

# The Great Simplification

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Jeremy Grantham (00:00:00):

One of the main things in life is purpose. And most people born in the history of man have not had particular purpose other than staying alive. We have an opportunity to not just stay alive, earn a living, feed yourself, but we have an opportunity to change the outcome for future generations stretching out for more or less ever.

Nate Hagens (00:00:31):

Today, I'm pleased to welcome Jeremy Grantham to The Great Simplification. Jeremy, almost 50 years ago, founded the investment firm GMO, where the G stands for Grantham and by societal metrics, he is now a billionaire. Though in this conversation, he corrects me on the definition of that.

(00:00:52):

What an amazing mind. And I long ago followed him because in his GMO research notes, back when I oversaw the Oil Drum, he was writing about phosphorus, and about oil, and about climate change, and integrating lots of the same topics in the biophysical economics field where I reside. It's very encouraging to me to have such a financially successful person almost fully dedicated to environmental causes, particularly climate change, endocrine disrupting chemicals, plastics, population.

(00:01:36):

And I hope this conversation can act as an Overton window or a siren song to more people of means to look at the big picture of how energy humans and the environment fit together. There is no greater story. Please welcome Jeremy Grantham. I have so many questions for you because you are what I might refer to as everything bagel, as far as understanding the human predicament.

(00:02:22):

Not only are you an expert in finance and stock market and conventional investing, but you also deeply care about the environment, including, but not limited to climate change. Let me start by asking you this. We live in a culture that the last generation or so has rewarded reductionist experts like real estate developers or physicists.

(00:02:47):

And we don't really reward generalists who know something about everything and how things fit together other than maybe librarians and in your case, hedge fund managers. So how did you begin your lifelong career interests and how everything fits

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together in multiple subjects? And when and why did you start to integrate specifically energy, ecology, and the environment into your worldview?

Jeremy Grantham (00:03:17):

Well, there are people like us that when confronted with any situation, eventually get around to saying what are the bigger issues that circle around the outside of what we're doing and how do they interrelate? And then gradually, your familiarity expands outwards. And if you're curious enough, you keep on going.

(00:03:47):

And whether you like it or not, you're thereby becoming a generalist because you want to know what causes, what causes, what causes, and you work your way, in my case quite slowly, from the stock market. What drives the stock market? What drives people? What are the big issues? What are the weaknesses of human beings? What are the problems therefore that come out of our weaknesses?

(00:04:15):

And pretty soon, you arrive at nature and then you get into the whole thing about what we owe to nature, what it contributes to our wellbeing, to a true benefit GDP, if you will, as opposed to the actual GDP, which is a list of costs when you get down to it, not benefits.

(00:04:42):

And so onwards and upwards, nature, aspects of nature, limitations, Kenneth Boulding, the finiteness of the world, spaceship, Earth, hurtling through space with only what it has. There are no space stations to go and reload with fuel or torpedoes or anything. You've only got what you've got.

(00:05:13):

And if you think about what rules and regulations you would need for a multi-generational space trip in a rocket, it gives you some ideas of what rules you really should have on planet Earth. And you keep on going until you end up with my self-described job at work, which is underrated long-term problems.

(00:05:40):

And that has been a fabulously rewarding era for about 15 years because they are the things that are really interesting. Obviously, they're the things that really matter and they are bottomless pits. So you'll never know too much. You keep trying and you still

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only know a tiny fraction of the problem. And pretty soon, you're on a podcast with you.

Nate Hagens (00:06:17):

Well, since we both have financial backgrounds, let me follow up with this question. We don't have prices or incentives to solve most of those underrated long-term problems. So I've had a lot of financial people that understand energy on this podcast.

(00:06:40):

And I know a lot of them in my circles. But it seems that the more financially focused people are, the less they're focused on the environment, not so much in your case. How do you integrate what's going on there? Because a lot of financial people are almost to the point of cognitive dissonance, dismissing climate change and other environmental risks.

Jeremy Grantham (00:07:06):

I am absolutely shocked over the last 30 years at how little interest my fellow financial types have throughout the industry in these issues on which our long-term wellbeing absolutely depends. It is cognitive dissonance and it's surprising because some of them are unbelievably smart and yet missing whatever it is.

(00:07:43):

I don't know if it's wisdom or if it's peripheral vision, being wider, but they're just not interested. It is enough for them to become expert in fiddling and diddling with finance and making a lot of money. And I think I have mentioned to you before that I got into finance for a very profound reason, and that was I asked which of my classmates from business school were having the most fun?

(00:08:21):

And back then in 1968 by a very wide margin, the guys in the stock market were having the most fun. And so I thought, well, I don't want to miss out on that. And then I was amazed that I was earning \$12,000 in consulting and up from \$10,000 in a year. And they hired me into the financial business in Boston at 18, and that was the going rate, just 50% higher, 50% higher I might add than they needed to pay me.

(00:08:57):

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I would've gone for \$10,000, forget \$12,000, forget \$18,000. And so that was very much a secondary discovery. They were not only having more fun, but they were getting paid a hell of a lot more money. What's not to like about that?

Nate Hagens (00:09:17):

Well, we're going to get into some of the deeper issues on the environment and endocrine disrupting chemicals, climate change and other things. But let me ask you this, energy underpins the natural world and it underpins human systems. And I think people are starting to understand that a little more.

(00:09:42):

But finance is a layer on top of that because money is a claim on energy and debt is a claim on future energy. So if we're really going to change the extractive growth ecosystem destructing human enterprise, don't the people at the helm of finance need to be the ones to change? Doesn't that have to change somehow?

Jeremy Grantham (00:10:14):

Yeah, we're not going to win what I call the race of our lives without huge government backing and without the governments finding a way to encourage corporations to act more responsibly. And I think we may do that, but we may not. It's a hard call.

Nate Hagens (00:10:44):

Yeah, so we'll get back to that. I want to focus on climate energy and the environment in this conversation, but you were on record recently in your main vocation regarding stock market levels saying that we are in a super bubble. I think most people are aware of you and your acumen in the financial sphere, not in the environmental one. What is a super bubble and why are we in one?

Jeremy Grantham (00:11:17):

A super bubble is typically about two-and-a-half sigma. All bubbles, in my opinion, we had to define them arbitrarily. So we took the historical data and we said every two-sigma event, which is in a random world every 44 years. In the stock market world, every 35 close enough for government work, we would call that a bubble.

(00:11:43):

And we went through every asset class in the database, took us months, and in the end, we had a couple of hundred two-sigma bubbles. There was a handful of

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interesting paradigm shifts that didn't break, such as the whole Indian economy making a phase change from real peasant economy to a more complicated industrial economy. They're exactly the kind of exceptions you might think.

(00:12:19):

Also, oil appeared to go through a paradigm shift back in the first OPEC shock and never regrouped from that level. Whereas the rest of commodities continued down for the 20th century. Oil you could say really was flat slightly up. And that was the great exception and a very important exception. And again, very plausible. You might think that oil would show the first signs of beginning to run out before other things, and I believe it did.

Nate Hagens (00:13:00):

But I saw a podcast with you a few months ago that you say we're in a super bubble now in the stock market, and that's more based on your conventional analysis.

Jeremy Grantham (00:13:11):

Okay, no, everything is critical to what is a bubble, a two sigma. And in the developed world, they all went back to trend, to the previous trend prior to the bubble starting. And a classic bubble is two or three years up, two or three years down. And in the stock market, they've been very well-behaved.

(00:13:43):

A super bubble is kind of much more interesting because that has penetrated through the two sigma territory of a badly overpriced market and continues up. It also has a second criteria. It has to have really crazy speculation, increase in all sorts of financial activity. People have to start thinking that it will go on forever, that it's a new paradigm, that they only worry about missing out.

(00:14:21):

They buy stocks that because they're going up not because of anything to do with the fundamentals. The classic being the meme stocks probably one of the greatest examples in modern times of 2020 and 2021. And there aren't many of these. 1929 was a humdinger. 1972, 1974, the NIFTY 50 was an honorary member right on the cusp. You could put it either way.

(00:14:55):

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2000 was another humdinger, bigger and better than 1929 full of absolutely crazy behavior. The housing bubble was very much a housing bubble, crazy behavior, a three-sigma event, a bigger remarkable breakout of housing prices even than 1929 and 2000 in stock prices. And then once again, in 2021, we had the two-and-a-half sigma and an utterly crazy behavior. I believe if you look at the scale of it, the biggest, most significant crazy behavior in recorded history of the US stock market. And when you look at those, they go back to trend like all the other normal ones, but they cause a whole lot more pain because they distort the system. On the way up, there is a huge income effect and wealth effect. And when they inevitably break, they're always a shock because everyone has locked into the new paradigm. And they nearly always take longer than people think because they're so powerful and they didn't get there by accident. They were driven by some underlying important fundamentals. So there was lots to believe in.

(00:16:24):

But they eventually come down to trend and all but one of them in history go below trend for a while and that creates an enormous negative income effect and has always caused a recession. If you miscalculate, the recession turns into something really terrible like the depression of 1929, like the bitter recession of the NIFTY 50, '72, '74 of the near total financial collapse of the housing bust in '08.

(00:17:01):

And one should expect something pretty bad this time. And we await to see if this follows the pattern of history or whether it is indeed that lovely creature, a new paradigm. But history is not kind to the new paradigm thinking.

Nate Hagens (00:17:21):

So let me ask you a couple follow-ups to that. Your analysis of these super bubbles is based on the concept of mean reversion that we revert to the trend, but the trend of the last century has been one of rising energy access globally. We're now at a 19 terawatt global metabolism.

