Dwarkesh Podcast #96 - Why Rome Actually Fell: Plagues, Slavery, & Ice Age – Kyle Harper

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Dwarkesh Patel
Today, I have the pleasure of chatting with Kyle Harper, who is a professor and provost emeritus at the University of Oklahoma, and the author of some really interesting books: The Fate of Rome, Plagues Upon the Earth, Slavery in the Late Roman World, and an upcoming one called The Last Animal.

The reason I wanted to have you on is because I don't think I've encountered that many other authors who can connect biology, economics, history, and climate into explaining some of the big things that have happened through human history in the way you can. The most recent reason I wanted to have you on is I interviewed David Reich, the geneticist of ancient DNA, and some of the questions we were discussing, he kept emphasizing this overwhelming and surprising role that diseases have had in human history, not just in the recent past, but in his work going back thousands of years, tens of thousands of years.

He said, "You gotta have Kyle on." I emailed him afterwards, asking "Who should I interview next?" And he said, "You gotta have Kyle on".

You have this graph in The Fate of Rome.

You show human population over the last few thousand years. I assume that these two downspikes are both the bubonic plague, Yersinia pestis, right?

Kyle Harper
Yeah.

Dwarkesh Patel
And so this is not like some small little nudge you can see, like the overwhelming —I mean, other than the hyper exponential growth in human population— the overwhelming, not just one, but the overwhelming two major features in human population going back the last 10,000 years, is this one bacteria, right?

Kyle Harper
Yeah.

Dwarkesh Patel
One of the things you discuss in the book is that the collapse of the Roman Empire was a result of this one particular event.

Kyle Harper
The period that I normally work on is from the High Roman Empire, the glory days of the Pax Romana in the first or second century, through what we call the late antique or early medieval period, the sixth or seventh century. At the beginning of this period, Rome

dominates this Mediterranean empire. It's what you think of when you think of ancient Rome. It's the largest city in the world. It's the center of this huge network.

By the end of this period, the city of Rome has 50,000 to 100,000 people. It's a tenth or twentieth of its former size. I think we now can say pretty clearly that environmental factors like climate, but also especially diseases, play a part in that really big transformation.

While there's a problem because we don't have the same kind of modern government mortality statistics that we do for COVID or even for the last century or century and a half, we have to piece together from clues. But it's pretty clear that the bubonic plague events, whether you're talking about the Black Death of the 14th century or the plague of Justinian in the sixth century, these events are capable of causing death rates, temporarily, that are just orders of magnitude beyond what we're accustomed to. Even in these ancient societies, the reason why these were so shocking, in a world where the death rate is always pretty high—probably several percent of the Roman population, three, four percent a year may be dying in a normal year—is telling. For them to just be utterly shocked by the death rate already tells you that it's some multiple of what they're accustomed to.

Dwarkesh Patel
Yeah. I think you discuss in the book the possibility that the death rate might have been close to or even over 60% wherever the Black Death hit. This is literally the most significant thing.

Kyle Harper
Yeah. It's mind-blowing. In the case of the Black Death in the 14th century, it's pretty clear. It kills 50-60% of the population in entire regions. We don't necessarily think that it killed 50-60% of the whole continent, although that's actually not impossible. But even the fact that it's killing 50% of the people in cities, in provinces, in countries, is just beyond the damage that other plagues do.

Dwarkesh Patel
Right. And do you think that were it not for this 60% mortality event plus the fact that we haven't even discussed yet, this super severe cold snap, do you think that the Roman Empire might have otherwise just kept going? You discuss there were these two previous other big pandemics. The empire still survives.

I think Will Durant had this quote that the Roman Empire fell for longer than most empires have lasted. Do you think it'd be similar to China maybe? Maybe a dynasty collapses, but fundamentally, the same sort of cohesive nation reemerges?

Kyle Harper
Yeah. That's a great comparison. Not just decline and fall of dynasties, but also geographic changes in the configuration, that parts get added and parts get cleaved off, but you still kind of think of it as fundamental continuity in the core. That to me is a very plausible counterfactual.

Justinian, the emperor in the 540s—he reigns from the 520s to the 560s—he's on a path of success. He's retaken Africa. He's mostly retaken Italy when the plague hits. To me, a very plausible counterfactual is that a more or less Mediterranean core of the Roman Empire could have survived east and west. It does sort of survive in the east, but even including really all of Italy, Africa, and probably Spain. That would have been a very reasonable outcome of the sixth century if you hadn't had this kind of random shock.

The Roman Empire would keep going. Remember, it does, and it calls itself the Roman Empire until the 15th century. But we would think of it as maybe more the Roman Empire if it still included the western Mediterranean and was this major, powerful, urbanized polity that resists invasion from the southeast, as happens in the seventh century. So the answer is yes, I think that the Roman Empire absolutely could have had another turn as the thing we kind of mean when we say the Roman Empire: this pan-Mediterranean, powerful, urbanized empire.

Dwarkesh Patel
Yeah, okay. One of the things I found really interesting was you were discussing the firsthand accounts as this big... and feel free to explain the cold snap as well as it's happening. But the firsthand accounts of people who are experiencing this, some of whom come from this burgeoning Christian faith, which already lends itself to millenarianism and apocalyptic thinking. I'm curious basically how did different people try to make sense of this once in a 1,000-year event that's super intense?

Kyle Harper
Clearly, people have to try and explain, within the elements of a worldview that they have, how something like this could happen. They don't have modern science. They don't have germ theory. They don't think of it in terms of a biological event or climatic event. Since that's come up and you've invited, I'll say a little bit about that. This is one of the other really exciting frontiers where we're learning new things about the human past that we just didn't know 10 or 15 years ago.

In this case, we now have really cool paleo climate data that helps us understand that this period of the sixth and seventh century was also a period of really abrupt and significant natural climate change. We're all familiar with anthropogenic climate change, that carbon emissions stay in the atmosphere, trap heat. Humans are changing the climate. That's a big problem and we can talk about it if you want. I just want to clarify, that view is not

incompatible with the reality that the climate does also change for natural reasons on every timescale, from long geological timescales to much shorter timescales.

We live in the Holocene. The last 11,700 years have been pretty stable, pretty warm. It's an interglacial. We're literally between Ice Ages right now. It's been really stable in the big picture. Yet even within that stability, there are smaller scale climate variations and climate changes. Because we need to understand how the earth system works, how the climate system works in order to be able to model what's happening, we need an empirical record of what the climate has done.

