

Freethink

A call to innovators in Silicon Valley and beyond to help chart the new way forward

At a recent Freethink Conversation, Peter Leyden urges innovators to drive progress and help build a much better world.



By Peter Leyden June 24, 2025

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The Great Progression: 2025-2050 roughs out a new grand narrative of our historic opportunity to harness AI and other transformative technologies to drive progress, reinvent America, and make a much better world.

On a literal level, the video below is my kickoff talk for a new physical event series. I delivered it to about 250 innovators from a wide range of fields, all jammed into SHACK15, a club in the Ferry Building in San Francisco — ground zero for all things AI.

On a larger level, the talk is a call to what I call the A Team — the advance team of innovators throughout Silicon Valley, the whole tech and innovation economy of the region, and, really, the A Team in every field through all America — to come together consistently and start figuring out the new way forward into The Great Progression.

For those of you who are new to this Substack series, this short talk lays out all the general themes that have emerged from my last dozen essays of “The Great Progression: 2025 to 2050.”

For those of you who have been following the series since the relaunch three months ago, this talk ties all the key big ideas from each of the essays into one integrated whole, creating a new piece that is greater than the sum of the parts.

We're all living, folks, in an extraordinary moment in history, in the United States, in the world.

This Substack series is a core part of an ambitious project that will culminate in a book of the same name, which HarperCollins will publish in January 2027, just in time for the start of the next American presidential political cycle.

The new physical event series in San Francisco is the next stage of the project done in partnership with Freethink Media, which has been syndicating my Substack articles to broader audiences through their media world online.

We launched the quarterly series on May 29th, and my keynote talk was designed to sum up in 25 minutes many of the biggest ideas and key themes from my dozen essays in the Great Progression Substack series, bringing attendees up to speed on the foundation of ideas that we have built up over the last three months.

Freethink produced an extremely well-done video of my talk that you can watch in full below, which includes many of the graphics developed for the essays. Those 25 minutes are the most efficient way to absorb all the key ideas of the series — and perhaps the most fun.

I've also included a transcript of the keynote below the video in case you prefer that format or want to cut and paste the ideas that resonate with you. I've layered some of the key visuals into the transcript, but not all — best to sit back and watch the video for the full effect.

In a world of endless noise, Freethink Media creates live experiences that connect, inspire, and transform. [Sign up](#) to get notified of upcoming events.

The following transcript has been lightly edited for length and readability:

We're all living, folks, in an extraordinary moment in history, in the United States, in the world. This image, this kind of iconic image that we're using for [this series](#), you can look at what's going on in the world — with climate change and what Trump's doing and geopolitical tensions — and you can see the world falling to pieces. You can see gloom and doom.

But you can also look at the other side of it. We have these world-historic technologies coming. We have these tools. We have these other pieces lining up here that could drive great progress. We could reinvent America for the 21st century, and we could really make moves towards a much better world.

It's that kind of dividing line. We are here in that moment, and we're here in the Bay Area, which is a critical, critical piece of the puzzle to figuring out this going forward.

Now, the way I talk about this is — I've been saying it for the last three years — is it's the Great Progression. I'm trying to get people to focus

on how we could be on the verge of a great era of progress, literally starting now for about the next 25 years. I'm trying to get people to stretch their minds in the same way we were trying to do in the '90s, trying to explain to people the next 25 years — What happens when the internet connects everybody? What happens when these little startups become giant companies? What happens? — and largely, it did play out.

I've been talking. I've been doing keynotes. I've probably done 40 talks on this in the last few years. I've been writing on this [idea of the Great Progression], but what we've decided to do is start an event series on this, and we're doing it in partnership with Freethink.

They bring the production value, the media, and their networks. Some of you here are coming from their networks. We're doing it with SHACK15. We said, "Hey, we want to throw this, catalyze this network," they said, "We're in." They're giving us this space, and a big portion of you are coming in from SHACK, which is kind of a global network of all kinds of entrepreneurial characters, innovation characters, including those in Gen AI.

Then I bring a bunch of OGs, kind of the old guard and the networks that, over the last 30 years, I've collected: people from the tech world, from [WIRED](#), from Global Business Network, from The Long Now Foundation, from UC Berkeley, Stanford...

This is a crazy-interesting network of people mashed up here, and so that's partly why we've reserved an hour and a half at the end for you all to have a party and connect up

We are witnessing the arrival of three world-historic technologies.

I'm going to give you a little quick history on what happened here.

It was Freethink that approached me three years ago, in 2022. They said we needed another kind of "Long Boom" cover story, and they

commissioned me on a 10,000-word magazine piece, which was called “The Great Progression: 2025 to 2050,” even though it came out in September of ’22. Just to put this in context, ChatGPT 3.5, generative AI arrived on the scene in November of ’22, so this predates that.

I came up with this idea of having to rethink how much possibility we had in the future in a more can-do, forward-thinking way. That has now morphed into a Substack series, which I’ve been doing for the last two months here, a weekly essay that is just going gangbusters in Substack.

For those of you aren’t on [Substack](#), you’ve got to tune into this thing. It’s just a hive of great thinking. A lot of these pieces, I’ve tripled my audience. People are loving these ideas. Not just because of me. People want to positively think about the future and what’s possible here.

I also have a book deal coming out of this with HarperCollins. They grabbed the global rights. It’s going to be coming out, and they want to push it out into the world, so we have a vehicle here to actually squeeze down some of the new ways forward.

But the key thing is this quarterly series. We’re going to start doing this every three months.

Now, the big idea that starts this is that we are actually witnessing the arrival of three world-historic technologies. These are technologies that we could only dream about 25 — let alone 50 — years ago.

One is AI. Just without question, a world-changing technology, and I’m not going to have to preach to the choir here, but I’m just saying we take that as a given, that this thing is a world-changing technology.

The second one is we’re making a transition into clean energies. Energy is going from a commodity — a carbon commodity — to a technology, which means you can drive down the cost, so we’re on the verge of abundant, clean energy — with also fusion on the horizon.

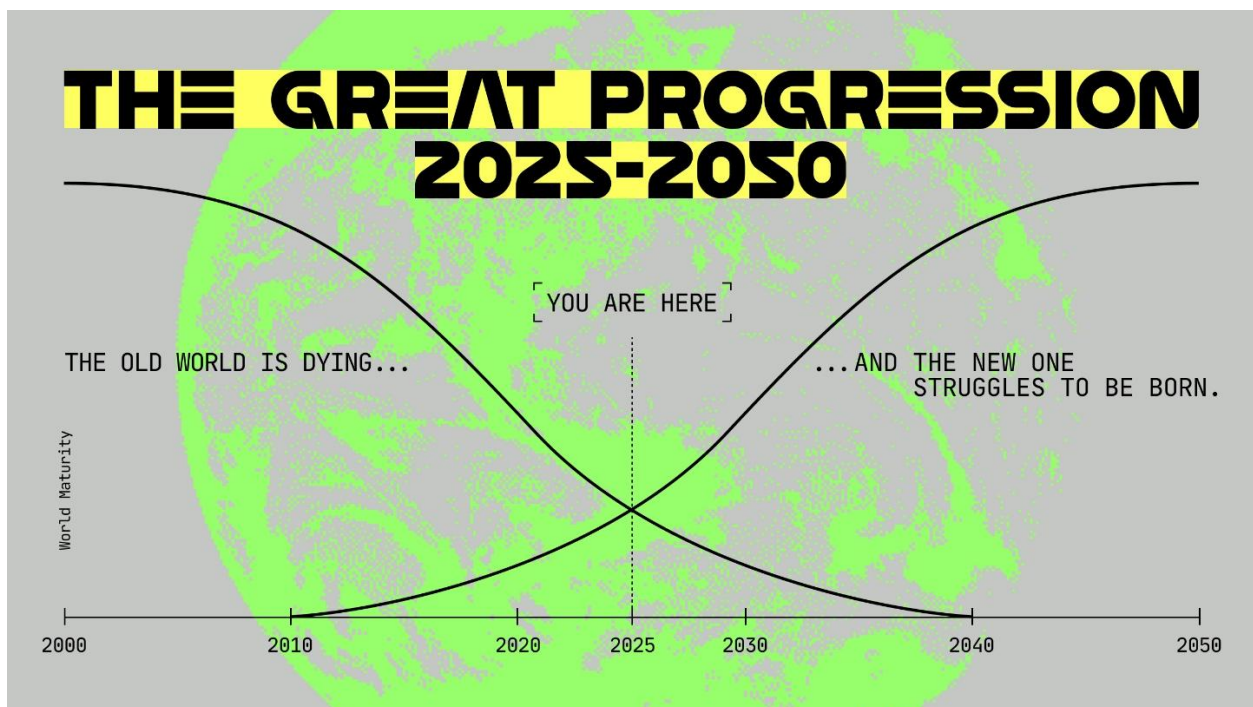
We've also in the last few years figured out how to bioengineer living things, which is a crazy, wild thing that's happened in the last 25 years, but recently we've gotten the capability to do this and now we could rethink so many materials, products, as well as extend lifespans and all kinds of things that we're on the verge here.

This is all hitting, triple whammy, at the same time.

So, we're actually entering an AI age — that is essentially giving us a fundamental step change in capabilities. We can really reorganize the world around AI in ways that are profound, and we'll never go back. Humans, for centuries, will be on AI.

We are actually crossing this threshold into the potential for abundant clean energy, and the function of any civilization is how much energy you can draw off of without blowing out the climate — we're on that threshold.

And we're on the threshold of an age of bioengineering, synthetic biology, and the like.



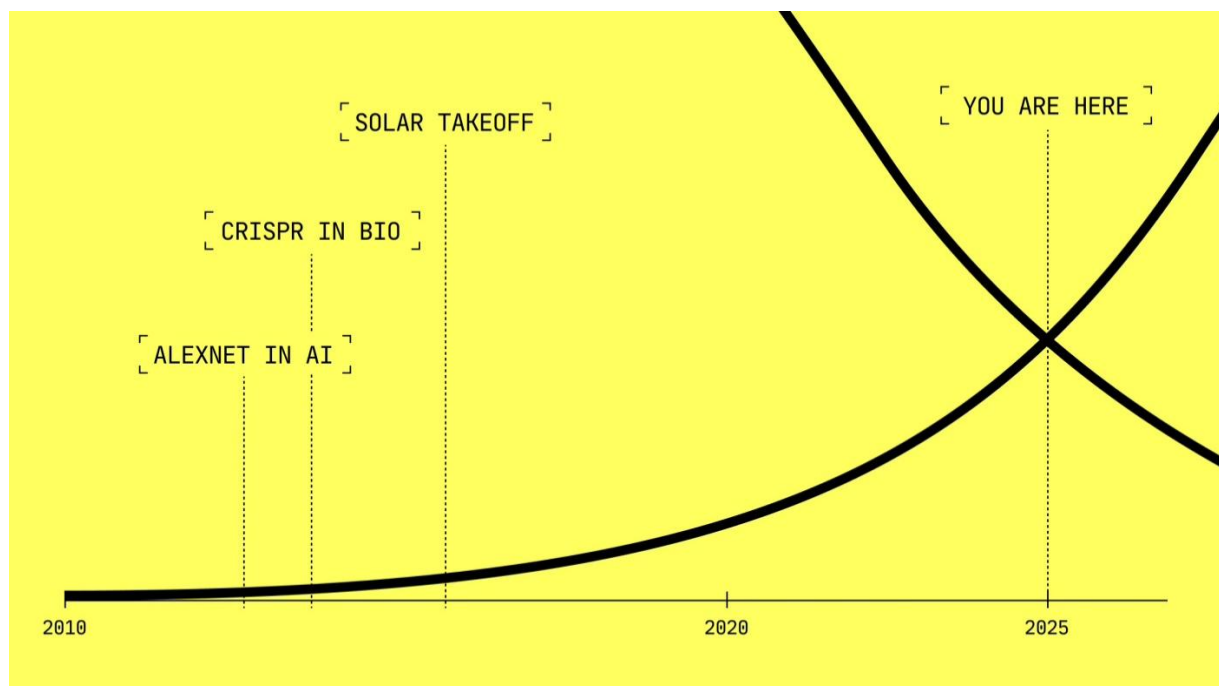
One way to think of what's happening to us today is that we are witnessing an old world that's dying. The old world could be carbon energies that are dying. The old world could be the post-World War II, Pax Americana world, the welfare state, kind of going down.