(00:17:46):

And so your analysis suggests that we're going to mean revert to the trend, but on top of that analysis, there's also peak cheap oil, geopolitical competition for a finite pie and growing ecosystem disruptions. So I think the entire trend line might start to flatten or decline. What are your thoughts on that?

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Jeremy Grantham (00:18:19):

Well, regrettably, you may very well be right. Our last couple of papers began to spell out what we thought the fundamental problems were that could get worse. And I conclude that they are worse and more potentially dangerous than the collection of fundamental surrounding all the other super bubbles, including 1929.

(00:18:52):

We were really ham-fisted in 1929. We persevered in some terrible international trade wars which was unnecessary and destructive. And maybe we will be very clever this time. Maybe we will be stupid once again, who knows? But there is a very dangerous set which you were beginning to describe, but with Russia and China, the Ukraine and the resource impact of Ukraine, Russia, and so on.

(00:19:25):

And with the breaking down of the world in which international trade increased to one in which international trade may very well slowly decrease, going from an increasing efficiency to increasing inefficiency. And with the population profile shifting fairly violently by any population standard, we have never seen a shift of this magnitude going from rapid growth to rapid decline in a 30-year window. And as recently as the early 1990s, you couldn't find people talking about a population slowing down. We were roaring along. And now the baby cohorts are in free fall. They're dropping rapidly and people don't realize that the global cohort of babies is below '98 now, 1998. Though we peaked in about '05, '06 and we've been declining every year, even though African baby cohorts are still going up, on a global basis, the totals going down.

(00:20:36):

And in the developed world in China, we are having in most countries fewer 20 year olds entering the workforce. And that is completely unique and could have very bad consequences. And then we have the resource component. I think my colleague and I are scooped. We've only had one scoop and that was 2011. We wrote a paper, Time to Wake Up: The Age of Plentiful and Cheap Resources Is Gone Forever in which we made the case that of course in a finite world, you would eventually expect that to happen.

(00:21:14):

And there were now finally signs that it was happening. But the final push over the edge had been the amazing and accelerating growth in China's demand for important

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resources. For the last four years, they accelerated to double-digit. They were increasing at over 10% a year in their demand for cement, iron ore, coal, and one or two other things, but not oil.

Nate Hagens (00:21:48):

So you have earned deep respect in the financial community for your long-term success as an investor. But I think I suspect many of your peers still look at money and technology as the driver of the human experience. And may look at your views on commodities and energy and the environment as somewhat malthusian. What are your thoughts there?

Jeremy Grantham (00:22:21):

Well, my thoughts are that Malthus and what he said is a nice complicated topic that we could discuss for a minute or two that for a year or two after our paper in 2011, as we hit the temporary cyclical setback caused by China slowing and global grain weather improving, everyone thought we were entertainingly wrong.

(00:22:50):

And it took a few years before the long-term trend line to clearly be different. The long-term trend line for... We keep a very interesting index at GMO, 33 important equal weighted commodities to study the question what is happening to commodities, not what is happening to oil and iron ore. And those 33 declined by 70% in the 20th century.

(00:23:17):

And yes, there were three spikes, World War I, World War II and OPEC, of course. But in between, they dropped back to the trend line which was declining at just over 1% a year, which accumulates pretty damn fast over 100 years. So a drop in the average price of important commodities of 70%, enormous help in getting rich. And then in 2002, it shifted and the index that had gone from 100 to 30, is back over 90. It has tripled since 2002.

(00:23:54):

This is not the trend that we all grew up on. This is a new world in which we are going to have to come to terms with the finiteness of almost everything. I think for reasonable purposes, there's enough aluminum and iron ore to get the job done. But everything else, most of the metals we think of on the same level with iron ore are a

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hundredth or more often a thousandth as frequent in the Earth's crust as aluminum and iron.

(00:24:32):

I think aluminum is about 7.5%, 8% of the crust, iron ore is 4.5% .and copper cobalt, lithium nickel that we use for batteries and so on, they range from 0.002% to 0.006%. That's the range. And you can take 30 of those important chemicals like nickel and copper and add them all together. And they aren't 1%, they aren't a tiny fraction of iron ore or aluminum, and nobody really gets that. And there are no reserves anymore. China pretty well bled the last great mines of these important, but actually rare metals.

Nate Hagens (00:25:25):

Well, in a convoluted way, the 70% drop in that commodity basket in the 20th century was due to an expansion of fossil armies of hydrocarbons that did the work for us and all those extraction industries, the rise of the machines. So we had more access to oil and that oil and the machines that had powered gave us more access to get the overburden from the mines for copper and nickel and all the things you were mentioning. But you said that that change in 2002, I think 1999 was the all time inflation adjusted low for oil. And we've been going up since, and the extraction cost for oil have tripled since around that time. So we are in a new paradigm. There's just maybe a two decade lag before people start to notice it and puzzle it out.

Jeremy Grantham (00:26:24):

I agree.

Nate Hagens (00:26:25):

So do people in your sphere, when you go to hedge fund conferences or whatever those are nowadays, do they start to see the world through an energy lens or is that not yet happening?

Jeremy Grantham (00:26:40):

First of all, I don't do that. I spend more time mixing with people like you and going to green gatherings and green tech gatherings. And I haven't been to a hedge fund gathering for 15 years, but I can pretty well answer for them. And most of them with a few interesting exceptions, do not get it at all. And it's a pretty good reason.

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(00:27:10):

And that's because the economic establishment has never gotten it. The classical economists had their feet on the ground, they understood they lived in a real world, and Keynes did. But the establishment since then basically wasted in this efficient market, rational expectation nonsense building models to be neat and mathematical and show their physics envy, but totally useless.

(00:27:46):

They completely lost the plot as Kenneth Boulding, who started out as a typical mainstream economist and then kind of resigned when he was about 50 because he found economics totally useless as in the direction it was heading. And in my opinion, he's totally right. So everything you read from the mainstream economics ignores the role of energy and resources.

(00:28:11):

You make a loaf of bread with capital and labor with the oven and with the worker, with the great paddle to stick it in the oven. You do not apparently need any wheat and you don't apparently need any heat. It is absolutely a laughable state of affairs, but when you throw in these more difficult things, your equations become too complicated and start to break down.

(00:28:39):

And when you leave them all out and you assume everything away and you assume perfect knowledge and perfect information flow. And in the stock market equal knowledge on the side of the buyers, on the sellers and all these ludicrous assumptions as if it isn't a kind of wilderness of psychology, the stock market. You get nonsense out of the end of their...

(00:29:03):

You get nonsense out of the end of their equations and big corporations and finance pick up on that. It impregnates their business. So the financial equivalent of wasted 70 years of economics is the efficient market hypothesis, which ran the university finance system for 50 years. Again, a total waste, worse than a waste. It was damaging, punishing and sending the world in the wrong direction.

Nate Hagens (00:29:41):

Eugene Fama and Ken French were my honors advisors at the University of Chicago and in the entire two years I was there, the word, energy, was never mentioned.

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Jeremy Grantham (00:29:52):

Well, you demonstrated commendable restraint by standing your ground. That is a sneaky way of saying, if you'd known what you were doing, you would've left and gone somewhere more sensible.

Nate Hagens (00:30:05):

I did that three years later after I started to figure it out. One of my, I was a high net worth salesman at Solomon Brothers and one of my clients eventually started to trade oil futures and I was learning about that. I was learning about how amazingly powerful this stuff is, how we don't pay for the costs of the externalities, the pollution, and how it's going to peak and decline in my lifetime. So soon after that I quit and went and studied with Herman Daily and others. So that's how that happened. That was over 20 years ago, Jeremy.

Jeremy Grantham (00:30:40):

Yeah, no, it's surprising that you could have something so valuable as oil and metals and have them cost nothing except the cost of digging it out of the ground.

Nate Hagens (00:30:54):

And that is right there, the fundamental flaw in economic theory and in our governance and expectations of our current system, is we're only paying for the cost of extraction. And the sad part is looking back, all this magical pixie dust that earth trickle charged from prior photosynthesis has been wasted, especially in the West. We don't really have anything to show for it, anything of long-term value. So piggybacking on something you said earlier that we were ham-fisted in our response to the Great Depression in 1929, and you hope that people could be more clever as opposed to not clever this time around. So with an energy lens and an ecological lens, how could we be more clever this time around? In theory.

Jeremy Grantham (00:31:59):

That is pretty simple. You need a carbon tax. Now, pigs will fly. No, that's not true. Eventually we'll all have carbon tax because we'll get desperate and everybody knows, even the idiot economists get this right that a carbon tax is far and away the most effective way of dealing with climate change. And you can bribe people into doing the right thing through subsidies, but it's very inefficient and expensive in contrast, and it's

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just politically easier. A carbon tax would be the first enormous step in the right direction.

Nate Hagens (00:32:43):

For two reasons. One, is going to be politically unacceptable at the moment, which is half the people don't believe that climate and ocean absorption of our emissions is critical and urgent and human caused. So it will be politically difficult for that reason. But the other reason to have a carbon tax is to make this incredibly-

Jeremy Grantham (00:33:08):

I have to interrupt. Half of Americans, it is nothing like a half around the rest of the developed world.

Nate Hagens (00:33:15):

Okay, good point. Good point. Yeah, I read recently that if you know nothing at all and you just ask someone what their belief is on climate change, that the single biggest predictor of people's opinion on climate change is their political affiliation, which really tells you something. It's quite amazing. It tells you that we get information from different sources among other things. Thank you for the clarification. Here's the other reason that a carbon tax would be helpful longer term from the perspective of we're wasting this incredibly valuable substance. If there were a carbon tax, the prices would be more commensurate with its true cost and value. And so we would conserve, we would send the right signals to innovators and investors like yourself that this phone here might cost \$3,000 because it's got a lot of non-renewable inputs in it. So there would be repair and different industries would crop up around that. But the challenge with such a carbon tax is we are in financial overshoot, not to mention ecological overshoot. Any realistic carbon tax today would prick the financial bubble even worse than the mean reversion you expect.

