The Great Simplification

Tom Chi (00:00:00):

The reason that people try to follow fashion in season is they hope to connect with other people. They're hoping that through that consumption they get to connect with other people. But what if we skip those steps and just start to understand those are the two main things, let's go build an economy around doing those two things really well, and then let's do that for the keystone species as well? And if that's all we did, we'd be in pretty good shape.

Nate Hagens (00:00:25):

I'm pleased to introduce Tom Chi to this podcast. Tom has worked in a wide range of roles, from astrophysics researcher to Fortune 500 consultant to corporate executive developing hardware and software. He's played a significant role in established projects with global reach, such as Microsoft Outlook and Yahoo Search. Tom was also one of the founding members at Google X, developing technology such as Google Glass and Google self-driving cars. His current focus is much wider than these issues I just mentioned. He's delving into human development with social entrepreneurs around the world. His new project is a climate green tech fund called At One Ventures. We discuss his worldview, his philosophy, the great ask of humanity ahead of us in the next century, his successful investment techs in the green sector. This guy has a big heart and a big mind. And this was another fire hydrant full on conversation. I hope you enjoy it. Please welcome Tom Chi. Hey Tom, great to see you.

Tom Chi (00:01:54):

Hey. Good to see you, Nate.

Nate Hagens (00:01:56):

Tom and someone else you have on your lap.

Tom Chi (00:01:59):

This is my cat.

Nate Hagens (00:02:03):

Frank was with me a few minutes ago, is no longer. He went outside. Tom, I will start with an admission of sorts or a self-reflection, self-observation. You and I were at a dinner four or five years ago and I immediately was impressed by you and liked you. But I was thinking to myself, "This guy doesn't get it." And you and I were at a dinner a few weeks ago and I talked a lot with you about your projects and what you're doing, and I had a realization that maybe I am the one that doesn't get it. I hastily scheduled you to be on the show and I want to unpack a lot of your ideas, your ethos, your work, and I'm really looking forward to this. Let's start at the big 60,000-foot aerial view. In one of your talks in the last couple years, you explain your vision of the future, what you break down into three epochs. Could you explain what these are and why they're important and how you see them progressing?

Tom Chi (00:03:12):

Yeah, absolutely. And the context for this is at our annual meeting I give a talk to all of the investors in our funds and our firm. I run a venture capital firm called At One Ventures. The purpose of the firm is to help humanity become a net positive to nature. A affirmative goal that we actually want to move toward as opposed to thou shall not exceed 1.5 degrees C, which is a very different goal construction psychologically. A whole different topic really.

Nate Hagens (00:03:45):

When I saw your email address and your company's name, I thought it stood for Atone Ventures like we're atoning for wrongs.

Tom Chi (00:03:54):

Oh, actually that's on purpose. The way it's spelled out is At One Ventures like being at one with yourself, nature and the universe, and that is part of the goal. And being at one with things like with the greater totality of things is very central to a lot of eastern spirituality, whether it's the idea of the Tao or many other phrases, Chi, all that kind of thing. And then atone is actually very central to western spirituality where there's original sin and atonement and forgiveness and all these sorts of things. At the end of the day, I do think that there is a spiritual core to one's work because if you only try to use capitalism as your moral guidance, there's a lot of bad places you can

end up. It's helpful actually in the name to go evoke both of the large spiritual traditions on planet earth and yeah, kind of on purpose.

(00:05:04):

But yes, with all that context then the subject you're talking about is some framing that I did on what it looks like for humanity to become a net positive nature. And one thing that I tell our LPs is that that's a big project. It's a project that'll probably take 200 to 500 years. And I don't know that very many venture capitalists are basically saying, "Our mission will not be accomplished in this lifetime or the next three generations." But I'm a physicist as well, so I'm very used to what it takes mass energy flow wise for things to go change their state. The cryosphere is in a bad state. If everything was fixed, it'd take at least 50 years for the ice caps to refreeze into some sort of stabilized position if not a bit longer. Even if everything was already fixed right now, it would be a half century to get to the actual moment of repair even if you're on a good trajectory of repair.

(00:05:58):

I think it's useful to take the step back and start talking about things on that type of timescale. And the arc that I built for them was this idea of three different epochs of ecological technology that we will start on the ones that are closer to us right now, we can actually do a huge number of our investments will be in that first epoch, but we can build toward a powerful visionary one, which is actually where a lot of the economy gets redesigned around that idea. And it puts us in a spot where the basic function of the economy helps humanity become a net positive to nature. But one doesn't redesign an economy overnight. An economy doesn't take a different form overnight, so even that project would take 50 years even if everybody was totally on board and wanted to go change how all these systems worked.

(00:06:48):

That's why to think in those time scales, but jumping right into it, epoch zero is where we are right now and doesn't count that much. And it's actually the one that people are most familiar with, and actually you do a lot of talks about which are the failings of an extractive economy. But I'll mention it very quickly because one way to go understand why economies become what they become is to go look at what are the axiomatic ideas inside of that economy? Inside of the extractive economy, if you can

go extract more resources and less time, if you can clear cut that forest faster, then that is you getting financial leverage. And in fact, we have built generations of machines that can go take the resources, whether it's grown resources or mined resources, take them out of the planet faster and process them faster and then make them into board feet or mineral stocks of various types and into primary manufacturing, all that kind of stuff.

(00:07:53):

And if that's your underlying principle for how you get financial leverage in an economy, then of course you're going to create an economy where the further success of the economy is the direct detriment to the natural environment. And I say that the current economic design is either oblivious to you or actively against the health of the biosphere, and that's why it basically can't continue forever. But let's not spend that much time on that. Let's get into the first epoch. The first epoch is called material productivity. And instead of doing the flat idea of let's maximize GDP or let's extract resources as quickly as possible to go make the most money in the least time, then its guiding principle is more along the lines of understanding that we live on a planet that doesn't have literally infinite physical resources. There are some things that are infinite and we will get to that in a little bit, but it does not have literally infinite physical resources.

(00:08:55):

The material productivity economy asks a slightly different question, but one that highly overlaps with the existing economy, which is what is the maximum GDP that I can get for a ton of feedstock? What's the maximum GDP that we can get for... If pollution must be created in this industry, what's the maximum number of GDP economic benefit, human benefit that can be created if you have to have a ton of pollution? Right now, we don't ask those sorts of questions, so we're actually very inefficient with those things. But to give you a sense of how much room there is, if people really decide to be skillful around the use of materials, well, you think about it, if you go grab a chunk of sand, let's say I go and grab a kilogram of sand and I go sell that to the construction market, it's pennies.

(00:09:47):

It's literally worth almost nothing. But if I take a kilogram of sand and it becomes advanced chips that go into GPUs or new AI processing units or fast multi-core processors, that same kilogram of sand might actually have $10,000 of economic value. Now, the difference between a couple pennies for the kilogram of sand in a construction context versus thousands of dollars in a semiconductor context basically shows the same material. And I know that semiconductor sand can only be grabbed from particular places, it's fine, but the same core material in terms of what it is, silicon dioxide largely can become something that is literally thousands to millions of times more valuable. And that's getting a lot more material productivity out of the same kilograms of feed stock.

Nate Hagens (00:10:47):

But isn't the material productivity the same? It's just the incentives or who's getting the benefits is different because someone now is paying pennies for that sand and having it worth thousands of dollars if they turned it into chips?

Tom Chi (00:11:07):

No, because there was a point in the economy that sand could never be worth more than pennies. So many inventions need to happen in the course of finding the new echelons of material productivity. But once the stuff is invented, you can't uninvent it. You can decide not to use that type of production in the future, but we know how to do it at that point. And back then, if you go back to before we knew how to do those things and you challenge somebody to take a kilogram of sand and make $10,000 with it, they'd be hard-pressed. I don't know how you do it actually. Actual economic value is being created and you're using the same amount of physical resource to go do it. Now, this is a different type of leverage. In the extractive economy, you want to make the money twice as fast, you cut down the forest twice as quickly, and it's not really giving you orders of magnitude improvement.

(00:12:04):

But if you are very skillful at material productivity, whether it's from the feedstock side or from the pollution side, then you can get a lot more human benefit and outcomes, economic benefit. Actually getting to something really concrete, in our portfolio, we have a company called Gradient. And Gradient, just like every other air conditioner on

the planet, does have some greenhouse gas impact from its refrigerants. And most refrigerants for air conditioners and refrigerators in the world are based off of fluorinated gases. EPA calls them broadly classed as F gases. They're one of the four major greenhouse gases and they're one that is not talked about that often, but they are extremely potent per gram and they also have an insanely long half-life in the atmosphere. It's not unusual for a fluorinated gas, including ones that we use in industry to have a 10,000 or 50,000 year half-life in the atmosphere.

(00:13:11):

Way longer lived than carbon dioxide massive, massively longer lived than methane. Now if you think about the world in very short timelines, then methane proportion gets real big. If you think on the GWP of a hundred, which most of our stats are keyed off of, then carbon dioxide first, methane second. Go down the list. But if you think about a long timeframe, a thousand years plus, then the F gases are the main thing that's left.

(00:13:36):

Anyhow, Gradient is for the refrigerant pollution that is created from air conditioning. We actually use a refrigerant that has 6,000 times less greenhouse gas impact, so you're getting the same cooling tons. And by the way, the OPEX is two X cheaper as well, so it costs you less to run the air conditioner, so you're saving twice as much money or your bill is half as much every single month for the same amount of cooling tons that you're getting from your air conditioner. But in terms of the pollution footprint that you're leaving relative to the refrigerants that you're putting up in the atmosphere because a little bit's always getting out, then we're getting 6,000 times more benefit.

Nate Hagens (00:14:19):

But from a CO2 standpoint, you're not getting a significant benefit, but from a total greenhouse gas over a long time, you're getting a massive benefit.

Tom Chi (00:14:30):

Well, the CO2 footprint is mostly related to the energy use going into the device.

Nate Hagens (00:14:36):

To wherever you live and if you live by a coal plant.

Tom Chi (00:14:39):

And on that one you could say we're not getting a huge benefit, but we're getting a two X benefit, so it's about half as much carbon intensity depending on how carbon intense your specific source is.

Nate Hagens (00:14:52):

That's impressive. Let me ask some questions because knowing the way your brain works, I'm going to have to interrupt so that I understand.

Tom Chi (00:15:00):

Let's do it.

Nate Hagens (00:15:01):

Doesn't the individual and the societal discount rate matter hugely for these sorts of questions? Because if our society totally doesn't care about a hundred years from now because they don't believe in the future or they're too pessimistic or any other thing, let alone 6,000 years from now, isn't this endemic to the human biological condition that we don't see? The future is about as real to us as leprechauns, and does that matter to your investors, to the inventors, etc? For instance, if we had a much shallower discount rate and cared as a culture about 6,000 years from now, the Gradient product you just said would go like hotcakes, and then there's the Jevons paradox, which we'll talk about in a minute. But what do you think the discount rate of our culture affects some of the projects that you're talking about on these different epochs?

Tom Chi (00:16:03):

The reason that it doesn't affect the way that we do this investment in epoch one is because in all of our investments, we're looking for something that's called the triad. Triad is a disruptive deep tech, which is ushering in radically better unit economics, paired with radically better environmental economics, and I would say 95 plus percent of the customers of our portfolio companies, they honestly could care less about the environment. They buy it because it makes them more money or saves them a ton of

money. An air conditioning bill might be $300 in a month during a hot month, it might be $200 in a month in a hot month, it's nicer if it's 80 bucks, it's nicer if it's a hundred bucks.

Nate Hagens (00:16:46):

This company Gradient or this product is two times cheaper than regular air conditioners, and it's over a long timeframe, 6,000 times better from a GHG-

Tom Chi (00:16:58):

Immediately, because right now you would be using F gas-based refrigerants that have 6,000 times more greenhouse gas impact today. But in the long run, the proportion even gets worse because of the long-lived nature of F gases. Upfront it is also cheaper to run.

Nate Hagens (00:17:17):

Well, then the logical next question is two part question. If it's cheaper to run and we're headed into a warmer world and it's a groovy air conditioner technology, A, why isn't that selling hotcakes all over the planet and B, if it does, don't we run into the Jevons paradox rebound effect where people then save money and buy a second air conditioner or they save money and go to Home Depot and buy something to build? That gets beyond the scope of your company and your vision, but we live in a-

Tom Chi (00:17:54):

If they bought 6,000 of them, then sure they would catch up, but there's a point where you win by enough that it's hard to actually create as much damage. But the answer to your first question is it wasn't going like hot cakes initially because part of our investment thesis is to get into these companies before they get to manufacturing scale. And we have a bunch of people on the team that... All three partners have a background in manufacturing. We have a dedicated manufacturing support core, so by the time we're done working with you now you're at scaled manufacturing, so we've been working with them along the way, and it is selling like hot cakes. They got a $24 million preorder to go buy a bunch of units. They just closed another $34 million preorder, so they already have more than 60 million in bookings for a relatively early stage venture. And 60 million is not going to change the planet overnight, but when

your unit economics are that advantaged, then that is eventually going to be the way that we do this industry.

