

Things You Can't Live Without

Episode 1 – Susie Dent's online dictionary

No. of words	1,496	Time	34 minutes
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Dr Anna Ploszajski [00:04]

Smartphones, reading glasses, cooking equipment. These are just some of the items from our daily lives that our guests simply cannot live without. And on this podcast, we dig deep, quite literally to find out how these items came into existence and the impact on our planet of our obsessions. I'm material scientist Dr Anna Ploszajski, and my guest today is one of the world's leading lexicographers. She's written 13 books, hosts an award-winning podcast, is a viral tweeter of words and has been on our TV screens for the last 30 years appearing in dictionary corner on the beloved TV program Countdown. Even more impressively, she has been recreated as a Barbie, a piñata, a lollipop and even that most British of party decorations, bunting. It is, of course, Susie Dent.

Susie Dent [00:56]

Hello. Yes, I have to say it's not that impressive that I have a Barbie because it didn't exactly go on the production line. It was just a prop for the comedy version of Countdown. So it belongs to me and me only but she is sitting on my shelf looking down at me.

Dr Anna Ploszajski [01:10]

In pride of place, I'm sure. Yeah. So Suzy, this is a podcast about the items that you can't live without. So tell me what is the one thing that you can't live without?

Susie Dent [01:21]

Well, it's a very nerdy answer, and probably a very predictable one. But I spend my life with my nose buried in a historical dictionary, and specifically the Oxford English Dictionary, which is my Bible. And actually, I say my nose. But nowadays, I am consulting it almost exclusively online, though it is available as a 20 volume collection, but it's much, much quicker, obviously just to look something up. And because it's an ongoing enterprise, things are updated all the time as well. So I have to say, I have never Anna really considered the cost to the planet of that specific passion and, you know, mainstay of my life. And so I'd be really interested to hear whether I should be going back to the books that are weighing heavily on my shelves.

Dr Anna Ploszajski [02:05]

Yeah, so we're going to be digging deep into all of this. Since I'm a scientist, and since we're going to be looking into the science of words and dictionaries and materials today. I was wondering if you could give us an insight into any particularly interesting scientific words and some of their journeys.

Susie Dent [02:22]

Well, I love science itself, actually, I mean, I have to put my hand up and say science was not my forte at school, I was always drawn towards words and language and literature. And I did a

podcast with Gyles Brandreth, where we talk about words. And whenever we hit a scientific subject, we're both painfully aware as our listeners that we don't really know what we're talking about. But we can kind of focus on the language at least. But science itself is a beauty really, because it began with the Latin *scire* meaning, or *scire*, meaning to know. So science is knowledge. And actually, it first applied to all areas of learning, much as grammar actually did the same thing. Grammar was learning it was education, and it was only later that it focused on a specific area. So they both narrowed in their meaning, which is really interesting, actually, because often it works the other way around. So I love that and it means that science is actually linked to conscience, but we don't see the link because it's pronounced very differently. But a conscience is your inner knowledge, if you like. What was once called your *inwit* and your *outwit* was your outer perception of the world, your external perception of it. And if you would like me to give you my favourite word linked with science, and so many of your listeners will be fully aware of this and you will know it yourself because it is pulled out every single summer. But it's *petrichor*, which always goes viral on social media and *petrichor* is that really gorgeous, distinctive smell of rain after a long hot, dry spell. And it was coined by two, I don't know, I'm not sure if they were physicists or geologists but in the 1960s and I just, well, I love the fact that there is a word that describes that really sort of musky, musty smell, but also the kind of process by which they chose the name because *petri* looks back to ancient languages really for stone. And *ichor*, even more beautiful is from mythology and *ichor* was the ethereal essence that was said to flow like blood through the veins of the gods. So they thought it was this really magical, mystical thing that was permeating the earth. I think it's a compound called *geosmin*, which produces that smell. But it's just it's just beautiful. It fills a gap and also, as I say, it has the most beautiful story behind it.

Dr Anna Ploszajski [04:38]

I love that. Yeah, really beautiful. And from the gods to the devils. I remember writing a article a while ago about the metal nickel. Yes, reading about the origin of that name. Can you remind me the story?