Jeremy Grantham (00:34:52):

Yeah, I think we shouldn't overlook the benefits of a carbon tax to government income. It would not only be a great source of income, but it would be taxing something you want people to use less of like tobacco instead of taxing labor that you want people to use more of and it would be a much better way of raising money. But you would have to make sure that you've reduced income tax on particularly the poorer end of the spectrum to compensate for the tax on energy. But the rich people use 20, 50

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times more energy than the poor people around the world and maybe even within the country 10 or 20 times. As we get more desperate, sooner or later a political regime will find its way to do something that effectively attacks on carbon. There is an 800 pound gorilla lurking around here that you're not aware of, and that is, I don't agree with only one part, one little slice of your argument as reflected so well in your 95/96 podcast, and that is the role of debt and finance in general.

(00:36:31):

The good news is if you take all the people in this game of overshoot, living beyond our means is how I think of it, and you look at how much they obsess about finance and have done forever, for 30 or 40 years, and you go back and you take it all out of everything they ever said or ever wrote, it doesn't make any difference at all. It has not changed anything that they, in my opinion, have gotten it wrong and it probably will continue not to change anything. So as long as they are generally heading in the right direction, everything will work out fine. But I think debt is the most misunderstood thing of all. And the reason is pretty clear. At the individual level, when you're making a list of what you're worth, you add up your assets and you subtract your debt. It is a negative.

(00:37:40):

At the societal level, debt is not like gold. Debt is not like copper or like stock market, a claim on real corporations with real workers and real output. Debt is a zero entry. Debt is double entry bookkeeping. We might as well say, "Aren't the Japanese incredibly rich that they can lend so much money?" But we don't say that. We say, "Look at the incredible Japanese debt. My God, they will collapse." As we have been saying for 40, 50 years waiting for them to collapse. Unsuccessfully, I might add. Debt is shockingly misunderstood and exaggerated insignificance. You cannot move resources through time other than a few cans of bully beef in your basement or at least make sure that the infrastructure is set up in good shape for your children. Other than that, you cannot move assets. You cannot move income. The Germans at least understood this with their social security.

(00:38:52):

They know that it is a pay as you go. They don't pretend as we used to about lockboxes and social security going bust or accumulating. You only have the sum of your goods and services each year to pay your pensions. And if that goes down, you will have less either to pay the pensions or less for everybody else. It is not about debt claiming on the future. Debt does not claim on the future. What debt does is I give

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you my money today that I could spend and I lend it to you. That is not a claim on the future. It does not transfer income through time, but it scrambles everybody's thinking. And luckily in this field of overshoot, it doesn't make a damn bit of difference.

Nate Hagens (00:39:42):

Well, you're a billionaire and I'm just a podcaster with a few rows of potatoes and a draft horse, but I am going to push back on that a little bit. Yes, you're right that so far it has not made a difference because so far we have lived in a world of rising energy access every year with the exception of a couple of recessions. Yes, you're right that in a financial lens it's a zero sum game. There are assets and liabilities. So from that perspective it is a Pareto problem where the wealth gets more and more concentrated and the creditors end up having a larger share of that pie. But from a biophysical perspective, every time we create money via commercial banks or recently via central banks, there's this same amount of oil and forests and copper and dolphins. And so what ends up happening right now, the United States has increased our debt \$1 trillion in the last three months.

(00:40:52):

I mean, it's like almost a billion dollars an hour. Yes, that's allowing us to consume more today and it's papering over other problems and it's one of the reasons stock market and Bitcoin and other things are up. But eventually when all this money has to be called in to be spent, that especially if we're on the down slope of oil and instead of a hundred million barrels a day, we have 90 or 80 or 70, it's a musical chair sort of situation. So I agree with you that so far debt has not been a problem, but I think what it's done is it's an example of risk homeostasis that we've run a red light 10 times and nothing bad ever happened. That doesn't mean that running a red light isn't dangerous.

Jeremy Grantham (00:41:38):

I understand. You have to protect your opinions.

Nate Hagens (00:41:45):

No, no, no. I want to learn. If you disagree, please educate me.

Jeremy Grantham (00:41:49):

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I was counting on you saying that. Happily, I don't think it matters. So I don't want us to spend any more time because I have an eccentric view. And plenty of people would think you're right, they share your view. Just one point, though, I am only a billionaire by a strange and generous construction, and that is if you count the money I have given away, which is a pretty whimsical way of calculating someone's net worth. But in terms of what I actually have and could go out and buy my daughter back from being kidnapped tomorrow, I don't have, I'm at least an order of magnitude short of that.

Nate Hagens (00:42:47):

Well, I actually think that is a wonderful way to define being a billionaire in the future, isn't it? Going forward that you count how much money you have given away towards pro-social, pro-future ends. I mean, that's a better definition, wouldn't you say?

Jeremy Grantham (00:43:04):

It would be conducive to better behavior, maybe. But it is important at least to get that out there. And most of what we have left we see as a potential reserve for a rainy day. And incidentally, we have a rainy day in our foundation. Our foundation is about 1.4 billion and we have invested perhaps an unwisely large piece in venture capital, a large chunk of which is green venture capital. And the reason for that is we think that green venture capital, if you only invest in things that seem really important and you concentrate on those that have a hard time raising the money, you'll end up with a risky portfolio. But on paper should give you in a hundred deals a very high return and traditionally it has, but every 15 or 20 years it participates in these, excuse me, bubbles. And so we get hammered and we become illiquid and the companies call for the money that we've committed and they stop funding it back, which we really count on and that causes a liquidity squeeze. So times are tricky.

(00:44:40):

I will say this, though, that I think a diversified package of important green venture capital drives the cause better than anything. It's very hard for a dollar of grant to keep up with a dollar of green venture capital because the green venture capital on average comes back with 15% profit and then goes out again and out again and out again. So those dollars can be really in the long run, very, very effective.

Nate Hagens (00:45:15):

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So what are some projects you're particularly excited about in the green venture capital area of your work?

Jeremy Grantham (00:45:24):

Well, if you started at the top end, what could be a get out of jail card from a conundrum or a potential get out of jail card, you would have infinite, cheap green energy, right? So that would be a huge help and wind, solar and storage might make it, but we'd probably need an order of magnitude improvement in storage costs, a drop to 10 cents on the dollar and we'll probably get it. It might take 10 or 20 years and it might take, who knows, longer, shorter. But the other ones are geothermal. I am very optimistic that if we could take our incredible ingenuity and the experience and the trial and error from having drilled 200,000 fracking wells learning on the job, if we could take some of that skillset and move it to geothermal, there is a virtually infinite supply of energy under our feet.

(00:46:44):

If we could learn through ingenious ways of drilling to handle the temperature, to frack it, to pick up the heat, turn it into either electricity or even just into heat and do it here and there all over the planet, that would be huge. And next and even more of a long shot is naturally occurring hydrogen. Hydrogen is obviously going to be incredibly useful, but getting it is energy intensive so that really in the current state of affairs, it's more like a battery than a source of energy. But naturally occurring hydrogen, of course, is a source of energy and we don't know, in 10 years it will probably be a done deal. We'll know that it's not a workable impressive component, but it may be. And so that's pretty thrilling. And then we have fusion. There are maybe now 40 diverse efforts, different efforts, and it's the difference that makes it interesting.

(00:48:02):

I think one or two of them may well make it from an engineering technology point of view in a few decades, and that is, again, infinite source of energy. What I worry about, we have a few investments, what I worry about for them is that by the time they make it may turn out that wind, solar and storage has made so much steady progress or that geothermal and naturally occurring hydrogen has, that they will not be necessary, that the capital costs will be too high to compete. But it may be fine and we have to do it. We need to try everything.

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Nate Hagens (00:48:46):

So I have a lot of follow-ups to that. If you were just an investor, I might leave it at what you just said, but I know you also are aware of the work of Patrick Ophuls and ecologist William Rees who were both on my podcast, friends of mine and technology itself is necessary but not sufficient to solve some of the larger issues. And climate change from an ecological perspective isn't the problem. It's a symptom of a much larger problem, which is overshoot. So in addition to technological green investments, we're also going to need something on the cultural and political side, otherwise the productivity from these new improvements that you're advocating and hoping for will just be fed back into a global energy and resource consumptive system if GDP is our goal. What are your thoughts about that?

Jeremy Grantham (00:49:51):

Nearly infinite, cheap green energy is a very helpful but not sufficient condition. I do not think there is any hope of creating a degrowth culture profound enough or quickly enough to save our bacon. I do think we can tip it slowly on the margin in that direction. What I think may save the day is population. Population, particularly in the high resource areas, is dropping rapidly. And by population standards, it's nose diving and nobody really appreciates the speed at which it's dropping. To take the extreme case where Korea has a fertility rate, South Korea, of 0.8 last year and not much higher the five years before that. At 0.8 it means in three generations, a hundred years, your baby cohort will be six and a half percent of what it is today. Basically, you're out of business. And if I am right in what I see as the reasons for this, it is highly likely that the population of high energy, high resource using rich countries and China, but will be substantially lower in, let us say by 2200. I think we could drift down to about 2 billion people which we could sustain.

(00:51:43):

And it's only that piece of incredible, you could say good luck, if we can hold the system together under the stress of going to 2 billion people combined with nudging us towards a degrowth philosophy and understanding that we have to restructure ourselves to live within our limits, that gives us a decent chance of making it and to have cheap green energy would make a big improvement in the odds.