Nate Hagens (00:18:58):

Well, I was just in India, and India is planning to double coal production by 2030, partially because they want to be self-sufficient in energy, but partially because they realize they're going to need a lot more cooling and electricity for air conditioning, so I would think something like this would be scalable.

Tom Chi (00:19:22):

This will definitely have some pickup in that part of the world. It's also going to get a lot of pickup in Northern Europe, places that did not traditionally have air conditioning and now really need it. The orders I mentioned so far are all US and North America based, but yes, we see very strong prospects around the world.

Nate Hagens (00:19:45):

And did you fund this or the inventors invented it with optimizing for CO2 pollution?

Tom Chi (00:19:53):

We're venture investors, so I got into this pretty early. I actually got into it when it was a three person company as an angel investment, and then when the firm started, we warehoused it into the firm and then added to our position and took a little bit more of a meaningful position.

Nate Hagens (00:20:12):

But the inventors of it, the three person team, did they begin by optimizing for CO2 biosphere impact or for cheapness and profitability in the epoch zero framework?

Tom Chi (00:20:29):

They were thinking about both. They definitely wanted to see if we could use a refrigerant type that had way less greenhouse gas impact than fluorinated gases, so that was definitely part of the original invention constraint and premise. Now that said, if we happen upon an inventor that wasn't trying to invent it for ecological reasons, but it still has this massive ecological benefit, we're not going to fault them

for it. We're just like, "Hey, you may not have noted this, but you have created way more material productivity around XYZ. We'd love to back it."

Nate Hagens (00:21:05):

Tom, when you and I met five years ago, relative to today, how many people are you coming across in your position that are those three-person teams or what have you that are really developing products with an eye to ecological sustainability and the longer timeframe?

Tom Chi (00:21:27):

Well, I think the numbers definitely increased. I actually never thought it was actually a small number. I will say that it's been chronically underfunded because we had 20 years of everybody deciding that Silicon Valley venture capital is just software and enterprise SaaS is the easiest way to make the most money for the least amount of money in. But I think we solved a lot of the important enterprise SaaS problems. Not to say that there's none left, but you're now at the spot where it's like, "Hey, this thing is going to optimize your procurement system by 5%." Well, we already have 50 of those. I'm not saying that you can't build a 51st version of that software, but the other 50 we're okay already, so I think we're running out of gas on that. But what it means is that we have a lost generation.

(00:22:23):

The place is called Silicon Valley. It's not called Enterprise SaaS Valley. It's not called Lines of Code Valley. It was called Silicon Valley because we solved important things for the semiconductor revolution. Then we solved important things for the physical hardware of the internet revolution. And then we got into the web software and other things on top of that, and then we got into these overly easy business models around SaaS or advertising, and then everything just narrowly popped into that. But ahead of all this, we had a couple generations of venture capitalists that were very skilled at physical hardware and building physical things, and you can make a lot of money out of it. Those people, they have their names on the side of buildings right now because you absolutely can make money at it.

Nate Hagens (00:23:10):

Before we move off onto epoch two and epoch three, presumably, let me make sure I understand. Epoch zero is business as usual basically. Epoch one is determining how much GDP you could get from a certain amount of scarce non-renewable material-

Tom Chi (00:23:31):

From a kilogram of material or a kilogram of pollution that must be put out.

Nate Hagens (00:23:36):

Given the pollution that has to come out, how do we use the least amount of inputs to get that?

Tom Chi (00:23:43):

Well, how do you get the most GDP for each kilogram of pollution that you make?

Nate Hagens (00:23:46):

Got it.

Tom Chi (00:23:47):

This still makes refrigerant pollution. It's just 6,000 times less impactful, and you're getting the same number of cooling tons.

Nate Hagens (00:23:58):

What comes next then in your longer term framework?

Tom Chi (00:24:03):

Epoch two is the first big leap, and then epoch three is an even further leap. But the first big leap comes from the fact that in epoch zero and epoch one, we were still treating resources as nouns. This forest can become board feet. The forest is a noun, the tree is a noun. We cut it down, we make it into board feet. That's a noun. The first big jump is to actually understand that the resources are there, not because of nouns, but because of verbs. A forest can also be understood as a verb. A piece of land forests itself like a verb. And that comes from having access to the right amount of water, nutrients, resources in the air, and then the right biodiversity around it.

Nate Hagens (00:24:54):

And lack of chainsaws.

Tom Chi (00:24:56):

Sure, exactly. Now the whole point, if you understand the verb to be the locus of where value is being created as opposed to just thinking about that as the noun, as the output of the value being created, then you can understand that there's a different way to get financial leverage by investing in the robustness of the verb. If the verb is incredibly robust, the forest grows quickly, it grows with good disease resistance.

(00:25:28):

We make all these monocrops and then we end up with disease problems for obvious reasons. And then we ask questions later on. It's like, "Why is it so expensive? We have to put all these inputs on the land." You didn't necessarily need to. You didn't have a healthy verb, and because you didn't have a healthy verb, because the only thing that you thought about was the noun at the end of the day, you were focused on the amount of yield that was coming from this land and the idea of a noun. But you can actually get an enormous amount of financial leverage if you invest in the healthy metabolics of the forest so that it is more self-sustaining, more pest resistant, more able to go use the natural resources that are available to it in a skillful way.

Nate Hagens (00:26:07):

Is embedded in your statement you just made somewhat of an oxymoron that you're getting more financial leverage by treating the forest as a verb? Because if you're still focused on financial outputs, then somehow that's not going to jive with ecological stability unless we're at a much lower scale.

Tom Chi (00:26:29):

Well, not necessarily because if you look at the ancient land practices, including a number of indigenous people that actually used a lot of wood for fuel, for building material, for basically a lot of the same stuff, we still use it for actually, then there was practices where there was a lot more selective culling, but actually plenty of culling. And they would go and purposely pull down particular trees that would open up

canopy in order to allow things to go happen on the floor around them. But they were doing it in a skillful way, not just on a monocropped thing.

(00:27:01):

And then they would rotate around the faces of a hill, for example. Over the course of a generation, they would do one full rotation around the hill, and the entire thing that they started with would've grown back even stronger than when they started. In that case, they're basically doing continuous take. You can clear cut and just move sideways and try to clear cut again and move sideways, but you just eventually run out of space, so you end up with a business that might actually integrate to less value creation over time than to skillfully rotate around and do a little bit of investment in the metabolics of the forest.

Nate Hagens (00:27:39):

And what is epoch two called?

Tom Chi (00:27:42):

Well, epoch two is focusing on the metabolics. It's basically understanding the underlying flows of a system as opposed to understanding everything as the nouns.

Nate Hagens (00:27:59):

It's the verbs. Epoch two is the verbs?

Tom Chi (00:28:02):

Yeah, there's a lot of different ways to go phrase it. I think verbs is the simplest phrase for it. The more nerdy term that I gave in the talk was the idea of enriching ecosystem metabolics. And this is actually a point that's worth making because a lot of people are saying, "We're moving into a fully virtualized economy. Everything's digital today and dah, dah, dah, and all the money's going to be made." No. Everything in the economy was either mined or grown. Look around you. Everything that you do, even the things that we're talking on right now, this thing, the screen I'm looking at, all these sorts of things. All of the stuff was mined or grown. If you can go make a bunch of money off of the same device, then great.

(00:28:45):

This is material productivity-wise better. That's fantastic. But you cannot get away. There's no such thing as a virtual economy. You can pretend that the system line stopped there, but at the end of the day, there's a physical substrate that you're working off of. If you understand that everything in the world is mined or grown, then you understand that there were metabolic processes of the Earth that created the opportunity for you to harvest the thing that was grown to harvest the thing that you're getting through mining. And if you start to understand that you can get tremendous financial leverage by focusing on the health of the thing that makes the valuable thing. This is birthing the goose that lays the golden eggs as opposed to hoarding all the eggs that come out or cutting the goose open in order to grab the eggs that are inside of it. We're way closer to that.

Nate Hagens (00:29:37):

Which is what we're doing now. This is the first time I've heard this. Let me repeat it back to you in a way that might clarify. Epoch one is material productivity, figuring out how much GDP you could get for a unit of pollution or a unit of raw material input. But now this is the first derivative of that where you're looking at the ecosystem metabolics and figuring out how much GDP can I get from a stable healthy ecosystem metabolics?

Tom Chi (00:30:08):

That's right. And actually, because you start to work with the metabolics of that ecosystem, then actually nature's on your side. A lot of times in the extractive economy, nature's either against you or at best neutral. It's just sitting there to be taken.

Nate Hagens (00:30:27):

Can you give us an example of Epoch two versus epoch zero? How we are working against nature right now and how that same product or human service might be different in your Epoch two framework?

Tom Chi (00:30:42):

Yeah. Well, there's a couple that I can go share. One of them is actually a very well-known example, which is the water purification of the Hudson Valley and the

water system of New York. And they basically used to have multiple billions of dollars that were going into wastewater treatment. And it's understandable, you're trying to make water for eight, nine million people, so I get it. But then they realized that actually if they went upstream and they worked with some of the landholders to go change a little bit of their land use practices upstream, that it was reducing the amount of water processing that needed to happen downstream by a factor of 10. And it was a very small financial cost for them to go talk with those landholders and be like, "Hey, can you make this tweak? Oh, can you go adjust how you're working on this land in this way?"

(00:31:35):

And they financially compensated some of those landholders as well, but massively cheaper than trying to go solve that problem downstream because basically the natural systems were doing a number of things that the water treatment system would eventually do. Now we call those nature-based services when it happens in this non-financial context. But to give you another one, one of our portfolio companies is called Dendra Systems. They use all sorts of tools like drones and other sorts of robotics and scanning technology in order to massively accelerate ecosystem restoration. Where in the world is eco-restoration a business? Well, it turns out that in the regulated resources market, it's definitely a business. And what it looks like is there's all this mining that we do in the world, and let's say a strip mine goes and there's a strip mine and it covers 5,000 hectares. Well, typically in order for a mining company to keep their mining license after they have destroyed that land, they are on the hook to go restore that much hectarage times a small factor, typically between two and five.

(00:32:47):

If you destroyed 5,000 hectares, you'll be on the hook to restore 10,000 to 25,000 hectares as the repair that you do in exchange for doing all that damage. What they would normally do back in the day before Dendra, is they would hire these super low paid field crews to go out there and hand plant things. And the problem is that a mining site is actually physically dangerous. And also a bunch of people would get heavy metal poisoning just from breathing and touching the soil in that area. It was honestly not a nice work environment in any way either. And they're being paid terribly, small amounts to do eco restorations that were just okay. But what Dendra is

able to do is they're able to fly the drones over, scan the landscape, analyze exactly where to plant things, including what species and what locations as a function of light exposure, moisture exposure so it would require the least amount of maintenance in terms of being able to have to go back to that land and take care of those plants and plant them in the right proportion.

(00:33:58):

And an example of nature working with us is there's this landscape that had been completely destroyed by a strip mine and the ore had been removed. And after the ores removed, they usually put the dirt on the side and they call it the overburden. It used to be called an ecosystem, but in the context of mining, it's called overburden. And then once you've done the thing that you've done, then they just throw the dirt back on and then they try to start ecosystem restoration.

(00:34:26):

If you don't have a good intervention, that becomes a muddy eroded landscape, it might as well be the surface of the moon or if you have anything, it's just some weeds. Definitely doesn't look anything like the ecosystem that was there before. But working with local ecologists, we got advice on what are the sprinter species that we should plant? And by going in there-

Nate Hagens (00:34:48):

What's a sprinter species?

Tom Chi (00:34:49):

Oh, the sprinter species are the ones that in the course of ecological succession, those are the first that actually get established, which then create the foundation that the next set of species can come into the ecosystem and then through a series of phases like that, which is called the series of ecological succession, then you arrive at the ultimate best ecosystem for that spot, which is in ecological terms, called the climax community. This is like the peak of biodiversity that that land at carrying capacity could have.

Nate Hagens (00:35:22):

So the enriching ecosystem metabolics in the Epoch Two is trying to optimize for climax communities in various ecosystems, in a way.

Tom Chi (00:35:32):

I think you'll get it when I share this data point.

Nate Hagens (00:35:35):

Okay.

Tom Chi (00:35:35):

So the ecologists told us what the sprinter species were, and instead of having a bunch of low-paid, untrained people just willy-nilly try to repopulate the thing which has a way lower success rate, we put the right mix of species in the right place and we planted about 15 different species in the right places in the landscape. Now, once those 15 species were in the ground, 18 months later, our survey of the land had 70 species coming up. Now where did all the other species come from? They were in the dirt. The seeds were waiting in the dirt, and because we had put the right foundation down, we were working in line with the metabolics of how that ecosystem wanted to come back, and we massively reduced the time of that first stage of ecological succession. So 15 species actually became 70 species, which were then self-propagating, and then speeding up the pace that the next stage of ecological restoration and succession happened.