For historians, this is great news because now we have a huge number of sometimes even pretty high resolution climate reconstructions for historical periods across the Holocene. We now know, like we did not know this 20 years ago when I started graduate school, that the Roman period experienced some really abrupt episodes of climate change. In this case, the sixth century, we know the cause: there was a series of really significant volcanic eruptions. Volcanoes are a very powerful short-term climate forcing mechanism. They eject sulfur into the stratosphere. It aerosolizes and creates a reflective shield that scatters the radiation entering the atmosphere.

It leads usually to short term cooling. In this case, you had a series of really significant volcanic eruptions that cooled the climate for several decades. In some ways, the later series of eruptions even like a century and a half. It wasn't just a little bit cooler, it was like a degree to two degrees cooler, which we all kind of know now: two degrees isn't weather, this is climate. Two degrees doesn't affect your day, but two degrees globally is a pretty different globe.

All of a sudden in the late Roman world, it's much, much cooler. Probably areas that have been wetter are now drier. Places that are drier may be wetter. It changes the hydrological cycle as well, which is more complicated. In addition to the shock of the plague, you have this simultaneous and probably not unrelated shock to the climate system. We know that it was essentially challenging for agriculturalists. When the sun is blocked and it's really cold and the wheat doesn't grow, your society then starves.

The Romans get this wham bam double shock of climate change, famine, and plague. So back to how people explain this. Apocalyptic thought is one of the principle ways people frame it. To them, nature's going crazy. Huge amounts of the population are dying of this horrible sudden disease and the crops don't grow. You don't have microbiology and you don't have climatology. So you explain it with the resources of the worldview you have.

There's a huge burst of apocalyptic thought in the sixth and seventh century, which is always kind of there. You mentioned that Christianity is eschatological. It is, yes, fundamentally, but that comes out in different ways with different emphases in different

time periods. This is a period, the sixth century, when there's a really sharp emphasis on eschatology in Christian thought.

Dwarkesh Patel
I found your early chapters in the book about what the Roman economy was like in this happy period quite interesting. There's a bunch of questions I have about this. If you read Gibbon, writing in the 1770s, I think he says that the happiest time in human history was this period you're talking about. That was true at least according to him as of a couple centuries ago. This was still peak civilization.

You discuss the complexity of the Roman economy. The fact that millions of tons of wheat and other products have to make their way to Rome and the trade networks and everything. You basically say they were experiencing productivity gains. The wages were increasing, population was increasing, but they were still not at the level at which it was plausible that, say, for these climactic and biological factors, they might have had an industrial revolution. I'm curious why you think... paint a picture for me of what the Roman world looked like as of this happy period and why that still counterfactually couldn't have just saved us a thousand years of history if they were on the right track.

Kyle Harper
First of all, I think this is the sort of question that historians ought to worry about all the time: why didn't the Roman economy catalyze the takeoff? In some ways it was so precocious for its time period, and it seems not utterly impossible. The Roman world is still a pre-industrial economy so agriculture is the dominant sector. The majority of people work in agricultural pursuits and productivity is low. They don't have modern mechanized traction. They don't have modern synthetic fertilizers. They don't have the modern green revolution yields, all the things that have made agriculture stupendously productive.

The primary sector is fairly limited in terms of its productivity because of the limitations on technical inputs. We can think of the inputs to an economy are going to be capital, labor, and ideas. What the Romans have is people. They have some investment, but they don't have technology. They don't have ideas. It's a late Iron Age civilization. I do think there's productivity growth and that productivity growth comes from markets, from trade where you get comparative advantage.

In Egypt, I'm really good at growing wheat. You can make glass in Syria. And then we'll trade. The urbanization of the Roman world certainly facilitates that. Cities are these hubs of productivity and exchange. There's some technology. If you look really hard over five or six centuries, there's certainly economies of scale where the production process and manufacturing is moved from artisanal to industrial scale. But there's no takeoff because they don't have science.

They don't have research and engineering that drives continuous productivity gains. I think they go precociously far in a pre-industrial setting where you take trade really far. They have good institutions in terms of strong property rights. There's relatively reliable contract enforcement. There's financial markets. They have the most advanced financial markets in the world before the 17th or 18th century. There's impersonal financial intermediation.

It's not like you have to know me and come ask me for a loan if you wanna build a ship and go trade something. There are banks that take money from depositors, keep balances, and then lend out to debtors who want to go and do entrepreneurial things. They have so much potential, but there's no spark. You never see these sustained productivity increases. I would just say ultimately it's because the Romans don't have technology improvements that are really self-sustaining.

The reason they don't have that is because they don't have science. Their science sucks. I'm offending some of my colleagues, I'm sure. Galen is great. Ptolemy's incredible. I love Pliny the Elder's encyclopedia, but if you look in the big picture, the contribution that the Roman Empire makes to our knowledge of how nature works and then the applied technology that comes out of that is really pathetic for five, 600 years. They go as far as you can with Smithian advantages to market exchange and specialization, to banks and finance. But without the kind of creative destruction of new technologies that improve productivity, you're eventually gonna run out of improvements.

Dwarkesh Patel
If you're Augustus or some other Roman emperor and you're like, "Look, we've got this big good economy, but I wanna see productivity gains," and you wanna make it happen somehow, is there something from a top down perspective you could have done? In Britain, the government subsidizes the royal arts and so forth and the Longitude Prize.

Kyle Harper
That's exactly what I was gonna say. This happens first in France and then Britain, but you get royal societies for science where you're doing really... I would say there's like three things that are essential there. One is the promotion of what we would call basic or fundamental science. It doesn't all have to be immediately practical or commercialized. But you're promoting deep knowledge of nature.

Two, you're doing it in an empiricist way. This is something very important in the 17th century that the Romans by contrast don't have, is the spirit of Francis Bacon that we need to ground our knowledge in experiment and observation, not just believe whatever authorities or Aristotle said. That's very much the spirit of places like the Royal Society: we don't take things on anybody's word, especially Aristotle's. You need basic science. You need empiricism, rigorous and self-correcting.

Third, you need a sense of useful knowledge, and that's the other thing that really comes together in the 17th century: not just the basic and abstract science, but the application, and the 17th century language for that is useful knowledge. That is something that doesn't ever get wired together in the Roman Empire. There are tinkerers and engineers, but they're not talking to the mathematicians and the physicists. If you were from on high to design self-sustaining innovation, I think you would want to bring those elements into proximity. Augustus, unfortunately for them, didn't do it. Probably good for the world. The Romans are pretty nasty people in a lot of ways.

I definitely am of the opinion that the high science matters, that Isaac Newton is not a tinkerer. He's not building pumps. But the guys who are are his friends. They're in and around the Royal Society, and they're absolutely... Look at Denis Papin, who was a French engineer who was very much in the circle of Leibniz and the very high abstract mathematics, trying to build vacuum pumps.

