



# The Cutting Edge

An overview of the historic development of knives.

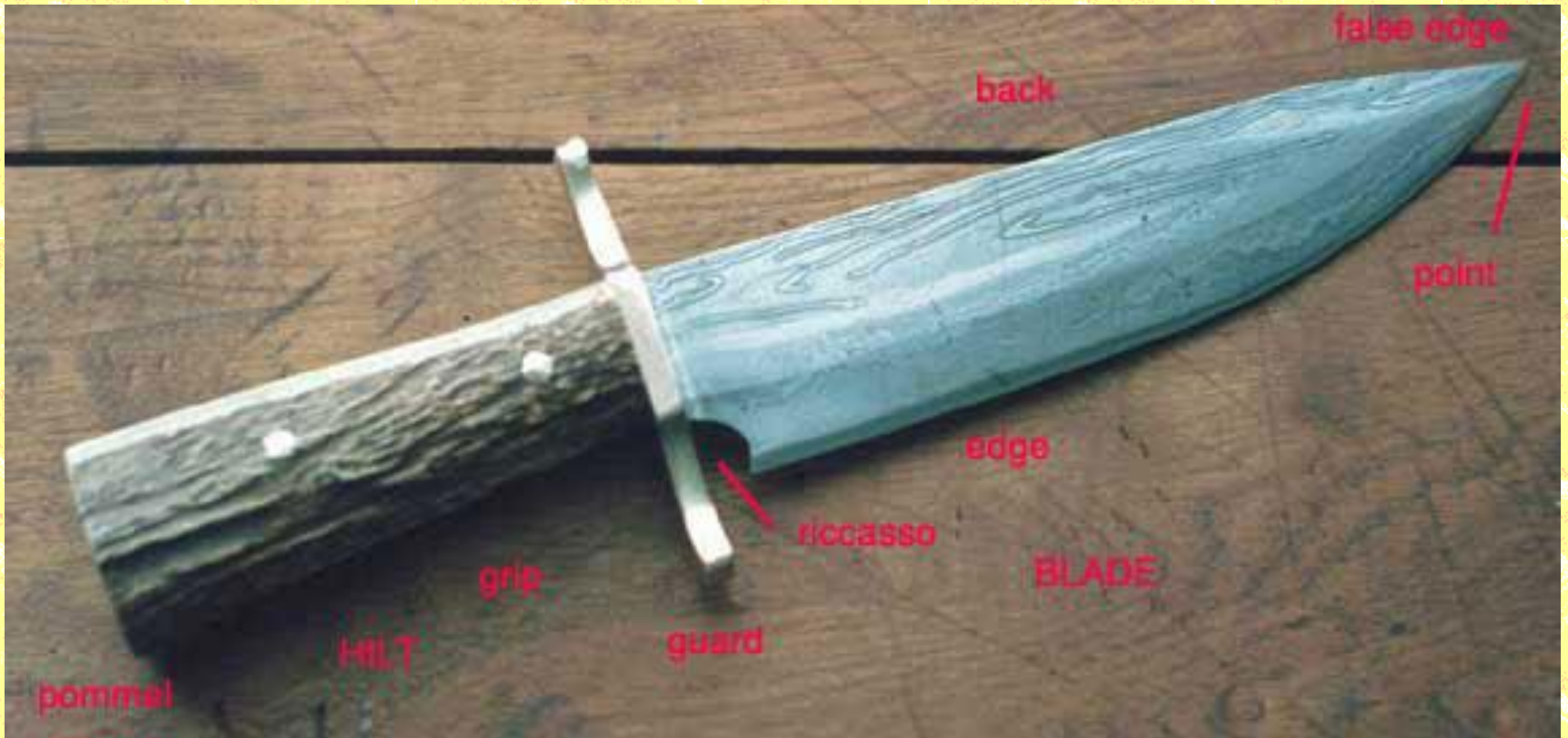


**Darrell Markewitz**  
The Wareham Forge

Forward Into the Past 23 - 2013



# Definitions !



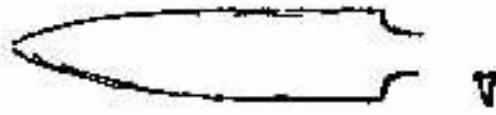


Definitions !

# Basic Shapes



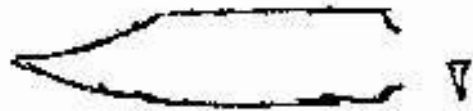
BEAK



DROP POINT



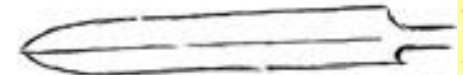
SMALL TOOL



CLIP POINT



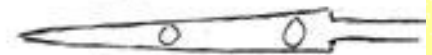
STRAIGHT BACK



DOUBLE EDGE



LEAF



RONDEL

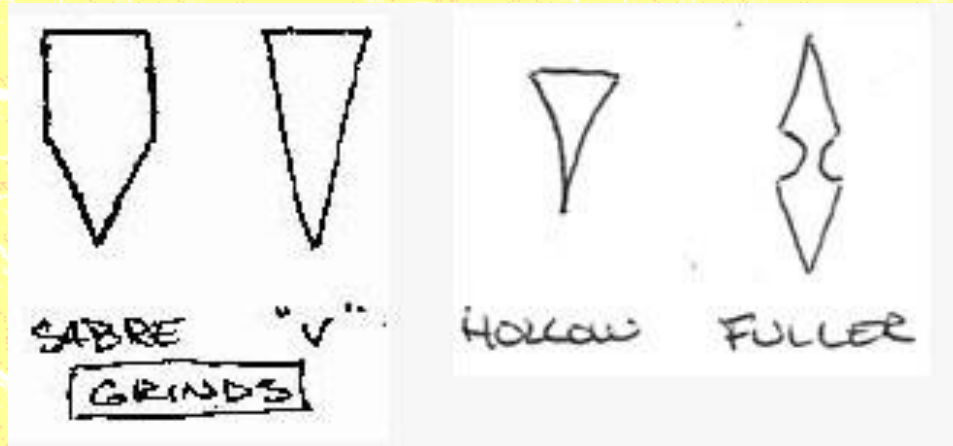






Definitions !