Nate Hagens (00:36:32):

Did this, whoever owned the land and got the minerals out of it or whatever, how did this change their cost structure, what you just described?

Tom Chi (00:36:39):

It's way lower with a better outcome, and that's the case of basically, all of our companies, cheaper cost structure, way better outcome, both in terms of performance and massively better outcome in terms of ecological benefit.

Nate Hagens (00:36:53):

How many places around the world is an example of what you just described happening?

Tom Chi (00:36:59):

Well, that particular company is already planted across 20 different ecosystems on four different continents. So I'll tell you many places in the world where we have very concretely done this work and the images relative to the strip mine I'm talking about, were done in dry land moderate elevation, but we also have fantastic restorations that I can show you where we're doing massive mangrove planting, which is obviously the opposite. Very humid, near the shore, partially aquatic ecosystems. Actually, the team is out in Abu Dhabi right now and on planting, during the planting season when they go out, they're actually able to plant about 120,000 mangroves a day with four field operation people. And in that process restore about 83 hectares a day. Now the 120,000 mangroves, once you put it through the actual germination to successful survival to adulthood rate, comes out to about a hundred thousand mangroves that get established per day.

(00:38:08):

So yeah. No, it's a very interesting scale and it's something that, yeah, look, I mean there's a really simple way to explain this. The tools of conservation, we didn't give them anything. You talk with the conservation and restoration folks, they're still using the tools from a hundred years ago like binoculars, little quadrats where they can go count the species inside of a square meter, little clickers to be able to count bird populations and fish populations. They're still using the same kind of stuff we had a hundred years ago and every other industry got to advance and do manufacturing at a thousand x the scale or a hundred x the quality or what have you, and we didn't give any better tools to conservation. And if you spend any of the modern skills on those areas, you'll find that there are 10 X hundred x wins to be had in those areas as well. We just never spent the time working on those tools.

Nate Hagens (00:39:03):

10 x to a hundred x financial returns?

Tom Chi (00:39:07):

Well, in terms of efficacy per dollar in. Now, if that is related to something financial, in the case of regulated resources, it absolutely is related to something financial in that, if a typical mine that we might work with in Australia, let's say, is top lining like $700, $800 million per year. So if they actually have an environmental violation that shuts them down for a month, the cost is astronomical. Now, if you could spend $2 million to go have the ecosystem restoration come through really well, then if you can take the number of down days because of infractions from 40 days to one day, then it massively more than paid for itself.

Nate Hagens (00:39:54):

Okay, I have a lot of questions. So you're implying and your stellar returns of your fund would give evidence to the fact that these technologies are working even without a major change in incentive structures and regulations and things like that.

Tom Chi (00:40:15):

That is by design, those are the types of investments that we back, yes.

Nate Hagens (00:40:20):

But wouldn't the type of technologies that the people you're investing in are developing like be complete moon shots if we changed the regulatory structure and started to price in ecosystem services or externalities or things like that just a little bit?

Tom Chi (00:40:41):

Oh, look, if we did governmental changes and that type of incentive change, then yeah, then the businesses are even more amazing, but everything that we get into actually already has better unit economics, so it's already viable without regulation. And there are some things that we haven't been able to go kick, and some of those things may require regulatory. Like the death of honey bees in North America could be understood as a three-part comorbidity model, and one of the elements, the neonicotoid pesticides, I don't think we're going to be able to find something that has better unit economics than neonic pesticides. Because basically, a one-time application that then gets through the entire plant as opposed to surface applications which need to account for the weather, whether things get washed off and need to be applied

multiple times in the season, blah, blah, blah. Then I don't know how we beat the unit economics in neonics.

(00:41:43):

That said, we did back the first company in the world to develop a vaccine for a number of critical honey bee diseases, specifically bacterial brood diseases, which is one of the other three in the three-part co-morbidity model. It's the diseases, the varroa destructor mite and neonic pesticides. I don't know how to go win against neonic pesticides on a pure economic basis. The vaccine, absolutely is actually getting really interesting kind of financial possibilities for it because it's obviously not only the first vaccine to ever protect honey bees, but it's actually the first vaccine ever developed by humans to go protect any invertebrate and it's actually opening the door to so many other things that we can do that would be economically valuable from it.

Nate Hagens (00:42:32):

Okay. This is all super impressive, as it was when we met a few weeks ago-

Tom Chi (00:42:39):

And actually, that's a good example because that is still in Epoch 2 because the metabolics of pollination are really critical for the health of the planet, and to the extent that we can go work with the pollinators that then give all of this oomph to how the flowering plants and the majority of biomass on planet earth is plants, 80% of all plants are angiosperms, which are flowering plants, so they're obligate mutualists that require a pollinator. So to the extent that you have technologies that really strengthen the pollinators on planet Earth, you are strengthening a huge swath of life on planet Earth and those are metabolics that are on your side. We're not paying for most of that.

Nate Hagens (00:43:19):

So does the enriching ecosystem metabolic framework, is it scale agnostic? I mean, right now, we have a 19 terawatt metabolism as a global human economy. So let's just say that you use tech to make all these things better that you were just describing, and that adds a productivity to the whole system while increasing the ecosystem

health, except that productivity gets turned into dollars and yen and rubles and euros and is then spent on Home Depot and NASCAR and Walmart and other stuff. So is there a decoupling or does that environmental impact at the broader meta scale still happen under this framework?

Tom Chi (00:44:13):

Look, I mean the reason that there's things at different Epochs is if they then go to Home Depot and buy materials, for example, we have an Epoch 1 bet that is about how to massively improve those materials and do it with much less waste and do it at a way lower cost structure. I mean, I can talk about that company if you'd like as well. But so we're trying to hit it on all these different fronts. It is true that you solve a thing here and then you might get some reflow in some other spot, but if you're solving on multiple fronts at once, then it's like, "No, I mean, you'll run into some improvements if you go in this direction too, and you run into some improvements if you go in that third direction."

Nate Hagens (00:44:56):

Well, it's not your job to change the entire incentive structure of our capitalist society. You're just trying to-

Tom Chi (00:45:03):

I'm not changing the incentive structure, no, I'm basically... The incentive structure is exactly what we're working with. These businesses want to make more money. That's the reason that they buy our equipment. That's the reason that they use our materials. That's the reason that they save energy with the things that we ship to them. Yeah, absolutely.

Nate Hagens (00:45:23):

So let's just assume that we stay at today's level of GDP and 19 terawatts of energy are required to power it. If your companies doing these things would scale, then our pollution and our footprint, our ecological footprint, on hurting nature would decline quite a lot because we're using a technology and applying it to improve the metabolism of ecosystems, for example, planting mangrove trees, etc.

Tom Chi (00:45:56):

Yeah, that is correct. And actually, look, we're at the point where even without pricing in the value of nature-based services and all that sort of thing, one of our first big mangrove restoration projects in that company, happened from land that was cleared in southern Myanmar, and the government purposely cleared out the mangroves like, "We're going to start a huge shrimp industry down here, and they're just going to make so much money." In practice, they cleared all these mangroves and there was a large population of folks that were doing subsistence fishing from the mangroves, and those people started needing federal government assistance 'cause they're starving now. They literally took away their fishing and hunting grounds. And basically, it was more expensive for them to pay the folks to not die than it was to just put the mangroves back.

(00:46:50):

Actually, similarly, in Abu Dhabi, they cleared their own mangroves in order to have these particular types of beaches and a particular type of shoreline, and then they found out that hey, stuff is eroding away, and then all of a sudden they were spending billions of dollars dredging sand, and now, instead of spending billions of dollars dredging sand to put their beaches back, they pay us $50 million and we put the mangroves back. So once again, insanely cheaper than what you were already doing.

Nate Hagens (00:47:18):

So instead of boosting labor productivity, you're talking about boosting ecosystem productivity, and yet that's still from an anthropocentric viewpoint, it's boosting the ecosystem productivity for humans.

Tom Chi (00:47:36):

Well, this is the bridge, because at the end of the day, would we have backed pollinators if we didn't need the honeybee economically? Probably not, right?

Nate Hagens (00:47:46):

Right.

Tom Chi (00:47:47):

Would we have put the mangroves back in Abu Dhabi if it wasn't so expensive to do sand dredging and try to fix that only for it to be a temporary fix? Probably not. But this is why I say that some of this stuff is going to take 200 to 500 years. We get to do lots of Epoch 1 bets where every normal capitalist is like, "Oh, I get why that's amazing." Because you're getting same cooling tons for half the energy or you're getting it for a fraction of the pollution or you're getting for… That's very easy for them to understand Epoch 1 bets, and I'm going to say, 75% of our portfolio is Epoch 1 bets, so that makes it very easy, it's like walk up easy for people to understand.

(00:48:28):

Epoch 2, like I said, is the first big leap because we start to talk about verbs instead of nouns, but it's a very powerful position to come from, in terms of leverage. You think about the Archimedean idea of, if I find the right place to stand to get the leverage, the verbs have way more leverage than kind of mucking with the nouns. Now that said, at this particular moment in history, we can only get Epoch 2 bets off if they're half a step away from something that we obviously, economically care about, like pollinating crops that we want to go eat or restoring a coastline that we want people to live on, or we want to do real estate development done. And hey man, that's the world today on that front, I wish some of that stuff was different, but at least one is able to go introduce how much leverage that can come through the backing of verbs instead of nouns.

Nate Hagens (00:49:19):

I mean, this is not your job, but if society had a more longer term or an optimistic view of the future that would enable people to visualize and care about Epoch 1 and Epoch 2, and as we head into, what I call, the Great S implification with potential wars or climate impacts or a financial reset, all of those things actually do the opposite. They steepen people's discount rates, which makes it tougher to invest in and then imagine the things that you're doing, which means that there needs to be kind of a cultural, in a way, explaining your framework of the different epochs.

(00:50:10):

In some ways, that is a parallel and as important project as the tech that underpins it.

Tom Chi (00:50:18):

Well, I think the framework is important because like I said, 95% of the customers of our port co's could care less about the environment. They don't even know that they're benefiting things because they're just going after their own economic benefit. But if at the core of it and the 5% that were looking for something that was more sustainable, they happen upon our companies and they're like, "Oh my gosh, I was just going to do a pilot thing and then make a blog post or a press announcement about it, but this is a better way to do this part of the business. We should adopt it for the whole thing. We shouldn't just do a pilot." So I would say that even if you have a steeper discount curve on time, then these people would, as rational economic actors, would still be excited about the stuff in Epoch 1, absolutely. And remember, Epoch 2 is still way cheaper than dredging sand. Epoch 2 is way cheaper than hand pollinating. Epoch 2 is way cheaper than a lot of the other things that the tech that we're doing at that level is supporting.

Nate Hagens (00:51:22):

And what's Epoch 3?

Tom Chi (00:51:24):

Yes, Epoch 3 is the biggest leap. And in order to go understand Epoch 3, you need to have the foundation of understanding that value can be created and leverage can be created by supporting verbs, but you got to build on that even further. Now, in order to go understand Epoch 3, then there's, I call the philosophical foundation of Epoch 3, the idea that there's plenty of room in the middle, and this is kind of a nod to Richard Feynman. He wrote a paper and gave a talk back in 1959 that was called Plenty of Room at the Bottom. And what he was basically saying is, well, physics wise, we've mostly made things that are kind of human scale or we've made things that are factory scale, or if we've ever made a small thing, maybe like a Swiss watch, we've made some pretty small components in a Swiss watch. Because think about the world up until the '50s, the smallest things we'd ever made. But basically, what Feynman was saying in his Plenty of Room at the Bottom was like, well, with lithography techniques, we actually should be able to make things really, really small. We can actually make denser and denser computation. We could make micro machines, we could make...

(00:52:39):

So he basically predicted the semiconductor revolution, the nanotech revolution, and half of the stuff we still haven't finished yet, but he predicted two huge economic arcs that happened in the subsequent 50 years because the physics basically said there's plenty of room at the bottom to do more value creation at smaller and smaller sizes, as opposed to the Swiss watch being the detail limit for the size of things that human beings were engineering at that time.

(00:53:07):

Now, Plenty of the Room in the Middle refers to the following. So almost all the energy for life on planet earth comes from the sun. There's a little bit that comes from geothermal vents and all sort of thing, but almost all the energy that powers the biosphere is coming from the sun. And a photon will arrive from the sun and it'll spend a certain amount of time on planet Earth, and after a certain amount of time, the energy from that photon will be reradiated back to space in the form of infrared. And the input and the output are always equal. If it didn't, then the planet would just over time, would overheat like crazy. Now, the reason that the planet is warming at all, is because of greenhouse gases. There's just a longer residence time of that energy in the atmosphere before it radiates back out. But it's always equivalent, the amount of energy in and the energy out. And the middle is that time period between the photon arriving and its energy being radiated back out in space.