The proximity of high math, high science, very abstract with what is ultimately gonna be the sectors that lead to mechanization where then you can harness this source of energy that is there all along but hasn't been tapped in coal. That's what catalyzes the big positive cycle of positive feedbacks. What the Romans don't have is that. What the Romans do have is the kind of specialization, and now that we look for it, it's there. When you look at food processing, which is a huge sector, the way that they built mills, there's definitely improvements. But there's never the catalytic change where you get runaway positive feedbacks

Dwarkesh Patel
That's right. A previous guest of mine, Nat Friedman, I don't know if you saw this, launched this challenge called the Vesuvius Challenge. This library at Herculaneum in 79 AD was buried under the ashes of Mount Vesuvius when the volcano erupted; speaking of volcanoes. Now they figured out with modern techniques how to read the burned scrolls and it is supposedly the biggest library of classical text ever. It would double the amount of classical text we have. As a scholar of ancient Rome, what would you personally find most fascinating? What are you excited to find from this data?

Kyle Harper
I'm super interested in the history of math. What happens after Euclid? It's very hard to say because you get these really interesting people that pop up, like Diophantus who's later, in the early Roman Empire. There's still really interesting math going on. Euclid is incredible. The Greek experiment in math and science is the one that I think had the better chance of sparking sustained takeoff.

And it didn't. It'd be interesting to know more about why. Why did things stall? Because these people... Euclid is not just a towering genius who comes out of nowhere. He's very

much a product of the culture and the questions that are being asked in the generations before. It just sort of feels like after him, you fail to get that kind of sustained continuous progress and advance. Maybe back to that big question that we were asking before: what prevents the kind of breakthroughs that we see in the modern world?

Dwarkesh Patel
What is the population of Greece during their golden age?

Kyle Harper
Of the greater Greek world or individual city-states like Athens? We think of Athens as being a couple 100,000 people. Not massive.

Dwarkesh Patel
So I wonder if the Greeks had the science but not the people to sustain a modern economy. Or not modern, but even a sort of industrial economy. And then the Romans had the people but not the science.

Kyle Harper
Yeah. There's probably something to that, that there's just not the critical mass of educated people, of sheer cognitive power to keep it going.

Dwarkesh Patel
Let's turn to another one of your books, the one about slavery in the Roman world. I did not realize before I read that one how much Rome was a slave society. I guess that just isn't a salient thing in a conventional understanding of Rome. Why don't you paint us a picture of how much slavery was involved in that world?

Kyle Harper
Slavery tragically is a really important institution throughout history. We sometimes tend to think of it as a distinctly modern phenomenon, but that actually misses the deeper picture. In fact, it obscures the importance of modern slavery because modern slavery is uniquely important and it's uniquely tied up with certain kinds of market exchange and certain kinds of production, certain kinds of racial ideologies. There are things about modern slavery that are really important to understand are different, but not just because slavery is there.

Slavery has this longer history and slavery is more important in some societies than others, and we want to try and understand that, to ask why and then what implications does that have for understanding those societies? Rome is one of those societies. Slavery is really a prominent institution in Rome from the late republic. As the Romans conquer other parts of the Mediterranean, they start taking captives as slaves en masse, and they build an economy that really relies on slave labor in important sectors of the economy.

Plantations where commodities like wine, olive oil are produced for market exchange that allow landowners to amass enormous amounts of wealth. Slavery becomes this really important institution that's entangled in the development of the Roman economy from maybe the third or second century BCE, and then with ups and downs and really important changes along the way for centuries and centuries.

Dwarkesh Patel
So you're pointing towards from the supply side, all the Roman conquests lead to all this surplus labor that they can make use of, and on the demand side, these cash crops.

Kyle Harper
Exactly. I'm very big proponent of the idea that you have to have both. You have to have a source of slaves. After the conquest stops, the Romans figure out other sources of slaves. If anything, the demand is equally or perhaps even more important because if there's not a mechanism, if there's not institutions that let you turn this kind of exploitation into cash flow, the institution's not gonna go very far. It really is the institutions, the presence of markets where you can take labor and turn it into profit that's the most important element.

Dwarkesh Patel
One of the things I find interesting is in the age of colonization we're used to thinking about slavery in terms of race but also religion and other things which more obviously demarcate free and slave populations. In the Roman world, it doesn't seem that that's clearly the case, yet there's no abolition movement the way that emerges out of England in the 19th century or maybe even before that.

The reason that's mysterious is, if you were literally descended from slaves, if you were like, "My grandfather was a slave but then we were freed," and they're basically just like you, you would think that there would be more of a sense of... not everybody would be an abolitionist, but at least some people would be writing about abolition. With Christianity and so forth burgeoning, they didn't seem to have a problem with it. Why is there no abolition movement despite the heterogeneous nature of the slave population?

Kyle Harper
It's sort of disturbing in a way, isn't it, that humans have the ability to convince themselves that it's okay to own other human beings as property through a variety of different kinds of ideological justifications. You see even in the ancient world there are different models that people use to say that slavery's okay. Aristotle develops a theory of natural slavery that actually some people deserve to be slaves by their very nature and that it's actually good for them to be in bondage.

What's really interesting though is that that doesn't actually ever seem to be the dominant ideology. The Roman ideology of slavery is not racialized. It's not like the Romans think that

the Greeks or the Germans are some fundamentally separate kind of human that justifies their exploitation. The Roman ideology of slavery is really rooted in the law of property and status. They think that slaves are people who've been conquered and rather than killed, they've been spared, and they've been sold into the condition of being somebody else's property.

This seems to mentally explain to them where their slave system comes from and why it's justifiable. You have different kinds of criticism of the slave system from within, but remember, most of what we have written is from the slave ownership class. I don't think the slaves were themselves believing this ideology, and there must have been sort of what we would think of as abolitionist movements or spirit that we just don't have really good records of.

It is this curious thing that the Romans are able to build this huge system that's really brutal and really violent, but has this kind of flimsy ideology where they tell themselves these stories. The deeper lesson of that is that humans can create these systems of belief that will exclude others and justify almost any form of exploitation and convince themselves that it's okay.

Dwarkesh Patel
I hope your next book about The Last Animal discusses the potential parallels with factory farming.

Kyle Harper
There's some... there's a pretty gruesome chapter, I'll say that.

