

Bronze

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The very first metal

Have you ever given the thumbtacks on your bulletin board any thought? Or the paper clips on your desk? How about the eyelets in your sneakers for threading your laces? Probably not, or at least not so often. But maybe you daydream that you'd invented something as simple as the thumbtack. That everyone used your invention and it made you incredibly rich. But there's something else special about all these small, everyday things that make your life easier, without you realizing it. It is the stuff they are made out of: metal.

Not at all ordinary

What's so special about that, you might wonder. Because metal is everywhere. It's in nearly everything you use. In your computer and your smartphone. The knife you use to smear peanut butter on bread. Or your braces, if you have them. They're made of metal, too. It might seem pretty ordinary, but in fact it's not ordinary at all. Because before someone could think up the thumbtack, someone else first had to discover metal. Or, better put: how to use metal to make things.

Before that happened, most tools were made out of stone. Animal bones and deer antlers were useful, too, but stone was the hardest and sharpest thing on hand. Especially flint. Flint is even harder than steel. It just lies there on riverbanks, or in the clay and sand that got pushed through the Netherlands on huge glaciers during the Ice Age, about 150,000 years ago. In some parts of the country it's found underground, but not too deep, so that it can easily be dug up. This was already common practice in prehistoric times. Using hoes and axes made of stone or antlers, people dug narrow tunnels straight into the ground to get to the layers of flint. There are lots of places where you can still see those prehistoric mines.

Can you picture it? Being lowered on a rope into the darkness without a flashlight or helmet? There were no beams to support the tunnels, or conveyor belts to bring the flint back up. It was hard, dangerous work. But people did it anyway. That's how important good flint was.

Shiny stones

Hitting flint really hard with another stone makes splinters fly off that are so sharp you can use them as a knife. And if you hit, push, and bang on a larger chunk of flint, you can shape it into any form you want: an axe head, for example. But even if your tools are super-hard and razor-sharp, eventually they will break. So people were always on the lookout for new stone.

One day, somewhere in the mountains of Serbia or Turkey, someone noticed an unusual rock that shimmered in the sunlight. Pink, a bit like the color of the early-morning sky.

Hey, that's something, they probably thought. This is going to make a fine arrowhead!

And that shiny stone got put into a leather bag. Some time later, back home and by the warmth of the fire, the person took out the stone. She studied it a bit more closely.

It looked a bit strange, different from other stones. But she shrugged her shoulders, held it firmly and gave it a whack with another stone. And what a surprise she must have got: the shiny stone didn't splinter at all – instead, all she saw was a good-sized dent. She gave it one more whack, and then another. Still no splinters. The stone only got flatter and flatter. How far could she go?

She went on hammering until what was left was a flat sheet that glistened in the light of the fire. It wasn't the arrowhead she had hoped for, and it was chipped here and there, but it sure was pretty! She couldn't wait to show it to people. So she rolled up the gleaming pieces, one by one. She had a piece of cord somewhere. She threaded the small rolls onto the cord and fastened it around her neck. Nobody around here had beads like these!

That pinkish, gleaming stone wasn't stone at all, but copper. You guessed right: that was the first-ever metal. Just like gold, it shines beautifully. And it's soft, too, so it's easy to work with. It's possible that copper was discovered the way I've just described, but of course no one knows for sure. If this happened to you, you would write about it. In your diary, or maybe on your blog. But back then, close to nine thousand years ago, nobody wrote things down. There weren't even letters yet. But those copper beads, they were for real.

Copper-hunters

You can imagine that everyone who saw a bead like that wanted one too. So people went looking for copper. And those who knew where to find it made a beeline for those places, to snatch up as much as they could. Because maybe they had been hoping to get a new cow to expand their herd. Or they had seen someone wearing something that they would also like to wear. And if there's no money . . . you have to swap. What's better than having something that everyone wants?

Soon there wasn't a single nugget of copper left. But still it became more and more popular. Some clever folks figured that if there was all that copper lying on the ground, then there must also be more . . . *under* the ground! Because if that was a way to find flint, then why not copper, too? But the ground where copper was found is much harder than the ground with flint. So you couldn't just dig tunnels into the dirt.

Luckily, they soon came up with clever idea. They built a big fire on the spot where they expected the copper to be, so that the rock got really hot. If you threw cold water onto it, the rock would shatter and was then easy to chop away. This way people made their way deeper and deeper into the ground, until there were real copper mines with long, dark tunnels echoing with the dull thud of axes.