# Grinds

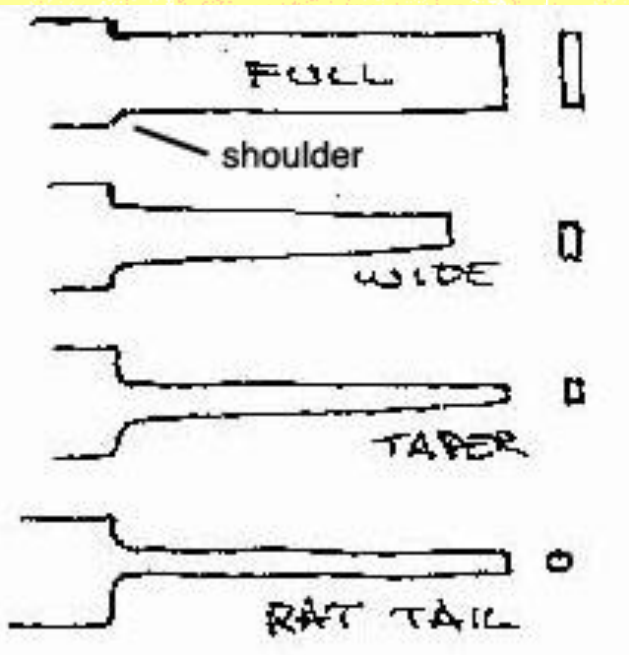




Definitions !

# Tang & Grip Construction

## Mounted Tangs





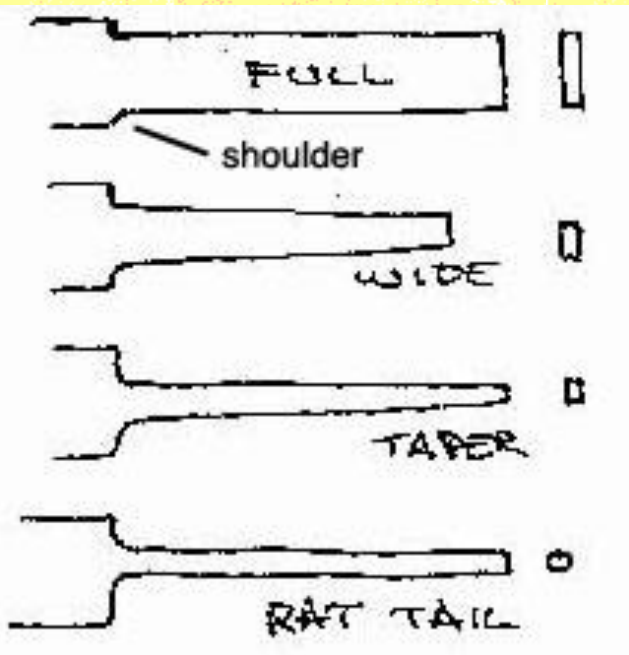
Definitions !

# Tang & Grip Construction

## Mounted Tangs

## Full / One Piece

- Plain, Slab or Wrapped
- Inlaid







Definitions !

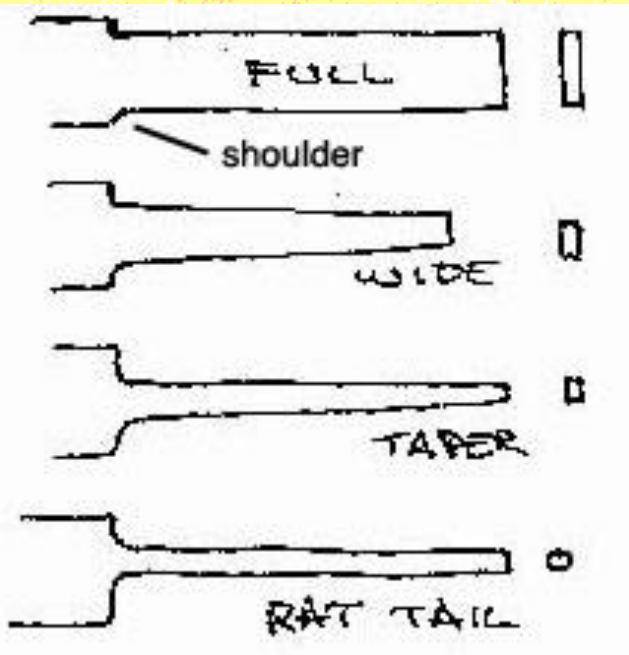
# Tang & Grip Construction

## Mounted Tangs

## Full / One Piece

- Plain, Slab or Wrapped
- Inlaid

## Socketed Inset





# The Human Problem...



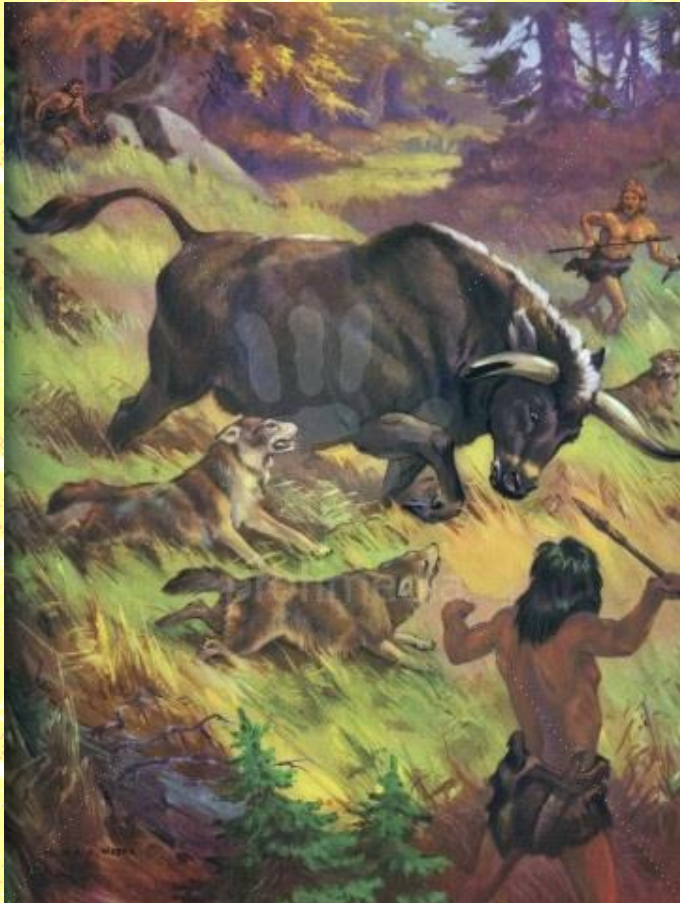
**How smart do you need to be -  
To sneak up on a PLANT...**