Susie Dent [04:51]

Yes. So nickel began as *Kupfernickel* in German, which was copper demon. And it was because miners would chance upon nickel thinking it was very precious copper because it looks like copper only to be disappointed. So it was it was a demon because it kind of thwarted their ambitions if you like. So yeah, *Kupfernickel* is a lovely one and actually that nickel, you will also find in the bread *pumpernickel* believe it or not, which if you trace it back to its German ancestry means farting demon. So the demon is still there. So, you know, the idea is that as it produces slightly windy qualities in the person that eats it, so, yeah, so nickel and *pumpernickel*, believe it or not are related.

Dr Anna Ploszajski [05:36]

Love that, very cheeky, both very cheeky in a geological and flatulence sense. So it's funny, you should mention copper, it's almost as if we planned this listeners, because that's the material that we're going to be talking about today. So the first printing machines were Chinese printing presses, these were developed ever since around the 9th century. And initially, what they did was they carved entire pages of text into a single block of wood, covered that with wet ink and then pressed paper, which was another Chinese invention, onto it to transfer the design. So you would make loads and loads and loads of page one, and then you'd make loads and loads of page two etcetera. Later on, they developed what we call movable type. So they would just have individual characters made from individual blocks of wood, or sometimes clay. And these blocks are assembled in the right order to create the desired meaning. All of that came to Europe in the mid-15th century, you've probably heard of Johannes Gutenberg, the Gutenberg Press. He was a German Goldsmith, who his kind of major development was to make those individual movable characters not out of wood or clay, but out of brass. And brass is an alloy of....

Susie Dent [06:47]

Copper, is it?

Dr Anna Ploszajski [06:48]

Yeah, copper and zinc, exactly.

Susie Dent [06:49]

Amazing.

Dr Anna Ploszajski [06:50]

So the early dictionaries, the only kind of printed forms of the dictionaries owed absolutely everything to copper. And, you know, it was what kind of democratised I guess, dictionaries and language, in general, to the masses.

Susie Dent [07:02]

Yes, it had a huge impact. If you take William Caxton on spelling, for example, because before he came along, and his team, you know, spelling was all over the shop. And William Shakespeare spelled his own name differently twice on the same document, which was his Will. And there were, I think, 13 different spellings of his name in his lifetime, and something like that. And it really was crazy. But because, as you say, you know, suddenly the written word could go to the masses. It had to be standardised because people up north had to understand people down south etcetera. So yeah, massive impact.

Dr Anna Ploszajski [07:38]

The problem though, with paper dictionaries, as you've laid out, you know, if he was to put all of the words in the dictionary, it's, you know, today 20 volumes. So this data storage issue, massively difficult to overcome. Out of interest, how many words are there in today's OED?

Susie Dent [07:55]

Oh, that's a really good question. And, do you know what, there's never an easy answer to this. Because people always say, 'Well, how many words are there in English?' And we can never really answer it. Because if you take the word run, are you going with runs, running, ran, etcetera, etcetera. There are so many different forms of each word as well. But we're looking at certainly the dictionary that I use, I think on Countdown, we're looking at about 300 to 500,000 words and phrases, depending on how you count them. So you know, it's a lot.

Dr Anna Ploszajski [08:26]

That is a lot. So to solve this data storage issue, I guess, one option is to just type in increasingly smaller fonts, that after a while, obviously, we needed a much more practical solution. And then fast forward a few centuries. And we have, of course, digital data storage, and your computerised form of your dictionary on your smartphone that contains so many more materials than just paper that's been printed on right. Yeah, there's the screen that lights up. There's the ones that make the sensors. There's the battery, there's all the materials that store and process the digital information itself. Modern smartphones have over 90 elements from the periodic table inside them. Yeah. So very, very complex mix of lots and lots of different materials. And all of these different components of the computerised dictionary talk to each other using the material of copper that we're talking about today. [musical interlude]

Dr Anna Ploszajski [09:19]

So you've heard about the origins of our words, we've heard about the origins of the dictionary itself. Now it's time to turn to the origins of the materials that make up our digital dictionaries. And to take us through this material world, we're joined by mining expert and Chief Scientist at Rio Tinto, Nigel Steward, welcome, Nigel.

Nigel Steward [09:37]

Hi, Anna. Hi, Susie. Good to meet you both.

Susie Dent [09:39]

Likewise.

Dr Anna Ploszajski [09:40]

Nigel, can you first outline for us why copper is such a critical material in the creation of the computerised dictionary?

