

10. A Short History Of Metals

10.1 Copper - First Metal in Ancient Times

10.1.1 Discovering Metals

The Problem of Finding the "Truth"

First a word of warning! I will not give you an authoritative account of when and how humankind discovered the various metals and alloys that it has been using ever since. I simply don't know the truth and nothing but the truth about that. I have read a *tiny* little bit of what others have to say - a few hundred articles and books - and I know a bit about the archaeological evidence by roaming around in museums. Reading *all* that has been written about the topic would not only need several lifetimes, it would also be a major waste of time since a lot of what has been written is obsolete. A kind of short and naive version of what is to follow can be found in the early module shown on the right.

[Advanced Link](#)

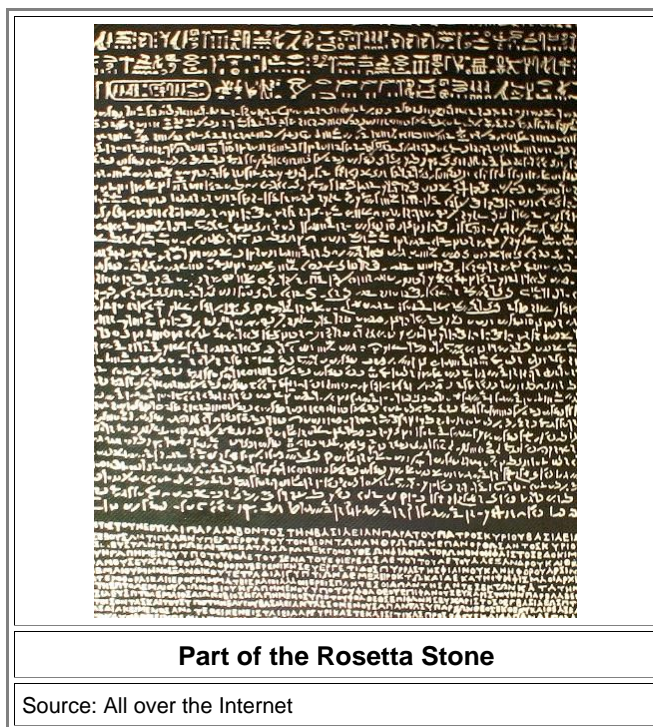
The Ages

The history of metals is muddled to some extent because it is messily entwined with the history of archaeology and the history of science. Only archaeology can unearth the truth about the history of metals by digging up relevant artifacts, and only the modern science of solids can make sense of those artifacts. The trick is to get the two together. You may wonder that archaeology has a history. Didn't people everywhere and at all times have some interest in the past and in whatever artifacts that were around and could not be overlooked? Yes, but what I'm alluding to here is "scientific" archaeology, or *digging* for knowledge and *not* for finding treasures, art, literature or justifications for your religious beliefs. "Scientific" means that those archaeologists dig for finding out how *all* the people lived (not just the rich / nobility), what they did in the period in question, how they developed, and what kind of parameters influenced their development. And so on.

The first scientific diggings or excavations in that sense took place in 1748 in what used to be the old Roman towns of Pompeii and Herculaneum. That was done just fine but not really scientifically - because science was still in its infancy. The archaeologists then could not have identified a steel object because they simply did not know what steel is.

A little later, some specialists or early scientists marched along with Napoleon's army from 1798-1801. The emperor then invaded Egypt for not immediately obvious reasons, and his civilian followers did some digging and exploring there. This culminated in **Jean-François Champollion** deciphering the **Rosetta stone**, enabling the reading of hieroglyphics, and thus establishing the thriving field of Egyptology. The Rosetta stone, by the way, is now in the British Museum in London because British troops, invading Egypt for not immediately obvious reasons either, defeated the French in Egypt in 1801 and took whatever they could grab (nobody asked the Egyptians, of course). The British also [destroyed Copenhagen](#) in 1801 for some reasons of their own, and they are still proud of all that. Also in the beginning of the 19th century, in a kind of team effort, [cuneiform](#) was deciphered, opening the way for looking deeply into the ancient Mesopotamian civilizations and for learning about the [importance of beer](#).