(00:54:05):

And what I mean by there's plenty of room in the middle is that one can go design an economy around how many organisms are benefited in that middle time period between the photon arriving and the energy exiting the earth's system. Now to make this really concrete, let's talk about some fates to this photon. That photon could arrive on planet Earth, it could hit a rock and it could immediately radiate back out as infrared into space and zero organisms were benefited. Maybe if a lizard lays on that rock later, it'll warm its belly a little bit and like something would benefited, but there's many rocks where that doesn't happen, and therefore that photon benefited nothing in the middle, in that time period between arrival and re-entry of its energy into space.

(00:54:51):

Now, think about a second case where the photon arrives, instead of hitting a rock, it hits a solar panel. Well, now it's going to be part of helping a couple of organisms in that household. So whatever, maybe four people and a dog, great, fantastic. Well, five organisms got benefited because of this photon arrived before it got radiated back out. Now, let's talk about a third example where the photon arrives and instead of hitting a rock or a solar panel, it hits a green leafy plant. Well, now the plant is going to go use that to go synthesize plant sugars that then get fed down into the roots and drive the entire underground ecosystem and all the different critters that live in the underground ecosystem. That plant, of course, it's powering its own body, and if it then gets eaten by an herbivore, which then gets eaten by a predator, which then eventually dies and gets eaten by detrivores and that sort of thing, you might be helping dozens of macro-organisms and many millions to billions of micro-organisms with just that one photon.

(00:55:53):

Now, that's basically saying that the amount of good that a photon can do between in the middle is incredibly elastic. It can get to a very, very large number. And Epoch 3 is called the maximization of diverse nutrient flows because it's built off of two ideas of what life is doing in the universe. If you had to boil the algorithm of life in the universe, or at least the life that we know of in the universe in terms of what it's trying to do, life is trying to savor every photon, savor every water molecule, which is do the most in the middle with the photon, do the most in the middle with the water molecule. What the middle for the water molecule is, is most of the available water in our planet because a bunch of it's locked up in various places, but most of the water that's available to life is part of the hydrosphere where it evaporates off of the ocean and then it rains down over the land and it'll start at a high peak at the top of a mountain or in a snowpack, and it'll run back down to the ocean and between the top of that elevation and the bottom, that's the middle for the water molecule, and there's many organisms that could be benefited in that middle.

(00:57:04):

Now, basically, life is trying to go savor every photon while it's in the middle. It's trying to savor every water molecule while it's in the middle and over time, life works toward the maximization of diverse nutrient flows.

Nate Hagens (00:57:16):

Is this akin to the maximum power principle that says organisms self-organize to best degrade an energy gradient? You don't have an oak tree that has one leaf, which would be maximum efficiency, and you don't have a billion leaves because they would be shading each other and they would cost so much. You have the exact number of leaves to get the most sunlight in the middle.

Tom Chi (00:57:42):

So I think you're talking about that from the particular standpoint of an organism or a species, and that's certainly part of what is happening to go make this macro arc happen. But that principle by itself is not the whole macro arc. The macro arc spans well beyond any species or any time era in the history of the planet. But when one thinks about the maximization of diverse nutrient flows, we likely had life on planet earth, even in the late Hadean. In the early Hadean, it was literally like, the floor is lava. It was pretty difficult for things to live because the-

Nate Hagens (00:58:22):

When was the Hadean?

Tom Chi (00:58:23):

The Hadean was the very first half billion to three-quarter billion year of planet Earth, 'cause there was still a bunch of bombardments from solar system objects, and basically, the whole planet was pretty molten, basically. Conditionally cooled in spots and eventually, cooled down and had a hard crust. And then at the end of the Hadean started the Archean. Now the Archean basically led to a massive proliferation of single-celled organisms across the planet. We didn't have Eukaryotes yet or anything, but we had really simple single-celled organisms, and that is obviously, that's way more life in the middle than when we had the Hadean, right? Almost nothing could live in the Hadean.

(00:59:08):

So that's part of the maximization, but it wasn't quite diverse yet because it was just a couple species of single-celled organisms, or actually, even the definition of species was a little funky back then. But we don't need to get into the minutia here

necessarily, but if you give it some more time, what life wants to do is, continue to go diversify those nutrient flows by making new species that are taking different ecological niches in terms of doing interesting things with minerals that are available, doing interesting things with different forms of energy that are available.

(00:59:43):

For example, like, Hey, I can use acoustic energy to hear things. Well, that's pretty interesting. Well, now I can do more diverse set of behaviors that can then help me do interesting in different niches. That is basically what life is trying to do in the universe, period.

Nate Hagens (00:59:59):

So I can't help but make a simplifying observation from your explanation of Epoch 3. You said that if a photon hits a solar panel, it helps five organisms in a house, but if it hits a green leafy plant, it helps unknown ones in the biology under the soil, etc.

Tom Chi (01:00:18):

It's knowable, it's just such a large number, we don't spend a lot of time counting it. Yeah.

Nate Hagens (01:00:21):

But does that imply that solar panels are not the optimal path for this photon given the Epoch 3 framework?

Tom Chi (01:00:30):

Well, look, it might be the right thing in particular cases, but actually, the punchline is something different, which is... Because there's a lot of discussion around like, okay, do we do donut economics? Do we go into degrowth? I mean even a lot of the work that you're talking about on the Great Simplification is kind of along those lines, like, "Oh, we're in Epoch 0 and it's garbage. We absolutely need less of Epoch 0." So I have nothing against the idea that we need less of Epoch 0. We absolutely need less of Epoch 0, and that leads to the ideas on degrowth and all these sorts of things. But you have to understand that life on Earth, if you follow the algorithm of life on Earth, you don't need less of it. You need more of it. What earth has been doing over these

billions of years, is actually making more life and way more diversity of life, touching more and more niches. That is the algorithm of life on planet earth. And if you wanted to go-

Nate Hagens (01:01:24):

Interrupted five or 10 times with minor and mass extinctions.

Tom Chi (01:01:29):

Oh yes, of course.

Nate Hagens (01:01:30):

But yes, I agree.

Tom Chi (01:01:30):

But even then, we actually have the most diversity of anything in Earth's history now, even after those mass extinctions. We can get set back pretty hard, but we had the Great Dying, we lost 95% of biodiversity at that point, but sprung back pretty strongly. Anyway, the whole point is, that is what life is trying to do on planet Earth, and one can design an economy that can go on forever if you focus on the maximization of organisms benefited in the middle, 'cause you can keep on getting more and more economic benefit.

Nate Hagens (01:02:00):

This is where you go beyond the anthropocentric lens in Epoch 3?

Tom Chi (01:02:04):

That's right, because in the early Archean, the thing would go hit a single-celled organism and it would kind of do its thing. And there wasn't a complex web of life in the soil. There wasn't a complex ecosystem of herbivores to predators, to detrivores or whatever. That type of diversity didn't exist on Earth yet. It basically would receive a little bit of energy from the environment, live its life, and that would radiate back out as infrared. So it actually, life itself was starting at a lower level in terms of how many organisms were being benefited in the middle. But if you give life enough time, it diversifies things which are creating a type of wealth, which we really do experience as

wealth. It's not limited in the same way that mineral extraction or clear-cutting a forest is limited.

Nate Hagens (01:02:57):

One of my recent guests, and I forgot who, was a climate scientist and said, in a three to five degree Celsius world, we actually could have more life on the planet, but it would be cockroaches and jellyfish and bacteria, and it wouldn't have much complex life like whales or dolphins or elephants or humans. So are you saying that the more organisms, the better, or do you qualify by complex life or other metrics?

Tom Chi (01:03:27):

The reason that we would have less complex life is because of how acutely it happens. So if it happens as an asteroid strike or if it happens as human beings like careening the temperature out of control in sub-one thousand years, then yeah, a lot of things are going to die. I mean, things died during the ice ages to interglacial time periods as well, even though that was a way more gradual transition. You gave a thing whatever, 10,000 years to go adjust as opposed to a hundred years. So we will lose a lot of species because of how acute the change is, but if it stabilizes for a period of time, then Earth will achieve a pretty substantial amount of biodiversity. Now, that said, I don't think we should be irresponsible. Like when the Great Dying happened, it basically took easily tens of millions of years, but one can interpret it up to 50 million years for the biodiversity of planet Earth to recover. And I don't know that humanity is wanting to be responsible for wiping out 50 million years of progress.

Nate Hagens (01:04:34):

I think very few people are aware that that is at stake. But let me ask-

Tom Chi (01:04:39):

That is what we are currently engaged in, but yes.

Nate Hagens (01:04:43):

Yeah. So you are a businessman. You run a venture fund. I like the framing of the Epoch 0, 1, 2, 3. Epoch 3 though, is really almost your philosophy, your story about the next thousand years as kind of an Overton window, ethical stake in the ground as a

story. And I think if more people thought of that story, then maybe that would change our values, our consciousness, and maybe our decisions and our investments. Is that what you're hoping for?

Tom Chi (01:05:20):

I actually would frame it slightly differently, which is, in Epoch 3, I'm actually just describing how life works in the universe, and we can end up with an economy that is well aligned with that or not. If we end up with an economy that's not aligned with that, then a lot of death happens and hey-

Nate Hagens (01:05:38):

Yeah, got it.

Tom Chi (01:05:38):

And look, there's many survivable civilizations where we don't get fully in line with that. That's where some philosophical elements of economy design can come in, but the actual underlying thing that's happening, I am describing just how life works in the universe.

Nate Hagens (01:05:54):

So could you visualize and explain that if we, in the coming century, graduate from Epoch 0 to Epoch 1 and we integrate Epoch 2, what would an Epoch 3 human civilization society look like 500 or 1000 years from now?

Tom Chi (01:06:16):

Oh, yeah. I mean, I think we actually have little peeks of it. Because what happens in that sort of, if you are really understanding maximizing the number of organisms that are benefited in the middle, and you start to really go and build an economy around it, it means that you need to be listening to more organisms than we are today. We mostly look at organisms as resources or food or materials for ourselves. That's how we look at organisms. We don't think about, well, what is this organism trying to be? What is a great life for this organism? What would be a maximization of its life experience? Now, that said, we have little peaks of it. People interact with their pets in a very deep

way, and that actually shows that even across different species, we're able to start understanding each other.

(01:07:13):

And actually, I have a cat, and recently, it was established that cats actually don't meow at each other. Cats, it's a very rare thing for cats in colonies to meow at each other. That's not how they communicate. Cats actually developed meowing to talk to us, and that's actually showing that a species can work out like, "Hey, I need to relate to you better, and I'm going to start vocalizing because vocalizing is a way that you guys interact. And by vocalizing, I'm able to interact with you in a more skillful way." Now, in the same way that a cat can have the consciousness to go figure out how to go do that, and because of that install themselves in households around the world, then imagine human beings had some of that same affinity.

(01:08:00):

Look, we do have it going one way with our pets and some of the animals that we care about, and some of the protected species people are very passionate about, and they want to have that deeper connection with. But imagine it was just part of the larger vocabulary that people are thinking about organisms not just as resources, but organisms as other types of sentience that we are effectively wanting to listen to as a process of maximizing how many organisms are benefited in the middle.

Nate Hagens (01:08:31):

So that sounds aligned with a lot of indigenous thinking, but let me ask you a really difficult question, which might be slipping into the minds of some of the viewers. There are now 1.2 billion dogs on the planet or something like that. I'm a dog person. The amount of dogs on the planet outweigh all the other wild mammals on the Earth at this moment. So given your Epoch 3 goal of maximization of diverse species-

Tom Chi (01:09:02):

So we're not winning on diversity yet, 'cause we have such a small aperture for compassion for other organisms. So right now, we have a real small cadre right now, the reason that I know that it can be much larger is that I've seen folks start to build relationships that are a lot more diverse than that. And I live in San Francisco part of the time but I also live in Hawaii. And our old place in Hawaii was next to these

volcanically heated tide pools and because of it, a bunch of people lived along the shore next to wild fish. And actually, one of our neighbors, Joe, basically had a puffer fish that knew her and honestly, loved her. Basically, Joe would come out there and over a couple interactions figured out, Oh, the thing that the puffer fish likes the most is stewed chicken. Nice. So they would have a little interaction where Joe would come out and see if her... And the puffer fish was named Esmeralda.

Tom Chi (01:10:05):

They didn't tell us her name, that's what Joe named her. And basically Joe and Esmerelda had developed this amazingly deep relationship, and because we knew Joe, we would sometimes go over there and hang with Esmerelda and feed them as well. Like Esmerelda could absolutely tell the difference between our different faces and it would go behave differently around us. It actually would have a different personality around us just knowing how we were. Actually closer to home, in that same house, we had a koi pond in the backyard. And between myself and my wife, we have different feeding behaviors. I would look on the back of the thing, and it's like this many koi that weigh this much, here's how much food to put into the water. And I would typically put it in the same spot in the pond just so it would be organized.