Nigel Steward [09:48]

Well, I think it all comes down to electricity, and you know, the invention of electricity by Edison and Tesla and that was commercialised by Westinghouse that really launched copper as we electrified the world with lighting and things like that. And it's really electricity that enables a modern computer to work. So when you think about the elements that sit within a computer, there's the silicon in the chips, there's the power to the chips, which comes quite often from a lithium ion battery. In the case of tablets and portable computers. We have things like indium tin oxide on the touch screens so that we can navigate the computer. We have rare earth metals that are going into the various memory devices within the computer. But all of that needs to be connected and all of it functions because of electricity. And that electricity is conveyed with copper. And you really see a huge growth in copper when the electrification of the world happened at the beginning of the last century. And that's where most of the copper has been produced during that period of the last 120 years or so.

Dr Anna Ploszajski [10:45]

Right. But we knew about copper for many, many millennia before that, right? Because copper is one of those rare metals that actually can be dug out of the ground on its own, not wrapped up in ores, right?

Nigel Steward [10:57]

Yeah, that's right. So when you when you think about it, we had the Stone Age, and after the Stone Age, we had the Bronze Age. And bronze is an alloy of copper and tin. And that was really the first metal that we used as human civilization. So that dates back sort of 5000 years before Christ. So it's been around for a long, long time. And you're right that first copper that existed, you could literally pull it out of the ground. It's what we call native copper. So it existed as copper metal as we see it today. Today, things have changed all of that easy to grab copper has been found. And we now have to mine minerals in the form of ores, which contains different forms of copper. So copper and sulphides or oxides, for example.

Dr Anna Ploszajski [11:37]

Okay, I really like thinking about copper as sort of the metal that kind of taught us metallurgy really, because that smelting that you describe of getting the copper metal out of rocks, essentially, that must have been an early example of how we learned to do that technology, not to mention the kind of melting it down, casting it into moulds metalworking itself.

Nigel Steward [12:01]

Exactly, yeah, bronze was the first alloy. And then after the Bronze Age and discovery of how to liberate tin, how to liberate copper, how to combine them together to form an alloy. After that, we get into the Iron Age. And then gradually, with the use of iron over, over many, many years, we eventually get into the production of steel. And that era, then Victorian era, it was all discovered by people like Bessemer, for example, in the UK, very much the birth of metallurgy, as you say.

Dr Anna Ploszajski [12:26]

Right, exactly. So it's kind of taught us how to work with metals. And then that, of course, led on to, you know, much of the modern world that we know today. In terms of the story of copper, you've mentioned that is a very important conductor of electricity, and how we use so much more of it once we developed a kind of electrified society. Is there anything else important that uses copper?

Nigel Steward [12:49]

I think the other big use is in you think about housing and the water supply, I always say there are two things that you always complain about when they don't work. And they're the things you don't see that's electricity supply and water supply. But certainly we lose those two things, our world certainly changes very dramatically and very quickly. So that's the other big use, I think, is in the conveyance of water plumbing. And that's a big use for copper, both in the form of pure copper tubes, but also in the brass connections that enable us to connect the pipes together. And copper is really quite interesting because it has antibacterial properties. So it also kills bacteria. I know and there have been many cases of communities with without copper piping, where they've had bacterial sort of growth and infections getting into the water system. So copper has that unique property, that antibacterial property too. I think one of the other interesting things for me, it's just the role of copper because it's a very good electronic conductor. So it conducts electricity very well but also conducts heat very well. So it makes it very, very important in heat exchangers, and particularly for refrigeration. So refrigeration really wouldn't happen without copper. And you think about what our world would be like without refrigeration. We might die because of bacterial or fungal infections because our food is not well preserved. We use refrigeration for food and preserving food. And that's really transformed, you know what we eat today as well. We can transport food all over the world, thanks to refrigeration. I think the other thing is, is vaccines. Vaccines are quite often they have to be refrigerated and cooled down to very low temperatures. If you just think about the recent COVID vaccine, what would we have done if we hadn't had copper to enable that refrigeration? So I think those are some of the really significant uses of copper in our world.

Dr Anna Ploszajski [14:27]

Yeah, absolutely.

Susie Dent [14:28]

Can I ask you one question, Nigel?

Nigel Steward [14:30]

Yeah, sure, Susie.