Dwarkesh Patel
I don't know if you mentioned, what numbers you say, I think it was like 10 to 20% of the population under the Roman Empire was enslaved. Given that large a size of a slave population, it's surprising to me that there are so few slave revolts not only in Rome, but even throughout history. There's Spartacus in 71 BC, then there's the Haitian Revolution. If 20% of the population is enslaved, how is this sustainable? If you're running a farm and there's 4,000 slaves and then the next farm over also... why aren't there more slave rebellions?

Kyle Harper
Why not? How did they do this? They have a really elaborate system of repression. They're worried about it. Probably the parts of Roman society where there are 20, 30, 40% slaves are pretty limited to certain regions and certain time periods. Partly because once you cross some kind of threshold, the challenges of repressing direct violent resistance increase.

It's a system of exploitation. That means there's always a mix of carrots and sticks, to put it crudely. The Romans extract people's labor partly through physical violence, but also partly through systems of manumission that try and incent people to obey and not to rebel in order to earn their freedom. They're using everything from literal chains to enticements to try and keep rebellion from ever coalescing in a way that can turn into collective violence.

It's a little bit challenging for us to look back. We know in Pompeii, the slave population is huge. It must be 30%. Not all of these people would've been plantation workers who were lashed every day and worked to the physical bone. A lot of them are nurses and textile workers and maids and tutors and all sorts of things that are sort of quasi-embedded in households as well, where there's always this weird psychological dimension too. Part of the strangeness of slavery is how deeply embedded in domestic institutions it is as well.

There are ideologies in which the paterfamilias is sort of the father and the master. That tries to brainwash people against resistance. The important thing to recognize is it's just a pervasive system that tries to colonize people's minds and pervasively tries to keep them from resisting.

Dwarkesh Patel
I wonder if we can close the loop with the question we began with, which is, why didn't Rome have an industrial revolution? I don't know if it's a plausible explanation that cheap slave labor reduced the incentives for mechanization and engineering and other crafts or if not. I don't know.

Kyle Harper
It's definitely an argument that's been made. Aldo Schiavone was an Italian historian who argued that. It's kind of a neo-Marxist tradition that argues this. It's an interesting argument. I don't buy it at all. The good version of that argument would just be that the Roman Empire is using slaves in many of the most forward elements of the economy too. We tend to think progress and economic growth and innovation is good, and we know slavery's bad, so we tend to think that those things don't go together.

But in reality, it's the most economically advanced sectors of the Roman economy that had a high degree of organization and productivity that tended to employ slaves. In the Roman world, you could make the argument that if the labor in those sectors had been free, there would've been more opportunities for positive feedback loops. The way the argument's usually made is just that the Romans got rich without really thinking about productivity. They just wanted to extract labor, extract wealth rather than create wealth.

That's not a terrible argument, but ultimately I don't think it's the system of labor that keeps the Roman world from industrializing. There are lots of sectors in the Roman world where slavery is not a dominant institution, and it's not like they're more productive or flirting with

some kinda breakaway. So it's an interesting argument, but not one I've ever found all that persuasive.

Dwarkesh Patel
Final question about Roman slavery. What did Gladiator get right and wrong about? Would they just abduct you in front of your house and make you a slave?

Kyle Harper
You mean the first one? The first one got right that when you're making a movie you should worry more about making a good movie than a certain amount of history, but actually the first one's a great movie. If it was completely historically accurate, it would've been much more boring. So I'm not gonna be critical of that movie. It plays very loose with the facts of high politics around Commodus and the creation of this character. But who cares? Russell Crowe's incredible.

Dwarkesh Patel
But on slavery in particular.

Kyle Harper
On slavery in particular, I think actually that's one of the strong suits of the movie. You see this completely exploitative system that brings people from very different parts of the world who have very different backgrounds. The system of urban spectacle is very real. The use of slave labor in that is certainly a part of it. So the movie actually gets some really important things about that right. That makes it totally forgivable that it has to create a kinda high politics storyline.

Dwarkesh Patel
Okay, I think that covers all the questions about Rome. We can get back to your most recent book about human history and plagues.

What do you make of the general argument that people have often made that we were living in a sort of Eden before agriculture? Especially given you've explained that all these diseases that we're sorta stuck with are actually quite new. If we take that perspective seriously, was life before human population exploded and we had agriculture just much more pleasant, at least in comparison?

Kyle Harper
Homo sapiens is 200,000 to 300,000 years old. We emerge in Africa and disperse, multiply, but we spend 90, 95% of our history as foragers. People who are hunter-gatherers, who take energy from wild food sources, rather than sedentary farmers who've domesticated plants and animals and live a sedentary lifestyle where you're enslaved to this wheat or rice, but it gives you reliable calories. That is along with the Industrial Revolution, and then

whatever this thing we're about to go through, the biggest change in the history of our species.

The shift from foraging to farming affected everything. It affected our beliefs. It affected our genetics. We're all basically genetically different, adapted to live in a different kind of environment with different kinds of diets. It affected our societies, it affected inequality, it affected culture in every possible way, and of course it affected our health in really basic ways. It affected our labor regime; doing the same kind of labor over and over every day is very different from running around as a hunter, chasing deer or whatever, which sounds quite nice.

It changed our labor regimes. It changed our diet, most of all. Hunter-foragers tend to eat high protein, high fat-ish diets, with no refined carbohydrates, but limited carbs. It's a very varied, highly varied diet. Sedentary farmers tend to eat more monotonous diets and they tend to be dependent on grains and starches, so a very narrow spectrum for your calories. Changes in labor regime, changes in the diet, and then changes in lifestyle, being sedentary and living in big populations that then puts you in proximity to other humans, puts you in proximity to human waste. Feces are a major conduit of infection. It puts you into proximity to the air they breathe, which is conducive to respiratory diseases.

This transition, which takes thousands of years, is more of a process than an event. It has massive implications for human health, including the infectious disease environment that we inhabit. It's not like hunter-gatherers were living in paradise. The infectious diseases that they had were seriously burdensome, they sucked, and probably most people died of infectious disease. Malaria is a really old disease. Lots of diseases existed in the Pleistocene, in our Paleolithic past.

It's not like it was Eden. There is this idea that the transition from foraging to farming... Jared Diamond called it humanity's biggest mistake. Certainly these changes entailed some things that were not net positive for humanity and one of them is that it definitely increased the infectious disease burden. Simply as our population multiplies and as we're in contact with feces and as we're sharing the air through which respiratory pathogens can spread, diseases are constantly trying to take advantage of this. That's just how nature works. Energy is scarce. Everybody's trying to steal it from everybody else, including microbial parasites.

The disease burden of humans over time definitely increases. The burden of infectious disease on humans goes up over time. Very broadly across these thousands and thousands of years, the diseases suffered by people by the time of the Roman Empire are absolutely much worse than what had been the case in Stone Age times.

