Experimental Roman Minting

By testing the hot and cold striking of silver and debased silver coins the author tried to determine the most efficient method for a given type of coin and draw conclusions on labour organisation related to the method most likely used.

■ Di Hu (US)

Introduction

Imagine an object that could tell you about the appearance, fashion, ideas, events, economy, politics, and beliefs of ancient peoples. Now imagine that there are millions of these objects: the humble ancient coin. Its value goes far beyond its face value. It is etched with history and loaded with valuable insights into the ancient world. The common coin in ancient days was, as now, a perfect intersection between the histories of the elites and that of the humble commoners. It was also a bearer of culture and meaning. The monuments, statues, gods, goddesses, mountains, rivers, palaces, public buildings, and prominent figures on coins spread the essence of each city or region's distinctive culture to the known world. Archaeologically, ancient coins tell of the policies enacted by rulers, the times of civil turmoil, important historical events, allusions to myths, the details of ancient architecture and dress, and the existence of otherwise unknown usurpers or rulers.

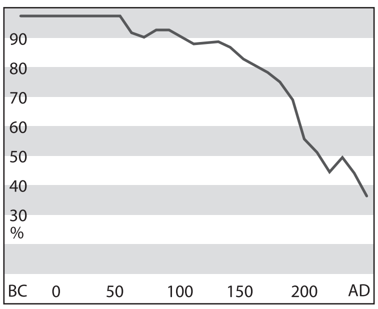
There is one group of people of whom we know very little, however: the coin makers themselves. These are the slaves and forgotten ones of the ancient world. On these people's backs and labor, the glory of Greece and the grandeur of Rome were built. The very objects they made were used to buy and sell them. Through experimental archaeology, one can find out more about these mint-workers, and indeed, empathize with them. Through the recreation of ancient Roman minting process, one can find out much.

In this study, I attempted to recreate the ancient Roman minting process for two different time periods: an era of debasement and an era of stability in silver content. Debasement of silver coinage occurred during periods of crisis, but the silver content of coins did not improve to the previous purity even after situations had stabilized (See **graph 1**). This led to a general debasement over time. For the first 150 years of Roman imperial history (30 B.C.-120 A.D.), the silver content of coins was above 90%, but over the next 130 years, the silver content of coins decreased gradually and dramatically to 35% (120 A.D.-250 A.D.). This was an indicator that Rome was losing its ability to ensure economic, political, and social stability (*Grant 1954:* 247). With the debasement of currency, confidence in the value of coinage declined. This cut at the root of trade and industry and caused widespread ruin (*Grant 1954:* 246). From the period from A.D. 235-284, over thirty emperors rose and fell from power. They were called the "barrack emperors" because they seized power by coup and just as fast and violently were deposed. There were so many emperors and usurpers that the whole empire was thrown into chaos. This was reflected in the more rapid than usual rate of debasement of silver coinage. In fact, during Aurelian's reign (270-275), silver coinage had only 2.5% silver left in them (*Carson 1990:* 117).

Two methods were used in ancient Roman coin minting: the cold striking and the hot striking of coins. With the assumption that Roman mints were primarily concerned with efficiency, this experiment set out to find which method was preferable for different types of silver coinage—nearly pure silver and debased silver coins.

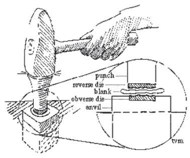
Background

Before the striking of coins by machinery during the Renaissance (A.D. 1450-1650), coins were struck by hand (*Laing 1969:* 3), ensuring that no two coins were ever exactly alike. Archaeological evidence for coin making gives basic information about the process. One artifact that is found is a coin blank, or flan. It can be made of many different metals such as silver, electrum (alloy of silver and gold), copper, bronze (alloy of copper and tin), lead, and gold. A flan is made either by casting in a mould or cut from a long cylindrical rod (*Laing 1969:* 5). Flan moulds are found throughout the eastern Mediterranean (*Laing 1969:* 4). Dies are the stamps used to strike the designs into coin blanks. The design of the coin is carved onto two dies—one for the obverse (heads) and one for the reverse (tails). Typically, the reverse die is movable, while the obverse die is set into an anvil.



■ **Graph 1** Percentage of silver of ancient Roman silver coinage from 30 BC to 253 AD.

