



# Bead Production in Scandinavia: converting archaeological evidence to a practical method



## In this hour

- What is experimental archaeology?
- Background on Viking Era bead production
- Initial Questions
- Summary of First Results
- Outstanding Questions



## Experimental Archaeology

**“Experimental archaeology** employs a number of different methods... in order to generate and test hypotheses, based upon archaeological source material... It should not be confused with ... living history or historical reenactment...” [wikipedia]



# Experimental Archaeology

In the case of technologies, that means

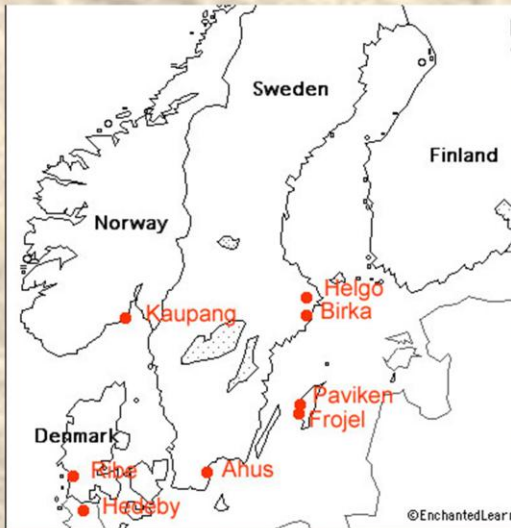
- Look at archaeological evidence
- Develop a list of questions
- Generate a theory
- Build a prototype
- Test
- Repeat

Limit the variables in each experiment

Limits – for example using blowers instead of bellows



## Background - Where?



- Birka
- Paviken
- Helgo
- Hedeby
- Ribe (18,000+ objects)
- Kaupang
- Frojel
- Ahus (71,000+ objects)

### Birka – unperforated beads (Arbman)

4 Tesserae

1 Rod

Unperforated beads

### Paviken – Lundstrom

39 Tesserae

9 Rods (7 monochrome) – 3 with tong marks – 0.1->0.2 cm

Another possible Mandrill

Crucible fragments

Millifiore beads (and matching rod)

### Helgo – Lundstrom

2 Tesserae

2000+ shards

6 rods (5 monochrome) – 3 with tong marks – 0.1->0.2 cm

Bead with end of iron rod inside it

Crucible fragments

Millifiore beads

Hedeby –

Very many rods

Ribe – The Vikings of Ribe – Jensen

-- German Article – Nasman

705 AD – 850 ish

4877 whole or partial beads, 6758 waste, 4033 tesserae (article says 200),

Furnace bit (25-30 cm x 50-60 cm)

36 rods (22 monochromatic)

Bone spatula

Frojel – Carlson

Kaupang

2 tesserae

160 rods (0.05 cm -> 0.5 cm)

Unperforated beads

Ahus



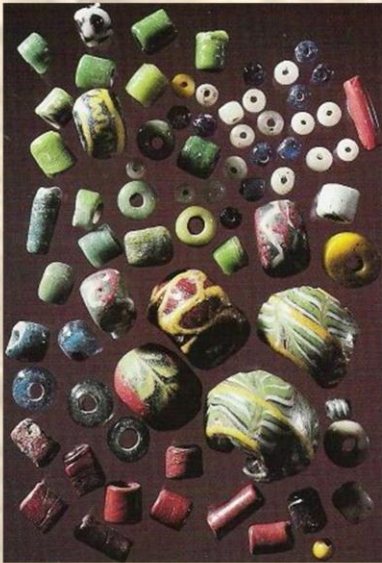
## Background - What

- Whole Beads
- Partial Beads
- Waste Material
- Source Material
- Tools
- Archaeological Remains