Susie Dent [14:31]

You were mentioning copper in terms of plumbing. And I know etymologically speaking this is all I know really is that plumbing goes back to plumbum which was lead for Roman so the Romans used lead piping and I think early British plumbers also used lead piping. Is copper superior to that then did we learn that copper was a better, just material, per se?

Nigel Steward [14:51]

Yeah, well, the issue with lead is always lead poisoning. So I actually live in a very old house and the municipality where I live they've just surveyed the water, and they wanted to know whether I had any lead plumbing in the house. So I had a water analysis done. And we found out there's no lead plumbing in my house anymore. It's all copper. So that's a relief.

Susie Dent [15:11]

Gosh, so this was really incredibly toxic. But we didn't discover this for, for quite a while then.

Nigel Steward [15:16]

Yep, that's right. Yeah.

Dr Anna Ploszajski [15:17]

So for the Romans who didn't know about the dangers of lead, it would actually be a very, very good plumbing material, it's very soft, it's very malleable. It's got pretty low melting temperature as well, which makes it overall very easy for plumbers to work with. It also doesn't rust, like metals, like iron, for example. So for all those workability reasons, corrosion reasons, it's a really good

material to be used in plumbing. And it was used up until around 1970, very recently. But around that time, we started to realise that it was contributing to the dangers of lead poisoning. And so around 1970, we started to take lead out of gasoline, other sort of packaging and consumer products. So the good news actually, is that overall, the levels of lead in our blood streams globally has gone down significantly since then.

Susie Dent [16:02]

That's really interesting. And my other question was, when it comes to electricity, all I know is it goes back to the Greek actually for amber. And it was to do with rubbing amber, wasn't it? I think, but I don't know more than that. Do you get some sort of electrostatic current from amber?

Nigel Steward [16:18]

Yeah, that's right. If you take a piece of amber and you rub it on wool or you know, on a woollen sweater.

Susie Dent [16:22]

Yeah, you get that crackle,

Nigel Steward [16:23]

It will generate static electricity. So these are some of the first sort of revelations that we had of the electrical current and what electrical current could do.

Susie Dent [16:31]

It's fascinating. Thank you.

Dr Anna Ploszajski [16:33]

So where does that word come from, then? How do you go from amber to electricity?

Susie Dent [16:37]

Well, it's from the Greek electron, which meant amber. And I think, exactly as Nigel said, I think maybe it was that sort of current or whatever was first discovered, when amber was, was rubbed, hence the name. It goes back a very long way.

Dr Anna Ploszajski [16:51]

Got you. So copper is integral to our digital dictionaries, as we've discussed, but Susie, I want you to imagine a parallel universe in which dictionaries don't exist. What would your life be like without the dictionary?

Susie Dent [17:07]

Ummm...that's almost an impossible question, Anna. Because I've never been without it. Really, I think, without the dictionary, I would have to resort to word detection in a very different way. I mean, there will probably be some positive aspects that will be more sociable, I probably have to go and talk to people. And I would have to painstakingly charge the beginning of a word through probably what the early lexicographers did 1000s and 1000s of slips of paper, slips of paper of evidence, the first editor of the OED James Murray lived in what he called the script or he didn't live in it. But he worked in the scriptorium, which was essentially originally shed in his garden. And he we talked about this crowdsourcing effort, he received slips from all around the world. There's just been a brilliant book written about actually by Sarah Ogilvy called the dictionary people, in which she uncovered the lives of some of these readers. Some of them were murderers. Some of them were vicars. Some of them were these, oh just, they were just incredible people behind all of them. But yeah, I think we would have to go back to that. And, and then I'm allowed paper aren't in this parallel universe?

Dr Anna Ploszajski [18:18]

Yes, yes.

Susie Dent [18:18]

Okay. So I think it would have to be that way. And then how we would disseminate that, presumably, without being able to print any more, we would have to go back to manuscripts, which literally means writing by hand. So it would all take a very long time.

Dr Anna Ploszajski [18:33]

That's horrifying. Nobody wants this future. [musical interlude]

Dr Anna Ploszajski [18:38]

Now that we've painted this horrifying picture of the future, we're all having to write things down again. And it's time to face those fears. Because, of course, copper is a finite resource, right? If we want a future full of dictionaries, and computers and vaccines and electricity grids, and healthy running water etcetera we're going to have to start extracting and producing it much more sustainably. So Nigel, you're in the business of extracting and producing copper, what's the biggest challenge for you at the moment?