■ **Fig. 17** Hot striking produced these debased silver coins.

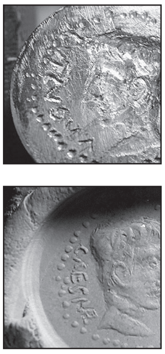


■ **Fig. 1** Basic idea of how minting worked.

Source: "The Production of Ancient Coins" http://www.lawrence.edu/dept/art/buerger/essays/production7.html

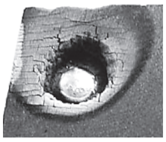
To strike the coin, one puts a flan on top of the obverse die that is set into the anvil. The reverse die is then placed on top of the flan, sandwiching it. A few hammer strikes transfer the image. As of 1969, only about 46 surviving Greek and Roman bronze and iron dies had been discovered. But the ones that have survived show a great variety and give a basic idea of how they worked (**Figure 1**) (*Laing 1969:* 6). However, this still leaves many other questions unanswered: Did the striking method, either hot or cold, change over time? How does the striking method relate to mint organization? What was the mint organization of an ancient Roman mint? What can information about mint organization during different periods in Roman history tell us? A tantalizing tidbit of history from emperor Aurelian's (A.D. 270-275)

■ **Fig. 2** Die carving process.



■ **Fig. 3** Completed obverse die with impression.

■ **Fig. 4** Completed reverse die with impression.



■ **Fig. 6** Charcoal block with silver pellet after heating with blowtorch.

■ **Fig. 10** Stress fractures in Roman coin of Treboninianus Gallus.

Source: http://www.wildwinds.com

reign warrants this investigation. There was a massive mint workers' rebellion during his reign, and 7000 soldiers were killed suppressing it (*Zograph 1977:* 51). How did the slaves, the mintworkers, get organized? Silver coinage during Aurelian's reign was below ten percent silver. Does the minting technique that was most efficient for striking debased silver coinage hold some answers to the mystery of the mint workers' ability to mobilize?

Objectives

Ancient Roman silver coinage became more debased with copper as time went by. **Graph 1** shows the periods of relative stability in silver content and the periods of rapid decline. With each war, economic crisis, or political crisis, the silver coins became more debased. Walker says that the debasement of Roman coinage almost always occurred at times of particularly high state expenditure: during war, plague, and power struggles (*Walker 1978:* 138). Reforms immediately after the crises brought the silver content back up somewhat, but the trend is always a "ratcheting" towards more debasement over the long run (see **graph 1**).

The midpoint in the long-term downward curve of debasement is a good point of reference for my experiment. According to Grant, the main reason for debasement was the impoverishment of the Roman treasury due to financing of wars (*Grant 1954:* 247). Because debased coins were minted even after a crisis was over, it does not matter much if the precise silver content of a recreated coin does not correspond to the content during a specific crisis. For example, the debased coins that resulted from the wars of the 2nd century A.D. still had much higher silver content than the coins minted in the relative stability of the 3rd century A.D. The debased coins I replicated corresponded to Elagabalus' reign (218-222 A.D.). His reign was one of the last before a true crisis broke out through the Roman Empire. These coins averaged around 60% silver (*Walker 1978:* 47). By 253 A.D., where the graph stops, coins averaged about 35% silver. The almost pure silver coins I replicated corresponded to the time of the first emperor, Augustus (27 BC–AD 14). These coins averaged 97% silver (*Walker 1976:* 5).

My primary objectives were:

1) Describing the practical details of minting two Roman coins from two different time periods.
2) Finding the most efficient method (hot or cold) for striking each coin.
3) Drawing conclusions about labor organization in the mints related to the methods most likely used.

Making the Dies and Coin Blanks

Dies in ancient times were made of bronze, steel, and iron (*Zograph 1977:* 45). However, most of the ones that survive today are made of bronze, since iron corrodes completely (*Sellwood 1976:* 69). Because the bronze dies were made of high-tin bronze they are brittle and shatter easily, I chose therefore to make the dies for my experiment out of low-carbon steel, comparable to the iron dies the Romans used.