Dwarkesh Patel
James Scott has an interesting theory in Against the Grain. I don't know if it originates with him, but he argues that one of the reasons that the early agriculturalists were so successful... And David Reich, if you've seen his stuff about The Yamnaya 4,500 years ago conquering all of Eurasia, but before them, the Anatolian... the initial farmers are the ones who displaced the initial hunter-gatherers across Europe and Asia.

He argues that initial wave was so successful because of these first diseases that the farmers had created the conditions to engender. Basically, the relationship these farmers had with respect to the foragers they were taking over from was similar to the relationship the Europeans had to the Native Americans, where inadvertently, the disease is just a significant player in why you were able to dominate them. I don't know how plausible you find that.

Kyle Harper
I mean, first thing, it's important, I think you were starting to get at this, that there's never a generation of humans that has the opportunity to make this choice once and for all, like, should we stay hunting mammoths or should we become sedentary farmers with basically torturous dentistry and die by diarrhea? This happens over thousands of years through an evolutionary process where nobody can... It's a story of unintended consequences. The mammoth are gone partly because we killed them all.

People start... the first livestock that are domesticated are goats. Nobody says, "Hey, let's become goat farmers." The goats are wild. They're ibexes. People are hungry, and so they start managing them to only kill the males to make sure that they can reproduce, and they start penning them and they start killing the wolves who are trying to attack them. Over very long periods of time, this becomes this tight mutualistic relationship where all of a sudden we're goat farmers. But no generation makes that whole decision for anybody.

That's part of it, is that it's unintended consequences that are made in very incremental steps. Two is, I definitely agree that there's some kind of cultural selection here where the farming groups are simply so much more adapted to extract energy efficiently from the environment. It's all about energy. You want to multiply, you want to grow, you want to survive, it's all about energy. Foragers require huge landscapes to extract enough energy to feed themselves and grow and reproduce, whereas farmers per unit of land can extract such higher rates of energy that then can be, through photosynthesis, turned into edible sugars that we can metabolize.

Those populations are just growing faster, that they quote unquote out-compete the hunter-gatherer population say of Europe that are largely but not completely displaced. Now, on top of that, just the energy story alone is a big piece of it, but then on top of that, you probably do have some kind of population difference in the exposure and possibly even

immunity to infectious diseases. I definitely think that early farmers, the first farming societies that are starting to live sedentary lifestyles where you have aggregations—these are not cities, these are villages—but still, that's more than a hunter-gatherer band.

Your childhood is then going to be constant exposure to a series of pathogens. Those kinds of populations, when they're then migrating into Europe, are probably carrying these pathogens with them that may have had a kind of further effect that on top of just being able to extract more energy and multiply faster, drives up the mortality of the existing populations.

Dwarkesh Patel
Yeah. The point you made about fertility is interesting. I vaguely remember reading that it's not just the fact that the energy density is lower, it's that you're also moving around a lot. Because of that, you're spacing out kids much more so than if you were just in the same place. I think the actual fertility for foragers is sort of like reasonable—I don't know if sustainable is the right word because I don't mean in an ecological sense but more so—it keeps your population constant.

Kyle Harper
Yeah. Don't make me swear, but it's like more like four than six. Because women who are moving with the foraging bands miles and miles on foot on average a day, and also carrying kids, are gonna have very different life history than sedentary populations. That's very clear.

Dwarkesh Patel
One thing I'm really curious about is what effect these diseases through history have had on the cognitive functioning of people. You discuss this in the chapter about more recent history of the great divergence and probably attributed the productivity of Europe that they were able to have public health earlier. But literally going back thousands of years, you mentioned, for example, that Caesar was 5'5" and that was considered tall during his period. Did the same diseases and malnutrition that caused these physical health effects also mean that the average IQ was much lower, because when you're a kid you're sick and that steals away nutrition from brain growth or something?

Kyle Harper
Yeah. Short answer, yes. Long answer, we know that in the modern world, say over the last 250 years, first in Western European societies and their settler offshoots and then more globally and more rapidly globally, there have been really deep physiological changes in the average human. We're talking about populations with distributions. What's happened is really two things. One is there's more energy per capita. People eat more, they eat more calories, and they eat better calories. They eat lots of bad stuff too, but people eat more. Two, the burden of infectious disease has been lowered.

Growth for a human is a very complicated trait that's influenced by genetics. I was never destined to be super tall. But it's also affected by environment, which includes nutrition and what you spend either doing labor or what you spend fighting infectious disease. Infectious disease imposes a huge burden on the body. The immune system is extremely metabolically expensive. If your childhood is spent just fighting infectious diseases, you're going to struggle to invest energy in growth.

There's massive increase in the size of populations over the last 250 years and even though it's an even more complicated trait, this improves people's cognitive abilities. People are smarter. May not feel like it—I think it has rapidly leveled off—but people are more intelligent today than they were 100 years ago. Their brains are better nourished and their bodies spend less time fighting pathogens. I think there's no doubt that pre-industrial populations, and again, populations—so you still have your Isaac Newtons, who whatever infected him as a kid, didn't slow him down—but at the population level, I think there's no doubt that not only were pre-industrial populations shorter, this is just a total fact that we know from their bones, but they probably also, on average, had a lower distribution of cognitive abilities. But with a big distribution.

Dwarkesh Patel
You have a great profile in the book about living in London in the 18th century and just how disgusting it was.

Kyle Harper
It was pretty disgusting.

Dwarkesh Patel
But at the same time, in that city, you were just mentioning, there are these scientists and people with towering intellects who were basically figuring out how the universe works and how to make all these machines and so forth. One answer is just like what you just said: the distribution was lower, but maybe Newton would have had an IQ a standard deviation higher if he was born today. Just seeing that from the small population, you're seeing so much genius. I guess the question is, how could you have had this much of a deleterious impact on cognitive functioning and still had enough spare geniuses to kick off the Industrial Revolution?

Kyle Harper
Obviously, it didn't keep them from discovering some pretty amazing things. So it couldn't have been completely destructive. That's what's interesting about the early modern period in the 17th, 18th century, in particular, is it's sort of this between period where you have the pre-industrial and the modern that are still mixed together in these really interesting ways. The example I use in the book is the very famous diary of Samuel Pepys, who's this

incredible figure and is very close to Newton and that social group and his name is on the first edition of the Principia. These people are this close to each other.

But the stuff that I evoke, I won't say—this is a family podcast—but the stuff that Pepys does, bodily functions, is mind-blowing to us. It's vile and disgusting. But at the same time, right down the way, you've got people who are making the most fundamental discoveries about the nature of the universe and inventing machines that will improve productivity and ultimately economic output. That's what's precisely so weird and interesting about that particular period is you have this kind of mingling of the old and the new.