Nigel Steward [19:07]

Well, I think if you think about how much copper we've mined to date, most of the copper that was on the surface that you know that especially the native copper that you could just pick up as copper lump that's all disappeared. That's all gone, particularly over the last 120 years when we've had this era of electrification in the world. All of the easy to get copper is really disappeared. And in a way, that's a good thing. Because when we're, we're mining and we're mining lower and lower grades, so a lower percentage of copper in the rock will end up generating more waste. And I think this is one of the big issues, we end up at the surface, we can generate large holes in the ground, we can generate a lot of waste, it consumes a lot of energy. So in the context of climate change, we're generating a lot of CO₂. You know, that's really been a challenge for us in recent years. So to find more copper, where do we need to go? And the answer is we need to go deeper underground. So that's going to be a challenge for us as we go deeper underground to find the copper that we need. The good thing is, though, is with underground mining, you can mine an ore body in a very focused way, you don't generate a lot of waste rock. And also those grades deeper down and much higher. So we generate a lot less waste when we extract that copper from these higher grades of ore that we find deeper underground. So that's kind of the direction in which the world is going now, because for the energy transition, this is our big challenge is not just dictionaries. But for the energy transition, we're going to have to, for example, replace a huge amount of energy that's currently delivered to us through fossil fuels. And if we want to electrify that energy to eliminate the use of fossil fuels, we're going to have to multiply the size of our electricity grids by a factor of four. So that's electricity that has to be conveyed by a lot more copper, we also have to generate, produce a lot more renewable electricity, and we've got to multiply the amount of zero carbon electricity that we generate a day by a factor of 16. So again, to generate electricity that requires copper as well. So there's, there's going to be this huge demand over the next 20 years, we've got to produce as much copper as we've produced in the last 5000 years of human history.

Susie Dent [21:11]

And that's nothing that can replicate synthetically, which arguably would be a disaster anyway, that can replicate those properties. And there's no sort of quest to try and simulate it in some way.

Nigel Steward [21:23]

Probably, the elements that come close to copper in terms of electrical conductivity, and thermal conductivity, are silver, gold, and aluminium. So gold and silver, you tend to find with copper. So we're not really solving the problem there. But aluminium is a real sort of use case. So you can use aluminium. So if you think about the overhead cables that you see that are conveying electricity across the country, that sort of rose gold colour of copper, they are silver, so there's a lot of aluminium that goes into those. So we already use a lot of aluminium today as well in combination with copper. But of course, aluminium needs to be mined, refined, smelted as well. So it's just

another material.

Susie Dent [22:04]

So there's nothing we can achieve with 3D printing, or anything, but no. It's all these natural properties, which is incredible all these millennia on, isn't it?

Nigel Steward [22:14]

Yeah, and I think one of the interesting things about copper is that the reason why you don't see a complete conversion to aluminium, is aluminium is quite a reactive metal. So if you join it to another metal, you create a battery and it corrodes. Whereas copper is quite unique. It's a noble metal, it's almost like gold and silver, it retains a huge amount of stability, chemical stability, and that's what makes it so good for these long use cases in, in water for plumbing, and also for electricity. Because we tend to install these things in our houses, homes, in our cities. And we'd leave them in place for a long, long time, and you want to know that they're going to stay in their original state and not degrade over time. And that's what makes copper really, really unique. Its properties as a noble metal.

Dr Anna Ploszajski [22:58]

So if we can't replace the copper, we just need to find more of it. How do you know where it is, by the way? How do you know where it is underground?

Nigel Steward [23:06]

Well, we've learned how copper deposits are formed. The principal sources that we use today come from your really old volcanic activity from many, many millions of years ago. So if you think about molten magma between beneath the earth's crust it sort of pushed up through the surface, and what followed that is quite often these metal rich fluids came up to the surface that contained a lot of dissolved metals, things like the copper, the gold, the silver. And when they came up, they then deposited in that host rock that was left by the magma intrusion. So what we do is we search for those. And eventually we find copper, and we start to explore, drill and see if we've really got copper there or not. Sometimes we don't find copper. Sometimes we do.