# The Human Solution...



## TOOLS

To extend reach, magnify effect



Bone Knife : 8000 BC (?) China



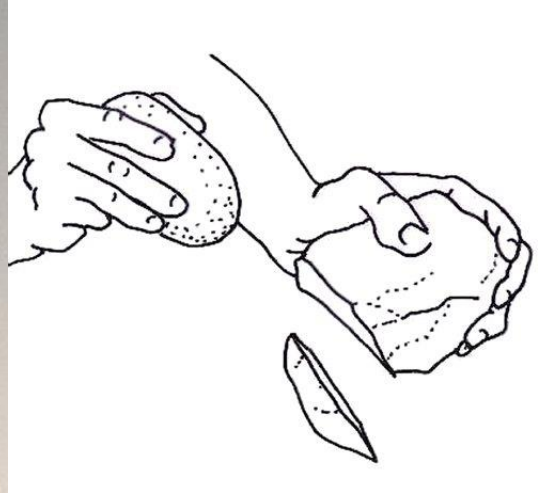


# Working Stone

## Paleolithic



Flint Hand Axe - 21 x 9 cm (730 gm) : c 20,000 BC,  
Spain



‘Old Stone Age’ :

- Roughly chipped and shaped cores
- Use of simple flakes



Chert Flake Tool - 6 cm : 40,000 - 27,000 BC,  
France







# Working Stone Mesolithic



Hand Axe : Winchester England



'Middle Stone Age' :

- Complex chipped edges
- Shaped forms



Chipped Edge detail : (age ?) Kenya







# Working Stone **Neolithic**



‘New Stone Age’ :

- Polished stone edges



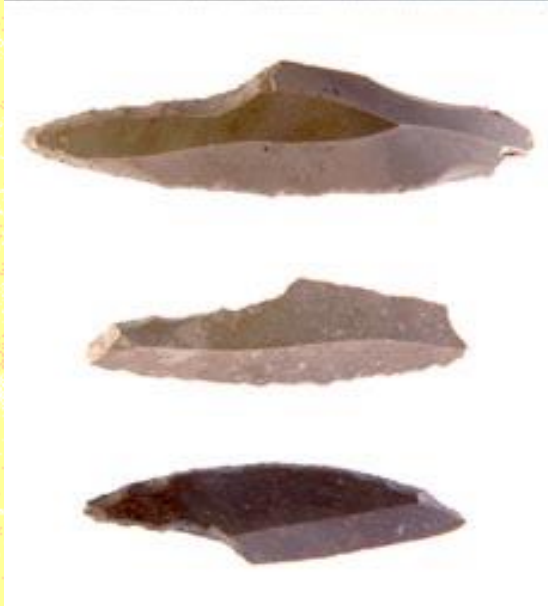
**Polished Tools Group : 4500 - 2000 BC**

**Inuit Stone Knife : (age ?) Nunavut**





# Working Stone Classic Shapes



**Flaked Quartzite Knives :**  
'Tamukai', Japan, + 13,000 BC - 4  
- 6 cm cm

**Chipped Stone Spear Head :**  
'Adena', Ohio USA, 3000 - 1200 BC -  
10 cm



**SLICE**

**Small Tool Blade**  
(to Paleolithic)

**Double Edge  
'Dagger'**  
(to Mesolithic)







# Working Stone **Advantages**

- Relatively common materials
- Can be EXTREMELY sharp
- Relatively durable \*edges\*



Aztec Obsidian Sword







# Working Stone & Limitations

- Relatively common materials
- Can be EXTREMELY sharp
- Relatively durable \*edges\*
- Limitations on shapes
- Overall - fragile materials
- Not 'owner serviced'



Aztec Obsidian Sword





# Working Metals

## Native Copper



© 2002 Wessex Archaeology

**Flint & Copper Knives : Wessex  
England, 2300 BC - about 15 cm**



**Copper Tools : Rat Indian Creek,  
Yukon, 1000 - 200 BC**

Neolithic Period -  
9000 BC

- Raw nuggets
- Cold hammered
- Small objects





# Working Copper **Classic Shapes**



**The Clip Point**







# Working Copper **Advantages**

- Flexible material
- Owner sharpened
- Relatively easy to work





# Working Copper

## Advantages & Limitations

- Flexible material
- Owner sharpened
- Relatively easy to work
- Poor edge holding
- Rare material
- Small objects only \*



Polished Stone Knife : Cairo Museum, Egyptian, 3000 BC - 50 x 7 cm

## Copper as Status material

\* Smelted Copper / Casting + 7500 BC





# Working Metals

## Bronze

Alloy 'Accident' from smelting Copper  
+ 3500 BC

- 5 - 10% TIN
- Casting process
- Much harder metal than copper !



**Bronze inset axe blade : Dorset,  
England, 700 BC**



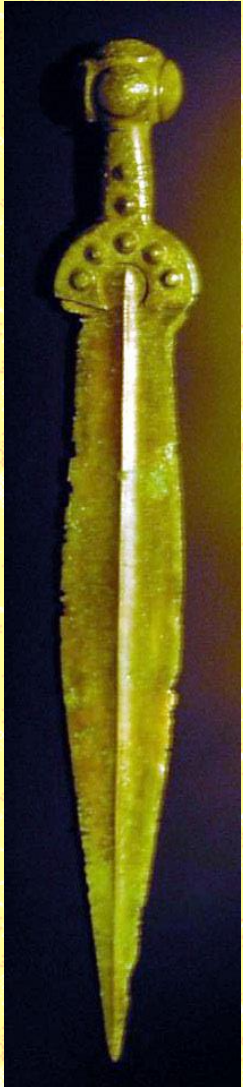
**Bronze weapons : Mycenaen, Greece,  
1600 - 1100 BC**