Dwarkesh Patel
When I had Joseph Henrich on, one of the things he discusses is if you look at... cultural evolution has figured out some remarkable things. If you look at the cuisines of different cultures, apparently the spices they use match the antimicrobial and antifungal properties you need in that particular biome. At the same time, you're reading that part of the book, I'm like, "Okay, I get in some cases, they just genuinely did not have the resources to invest in public health and so forth". But come on, you're just like sleeping in your own vomit and so forth. Why didn't cultural evolution or something like foresight just be like, "Hey, this we can sort of do without"?

Kyle Harper
It's a deep question and what I think we don't think enough about is how, in a really fundamental way, hard are some problems to solve? Some problems are just very, very hard to solve. Even though the incentive is really there, you think, "Ugh, that took a really, really long time to figure out". Even though if you'd only known, it would've made your life so much better. There's tons of trial and error.

The example that comes to my mind is the mention of vaccination. Which is one of the great human achievements, like, of all the public health improvements is the most important one. Public health is never perfect. It's this system of six or seven really critical tools that involve clean water, personal hygiene, vaccines, antibiotics, different kinds of therapeutic interventions or rehabilitation therapy. We still can't fend off all the germs. You have to have all of that and you can sort of achieve this equilibrium state where you mostly have it under control.

Vaccination's the most important one and it took forever to find the first vaccine. It took this huge period of all kinds of weird trial and error, like inoculation with the actual smallpox, which is very, very dangerous. Not vaccination. Vaccination uses cowpox, the lymph of an infected cow, to intentionally cause the immune reaction of humans. Before that, people would inoculate a person with actual smallpox, which is just giving somebody smallpox. You do it through the skin, but you're giving somebody smallpox.

It was absolutely in a utilitarian way, the rational thing to do. It had these horrific death rates. It would never get FDA approval. But in a world where 10, 20% of kids die of smallpox, it's this horrible decision, but you'd be rational to do it. We actually don't know where that comes from. It may come from Africa, it may come from China. It spreads for like a century or more before Jenner discovers vaccination. So it's clearly really hard to figure that out.

Even after Jenner, it's like another 60 years, 70 years before Pasteur kind of systematizes it and says, "Hey, we could do this for everything". Some of these discoveries and innovations are really, really hard to discover. But then the beauty of cultural evolution is that we can store that information, and you and I don't have to figure out any of that. We can go on to the next problem because that's now been collectively stored in the library of cultural evolution. It's known, we don't even think about it most of the time until it's controversial. What a blessing to live after people like Jenner and Pasteur who figured that out.

Dwarkesh Patel
There's this great blog post by the author Slime Mold Time Mold where it's discussing...

Kyle Harper
Wait. Author what?

Dwarkesh Patel
You don't know internet culture, you know, there's a bunch of weirdos out there.

Kyle Harper
I'm in a different world, sorry. What did you call them?

Dwarkesh Patel
Slime Mold Time Mold.

Kyle Harper
You can't just drop that. Like I'm gonna let that one slide. Okay. I got some homework.

Dwarkesh Patel
Anyways, they have a blog post about scurvy and why it took so long to discover, and he was discussing all these sort of... it's sort of an epistemic conundrum because you can use lime and you realize, "Oh, it works". But then if you use lemons, which have much less vitamin C, or maybe it's the other way around, they just work way worse. Then there are certain kinds of fruit which have vitamin C, certain kinds which don't. It's actually hard to figure out what is it if you don't have a mechanistic explanation about how you solve this problem, and I think they had once figured it out and then they lost the knowledge until it was rediscovered again.

But it makes it all the more mysterious that the kinds of things that Henrich discusses forager societies having figured out. Literally, there's this 10-step process for how to process a certain kind of bean so that you don't get cyanide poisoning, and if you mess up any one of those 10 steps, you're gonna get cyanide poisoning. A society just figures out the right taboos and traditions to process beans. But you can figure that out, but this thing which is causing 20% mortality, you only get in the 17th, 18th century.

Kyle Harper
Yeah. We need to think more about the computation that's happening. You said it takes like 10 steps to figure out how to process this one particular kind of food, but I'm guessing it is just really hard to figure out infectious disease. It's a really steep mountain. Once you get up to a certain plateau, then the discoveries come really fast. They become systematic, and they become more fundamental. But it was really hard to get there.

Not that many societies really scaled it, not even within the societies that did. It was just a handful of people at first, but they did get there.

Dwarkesh Patel
Okay, and then asking about where different countries were at around this time. What evidence do we have about what was actually happening in India before the British or the Mughals because it does seem to be this sort of black box in terms of historiography? Do we know if there were these huge plagues?

Kyle Harper
Yeah, it's such a tricky problem. Start with the third plague pandemic in the late 19th century. We know that that's in India. India's a big part of its history. In fact, it's where the plague bacillus is discovered by Alexander Yersin. It's called Yersinia pestis in his honor. A Japanese scientist finds it exactly the same time. Gets left out of the nomenclature.

Dwarkesh Patel
It's a special kind of honor to have the deadliest agent in history.

Kyle Harper
To be the worst pathogen ever; immortality. The plague is definitely in India in the 17th century. We know that from contemporary written records that are pretty unambiguous about the presence of the disease. What we don't know is was it there before that? And if not, why not? Because it kind of actually seems like it's not. At least not in this same explosive way. That's pretty curious.

We don't have a great explanation of that because India's connected to the Central Asian world where the plague is endemic. There's plenty of trade. It would have plenty of chance to move to the subcontinent. So we don't understand that. If you go back even further, that's

the Black Death. You go back even further to the late antique period, it's like a total mystery, and the Indian sources from the fifth and the sixth century are not great.

They're hard to use. This is totally outside my language abilities. They require totally different expertise. I've worked with some people who think that there are oblique references that may be interpreted as epidemic. One of the interesting things is we actually think that the plague moves through India to get to Rome.

This is not definite, but the plague's enzootic, its natural animal reservoir is the Tian Shan Mountains where China, Kazakhstan, and Kyrgyzstan meet, and we can actually identify a pretty small region where the pandemic lineage comes from. We know that it doesn't go overland, so it's not like the Black Death, which goes across the steppe, the Mongol trade networks, military networks carry it. In the sixth century, probably, the plague goes south through India, and maybe the ports in Gujarat or along the West Coast that are still pretty connected with the Roman world, with East Africa, with Arabia, with the Red Sea, that the plague travels on ship across the Indian Ocean, because the Plague of Justinian shows up in the Red Sea.