Dr Anna Ploszajski [23:51]

So what are the big kind of sustainability success stories in copper extraction?

Nigel Steward [23:57]

Well, I think we're looking more and more at, like I said, going underground and accessing much, much higher-grade ores and mining in a very targeted way. So we reduce the amount waste that we produce, I think that's the first thing in terms of sustainability. And when you start to reduce the amount of waste that you produce, you can start to think about other uses for that waste as well that can actually serve the energy transition. A great example that we're working on at the moment is that when you extract copper, you don't completely extract it, but the technology is, and some of that copper gets left in the waste. So we're going back to the waste, and we've created a process that can extract that last amount of copper from the waste. So that becomes another source of copper. So we can look back at our old closed copper mine sites and think about well, how do I actually go back and they become new resources for us going forward? It's interesting, you talked about a lot of the elements that sit in our computers and tablets and phones. We're beginning to find that those trace elements can also be found with copper. So we're looking at co-extracting those materials. So recently, we've just extracted tellerium from our copper operation, because tellerium was also found with copper. And that's now going to the manufacture of cadmium telluride solar panels in the United States. So I think we're looking at almost like nose to tail mining in a way, let's see what we can extract more completely from these ore bodies to provide us with the materials that we need. And of course, we're going to have to do this with a zero carbon footprint in the context of the energy transition. So otherwise, it makes no sense at all. So we're exploring ways in which our mining equipment will not produce CO2. So like, we have electric cars, we now have some electric vehicles underground in our underground mines. And we're doing that for our

surface mines as well. And then in our processing plants, we're looking at how we move towards the smelting process that uses electricity, rather than using fossil fuels. So we're switching these things out as well. So this is the big challenge that we face.

Dr Anna Ploszajski [25:56]

Yeah. And you also have to do that pretty quickly I'd imagine. The climate emergency is not going anywhere.

Nigel Steward [26:03]

I know, I think, you know, if you just look at copper, the pace is the scary thing that we've got to produce in 20 years, what we've produced in 5000 years of human civilization. So that's the scale of the challenge that we're on as we address climate change.

Dr Anna Ploszajski [26:19]

Yeah, would there be any one technology that you don't yet have access to that we haven't quite developed yet? That would change everything that would just make all of these problems kind of go away, any kind of silver bullets that we can hang our hopes on?

Nigel Steward [26:29]

I think the thing that concerns many people the most is we know that renewable energy, wind and solar, they're not firm. So they're not running all the time, we only generate electricity from solar when the sun shines, and from wind when the wind blows. So how do you firm that because our electricity today runs all the time. So we need some form of storage. We've found that we can use renewable power to store and firm heat economically. But we haven't found a way of doing that for electricity yet. So this is an area of very, very active research with many startups in this field. And that's one of the big challenges that we face. Our other alternative, of course, is nuclear power. And we all hope, keep our fingers crossed that fusion is going to work one day.

Susie Dent [27:13]

That was James Lovelock's thing, wasn't it? I was tapping away on my computer, I was so fascinated by what Nigel was saying I was just tapping away as he spoke, it's really interesting. And with the storage of electricity, presumably that would also mean that we can get rid of bloomin' chargers for every single thing that we own, would it? Or is that to do with having stronger batteries? I don't know. I find it astonishing that we still have to plug every appliance in to charge it. It just seems so archaic still. Anyway, that's first world problems. That I agree.

Dr Anna Ploszajski [27:45]

Yeah, but let alone a lot of copper tied up in all those charging cables.

Susie Dent [27:48]

Well, yeah, exactly.

Dr Anna Ploszajski [27:49]

How much copper do we all have in our spare drawers at home?

Susie Dent [27:53]

And what happens to those when we throw them away?

Nigel Steward [27:55]

I think this is one of the things we need to get much better at Susie, I think it's a great question. It's embracing more of the circular economy in what we do. And e-waste. So electronic waste. And this includes things like those chargers are very, very rich in copper, and also all of the other elements that Anna and I spoke about earlier. And the extraction of those is going to be really important for us going forward, that can be another really good added source. So when you think about it, it's very, very rich in copper e-waste, and it comes back fairly regularly. Our phones, our chargers, they don't last as long as say the electrical cable or the plumbing in our homes. So those sorts of

things that the plumbing and the electrical infrastructure that stays in place, and that doesn't get recycled. But everything in our phones, our consumer products, this is what we should be looking at more and more is recycling that e-waste and bringing all of those valuable raw materials back.