(01:10:50):

But my wife when feeding the koi fish, she'd be like, you get food and you get food, and basically throwing food all around, not consistently measured. Just different styles. Anyway, these fish could recognize us from 20 feet away and when I was walking up, they would all swim to the one spot that they knew I was going to start putting the food in. And when my wife was walking up, they'd start swimming in circles because they were excited because they knew they were going to be fed, but they didn't know where the food was going to land.

Nate Hagens (01:11:19):

So, this is all in my wheelhouse of empathy with other creatures. However, from a biological scale perspective, this isn't good for the chicken, the puffer fish. And the farmed fish or cow parts or whatever you feed to the goldfish. I mean, there's a preference of species. So, here's my hard question for you. If we value the relationships between species, between organisms on the Earth, and you're talking about Epoch 3,

500 years from now, a thousand years from now, what sort of human economy could thrive and live like that? Couldn't you argue that the rest of the world and the rest of the species would be better off if there weren't humans?

Tom Chi (01:12:15):

Well, this is really the question of how wide does our aperture of compassion eventually get. If it ends up including a bunch of organisms, then no, actually things might go quite well. And one thing that I noticed from visiting a lot of indigenous lands, is if you look at how a number of things were actually organized in society, because I think we're already well aware that when keystone species are healthy on a landscape, the entire landscape is healthy. You don't need to literally take care of every single critter on the landscape. But if there's half a dozen keystone species on the landscape and they're all taken care of well, then actually the whole landscape is quite healthy, even if that might have 5,000 species on it. But if you go to the Pacific Northwest and you look at the totem poles, the animals that are represented are basically all keystone species.

(01:13:12):

I spent some time with the Ioway tribe, which it's Ioway with the letter Y at the end, this that's where their original lands were. They now live in Kansas because we dislocated them multiple times, but their society was built around 12 different clans, and it was the buffalo clan and the beaver clan and the bison, sorry, the bison's buffalo, and the wolf clan and all that sort of thing. And every single one of those clans was referent to a keystone species. And the purpose of that clan was to be more empathetic to, to understand how to relate to and pay attention to the health of that keystone species amongst other responsibilities. Now, that is an achievable point where a relatively small expansion in the circle of empathy allows you to have incredible leverage over the overall ecosystem becoming healthier and the thousands of organisms as opposed to, the thousands of species as opposed to just the six or 12.

Nate Hagens (01:14:11):

Earlier on this show, I had a Vandana Shiva, Jason Bradford, Andrew Millison and others talk about the fact that we could, with the technology we have today, grow as much or more food without using fossil fuels. But it would require a lot more human

labor input and applied technology, which we didn't know before we had the Haber-Bosch. So, what you're saying is almost the cultural equivalent of that. That somehow along the way, we have the potential at least, it's unknown, that we could morph from extractors to stewards.

Tom Chi (01:14:53):

Well, I'm actually saying something maybe even more hardcore, which is we already worked this out a bunch of times in a bunch of different places. We just, through colonialism, we wiped out a lot of those people. Now, that said, it doesn't mean that we can't rediscover. It doesn't mean that to the extent that any of their cultures are still extant. Because when I was with the Ioway tribe, I was like, okay, well there's the 12 clans, and then the person that was telling me about this history, who is of that tribe was like, yeah, all but three of the tribes have died out, all but three of the clans have died out. And it's like, oh, crap. Right, so yeah, think about the deep wisdom that happened in those nine clans that were focused on, one is focused on the beaver and one is focused on the coyote and whatever.

(01:15:41):

Think of what was lost with those folks. Now that said, luckily there were still three left and I got to talk with some of the folks from those three and the wisdom's there. Now, can we recreate that wisdom? Absolutely. Can we make decisions about how we run some things in society that would allow us to take a little bit more care? I think so. It doesn't sound that hard. But yes, you can get incredible leverage out of that sort of thing. And even like Andrew Millison Vandana Shiva stuff, one thing that I'll say is that what happened with industrial agriculture is that we used to do everything by hand. We used to weed by hand. We used to handle pests by hand, right? So what happened in the 20th century is we replaced manual mechanical labor with chemical labor. But what is actually possible in the 21st century, because I have a background in robotic signal processing, I built very sophisticated robots, you can actually replace a bunch of that stuff again with robotic mechanical as opposed to human mechanical, and you can actually beat the unit economics of input costs relative to chemical.

(01:16:51):

Now that said, I love the work of Vandava Shiva and Andrew Millison, a bunch of the folks that you're talking about, because I think embedded in their work is also more

time with human beings building a more fluent relationship with many of the organisms that I'm wanting the wider circle of compassion and empathy to extend to. So, you get a two-for-one. But I will say that even within the auspices of our current modern economy where people are flipping out that everything's going to robotics and AI or whatever, no, you actually have a moment where you might be able to start back down the right chain, instead of soaking everything in chemicals. Whether it's glyphosate or nitrogen based fertilizers or whatever. You actually start to fix some of that stuff mechanically the way that we used to do human mechanical labor to go do this stuff. And yeah, it'll just be robotic mechanical labor with still compelling or even better economics than chemical.

Nate Hagens (01:17:48):

What happens to the humans that used to be doing the labor that are now replaced by robots?

Tom Chi (01:17:54):

Well, what's actually happening right now in U.S. Farms, at least, especially now that we have tightened up the border, is that a lot of folks are not able to actually even get the full agricultural output of their land because they don't have enough labor available. So, it's the opposite problem at the moment. Look, more than half the food in the world is grown by small landholder farmers, people that are farming like half an acre to five acres, let's say. But I will say that a bunch of those folks, if you do give them a better route, and actually to be very straightforward and connected to personal story, it's like my parents are from rural Taiwan. They were those people as well. They were close to the land, growing rice, growing tea up in the mountains of Taiwan. My dad's family did a bamboo export business because he was born under Japanese occupation.

(01:18:52):

Anyway, so we were exporting bamboo to Japan. But they were those people as well. Now, as soon as they actually had an opportunity to not be farmers, a bunch of them were like, I wasn't trying to be a farmer. This is just how anybody made money in this setting, so we had to do it. So look, there will be a percentage that didn't want to be farmers, and that's fine. Let them not be farmers. That's like my parents. There's a

percentage in the western world where we've tightened down on immigration laws where they can't even manage the fields right, now there's a shortage of labor. In which case there is no resisting the robots. Now, if you have a setting where this actually is displacing people that want to be farmers, then it's a deeper conversation, let's talk about it. But there's so much to do before we got to a head-to-head battle where people want to be farmers and robots are taking their jobs.

Nate Hagens (01:19:42):

So, let me move on to the topic where you and I met on a couple occasions, which is climate change. So, much of the climate research currently is focused on extrapolating business as usual, and our current trends to see that we're going to negatively affect the biosphere and we're headed for warmer temperatures, two degrees, maybe three degrees. Oceans continue to absorb CO2, get warmer and more acidic. You and your work suggests that we could perhaps reverse engineer this practice to figure out specific actions that would result in better climate outcomes. You just mentioned Taiwan and bamboo, and I want to ask you also, is bamboo something I've been hearing about as a regenerative ag sort of thing? So, could you break down how you envision reverse engineering what's happening to climate and some examples you're currently aware of?

Tom Chi (01:20:42):

Well, I think we have, and there's a communications question as well as a practical work question, but I think we've over rotated around just that CO2 number. Now, the reason the CO2 number is important, and it is very important, so I'm not saying it's an unimportant number to track but we literally made everything just about this one number, is that if you focus it just on that one number, then you'll start to see things like huge direct air capture plants as a possible solution. But I did a calculation that the biggest direct air capture plant ever built, it's actually going to have less impact than 200 beavers. And it's like, okay, well trust me, the 200 beavers were way cheaper than the billion dollars that went into making the plants. So whatever, right?

(01:21:34):

That's us missing the point because we got so focused on this one number and we got so focused on how capital can go play with how you move this one number. But

beavers do a fantastic job sequestering carbon because they build dams, and then the river system feeds all this organic material which then goes into the sediment and gets trapped there. Fantastic. That's why a bunch of our oil and gas deposits were historical wetlands. Those are places where you really concentrate a lot of compressed organic material and basically beavers make those wetlands. Now, long story short, we don't think about that because we have such a narrow view of how the system works.

Nate Hagens (01:22:14):

Well, we're like idiot savants that are focusing on one thing and to the detriment of everything else.

Tom Chi (01:22:20):

Yeah, because there's going to be a lot of resources that are extracted to go make that direct air capture plant. And then of course, with that one number in mind, the biggest direct air capture plants, they're focused on, well, I can use this carbon for enhanced oil recovery. In which case they might even be carbon emitting. And it's like, okay, we're super losing the thread here. Now, if we move beyond the price of carbon and I'm not saying that we shouldn't try to do some of those things as well, though honestly, I don't think that we should have a carbon trading scheme. I think we should ramp it down the way that we ramped down CFCs, the way that we ramped down DDT, the way that we ramped down lead and gasoline, all things that happened in the modern era. These were not a super long time ago type things.

(01:23:01):

These are like 1980s, 1990s type interventions. And what that basically looked like is you didn't put everybody out of business on day one, but you made it more expensive to use those substances. And then after a couple of years, you turned the dial up even further, and a couple more years you turned the dial up even further. And by year 10, it was basically impractical to go use that stuff. Now, it meant that the folks that had recently bought CapEx that was still productive, they're like, well, look, we'll change over on year seven. It'll be pretty expensive for us but by then I would've gotten most of the use out of my productive CapEx. But I'm definitely not buying new CapEx in this space. And the people that were about to retire their CapEx was like, let's upgrade

now. Because you might as well upgrade because we're about to start getting penalties on this old CapEx.

Nate Hagens (01:23:46):

So, effectively you're talking about a slow release carbon tax or non-renewable tax sort of thing?

Tom Chi (01:23:52):

Yeah, that basically ramps up. So, instead of a trading scheme where you need to go populate the stuff with credits and then people can disassemble all sorts of things and play all kinds of games on how credits are counted. No, no, no, it's just polluter pays, and polluter pays on a graduated scale that kicks up. And you can't do this on 10 years relative to the carbon economy. It'll take a little bit longer, but you might be able to do this on a 25-year scale in terms of the age out of the productive CapEx related to a high carbon intensity economy. So anyway, long story short, going back to the more basic idea is, look, we over-rotated on carbon and we made it too complicated. It should just be polluter pays and we shouldn't just think about carbon.

(01:24:40):

We should think about the natural ecosystems that are supporting life. Now, if we understood that, we would understand the benefit of beavers in the first place and would've come to us pretty quickly like, oh, if you want to do that and also make your landscape more fire resistant. We're also pretty annoyed with wildfires right now. Well, it turns out that landscapes recover much faster if there's beaver dams in the area because they basically create an area that doesn't burn down, that repopulates the seeds around it, right. So, on many, many fronts like things that we are… insurance companies are retreating and losing billions of dollars because we can't insure any of these landscapes anymore, they're fire prone. It's like, okay, well, you lost billions of dollars over there. You're spending billions of dollars on direct air capture. A beaver would solve both of those problems.

Nate Hagens (01:25:27):

I would be remiss in not asking, are you investing in beavers?

Tom Chi (01:25:33):

I'm not. And this is actually a really important thing, which is why wouldn't we have already done this if beavers are so much better at. It's because it's hard to financially enclose a beaver and the things that get economic scale in the economy or things that are easily financially enclosed. Even if they don't create value, right? A credit default swap doesn't create any value, but it's intrinsically financially enclosed. And NFT is really a financial enclosure, envelope. Nobody even cared about the art inside of it. So, basically financially enclosed things trade quickly, they attract money quickly, that sort of thing. We don't know how to financially enclose a beaver and because of it we have that mismatch. Now, if there was a design problem to go do, it might be to ask the question of how does one successfully financially enclose, but without poisoning how this natural thing works? In order to get more money into the spot to go have these things happen in the world.

Nate Hagens (01:26:30):

Well, and then I don't know a lot about beavers, but I would presume if we scaled the beaver population, 2X, 5X, 10X, that that would be deleterious to some other animal or organism?

Tom Chi (01:26:43):

It probably wouldn't be because when the colonists came to North America, it's estimated that there was over a hundred million beavers in North America in 1600. And now we're down below 5 million. We almost wiped them out. It's actually when the... at the point that the colonists first came over to the Americas, there was about 75 million people living in the Americas and 85 million people living in Europe. And then we wiped them out 95% as well. So trust me, there was plenty of carrying capacity for those things, and the land was healthier because of it. The bison also built the soils on the Great Plains. Now we're at the point when we first inherited the great plains, inherited, I mean, we killed all the people and displaced them, and the Ioway tribe lives in Kansas now. You get it, right? But when we first got there, there was multiple feet of topsoil in the Great Plains. Five feet, eight feet, nine feet, very normally seen. Now in agricultural soils across America, the average topsoil depth is a quarter inch. So, we really mucked it up badly and it wasn't because there wasn't

enough carrying capacity, and the bison were mucking up. No, the bison were creating the carrying capacity. The beavers were creating the carry capacity. That's why they all had clans assigned to them.