We're also watching the new one [that] is struggling to be born.

What I'm calling this is The Great Progression.

You are here. One of the reasons it's so confusing right now is we're caught in the middle of both things happening at the same time, and we're freaking out about one going down, and we're kind of starting to understand what's going up.

Now the key thing that people forget about is that scaling up holds the potential for what economist Carlota Perez calls the "Golden Age." Every transformative general-purpose technology eventually gets over this hump, and you can open it up for everybody — it leads to what she calls "The Golden Age of Technology," which we will chat about a little bit later.



When you look back here, all three of these technologies had huge breakthroughs just 15 years ago.

One was AlexNet in AI. That was essentially a neural network, using large language models, was able to identify pictures, cat pictures, better than any kind of human-coded AI could do.

Then, we had the breakthrough in CRISPR — cheap, easy gene-editing breakthrough that happened there.

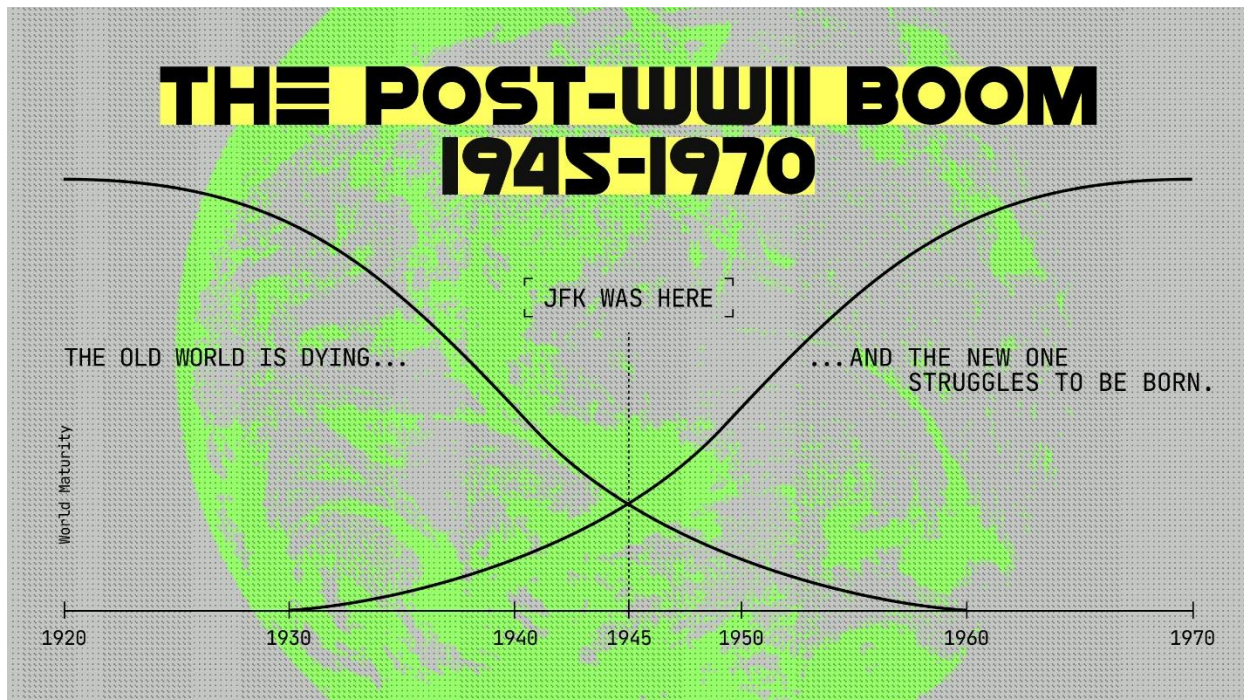
The third one, we didn't have an exact date, but we basically had breakthroughs in scaling up solar energy.

So all three of these things has happened, but they're just taking off, and we haven't seen them all come into fruition. We haven't seen what's going to happen here, and what I'm trying to breathe life into and what we're trying to do in this series is breathe life into: What does that look like? How does that work? How does that world actually operate? What's the best we can do? How can we make the most of this stuff?

When you have transformative technologies, general-purpose technologies, when they come out, if they're big enough deals — which these are — they start reshaping how the economy works. Once the economy starts changing, it reshapes how society works. Ultimately, with certain technologies, if it's big enough, it actually has civilizational-scale change.

I'm basically positing here that we're starting this chain reaction.

Everyone's talking about the technologies today. This series is going to start looking at the next layers. What's the economy we can make? What's the society we can do? And even some of this across the century, how can we start thinking civilizationally?



Now, when you start thinking that way, the closest thing we've been to in America in living memory for some people — not anyone in this room, but my mother, for example — is what happened after the Great Depression / World War II. We saw a similar thing, a dismantling of an old world of colonialism and all kinds of stuff, laissez-faire capitalism. We saw new things trying to struggle to get born, setting up what eventually became the post-war boom.

JFK, for example, fighting in the war, and later, the first GI generation president, was there. We can remember this great boom from 1945 to 1970 — it goes down in history as one of the biggest, greatest booms ever. We actually rebuilt America. We rebuilt Europe. We rebuilt the whole thing. That wasn't an odd thing, because we've done this several other times in history.

We go back to the '30s and '40s, and FDR was elected, but there was ferocious politics. The Republican Party at that time was literally on the verge of, certainly isolationism, but even fascism. You had world-changing technologies, like nuclear fission, and you had geopolitics at an incredible scale, where you had the rising powers of Japan and

Germany — we had to fight them off. Essentially, it set up this great boom.

This is a big deal. We're on the scale of that kind of change, and we gotta tune into this.

The nice thing about this is ground zero is the San Francisco Bay area — there is no other place on the planet, without argument, in terms of these core technologies and particularly AI. Now, you could kind of quibble on the other two a little bit, but the point is this: You are here.

You are literally sitting right there. We're in the middle of this, so we bear some responsibility, frankly, folks, for helping think about the new ways forward, how to make the most of this, how to make it work for everyone over the long haul.

We're having a triple whammy phase shift in three step changes in human capability.

I want to just run over some stuff here on technological step changes. We're making three of them, and to be fair, folks, historians of technology say there's been about 25 world-changing general-purpose technologies. This is like the printing press, electricity, the wheel, and things like that. We're in that league. These are going to go down as world-historic, world-changing capabilities.

Now, one thing here is AI is a special category of this, because you could actually argue that, until The Enlightenment and the Industrial Revolution, humans could augment their physical power by just hanging onto a horse or then something like a plow, but once we cracked a machine, a steam-powered machine, we could get the power of 200 horses.

That was the beginning of the Industrial Revolution, the beginning of the world that we're living in today, the modern world of prosperity and wealth and all the things that we take for granted today.

But up until now, anything to do with intelligence had to have a human brain connected to it. Anything. The simplest thing. You're sensing the world. You're reasoning about what's going to happen. You're making the decision. You had to have a human doing it — until now.

We now have machines that can augment our mental powers. Not our physical powers. Our mental powers, our intelligence. This is an unbelievable shift because intelligence can be applied to everything. Every industry. Every field. That's what people haven't fully grokked: how big a deal this is going to be.

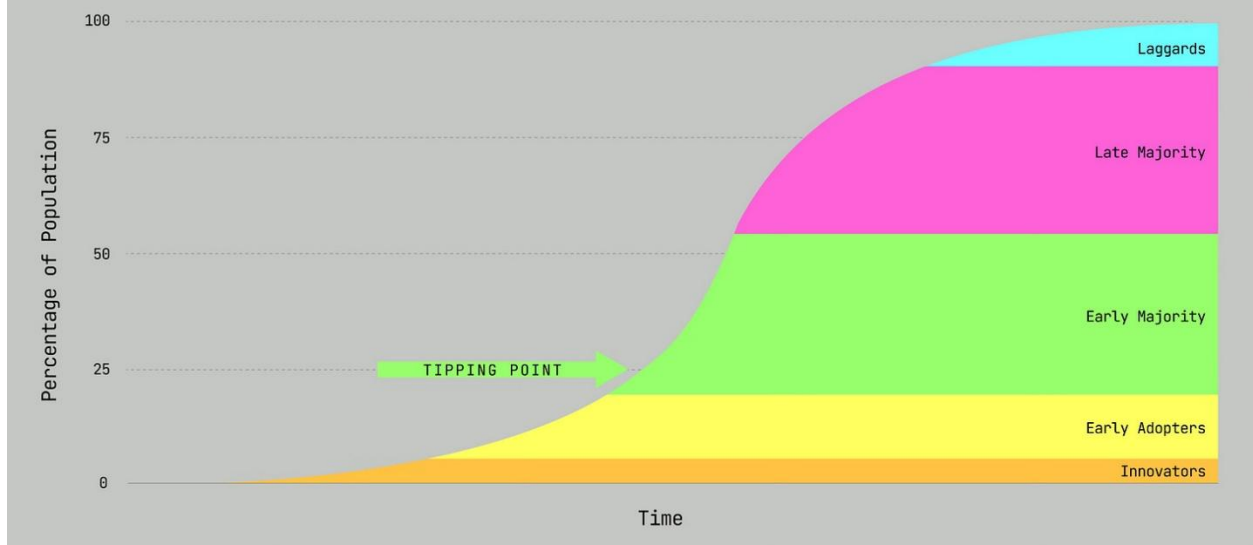
Now, there's been other game-changing technologies. If you go in the past, The Enlightenment, we had the printing press, and it changed the world, which is more communication. We've had energy. We figured out how to dig coal out and have energy at scale, and then we had, again, machines.

We are in the same game now, because you could say AI's basically applied to everything, but it's communication, simultaneous language translation. We're shifting in energy in a fundamental way, and we're shifting in production towards bioengineering, synthetic biology and the like, which could supersede industrial production in many ways over this century.

When we first came out with electricity, it took us 40 years to come to terms with that. Then we had the car revolution, and then we had the digital revolution that a lot of us in this room have lived through.

But we're having a triple whammy phase shift in three step changes in human capability. That's what I call the Great Progression, and so that's kind of the frame of what we're trying to do here.

ADOPTION CURVES & TIPPING POINTS



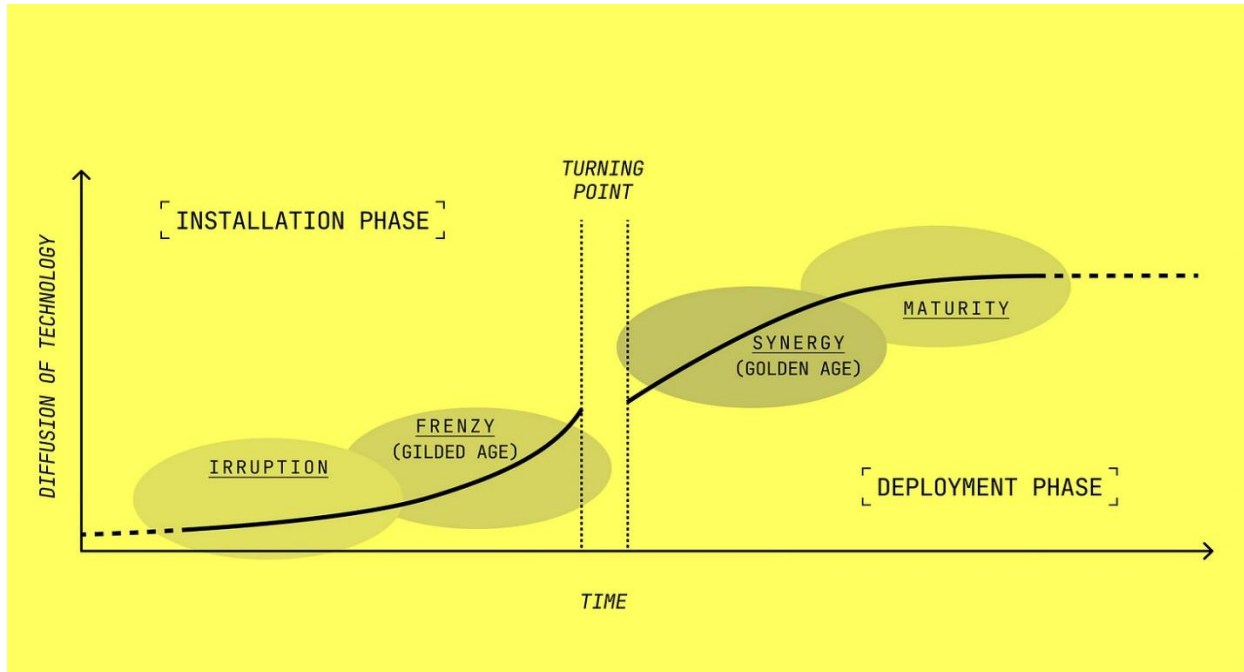
[In] “The Long Boom” cover story, we had tried to project 25 years in the future — me and Peter Schwartz, a famous futurist at the time — and I will say one of the reasons you can do this is there’s a way to start to understand tipping points in technology adoption curves.