# Working Bronze Classic Shapes



Hunting scene with Xiphos : Greek,  
400 BC - (actual) 50 - 60 cm

Bronze Sword / Dagger :  
European, 1700BC



Socketed Spear Head : Early  
Roman, Italy, 500 - 300 BC -  
10 cm

## THRUST

### Leaf Shaped Blades

Double edged

Single edge variant

### Socketed Spears





# Working Bronze Advantages

- Complex shapes
- Owner sharpened
- Mass Production



**Socketed Axe Head :**  
London, England,  
1500 - 1400 BC

**Swords / Daggers :**  
Celtic La Tene - 50 +  
cm



**Spear Head : Celtic Britain, 1200 - 800 BC -**  
40 x 6 cm







# Working Bronze

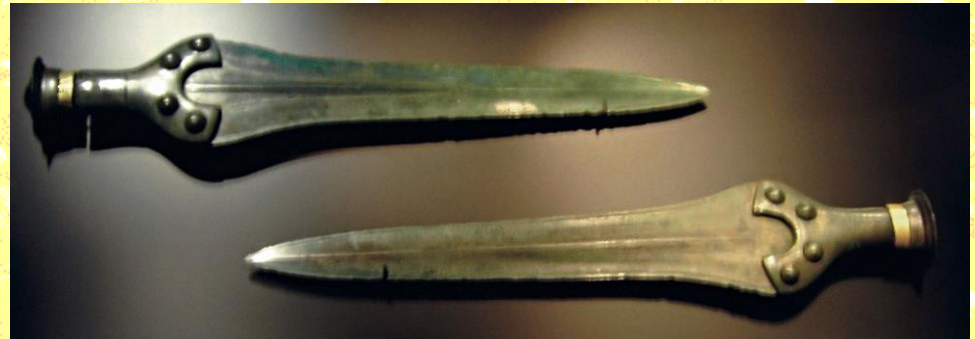
## Advantages & Limitations

- Complex shapes
- Owner sharpened
- Mass Production
- Brittle \* - Thrust Primary
- Tin extremely rare material



**Socketed Axe Head :**  
London, England,  
1500 - 1400 BC

**Swords / Daggers :**  
Celtic La Tene - 50 +  
cm



**Spear Head : Celtic Britain, 1200 - 800  
BC - 40 x 6 cm**

\* Depends on exact alloy mixture







# Working Metals

## Meteoric Iron



Inuit 'Iron' Point : Cape York  
Meteorite, Greenland - c 1818



Tutankhamun's 'Iron' Dagger : Egypt,  
c 1320 BC - 20 cm blade

**Iron normally only OXIDE**

Nickel - Iron meteorites

- Rare but valuable !
- 7 to 15% Nickel
- Earliest are cold worked
- Later simple hot forging







# Working Metals

## Smelted Iron



Iron Axe (bronze mount) :  
Assyrian, Iran, 1000 BC - 14  
cm blade



Celtic Dagger : 450 BC ?

**Oxide Ore REDUCED to Metal**  
2500 to 2000 BC

Turkey / Afghanistan region

- Connection to copper smelting?
- Material is hot forged







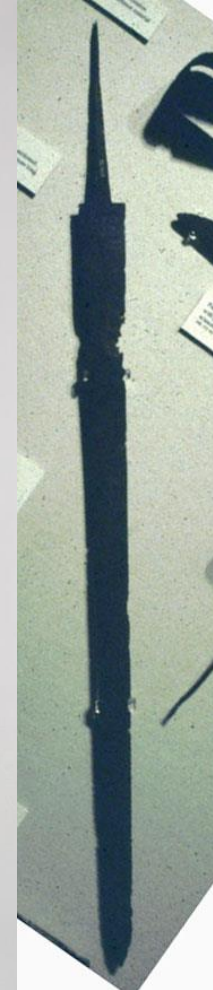
# Working Iron Old vs New



Roman Military Weapons : c BC/AD



Celtic Long Sword (in bronze scabbard) : 100 BC



## SLASH

### In Europe

Bronze  
'swords' (@ 50  
cm) are  
replaced by  
IRON daggers  
about 600 -  
500 BC

Roman Long Sword  
: c 200 AD





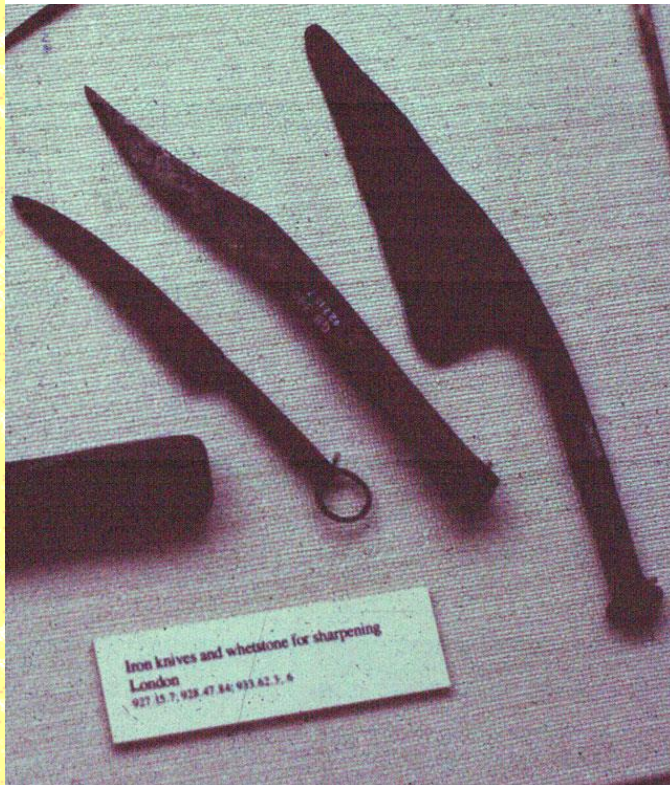


# Working Iron Knives

**Typically SMALL**  
**7.5 - 10 cm standard**



Stor køkkenkniv fundet i St. Skindbjerg, Dejbjerg.