Nate Hagens (00:52:15):

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So let me clarify something. So the global population is still increasing. The global population growth rate, I think, peaked in 1965 and has been declining ever since then. But we are still, net births over deaths is around plus 80 million humans per year. And that's declining, but it's still growing the total population. So are you saying, because Elon Musk has a much different perspective, he thinks global population decline is the biggest risk that humans face. So population is do we have too many people or not enough, and how do you marry those two views?

Jeremy Grantham (00:53:06):

I'm only interested in births because in the end, accumulating retirees doesn't really matter. The long-term wellbeing of the species depends on young people.

Nate Hagens (00:53:23):

Except there are some people in your sphere that are advocating for longevity and that we're going to with AI and other things, we're going to live to be 120 or 130, which would also have an ecological impact if that comes to pass.

Jeremy Grantham (00:53:39):

For 60, 70 years, I mean, the fact is they die off. The dynamics that matter are the dynamics of young people and how many children they have. You can have an army of old people and that long-term significance is negligible. Once you know the flight path of babies, you know the flight path of 20-year-olds, you know the flight path of the economy, yes, there is a risk that dropping at this speed will stress out the economy and we will in 20 years think that we're poor and that we can't afford to do the necessary things on the environment to protect our existence. That would be very sad. On the other hand, if AI is half as good as some people believe, it will mesh very well with a rapid decline in workforce and we will have a rapid decline in workforce.

(00:54:50):

I rather hope there is a brilliant development in AI so they can look after the old folk and so on and life will go on holding together. That's the big trick. Can we hold together to 2200 to arrive in a world where there are 2 billion people, including the old fogies and where we could be a world where at least half of the land is rewilded and we're living eventually within our means. And it may not be 2 billion, it may be 1 billion, it may be two and a half, but it's going to be something like that.

Nate Hagens (00:55:34):

## The Great Simplification

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I know that the advocates of AI who are aware and concerned about climate change, do you think that AI can solve climate change? And for the same reason I mentioned before, Jevons Paradox, artificial intelligence can make things more efficient and do demand side management for our energy use and all those things, but it can't do, at least not AI, maybe AGI, it can't do wisdom, so it's not going to change our cultural objective or cultural aspirations. And I actually think the declining labor force, which you're talking about, is from smaller baby cohorts. AI is going to do that because it's going to take people's jobs away. And so I think there's a real wealth and income inequality risk with AI that gets thrown into this picture as well. Do you have any thoughts there?

Jeremy Grantham (00:56:32):

Yes. I'm on this topic rather pleased with myself because 15 years ago I wrote a little piece about the country club on the beach being served by Androids. And the last human supervisor/helpers has just been talked about in a message that one of the Androids has sent to his fellows that Fred, a nice guy as he is, is really starting to get in the way. And after that point, there is no productivity per man-hour. There is only productivity per robot hour or if you will, return on capital. And the capital owners sit in the country club and around the perimeter, one might think barbed wire, there are hordes of other humans who have no job and are therefore totally useless and worthless, et cetera, et cetera, hoping for some handouts from the country club and that the real job of government in AI is an income dispersion job. Let us imagine that world in 300 years when we've been really lucky and have survived all these other existential threats and the robots are doing all the work. Do the capital owners get everything? Do the rest just disappear and starve? Or long before that, do they revolt and get put down by the robots or vice versa and so on? But an enlightened government will move to head that stuff off pretty quickly by making sure that there is a fairly broad acceptable income distribution. And we are already falling foul of that. Our income distribution in the US is no longer passing that test. It has resulted in the estrangement, almost bitterness and anger of at least a third of the general public who feels they have been badly treated. And I think you could make a pretty good case that, yes, they have been royally screwed since about 1975.

Nate Hagens (00:59:13):

That's why I'm less sanguine on some of these electric car forecasts and things like that because as of now, as the sugar high from the Covid stimulus is waning, I think I

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saw a stat last week that 50% of Americans cannot afford a car payment at today's rates, with higher interest rates are built in. So we're one of the richest nations in the world, but the wealth is certainly not evenly distributed.

Jeremy Grantham (00:59:43):

Right. And if you think of car payment, much more important really is house payment and buying a house, it's such a high unaffordability index now. Peak prices as a multiple of family income times 7.8% mortgage, you're sitting there down in Washington with a mortgage of 2.7, real story. It's pretty hard to move to Boston at 7.8 or 7.9. That is a brutal increase in your cost. So cars, houses, and real life, this is not a super comfortable world for everyone below halfway on the income scale. And it's not that great in the last 30 years from the 50th percentile till about the 20th. It's been great for the 0.1.

Nate Hagens (01:00:47):

So most people think that all capitalism is the same thing, but you've frequently pointed out that American capitalism is unique. What do you mean by this and what are the alternatives? And ultimately I want to get to, is there a different way that we can allocate capital, our scarce capital, which is energy, resources and our impact on ecosystems going forward. What are your thoughts on that?

Jeremy Grantham (01:01:18):

We have fallen in many ways on bad times from about 1975. From about 1930 to '75, everybody got richer at about the same rate. There was a very slight tendency for the poorer to outgrow the richer. And so by about 1965 to '75, we reached, by American standards anyway, a rather egalitarian level and people frequently quote the Fortune 500 CEOs earning 40 times, which turns out to be about what the Japanese CEOs were earning too. And now 50 years later, the Japanese CEOs earn 40 or 50 times their worker, average worker, and we yield about 250 to 400 depending on who's doing the calculating. But it is, you have to say obscene, it's unnecessary too. Most of these people are very average qualities. The people who start their own darn firm like Mr. Musk, and in a sense they deserve what they get. People who start a new enterprise, when you've paid all the rent and you've paid all the salaries, what's left is yours. I get that. That's capitalism. It's the best part of capitalism.

(01:03:01):

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When you put a bunch of your buddies on the board and you decide to give yourself \$200 million of stock options over three years because they're your friends, that isn't capitalism. That is stock option culture gone wrong. And it has been aided and embetted by increasing monopoly. Every industry in America has become more concentrated. And in more recent years you have had the fashion of cutting back on CapEx. CapEx is real life, it's up and down, it's unpredictable, it makes your earnings volatile. Who needs CapEx? So let us use that money to buy our stock back. Buying stock back is said to be a dividend. It has many dividend like qualities, but it has one incredibly significant difference and that is a dividend goes neutrally to everybody and stock buybacks constantly take out the least optimistic of your stockholders.

(01:04:14):

And if you can find a way, month in month out, of getting rid of your least optimistic stockholders, you better believe you're living in a different world from a bland, universally delivered dividend. And so you push the stock price up and the evidence is completely compatible with that view. A combination of all these things has increased. The inequality has enabled the excessive payment of most CEOs who, to be friendly, bring along a handful of their top management with them and bear down quite hard and quote efficiently or half heartedly, you could argue if you were a humanitarian. They bear down on the workers. And in that the government has helped them along. The government has allowed the inequality, the ginny ratio, to worsen in the US through every administration except Bill Clinton's where it was flat. He did not generate enough momentum to send the pendulum swinging back a bit, but he held it for eight years and nobody else, including Obama, did. It continued to become more unequal.

(01:05:40):

And in more recent years, of course, the whole tax structure has been moved away from capital, therefore by default to labor. If you lower the tax on dividends and interest and capital gains tax, you must understand that you are increasing it on everything else, which is to say the ordinary people. And that has been a very profound transition. We are now as unequal as Mexico and Brazil, and we used to use them back in the sixties and seventies as the rubber barrens and now we're with them. It's not that they have improved, it's we have joined them in an equally unequal society.

Nate Hagens (01:06:22):

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Well, tying that back to what you said earlier, about 2002 started a tripling in commodity prices that acted as a tax on our society and to stick our fingers in the dyke, as it were, we went to debt and central banks started to grow their balance sheet and via, I think it's called the cantillon effect, that those that are closest to the monetary spigot gets the most benefits. That benefited asset holders and not the general public. So we're papering over our economic problems with central bank reactions, but it's not helping the average person. It's more going to the people who are ready, who are asset holders.

Jeremy Grantham (01:07:14):

I don't see it as papering over, but it is undeniable that if you push up the price of assets through pushing down interest rates, you will increase inequality because the rich only assets and the poor do not. And that is precisely what happened. And I think the Federal Reserve has played the biggest role in doing that. Greenspan and his, it appears almost as acolytes since then. They have all followed pretty much his flight path. So yes, that increases inequality. And when you lower the rates, you also make debt available to people who can handle borrowing. That is to say private equity and hedge funds and leverage in general, that is a windfall gain. You're giving free money for these marginal economic activities. And the only purpose which, really when you look at the bottom line, is the enrichment of the people who run the private equity firms. That the value created for society is negligible according to almost every academic study.

(01:08:26):

And they have pretty good lives and they are some of the main beneficiaries and they change reality by bidding up the price of corporations and helping increase the overpricing of the stock market.

Nate Hagens (01:08:45):

How would the United States, as the example of where we both reside at the moment, how could we shift away from American capitalism and is it even possible or would it have to happen during a crisis or are there policies and ways that we could change it ahead of a big financial crisis?

Jeremy Grantham (01:09:07):

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It used to be considered, for example, that a stock buyback was manipulative and it was illegal until the mid seventies or later, all the way from the 1930s. You have to have a policeman at the corner of broad and wall in order for things to work pretty well. You have to keep an eye on them. And other things being even to have companies buy their stock back whenever they feel like it, and it's not a great idea. I think let them pay a dividend, but let them keep their nose out of the stock market. It is too easily manipulated and was banned for a very good reason and was unbanned for also a very comprehensible reason, which was to be nice to corporations. And it is nice to corporations and it's a big part of the inequality equation. But then you have reform of the Fed. I think the Fed has been given far too many responsibilities. If it was just responsible for making sure there was a decent amount of money available to deal with the economy of that age and allow quote the government to have to worry about other things.