The first major excavation conducted along what one could call scientific principles (the catch word is "stratigraphy") was that of Hissarlik, the site of ancient Troy. It was started by **Heinrich Schliemann** in 1871, a German "amateur", who was fought and ostracized by the professionals that hasn't changed, by the way. The majority of professional archaeologists still consider any "amateur" (like me) to be an unmitigated nuisance.



Part of the Rosetta Stone

Source: All over the Internet

To be sure, deciphering hieroglyphics, cuneiform, and so on is a highly *scientific* enterprise. Without some experts being able to read and understand the old texts, large parts of archaeology would not get very far. It is thus clear that scientific archaeologists in the 19th century were highly trained in the "humanities". It takes some dedicated long-time effort to become familiar with ancient dead languages and their weird scripts. You can't blame those old guys for not spending much time for learning a bit about physics and chemistry after they had learned hieroglyphics or cuneiform (besides, of course, Latin, Ancient Greek, some Hebrew, French, German or English). It wouldn't have helped much anyway, because before the end of the 19th century the knowledge concerning metals wasn't at a level where it would have been very useful.

A "classical" 19th / 20th century **archaeologist** thus had a strong tendency to answer technical questions in the way that came naturally to him:

1. Find out what the ancient Greeks had to say about the topic. If they had recorded something - that's it. Steel, for example, is then particularly pure iron.
2. If the old Greeks are mute: is there anybody else, preferably Roman, halfway prominent and long since dead, who had an opinion on the topic? If yes - that's probably it.
3. If there isn't anything or only obvious crap: Sit down, think hard, and publish the results of your thinking as the answer.

What you will never ever do is to conduct *experiments*. You have *seen* on wall pictures in old graves that a granite block is hollowed out by something that could only be a hollow copper drill plus stone "hammers". So that's how it is done. There is no need to try experimentally if that is actually possible or how long it would take to make a decent sarcophagus. You also don't analyze King Tut's iron dagger to see if it was really made from meteorite iron because the old Egyptians referred to the stuff as "metal from heaven" so it must be of meteoric origin.

This has changed in the last 30 years or so. "**Archaeometallurgy**" established itself as a new interdisciplinary field and there is a rapidly increasing number of papers dealing with thoroughly analyzed metal-related artifacts, resulting in a better and better understanding of the development of metallurgy in different parts of the world.

Interested laymen like you and me profit from that - but we also have a problem. We do not like to read learned papers, published in arcane and hard-to-get archeological journals, describing just some tiny detail concerning the history of iron, steel and swords. We neither have the time, the required prior knowledge, nor the incentive to construct the big picture ourselves from all those small mosaic stones.

We rather like to look at objects in **museums**, learn the interesting points from the description there, and then possibly buy the general book going with the exhibition in the museum shop, hoping that it would provide the perspective we are after.

The problem with that approach is that we invariably get:

1. Far too little information, and
2. Quite often misleading if not completely wrong information.
3. No museum book in many museums.

While this is deplorable, it can't always be avoided. Museums cannot change exhibitions frequently, and much of the doubtful explanations you get were put there many years ago. It is quite possible that people then just didn't know better.

However, when a completely new exhibit is designed in our present times, with great labor and cost (example:

[Link Hub](#)

**Critical
Museum
Guide**

"Türkische Cammer" in [Dresden](#); see the picture below), or when some special exhibit is made "to order" (example: "The Celts" in [Stuttgart](#)), the partially hair-raising nonsense encountered there *with respect to metals* is inexcusable. That's why I have started the critical museum guide accessible in the link above. The picture below illustrates what I mean.



- The picture shows the Dresden copy of the "[Zulfiqar](#)", Prophet Mohammed's *bifurcated* sword, quite famous in the Muslim world, as envisioned by "professionals". This is utter bullshit, of course. But zulfiqar renditions like the one above have a history of their own, and it would have been quite interesting to learn about that in the museum.