Iron knives and whetstone for sharpening  
London  
927 15 7, 928 47 84; 933 62 3, 6

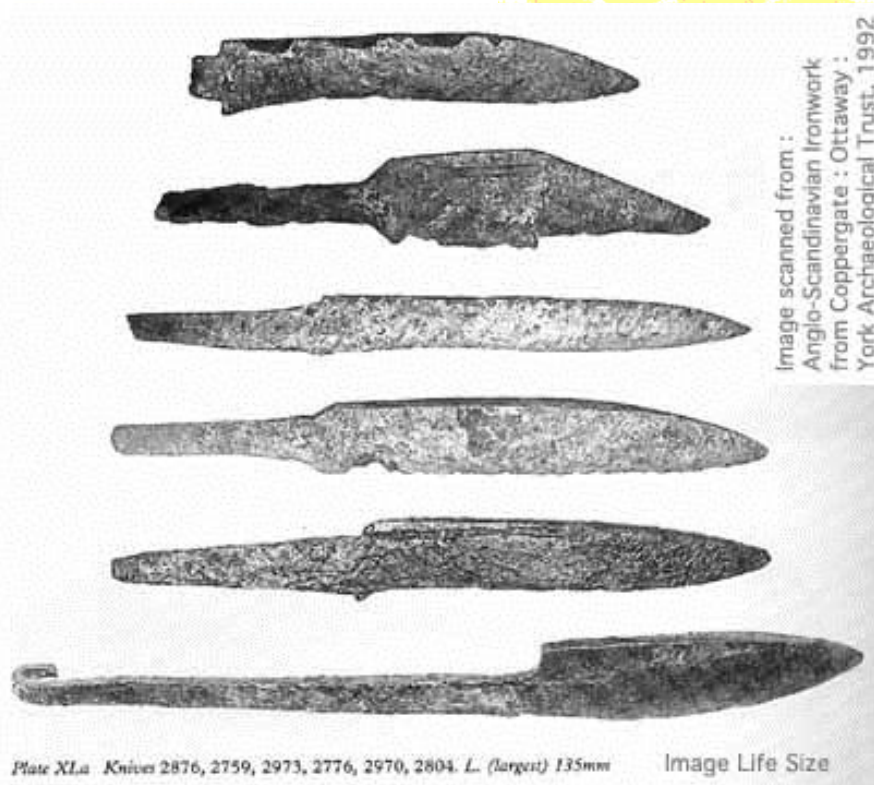


Image scanned from :  
Anglo-Scandinavian Ironwork  
from Coppergate : Ottaway :  
York Archaeological Trust, 1992

Plate XLa Knives 2876, 2759, 2973, 2776, 2970, 2804. L. (largest) 135mm

Image Life Size

Romano-British : London, England, c 450

Danish Iron Age

Anglo-Scandinavian : York, England, c 900







# Working Iron Advantages

- Ore widely available
- Flexible and durable
- Owner sharpened
- Allows for large and complex shapes



Iron, cold iron, will rule them all...







# Working Iron

## Advantages & Limitations

- Ore widely available
- Flexible and durable
- Owner sharpened
- Allows for large and complex shapes
- Extremely complex production (smelting) methods
- Secondary Forging processes
- Complex (mysterious) Heat Treating methods



Iron, cold iron, will rule them all...







# Art & Mystery

## Iron & Production



Ancient Process :  
Direct Bloomery Furnace /  
**Wrought Iron**





# Art & Mystery

## Iron & Production



Ancient Process :  
Direct Bloomery Furnace /  
**Wrought Iron**



Medieval Process :  
De-carbonize cast iron





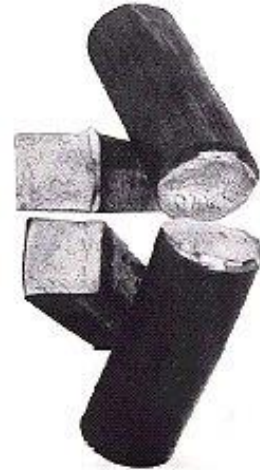


# Art & Mystery

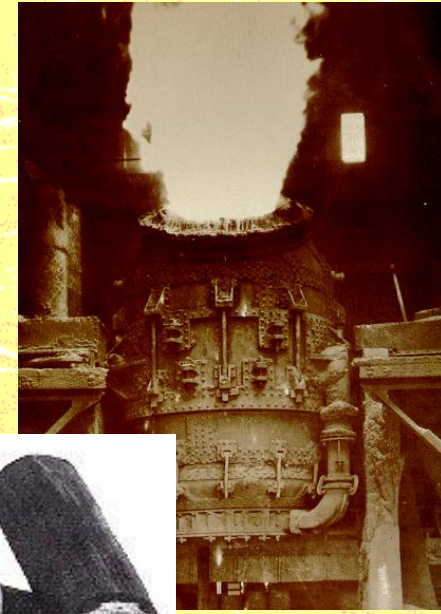
## Iron & Production



Ancient Process :  
Direct Bloomery Furnace /  
**Wrought Iron**



Medieval Process :  
De-carbonize cast iron



Modern Process :  
Bessemer Steels







# Art & Mystery Iron & Alloy

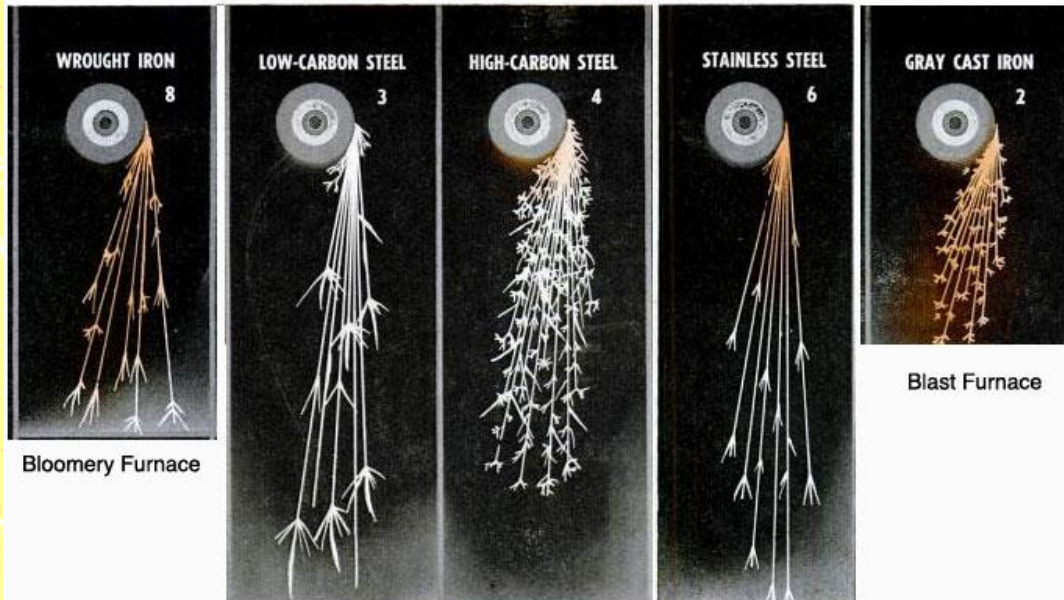
Carbon Increases

1/5 %

1 %

(1/5 % C + 1/2 % Ni)