(01:10:40):

But to have the Fed worried about inflation, about growth, about debt, unemployment, it's a pretty well guarantee it will settle for some simple policy of making rates cheap. Rates cheap was terrible for retirees. They were not getting paid anything. After adjustment for inflation, which people have forgotten all about after 20 years, they were being charged for the privilege of putting their money into fixed income. And everyone had told them that as they got older, they should have more and more as a percentage in fixed income. And suddenly for the last 15 years they have had little or no return until today. Suddenly they're now getting paid. They're awash with money, these people, compared to where they were two years ago. They're getting 5, 6%, 7%, whereas they were getting nothing a few minutes ago. So I think reform of the Fed and no stock buybacks, and I would be even careful about stock options. Pay people an honest amount of money on which they pay an honest tax. And if you think they're great, pay them a lot of money.

(01:11:57):

But stock options, stock grants, stock buybacks has created in the real world, I think, a rather nasty stew that is in favor of the top handful. I wouldn't mind reforming boards too to make sure they had one or two worker representatives in the larger corporations and one or two outsiders and not wall to wall friends of the chairman.

Nate Hagens (01:12:27):

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Or maybe one or two stand-ins conceptually as members of other species who have no say in our economic decisions.

Jeremy Grantham (01:12:38):

Yeah. By the way, when people say to me, what should America do? My semi frivolous answer is we should hand over our government to a consortium of the Scandinavian countries, Norway, Finland, Denmark, Sweden. Lord knows they have to get elected. They have on paper all the problems that we have in that respect. And yet they have sensible policies aimed at the wellbeing of their people. On social measures, they do better in everything than we do. The life expectancy in Sweden 30 years ago was two years longer and now it's eight years longer. When do we blow the whistle and say something is going drastically wrong? But if you look at any measure, educational achievement, number of women who die in childbirth, everything you could list, they score better.

Nate Hagens (01:13:42):

I was just there in Stockholm and I was really impressed and there's just a different feeling there, Jeremy. In Europe more generally as well, but in Scandinavia for sure. Let me ask you this. I didn't plan on asking you this, but it bothers me a lot. It seems our current culture, self-selects for candidates for national political office, senators, congressmen, presidents, it almost self-selects for sociopathic type personalities that care about themselves in a narcissistic profit connection power way. And we've gone very far away from I want to help this country because I feel obligated to, I feel a fiduciary to making the future better, like a real civic responsibility. Can the politicians that we have now understand the type of things that you're saying? You mentioned earlier enlightened politicians, which in our current society seems like an oxymoron to me. What are your thoughts on that? Is there hope that we could have a different system that is commensurate with not only the financial and resource risk that you've pointed out, but the ecological and climate ones?

Jeremy Grantham (01:15:10):

As an individual, I tend to agree with the tone of what you're saying, but how we would get there, I haven't a clue. Can we get there? I haven't a clue. It is disturbing and one should feel discouraged, and I do, but I have no idea what to do about it.

Nate Hagens (01:15:36):

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Well, I think politicians get to be politicians because they're elected by people. So I think we need a cultural shift, but we also need institutional change. So based on what you were earlier saying, does there need to be a fundamental change in the way business is done as an alternative to the mega corporations, multinational corporations centered around just shareholder value in addition to the reducing stock options and the board restrictions that you mentioned earlier. Fundamentally extraction of finite, non-renewable resources, turn to concentrated profits is our Homo sapiens 2020s model. Does that need to be shifted and how?

Jeremy Grantham (01:16:27):

It feels like a huge hill, doesn't it, that we've got to push this rock up and how do you improve things this basic? The rather disturbing fact for me is that the older I've gotten, the more aware I've become of how little processed information the average guy has. He's concerned with, or she, with making a living, paying the rent, bombarded by political views, particularly now in the world of X and so on. And I'm extremely sympathetic, in general from a financial point of view, they've been very badly treated. But the level of processed information, of just what passes for the hardest facts we can get out there, is so little appreciated. It reminds me of the famous quote from Churchill about if you want to be frightened about the future of democracy, try five minutes with the average voter, that will do it. And how do you address that? And it's the work of many decades and many governments all trying to be modestly sensible.

(01:18:26):

And what is the social contract, in a nutshell. That's the bottom line. How responsible for our neighbor's wellbeing do we feel? How willing to sacrifice a bit for the wellbeing of everybody are we? And the answer is not as much as we used to. Back in the day, particularly in World War II, everyone pulled together, everyone knew they had to give up this, that and the other because it was necessary, because it was necessary. And everybody did and they were not unhappy. So I grew up as a little kid in World War II and people spoke to each other a whole lot more than they did, I am told, than they did a bit later. And it certainly seemed in many ways, like a fairly cheerful era because everyone was suffering, but everyone was suffering together. Everyone was trying hard. Almost everybody had a job, et cetera, et cetera. And the social contract was very strong and the same in the US, the UK. And it's pretty strong in Scandinavia, it's very strong in Japan.

(01:19:50):

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In Japan, got to tell you this story because that government was incompetent, in my opinion, on Covid. It went out of its way in only two respects. It said, you absolutely do not have to wear a mask if you don't want to. You absolutely do not have to be vaccinated if you don't want to. It's your complete civic right to do what you want. And that was their contribution. And what did the Japanese people do? They all wore masks and then they all got vaccinated and they had the oldest population in the world, and we know that was the main variable for catching Covid. And they had one in 20, they had 5% of the death rate that the US had. Amazing demonstration of social cohesion, looking after each other and also being generally fit and leaner than we are, which is also, again, part of, in a way, part of the social contract sensible behavior.

Nate Hagens (01:20:52):

I have a bunch of more questions for you. I just want to thank you briefly. I know you're very humble on your contributions, but these are the type of conversations our culture needs because-

Jeremy Grantham (01:21:10):

I'm not humble.

Nate Hagens (01:21:10):

You're not humble? Well, you're humble relative to other people like you that I know. We'll say that.

Jeremy Grantham (01:21:18):

Instead, I don't see giving money away as philanthropy because I'm not giving it to help the poor. I'm not giving it to the hospitals, not giving it to the schools. I am saying we have a problem. We, the people, my grandchildren. Let us do whatever we can to stay afloat and poverty will always be with us, and I do care about it but my limited resources better focus on what I think the most likely thing is to derail the whole society. I consider everything we have spent to be defensive, defensive for my family, and in a sense, everyone else gets a free ride. So I wouldn't want you to construe this as fabulous philanthropy. I consider it sensible long-term behavior for me and mine and for everyone I'm interested in.

Nate Hagens (01:22:31):

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Fair enough. I didn't say you were generous. I said you were humble. You don't call attention to your own accolades. But the reason I wanted to give you that praise is because our culture, rewards and lauds financial and economic success. And so you are very successful in that realm, and yet you're putting most of your investments, your wealth into climate research, climate tech, because you've determined that that is our existential risk. But beyond that, you also care about bird loss and endocrine disrupting chemicals and many other environmental issues. So my reason for calling it out is you're one of the very few financial icons that is talking deeply about our environmental risks. And I wish more people would integrate that into their business decisions, into their values and into their philanthropy. That's the point I was making there.

Jeremy Grantham (01:23:44):

I don't get why so few people with money do not realize the opportunities they have to improve the situation and how desperate it is that they do that. I just don't get it. Because they're smart, and this is not rocket science, this is really obvious. I am also very big on toxicity. And we should, and I know you've covered it in a few of your-

Nate Hagens (01:24:13):

Yeah, so Shauna Swan was one of my first guests, and I know you funded her research on sperm decline. Why don't you talk about that a bit, Jeremy?

Jeremy Grantham (01:24:24):

And she talks about it wonderfully well, which is part of the reason we support her. But people don't realize that toxicity is, I believe, moving faster than climate change and will be more deadly. What we have done is we have created a world which is hostile to life in almost every form, including our own. To take insects, the biomass is down at least 50%, maybe as much as 75. Just the weight of all of those little critters. If you talk to an insect expert, too late for you to have a podcast with EO Wilson. But together with two of my colleagues, I badgered him for about three hours until he was obviously weak, but he couldn't get away because it is exciting always when you're talking to people who are thrilled by what you've spent your life doing. And we were asking him, give us some proof of the damage that will be done as insects implode. And they're dropping at almost 2% a year. Anyone who knows anything about compounding knows that that is catastrophic.

(01:25:51):

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And he believed profoundly, he was the ant man. He believed that if we lost insects, we would probably go out of business ourselves. And he couldn't prove it. Why couldn't he prove it? Because there hadn't been many research programs. There was no money in insects, no funding. And the interaction of all the insects is one of the most colossally complicated systems out there. Very, very hard to study. But in almost every environment, we measure a great loss of insects. Similarly, if you look at human sperm count, it's dropping at the same rate of insects between one and a half, 2% a year. And what we did, because we can, because we're not academics, when the first Shauna Swan report came out with Hagai Levine, that's kind of co-boss, we rapidly extended it backwards and forwards. We extended

(01:27:03):

it backwards to 1945, the age of DDT and so on, hugely damaging for insects, hugely damaging for humans. And we extended it back at half the rate that they had proven from 1973 to 2017 and then we extended it forward for six years at just the same rate, despite the fact that Hagai Levine said that if anything it seemed to be accelerating. And then we did fund the program for them to back it up for six years and they found that indeed it was accelerating. So our extension had been conservative. And we used half the rate back to 1945, which is almost certainly conservative. And our total, which we'd been using for years before they managed to do the follow-up, showed that there was a 60% from 1945 to 2021 when we were talking about it.