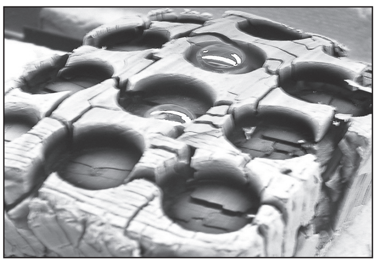
For the upper die, I cut a five-inch rod of one-inch diameter. For the lower die, I cut a one-inch rod of one-inch diameter. Next, I penciled the designs on to the dies and then painstakingly carved the designs using hand gravers (**Figures 2, 3, 4**). The obverse, which depicted a head, took about twenty hours; the reverse, a comet, took only four. I made only one pair of dies due to time constraints and to maintain consistency. If I made two pairs of dies to recreate the actual appearance of the emperors from the two different time periods, they would have had slightly different depths.

I replicated the coin blanks through a method described by Beer (*1982*) and Zograph (*1977*). Zograph said, *"For gold and silver coins which required this precision …The precious metal, in the form of grains of granules to the amount required for a given coin, was weighed out on a balance and was put in a refractory crucible which was then placed in the melting furnace, where the grains ran together into a single pellet"* (*Zograph 1977:* 36). The surface tension of liquid metal automatically pulls the granules together into a single pellet. In Beer's (*1982*) experiments on minting ancient Aegina turtle coins, she measured the desired weight in silver granules. She then used a blowtorch to melt the granules in a depression in a charcoal block. This formed a silver pellet (*Beer 1982:* 49). Because charcoal creates a reducing atmosphere, oxidation would be kept at a minimum. Oxidation, which causes a discoloration of the coin, may happen with a clay mold. Overall, the decision to use either a charcoal block or a refractory crucible should not affect the blanks produced.

At first, I did not want to melt each pellet individually using a blowtorch because Beer (*1982*) described the process as taking about five minutes for each. Instead, I weighed the granules (3.7 grams) and put them into multiple depressions in a charcoal block. I then put the whole charcoal block in a furnace, hoping to produce many pellets in a relatively short time. I tried this procedure with a charcoal block and enough granules to make two pellets, but it failed. Although the silver eventually melted into two pellets, the charcoal block became ashy and extremely fragile due to the prolonged exposure to intense heat in the furnace (**Figure 5**). Putting the charcoal block in the furnace was also not a good idea because it cracked the block in many places and this would have allowed silver to seep through the cracks. Because of the failure, I decided that I had no choice but to use a blowtorch.

To make the coin blanks of correct size, I followed Sellwood's advice (*1976:* 66) and hammered the pellets flat. First I melted the metal into a pellet, and then I pounded the pellet with a hammer until it was the right diameter (20 mm) (**Figures 6, 8**). My experimental design (see methodology below) required 120 blanks. I made an additional 60 blanks to practice on. In all, I spent about twenty-two hours making them.

The silver-copper blanks, 60% silver and 40% copper, had extensive oxidation. I weighed 1.5 grams of copper and 2.2 grams of silver and combined the two quantities for melting. The oxidation was removed in Roman times



■ **Fig. 5** Charcoal block after heating furnace. Note silver pellets.

■ **Fig. 7** Debased coin blanks after vinegar treatment.*

■ **Fig. 8** Silver coin blanks. *
(*with US penny for scale.)

■ **Fig. 9** Stress fractures on silver blanks.

by quenching the hot blank in acid (*Clay 1988:* 347). This rids the coin of oxidation and also leeches away some of the copper from the surface, giving the alloyed coin a more silvery appearance (**Figure 7**). However, the copper tone is still obvious. It takes about 7 to 8 minutes to melt and hammer out one silver-copper blank, because of the hardness of the alloy.

The silver blanks had little or no oxidation (**Figure 8**). It only takes 3 to 4 minutes to make a silver blank (3.7 grams), because of its relative softness. However, because of this these coin blanks had a much higher occurrence of stress fractures compared to the silver-copper alloy blanks (**Figure 9**). These stress fractures are seen in many Roman coins (**Figure 10**). I tried to reduce the stress fractures by experimenting with hammering the pellets while hot and while cold. In both cases, the stress fractures still occurred. Contrary to what Sayles (*1998:* 131) suggested, stress fractures had no relationship to whether the pellet was hot or cold struck. Rather, the stress caused by the hammer blows seemed to exploit weaknesses in the structure of the pellet. I noticed that the more thoroughly melted the pellet was, and thus the more uniform the structure of the metal, the less likely stress fractures were. This was the same for silver-copper pellets. **Table 1** is a summary of the time it took to do each of the tasks described.