That is a clue that it probably is imported on this seaborne commerce. But how it got from Central Asia to Gujarat is a hard question.

Dwarkesh Patel
Huh. I know the way we found that the Yersinia pestis existed in these Yamnaya 4,500 years ago is by... Didn't they just find the...? I don't know how, but if you can figure that out, why can't you look at the fossils of people 500 years ago or 1500 years ago and just see if they have Yersinia pestis in them?

Kyle Harper
There's two things. First of all, you have to look. There is at present not nearly the same amount of ancient DNA laboratory work that's happening on remains from ancient India. So if you're not looking, you're definitely not going to find it and people aren't looking.

Secondly, it takes a lot of luck for it to preserve. The DNA molecule starts degrading the second you die, just starts falling apart. Even in the best of cases where we're getting it from... usually, if it's pathogen, you're getting it from the dental cavity. If it's human DNA, you're getting it from the inside of the skull. But it takes a lot of luck for it to preserve because the soil conditions will affect the degradation, the temperature will affect the degradation. Just in a crude sense, heat is bad. That's why there's more DNA, ancient DNA, that's preserved at more northern latitudes so far. But it has as much to do with the fact that people aren't looking. We should be looking, and if you've got skeletal materials from an ancient mass grave in India, call me. We can definitely look.

Dwarkesh Patel
And just to be clear for the context -

Kyle Harper
Ancient, ancient, ancient.

Dwarkesh Patel
Okay, going forward to the future a little bit, speaking of future technology, maybe the one that's more relevant than AI is synthetic biology, and there's a worry that you can potentially create diseases which... maybe the evolutionary gradient is one that is not catastrophic where diseases are incentivized to be transmissible but keep you at a chronic level of infection that doesn't necessarily kill you immediately. Actually, it's interesting why the bubonic plague diverges from that selection pressure, which maybe you can answer. What do you think about the potential that with synthetic biology people can make diseases that have the transmissibility of measles, but also the deadliness of something like Ebola? Is that, given your understanding of biology and whatever, is that plausible given your understanding of biology?

Kyle Harper
Let me start with the plague where I'm a little more comfortable and can say something as a knowledgeable person. I think it's relevant because you said it's weird that the plague seems to sort of evade some of these evolutionary constraints, and it's worth saying what these are. A pathogen is a disease-causing organism, a microbe, usually a virus or a bacterium, but also fungi and single-celled organisms like protozoans that cause disease in a host. They're not trying to cause you disease. COVID doesn't hate you. Plague doesn't hate you. It's just evolution. It's just trying to steal energy or hijack your cells to reproduce its genes.

In fact, it has incentives to try and do that as well as possible while doing the least possible damage. It's always kind of trying to thread that needle or to find the right balance, because if a pathogen just kills you instantly there's nothing to steal and it can't transmit its genes into the next generation. Every pathogen has these basic evolutionary problems. How do I get from one host to the next? And how do I evade my host's immunity, which our immune systems are incredible, for long enough to multiply?

Most pathogens have to explore the space where there are these various constraints, and they find all sorts of weird ways around it. Evolution is really good and really creative, unfortunately for us. The tricks that they find to hide inside your immune system or to fake it out are really wild. There are two reasons why plague is so weird, and we don't completely understand why plague is so weird, but I think there's two basic reasons. One is that it's vector-borne, which means that it's transmitted through another organism that is the intermediate.

Arthropod or insect vectors are really annoyingly helpful to certain pathogens, and most... there's actually a relatively small number of diseases that are transmitted through a vector like this, but they tend to be really nasty, like malaria, typhus. They can kind of get away with it because even if you're dying, a mosquito can come and bite you and transmit malaria to me. Plague is a vector-borne disease. It's very well adapted to transmit, particularly by fleas, but we think also maybe by lice and other biting organisms, but really by fleas. It's really good at transmitting by fleas.

That's evolution. This is one of the cool things with ancient DNA we've been able to piece together at the absolute molecular level, the genetic changes that let it make this protein that have this effect in fleas. It's really weird, it forms this biofilm in the gut of the flea that chokes it and makes the flea feel like it's starving. So the flea just starts feeding and feeding and feeding, and meanwhile it's regurgitating bacteria.

Dwarkesh Patel
Sorry, can I ask a question about that? Why is it the case... 'Cause there are diseases that hijack the flea's mind or ants' minds or something. Why isn't there a disease that makes humans zombies? Is it just the human brain is so complicated that it's like...?

Kyle Harper
Let me come back to this. We can talk about zombies, but we need to wind up for that. Okay, so one, flea- So the plague is vector-borne, and it's really good at manipulating the fleas, and it's just evolution. Two, I said this before, but it's an animal disease. We're like collateral damage. We're totally irrelevant to the really core evolutionary history. The plague just wants to infect rodents. Of course, I'm... it's not really wanting to do this. The plague makes a living, it survives out there in burrowing rodent colonies.

We're like tertiary. It doesn't care at all. It has no evolved incentive to modulate its virulence to be able to transmit sustainably. Plague never sustains itself in human populations. It can transiently infect human populations, but then it always dies out. It becomes extinct, that lineage.

Dwarkesh Patel
And then what is the reason that you have these 1,000-year cycles basically? Why is it not 500 years? Why is it not 10 years? Why is it not... What causes it to go dormant? What causes this to reemerge?

Kyle Harper
You need to ask me in five years because we've learned so much and now this is like the thing that would fall in the category of almost a new question now that we can ask. Now that we have the Neolithic lineages and the Bronze Age lineages, we're starting to piece together this fuller history. But we still don't even totally understand the boundaries of when the

plague is really sort of not circulating in human populations, and what are the factors that cause it to be so explosive. Like, is it evolution of the bacterium? Is there something about the genetics of the lineages that escape from the animal reservoirs that are especially transmissible? Is it human ecology, like, that we put rodents like black rats in the right place to get the disease? Is there something about the climate stress that renders the population...? We don't have a great understanding of like why the plague comes and goes.

That's scary. Connecting it to your other question about these superbugs, what's interesting in the very big picture about the plague to me is the history of infectious disease is like, on the one hand, there's a real core of it that's just basic principles of ecology and evolution. We do certain things in the environment that creates the conditions that pathogens can evolve and take advantage of. But on top of that, evolution is just creative and weird and contingent and unpredictable. It's those little, contingent facts that can end up having these really huge effects.