Nate Hagens (01:28:03):

Well, we financialized the human experience.

Tom Chi (01:28:07):

Sure, well look, once we've worked out the corporation and a bunch of methods of financial enclosure, then that took over as a virus on everything. And look, I'm not saying that that can't be an improved thing. You can have new mutations and you can have a healthier version of an organism. So, there might be a new mutation on financial enclosure that is able to go include things in this more thoughtful way in a longer term way, and really pay attention to the myriad explosive benefits of taking care of a couple keystone species. Taking care of a couple natural systems.

Nate Hagens (01:28:46):

So beyond beavers, in your work, do you have hope? Are you seeing regenerative technologies that potentially have the ability to pull carbon from the atmosphere in tandem with maybe we cap or eventually slow the amount of emissions that the global economy emits?

Tom Chi (01:29:07):

Well, in terms of the practical stores, there's basically five. It's forest soils, histosols, ocean micro and ocean macro. And all-

Nate Hagens (01:29:18):

What's histosols?

Tom Chi (01:29:19):

... Histosols are wetland soils. So, it's like a special case of soils in that histosols have incredible carbon intensity per acre compared to a grassland soil or agriculture soil.

Nate Hagens (01:29:34):

Okay, five categories.

Tom Chi (01:29:34):

So, when we drain the wetlands, that sort of thing, we really did, and you've seen the math, I'm sure, on when we drain a peat bog and then we go and burn a bunch of stuff. Yeah, the emissions' footprint is insane because that was such a concentrated source of carbon. So anyway, all five of those places in nature can store way more carbon than what we've emitted since the start of the Industrial Revolution. Now that said, we have not been on a task of actually putting any of that stuff back in a skillful way, but one thing I like about thinking about those five sinks, is at the end of the day, one can, so I'm formally trained as a physicist and electrical engineer with a specialization in robotics and signal processing, and my physics brain basically says this is basically a mass transfer problem.

(01:30:24):

We currently have 1.7 trillion tons of CO2 that's in the wrong place. About a trillion up in the atmosphere, about 0.7 dissolved in the ocean. It's all in the wrong place. That mass needs to go to a different place, right. Now that basically is a mass transfer problem. If the mass needs to be transferred and it needs to go through a collection aperture, then there's two ways to approach the collection aperture. You can either have an enormous collection aperture like a forest or fields or wetlands or what have you, or you can have a tiny collection aperture, like a direct air capture plant that you build on one square kilometer of concrete. Now, if you try to do it on a tiny aperture, it's like trying to suck all the carbon through a soda straw. So, if you look at the balance of plant for a bunch of these direct air capture plants, a huge percentage of the energy just spent fans sucking air through the tiny aperture. But if when you work with a huge aperture-

Nate Hagens (01:31:21):

Yeah, those things make no sense.

Tom Chi (01:31:22):

... When you work with a huge aperture, then sunlight powers the whole thing. It typically improves the local ecosystem, which gives you more resilience anyhow, and

then you can capture a huge amount because your collection is so large without forcing any air over it.

Nate Hagens (01:31:38):

So, you're hopeful that we can move the pools of carbon from the atmosphere into those five sinks?

Tom Chi (01:31:47):

Those five things already store more than what we've done since the Industrial Revolution and some of them much, much more.

Nate Hagens (01:31:54):

But can they increase the amount that they store?

Tom Chi (01:31:57):

They can increase the amount if you invest in the metabolics of them. This is part of the reason for the talk as well, right? If you understand Epoch 2, you will understand the metabolics of carbon pick up in these five sinks.

Nate Hagens (01:32:09):

Except what if you have to emit and burn more carbon in order to get the existing carbon back to the sinks?

Tom Chi (01:32:18):

Well, that will happen a bit no matter what, but I think it's really just about the ratio, right. There's some things that give you a lot of leverage and some things… because look, a direct air capture plant captures carbon, but you need to build a lot of facilities for it. A beaver, you don't need to build as much facilities. Did it maybe cost you something to go truck a beaver 300 miles over to some other stream? Yeah, there were some carbon emissions related to trucking the beaver over.

Nate Hagens (01:32:45):

So, is this a core part of your work is looking at regenerative agriculture, negative carbon emission technologies?

Tom Chi (01:32:54):

Well, absolutely. I'm spending time on this and studying. Part of the reason I was out in Kansas with that tribe is they are part of a large project to go regenerate their soils. So, I was looking at both indigenous practice as well as improved regenerative agricultural practice and basically seeing at the ground level what it looks like to go do that. Now, of course, I come from the venture capital world and I work with all these other capital allocators. So, while I'm sitting there, I am thinking about is there a party for which this would be the right thing to point their capital at and how would it mesh? Now that said, these folks are getting done with actually relatively small amount of capital already. So, if capital doesn't need to play, then that's totally great too. But at the end of the day, I'm quite interested in what does it look like for us to do the work practically, and then if there is a way that a tiny bit of financial enclosure helps to speed it up, then let's talk about it.

Nate Hagens (01:33:57):

So, from a practical standpoint, you've looked at lots of different technologies. You clearly know the path we're on with CO2 emissions and the growing metabolism of the human economy. How confident are you that we could move from 425 parts per million to 400 to 375, keeping the economy, I mean, morphing the economy in the direction of Epoch 1 or Epoch 2, but using regenerative agriculture to move into those five sinks? Is it a moonshot? Is it 50/50? I mean, how confident are you that that can actually happen and name a couple of technologies that are promising?

Tom Chi (01:34:40):

Well, I think it can definitely happen. And I gave a talk about the future of agriculture at this event, and one of the folks in the Q&A afterwards was like, but how could it change? You got Monsanto and Syngenta and these huge companies that have these vested interests, and we've been doing this huge unsustainable agriculture, how could it ever change? And my reply was like, hey, we literally just invented unsustainable agriculture 50 years ago. So, why in the world do you think it could never change? I'm not saying that it's easy to change, that it's going to happen in a day, it won't. But I think our scope of imagination needs to be a bit bigger than what happened in the last 50 years must happen for the rest of time. We know that it can't because right

now we keep on burning down our tiny little wealth of topsoil, and you get to the end of that, there's nothing that you can do in this current system. So, the turning point on that is coming soon, whether we like it or not, just as a function of topsoil availability and how viable these farming businesses are right now. A lot of American farming is a money losing business. We can't keep on doing that forever.

Nate Hagens (01:35:58):

So, can you briefly give me a couple of technologies in agriculture that you are really excited about that can draw down carbon?

Tom Chi (01:36:09):

Yeah, so a couple different things. So, one of our companies that is a half unicorn already and they're adding millions in top line quite quickly, the product market fit is excellent, is Monarch Tractors. It's autonomous electric tractors. Now, what's cool about that, well, obviously by being electric, then you're saving all the diesel emissions and also the cost of the energy is about four to five times cheaper in terms of all the work output that you're getting and how much you're paying for the energy in the tractor. It's dramatically cheaper than paying for diesel. So, you see why farmers already like that. But the autonomous part of it means that because we have these labor shortages in American and Canadian agriculture, then they can get a lot more done with the staff that they do have. So, even basic autonomy things like mowing and bailing, and all that sort of thing, well just let the robot do it then, right?

(01:37:11):

Go and have your farmhands go work on higher value per hour tasks, and we're seeing a bunch of adoption. That's why it's like a rocket ship in terms of the demand for that product. And I look at that, the autonomy stuff. Right now we're doing the easy autonomy stuff. Mowing is actually pretty easy autonomy task, though I don't want to oversimplify the complexity of autonomy. Still takes some work but still, it is something that the robots are confidently doing, no problem. As you start to talk about the more sophisticated field operations, that starts to overlap with some of the stuff that Vandana Shiva and other folks are talking about where it's like, no, there actually are ways of, for example, drill tilling as opposed to, well, look, you can have a machine go do that, where you could have a hand go do that. And if you can have the

tractor pull something behind it that is autonomously doing that, then actually you are closing that labor gap.

(01:38:07):

That's what I was saying about we had mostly a mechanical farm economy where it was like human labor, oxen as labor, mechanical plows, all that kind of thing, and then we move to a chemical type farming and we can move back to mechanical, but robotic mechanical. So, I look at this as like, well, not only are you saving people direct fuel costs and people are already excited about that, you're saving them labor costs, but you're also allowing more sophisticated labor to happen for the same amount of money, including labor that would be the right precursors to be able to move into some of the regenerative ag practice. Now that said, there's still plenty of implements to go build. Still plenty of automation routines to go build, and you start at the easy end of it and you work toward the middle, and then the human beings do the sophisticated end for now. But that could be a huge boon in terms of making more sustainable agriculture within reach within the labor fraction that we currently have available.

Nate Hagens (01:39:09):

Do you know anything about bamboo? You mentioned it earlier and I have some friends that think there's a big potential of sequestration if it's scaled in Europe even. Can you speak a minute or two about that?

Tom Chi (01:39:20):

Bamboo grows like a weed. It's a type of grass. It's basically perennial. You don't need to spend a bunch of time planting it. It basically can grow laterally, rhizomatically. So, it honestly spreads out of control. Whenever people say to go plant it in their garden, it's like, oh, plant it in a box that is contained so it cannot go and take over your entire yard. So relative to farming difficulty, I'm going to say not that hard to farm as things go.

Nate Hagens (01:39:54):

But as it grows laterally and upward and fast, it's sequestering carbon, yes?

Tom Chi (01:40:00):

Yes, it's sequestering carbon, and if you go and harvest that and make it into durable goods, then that carbon is stored for a reasonable amount of time, right. I live in a wood frame building that was built in 1911, and yeah, all the carbon in that wood is still right here. Even though it's a biodegradable material that is Earth compatible, and if all the wood in this building was broken down and thrown in the dirt, it would become dirt over the course of a year. Then no, you can go and grab useful building materials and effectively sequester them through use.

Nate Hagens (01:40:29):

Are you looking at any companies that are scaling bamboo or using bamboo in different ways?

Tom Chi (01:40:35):

Yeah, we've looked at some things in that front. A lot of it has to do with the kind of processing technologies in order to go make them more compatible with how people are currently building. Because look, the more wild things, and honestly I love this type of work, are the folks that are really using all the properties of the bamboo, like the flexiness and the way that it drys over time and all sort of thing, in order to make these really compelling woven structures, every kind of thing. Now, that said, that's not how we make most of our buildings in the world. So, to the extent that you can go and take a bunch of thin strips of it and then you can make it into something that's like a big old cross beam, then we like that. We know how to build with that kind of material. So, to the extent that we can simulate some board feet or simulate surfacing and all these sorts of things that we would otherwise use a different building material for, and then make it easily metabolizable by the construction industry. Then yeah, we can pick up a lot more. We can build out the demand side of that pretty substantially.

Nate Hagens (01:41:44):

I don't know how you even have time to do a podcast with me because you're on top of so many things. So as head of a very successful venture capital fund, how do you decide which ecological projects are worth investing time, brain power, and capital into?

Tom Chi (01:42:03):

Well, I mean the reason that we have time is actually really straightforward. Which is even if we hit all of our goals and we raise every penny that we are trying to raise and deploy every penny really well, then we're still going to be deploying less than 1% of the capital that's going into climate and an even tinier fraction of the money that's going into venture. And given that we spend a bunch of time, the reason that the 3 Epochs talk was written was to speak to our LPs. Our LPs in our annual general meeting represent over a trillion dollars of capital under management across the funds that they manage. We obviously get a little sliver of that and that's great, but it's like imagine what happens if a trillion dollars of capital gets to hear messages like this and starts to open up the perspectives of where they can look to get interesting returns.

(01:42:55):

So, I do things like this reasonably regularly because our firm is... there's a lot of things about what we do that I think people have said, oh, that's very visionary, that's very exciting. It's like, great. But I think about myself as a boringly practical person, and I think the reason that I like to go share these things is I'm not trying to go share some funky theory about the future. Number one, the farthest Epoch is just describing how life works in the universe. That's not a new thing that happened. That's just an old thing that's been happening forever that we forgot. So, there's nothing to prove about it. That's just how life works in the universe. It's maximizing every photon. It's trying to maximize diverse nutrient flows. That's just what it does. But relative to the work that I share in investment, sometimes I call myself the anti-entrepreneur because most entrepreneurs are talking about what's going to happen if you give me money.