Methodology

My objectives were to create coins using two ancient Roman methods—hot striking and cold striking—and then to compare the efficiencies of the different methods using different silver contents. In other words, I compared the efficiencies of:

1) hot striking silver coins and cold striking silver coins, and
2) hot striking debased silver coins and cold striking debased silver coins

Efficiency was determined by the time it took to strike 30 coins from each of the four categories (cold/hot, pure/debased) and then assessing how many were acceptable. I did the cold striking for the pure silver and debased silver coins first. Then I did the hot striking for the pure silver and debased silver coins. For hot striking, I put the coin blanks in a furnace at a temperature of 600 °C.

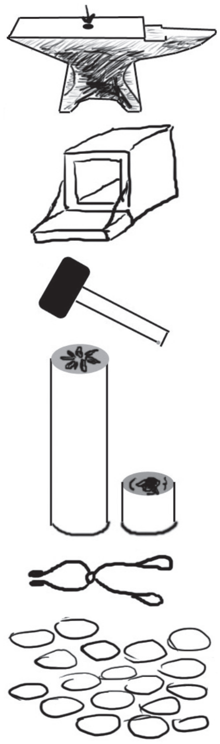
After striking 30 coins of a certain type, I recorded the total time it took. Before I conducted the experiment, I practiced minting the coins to get a feel for how many strikes were required for each method. I used 1, 2.5, and 4 pound hammers in the practice strikes to find which one was the most comfortable for me to swing. The weight of the hammer I used for the experimental striking was 2.5 pounds. **Table 2** is a step-by-step explanation of the actual striking of the coins. Also, refer to figure 11 for the basic supplies used in this experiment.

Results

Cold Striking and Pure Silver Coinage

The time it took to cold-strike 30 pure silver coins was 8 minutes and 55 seconds. I judged an "acceptable" coin to have minimal or no multiple striking. Also, the obverse legend should be readable. Most of the facial features should be clearly transferred. Only about 3 out of the 30 struck were acceptable in terms of quality (**Figure 14**). Thus, it took 18 seconds to make one coin. For every 178 seconds, one acceptable coin was made. Many coins were unacceptable due to the bouncing and subsequent shifting of the coin blank and upper die. Each time the upper die was struck, the coin blank and upper die moved slightly before the next hammer strike. This shifting caused multiple images to be impressed onto the coin blank (**Figure 12**). This error was not uncommon in Roman times (**Figure 13**). It took anywhere from 4 to 10 blows to transfer the image fully from the dies to the coin. I noticed that after a certain number of blows, usually around 5 or 6, the coin blank hardened, became so much that it becomes difficult to transfer the image onto the coin blank with subsequent blows. After this point, bouncing is all that occured.

I found that my small hand was something of a disability in striking because of the length of the upper die. I held the upper die firmly, but this did not stop the bouncing and shifting of the upper die and coin blank. However, when my advisor Jim Mathieu struck a coin, I noticed that the upper die shifted less because his hand was bigger and could manage a firmer grip braced flat against the anvil.



■ **Fig. 11** Basic supplies (anvil with hole for lower die, furnace, hammer, upper and lower die, tongs and coin blanks).

Hot Striking and Pure Silver Coinage

The time it took to hot-strike 30 pure silver coins was 14 minutes and 30

Upper die	Lower Die	Silver blanks	Debased blanks	Weighing and preparation
20	4	6.5	10.1	5.4

■ **Table 1** Summary of time (in hours) it took to make dies and coin blanks.

■ **Fig. 12** Coin error type 1: Multiple impressions.

■ **Fig. 13** Coin error type 1 in Roman coin.

Source: http://www.wildwinds.com

seconds. Thus, it took 29 seconds to make each coin. Out of the 30 coins struck, 12 of them were acceptable (**Figure 15**). For every 73 seconds, an acceptable coin was made. It took 16 minutes for the furnace to heat up to 600 degrees Celsius. These coins were of much better quality than the cold-struck silver coins. The heat made the silver more malleable, so that most or all of the force is transferred into the coin blank and not back to the upper die. Thus, there was less bouncing of the upper die.