In the case of the plague, if you were really knowledgeable about the basics of ecology and evolution of disease, you would never be like, "I think that every now and then a rodent disease from Central Asia is gonna wipe out half of the continent". Like, that shouldn't... that's not predictable. That shouldn't be happening. That one's kind of an outlier, but infectious disease is always kind of like that. Tuberculosis has probably killed more people maybe than any other infectious disease. It's like this horrible disease. We don't really understand it. Now we really don't understand where it came from because it doesn't look like it has an animal host before it has humans.

It's just a weird disease. It's just a bacterial pathogen that, in the huge world of bacteria, this one is very good at hiding. It gets in your chest and it just lurks. Then it'll just waste you away, particularly if you're poor and you're stressed. There are some core principles there, but then it's just something weird about it. It's just this terrible luck that makes it what it is. To me, there's going to be another pandemic, maybe bird flu, maybe something else.

But it's the real outliers and the weird ones that we should maybe worry about a little bit more than we do. If you want to go to zombies, I'll go there. You don't have to twist my arm too hard. But like prion diseases or fungal diseases where we don't have nearly the same infrastructure and level of knowledge, biomedical research as we do for bacterial and viral diseases, if we create the incentive, evolution is gonna find some weird ways to exploit it. It's not just transmissibility and virulence. Those are like two really basic parameters.

When you look at even COVID-19, part of what made it insidious is it just has just the right parameters to be latent for just long enough. The first COVID, SARS-CoV-1, 2003, slightly more virulent, and in fact, it was just more virulent enough that it made you sick pretty quick. Just that little difference was enough to contain it because you could figure out who was sick. COVID-19 was impossible to contain because it took several days before you really

presented with clinical illness. It's just that little quirk that made it totally impossible to control through non-pharmaceutical interventions early on.

Follow that train of thought... if pathogens are going to find ways to take advantage, and there may be pathogens that push the limits on latency, it can be very hard to control. One of the takeaways or the big evolutionary history of our pathogens is evolution is very weird, very contingent, very creative at exploiting whatever weakness we give it. It's because there are billions and billions and billions of microbes in this room. I don't know how many tens to hundreds millions of species of microbes are in this room. Most of them are not even remotely pre-evolved to be pathogenic, but lots are and they're constantly seeing if you managed to lock that door. They're just looking for a way to break in.

Dwarkesh Patel
Okay, just a couple more rapid fire questions for you. Have you found tools like Deep Research useful for especially your kind of work where you just have to compile insights from many different fields? If we throw in a question, the kinds of questions you honestly investigate and now maybe they can rely on you as a citation for those particular questions about what effect did climate have on the fate of Rome or something... But if you just had a different question which maybe you would write a book about in the future, how well do they do at synthesizing this kind of literature and coming up with a thesis the way you do?

Kyle Harper
Yeah, amazing. But not yet completely displacing or totally threatening the kind of work that a historian does. But at this point, I can't even conceive of what a research project would look like without using AI.

Dwarkesh Patel
Really? Oh, really? That fast it's become so central to your work?

Kyle Harper
Yeah, but for just like, it's just like a constant conversation partner when you're doing research, when you're writing, you know, you can go back to that PDF and ask whatever, "How many species are there in this taxon," or you can just ask the AI. You still have to check it, but it's getting obviously more and more reliable really quickly.

But I think it hasn't yet... in some of the deeper research, it's not the equal of humans yet, and then in the synthesis, it's really not. There's still that creative element of synthesis that's... where conceiving of the question is as important as the answer. It doesn't feel like it's right around the corner. But it's changed.

Dwarkesh Patel
Have you used Deep Research?

Kyle Harper
Oh, yeah. I started using it like two weeks ago or so. I don't know how long it's been around? Somebody told me about it.

Dwarkesh Patel
It's not that much longer.

Kyle Harper
Okay, somebody told me about it less than two weeks ago. Yeah, it's incredible. I mean, it's really incredible.

Dwarkesh Patel
Yeah. Now, I want to touch on your next book that isn't out yet, The Last Animal. One question I have is basically how worried should we be about extinction given that we're on the cusp of technologies which will make it possible for us to reanimate many lost species? I assume if we have their genome or something, our descendants will be able to make more wooly mammoths and saber-toothed tigers and so forth. Should we discount the value of endangered species as a result?

Kyle Harper
I would say no. We should still be concerned with extinction for a couple reasons. One is, absolutely this is a legitimate, serious scientific field to understand the genomics of extinct animals. There is small but serious enough science of de-extinction. It's feasible that some organisms could be targeted for serious de-extinction efforts.

At the same time, a couple of thoughts. One is, I'm not that optimistic that it will work, not because I think it's necessarily impossible, although it's not yet totally feasible, particularly for animals that don't have very similar modern descendants. It's because a species isn't just a genome. A species is an organism that inhabits a food web and an ecosystem. We could bring the wooly mammoth back, but there's nowhere for them to live. The mammoth steppe that they need to thrive is not there.

There's really very little point in bringing an animal back from extinction just to put it in a box at a zoo to satiate our curiosity about it. Without the ecosystem, you can't have the species. One of the themes that I try and get at in the book that I'm trying to finish is, we need to think about living systems, ecosystems, and the extinction question is very much a question of what kinds of systems will exist on the planet? Whatever happens technologically in 100 years, 1,000 years, the impacts that humans have on biodiversity is gonna be very long-lasting.

We're part of a species that has been impacting biodiversity for over 10,000 years, and there are things we can't undo. There are things we can't change about the past. We're making

decisions right now that will be binding on the future whether our descendants like it or not. We need to think very hard about what choices do we want to make to keep intact the kind of variety and vibrancy of living systems that in 1,000 years, 10,000 years, that will be a huge part of our legacy. The impact that we make on the stream of macroevolution will be one of the really big things that our species does. It can sometimes be very hard to recognize that in our individual lives, but collectively, it will absolutely be part of our forever legacy on Earth. We need to think very carefully about the choices that we make.

Dwarkesh Patel
I think that's an excellent note to close on. Just to plug one more time, we've been discussing Plagues Upon the Earth, which is the history of disease going back through the Neolithic to modern times, Fate of Rome which discusses the plagues and history of the Roman Empire considering climate and biology. We also discussed, what was the name of the book on slavery? Slavery in the Late Roman World?

Kyle Harper
Slavery in the Late Roman World.

Dwarkesh Patel
Yep. And the upcoming book is The Last Animal.

Kyle Harper
The Last Animal.

Dwarkesh Patel
All linked in the description below. And where else can people find you?

Kyle Harper
In your descriptions. That's it. I'm not on social media, sorry.

Dwarkesh Patel
Okay, got it. Well, you can find him here on this podcast.

Kyle Harper
Yes, exclusively.