## What – Whole & Partial Beads







## What – Waste Material



- Twisted Rods (too small)
- End Bits (from tweezers)
- Lumps



## What – Source Material

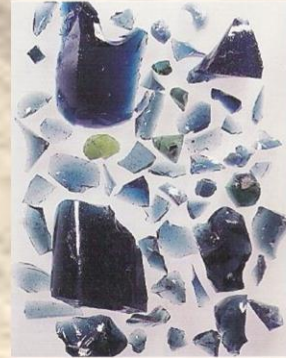


### Rods

- Millefiore
- Decorative
- Reticella



### Tesserae

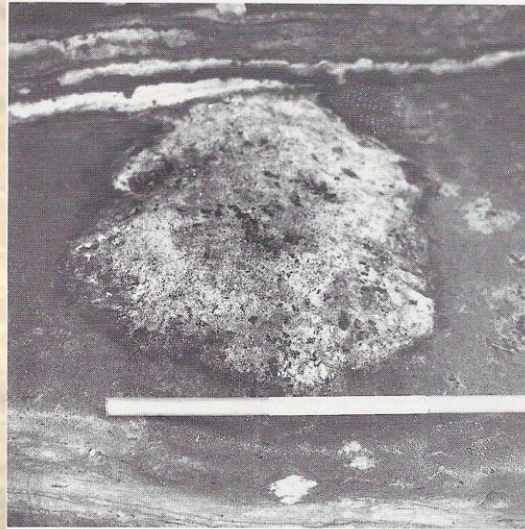


### Sherds



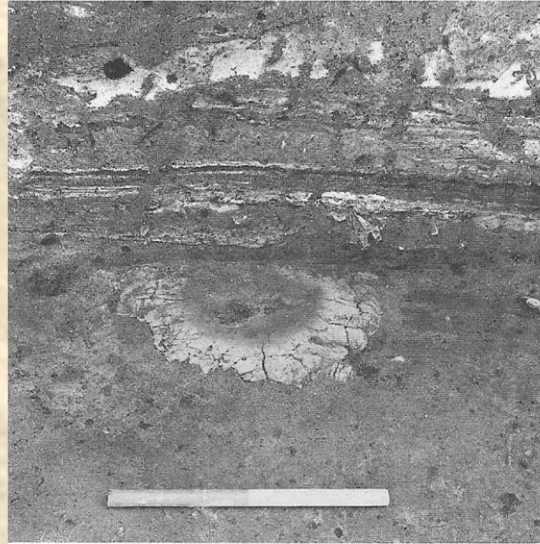
## What – Furnaces (Ribe)

*Fig.50 4M75, Kunstmuseets have. Hearth ACU, placed directly on to the surface of the phase-2 layer ADX.*





## What – Furnaces (Ribe)



*Fig.60 4M75, Kunstmuseets have. Hearth QA.*





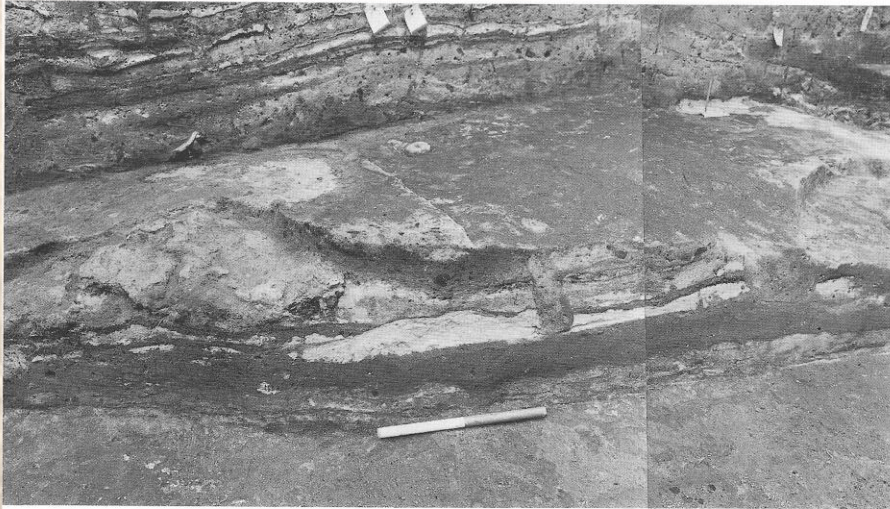
## What – Furnaces (Ribe)



*Fig. 59 4M75, Kunstmuseets have. Hearth UN. Left of this is tuyere XC. In the foreground is a bone spatula and to the right of this is beadmaking detritus.*



## What – Furnaces (Ribe)

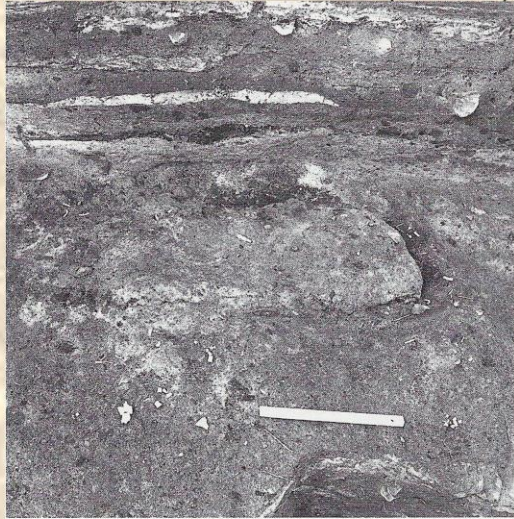


*Fig. 57 4M75, Kunstmuseets have. Part of layer-accumulation 1. In the foreground the pit for the Renaissance-period well GW, to the left hearth UR. The dark layer to the right is the overlying activity level X0.*





## What – Furnaces (Ribe)



*Fig. 54 4M75, Kunstmuseets have. Hearth ÆZ, surrounded by beadmaking detritus.*

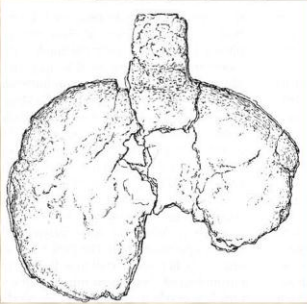


## What – Furnaces (Ribe)



*Fig. 55 4M75, Kunstmuseets have. Hearth ÆZ, long-sectioned.*

Annoying question: We found these things near bead making debris – does this mean they used them to make beads?