2.5 to 4 %



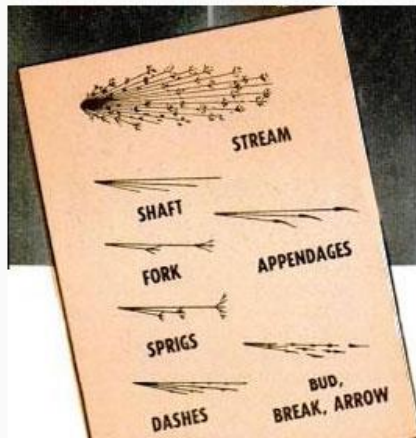
Bloomery Furnace

Bessemer Furnace

Blast Furnace

## CARBON primary addition

- Effective amounts very small
- Increases Durability
- Increases Brittleness



### SPARK CHARACTERISTICS

- 8. WROUGHT IRON.** Stream is yellow, about 65 in. in length. Volume is fairly large, streamers ending in forks, appendages
- 3. LOW-CARBON STEEL.** Color is white, **spark** stream moderately large. Length is 60 to 70 in. with forks, appendages
- 4. HIGH-CARBON STEEL.** Stream is white, of fairly large volume with numerous small, repeating sprigs. Length 50 to 55 in.
- 6. STAINLESS STEEL.** Stream is moderate in volume, straw-colored near wheel and white near end. Streamers end usually in forks
- 2. GRAY CAST IRON.** **Spark** stream is straw-yellow, length about 25 in. Sprigs are small, repeat along length of each streamer

Adapted from 'Shop Notes'  
[www.scrapmetaljunkie.com](http://www.scrapmetaljunkie.com)