➤ Museums and their exhibition catalogues are not the only problems encountered when searching for "the truth". Go and google for some general topic like "first use of copper" or, if you want to be more specific "[Cayönü Tepesi](#) and copper" or "[Luristan iron swords](#)". You find lots of articles from all strata of interested sources. Crackpots, tourist agencies, and interested laymen let you have their materials, professor's teaching materials can be found, blogs from all kinds of people (including archaeologists or experts in related fields), master and PhD theses, and the occasional freely accessible paper from a real scientist.

[Illustr. Link](#)

Confusing the issue

What you rarely find are the original sources: papers or books with pictures and explanations from the excavators or first investigators. What you find will tend to confuse you (see the link for a few examples).

- If you look for pictures, you are in for a disappointment. Try to find a picture of the famous and celebrated first copper objects found in Cayönü Tepesi. You won't. And if you happen to find something, do not automatically believe that it is really what it claims to be. There are many mistakes!

➤ Now I can get back to the [beginning of this chapter](#). I can't give you an authoritative account of when and how humankind discovered the various metals etc., because *nobody* can. First of all, in different areas of the globe, the history of metals is typically quite different. Second, much of what was supposed to be solid knowledge is now being challenged, and the final word hasn't always been spoken yet. Read [A. Haupmann's rather recent book](#) - it is presently one of the "last" words on the subject. It dedicates a lot of space to refuting views of others, and to point out the many white spots on the metal history "map".

- I'm not the only one with that kind of problem. The eminent scientists Sherby and Wadsworth, whom we will encounter as soon as I get finally around to swords, got so fed up with the prevalent beliefs about the history of metals in the archeological community at large that they wrote a full paper², proposing that the iron age not only precedes the bronze age but may even go back to Neanderthal times, i.e. to 300.000 BC - 40.000 BC. Sherby and Wadsworth are serious scientists and not crackpots, and while they may have a point; I don't subscribe to it.
- Talking about crackpots, and just to be on the safe side, I want to make one thing very clear: I certainly do *not* count the various claims of all those people that believe in more unorthodox things - for example that early metallurgy goes back to some aliens that long ago visited the earth - as real challenges to the mainstream history of metallurgy. But I do not call *all* of them crackpots, however. Some of them did raise valid points on occasion. I have researched the "alien hypothesis", together with other science students for quite a while after von Däniken brought it up (once more) in the seventies. My conclusion was simple: It's not impossible that aliens visited the earth long ago, just very unlikely. The evidence provided, while stunning on occasion, does not really support the claims made. Nothing in the last 30 years has happened to induce me to change my opinion. Sorry about that. I would have liked the alien stuff much better.

➤ What I am going to do is to look at the discovery of metals and metal technology by humans not along the time-honored but questionable system of "[The Ages](#)" (like stone - bronze - iron age) but along the more natural lines of:

- Forging of native metals.
- Carbon smelting of "Easy" Metals, producing liquids.
- Casting and producing alloys
- Carbon smelting of iron, producing a solid "bloom".
- Electro-smelting of "difficult" metals.

- It's a slight variation of the system proposed long ago in an [advanced module](#) in chapter 2. But now *you* have advanced your knowledge about metals and material science quite a bit, and I can now look at all this stuff right here in the backbone.

➤ I will look at the first point in the remainder of this sub-chapter: the **discovery of elemental or native metals**, and the first simple techniques to turn them into pretty or useful objects. I will plagiarize myself heavily here, using what I have written earlier in the links you are by now familiar with.

Working with Native Metals - or Possibly Not?

Stone age woman did not just make flintstone tools. She also painted art on the walls of her cave some 15.000 years ago, and long before that - 30.000 to 40.000 years ago - she made complex ivory sculptures including a figurine known as **Venus of the "Hohle Fels"** (hollow rock). And he or she made music. With flutes from bird bones. At least if she lived in what is now Suebia in South Germany, the area where I was born. I can't resist the temptation to claim several "firsts" for my early countrymen; use the link for details.