Every successful technology goes through this — a lot of people in this room, I don’t have to repeat this — but the point is, boom, the tipping points. When did the tipping points happen? I’m arguing we are hitting the tipping points on all three of those. They’re all tipping. It’s not like a debate: “Is it going to happen? When’s it going to happen?” It’s happening. It’s going to go fast.

One thing about tipping points is, up until that point, everyone’s kind of, “Eh, it’s not quite working.” Boom. After it, they think, “Oh my god. This is amazing.” We’re on the amazing point of all three of these.

Now, this is Carlota Perez’s version. I borrowed this and reworked this, but she put it in a bigger way that every major technology, from a societal point of view, goes through a “Gilded Age” when it’s a frenzy of making money. Then, after this turning point or tipping point —

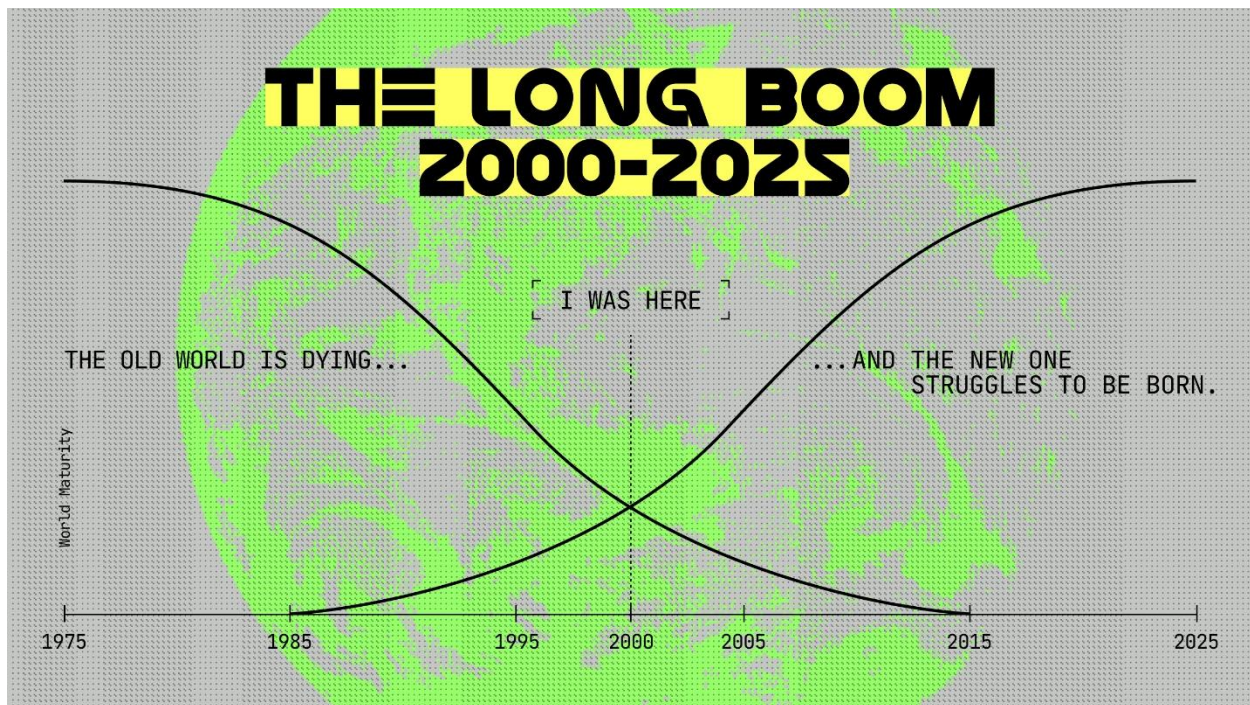
particularly with government intervention, if you intervene it the right way — you can make it work for everybody, and that’s the “Golden Age.”



I’m saying that we’re at that stage now where we have to figure out the new way forward, and we need some intervention to make it work for everybody.

Now, the Long Boom version of this, for people who remember that stuff — this is not the same scale, but we saw the old media dying. We saw the new digital media coming.

I was trying to write about this, The Long Boom, looking out there. I was there, A lot of you people in the room were there. We understand how that works, because when you went back into the ‘90s, the Mac came out, and then the web came, and then the dotcom boom. Get a little frenzy there of making money, and then we basically had the Long Boom.



What I'm saying is we're just applying the same thing to this here.

So, what happened? In the last 40 years, we built the power of these computer chips. That's what the Long Boom said: We're going to keep getting stronger. We're going to connect everything to the internet. Okay. It happened. We got to digitize all our information. Then, we got to get it all in the cloud — that took 15 years of convincing every business to do that. Then, we had to have prosperous tech companies to pour billions into this since the government wasn't doing it, and only then we got AI.

But here's the point: The foundation for AI is built. It's done. We don't have to wait, like in the mid-90s: "Well, someday someone's going to have fiber optic cable at your house." That took 20 years, right? But that's all done, so this is going to move fast, probably faster than any tech transition we've ever seen.

Now, technological revolutions go through two big revolutions — go through two stages — and I'll give you just the car one [that] everyone gets. I just want to do this quick, but it took about 40 years from the

Model T Ford to get a gas station in every neighborhood, to build roads, to figure out where to drill oil — 40 years it took to do that.

But then after the war, when we finally did that, everyone had a car, and they said, “Well, what can you do with a car?” And then, it was like, “Oh, shit. We can do the suburbs, malls, drive-ins.” I mean, it just exploded in innovation and fundamentally changed the world, fundamentally changed what America was.

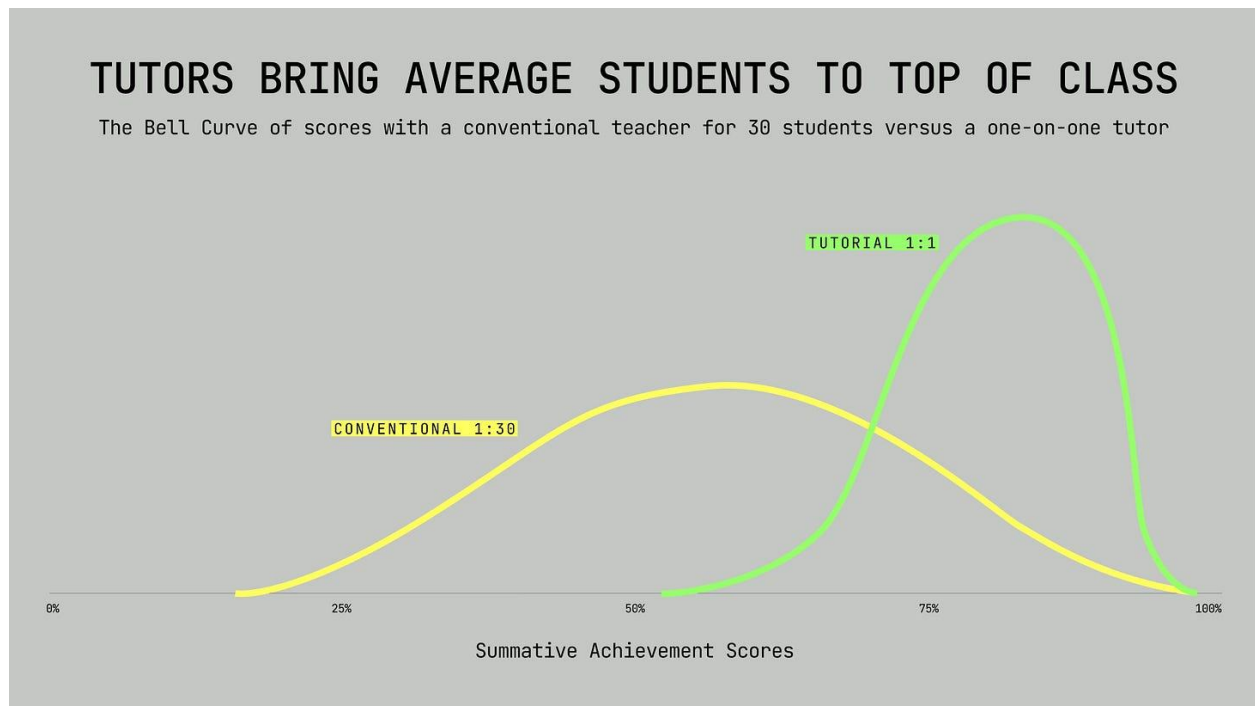
We’re in that same thing now. The foundation, we’ve already got. We spent 40 years trying to explain what the hell the cloud was to everybody, and now we’re at the point where, “What can we do with AI?”

Executive assistants for everyone. Individual tutors. Oh, wow. Autonomous vehicles. You can start to see them, right? It’s like now we’re just starting the explosion of innovation in all directions, so we are all going to get personal assistants for everybody. I mean, it’s just happening. In fact, in the next two years there’ll be agents you’re going to be surrounded by. This is just one person — you’re going to have 25, whatever, agents in every direction, telling you everything you know. If you know a little bit about climate, you don’t know shit about finance, let your agent help you do that.

Anyhow, it’s crazy, so it’s possible productivity rates could go up, growth could go up. There’s a bunch of things. We might have another kind of Roaring Twenties. Some economists are starting to think this: “Hey, this is going to do it.” I’m going to talk to Steven Johnson about this in a minute.

Same thing with tutors. Here’s a good example. Now we have AI. Clearly, you could have a tutor for every kid. We know that, basically, everyone in this room had one teacher to 30 kids. A few of us got it. Hopefully a lot of people in this room got it. The middle of the people kind of got it, and the people at the bottom had no idea what was going on, but it was one teacher. She or he was trying to do their best.

We know, with human teachers, you can take any kid in that group, put them in the top 5% of the class with one human tutor. It's clear that we're going to be able to, basically, supplement this assembly line of education with one AI tutor that learns what the kid is like for their whole life, and then for that matter on, that tutor can kind of live with you for the rest of your life.



This is possible now. Why aren't we thinking from scratch, how to [redo education from scratch](#), as opposed to grafting into something or figuring out if a kid is cheating with it?

So, this brings up this abundance idea. Rich people always had tutors, but what happens when everybody has a tutor? That's abundant education. Same thing with energy. One thing, if solar is so cheap, it drives the price. Poor people will be driving electric cars because they're going to cost five grand or something. We have this [possibility of abundance](#). That's why you're starting to see it in politics coming up.

So everyone here is probably like, “Okay. Well, how are we going to get from here to there?” And I’m going to tell you one way we’re going to do it.

So, what I would say — and again, we have a whole party where we can talk about this later, and I’ll argue with probably everybody at the bar until midnight — but basically, [Trump is a populist backlash](#) against the old thing that wasn’t working. And frankly, the old thing wasn’t working. The kind of Pax Americana, we couldn’t sustain it with our deficits. The welfare state. The bureaucratic thing. It just really wasn’t solving the problems.

I mean, be honest. No matter what your politics are, it’s been 80 years, those two things. I think the main reason that Americans voted for him, in their gut, was somebody was going to at least try to change, as opposed to just keep it going, keep it going, keep it going, which is what the Dems essentially keep saying all the time.

So don’t think of him as the future. Think of him as the spasm against the past. But what’s interesting about American politics is we’ve gone through this many times, and basically there’s a pendulum swing in American politics. Let’s say we’re at the 50/50 spot here, right? All it takes is a shift of 10% of the country into one camp or the other, and then you have a 60/40 majority, and then you can drive change for as long as 40 years. This happens frequently.

All we have to do is, one way or the other, depending on what your politics are — and it doesn’t have to be the same kind of vicious politics that we’ve got now — but I’m saying, to build a political coalition going future-forward is not that hard.

There’s room to start to talk about a new way
forward in politics.