The copper from under the ground looked different than the shiny pink nuggets that you could just pick up off the ground. But by then copper had been around for a while, and people noticed that even those pretty beads eventually turned a greenish color. And that was exactly the color of the copper under the ground. Aha! So you could still tell what it was. The underground copper – in this form it's called copper ore – ran in green streaks through the gray stone. But that's still not a bead.

By now they had discovered that when copper gets hot, it becomes easier to work with. So the copper-hunters tried the same thing with copper ore. Nothing happened at first, so they made the fire hotter and hotter. They did this by blowing air into the flames with a bellows and throwing pieces of charcoal on top. And guess what: there was the copper! Shining nuggets and beads appeared among the chunks of charcoal.

Hotter is Better

Soon the copper-hunters knew that if you made the fire even hotter, copper would melt. Then you could pour it into molds, forming it into just about anything you want. This process is called 'casting'. The mold was usually made of stone or baked clay. It works a bit like a cake pan with a fun shape, like a teddy bear. You pour in the batter, put it in

the oven, and after a while you have a firm bear-shaped cake. Although copper works the other way around: when copper is hot it becomes liquid, and it hardens when it cools off.

Now things get interesting. Because as terrific as those beads were, casting made a whole lot more possible with copper. Maybe you could even make a knife or an axe! Casting is lots easier than whacking splinters from a stone, and it's nicer to look at, too. But even though a copper axe might seem much better than a stone one, in some ways that wasn't so. Because copper is soft. It quickly goes dull and is easily bent out of shape. Not so handy, actually, for a knife or an axe.

And yet the advantages outweighed the drawbacks. You could sharpen copper tools, so they lasted longer. Also, you could reuse them. A broken stone just gets thrown away. But if your copper axe is so dented and cracked that it's really no good anymore, you just melted it down and made a new one. Or you crafted something else from it. All you needed was a new mold.

From copper to bronze

Meanwhile, people thought up all kinds of ways to improve copper. But how? It might have happened by coincidence. Copper ore nearly always contains other metals, too, and these melt along with it. They determine how hard or soft the copper ends up, although people weren't really sure quite how. You probably had a few showoffs who would try anything, and thought: say, if you can melt metal out of one kind of stone, why not with other kinds?

There was probably a lot of yelling, cursing, and feet-stamping. Not all stones contain metal, so not every chunk of stone is ore. You can't always tell by just looking at it. Some stone explodes in fire and sometimes the metal, once you have it, won't always do what you expected. It can even be really dangerous. Arsenic, for example, is a metal-like substance that is super-poisonous. And yet arsenic was the first thing to be mixed

with copper. Because that turned out to be the secret: mixing copper with another metal made it stronger.

People were quick to realize how bad arsenic was for you. It gave you a bellyache, spasms, and fever, and you could eventually die from it. Besides, it was hard to tell exactly how much arsenic there was in your ore, so you never really knew how your copper was going to turn out. So the copper-hunters kept on experimenting and looking for something better. Until they arrived at the ideal mixture of copper and tin. A new material had been invented: bronze!

It doesn't take much tin to make copper stronger and harder. One-tenth, or even less, is enough. And that was a good thing, because tin is much harder to find than copper. So in the countries where copper and tin were plentiful, bronze tools quickly took over from stone ones. In Turkey, for example, and later in Eastern Europe and Britain. But you don't find copper and tin everywhere. Like in Belgium, Holland and Denmark. So what did they do to get their hands on bronze?

Trade

For a while, tools in those areas were still just made of stone. Nobody knew what bronze was. No one had ever seen it. But people traveled. By foot, or in a canoe or an ox-drawn cart. Eventually the people without bronze came across those who did have it. And as soon as they saw a beautiful, shining axe or a smooth, glossy armband, they naturally wanted one, too!

This resulted in a lively trade in bronze: ready-made objects, but also in scrap bronze or in copper and tin. Some traders became wealthy. There still wasn't such a thing as money, so you mostly saw how rich they were by the beautiful things they had.

Bronze axes soon replaced stone ones. But how would your townsfolk feel if you were the only one with a bronze dagger? Or a sword, even? Maybe the way you'd look at someone with a fancy car nowadays. You admire the car, try to imagine what that

person had to do to be able to afford it. You might have immediate respect for the owner, or even become a little jealous.

That's how it could have been four thousand years ago. Having things made of bronze made you an important person. Or maybe the reason they got bronze things was because they already were important. Hmm, that's a tricky one. It could have been either way.