(01:28:05):

The 60% drop in the sperm count in the developed world, and you can say, and China. And what that means is it's real trouble now. We were over-engineered, I like to say, like a Victorian bridge. So dropping to almost 40%, 50% didn't matter. But beyond that, it suddenly started to matter a lot. And we have gone from a rounding era of young couples having trouble getting pregnant to about 15%. And the international health guys come out the other day and say it's one in seven, which is exactly what we agree with. What they didn't have the nerve to say was that 30 years earlier it was pretty well zero. That it had gone from nobody having trouble to one in seven having trouble. And it's accelerating at 2% a year, which means come back in 20 years and there will be hell to pay for ordinary people around the world having children.

(01:29:06):

And this is all because of the stuff that was covered in Shanna Swan episode two, I think. That there's so many endocrine disruptors. I believe the data suggests that pesticides on fruit and vegetables are the main culprit. Pesticides on fruit and

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vegetables eaten by pregnant women are probably half of all the damage done by chemicals to humans. And it is an enormous amount. There were a couple of studies that looked at men at Harvard and Mass General, arguably best hospital or a candidate in America. And yes, there were only like 800 of them, but for six months they looked at them whether they were eating more chemicals or less chemicals based on the kind of fruit self-reported. And the top quartile had twice the sperm count of the bottom quartile.

(01:30:07):

And then the following year they did women having trouble showing up at their clinic, and the ones who had the best diet had 65% successful births and the ones who had the worst quarter had 38. Just shocking. Amazing with that kind of power in the data. Yes, you should have huge follow-up studies, no money, no follow-up studies. But it suggests that we're on our way out of business. And that's what Hagai Levine says. It seems that we're going out of business. At this rate 20, 30, 40 years and we hit the fan, bang. And it scrambles. Everything else we talk about, Nate, everything we're obsessing about is affected by this shocking drop in fertility.

Nate Hagens (01:31:04):

You were probably not surprised to know that I have many follow-up questions to that. So I know you know Shanna and supported her work. Her recent paper, her latest paper, which was released after the podcast I did with her, A, showed that the sperm drop is accelerating. And B, that it's not just a United States thing, it's global, right? And is it also extend to non-humans, to animals?

Jeremy Grantham (01:31:35):

They covered that a little bit in the first study that there were some footnotes that suggested that dogs had been tested and that they were having just the same trouble. But we can deduce from insect problems that is a major impact. We can also sadly deduce from the insects that we are in the cascade effect that EO Wilson and the rest of them have so worried about. Which is to say, the best study was in Germany where they had thousands of citizen helpers, many of whom had PhDs and so on by the way. And they were amazingly Germanic and thorough in their study. And they put out these nets in exactly the same part of the forest on the same day of the year sort of thing. And they gathered them all and they were just amazed over the passage of decades how quickly they all declined.

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Nate Hagens (01:32:43):

It was like 85% decline.

Jeremy Grantham (01:32:45):

Yes, Germany has not been particularly badly behaved in the last 20 years. What is happening, in my opinion is that they are paying the price now for the massive breakup of the countryside that went on in World War I and World War II. Where they were in a sense blockaded and beginning to starve, and growing food wherever they possibly could and breaking down what had been very extensive forests in Germany and growing food. And that has made Germany just less fitting for insects. And then you tentuple the amount of pesticides you're throwing at it. Bear in mind, this study was done in forest preserves, so you have to have such a massive chemicals that it's blowing in the wind, running in the streams and even in the rain to some extent.

(01:33:50):

And then you have the temperature. And the temperature has very little effect in Germany. But at the same time, they did a study in Puerto Rico and we spoke at great length very quickly to the person who did that study. So early that he was very, very happy to talk to us. Later he became quite trendy. But in this forest preserve set up by the king of Spain hundreds of years ago in Puerto Rico, what they found was almost certainly that heat is making tropical insects sterile. In the tropics, the temperature varies very seldom. So they have a spiking heat one or two days a year, and suddenly it's 12 days a year.

(01:34:35):

And this bright spark at the University of East Anglia grabbed one of these tropical beetles and started to experiment with heat, and he exposed them to a week of abnormal heat and their fertility rate halved. And then after a couple of weeks to recover, they gave them another week and they were sterile. And that element is going on in the tropics, where it will be of course deadly because they are having this huge increase in extreme hot days and it is making the insects sterile. And so all over Brazil, the insect mask will be dropping just as fast.

Nate Hagens (01:35:19):

I know Shanna and many people in her network are friends of mine, one of them is on my board. And many of them tell me that endocrine disrupting chemical pollution may be a bigger risk to humans in the future than climate change. So wouldn't it be

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something if the biggest danger of a barrel of oil and natural gas isn't the emissions, but is the plastics and related things that come from it? How can this be happening with so few people in the world? Everyone's focus on GDP and consumption and Netflix and smorgasbord and vacations, miss the fact that we are undergoing eco side of the world's insects, which are trillions of tiny robots doing tasks that humans could never replace by ourselves.

Jeremy Grantham (01:36:17):

Yeah, it is an incredible, almost unbelievable description of Homo sapiens that we would be so reluctant to face up to reality, which is in a sense, freely available. The data is there, it's very high quality data, it's peer reviewed, it's done over and over again. My conclusion is if we do not end up banning most chemicals, including plastics, we will go out of business.

Nate Hagens (01:36:51):

By that you mean human extinction?

Jeremy Grantham (01:36:54):

Yeah, the loss of a reasonably stable global civilization that we may have pockets and so on here and there. But what we know of as a reasonably acceptable life will be gone. And there are parts where people are not exposed to chemicals, and they will do much better, but they are exposed to heat and some of those very parts, the heat and the humidity will get so bad that they will not be able to exist in the open air doing agriculture. So they might become hunter-gatherers in the pockets where they can deal with the humidity, keeping the shade and so on and live off fruit and nuts. But life will be tough, for the stock market by the way.

(01:37:51):

Long before then you have a situation where owning chemicals will be more exposed to lawsuits than even oil companies, which is a very high hurdle, because they're getting sued all over the place now. Because they knew and they paid money to obfuscate their knowledge just like the tobacco companies did. And they may have cost us 10 or 15 years or more. And for that, they should pay a lot to help us get out of the hole that they have helped us dig deeper than we would without them.

Nate Hagens (01:38:32):

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But if I look around my office, pretty much everything that I'm looking at, with the exception of maybe a glass drinking jar, has plastic in it. How would we remotely begin to use bamboo and hemp and other products to replace the ubiquity of plastics in our current system? It boggles the mind.

Jeremy Grantham (01:38:56):

I have an advantage over you all. In that, I remember being in my bathtub as about a 4-year-old, 3-year-old, and my mother came in with a little baker light sailing ship for my bathtub. This was a mottled brown plastic boat. That was the first plastic that came across my life. Baker Light was effectively one of the first one or two plastics ever made, thermo setting hard, not flexible, soft like polyethylene. And everything around me, as in everything, everything we fought a damn war with had no plastics guys. It can be done. And it is amazing how good we are at sucking it up and replacing and making do when we have to. And this is something that most people in our business, Nate, underestimate. They think we all kind of lie down and die because we can't have our luxuries and our two showers a day and our plastics and it just ain't going to be.

(01:40:23):

So we are going to be tough as nails pretty quickly and we're going to get by, and we're going to replace, we can replace plastics. We know that because we lived in a pre-plastic world quite recently. And we're going to have to find a way of using materials from nature. And again, you can't grow and do that. It stresses out. We don't have the capabilities, the resources. But if they're combined with a declining population, we very well may. So we have to replace petro plastics with bioplastics, and like cellulosic fibers and so on. And we can do that and have done it. And the potential for more discoveries are massive. We can have a vats of microbes doing photosynthesis and producing a cellulosic sludge or a material sludge.

(01:41:26):

And my semi joke is you then build buildings out of cross- laminated sludge having stiffened it up a bit with this and that, but it has to be biologic and industrial scale, biologic material and food. It doesn't sound very appetizing, but you can have microbes generate protein sludge and you can have raspberry flavored protein sludge guaranteed not to have any plastics, guaranteed not to have any toxins. And we can do this. We can combine technology and all the accumulated learning of thousands of years to the task at hand. And if we do that, we will make it. And if we're dopey and

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slow, we won't make it. It is, as I like to say, the race of our lives, but we do have a chance of making it.

Nate Hagens (01:42:28):

You're a hedge fund manager, lifelong investor, but also a philanthropist. Although you say that that's selfishly for your own family and grandchildren to have a livable biosphere. But given what we face and the things we've discussed on this call, biophysical limits, climate endocrine disrupting chemicals, changing geopolitics, do you have advice for other philanthropists or investors who have benefited from living through a unique period of the carbon pulse but who may just be starting to open their eyes to the broader eco side that is slowly but picking up speed happening in our world with respect to animals and insects and ocean and CO<sub>2</sub> in the atmosphere? I mean, this is the only habitable planet known in the universe, this blue-green Earth we all inhabit. Do you have advice for other people who've been successful on where the world needs support that's being overlooked?

Jeremy Grantham (01:43:40):

If you have money and you are getting older, I can assure you that this is the retirement project of all retirement projects. It is capable of absorbing any unit of energy you can find. It is absolutely fascinating. It has all the great important issues and a lot of the people who are suddenly sitting on vast pools of money are very smart, technologically savvy. They are ideally suited for playing a role in this area, and they will enjoy it. It will be part thrilling, challenging, exhausting, discouraging, encouraging, all of the above. But it will not be boring. You will not be reduced to playing too much golf. It is a great project and it's the issue that matters most. Let's put it that way. By the way, I'm not a fund manager. I play no role in investing, other than the meta level issues of should you invest in climate change, is there a bubble? I haven't come close to managing a hedge fund really ever. I have only done big issue top-down topics most of my life and some traditional stock picking long ago just to get the record straight.