Cold Striking and Debased Silver Coinage

The time it took to cold-strike debased coins was 13 minutes and 20 seconds. Thus, it took 27 seconds to make each coin. Only 1 out of 30 was acceptable (**Figure 16**). For every 800 seconds, one acceptable coin was made. Cold-striking debased coins led to the most bouncing and, thus, the poorest quality. The cold debased coin blanks were the hardest of the four types, so most of the force hitting the coin blank bounced back into the upper die. I also sustained an injury because of the bouncing problem. When the upper die bounced, it would sometimes wobble from side to side significantly. If the upper die was displaced too much, the hammer could miss the upper die altogether and hit my hand. This was exactly what happened. The upper die wobbled to the side, and because of the rapid nature of striking, I did not bring the die back into alignment before I swung the hammer again. The hammer scraped my left thumb knuckle.

■ **Fig. 18** Elagabalus Denarius (60% silver).

Source: Classical Numismatic Group

Hot Striking and Debased Silver Coinage

To hot-strike 30 debased silver coins, it took 13 minutes and 15 seconds. Out of the 30 coins struck, 11 were acceptable (**Figure 17**). Thus, it took 27 seconds to make each coin. For every 72 seconds, an acceptable coin was made. The hot-struck debased coins were of much higher quality than the cold-struck debased coins. The higher quality reflected the increased malleability due to the heat. Thus, there was less bouncing. As with the silver coins, the softer the metal is, the more force it can receive. The harder the metal is, the more force bounces back.

■ **Fig. 20** Ancient die with mushrooming effect.

Source: Zograph p. 38

Non-debased Silver coins (Cold Striking)

1) Gather necessary supplies: Upper and Lower dies, Anvil, Hammer, coin blanks.
2) Set up the work area as shown in the diagram for cold striking.
3) *Take a coin blank from a receptacle that contains the coin blanks.
4) Put the coin blank on top of the lower die as shown in the diagram.
5) Take the upper die and put it on top of the coin blank with your left hand FIRMLY.
6) Strike the top of the upper die with the hammer in your right hand until a clear impression can be made.

Non-debased Silver coins (Hot Striking)

1) Gather necessary supplies: Upper and Lower dies (new set), Anvil, Hammer, Tongs, coin blanks, furnace.
2) Set up work area.
3) Put a batch of 30 coin blanks into the furnace heated to 600 °C.
4) Wait until the furnace reaches 600 degrees.
5) *Take out one hot coin blank with tongs in both hands and place the coin bank on top of the lower die. Put tongs down.
6) Place the upper die on the coin blank firmly with left hand.
7) Strike the upper end of the upper die with hammer in right hand a few times until a clear impression could be made.

Debased Silver Coins (Cold Striking)

Same as cold-striking non-debased silver coins.

Debased Silver Coins (Hot striking)

Same as hot-striking non-debased silver coins.

■ **Table 2** Methodology (* = start recording time here).

I put the coin blanks in the furnace and heated them to 600 degrees Celsius. In the furnace, they acquired a gray ashy surface of oxidation. However, when I struck them, the oxidation flaked off, leaving a silvery surface. This was an interesting effect because I had wondered how the Romans made their debased coins look so silvery on the surface (**Figure 18**). My replica blanks were 40 percent copper, but they looked orange. However, when I put them in the furnace and then struck them, they gained a silvery appearance.

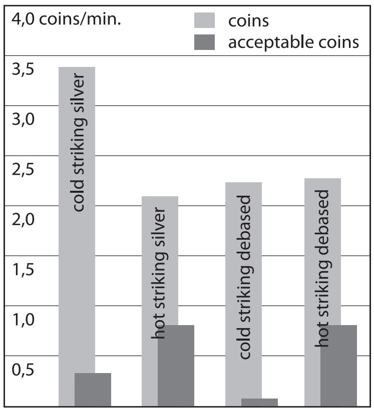
A summary of the numerical results can be found in **Graph 2** in the appendix.

Dies

The dies deteriorated faster with the striking of alloyed coins. Furthermore, the top end of the upper die, which received the blows, mushroomed (**Figure 19**). This effect is also seen in ancient dies (**Figure 20**). After the minting experiment, which produced roughly 200 coins, considerable wear in the design of the dies was evident (**Figure 21**).