An endless cycle

But now back to that thumbtack from the beginning of this chapter. It's made mainly of copper. Copper, which can be used and reused endlessly. It can be melted down, recast, and bent into any imaginable form. Maybe the copper in your thumbtack is brand new. But it could also have come out of the ground five hundred years ago, or even longer back. Maybe it was once a bullet in World War II. Or the key to the front gate of a huge castle. Metal can be anything. And it all started with bronze.

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One of the most famous copper axes we know today belonged to a man who lived about 5300 years ago. He trekked across the mountains, along the border between what is now Italy and Austria. The man wore warm clothing and shoes—just the thing for a trek through the snow. He was carrying all kinds of tools, but also had arrows and a bow he hadn't finished making yet. He never got the chance to finish it, because during his journey he was shot from behind. A flint arrowhead was still lodged in his shoulder when two hikers found him, thousands of years later. That was in 1991. No one knows his real name, of course, but he was given the name Ötzi, after the name of the valley where he died, the Ötztal. Why Ötzi was killed is still a mystery. Because he still had his beautiful, valuable axe with him.

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The beginning

We're asleep. At least, we think we are. It's dark here, pitch-dark. We're surrounded by rock. Every now and then we feel something soft creeping past us. Something alive, something that's looking for water. Roots. Plant and tree roots. Their thin, fine hairs graze our skin as they carefully feel their way downward. But we're not what they're looking for, so they creep further. We stay put. We've been lying here for so long already. Longer than those roots have been alive. Roots come and go, dry up and become earth, until another thirsty one pushes its way past.

We're not alone. We're part of the earth's crust. Once, long ago, we got pushed up from the depths with incredible force and then sank back into the earth's skin. We sleep and we dream of the deep darkness and a blinding red glow – heat that almost defies description. An ancient fire, long forgotten, no more than a vague memory.

We sleep. Or at least we used to sleep. Something's happening now. Something that shouldn't be happening, not here, where the silence is deeper than the most profound depths, where the loudest thing we ever hear is the scratch of a beetle's tiny legs. There's warmth, and the hiss of steam. We can hear a distant crackling. Then the earth trembles. Again and again. We tremble along with it. And the sound! Dull thuds. The thuds continue and come ever closer. The ground all around us shakes. Rock breaks. We don't see it yet, but we feel it coming: more light, more air, less weight pressing down on us. And there's nothing we can do.

Then something cracks right above us, and it sounds like the world is coming to an end. A blinding light comes streaming in, driving away everything we know and trust: the darkness, the rock. Even the tiny animals flee, something we couldn't do even if we wanted to. Then a shadow falls over us, the light is blocked and for a moment we're relieved to be back in the dark. But then something happens that we never imagined possible.

We're being hammered on. One, two, three, four blows. Something sharp is driven into our body, and then we split apart. We are separated from each other and from the earth. We, a product of the ancient fire and since then inseparable, break apart into little pieces. If we had voices, we would scream. Where are we? Part of us has been smashed loose. Who are we now?

The creatures who so brutally tore us apart now pick us up and put us in a large basket. The reed feels like dead roots against our skin. We've been torn apart, but we're still together, lying side by side.

Then we hear new sounds. Sounds made not by the weather or the wind or the animals we're familiar with, but from the mouths of the creatures themselves. They carry us away from the place where they found us. We don't understand, but we listen carefully. We want to find out who tore us from the earth where we were born. Some of us are afraid of what's next. Others dream of new places and adventures. We just don't know. Where will we end up? What's going to happen to us?

We lie for a long time in that darkened basket, although for us, 'a long time' is hard to describe. What is long, when you're as old as the earth itself? But now that we're in motion instead of lying still in the ground, time seems to move quicker. We bounce above the ground on the backs of those people. For that, we've learned, is what those creatures who took us out of the earth are called: 'people'. They feel our weight. We rub against their backs, hang heavily on their shoulders, let them know we're not going willingly. But they are determined, and do not listen to us.

Suddenly our journey ends with one last jolt as our basket hits the ground. We hear more noises, from people who weren't there before. They sound happy, even excited, and soon the lid is lifted off our basket and we see faces with wide open eyes and mouths. They laugh and ask questions, they touch us, bring us close to their face, study us, and drop us back in the basket. We crumble, we get covered in dust. Small bits of us come loose.