Nate Hagens (01:45:28):

Record is straight. Thank you for that. So I agree with you. There is no other greater ask for society right now than the human predicament as it pertains to the natural world and where we've arrived. However, the financial system, which you know well is optionality on power and resources. And as long as we have a fungible reserve

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currency in the world currently, the dollar, that dollar as you maximize it and grow, the amount of it is a claim on everything else that you can quickly turn it into land or a different currency or ownership in a company. And so to do the right thing for nature and our children and the biosphere reduces one's optionality. I told you, I used to work at Solomon Brothers and I had clients that had \$300 million and they were going to get to 500 million and they would quit. But when they got to 500 million, their buddies had more and it was a compulsion to grow the amount of assets. So how does that dynamic merge with growing recognition of the unbelievable tragedies that are unfolding in the natural world?

Jeremy Grantham (01:46:50):

Nate, I think it's an unanswerable question, from my perspective. It is too profound and philosophical for my skillset. So I am going to duck that one. It's the right question, but I am not the right person to answer it.

Nate Hagens (01:47:11):

Okay. I will ask a related question. I know that you also fund work at universities, especially on climate. So I'm going to start asking this question of all my guests because it's my belief that young humans, especially those in grad school or postdocs, are an incredible underutilized human resource to tackle some of the problems that you've integrated on this call. But they're working within an economic structure within the academy that is linear and doesn't integrate the things that we've been discussing. So in your field, climate, oceans, endocrine, disrupting, extinctions, how all that fits together, can you suggest some really big questions for postdocs, grad students, universities around the world that need research, need answers that are happening right now?

Jeremy Grantham (01:48:15):

What is really the threat in epigenetic problems changing the way that genes express themselves after exposure to chemicals? We really have to follow that up. We really have to follow up the sperm count studies and what can be done, what is causing the damage. They really don't know. Shanna thinks it's mainly the forever chemicals. I think it's mainly pesticides on fruit and vegetables. And it isn't known, but we should have important follow-up studies. The same with insects. We may be teetering on the edge of our own destruction and we just don't know it, because no one has ever funded insect research and you could take all our money, throw it at any one of these

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things, and it would still be a drop in the bucket, although it would certainly help. We have decided to throw all our money in a sense at green tech research, because we think it buys us time for governments and new rich people to get the point and start to change the way they spend their money and the way, yeah, the government spends its money. By time, through technology, to push the window away before we go off the cliff. But as you implied, these are not long-term cures. These are just buying time for the long-term actions to be taken. And the most impressive one to me is a population reduction. That I think is pretty well baked in the pie. We didn't cover one thing, which is shockingly politically incorrect and therefore we should probably do it. That is the main reason for population crash. It's not a population crash because of the old fogies living longer, but it's a baby cohort crash.

(01:50:46):

The main reason is the choice. Obviously more educated women are realizing that many children just impinge on the flexibility of their life and their ability to fully realize themselves anyway. So we have this huge correlation between female education and fertility, and secondly, postponement. Everyone wants quite correctly to get their career going before they interrupt it. And that makes a lot of sense. But when you postpone, you're not nearly as fertile, and I believe it interacts with toxicity in a nonlinear way. So it doesn't really matter if you have some toxic exposure when you're a 16-year-old Nigerian. Just to pick on a place with a very high fertility rate. Because you have many years to make it up. But your 39-year-old Parisian worker, you may find, you simply can't have a child. So that's reason number two.

(01:52:02):

The reason number three is toxicity, reduced sperm count, increasing miscarriages and all of the lesser problems that come with chemical exposure. Which is getting worse rapidly and will soon be overtaking postponement into second place. And then there is the one that no one talks about, and that is in addition to the measurable reduction in sperm count, et cetera, there is a hard to measure effect on hormone interference on your willingness, your eagerness to procreate. Every study, as far as I'm aware, and I've tried to look at them, every study on sexual activity says it's going down. In each age group pregnancies in 16 year olds and younger dropping rapidly.

Nate Hagens (01:53:02):

That's a lack of willingness to procreate or a lack of willingness to do the act that results in procreation.

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Jeremy Grantham (01:53:09):

No, a lack of interest in procreation. In other words, you are not motivated. You are not the 22-year-old of circa 1955. You have less interest, and that was available implication of the study from Shanna Swan and Hagai Levine, and it may be the most powerful force of all. 40% of South Korean 40 year olds have not had a child, and the activity in terms of dating and so on has really dwindled down so that it's the women's night out and the guys playing competitive computer games on a Saturday night and not going to the bar and hooking up or whatever we call it. This is, I think, potentially very profound and maybe the most important single consequence of chemical exposure.

Nate Hagens (01:54:36):

But can that be described by chemical exposure or could it also be described by the subconscious recognition of climate change and limits to growth and other things that people just don't have that inner freedom and Esprit the Corps of discovery and all that, that there's just appall and that we've become the walking worried? I don't know.

Jeremy Grantham (01:55:06):

Well, I can hazard a strong guess. As a betting man, I would put a very large bet on this. In the community in which we move, we bump into people who fall into your description. As a percentage of young people, I think they are a pretty small and confined to certain countries and socioeconomic groups. In China, for example, I would expect that to be a very small fraction of the opinion. But the proof of the pudding is that in the Korea, Japan, China, and probably when measured correctly, India, they're all acting as if, forget the choice. I am just not...

(01:56:03):

Forget the choice. I am just not interested. And that component is accelerating and that of course is a real threat to the species. And I think this is a real threat to the species, but it cuts right across all the other things we're working on, doesn't it? If our population is going to turn out to be substantially less than the low estimate of the UN by 2100 in just 70 years, and then much less by 2200, the main things we have to worry about maybe is holding society together. The demand for all the bad things like oil and copper will drop like a stone, but the stress on society and economy will be pretty high.

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Nate Hagens (01:56:53):

I don't know enough about that. I'm going to have to look into that, but you're right, it would affect everything else including the paying back of debt.

Jeremy Grantham (01:57:03):

That is such an important point about the payback of debt. I started out life studying big American industrial corporations who were in decline, International Harvester. And the retirees had certain obligations and the workforce supporting them were declining. The company was declining, but the retirees was static. And that is a very similar echo here in the following way.

(01:57:39):

The thing we haven't talked about is the cost of doing what we have to do. We think it's 50 trillion increment to green the economy. And the reason it's so low is because you have to buy a car anyway. You have to build a new factory anyway. You have to build, upgrade the grid anyway, and you combine that with greening it. And so it's a relative bargain, 50, maybe \$75 trillion. You then have the accumulated damage, which between now and a hundred years is probably going to be somewhere in the range of 30 to a 100 trillion. It's a very wide error bar.

Nate Hagens (01:58:28):

How can we put a price tag on insects, or ecosystems, or the Amazon?

Jeremy Grantham (01:58:33):

No, I'm just talking about floods, droughts and food problems. In other words, old fashioned simply measured pain, which is going through the roof as we sit, but 10 years ago was really quite marginal. And the biggest one of all, and that is we're going to have to end up, when we get to a zero carbon industrial system, we're going to end up with we believe about 550 parts per million plus or minus 50. That's if we do better, try harder, and have a steady stream of innovations. We started out live at 280, we're at 420. If we do a better job, we might peak this out at 550. But we've got to go back from 550 to 300. That's 250 parts per million. If we don't, the ice caps will melt, we'll have 200 feet rise and so on. And a lot of the fires, and floods, and transference of the Amazon to Savannah et cetera will keep going, so we have to do it.

(01:59:46):

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And when you green the economy, you have a lot of offsetting virtues. You drive as I do a Model 3. It's the best car I ever got in. You go through Boston in an electrified world in 20 years, it's the cleanest Boston will have ever been since its inception. It will have huge health payoffs by the way that no one talks about. So there are lots of offsetting virtues.

(02:00:09):

But taking out 250 parts per million is an absolute dead weight for which you will not see any direct advantage. Your survival depends on it, but you will not see any immediate payoff like you will with greening the economy. And we think we'll be ingenious and terrific, and we'll get the cost down to \$50 a ton, and currently 500, a 1,000 dollars a ton, but we'll get it down to 50. That's what we do well. When we scale this up, it will be brilliantly cheaper, \$50 a ton, but it's a lot of tons. And the total cost turns out to be 125 trillion. In other words, maybe twice as much as greening the economy. And we're going to take decades to do it.

(02:01:05):

And if the population drops steadily, we have this pension fund problem that you're alluding to. And that is, if we take a long time and we probably will, if we peak and at 550 one day and the population in terms of the workers has already halved, they have twice the burden. And then as they pay for it over a hundred years, it halves again. By the end they've quadrupled that burden. And it's a pretty big burden anyway. So there is an unfortunate intersection between a declining population, which is good for most things, and the cost of decarbonizing and extracting the excess carbon, which will be born by fewer and fewer people.

Nate Hagens (02:01:58):

So I'm going to have to have you back to discuss the greening of the economy because there's so many rabbit holes on that that I would love your expertise and wisdom on.

(02:02:08):

But for right now, let me ask you this. What are the most promising ways that you've come across for actually subtracting carbon from the atmosphere, or things on the come that haven't really been proven yet that you're optimistic about, regenerative agriculture, geoengineering, cloud seeding, marine cloud brightening. Do you have any opinion or optimism in that field?

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Jeremy Grantham (02:02:34):

I'm optimistic on everything you mentioned actually. I think we will have to get involved into cloud brightening, sort of relatively low risk, relative high payoff. Certainly geoengineering, everything to do with agriculture. We're desperate. We can't be too careful. We have to be careful, but we can't be ultimately careful because we're running out of time. And it's something that we can really do a good job at changing the characteristics of the agricultural process and plants in general so that they sequester a little more carbon and require less energy to grow and so on.