We’ve seen, for example, if you go after the war — that one I just told you, the Golden Age — that was a progressive period. That was a focus

on equality. Government intervention to build public infrastructure. Tax the rich quite large — I mean, the taxes on the upper 1% were like 90%, 70%.

That was a period where a lot of things worked. Then we had a different kind of pendulum swing. We've had 40 years — which has also got its revitalizing side — of unleashing the private sector. We were able to build the internet, all kinds of stuff around that. To be fair, that was a lot of progress in that period, too, so I'm just saying we're on the verge of another thing.

Trump is just trying to get rid of all 80 years of that, because both sides, Republicans and Democrats, kind of bought into that, but the American people were like, "We got to do something different."

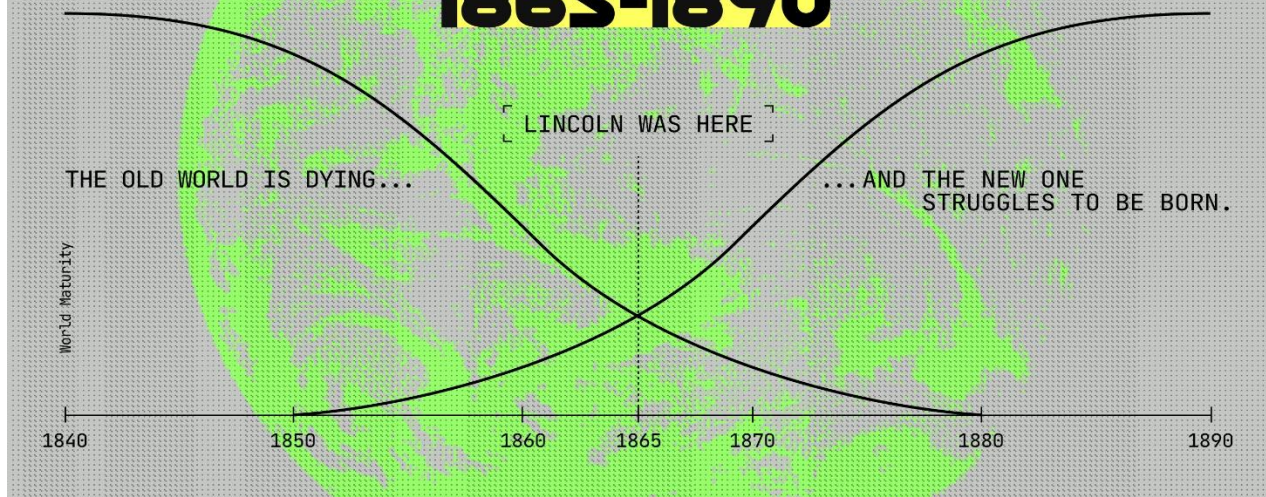
So, I'm thinking this is the thing, and this is where we're at. I think there's room to start to talk about a new way forward in politics, about what we could do here, because what's interesting about American history is we've seen these pendulum swings.

Basically, there was a populist backlash against the original crew and the Revolution. There was a whole Civil War. There was a progressive era — even the Republicans and the Democrats at the time were both kind of progressive. Then, there was the kind of post-war thing I just mentioned, and then there was the Reagan Revolution. We shifted that way, and even Dems kind of got on to the small government idea and all that.

There's something happening now. It's not Trump, but it's not clear who it is. I don't want to personify, but the moment is ripe for this kind of figure, is what I'm saying.

Now, here's the crazy thing about this. Those are revitalizations. Three times in American history, we have completely reinvented the country, and I would say we're in one of these now.

THE POST-CIVIL WAR BOOM 1865-1890

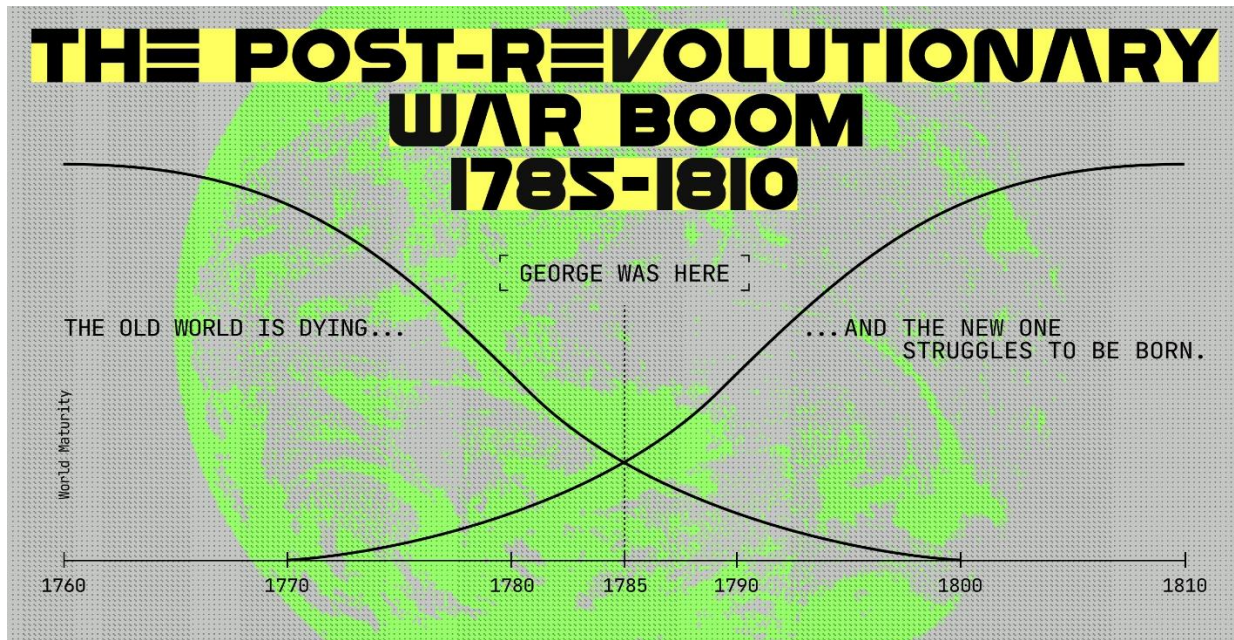


This is the crazy thing. It literally comes down to [every 80 years](#). There's a bunch of reasons for this — I've written [essays](#) on this, trying to explain it. Without going into the reasons for this, I will say we've watched this happen. I mentioned to you it happened coming off the Great Depression, World War II.

I went through that one, but the same thing happened in the Civil War. What was happening there is they had the old system dying with slavery, and the whole new thing being born with a manufacturing economy, free labor.

Then, we had this kind of period, coming off the Civil War, the boom. Lincoln was in the middle of there, and what happened is, once we settled that, after 700,000 Americans died in that fight — we think it's bad now? 700,000 people died in this debate over that one — but you actually had a Golden Age. We had a great expansion. Transcontinental railroad. Homestead Act. The American dream was born out of that whole period.

So we had these tensions, these horrible politics leading up to that. We had new technologies, like Bessemer steel for the railroads. Things happen, and then it also shifted.



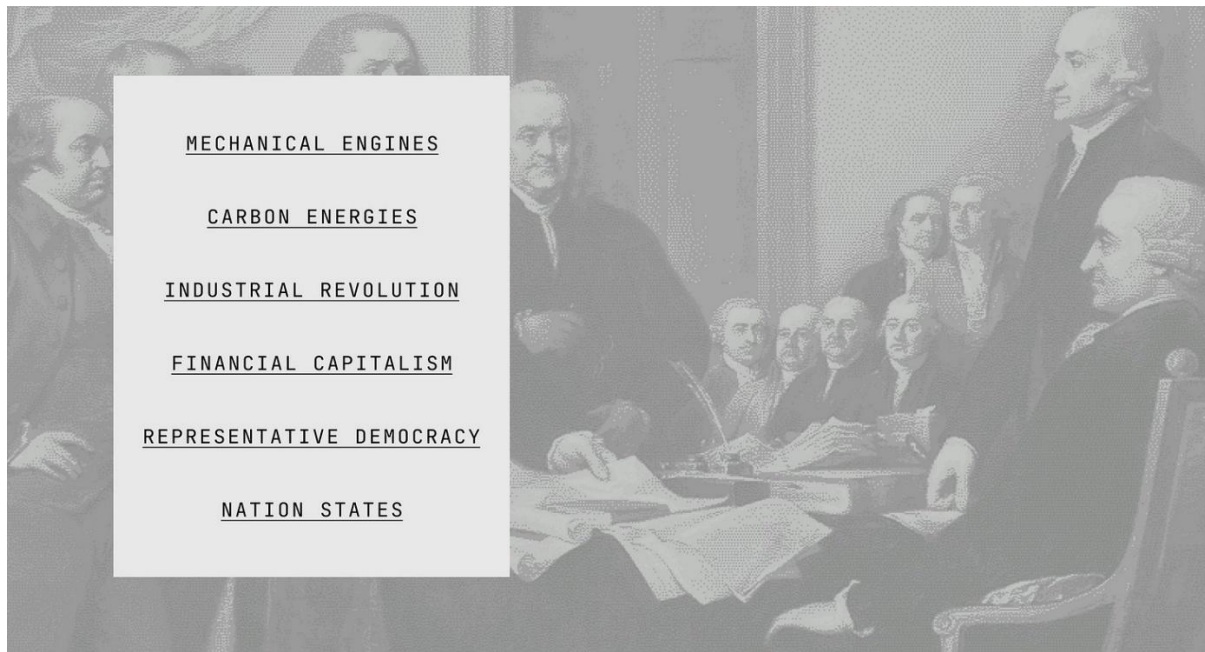
It even happened in the Revolution. If you really think of that as a reinvention of America, or an invention of America, the old system was the colonial system dying. The new one was this new thing trying to be born.

We basically had a boom coming off the Revolutionary War. George Washington was smack in the middle of it, and we did have a Golden Age. There was a huge expansion. All kinds of crazy stuff happened. The Louisiana Purchase, all kinds of stuff. We had the same tensions in those 15 years. Boston Tea Party. The Declaration of Independence. We had to have a war.

So what I'm trying to say to you is we're in another one of those moments now.

Now, the final little kicker I'm going to do here is the bigger way to think about this is we might even be in such profound change — the AI

is such a profound change — that we might be closer to [what happened in The Enlightenment](#).

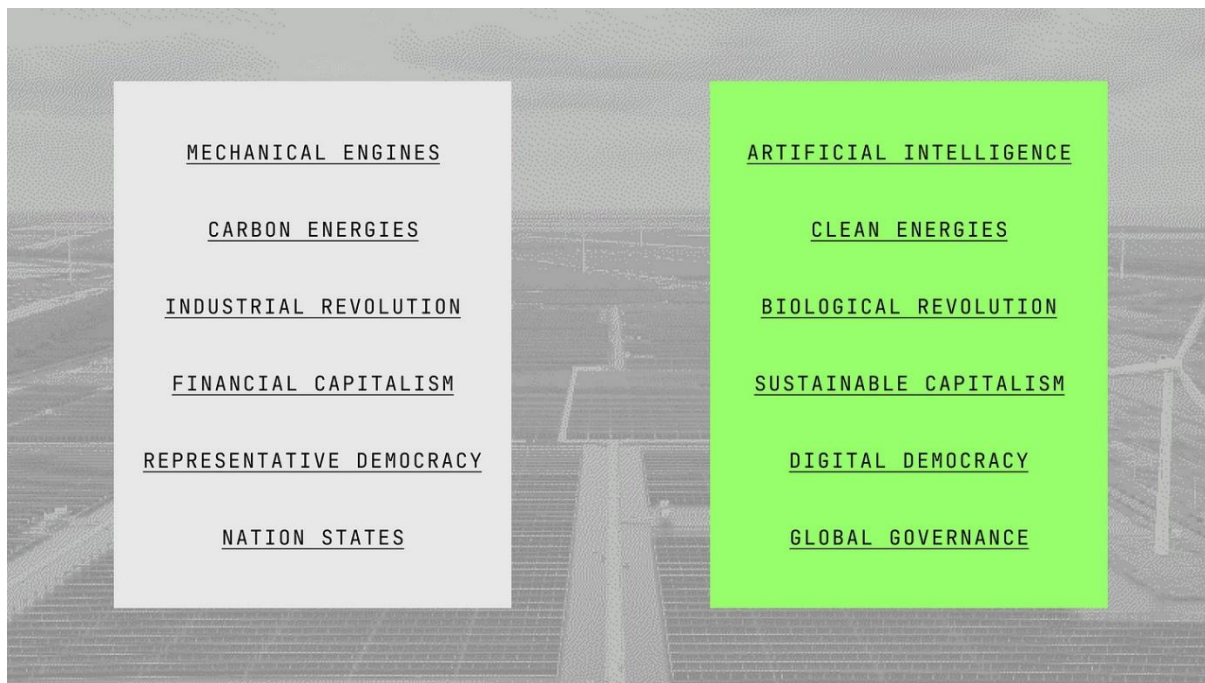


That was roughly 1680 to 1800, but in that period of time, we came up with six crazy-big inventions that the world is basically still defined by.