(01:43:49):

I'm almost always talking about the thing we already did. So, the amount that you need to, the suspension of belief that's required to go understand the thing is very light because it already happened. You can go out to the site, you can see the restored mangroves, you can go to the place where there was a massive outbreak of American Foulbrood, and then it's been addressed by a vaccine. You can go to the places where they're installing a ton of these air conditioners, and they can actually both heat and cool, these air conditioning slash heating units in New York because they have way better energy efficiency, and they also happen to have this fantastic

environmental impact. I think of myself as a boringly practical person that just reporting to people. Well, I know this works because we just did it, and if you want to measure how well it worked, then go ahead and measure it. But here's the headlines and if you want to have some further details on exactly how, then I'm happy to have that because again, that leverage of we're deploying less than 1% of the capital. So, how does the other 99%. The reason I'm dogging direct air captures, we've already spent more than 10 billion on that. And we probably could have just recruited 2000 beavers. It would've been fine.

Nate Hagens (01:45:04):

Do you have any other colorful examples like that you haven't mentioned so far in this conversation? Projects that you're really excited about, whether they work or not, that are novel and cutting edge that you think are cool?

Tom Chi (01:45:18):

If I needed to go summarize the more meta of the beaver point is, I think it would be very advantageous for us, in terms of practical leverage, I don't care what philosophy you build around this or not, to become the keystone species that takes care of keystone species. If that's all we did, we would have amazingly good leverage over the health of the planet. Then that would return to us many multifold, because now the hawks are working for us, and the salmon are working for us, and the coyotes are working for us, and the beavers are working for us. Not because they are actually working for us, because we are opening our circle of compassion enough to understand what they need, and in providing mutual care, then all of us get huge benefit, including the bison, including the wolves, the sea otters. I could keep on going. There's a ton of... Tapirs, whales, everybody.

Nate Hagens (01:46:15):

This segues into a concept that I've heard you talk about, that we are all connected. Not in the sense of mysticism per se, but rather from obvious observations in the world, like you just pointed out. Can you explain how you arrived at this realization and how that affects your outlook and the work that you do?

Tom Chi (01:46:40):

The actual answer is when I was 29 years old, I had built a pretty good career in technology. I was already an up-and-coming executive, but the way I had built that career is I worked under this idea that when problems get hard, I just work harder. That worked fine as an individual contributor, then when I started having people reporting to me, I would do this thing where it's like, "So-and-so's working hard, but they only got 80% of what needed to get done done. Okay, I'll pick up the other 20%." I would go around my team of five, "Okay, you were 20% short? No problem. I'll pick up the extra work. Oh, you're 5% short? I'll pick it up." That worked fine, because I'm a person that has a little bit more than normal capacity. But once I had a thirty-person team, that thing was killing me. I didn't understand that it was killing me, but I had a stress behavior where I would come into work every day, and I would fill up a 24 ounce cup with ice chips, and I would just chew ice in the morning as I worked through my day plan and my early emails and start working on items. What was actually happening is the stress was basically completely f-ing up my insides. At age 29, I had an incident where there was an acute disconnect in my lower GI tract where I lost 40% of my blood in less than 30 minutes. I almost bled to death. I luckily got to the emergency room, and the emergency room, because it was internal bleeding, they couldn't tell what was happening right away. Once they started taking my vitals, it instantly turned from, "I wonder what's happening," to "This person's about to die."

(01:48:23):

In order to keep me from dying, they had to do... A lot of times, "You're short on blood? We're going to do a blood transfusion." I didn't have enough time for that. They did four simultaneous blood transfusions, one in each limb, all at the same time. When that came through, that was not enough, too. They did another four simultaneously, immediately after that. I had eight transfusions just to stabilize, then two more over the night. When I woke up the next morning, the doctor basically told me, "Glad you made it through, because you were about one to two minutes away from irreversible organ and brain damage. You might've lived, but you'd be a vegetable. So yeah, glad you pulled out of it." But what I was actually feeling in those last minutes is my body was already in the process of dying. I can give you a whole explanation on what it's like to die, but in the process of dying, I actually had a very strong feeling of returning, and I was like, "What the fuck is that?"

(01:49:32):

Look, my dad's an atheist, my mom's a Buddhist, so it's not that I have... And look, I grew up in the east coast of the US, so I was exposed to all the American religions and all that sort of thing. I spent some time at bible study or whatever. I know some things about some of the spiritual traditions. No deep expert, but know a little bit about it. My overall worldview was basically a scientific pragmatist, and what would it even mean to be returning? After I ended up living, because the next morning I woke up and I realized a couple different things. Most of a human's body is fluid, most of that fluid is blood, and I had most of my blood changed out over the night, so I was actually more other people than myself that next morning, which is already a head trip.

(01:50:24):

Then the other part was that I had only lived because of the generosity of 10 people I would never meet. A bunch of those things, plus that sense of returning, basically set me out on this quest to be like, "What was that all about? What does it mean?" Now, number one, it did change my life philosophy quite a bit, because when you effectively die once, your fear of death changes quite a bit. Not that I had a really terrifying fear of death before, but afterwards it was none. Not to say that I'm trying to put myself in really dangerous situations, but I know what it feels like to die all the way down to the last little bit, minus the actual crossover point. So I was like, "No guys, it's fine." My fear of it is... And that helps a lot. It's almost like this life, then, is your second life. It's like an extra one up.

Nate Hagens (01:51:18):

You're free rolling.

Tom Chi (01:51:18):

Exactly. You grab the green mushroom and you get an extra life in the game and it's like, "Okay, this is a freebie, man. Free turn."

Nate Hagens (01:51:27):

Now you want to pay it forward to the three epochs.

Tom Chi (01:51:31):

It's a longer process because I needed to actually go and work out what it meant to return. I started to understand that actually, everything that we are made of is basically immortal stuff. What I mean by that is if you look at the decay time of protons, neutrons, electrons, it's substantially longer than the age of the universe. You need to be like a billion, billion times the age of the universe so far, for an electron, before you hit an electron's half life. And Protons even more, and neutron, it can be a little bit less, depending on the setting, but then the neutron just decays into other things that also have super long longevity. So you look at this, we're basically made out of immortal stuff. We're specific pattern configurations of immortal stuff. What, then, is the person? Because where did that pattern come from?

(01:52:26):

Those patterns aren't just in you for that one moment. The pattern that became DNA has had a multi-billion year run on planet Earth, and we're inheriting all of that pattern intelligence. The pattern that is the shape of a human being has got a couple hundred thousand-year history on planet Earth, and we're inheriting all of that. You start to understand that I am just a localized moment of pattern intelligence intersected in a particular way on immortal things. And even those patterns, even though they may not be immortal, are extremely long-lived.

(01:53:05):

What it means is that when you die, you're basically returning to the field that makes all things, including things like you. In some ways it's like, it'll emerge in different patterns. Actually, the same atoms are going to go emerge in different patterns, and they're going to get to do all kinds of things. They're going to be part of a blade of grass and a cat and a flower and a cloud. They're going to be every kind of thing, and they'll also be a bunch of humans in the future, too. So I'm returning to the field that makes that, over and over and over

Nate Hagens (01:53:36):

Powerful. I want to be respectful of your time, Tom, and I have a bunch of closing questions, but I wanted to ask you this. It's a non sequitur to what you just said, but I overheard you when we were together a few weeks ago, telling people that we were talking about space exploration and colonizing other planets, and you said, "We may colonize other planets someday in the future, but it won't be us. It won't be humans."

Could you just spend a couple minutes unpacking what you said or did I hear that correctly?

Tom Chi (01:54:13):

The thing I said is that multi-planetary species is an oxymoron already, because species, at least species as we know them, are organisms that are forward-propagating DNA, and the nature of DNA is to become of place. If we actually settle anywhere for 20 generations, we will speciate. We already have changes in the human genome that have happened in shorter times than that. And we've definitely seen with fruit flies and other things, we can get them to speciate in seven generations. I'm being generous with 20. But if you went to a place like Mars, no matter what you do in terms of, "Let's say we live in bubbles, and we go and make the atmosphere exactly the same as the Earth inside of that bubble, and, and, and… And we try to grow Earth food in particular ways." Well, we're trying to control it and trying not to speciate, but you're on a planet that has one-third the gravity. Species have speciated for way less of a environmental change than one-third the gravity.

(01:55:18):

Given that you spend 20 generations on Mars, we will not be humans, exactly. Now that said, if what people mean is, "We're going to become multi-planetary, and the seeds of our DNA are going to become the species of these other planets," then that could be an accurate statement. But I don't think that people actually have that mental model. They have the mental model of more like the Manifest Destiny, where it's, "The same people that we are are going to go out there and we're going to propagate everywhere." We would need to be insanely lucky to go find something that was Earth-like enough that we wouldn't speciate. This would be gravity and atmospheric composition and availability of resources. A lot of things would need to be similar.

Nate Hagens (01:56:03):

According to my worldview, the extremely unlikely event that we do colonize other planets, it will be the descendants of humans, and in some other hominid form, it won't be homo sapiens the way we are now, because of the conditions.

Tom Chi (01:56:20):

Yes. In just the same way that 20 million years ago, there were no great apes. Our closest living relative back then was a gibbon. Now you look at that, and to get to some of these stars, it might take us on the order of millions of years, when you think about the pace of space travel. So yeah, the distance between a gibbon to us is the distance that these folks would go, and they would probably have speciation on the trip, and then they would have further speciation upon arrival for the setting that they end up being in.

Nate Hagens (01:56:52):

I'm worried about the next 10 or 20 years. If we could segue to you giving advice to people watching this show who were concerned about ecological overshoot, climate, oceans, energy depletion, poverty inequality, financial overshoot, all those things. You are a problem solver and have a different mental outlook than a lot of people I've met in this space. What personal advice would you give to the people watching this program who want to play a role in our collective future but have anxiety and worry about all these trends I just mentioned?

Tom Chi (01:57:37):

Because I'm a physicist, then, I'm intrinsically a realist because you need to look at the physical state of things. I am not happy and excited about the current physical state of things. I'm also very realistic about how long it would take to repair it. I don't think that there's any venture firm or any group of people that, because of wham-bam sort of actions, goes and fix everything in 10 years. Literally, the physics of it, the mass energy, the time it takes for that to propagate is just too long, compared to how ambitious that people want. I say that partially because that's part of where the anxiety comes from. If you think you can solve it in 10 years and you're failing at it, then you will go and you'll work yourself almost to the grave, like I almost worked myself to death, just working harder, trying to make that difference in a short amount of time. If you start to understand that this is a 200 to 500 year arc, and that your generation is going to get to do the first five to 10% of it, and you're going to hand on the next five to 10% or 10 to 15% to the next party and the next party, and you get ready for something that might take five generations, that already starts to be a

psychologically healthier place to come from. Because that is what it will physically take, the time it'll physically take, to solve the problem. If your expectations are closer in line with what is physically possible, that's already helpful. The other thing I would say that is a helpful thing is the other anxiety that's happening is career anxiety, stability anxiety, because robotics and AI are coming to go take all the jobs, and all that sort of thing.

(01:59:18):

I worked on robotics and AI as part of my career path, as well as my university research all the way back to my formal training. I have a decent amount of familiarity with it. What I like to communicate to people is there will be a bunch of jobs in the 21st century, but those jobs will be built around what I call the four Cs, like the letter C. The four Cs are creativity, compassion, critical thinking, and community. These are things that AIs and robotics are not particularly good at. Somebody will go a bunch of prompts at things, and they'll pick the best one out of a thousand, and be like, "It looks like the robot is critically thinking." And it's like, no, no, no. Look at all the other prompts. It was a bunch of garbage. The responses to all these other prompts. It was a bunch of garbage and you cherry-picked it. Actually, you did a creative act in curating that one out of a thousand, that kind of sounds like the machine knows what it's talking about, but hey, we'll put that aside for a second.

(02:00:13):

If people understand that the core of jobs in the future are those four things, then I think particularly things like compassion and community are things that are going to be central to the repair of our civilization. That we got into a spot where everybody was told to hyper-consume in their own individualistic bubble, and it didn't lead to greater happiness for people, and it led to a lot more material consumption compared to the marginal happiness that it might have added. You actually get to a point where it's so much material consumption, you realize that the whole game doesn't actually do it for you, and some people fall into depression off of that. In which case, you've done a lot of consumption and are even worse off.

(02:00:56):

Now, if you start to understand that the jobs in the future, things like community and compassion, are really core to them, that leads you more into connection into being

with other human beings and making meaning in the way that meaning was always made. That process, with way less material resource use, actually leads to way bigger improvements in happiness. There's the Harvard longevity study, where they basically nailed it down to the two big things that make people healthy is healthy life habits, like diet, exercise, that kind of thing, and human relationship. That's it. Those are the only two things.

(02:01:38):

None of those things sound like the latest toaster oven from whatever or what's in fashion this season. The reason that people try to follow fashion of the season is they hope to connect with other people. They're hoping that through that consumption, they get to connect with other people. But what if we skipped those steps and just start to understand those are the two main things, let's go build an economy around doing those two things really well, and then let's do that for the keystone species, as well. If that's all we did, we'd be in pretty good shape.

