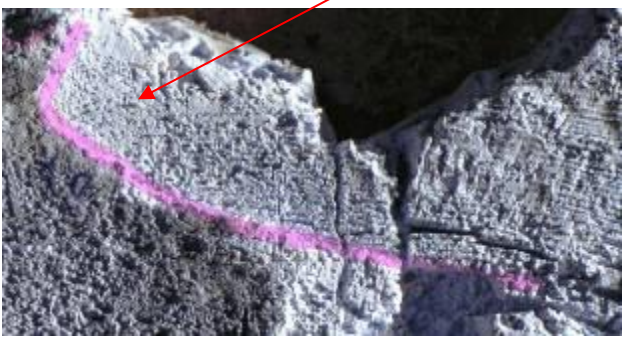
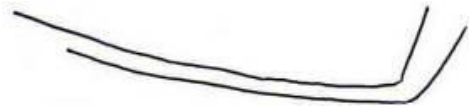
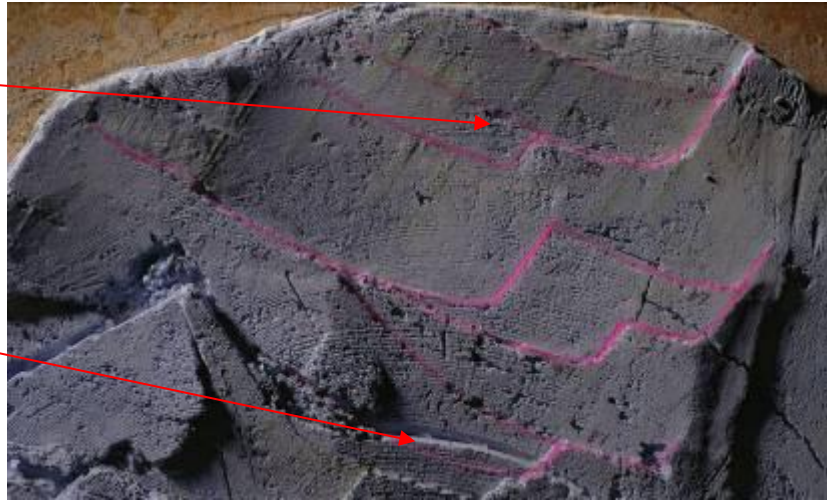
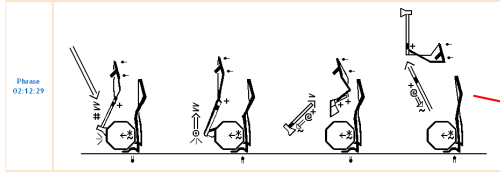


- Changes in angle between stopping point of the edge - and leading edge of the axe appear as deeper in the cut you come ..

- The tool mark changes and the angle becomes gradual more open



...compared with...



Connection between movement patterns and tool marks:

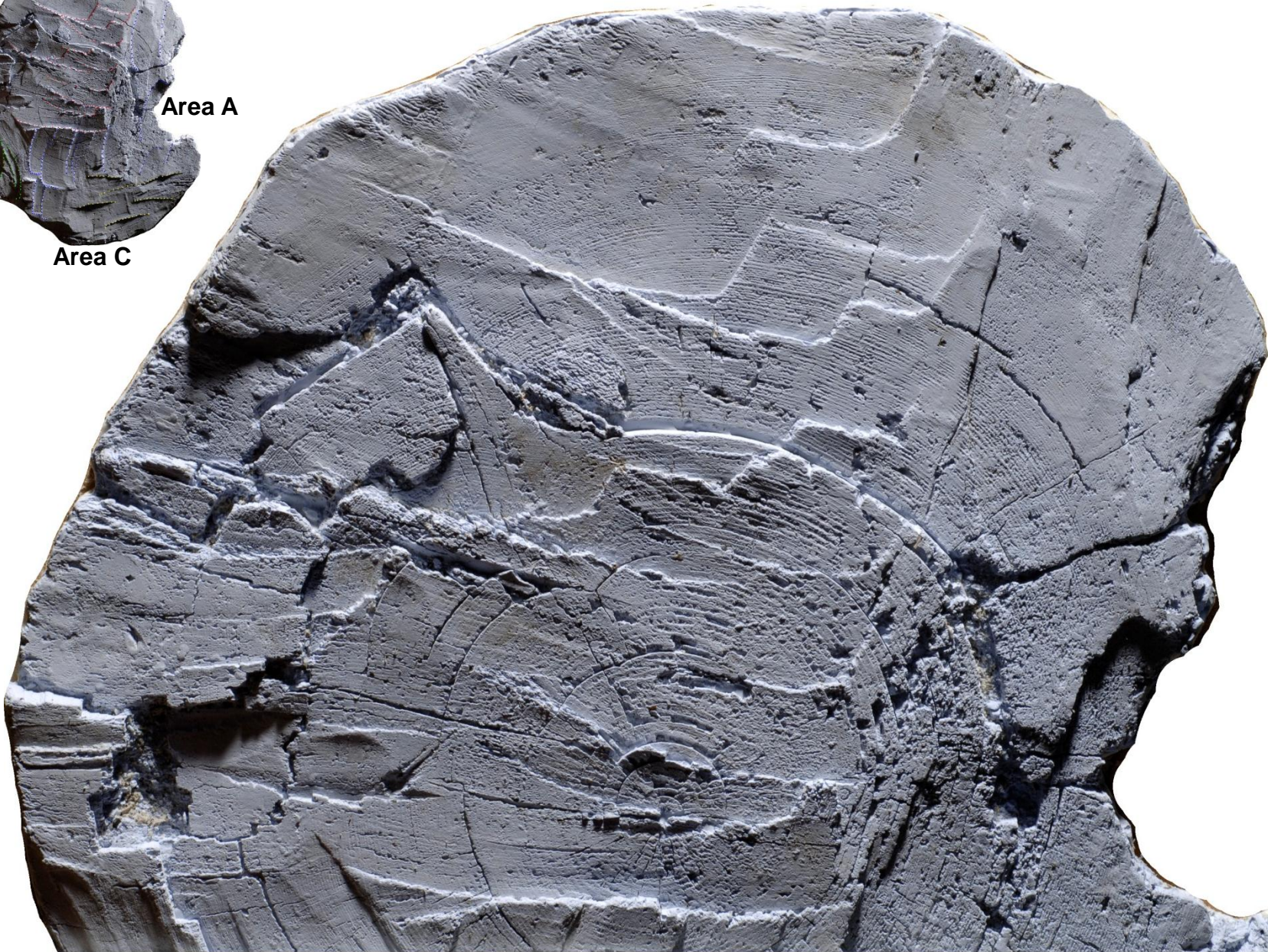
- As deeper down the craftsman works, as more open becomes the angle between outer edge and the edge stop point
- The craftsman working position becomes more bent (forward)
- His point of balance changes
- Rhythm changes

Area D

Area B

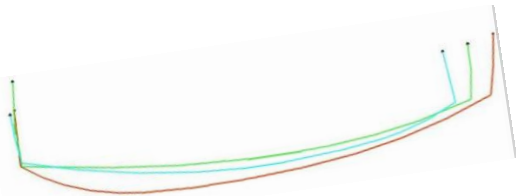
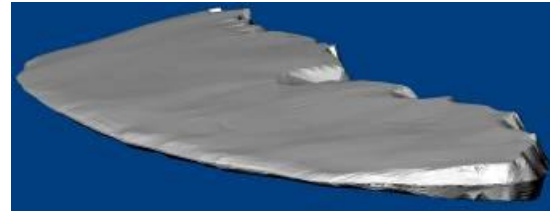
Area A

Area C





The tools behind the tool marks..



1077: 1-7 og 2-14

1145: 3-40 3-52 og 3-49

1145 side: 2-5 og 2-3

- A “bearded axe” (skjeggøks) was probably used in the last cutting process
- The experimental results gave tool marks very similar to the original one
- Our axe weight between 1,2 kilo – 1.8 kilo, the original one was probable over 1,5 kilos – and the axe had probably more weight in the front of the edge
- The shaft was longer than 50 centimetres
- The craftsman draw the axe towards himself
- The wood must have been raw