We had mechanical engines, I mentioned that. We had carbon energies at scale. We had the Industrial Revolution around those steam engines. We had financial capitalism to keep it going. We had to invent that. That didn't happen before this. We had representative democracy. That was the American version of that, although the French tried a shot at that, too. And we had nation states.

These didn't exist before, and they are still the world we're all working in, but they're also screwing things up now, including climate change.

So, what happened in that period was you had the technologies come out in the first 40 years — that was the breakthrough. The economy morphed in the second [40] years — Industrial Revolution all at scale, financial capitalism. Ultimately, it was the political revolutions that came after that, French and American.



What I'm just planting the seed here — and we're going to explore it later in this series — is are we in something comparable? Are we in such a big change of fundamental tech changes that we're essentially now, just like those, we've got our absolute game-changer: AI?

That's like a civilizational-scale reboot, but also we're watching clean energies emerging out of energy. We may see some kind of biological engineering revolution out of industrial production. We may see — and this is more open-ended; it's going to take a while — a different kind of capitalism, more equitable, better on the environment. We might see something supersede this goofy thing that we're still trapped in from 250 years ago that's certainly not working — Trump's banging his head against it. And then even some way to coordinate global governance.

I don't know how this is going to work. But I'm saying there is something at the scale of that era that I think we have to at least open ourselves up to.

I think we've seen the tech come — I just laid it out to you. There's probably going to be the economics, and ultimately, it might take a while for the politics, but you are here. We're out of the pure tech game

— we're into the "innovate everything else" game, and that's what I'm trying to get us technologists or people rooted in tech to be thinking big here.

Now, the final little kicker is it even gets more complicated because it's happening for everybody. We've got China, and so there's basically two AI superpowers. If that's the core technology of the future, there's two superpowers. There's nobody else on that, by the way. And there's been a battle from the history of the country between democracies and autocracies. We're slipping a little bit here, too — we might become an autocracy. But I'm just saying, the point is we've been part of a global community on this.

And so, the AI way of the Chinese is pretty much authoritarian, top-down. And boy, will it be a great authoritarian tool to monitor people constantly, the whole thing, and that's a model for the world.

And then there's the Western way, the American way, which is this bottom-up crazy-ass thing, but, honestly, I think we'd rather figure out the way forward in this. So I think we have a responsibility — beyond us, beyond America, to the world — to figure out how AI works in the future.

You are here. We are caught in this moment. It's an extraordinary moment. It's fraught with peril, but it also has so much positive possibilities here, folks.

We are at this moment where we could actually play a difference in shifting the zeitgeist of this country, potentially the world. And it's not out of the question that people in 50, 100, 1,000 years from now, they're going to look back and say, "Ah, people in that period, they figured out AI. They finally got over to AI, and the AI that we're still using centuries in the future." They'll say, "Ah, they finally got onto clean energy, abundant clean energy, so we finally solved the climate change thing. We figured they were going to do it eventually, but glad they did it then."

One more notch. They'll say, "Yeah, they figured out bioengineering. We're able to make a much more sustainable world, more in sync with nature, extend their lifespans, and get rid of diseases. Ha, that's great, all the things that we now use. They were able to pull this entire foundation for a civilization that we're still living in 500, 1,000 years from now."

They might even go one more notch, and they'd say, "Wouldn't it have been an amazing thing to be living in that time, in that period, where they were making all those insane changes? Wouldn't it be exciting to be part of that? Wouldn't it have been something to be in San Francisco at that time, at that moment when everything was so fraught with energy, but also could change so fundamentally?"

And I just want to end this by saying, folks, we are here. We are here now. We have this possibility.

So, what we're going to try to do with this series is we're going to try to pull together the networks, drive the conversation, get people thinking in this direction and around this framework, and do the best we possibly can to actually figure out this new way forward and figure out the new way into the Great Progression.



The Great Progression

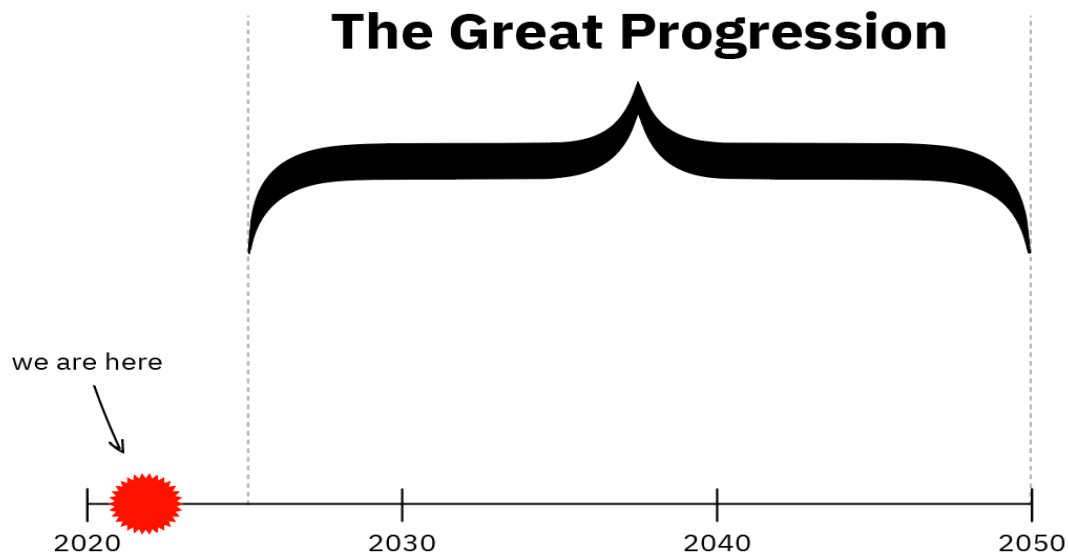
2025-2050

Peter Leyden

The world isn't ending! But we are likely at the beginning of a profound transformation.

“This slow-moving, **pro-progress story** is being missed by most of the mainstream media chasing the minute-by-minute story of crisis and decline.”

Peter Leyden is a thought leader on new technologies and future trends. He was the managing editor of *WIRED Magazine* working with the founders in the early digital revolution. He subsequently founded two of his own media startups focused on the future. Learn more at peterleyden.com



The time has come for a positive reframe of what's really going on in America and the world right now, and what's actually going to happen in the near future. For far too long we've been looking at our current situation and the coming decades through the lens of the past.

The Great Progression

Most people are stuck in the familiar default frame that sees many of our old systems breaking down in the face of myriad challenges like climate change, polarized politics, economic and social inequities, the paralysis of liberal democracies, and the rise of authoritarian states. That's as far as they can see.

2020203020402050

Yet we're now at the point where we can view what's happening, and what's soon coming, through the lens of the future. That view sees the many nascent systems emerging that are superseding the old ones breaking down. This perspective sees many slow-moving positive developments coming to head, transformative technologies ready to scale, and new trends building to the tipping point. This perspective focuses not on breakdown but on rebirth. So now there's a new narrative able to come together about progress emerging all around us, about progress that's inexorably coming as we lay the foundations for these new systems in the next 10 years, and about how they will scale in the next 25 years to help us solve many of the great challenges that appear to stymie us today. Let's call this the story of The Great Progression.

“There's a new narrative able to come together about progress emerging all around us. ... Let's call this the story of **The Great Progression.**”

This slow-moving, pro-progress story is being missed by most of the mainstream media chasing the minute-by-minute story of crisis and decline. Yet all the pieces of this positive story are now positioned to be catalyzed: There's a loose pro-progress movement that's emerging through different sectors of politics and the economy. There's a new way of thinking about how to move American society, the Western world, and the world at large ahead. There's also an emerging majority of smart, decent, and practical Americans who are realigning and getting positioned to make rapid progress in the years ahead. This pro-progress story gets even better when you step back and think about the really big picture, when you think through how people living decades if not centuries from now will look back on our times. From that vantage point, we're arguably at the beginning of a transformation that is going to change the world in profound and largely positive ways. In the next 25 years, the world arguably will deal with climate change and transition the bulk of our core energy sources from carbon to clean. We will transition our transportation systems from the internal-combustion engine to electric mobility as part of an even larger process of reinventing cities. We will scale up brand new industries and build a much more environmentally and socially sustainable society. We very likely will reform capitalism around new economic priorities that counter the current imbalances and inequities. And we can be expected to revitalize our democracies and push back on authoritarianism around the world. People in 50, 100, or even 500 years from now may well

look back on our era and marvel at the transformation that we're about to go through.

This is not just a nice utopian scenario, but a story of speculative journalism about what's actually starting to happen, and most likely will play out over time. We're up against world-historic challenges that require transformative and not just traditional solutions. America has pressed through historic junctures like this before, and we're poised to do it once again. We need rapid progress along many fronts, and we are fully capable of meeting the moment this time too.

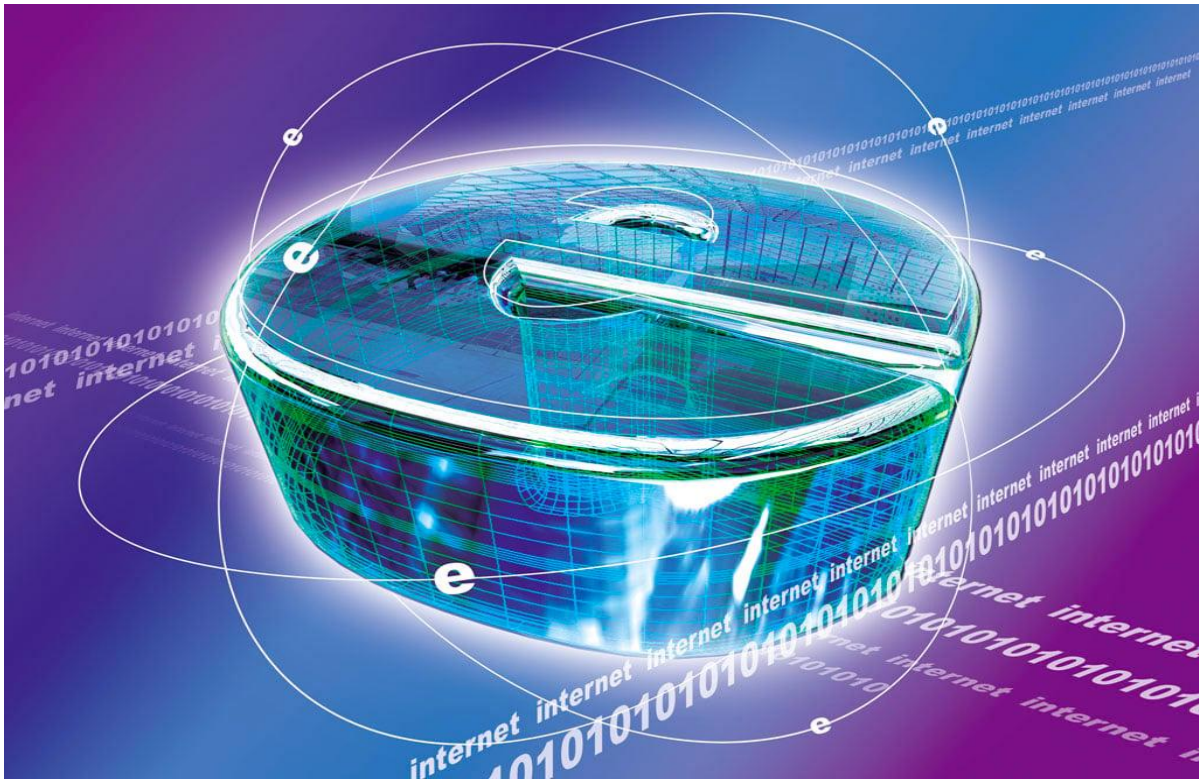
“We're arguably **at the beginning of a transformation that is going to change the world in profound and largely positive ways.”**

We have mind-boggling new tools like artificial intelligence, and unprecedented knowledge like the ability to understand and engineer the genomes of all living things. The evidence and material for this extraordinary story is all around us. This essay is going to lay out in broad strokes the world-historic story of the next 25 years of our lives. I'm going to explain the much more positive, pro-progress story of what lies just ahead. Hear me out because I've been through this drill before, 25 years ago, and that story proved to be very prescient.