The lid gets put back on the basket and all goes dim again. Nearby, things get pushed around and two people, a man and a boy, talk. The sounds that come from their

mouths are words. We have figured that much out by now. And those words slowly start to make sense to us. We listen intently, but the only thing we clearly understand is 'tomorrow'.

The man and the boy leave us alone, and the light that had seeped through the slits between the reeds of our basket gradually disappears. In the distance we start to hear more sounds, sounds familiar to us from our journey here: to singing, music. Drums and flutes. We like those sounds, and wish we could see what it was. We only stop listening when the last voice has died away. When do you suppose 'tomorrow' is?

The light returns. Now that the sun cautiously peeks through the reed of the basket and we can start to see things, the man and the boy are back. So that's what 'tomorrow' is. They putter around and talk a lot. Through the gaps we see an orange glow that reminds us of the very first days of our existence. There's a fire burning behind us, and we can feel it getting hotter and hotter through the basket.

Then we're set free. The lid is removed and the boy tips the basket over so that we roll out onto a hard earthen floor. He picks us up and lays us on a high, flat stone. Some of us stay behind on the ground because we don't all fit. We gather up close together, awaiting the boy's next move. Then, with a loud thud, he drops a second, heavy stone on top of us.

We crack and break. He slams us again, he pulverizes us, and then sweeps us into a bowl and lifts us up. We're as light as dust. If a breeze were to blow over us now, we would be swept away. But that doesn't happen. The man is there, too. He takes the bowl from the boy, runs his fingers over us and pats the boy on the shoulder.

The man walks slowly. When he kneels down on the ground, we can feel the fire close by. He looks down at us and smiles. Then he holds the bowl above the fire and scatters us over the coals. At first, we don't even feel the heat, because we've landed on small bits of black burnt wood that the man just put in the fire. Some of us fall further into the flames underneath. More chunks of black wood are put on top of us, and it gets dark again.

The air gradually disappears, eaten up by the fire. We start to sweat, to choke. But then there's a burst of fresh air, blown in through a narrow pipe in puffs, like the breath of a big animal. Soon enough the cool breath turns into a hot blast. The flames suck in the air and become bigger and stronger. They burn us. At first we fight back. We can feel ourselves changing, and we don't want that! But then, stunned by the heat, we let everything go. Including ourselves. We separate, we split up. Some of us stay behind while the rest seek each other out.

We're still glowing when they remove us from the embers, and we sizzle as we're dropped into the pan of water they've made ready for us. The water bubbles and fizzes around us as we sink to the bottom. When a small hand lifts us out of the dark water, we know everything will be okay. The boy smiles. We are reflected in his eyes. We're no longer rough and dusty, but pink, shiny, and smooth, even though we're still irregularly shaped. The boy puts us in a new bowl, which is rough and narrow and has a thick wall. We feel clean, cleaner than ever. We don't miss the part of us that has been left behind. The way it is now is how it was always meant to be. It feels good. We're content.

More and more of us are liberated in the same way. Our bowl fills up, and we're all beautiful, shining, as if we've sucked in the fire ourselves. The man and the boy work hard. After a while they stop talking and focus on their task.

We have no idea how much time has passed when they finally pick us up again. Once again there's heat and fire, but this time we stay where we are, together in the thick-walled bowl. The heat is even more intense than first time and we feel ourselves melt. We become as fluid as water.

But what's this? Newcomers? The boy drops them in among us, one by one. They look a little like us, how we use to be, but they're cold and gray. They're strangers, we don't want them here! But we can't escape. They talk to us with strange voices while they slowly melt, and before long they have mixed with us. We're stuck together. We're like one now, and we understand one another. They're going to make us stronger, they say.

We glow as though we're on fire. We're no longer dull gray or shiny pink. We're bright red, deep orange, and the air above us shimmers. Someone takes us off the fire. It's the man. His big nose and narrow face hover above us. He's sweating and holds us at arm's length. He slowly lowers our bowl, but we don't touch the ground. He tips the bowl sideways, and slowly we flow over the brim. We hold tight to ourselves and to each other. We flow through a small hole into a dark space, accompanied by burning-hot flames. Then, suddenly, we're doused with water. It cools us off, and gives off loudly hissing steam. We're trapped in the dark. Until everything starts all over. Again we feel a thud, hear stone breaking, just like this journey began. At first, light seeps through the cracks, then suddenly it blinds us. The man looks, and calls out.

'It worked!'

And we're happy. No, not 'we'. There is no 'we' anymore. I. I am happy.