Minting errors

There were two common errors in my replica coins that are also present in real ancient Roman coins. The first is the phenomenon of multiple images on one coin. With each slight shift of the upper die, the image of the coin shifts in the direction of the bounce, creating a trail (**Figure 12**). This is seen in ancient Roman coins also. If one looks at the reverse of the coin shown in figure (**Figure 13**), one can tell that it took four blows to transfer the image onto the coin blank. The



■ **Graph 2** Summary of results.

second phenomenon is related to the first. Sometimes, the bounces or shifts of the upper die are dramatic. When this happens, two widely spaced impressions are made (**Figure 22**). This effect can be seen in **Figure 23**.

Debased coin surface appearance after vinegar soaks

As noted before, I pre-soaked the debased coin blanks in vinegar to get rid of some oxidation. However, because I only soaked them for a few hours at a time, the surfaces still appeared coppery. After the experiment, the debased coins were soaked for an extended period of two full days. This ate away at the impurities and copper on the surfaces of the coins. The coins gained a much more convincing "silver" look like the ancient debased coins. However, the process left behind a red residue (**Figure 24**). This residue is the by-product of acid reacting with silver. Interestingly, some ancient debased coins show this residue, giving more credence to the idea that oxidized coins were soaked in some kind of vinegar (**Figure 25**).

Conclusions

From the minting experiment, I found that my initial definition of efficiency as the amount of time it took to mint a certain number of coins was too simplistic. The hardness of the metal turned out to be a crucial factor in the minting process. Although cold-striking and hot-striking debased coins took roughly the same time, hot striking was much better in making higher quality coins. Because time alone would put the two methods for striking debased coins at the same level of efficiency, one must take into account how many acceptable coins were struck. Hot striking clearly is more efficient in these terms, creating 11 times as many acceptable coins. Hot striking for both types of coins yielded better quality coins. Quality should be weighed with efficiency (defined in terms of time) to better judge which method the Romans likely used. The new measurement of efficiency, therefore, should take into account both the number of seconds to strike a coin, and the number of seconds to strike an acceptable coin.

For silver coins, the Romans probably had the option of both hot striking and cold striking. Hot striking may be less efficient by 38% ([29s-18s]/29s) in the number of seconds it takes to strike one coin, but it is more efficient by 144% ([73s-178s]/73s) in the number of seconds it takes to strike one acceptable coin. I decided that both cold striking and hot striking were viable options, because I assumed that with bigger hands, bouncing would not be as much of a problem for cold striking pure silver coins. With bigger hands, the upper die could be more fully stabilized, and more acceptable coins could be made. For example, if just three more acceptable silver coins were made through cold striking, the efficiency of cold striking in terms of the number of acceptable coins would be only 18% less efficient. This shows that with a bigger hand, cold striking and hot striking pure silver coins becomes comparable in efficiency. Because my hand is undoubtedly much smaller than an ancient male Roman mint worker's, I can assume that the ancient mint workers were more efficient at cold striking in comparison to the other methods than I was.

For debased silver coins, I found that hot striking was clearly more efficient than cold striking. It was almost the exact same efficiency in terms of the raw time it took to make a coin (only 0.6 percent more efficient than cold striking). However, it was 1010% more efficient than cold striking in terms of the time it took to make an acceptable coin. Even if I assumed that with a bigger hand, a few more acceptable coins could be made, the efficiency of hot striking would still be much greater than cold striking. Furthermore, because the cold debased coin blank is harder than the cold pure silver coin blank, one would have to be extremely strong and steady to keep the upper die from bouncing at all when cold striking debased coins.

From this experiment, both cold striking and hot striking were found to be acceptable methods for making pure or nearly pure silver coinage. But the hot striking method was necessary for making debased silver coinage. This implies that when the coins were nearly pure silver, mint organization could be flexible. With cold striking, the mint-workers could be kept apart from each other. Each could work independently efficiently (*Zograph 1977:* 48). In my experiment, I noted the difficulty of doing hot striking alone because I kept picking up and putting down implements. Also, the danger of the hot coin blank was ever present. In ancient times, they would not have had a furnace that automatically kept its temperatures at 600 degrees Celsius as I did. They would have had an open wood or charcoal-burning furnace. Thus, at least one other person was needed to stoke the fires. Hot striking would have been extremely inefficient otherwise. According to Zograph, hot striking meant that the mint workers would work together. One had to stoke the fires of the open furnace, another held the upper die, another put the coin blank on the lower die, and yet another swung the hammer (*Zograph 1977:* 50). Thus, there was much more potential for communication and

■ Fig. 19 Dies after experiments. Note mushrooming on upper die.