[Illustration Link](#)

Suebian things

What I'm driving at is: given all this sophistication more than 30.000 years ago, it appears to be likely that those people would also pick up those pretty yellow or brown-green-reddish "stones" - gold (Au) or copper (Cu) nuggets - that they encountered here and there, and then make something from it. Just as well we can assume that they picked up **any** pretty stone or object, and made something like jewelry from it. Just for fun. Or for averting demons and evil eyes. There are no other uses for gold, copper and pretty stones, sea shells and so on. These things are not directly useful for everyday life, like making survival easier.

Indeed, [serious archeometallurgist](#) from institutions like the British museum and major universities are convinced that metallurgy did not come into being from a need to use metals: "*We will show that metallurgy derived from the desire (...) to adorn the human body by using colorful (copper) ores and naturally occurring metals. It is only in the subsequent millennia that the application of heat in a controlled reducing atmosphere led to the smelting of metallic ores to produce lead, copper, copper alloys and eventually silver*", they write. Sorry - forgot which one exactly.

The desire to adore the human body is certainly very old, The "Sungir" people, living not far from what today is Moscow, certainly were into strings of (bone) beads to adorn their dead, and very likely also their living bodies, a long time ago:



Sungir burial, 28 000 to 30 000 years old, with lots of strings of bone beads

Source: Public domain; all over the Net.

From that reasoning it follows that the earliest metals used by humans should be native gold and copper for making adornments and jewelry. Well, that follows indeed - it just ain't true! The oldest **gold** artifacts (adornments, indeed) known **at present** are from **Varna** in present-day Bulgaria and go back to **only** 4.560 BC - 4.450 BC. **Copper** artifacts, for comparison, go back to about 8.000 BC!

The Varna Necropolis, accidentally discovered in October 1972, is a burial site that is internationally considered to be of prime importance for understanding world prehistory. It belongs (surprise!) to the "**Varna culture**" (sometimes also referred to as Thracian, even so Thracians proper came much later). The present day viewpoint is to see the "Varna culture" as the culmination or the end of the much older "Alteuropäische Kultur" that I will call "Danube culture" since the "official" English version is "Neolithic Europe" which is not a good name since the Danube culture most likely invented metallurgy and thus was not (neo)lithic, i.e. stone tool based.

[Advanced Link](#)

Danube Culture

Some Varna graves contained a lot of the **oldest gold artifacts** unearthed so far. They also contained copper objects and much more. Grave No. 36 contained by far the richest find of highly sophisticated objects of great value from that long ago. To put it in perspective: The pyramids in Egypt were built 2.000 years later (with copper tools); King Tut was laid in his grave 3.000 years later, the Jews bewailed their fate as prisoners in Babylon 4.000 years later, and Jesus was nailed to the cross with iron nails 4.500 years later. Gold in Varna was used for jewelry and adornments (including giving some lustre to a very male part of the anatomy), while the copper in Varna was used for tools and weapons. Interestingly enough, there are **no swords** or daggers among the Varna objects.

Large pictures of some of the treasure can be found in [this link](#). Below are a few details



● We see gold and copper objects plus highly polished and perfected stone tools. The gold stuff is only ornamental but the copper pieces (axe heads) are tools or weapons. More **regular-sized** pictures of the Varna gold can be found in [this link](#). While the gold is for sure native gold (pretty much all gold is), the copper must come from smelting. It probably signals the point in time and space when serious smelting of copper started.

▸ The Varna metals are a good starting point for asking some of the big questions that come up for any "old" metal. Before I start, let me give you a piece of warning: It's easy to ask big questions. It is not so easy to answer them. In fact, one point of the exercise I am about to lead you through, is to make perfectly clear why there are no easy answers to supposedly simple questions.