Nate Hagens (02:02:10):

I'm so glad I had you on the program because I think your job description as a venture capital tech investor... I usually don't talk to a lot of people like that, but you're thinking so many steps ahead that your ethos and your life ethic and your four Cs are actually very aligned with my thinking and that gives me this relational, synergistic feeling that was unexpected.

Tom Chi (02:02:39):

I'm not surprised that a bunch of people would arrive at, "Yes, this is what we need more of," because the lack of it is so glaringly painful. When you're in the din of what a capitalist or consumerist culture is telling you to want, then it's a little bit hard to pay attention to it. But I'm actually almost glad that we burned people out on social media and all these other things, because it ended the dream that more digital consumption is the thing. We had a whole arc around physical consumption, and I think we learned, the conspicuous consumption of the '80s, "Maybe this is not everything." And people pushed back and it's like, "We're going to wear grunge clothes now." Though they sell distressed jeans for 200 bucks now. But whatever, who knows? Which is hilarious.

(02:03:34):

I think we're understanding that digital consumption doesn't drive that much happiness, either, beyond a certain point. Between the two, sometimes you need to… Typically, people don't change until they have absolutely failed at their goal or they have absolutely achieved their goal and realized that it didn't do what they wanted. We absolutely achieved a bunch of physical goals and digital content goals and realized it didn't achieve what we wanted.

Nate Hagens (02:04:01):

Door number three and door number two were closed, and now we're switching our gaze to door number one, which is the four Cs.

Tom Chi (02:04:10):

The one other thing I'll toss out there, which I think is a very important framing for the economic arc, since the Industrial Revolution, is that we spent most of the 20th century figuring out how to strip mine the physical resources of the planet. Now with these digital tools, we're spending most of the 21st century figuring out how to strip mine the cognitive resources of the planet. If we understand that that's the basic arc of what's been happening, then we can get enough distance to imagine a different way that this could go.

(02:04:41):

If you get too involved in the tiny thing, it's like, "Well, this person got banned off of Twitter and that person got pulled back on, and now I'm going to go fight about that." No, no, no. At the higher level, we got multiple companies that are doing cognitive strip mining, that are basically… The sanctity of your thought processes is now intruded with ads and misinformation and on finite resources, which is, how many coherent thoughts can a person have in a lifetime? It's not infinite, because it takes a certain amount of time for neurons to go fire. The signals in your neurons, at their fastest pace, only move 90 feet per second. There's a actual, physical limit to how quickly one can think and how many actual, skilled, coherent thoughts they can have in a lifetime. We're ruining that resource right now.

Nate Hagens (02:05:25):

That's profound, and I understand it. That meta view of social media and technology is important to realize. Couple more questions, Tom. What is your biggest fear or worry in the coming decade? And what is your biggest hope in the next decade or so?

Tom Chi (02:05:48):

The planet has recovered from other mass extinctions, and given enough millions of years, it will get to some state of health. I am not so worried that the planet will forever be torn asunder, because look, we can do some real damage. We could do a Great Dying-type event, and it could take 50 million years for the planet to come back. That would be a real loss in terms of all the amazing stuff that could have happened in that 50 million years. Even if we're long extinct, we could still have that negative footprint in time. I think that's a very bad outcome, but you give that 50 million years and the planet is back. I think another bad outcome is we don't extinct ourselves, but we basically make it so that we only find 11 organisms to be useful, and we have a planet of 11 organisms. That's extreme, but you get it right?

Nate Hagens (02:06:49):

Yeah. Well, dogs and cats would be two of them, and then something else for our food.

Tom Chi (02:06:53):

Sure, right. A bunch of algae in a vat, and whatever for the food. That would be a very sad outcome because that would be almost going back to the Archean. It would just be down to a couple organisms again, and all of the planetary resources in the middle go to just a couple different species that have replicated to no end. We can come back from that, too. Obviously, we went from the Archean to a diverse ecosystem now, but man, that would take a real long time. That's a real bad outcome, as well. And I think the other bad outcome is more of an inner game outcome, that people buy into the types of things that... Because despair only helps the system continue to propagate. The people that would be in despair are the people that want change.

(02:07:48):

If you're already fine with the system as is, you're not in despair that the system continues, but if the system's not changing in the way that you hope, and it drives you

into despair, then the tiny subset of people that really wanted to change, and might have the ability to, are now not in the inner game state that they could actually do it. That's why conversations like resetting to say, "It might take 200 to 500 years," as opposed to Extinction Rebellion, "We got to get it done by 2030, otherwise we're all dead."

(02:08:19):

No, no. That is a setup for despair because it will not be done by 2030. There's no physics way for it to happen by 2030. Now, could you elect better people by 2030? I hope so. Could you pass better policies by 2030? I hope so. Could we already start to make some moves relative to how we do agriculture, industry? Yes, I hope so. I'm not saying we should sit on our hands, but when you set up the psychological frame like that, you're setting up for a lot of very passionate people to fall into despair. That is also a waste of the cognitive resources of the planet.

Nate Hagens (02:08:55):

Bayo Akomolafe said the world crisis is urgent, we must slow down. Or something to that effect.

Tom Chi (02:09:03):

You need to connect with the timetables that things actually do repair on. That's why I mentioned that the cryosphere, the ice caps, take some time to refreeze. Even if you've solved everything, even if we could get the carbon down to pre-Industrial Revolution level, 280 to 300, you would still need over a generation for that to refreeze. That's just what it takes, guys. Actually, going to the very beginning of the conversation, the reason that the tagline for our firm is to help humanity become a net positive to nature is that's a type of goal construction which is the world that you want. As opposed to, our goal construction so far has been thou shall not exceed 1.5 degree IC.

(02:09:51):

The reason I say that specifically is that a thou-shall-not goal is actually very common in human society. Obviously, the 10 Commandments is the most well-known collection of thou-shall-not goals. Psychologically, the problem with thou-shall-not goals is nobody reads the 10 Commandments and is like, "I'm so jazzed about going out and living life." The nature of a thou-shall-not goal is you could literally fuck it up until the

very last day of your life. So it's like, "Everything was great, and I coveted my neighbor the day before I had a heart attack. Oh, fuck. I messed it up."

(02:10:23):

A thou-shall-not goal constantly has you on anxiety's edge. That is not the cognitive frame that we can come from, because the thou-shall-not goal is always on the edge of being broken and you failing, and you are anxious because of that. As opposed to something that you're trying to actively build toward, like a society where humanity is a net positive to nature, where your day-to-day contributions can slowly build up to something that really matters. You're not on the knife's edge all the time.

Nate Hagens (02:10:54):

On that, is that what you find most hopeful in the coming decade, is more and more people coming to that realization and applying it in their lives?

Tom Chi (02:11:01):

That is definitely a hopeful thing because, look, that was in the very first talk that I gave, that kicked off even raising fundraising for the first fund. I gave that talk for the very first time in 2018, in Quito, Ecuador. I've had people come up, all throughout the years as I speak at other events. It's like, "I saw you give that talk in 2019. I saw you give it in 20... It still is in my mind. That's what we need to be working for. Then I changed this about how I did practice, changed that about how I do my practice." And I was like, "That's it."

(02:11:35):

Because we do need to solve these inner game problems. We can't be irresponsible about our goals themselves creating anxiety that's unsustainable. That's an instant fail. Nobody's pushing back on that right now because the goal is still real. We don't want to exceed 1.5 degrees C. But when you formulate it in that way, you're not formulating people, psychologically, for the long run. If it's going to be a long- run situation, like a multi-generational baton race, and you've situated your psychology so you're going to burn out in five years, we're never going to get there.

(02:12:11):

The fact that these ideas are, honestly, so simple, and a lot of what happens in the world right now is fighting around ideology. Most of what I share in the world is either scientifically true or it's one of the obvious ways that a thing should be done. Because look, any civilization that is net negative to nature, even a little bit, let's say a civilization is only 0.1% net negative to nature per year. It still has a thousand years, and that's its death date, because nature runs out. When you take away 0.1% per year, in a thousand years, you got nothing left. Literally, the goal construction is also something that obviously must be true, at some point in human history, otherwise we will not survive. Every civilization that has the opposite goal construction, where it's even a little bit net negative, we'll have a death date on civilization.

Nate Hagens (02:13:01):

That's clearly a threshold filter for your investments and your firm and your own personal ideology is net positive for the planet. That's the first pass.

Tom Chi (02:13:14):

A lot of my talks, they definitely do point at a way of seeing the world, but like I said, most of it is just scientific fact, because that's just how life in the universe works, or that's just how histosols work, that's how bison work, whatever. Or at least, as much as how we know they work. There's honestly no ideology to have other than, "Here's the data, and you could read the papers, and this is our best scientific understanding."

(02:13:43):

When I do assert something about the future, like working toward a world where humanity is a net positive to nature, you can have many other goal constructions, but that one's obvious that if you don't do it, that we're going to have some problems at some point. We're experiencing them right now. The reason that everybody's so stressed is that we're more than 0.1% net negative to nature per year. That's why people are more like, "Civilization is going to have a big reset in 100 years, in 50 years, in 200 years," because it's way more than 0.1 right now. I don't even consider the stuff that I'm sharing like an ideology. It's almost like, "We're going to end up there somehow, because if we don't, then every civilization that doesn't, doesn't end up lasting."

Nate Hagens (02:14:27):

It's a truism. It's a truism.

Tom Chi (02:14:30):

There's lots of ways to label the thing. I almost flip it around where you basically say, "Anybody that doesn't achieve that eventually runs out of gas."

Nate Hagens (02:14:43):

If you could wave a magic wand and there was no personal recourse to your family or your reputation or anything, what is one thing that you would do to change human and planetary futures?

Tom Chi (02:14:55):

It'd be useful for us to remember that the money system was created to go and track value. It's not value itself. That if we realized that, we would start to recognize a lot of places where we were tracking value very inaccurately in the monetary system. But people have found pockets where they can operate like that. And if the goal is money itself, then they're doing great by that standard. But if they all remember that money is meant to represent value and be able to exchange things that represent value, then we would remember we have this mismatch right here in the economy, mismatch right there in the economy, mismatch some other place in the economy. That would be a very helpful realization, and I don't see us quite getting there yet. There are some things that are culturally starting to move in that direction, but it doesn't feel like a breaking-the-ice type moment yet. It feels like a looking around, it's like, "It's real desolate up here, something's wrong. But we're not breaking the ice yet."

Nate Hagens (02:16:03):

This has been great. You are a multifaceted, wise, and intelligent human. Do you have any other closing words of wisdom for our viewers?

Tom Chi (02:16:13):

I don't think there's anything that's that special about the way that I'm thinking about it or the way that I'm doing it. It's very easy to do work in the style that I do it, but the

way that one does it is you pay attention to the nuances of things as opposed to generalizing them. Because when you generalize things, that actually shuts off your brain. Don't generalize, actually dig into, how does it work the way that works? The other thing to go look at is to go understand rates not states, because the state of the world is the culmination of the rates. You can actually tell what is going to happen in the future by understanding which things are working at the highest rates. It's very simple, which is that when the EPA successfully bans something, it oftentimes takes five, seven years to go ban a thing, even after they know it causes cancer or creates this problem in the environment or whatever. It takes them a while to actually get it done.

(02:17:12):

But when that substance gets banned, a chemical engineer will work around it. "Oh, I'll just take this out and replace it with a hydroxyl group," or "I'll double bond the nitrogen and that's a different molecule now," blah, blah. They'll get that done in three months. When you think about the rate of three months compared to the rate of seven years, I can already tell you who wins that race. A lot of things that are broken in society, you actually need to go back to the rates. What are the rates that are outpacing these other rates that is basically making this state? Actually, what's nice about rates is, instead of being overwhelmed by the size of the state… Because once it culminates to the state of the world, it feels overwhelming, and people feel like they can't make any change on the thing. But when you break it down to the tiny rate at the beginning, it's like, " Oh yeah, that rate is very approachable. That's just one human being doing something on a lab bench. Okay, I got it. No problem." And that could be different.

Nate Hagens (02:18:09):

I love that. That makes sense to me. Please come back in six, 12 months and give me an update on the tiny rates that you and your company have changed. Thanks so much for all the work you're doing to make our species and our planet net positive.

Tom Chi (02:18:26):

It's going to take everybody, and it's a multi-generational project. That's also why the firm is not named after me. Who wants to go and work at something named after

somebody who died like 500 years ago? That sounds dumb. It's called At One Ventures because I wanted it to be something that would still mean something in 500 years. Being at one with ourselves, nature, and the universe will still mean something in 500 years.

Nate Hagens (02:18:49):

Thanks so much, Tom. If you enjoyed or learned from this episode of The Great Simplification, please follow us on your favorite podcast platform and visit TheGreatSimplification.com for more information on future releases. This show is hosted by Nate Hagens, edited by No Troublemakers Media, and curated by Leslie Batt-Lutz and Lizzy Sirianni.