■ Fig. 21 Impression of lower die before and after experimental striking.

■ Fig. 22 Coin error type 2: Severely displaced double images.

■ Fig. 23 Coin error type 2 in Roman coin of Commodus.

Source: http://www.ebay.com

■ Fig 14 Cold striking produced these pure silver coins.

■ Fig. 15 Hot striking produced these pure silver coins

■ Fig. 16 Cold striking produced these debased silver coins.

■ **Fig. 24** Hot-struck debased coin after prolonged vinegar soak.

■ **Fig. 25** Reverse of coin of Philip I showing red precipitate resulting from reaction between acid and silver.

interaction with hot striking. Hot striking was most likely more associated with a factory-like setting than cold striking was. This could mean that the mint workers, who were all slaves, had a greater ability to organize.

This experiment might suggest the context in which they were able to mobilize in the massive mint workers' revolt of 272 A.D. Nearly 7000 soldiers were killed suppressing the rebellion. Because the coins of 272 A.D. were heavily debased, one can assume that hot striking was employed and that this involved a factory-like, relatively large-scale operation. A mass of disgruntled mint workers interacting with one another in a Roman mint at a time of instability could be a recipe for disaster. Indeed, the mint workers somehow did mobilize a large enough force to be a major challenge to the Roman army. Debased coinage requiring hot striking may be one of the factors in how they could have mobilized.

Because of the limited scope of my experiment, I was only able to test two different types of coins: pure silver and 40% debased silver. It answered questions concerning which method was most efficient for each type.

However, was efficiency important in the Roman mints, which were operated by slave labor? To find out, in future I hope, by means of micrographs and atomic absorption analysis, to find the relationship between the percentage of silver in a denarius and the method of striking. By studying the internal structure of an ancient coin, one can presumably find out whether it was hot or cold struck. Creating a graph that plots the relationship between silver content and striking method would be fruitful and further shed light on the world of the humble ancient Roman mint worker.

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Summary

Römische Münzherstellung im Experiment

Die Studie versucht, den Prozess der antiken römischen Münzherstellung zweier verschiedener Zeitperioden zu simulieren: eine Phase der Verringerung und eine Phase der Stabilität des Silbergehaltes der Münzen. Durch die Herstellung von Münzen mit Hilfe zweier antiker römischer Methoden, der „warmen" und der „kalten" Prägung, ist der Autor bestrebt, die effizienteste Methode für jeden Münztyp heraus zu arbeiten; von dieser Grundlage ausgehend werden Schlussfolgerungen zur Organisation der Arbeitsprozesse in Bezug auf die vermutlich angewandte Herstellungsmethode gezogen.

Die Effizienz wurde durch die Zeitdauer der Herstellung von 30 Münzen unter Berücksichtigung der vier Kategorien („warme"/"kalte" Prägung, höherer/niedrigerer Silbergehalt) und durch die Zahl der damit produzierten, qualitativ ausreichenden Münzen ermittelt. Da sich die Härte des Metalls als der entscheidende Faktor bei der Münzherstellung erwies, ist zu vermuten, dass die Römer für die Herstellung von Silbermünzen beide Optionen der Prägung nutzten, denn die „warme" Prägemethode ist einerseits zeitaufwändiger, sie liefert aber andererseits eine bessere Qualität. Bei Münzen mit geringerem Silbergehalt ist die „warme" Prägemethode eindeutig effizienter. Diese Feststellung bedeutet, dass die Organisation der Münzprägung sehr flexibel gewesen sein mag, wenn die Münzen aus mehr oder weniger reinem Silber bestanden. Bei der „kalten" Prägemethode konnten die Münzhersteller unabhängig voneinander arbeiten; die „warme" Prägung scheint dagegen jedoch mit einer fabrikmäßigen Produktionsstruktur verbunden zu sein und besitzt dadurch auch mehr Potential zu (überregionaler) Kommunikation und Interaktion.