First and foremost we want to know:

1. Were the old Varna people the first ones that used gold about 6 500 years ago?

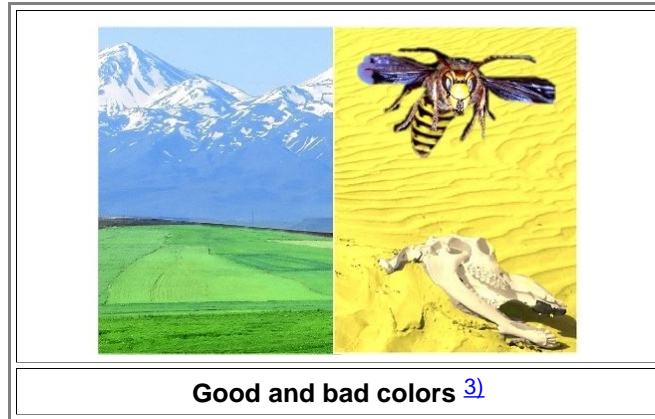
● The first answer is: It looks like it - so far! But nobody really knows. Maybe sometime in the future an even older place with gold artifacts will be found. Or maybe no such place will be found because there isn't any. That might be so because older cultures and people did not use gold, or because it was recycled and re-used. Gold was more plentiful in ancient times but still rather rare and therefore always precious. It can also be re-shaped very easily - in contrast to all those far older ivory or stone sculptures or anything ceramic. Graves were robbed for almost sure if there was a chance that they contained gold objects but rarely if all they contained was a bit of pottery and some flintstone tools.

Personally, I was inclined to believe that gold was used in areas where you could find sizeable nuggets of the stuff long before the Varna culture people put it in graves (which, amazingly enough, were not robbed). That excludes a lot of places (for example the romping grounds of those advanced [old Suebians](#) 30 000 years ago) but leaves quite a few. I can neither prove this claim nor can you or anybody else disprove it. At the moment it's a matter of

probabilities.

I might argue that the odds are in my favor since ancient people did use the *native* copper they could pick up long before the Varna culture people put plenty of *smelted* copper in their graves together with picked-up gold. Why copper and not gold? It's a good question. We don't know the answer for sure but some ideas for the copper preference will come up in what follows.

The probability argument goes against early uses of gold. More and more ancient sites are found where copper was used long before 4 500 BC - but never gold! We might speculate wildly and assume that gold was not seen as something special and therefore was only collected and used long *after* copper was "discovered". Maybe the fashion changed, or who knows. While there are indications that our ancient forebears did like colorful things (especially if they were green), it is just possible that they hated yellow. Yellow usually signals infertility, sickness or danger - look at a desert, pus oozing out from a wound, or that yellow jacket about to sting you, and you get the point!



Good and bad colors 3)

The *second* big question is:

2. Were the Varna metal artifacts cast or hammered into shape?

The answer is: In the literature to Varna¹) there is a general agreement that most gold objects have been formed by *hammering* the metal into shape. If you look at [all](#) the [pictures](#) I have provided, this is all but certain for pretty much all of the gold artifacts. It is very difficult to cast a thin foils but rather easy to hammer a gold nugget or piece into a thin foil, and that's what obviously was done in making many of the pieces shown.

If we accept the hammering hypothesis for a moment (and I do not suggest that we should), the question now is: how come many of those gold objects have the same size, considering that nuggets are typically smaller and of varying size? Actually, most gold is recovered as gold dust or "[placer gold](#)" by panning, so you only have very small particles. The copper objects are also far larger than the biggest elemental copper pieces they could find. So how do you get large pieces, and many pieces of identical size?

The answer could be: You must [hammer-weld](#) your little gold and copper pieces together to form a large piece, and then cut off standard sizes.

Hammer-welding of gold is not addressed a lot in the literature. There are some indications that it is easy - but only for *pure* gold, which native gold never is. About hammer-welding of copper I can't find anything except a few hints that it can't be done. [Rehder](#), for example, states that copper does not naturally weld together. It cannot be easy without some special tricks because copper is always covered with a rather stable oxide.

I'm inclined to say: forget about hammer welding for copper and gold! For copper, hammer welding doesn't seem to work at all, and for gold, even if it should work, there is a practical problem! How would you heat fine dust and then hit it with a hammer? Considering that your hammer and anvil was just some piece of stone?

To make a long and convoluted story short: Personally, I'm rather sure that the copper parts were fully *cast*, and that the gold parts were made by hammer-forging from *cast* ingots.