# Art & Mystery Iron & Alloy

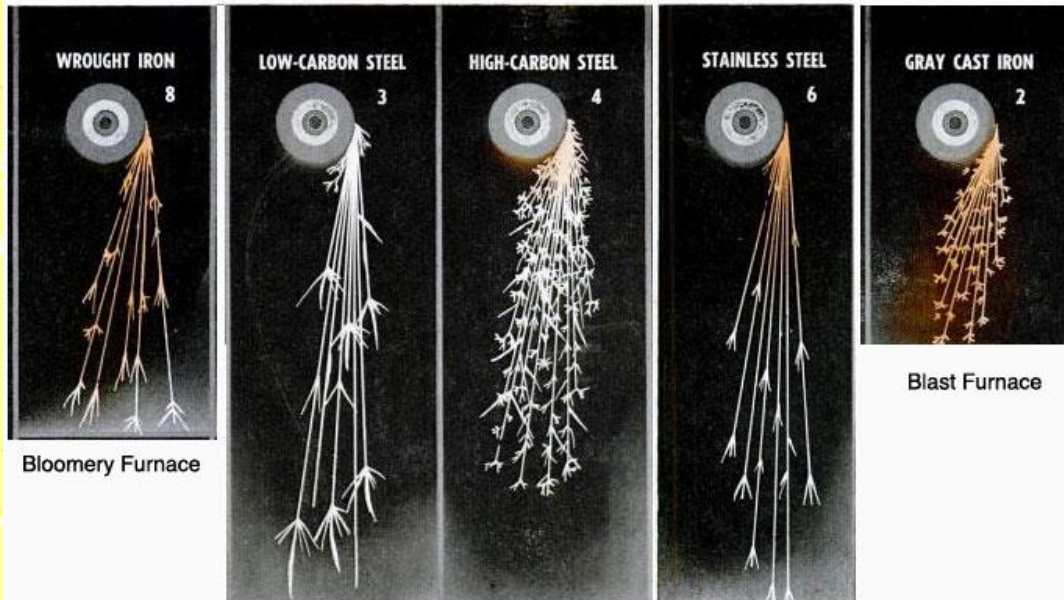
Carbon Increases

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Bloomery Furnace

Blast Furnace

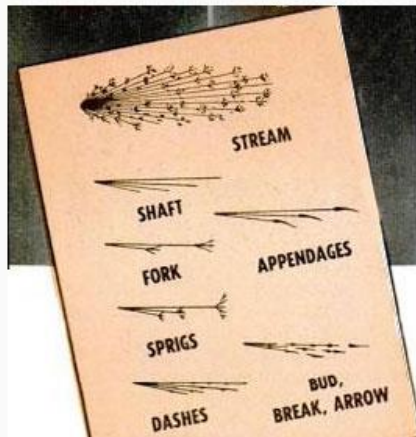
Bessemer Furnace

## CARBON primary addition

- Effective amounts very small
- Increases Durability
- Increases Brittleness

## Other Alloys Unknown Historically

- Use of Meteorites
- Variations in ore bodies



### SPARK CHARACTERISTICS

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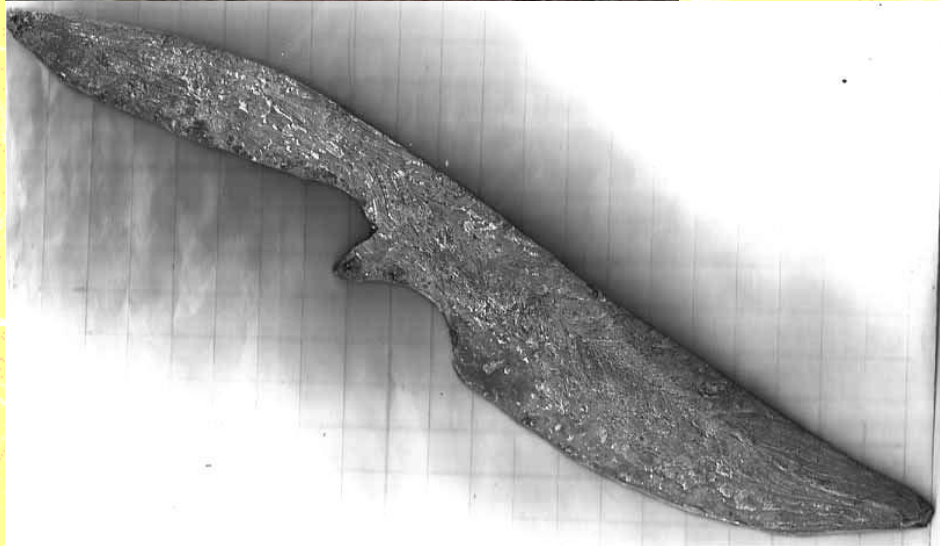






# Art & Mystery

## Heat Treating



**Develops AD - 500 (?)**  
**Carbon alloys only**

**Changing COOLING**  
**Modifies HARDNESS**

### **1) Annealing**

- SLOWLY cooling
- Releases strain
- SOFTENS metal







# Art & Mystery

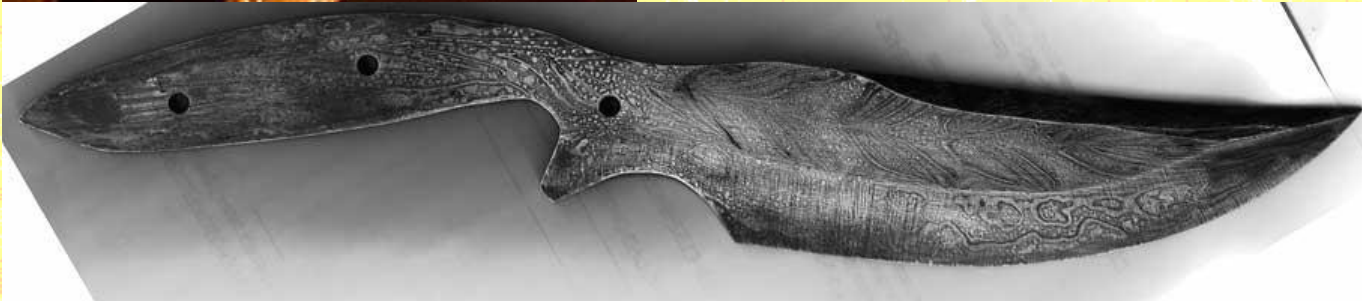
## Heat Treating



**Changing COOLING  
Modifies HARDNESS**

### **2) Hardening**

- RAPID cooling (quench)
- HARDENS metal





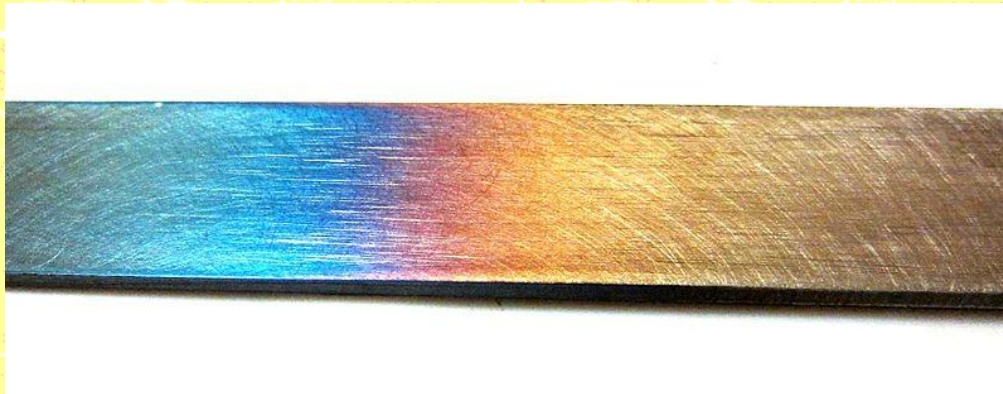
# Art & Mystery

## Heat Treating

**Changing COOLING  
Modifies HARDNESS**

### 3) Tempering

- SELECTIVELY heating
- Lower heat process
- Quickly cooling
- Selectively SOFTENS areas