## What - Tools

Tool remains from Ribe

- Melting Pan – metal
- Mandrel – metal & wood
- Ceramic bases

Mandrill – 30 cm long, tapered end

Pan – iron, 7cm diameter



## What - Tools



### Ribe – Artist's Idea

- Punty (collect melted glass)
- Mandrel (wind bead)
- Brush (texture, cleaning)
- Crucible / Pan (melt glass)
- Bellows (air flow)
- Tweezers (fine control)
- Pot (annealing)

Not too useful in even a moderate breeze





## What – Ribe Now



Annealing pot on top

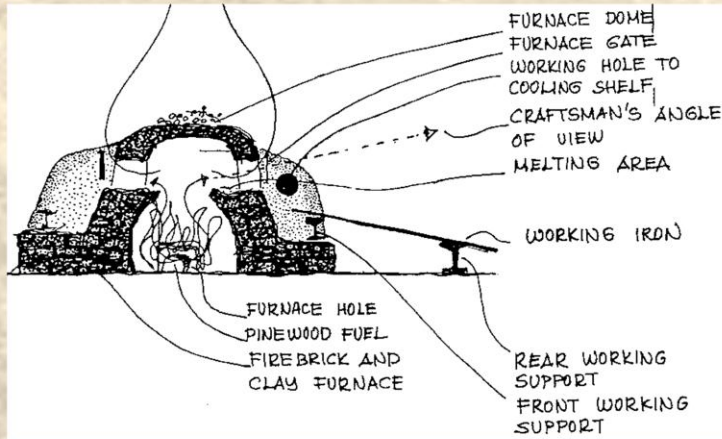
Spare Mandrills

Glass Crucibles inside



## What – Anatolia

- Region known for bead making from antiquity
- Images are of furnaces in current use

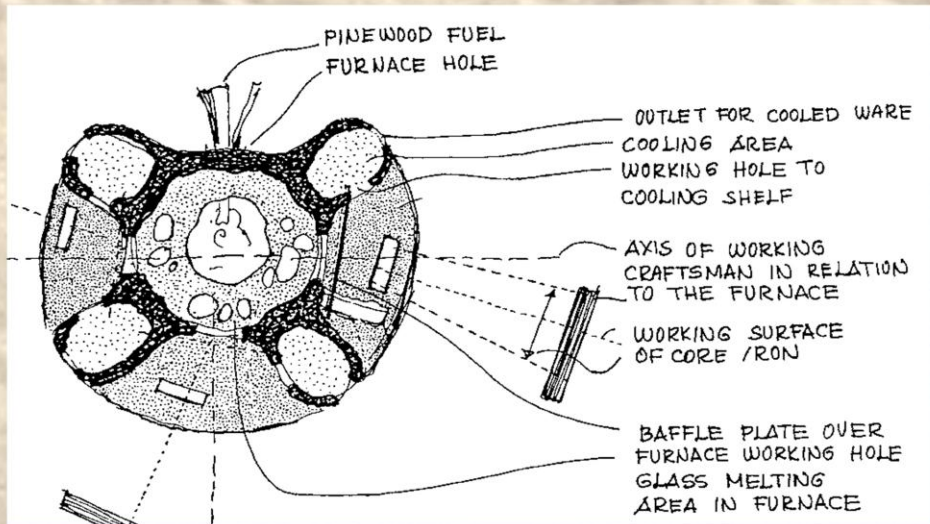


Top is closed – vents back towards workers





## What – Anatolia (cont)





## Initial Question



- Can we get glass to melt in a simple domed shaped – charcoal burning furnace?
  - Yes (Oct 2007)
  - A little surprising to get that positive a result that fast

Mark I furnace

Amusing error – many crucibles wouldn't fit into furnace...