Now you might ask: "If those people knew how to cast, why not cast the gold into the desired shape right away?" Because you want light-weighted objects with *large* surfaces, to better "show off" your gold with maximum effect. That simply demands objects made from *thin* gold sheets. Doing that by hammering was possible - but not by casting. For that you would have needed molds made with a precision that was simply not attainable 6000 years ago.

We have a first hint that metal technology, even very early one, is far trickier than you can possibly imagine. The link gives an idea of what it really entails.

If we surmise that this is indeed what the Varna people did with their gold and copper, one thing is clear: they must have had some prior metal working experience, including smelting copper, melting and casting. That is all but sure. These techniques had been invented in the general area just a few (hundred) years before the time in question, and the Varna people either knew how to do it or knew from whom one could buy the stuff. I will come to this in some detail in what follows.

[Science
Link](#)

**Early Metal
Technology**

That leads us to the *third* question:

3. Was "metallurgy" discovered in *one* place at some specific time and then throughout Eurasia? Or was it discovered independently in *many* places at *different* times?

This question can be broken down into many detailed questions concerning different aspects of metallurgy. Maybe the copper technology spread or "*diffused*" from *one* source, at least in Europe / Middle East, but iron smelting was discovered independently in *many* places, and so on. The "**diffusion - multiple discovery controversy**" exercises archaeometallurgists mightily at present. Scientists do love a good fight, in particular if it is about some undecidable arcana.

I have no opinion myself to that topic. There is some evidence that copper / bronze metallurgy spread from places in the middle-east outward, supporting the "[single invention / diffusion hypothesis](#)" (the link leads to an article promoting that view), but there are also good reasons to subscribe to the alternative view. For example, the [North American "Indians"](#) used native copper quite a bit as early as (maybe) 5 000 BC, and they did certainly not rely on a technology transfer from the Middle East. Nor did the South-American cultures - Maya, Aztec, Inka and so on - who did know how to make copper and bronze (not to mention silver and gold).

Needless to say: almost all [Chinese are sure](#) that everything remotely important was first discovered or invented in China. It so happens that they are *wrong* as far as metallurgy is concerned. That "diffused" into China from the West!

The *fourth* question is:

4. Is the Varna copper *native* copper or did it result from *smelting* copper ores?

I have tentatively [answered this question](#) already; here I'm going to dig a little deeper.



Note that I did not pose this question for the *gold*. Gold is *never* smelted, i.e converted from a gold compound into the element, simply because it is almost exclusively found in the elemental state, mostly alloyed with a bit of silver and traces of this and that. Gold was and is rather rare, and either you find *elemental* gold or you don't find anything. You do *not* have the option of finding plenty of some gold *compound* that you then can smelt into elemental gold.

To confuse the topic a bit, gold-bearing rock is still called gold *ore* even so this term otherwise always denotes a chemical compound of the desirable stuff.

Of course, when dealing with gold, just picking up the large nuggets you found when walking around in your backyard wasn't all there was to getting gold in ancient times (not to mention modern times). Quite early - as far as we know - something like a gold technology developed, including digging for the stuff, getting the silver out, shaping and welding it, making gold leaf and gold (nano) powder (e.g. for making red glass), and so on.

More to that in the link.

[Science Link](#)

**Gold
Technology**

● But back to copper. Copper (and practically everything else) is quite different from gold. [Copper ore](#), meaning copper *compounds* like green malachite ($\text{CuCO}_3(\text{OH})_2$) can be found in many places and in large quantities, while *native* copper is rather rare (except in parts of [North America](#)) and only found in some special locations, often together with malachite and other copper ores. For elemental *silver* it is even worse.

If you consider that *your* ancient counter-part was not so much interested in gold (since, after it became fashionable, his boss took it from him anyway) but very much so in labor-saving devices (like a good copper chisel, axe, fishhook or needle), it made a lot of sense to these people to develop smelting techniques, allowing them to produce copper in bulk from the local rocks. If you could do that, your boss would like you and order fancy objects like copper axes. But he couldn't use all your copper for himself (he didn't do any work and thus didn't need real tools anyway) and you could keep or trade some of the stuff. And even better: if you could *smelt* copper, lead, tin or silver, you got *melting, casting* and *alloying* for almost free! There was a way to become rich without being the Boss! This worked for some, at least in China.