The Long Boom, Revisited

I worked with the founders of WIRED magazine in the mid-1990s, and we found ourselves in a situation that was very similar to today. We were at ground zero of the digital revolution and talking to many of the early technologists, entrepreneurs, and innovators who were super-excited about the progress being made with the new digital technologies — and beginning to see the vague outlines of what they could probably do in the coming decade, and what was possible to achieve in the next 25 years. We at WIRED saw the need to articulate this future that was dawning on the early adopters but not seen by pretty much anyone else. I paired up with Peter Schwartz, one of the world's premier futurists and co-founder of Global Business Network, a pioneering strategic foresight firm (where I also later worked). We co-authored **The Long Boom, a History of the Future, 1980 to 2020**, an iconic cover story for WIRED, which later became an influential book in multiple languages. The Long Boom, in essence, was the pro-progress story of that time that helped catalyze the new zeitgeist of the 1990s with a positive reframe of what was actually happening. We took the historical perspective of how people in the future would explain the big-picture story of the 25 years that still lay ahead of us. We were about to go through two world-historic developments: the digital transformation and the integration of the world economy through globalization. But few really understood what we were heading into.

The Long Boom issue cover, Wired Magazine 1997; artwork by Micha Klein



You must remember that in 1995 almost nobody knew what the digital revolution was, let alone what a digital transformation would be. There were only about 25 million people in the world on the internet, and most folks had no idea how these goofy startup companies with names like Amazon would ever amount to anything. Our story had to fill out the picture of how these technologies would scale, how these startups would grow, and how a digital economy would work.

Likewise, in 1995 the Soviet Union had just recently fallen apart after 50 years of the Cold War, and the Chinese Communists were in the early stages of opening up to the market economy, with rural peasants starting to move to factories in cities.

We had to explain how the global economy would morph into one integrated whole for the first time in history. We projected that we

were about to head into a long digital tech boom, a long global economic boom — in other words, The Long Boom.

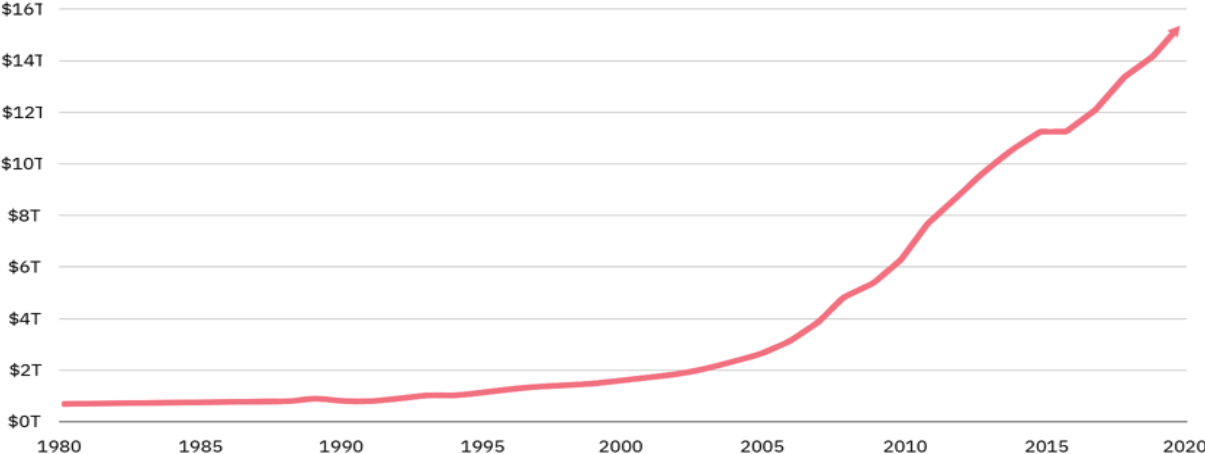
“*The Long Boom*, in essence, was the pro-progress story of that time that helped **catalyze the new zeitgeist** of the 1990s with a positive reframe of what was actually happening.”

How did we do? The broad-stroke through lines of that story pretty much played out by 2020. Those 25 million people on the internet grew to 4 billion, or 60 percent of all humans on the planet. The month our cover story came out, Apple begged Steve Jobs to come back as CEO because they were months from going bankrupt — yet Apple later became the first trillion-dollar company. China went from a middling country with less than \$1 trillion GDP in 1995 to a superpower with a GDP of \$15 trillion, pulling 800 million peasants out of extreme poverty. For that matter, the Dow Jones in 1995 was 5,000 but hit 30,000 by 2020. Another long boom, this time for stocks. To be sure, we got some specific parts of that future story wrong, as can be expected. We thought we would have made more progress on climate change. We thought humans would make it to Mars by 2020, though that might take another decade or so. And we did lay out 10 possible negative developments that we were worried could disrupt or slow down the larger positive story we laid out. All 10 did actually

appear in some form over the course of those 25 years (including a global pandemic), but the remarkable thing is that they still did not stop the overarching story. What mattered was that The Long Boom helped distill at an early stage what would ultimately be seen as most important about our times in the long run of history. We roughed out the new models emerging in that first decade that were hard for people to imagine. We then helped project how those new models would scale up over 25 years and fundamentally change the world around us. We pulled off a positive reframe and helped people see the actual story of progress happening and about to happen in the decades ahead. Now it's time to do something similar again.

China rises to second largest economy in world

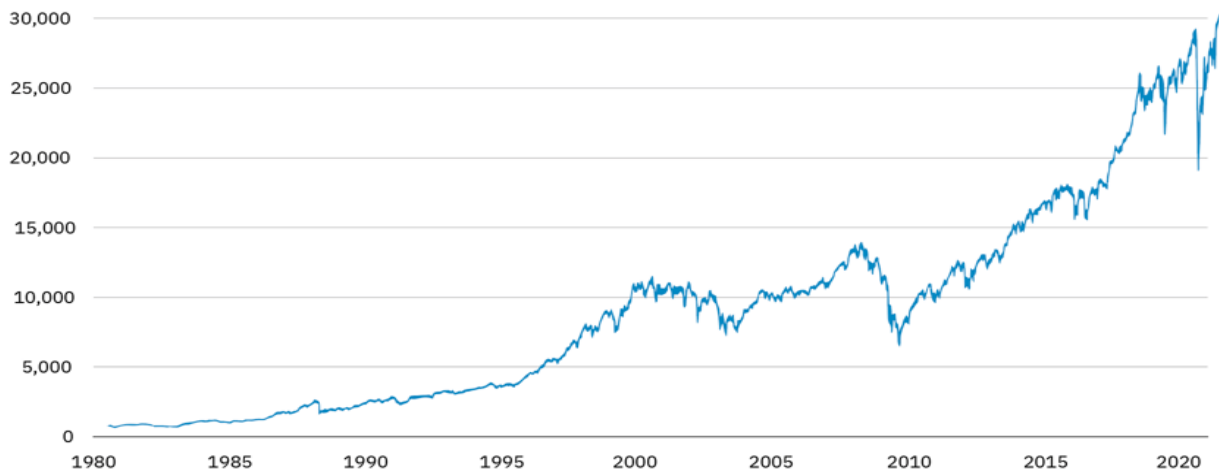
China goes from minor economic player to the second superpower in 25 years



Source: IMF World Economic Outlook, April 2019. Data Analysis by MGM Research

A stock market boom too

The Dow Jones rose from \$5,000 in 1997 to \$30,000 by the end of 2020



Source: The Wall Street Journal

Tipping Point

Chaos / Amazement / Disappointment

Source: Peter Leyden

The positive reframe of America today

We're living through an extraordinary time in American history, and really in all human history. Once you take that big-picture historical perspective, once you look at the whole forest rather than the individual trees, the real story of our times starts to make more sense. We happen to have arrived at a juncture between two very different historical eras and that makes everything on the ground very confusing, and very traumatic. One way to understand this is that for the last 40 years America and the world have been operating within a series of interconnected systems

that add up to one mega-system. Our energy system was rooted in carbon, and our transportation system was based on the internal combustion engine. Our culture was dominated by the huge Baby Boom generation and our politics tended to be more conservative. Our economics was all about unleashing the private sector and maximizing shareholder capitalism. Work was done in physical places and production was primarily industrial. Our uber-challenge was terrorism, and our geopolitical focus was the Middle East, which made sense because we needed to keep the carbon energy flowing to keep the whole flywheel of this mega-system spinning.

“We happen to have **arrived at a juncture between two very different historical eras** and that makes everything on the ground very confusing, and very traumatic.”

That whole mega-system, and all the subsystems, arguably are now breaking down and often causing more problems than they are solving. This world that older people spent their entire careers and lives mastering is coming to an end. This world that younger people were taught is “just the way things are” increasingly does not make sense. This world that politicians proudly had policies for, and that the media confidently analyzed and explained, is soon going to be over. Every one of those systems arguably is being

superseded by new systems much better suited for the 21st century. Our uber-challenge is now climate change and so our energy system must shift to clean power and our transportation system to electric. Our culture now is dominated by the huge Millennial generation and our politics are becoming more progressive. Our economics is raising the role of the public sector and capitalism being pushed to include all stakeholders. Work is now taking place much more virtually, and production is on the cusp of becoming biological. And our geopolitics is recentering on Asia, and in particular on the new superpower, China.

MEGA-CHALLENGE	Terrorism	→	Climate
ENERGY	Carbon	→	Clean
TRANSPORTATION	Internal Combustion	→	Electric
CULTURE	Boomer-centric	→	Millennial-centric
POLITICS	Conservative	→	Progressive
ECONOMICS	Private Sector	→	Public Sector
CAPITALISM	Shareholder	→	Stakeholder
WORK	Physical	→	Virtual
PRODUCTION	Industrial	→	Biological
GEOPOLITICS	Middle East	→	Asia

Source: Peter Leyden

America and the world have been teetering on the tipping point between these two mega-systems for the last decade or so — but the absolutely critical point to understand is that we have now tipped. The shift is happening. The forces are in motion. There’s

no turning back. There had been a debate, but that debate is now over. The transformation has begun. Here's the thing about tipping points: When they happen, they happen fast. This is a well understood phenomenon within the technology world. A new technology will slowly creep up in adoption until it reaches a tipping point — and then adoption will exponentially shoot up. The same phenomenon can be applied to trends and is used by the futures business. Some new trend will slowly grow in popularity on the fringes of society and once it gets enough exposure then — boom — everyone does it. Here's the other thing about tipping points: They prompt paradigm shifts in understanding what's really happening and in strategy about what to do. One day the world works one way, like it always has, and then the next day it works a very different way. One day the world had a clear goal, a familiar one, and then the next day, there's a very different goal. In other words, paradigm shifts set new north stars that rapidly reorient systems.