**Blue / Hottest = Softer**

**Straw / Coolest = Harder**



**Straw at Edge to Blue at Back, Point unchanged**

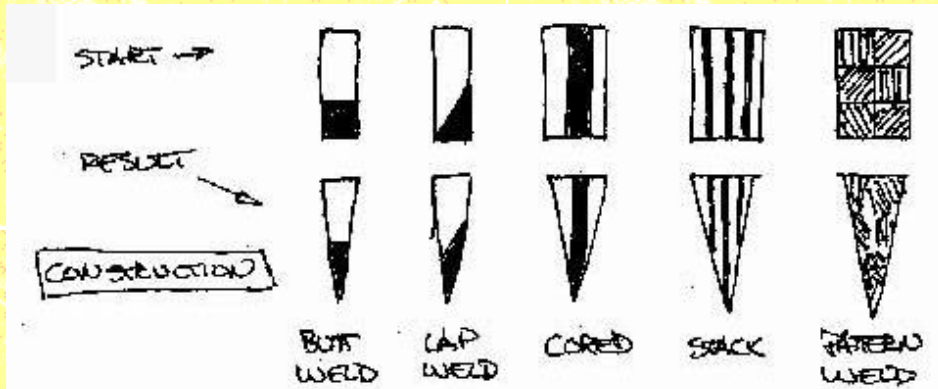






Art & Mystery

# The Bladesmith's Dilemma



Low Carbon is flexible but soft  
High Carbon is hard but brittle

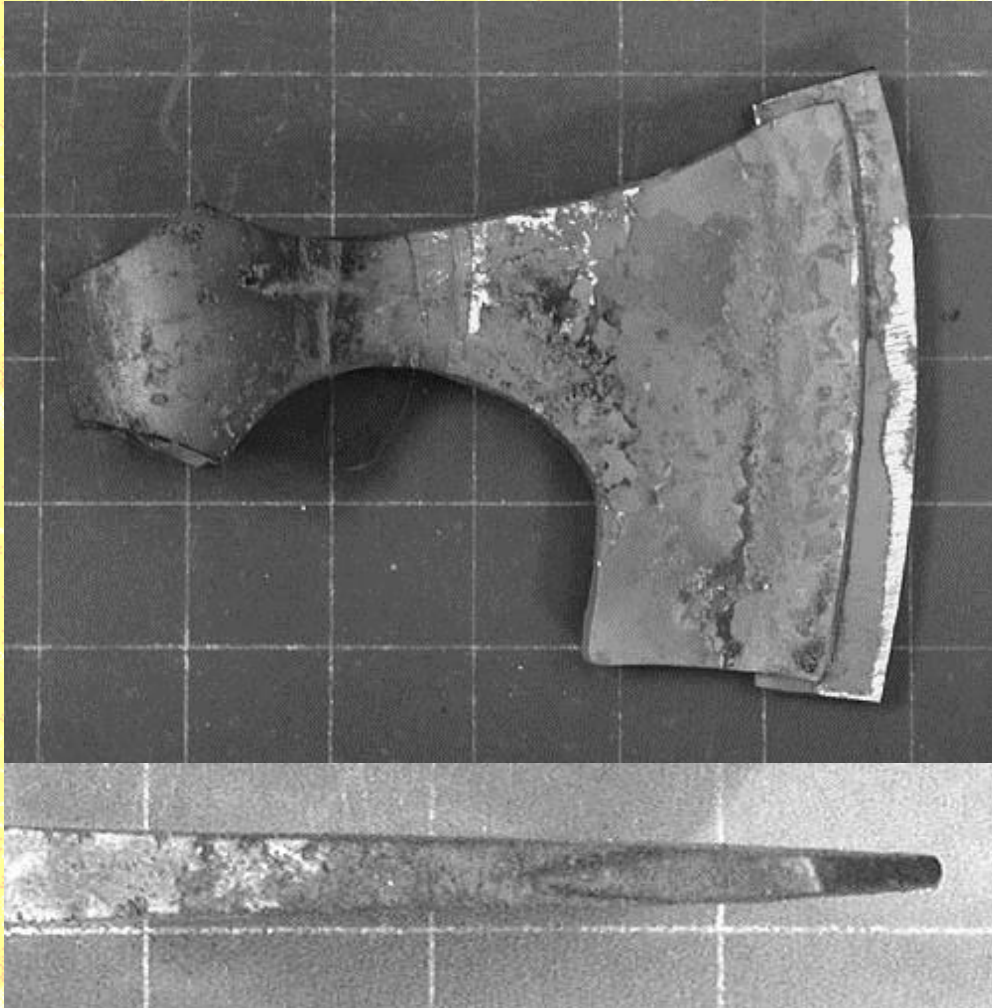
**Solution? - LAYERING**  
Forge welding process





# Layered Steels

## Inset Edges



**Soft iron body for mass and impact resistance**

**Hard steel cutting edge**

**Viking Age Axe : Jim Austin**







# Layered Steels 'Piled' Construction



**Sandwiched layers of hard and soft alloys.**

**Low layer is FUNCTIONAL, not decorative**





# Layered Steels 'Pattern Welding'

## Northern European

- Low layer count blocks
- Drawn to bars and twisted
- Re-welded for core
- Hard steel cutting edge
- Primarily used on swords



a After initial descaling

Image scanned from :  
Anglo-Scandinavian Ironwork  
from Coppergate : Ottawa :  
York Archaeological Trust, 1992



b After final descaling. The slight etching effect shows the darker steel cutting edge, the steel components of the pattern welding, and the steel 'sealing strip' along the knife back. Note the ductile folding of the cutting edge







# Layered Steels 'Damascus'

## Middle Eastern

- Medium to high layer count
- Blocks cut, then flattened
- Standard geometric patterns
- Used on knives & swords



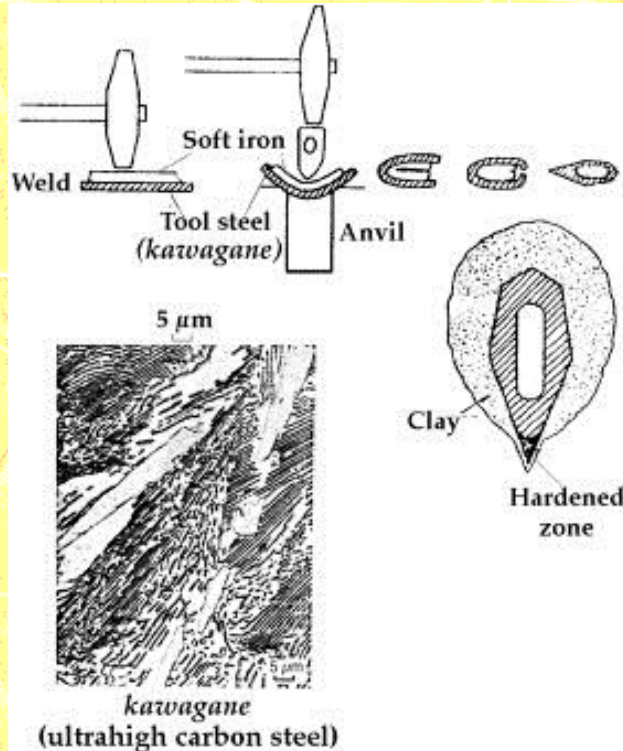
Knives by Howard Clark





# Layered Steels

## Japanese



### Far East

- Extremely high layer count blocks
- 'Carbon Migration' blends layers
- Blades created by simpler block forming methods
- Used on knives & swords



Shobu zukuri Tamahagane : Jesus Hernandez







# Crucible Steels

## Wootz

### Persia - India

- Pieces heated in crucibles
- Differential cooling effect modifies carbon contents
- Billets then forged
- Widely traded?
- Used on knives & swords



Detail, Persian Blades : 1760's





# Sorry - its MODERN



**Exotic Alloys**

**'Mosaic Damascus'**

Knives by Conny Persson







[www.warehamforge.ca](http://www.warehamforge.ca)



**Custom Bladesmithing - Specializing in Pattern Welding  
Training Courses in Blacksmithing & Bladesmithing  
Instructional DVD's**