So it only remains to sit down with the guys, have a beer or two, and invent smelting.

▶ Ha ha. Do a time travel and go some 6 500 years back (easy if you believe in standard TV movies). Then tell those Varna people that their precious copper stuff, reserved for their big chief, could be made from those *bluish* rocks out there by sort of cooking them in a fire made from "special" wood, and that you could show them how to do this for a little of their gold. The Varna guys would tell the time traveller: "Yes, *we* do know that - but do *you* know that you can also make copper from *green* rocks?"

It would be like some time traveler coming from the future, telling *you* that you could talk to anybody on the globe if you would buy *his* little box for a very reasonable price. You would not only believe him but show him *your* little box that could even send pictures to his girl friend, but comes much cheaper.

Sorry. Wrong century in both cases. These time travelers need to go back a few more centuries. Then nobody really knew how to smelt copper, and the idea that one could talk to people hundreds of miles away via a little box would have been totally absurd before about 1980.

● Now test yourself. Do *you* know, what exactly kept the nerds around 1850, 1870, 1890, 1910 1970 from making a cell phone? Or a computer tomograph? Or beer cans? They just didn't think of that or what? What kept the people around 6000 BC from doing some smelting?

● Smelting was most certainly not invented by some ancient Einstein, who thought very hard for a while and then proclaimed how it should be done. Smart phones weren't made that way either. Smelting was not [invented but discovered](#) - probably more or less accidentally, and in bits and pieces, like many big discoveries. It is also quite likely that it was *almost* discovered many times by ancient "[pyro-technologists](#)" (use the link if you want to find out what that is) but that most of these guys did not notice that something special had happened.

Times need to be right for big discoveries. Maybe you needed a somewhat stratified society before smelting could be discovered, with chiefs bent to accumulate special and rare things, however useless, to demonstrate that they are somehow above the lower strata of society. The role of status symbols - that's what a [copper mace head](#), a fancy pattern-welded sword or a wootz samshir with a Mohammed's ladder pattern were - for the development of science and technology should not be underestimated!

▶ Do you notice how cunningly I diffused the actual issue? It was: were the copper implements found in the Varna made from elemental copper or from smelted copper? Were they cast or hammered into shape? I gave you just my *personal opinion* but without any proof. I could just as well have given you the personal opinion of some archaeologist - but he or she doesn't have proof either since it appears that the Varna objects have never been properly investigated. There are ways to tell smelted copper from native copper as we shall see.

In order not to lead you astray too much, it now behooves me to state that there is a growing consensus that the [Danube culture](#) did smelt copper as early as 5000 BC. It might even be the culture that discovered the smelting of metals!

As it turns out, the simple and rather innocent questions I asked about some early metal artifacts here tend to open big cans of especially squiggly worms. We will see another example of this in the next sub-chapter.

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- 1) e.g. Colin Renfrew in his article "Varna and the emergence of wealth in prehistoric Europe" (in the book: "The Social Life of Things" Cambridge Uni. Press), or Ch. J. Raub: "The Metallurgy of Gold and Silver in Prehistoric Times", NATO ASI Series, 1995.
 - 2) Oleg D. Sherby and Jeffrey Wadsworth: "Ancient blacksmiths, the Iron Age, Damascus steels, and modern metallurgy J. Mat. Processing Technology, Vol. 117 (2001) p. 347-353
 - 3) Of course, if one subscribes to the **good color / bad color hypothesis**, one needs to explain why the bad golden / yellow color became good at the latest around 4 500 BC (Varna burials). Easy! People discovered [beer](#) around this time. No more needs to be said. I want this to be known as the PROSIT (Pursuing Radical Ostentatious Interdisciplinary Transactions) hypothesis.
 - 4) Donna Tartt: "The Secret History", a "mesmerizing and perverse" novel from 1992, Penguin Books.