(02:03:26):

One of my favorite down to earth little projects is a robot that runs slowly on its own across the field, gathering about half the corn stubble and converting it at very high temperature into biochar. The trouble, biochar is wonderful for microorganisms, wonderful for water retention, it really improves the soil. And the problem with it is that you have to truck biomass, which is fatal. And then when you've convert it into biochar, you truck it to a farm. And then you distribute it on the farm. It's all horrifically energy intensive. But this little machine is there. It takes the stubble right there and converts it to biochar right there. And it does it potentially very cheaply, incrementally something close to \$10 a ton or maybe zero because the value of the soil enhancement is enough to justify the process. And the carbon sequestration, which is very substantial, is a free good. Think about that. So that fits in what we call the too good to be true category, of which there are quite a few.

Nate Hagens (02:04:53):

I keep coming back to, we're going to have to value the natural world more than our current economic system does. And that is going to take money, and it's going to take money and resources away from stock car driving, or Las Vegas junkets, or Disneyland, or other things in the society. So who is going to pay for that? Is it going to be investors, or governments, or is it a cultural value shift that each of us tithe 10% of our income above a certain amount towards the natural world? Because then I think there's a lot more things that become possible among the things you mentioned. But until we get to that point, we are just outsourcing our wisdom to the financial market. And the financial market optimizes capital and not the environment.

Jeremy Grantham (02:05:49):

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Yes. And we will either improve, starting with the social contract, our attitude to we're all in this together, or we will in the end probably fail. In the meantime we're saying to ourselves, "That is a big ask and one with uncertain outcome." We know we can improve these things through technology. We know we can make it better. We know we can knock years off the research lifespan. Let us do what we know we can do that fits into a system that works pretty well. The venture capital world is the pride and joy of the American capitalist system in my opinion. It is unlike so many things where, far better to be in Denmark. It's far better to be in the US for venture capital. We suck in all the very best people. We have 15 of the 20 great research universities that are integral to the flow of ideas. We take risk better than any other group on the planet with maybe Australia close behind.

(02:07:14):

And this is it. This is the one little nook and cranny of the system that is great. People are flocking in from around the world into green tech. The green tech world is unlike any other quadrant of capitalism. They are actually thoroughly concerned with the problem and it's a big part of their driving force that this is an existential risk that they're doing something about. This is really heartening. I joke that they may get drummed out of the capitalism club because they have all these benevolent attitudes.

Nate Hagens (02:07:57):

Could you imagine what green tech and the demographic you just described could accomplish if we had not only a carbon tax but a tax on all non-renewable inputs to the economy that would give us the right signals for the down slope of the carbon pulse? And then you can apply all that ingenuity and creativity towards technological responses.

Jeremy Grantham (02:08:24):

And there is also the idea of the circular economy. And in France they're moving to make it expensive to design things that cannot be recycled, cannot be repaired. And in that sense... And the French are odd ducks as we... But they do some things very, very well. And I think this is such an enlightened attitude. And a lot of these problems are quite specific. So if you are in Denmark and you solve the chemical problem, you will simply live a lot longer and be healthier, and eventually other people will follow you. The trouble with climate change is it's fungible and there's a free rider effect, but we really depend on these handful of people who will set a good example and prove that

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it can be done, prove that in fact the economy in France 10 years later starts to grow a little faster than the others because they're insisting on more recycling and so on, a more circular, successful economy.

Nate Hagens (02:09:43):

Last question before I get to the final questions. There was a science article I think around eight or nine years ago that showed that if the United States went it alone, and did the Paris Accord, and did everything correctly for climate, that by the year 2100 it would make an infinitesimal difference into the global temperature. In other words, it has to be a global thing or it's not going to matter. So do you think there's possibility of global cooperation on climate endocrine disrupting chemicals and other environmental risks? Or does it just happen nation by nation and patchwork way?

Jeremy Grantham (02:10:31):

I fear that it will be patchwork, and in toxicity that works because people can see who is pulling ahead. However, I think as things get desperate, there is a decent chance that we will start to cooperate. People are a little stupid, but they're not completely stupid. And if we start to go to hell in a hand basket, will we not start cooperative ventures on a global carbon tax equilibrating policy where every product is treated the same way? Yes, I think that will happen.

(02:11:19):

In even more enlightened stuff it may or may not. We are going to make it... On 20 of these questions, we're going to make it if we are slightly more to the enlightened side than the unenlightened side, where we really exist well within a range of success and failure. I think even with our deficiencies, we're inventive. Taken all together, we can make it and we can fail. This is very unusual, that this is not a done job. This is not certain that we will fail. It is not certain by any means that we will succeed. And we will have hundreds of these little choices where some people will be more enlightened, some people will copy them, other people will be a pain in the ass. They will send the country back for 10 years. And the sum of all of these will decide whether we muddle through or whether we don't.

Nate Hagens (02:12:21):

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That is very well said. And that is the conclusion that I came to when I started this podcast, is we need more people to see the game board and how things fit together so that we can make better decisions and tilt towards the more enlightened.

(02:12:38):

So final few questions, Jeremy. You've thought about these issues for a very long time. You're 85 years young and you are uber focused on the things that really matter. Do you have any personal advice to the viewers of this program who are aware of climate change, endocrine disrupting chemicals, the flatness in our economy for the people in the lower three quintiles, et cetera? Do you have any personal advice?

Jeremy Grantham (02:13:09):

And before I answer that, I just want to say to the average, to the typical viewer, I have just spent 30 or 40 hours skimming through and occasionally really listening to Nate's 95 podcasts. And I by no means covered them, but I've tried to select the ones most relevant to me. And I have a real feeling for the style and what's going on. And let me say this is the kind of effort that if it takes wing, by the time you've done 3 or 400 of these, becomes the authoritative source that people go to get exposed to this line of reasoning. This is one of those things that can tip the scale a bit.

Nate Hagens (02:14:09):

Well, thank you for saying that. I can't imagine doing 300, but I'll keep going.

Jeremy Grantham (02:14:15):

Of course you can imagine doing 300. What sort of thought is that? I have about four people that you should really talk to. But that's only two or three years from now. That should be a piece of cake. You should be aiming at a thousand. There's just about a thousand useful people to talk to I should think.

(02:14:41):

The advice is, one of the main things in life is purpose. And most people born in the history of man have not had particular purpose other than staying alive. We have an opportunity to not just stay alive, earn a living, feed yourself, but we have an opportunity to change the outcome for future generations stretching out for more or less ever. And this is the purpose of all purposes, you lucky people. And if you do not attach yourself to this problem, you're missing the point, you're not paying attention,

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you're not being intelligent, you're not showing judgment. This is the issue that you should attach as much as your life to as you can.

(02:15:40):

And there is something to be said for make as much money as you can and deploy the money to people who know better about other things. That's perfectly acceptable. Or become an expert in any one of the thousands of jobs that are required to make it out of this mess. So it is a wonderful time to be alive in terms of purpose. And for my money purpose is one of the two or three things that make life worth living.

Nate Hagens (02:16:17):

I agree. How would you adjust that advice to a young human, 18 to 25 listening to this, becoming aware of these things? Sure, purpose, but do you have any other advice for young humans?

Jeremy Grantham (02:16:35):

Yeah, I mean it's the same advice really. Just pick a career that is useful. Tilt yourself to science and pick a branch of science that is relevant, of which many are, to this field. If you're a bit older, think about running a startup and make sure the startup has a chance of being really important. Think about getting into green venture capital because you can have some leverage, and raise some money, and show some scale. No, there are plenty of opportunities. This is a fortunate time.

Nate Hagens (02:17:24):

If you could... This is a question I ask all my guests. And if you listen to 20 or 30 of my episodes you know this. If you could wave a magic wand, Jeremy, and there was no personal recourse to your decision, what is one thing you would do to improve human and planetary futures?

Jeremy Grantham (02:17:40):

I suppose that's easy. I would wave a magic wand and have the global population become 1 billion. I like to say that we live at such a finely tuned part of the race of our lives that if you imagine a world where we have the population of 1900 and the technology of today, we have no problem. We've made it. If we had the technology of 1900 and the population of today, we're toast. We have no hope. The whole of this

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race has played out in the hundred year gap between population growth and technology. It's quite remarkable.

Nate Hagens (02:18:25):

That's well stated. I hadn't heard it put that way before.

Jeremy Grantham (02:18:29):

And therefore finding yourself at 1 billion tomorrow, I think we have enough time, and resources, and talent to muddle our way through.

Nate Hagens (02:18:43):

This has been quite a conversation. I would like to have you come back maybe as a round table guest or to take a deeper dive. Is there a topic that we didn't cover today, maybe esoteric, but relevant to our futures that if you were to come back and take a deep dive on that topic, does something come to mind?

Jeremy Grantham (02:19:05):

Well, my topics are toxicity, population, and the viability of the animal world, insect world, resource limitations, particularly metals, energy, inequality, deficiencies in capitalism. And we did a pretty good job-

Nate Hagens (02:19:34):

Yeah, we did.

Jeremy Grantham (02:19:35):

... Of at least getting into some of that, of each topic.

Nate Hagens (02:19:42):

Well, I hope this podcast is watched-

Jeremy Grantham (02:19:45):

And bubbles. That's my only other thing.

Nate Hagens (02:19:47):

And bubbles. Well, we're in numerous bubbles at the moment.

(02:19:54):

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Thank you for thinking and caring about these things during your career, and thank you for your time today. And to be continued I hope. And thanks Jeremy.

Jeremy Grantham (02:20:07):

And thank you Nate, the same way. Thank you for your efforts.

Nate Hagens (02:20:11):

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