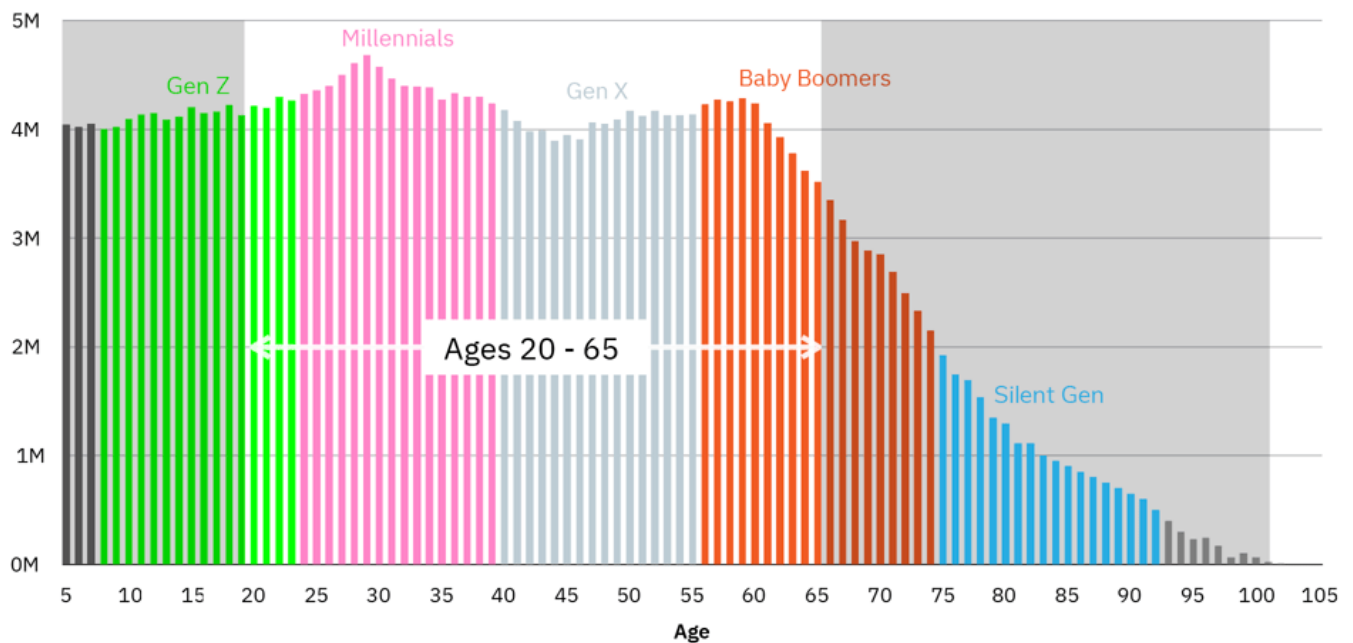
“Here's the thing about tipping points:
when they happen, **they happen fast.** ...
One day the world works one way, like it
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Some of today's tipping points — these system changes, these paradigm shifts — are easier to see than others. Take how all the

debate and the efforts around climate change have tipped and are now sending out signals about this new north star. This summer's so-called Inflation Reduction Act, which really is a \$370 billion public commitment to accelerate the shift to clean energy and transportation, is only the latest signal to Americans and the world that this transformation has begun. Tesla had already led the entire legacy auto industry around the planet into a historic transition to electric transportation. And global finance had already tipped to massive investments into solar and wind power for utilities and away from coal because renewables are now cheaper — and getting cheaper by the year.

Or take the demographic tipping point between two huge generations that provide the cultural ballast of American society — that's tipped too. The Boomer generation, now ages 58 to 77, is more than half into retirement and many are dying (the average lifespan of an American happens to be 77).

Rise of millennials & fall of boomers in 2020



The Boomers have been a highly individualistic generation in terms of culture, and the bulk of them were politically conservative from early on — contrary to the media portrayal of them in the 1960s. For every one of them out protesting on the left, there were two of them going off to war or getting ahead at work.

Source: US Census Data 2018; Pew Research Center

Generations tend to form their political allegiances in their first several election cycles and hold those political values through their lives, contrary to the popular misconception that political values change in different stages of life. They usually don't. The Millennial Generation, now ages 26 to 41, are now all in the prime of their work and consumer lives. No wonder that corporate America has fully embraced Millennial values like diversity in

their workforce and sustainability in their products and services. This shift makes even more sense when you factor in that Generation Z — now roughly considered ages 10 to 25, the bulk of them in high school or college — are remarkably aligned with Millennial values. The future in our culture and economy is getting clearer. All this will play out in our politics this decade, something I'll come back to later.

The New Long Boom, Squared

The original Long Boom story we told 25 years ago described the introduction of infotech, meaning digital computers and the internet, as a fundamentally new technology to the world stage. And then we described how it would scale up globally over the next 25 years and create a long tech boom and help drive a long economic boom, as well as a stock boom. The next 25 years will see the introduction and scaling up of not one but three fundamentally new technologies that will have world-historic impact. One will be in energy tech, one will be in biotech, and one will be the next big stage of infotech, which will be driven by artificial intelligence. We're heading into a triple-whammy tech boom — not just another Long Boom, but a Long Boom Squared.

“The next 25 years will see the introduction and scaling up of not one but **three fundamentally new technologies** that will have world-historic impact. We're

heading into a triple-whammy tech boom — not just another Long Boom, but a Long Boom Squared.”

Energy

The 2020s for energy tech will be a mad scramble to crack the new models. That energy tech world has tipped, the new north stars have been set, and the clear signals have been sent. We're past that stage. Now the hard work begins on how to build out a clean energy infrastructure, a clean energy system. Humans have never done that before. A lot more solar energy, but where? A lot more wind, but how? And how does the grid need to adapt to these very different conditions? Who pays for the infrastructure, government or the private sector? The through line is clear, but not the specifics. We'll get there through a churn of constant innovation and trial and error. It's just not clear exactly how. The scaling up of renewable energy, even at the most aggressive pace possible, won't be enough to get off carbon energy in 25 years. We must have other forms of clean energy and so look to the development and deployment of next-generation nuclear energy. These small-scale nukes will be able to stabilize the grids of massive cities and keep CO₂ out of the atmosphere. And they are far safer and the waste much less problematic than what people came to believe with the backlash from environmentalists in the 1970s. Even if we can get all our electrical grid on clean

energy by 2050, it's worth pointing out that some forms of carbon energy will still be needed off the grid, and we will probably need some fossil fuels indefinitely for other uses critical to our civilization, like ammonia. The new models for electric mobility will follow a similar trajectory in the 2020s. The auto industry is clearly on its way with \$350 billion in new private investment going into electric vehicles in 2021 alone. The charging infrastructure will need to be built, with a lot of prodding by governments and public investment. How do you charge private cars in dense cities? Millions of questions remain. But it's all doable and will be done.

Biotech

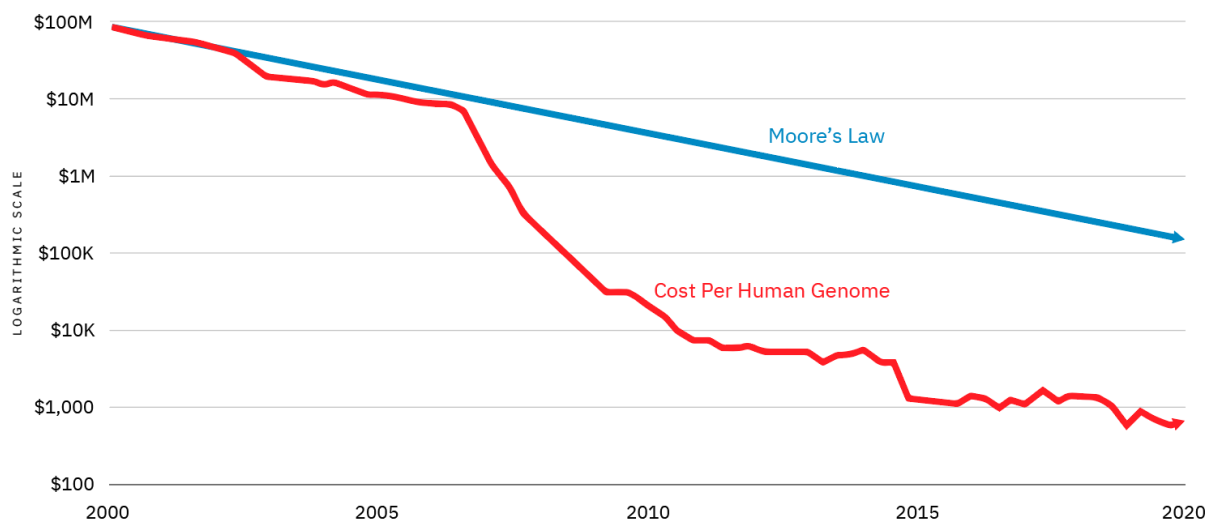
Then there's the coming biotech boom. Most people totally underestimate the historical significance of very recent breakthroughs and great progress in this field. The first human genome was cracked only 20 years ago after 15 years of work at a cost of \$2 billion. Today anyone can get their personal genome sequenced for \$1,000 and in the next few years the process will cost \$100. That is a mind-boggling pace of innovation that's roughly twice as fast as what happened in infotech with Moore's Law. Then 10 years ago we figured out how to cheaply and easily edit the genomes of living things with the breakthrough known as CRISPR.

The Biological Age has begun. If you can understand how genomes now work, and then are able to edit the configuration of those genes, then you have crossed the threshold into true genetic

engineering. This means that we can now expand human engineering from the physical world of inert materials into the world of living things. But there's even more to the story, thanks to recent breakthroughs not only in genetics, but also in many subfields of biology, like proteomics. We now understand how living things work below the cellular level, and we are getting better and better each year. We are expanding into a broader notion of not just genetic but biological engineering. This is what people mean by "synthetic biology."

Genome sequencing costs fallen 100,000 times

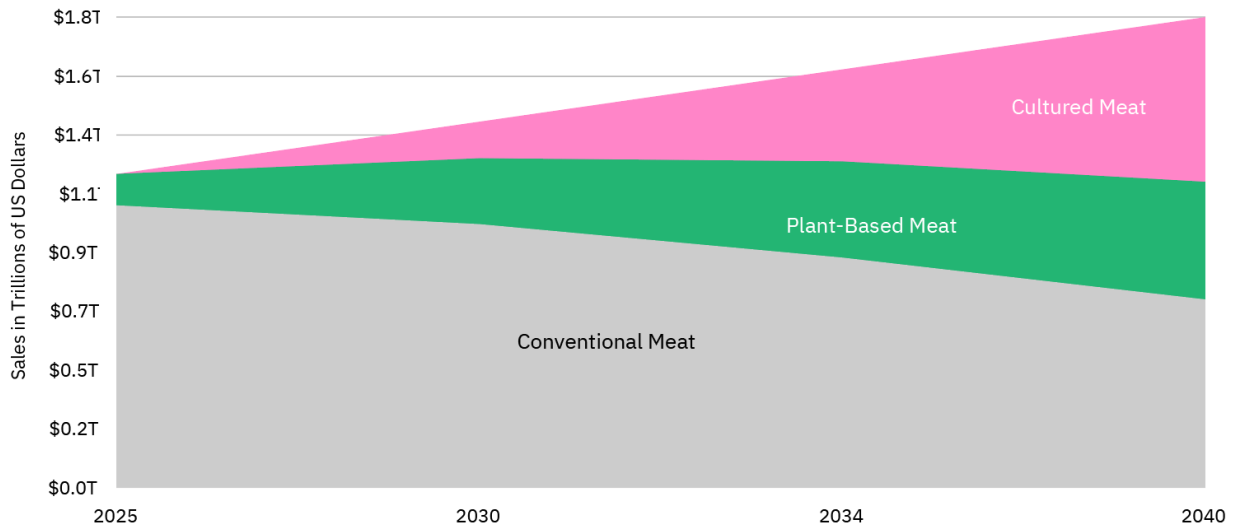
Sequencing 1 human genome went from \$2Billion in 2000 to \$1000 today - & soon \$100



Source: National Human Genome Research Institute.

Global meat consumption projected to 2040

Plant-based meat estimated to 25% of total while Cultured Meat grown from cells to 35%



The new field of synthetic biology can be expected to play a big role in the next 25 years. Like many fields, it will be driven by climate change and the increasing need for sustainable everything. Climate change will probably force the use of much more genetic engineering applied to crops. We are used to hastening the genetic evolution of plants that we eat through classic cross-breeding, and we've seen the first wave of genetically modified crops. But we'll almost certainly need to ramp up changes in most crops to become much more drought resistant, productive, and nutritious.

Source: United Nations, World Bank, Expert interviews; A.T. Kearney analysis

The sustainability imperative will probably also drive the dramatic expansion of biological engineering of "cultured meat." This is the new technique where actual cells from a live animal can be replicated and grown as cultures in vats more efficiently than those cells can be grown within the animal on farms (and without the need for mass slaughter). Beef cells will almost certainly be

the first to scale up because cows release methane and have a large impact on global warming.

“The new field of **synthetic biology** can be expected to play a big role in the next 25 years. Like many fields, it will be driven by climate change and the increasing need for sustainable everything.”