Daraus wird abgeleitet, dass die große Revolte der Münzhandwerker im Jahr 272 n. Chr. – zu einer Zeit, als sich der Silbergehalt der Münzen stark verschlechtert hatte – mit der damals vermutlich verbreiteten „warmen" Prägetechnik und ihrer fabrikmäßigen Organisation in kausalem Zusammenhang stehen könnte.

Frappe expérimentale de monnaies romaines

Cette étude essaie de reconstituer le procédé de frappe de la monnaie tel qu'il a été pratiqué à l'ancienne Rome, pendant deux différentes périodes: celles du rabaissement de monnaie et du taux d'argent stable. Expérimentant deux méthodes employées à l'ancienne Rome, à voir les frappes chaude et froide, l'auteur s'efforce de déceler celle plus effective relative à l'une et l'autre sorte de monnaie et à partir des résultats, de formuler sa théorie sur l'organisation du travail que les méthodes plausibles auraient imposé.

Alors, c'était dans 4 catégories (frappe froide/chaude, monnaie en argent/avilie) où on a testé le rendement, determiné en fonction du temps nécessaire pour frapper 30 pièces et de la part de monnaie valable. Au cours des travaux, on a constaté que la dureté du métal représente le facteur déterminant de la frappe. En effet, il est bien possible que pour produire des monnaies en argent, les Romains aient pratiqué et la frappe froide et la chaude. Bien que cette dernière nécessite plus de temps, elle est de meilleure qualité. Pour la monnaie avilie, la frappe chaude est sans aucun doute plus effective. Ces constatations laissent entendre qu'à l'époque de la monnaie en argent presque pure, l'organisation du travail a pu être flexible. La frappe froide rendait possible que les différents ouvriers travaillent individuellement. Par contre, il est probable que la frappe chaude a imposé une organisation „manufacturière" et celle-ci créait un milieu propice à la communication et la collabotation. Il paraît que la grande révolte soulevée par des ouvriers des ateliers de frappe de la monnaie en 272 AD, où on frappait la monnaie avilie, a été due à la frappe chaude et ainsi à l'organisation „manufacturière" du travail.

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It has been almost 20 years, but it is still relevant

In May 1987, the subcommittee on Archaeology of the European Science Foundation (ESF) organised a workshop on **"the reconstruction of wooden buildings from the prehistoric and early historic period"**. The session was initiated by professor H.T. Waterbolk from Groningen, Netherlands and professor O. Olsen from Copenhagen, Denmark. This workshop took place in Århus, Denmark with 31 specialists from 13 countries attending. The 1980s was the beginning of a boom in the construction of archaeologically inspired buildings inside and outside archaeological open air centres.

In their proposal to the ESF, they wrote of the problems of constructing at a 1:1 size. Some of the problems addressed are still valid today.

Unfortunately, the proceedings of this workshop were not published. One of the editors retiring shortly after 1987 and as none of the texts were available electronically, in the decade when computerisation was beginning, were just a couple of the problems that hindered the manuscript from being published. In addition, when we rediscovered the manuscript, one of the editors, Dr Reynolds, had unfortunately already died.

Of course, some 20 years later, many of the texts had already been published in one form or the other. However, on inspection a reasonable amount of the material still deserved to be presented, as the ideas were still valid and haven't been issued elsewhere.

The progress of modern techniques, which at first hindered publication, has now been an advantage as the texts which were to be published were scanned. The original session organisers, Waterbolk and Olsen have also agreed to us publishing these articles, as long as the original authors agree.

Waterbolk & Olsen described the lack of exchange between those involved as a reason to set up the workshop. *"Reconstructions have so far been isolated enterprises..."*. Which is exactly the same reason which started EXARC in 2001 and the Journal EuroREA which is also meant to foster a communication and to reach, as Waterbolk and Olsen put it for their workshop: *"a joint national or international effort to make optimal use of the new data"*.

It is with pleasure therefore that we can now offer the first two articles in the "ESF" series. Professor Coles has agreed to us publishing his article as did the relatives of the deceased Dr. Reynolds. We advise the readers not only to try and view the articles in the light of the 1980s, but to also see their relevance to the present.