## Secondary Questions

- What is the optimum shape furnace for working?
  - What are the sizes/shapes for extant furnace bases?
    - See previous slides – it varies...
  - Are there fragments of walls connected to the bases?
    - No
  - Does a heat pattern show on the ground or either side of the bases?
    - Yes
  - Is there any trace of an air flow shaping device on the bases?
    - No



Ribe Section BA: layers 39-42 - no size provided - Bencard et al 1990, pl. I table 2; Bencard et al, 2004 p. 84

Ribe Hearth Q: layer 8 - no size provided

Ribe Kunstmuseets have (4M75) layer-accumulation 1 (phase 3): 7 hearths, irregular shapes, no dimensions given - Bencard et al 1990, fig. 49 and p. 126, pl. XVIII table 31b; Bencard et al, 2004 p. 84

Ribe Hearth ÆZ - rectangular clay 53 x 23 cm, up to 5 cm thick - Bencard et al 1990, 95ff & figs. 54-56; Bencard et al, 2004 p. 84

Ribe Hearth UR - irregular outline, no dimensions - Bencard et al 1990, 99 & fig. 57; Bencard et al, 2004 p. 84

Ribe Hearth UN - Rectangular, no dimensions - Bencard et al 1990, 99 & figs. 58-59; Bencard et al, 2004 p. 84

Ribe Hearth QA - irregular lens 50cm diameter - Bencard et al 1990, 99-102 & fig. 60; Bencard et al, 2004 p. 86



## Furnaces



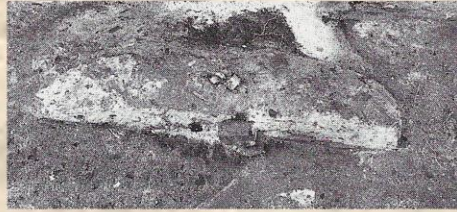
Clockwise from top left

- Mark II Initial firing (Jun'08)
- Mark II Second firing (Jul'08)
- Mark III First firing (Jul'09 – used again Sep'09)
- Mark IV (May '09)
- Teapot Mark I (May '09)
- Mark V (Jul'09, Jul'09, Sep '09)
- Teapot Mark II (Jul'09)





## Archaeology & Construction



Compare        – cobb construction indicators  
                     - lack of wall indicators on original

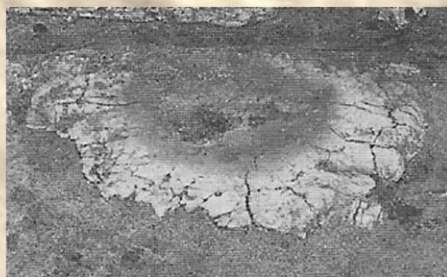
Top Right - Original Hearth AEZ from Ribe - sectioned by archaeologists

Left – Mark II (Jul 2008) after breaking following 2 days of use (fairly solid – mistake in moving it)

Bottom Right – Mark IV (May 2009) – straight clay, less than a day's use



## Archaeology – Heat Pattern



### Hearth QA – Ribe

Compare heat scars – note on Left a thermal protection tile lifted up (was under the furnace)





## Questions (Mark II)

- Will this work with a bellows
  - Yes
- Did the bellows add any concerns
  - Pulsing air increased ash in the air – more scars
- What staff is required
  - 1 bellows operator (could work all day)
  - 1 or 2 bead makers (could likely work several hours)
- What is the consumption rate for charcoal
  - Shockingly little – around 12kg for a 4 hour session



## Beads – ash scars, breakage



Breakage pattern – more longitudinal

Ash scars on originals and replicas



## Questions (Mark III)

- Work Technique –with tesserae (Jul 20'08)
  - understand how to work with other raw materials
  - some success
- Work Technique – adjusting lampwork (Jul 20'08)
  - Move work ports to ends
  - Internal air flow – split and swirl
- Removing beads from mandrels (Jul 20'08)
  - Find workable techniques

Removing beads – bang off (tended to pull mandrel from wood)



## Questions (Mark IV)

- Construction with Clay (May'09)
  - FAIL – furnace was falling apart with an hour
- Teapot style (May'09)
  - Lampwork option
  - 1 operator
  - More efficient with charcoal
  - Construction fail – clay not strong enough



## Questions (Mark V)

- Construction change – small chimneys (Jul'09)
  - Better for lampworking
  - Used for 3 burns (18 hrs) and still usable
- Teapot style (Jul'09)
  - Hard to keep heat up – needs shaped base (bowl)
- Work Technique – tesserae
  - Developed a repeatable technique





## Tools

- No significant focus yet
  - Using modern mandrels with dip
- Reproductions created







## Tools





## Beads





## Additional Notes

- Also need to develop skills to make beads
  - Workers have some lampwork training
  - Still producing additional errors
- Conflict between experiment and urge to succeed
  - Experiments that fail also have value
- Matched CoE glass



## The Plan

- Build Mark IX (Mark VIII is here today)
- Annealing
- Avoiding ash scars
- Variation on technique
  - Production Speed
  - Puntils for glass handling
  - Crucibles of glass melting in the furnace
- Tool use
  - Mandrel with no dip
  - That flat plate



## Contact us

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