Dr Anna Ploszajski [28:47]

So it's a hugely complex systemic coordination that's required right social, political and governmental coordination. So, Nigel, if we're going to be implementing all of these seemingly quite radical technological changes as to how we're accessing copper mining it, producing it, and processing it. What might some of the unintended knock-on effects be the unintended consequences of this radical shift?

Nigel Steward [29:14]

Well, I think we have to produce things with a with a much-improved ESG footprint and a zero carbon footprint going forward. And I think all of that is achievable. I think one of the things that sort of concerns me though, is the competition for land, particularly when we talk about renewable energy. And this is why I really hope that nuclear fusion works. And there is a lot of great work being done with international projects in the US and in France now with ITER. And many startups in that field are working on fusion. I think there's more than 30 now. So it's a very exciting time and hopefully something comes to that. And I think the importance of that for me is that when you look at how much area of land, a fusion project takes up compared to the amount of land that's consumed by wind and solar and given the just the sheer rollout of wind and solar that we will have to execute as a society. And then you realise that takes up land. But population is growing. So we're going to need more food and arable land and pastoral land that takes up land. And then we've also taken commitments Montreal at COP15, to preserve biodiversity of our oceans and also land. And so you can see this sort of clash coming. And then climate change, as well as is eroding some useful land for us as well as the world heats up. So I think these are the unintended consequences. We think, you know, wind and solar are going to solve our challenges, but they do come with an unintended consequence. And this is why our great hope should be fusion, and we should encourage fusion.

Dr Anna Ploszajski [30:44]

Yeah, so what we're talking about here is actually different from the nuclear power stations that are operational today. Those ones that work now are based on nuclear fission, which is a process by which you break very big molecules like uranium apart. And that process releases energy. Fusion is about fusing very small molecules together to release energy. And the reason that people are so excited about fusion is that it's the process by which our sun generates its energy. It involves smashing very, very small molecules together at very, very high temperatures and pressures. And the products when you do that is new fused molecules and various other subatomic particles, but also a huge amount of released energy. And this released energy is so huge that nuclear fusion, I think, is often thought of as the kind of Holy Grail of our global engineers. The reason though, that we don't have any commercially viable fusion reactors yet, is simply because we have to recreate the conditions of the sun on earth of those high temperatures and pressures, which in itself is a huge technological challenge. But as Nigel says there are loads of amazing folks working on this. And personally, I'm very hopeful that we will see fusion making huge steps forward in the next few years. [musical interlude]

Dr Anna Ploszajski [32:03]

So looking to the future, then, what's next for our beloved dictionary, Nigel, what technology are you most excited about that you think gives you the most hope for a future full of dictionaries?

Nigel Steward [32:16]

I think probably it's the way in which they're produced and producing everything that's sort of needed in the electronic world but also the physical world with a much, much lower environmental footprint and a much-improved social footprint, and definitely with a zero CO2 footprint going forward as well in the context of climate change. So any technology that supports us in those goals

is of great interest and excitement to me.

Dr Anna Ploszajski [32:37]

And Susie, reflecting on this journey that we've been on looking at where the dictionary comes from, how it's actually made. How do you see the dictionary continuing to evolve both linguistically and now perhaps physically as well?

Susie Dent [32:50]

Well, I don't see that there's going to be any turning back towards the paper version. The Oxford English Dictionary announced actually several years ago that they thought any future edition would be exclusively online. So I think we'll almost certainly be consulting things on our computers still, just as we have spell checkers for a very long time. And English won't stop evolving. I mean, it has to evolve in order to survive. So we will always need to be chasing the sun and we will always need to be documenting our language, not to preserve it, but to chart it and to explain it and to help us use it.

Dr Anna Ploszajski [33:26]

I love that. [music plays]

Dr Anna Ploszajski [33:30]

Thanks for listening to Things You Can't Live Without, which was brought to you by Rio Tinto. I've been Dr Anna Ploszajski. And my guests have been Susie Dent and Nigel Steward. Thank you.

Nigel Steward [33:39]

Thanks very much, Anna. Good to meet you as well, Susie.

Susie Dent [33:42]

Likewise, I have learned so much.

Dr Anna Ploszajski [33:46]

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