The bigger play for synthetic biology will be to take an increasing share of things that have traditionally been made through industrial production and make them through this new form of biological production. This moves synthetic biology into the world of materials. Building materials like steel and concrete account for a significant portion of CO₂ that's released into the atmosphere. Look for things like genetically engineered wood (stronger, heat resistant, faster growing) to replace them in an increasing share of structures — and suck carbon out of the atmosphere in the process. Or consider the plastics that are industrially produced from petroleum and then go into products like bottles and bags that litter our oceans and landscapes and only degrade after centuries. Biologically engineered alternatives could be designed to biodegrade within months after being exposed to salt water or extended sunlight. Much of the action of the biotech boom in the next 25 years will take place in the world of human healthcare, and many of those implications on personal well-being and even

life extension make many of today's headlines. Synthetic biology is in the relatively early stages and so is developing largely under the radar so far. But that should change this decade and synthetic biology will be seen as a significant driver of the biotech boom, too.

Infotech

Finally, there's the infotech boom, stage two. The first stage of infotech drove the last long boom but there's plenty more action left in this field. For starters, the 2020s will see the addition of 3 billion more people who will get connected to the internet for the first time. New systems of low-level satellites will go fully operational and offer internet connections to all those who are still off the grid, which is still half of the population in Asia, two-thirds of Africa, and 40 percent of Latin America. By the end of this decade, the entire population of 8 billion people on the planet will be able to work or learn or shop online. This experience will be greatly enhanced by the buildout of the metaverse, the three-dimensional online world where people will be able to do more and more things in their lives. The 2020s will also finish the digital transformation that most industries in the business world went through in the last 25 years. The world of government still has a long way to go on this relatively boring transformation, but the good news is the process will bring new efficiencies as well as new capabilities — as they did in business. And industries more entangled with the government and civic sectors, like education

and healthcare, will finally go through the full digital transformation as well.

“The 2020s will see the addition of **3 billion more people** who will get connected to the internet for the first time. ... By the end of this decade the entire population of 8 billion people on the planet will be able to work or learn or shop online.”

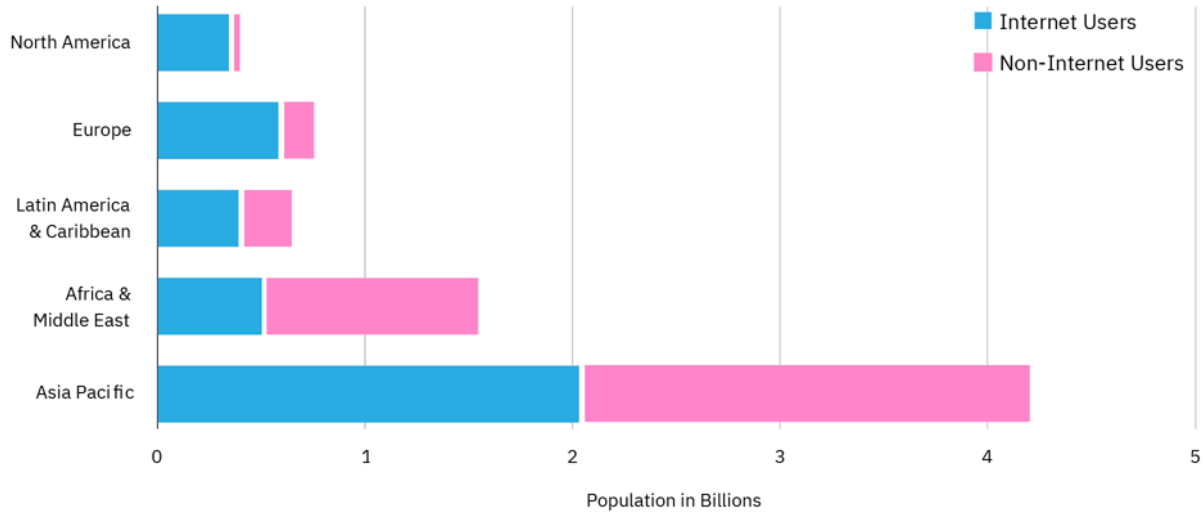
The new game-changer in this next stage of infotech is artificial intelligence. AI in the broad historical context gives humans a breakthrough superpower. Mechanical machines may have given humans the ability to dramatically enhance and extend our physical powers. AI will dramatically enhance and extend our mental powers. We will be able to let computers do things that in all previous eras required human intelligence, and more importantly, we will now be able to do things that human intelligence alone could never do.

This is a new, general-purpose technology that could eventually impact almost all fields over the next 25 years. Right now, we've seen early applications of machine learning pioneered by the big tech companies. (Ask any question and search all the information in the world to get an answer in less than a second. Wow. That's

something no human librarian could ever do.) The advanced business world has been applying the still relatively expensive techniques for the last decade to solve their problems. But over the course of the next 25 years AI will become increasingly simple, cheap and ubiquitous. Anyone will be able to take advantage of it through the cloud. AI is going to enable a mind-boggling amount of innovation. Take just the example of simultaneous language translation, something that AI will perfect this decade. Soon any person on the planet speaking any language will be able to fluidly communicate with any other person in real time, and with nuance, whether through video over the internet or with an earbud walking down the street. This opens up the world's business and diplomatic conversation not just to the roughly half-billion native English speakers, or the highly educated bilingual elites of other cultures, but to every single human, regardless of culture or class. Innovation essentially comes through the cross-fertilization of ideas and perspectives — and we are heading into a bonanza.

Infotech connecting up another 3 billion by 2030

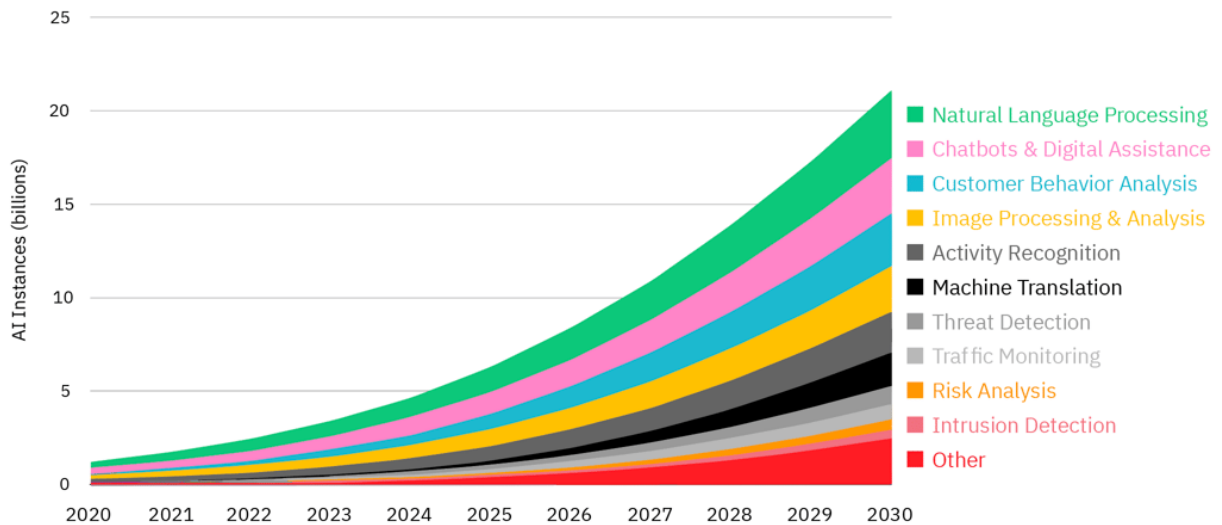
The developing world from Asia, Africa, Middle East and Latin America all in



Sources: United Nations / International Telecommunications Union, USA Census Bureau. Pew Research (USA), China Internet Network Information Center (China), Islamic Republic News Agency / InternetWorldStats / Bond estimates (Iran), Bond estimates based on IAMA data

Growth in uses of AI globally to 2030

How the main uses of AI will grow in the coming decade as measured by AI instances



Source: Transforma Insights, 2022

The new context of abundance

Long booms often create the conditions for progress. They are usually driven by the introduction of fundamentally new technologies, which create new industries, which create new kinds of jobs, which create new wealth. If the new technologies are transformative enough, then they can take decades to scale and fully build out. And so over that same timeframe those new industries help drive a growing economy which leads to a more prosperous society. Booms tend to spread income and wealth around, which tends to make people less worried about their own prospects, more generous about sharing, and more open to change and progress. Abundance is a big goal of every progressive era. Progressives want more of everything for everyone. Everyone should have a good job, good housing, good healthcare, good education, good opportunities, and good prospects. Everyone should be able to live a good life, not just the elites, or the top 10 percent of society, let alone the 1 percent. The good news is that many structural developments are aligning at this moment in history to create a different kind of 21st-century society of abundance. Let's think through how the theme of abundance might play out the 25 years now opening up. Abundance is the holy grail of the world of energy. The sophistication of all civilizations is essentially a function of how much energy they can use. The goal of our current shift to clean energies is not just to stop putting CO₂ in the atmosphere, as important as that is, but to create a much better energy system that can provide cheaper, more abundant energy over the long term. Renewable energies like solar and wind are already getting cheaper than carbon

energies, and they hold incredible potential to provide much of our energy needs. Still, they won't get us far enough. There will be many other efforts to develop other kinds of cheap abundant energy, like new approaches to thermal energy, or fourth-generation nuclear energy.

“Long booms often create the conditions for progress. They are usually driven by the introduction of fundamentally new technologies, which create new industries, which create new kinds of jobs, which create new wealth. If the new technologies are transformative enough, **then they can take decades to scale** and fully build out.”

TOP 10 SPOILERS

The Great Progression, the largely positive story of the next 25 years, may be probable but can't be considered inevitable. There are many potential negative developments that could emerge to slow down or thwart progress in solving the great challenges of our time. Here are my own top 10 worries about what could stifle the great progress that lies just ahead:

Liberal Democracies Fail / America and liberal democracies around the world need structural reforms to effectively carry out the actual will of their majorities and be able to more rapidly adapt to the big changes in the 21st century. They might not. **Quasi Civil War** / Zealots on the American far right

get so desperate that talk of civil war crosses over to actual political violence in a country armed to the teeth with guns. Containing such civil unrest could seriously set us back. **Enforced Group Think** / Zealots on the American far left take cancel culture to the next level and truly stifle open debate and free thinking in universities and other public forums, with the whole of pluralistic society suffering. **Losing Track of Truth** / Facts continue to get more and more contested until people can't communicate across parallel universes of media. Many of the fundamental pillars of advanced societies, like science, get jeopardized. **Tech Gets Demonized** / The dramatic success of tech companies in the last 25 years has made them new targets for misplaced scapegoating. We will need an array of new technologies and vibrant tech companies to help solve the challenges ahead. We can't demonize or undermine them too much.

The potential game changer that could emerge is fusion energy, the promised land of nuclear energy. In contrast to conventional nuclear fission, which breaks down atoms to release energy, nuclear fusion "fuses" atoms together to create much more energy with no waste. We're close to getting more energy out of these fusions than we put in, and we've seen a proliferation of fusion startups that are projecting that commercialization may be possible in the 2030s. If that happens, we might be able to achieve an unexpected energy abundance with widespread societal implications. For example, we might be able to rely on fusion for water desalination, which would require huge amounts of energy but could solve climate-related water shortages. Abundant housing might be an unexpected outcome of game-changing innovations in transportation over this 25-year period. The lack of affordable housing is not just a problem of America's big coastal cities, or now even just America. Almost every major city faces this problem — particularly the megacities of Asia. The one short

reason is individual car ownership. Modern cities devote about one-third of all their real estate to cars. The bulk of that is for parking spaces in offices, or shopping malls, or driveways, or lining the streets. Most cars sit parked 95 percent of the time, totally unused. Enter autonomous vehicles, which are just starting to be legally deployed in select cities like San Francisco. Expect autonomous vehicles to dramatically improve and scale up in our 25-year timeframe. One clear possibility is that autonomous vehicles will become a shared asset used by Millennials and Gen Z-ers who grew up sharing cars via Uber and the like. For the 5 percent of your life when you need a vehicle, you will summon one to your home or office (and maybe even jump in the driver's seat if you want). When you are done, the vehicle will then go to the next person, and keep in circulation, only stopping to charge up. If this happens, then up to one-third of the real estate of cities could be repurposed for housing, making housing abundant, and therefore cheaper. This is not inevitable, but very promising. Other increasingly costly expenses of modern American life might be poised for unexpected price drops in the next 25 years. Take healthcare, which the vast majority of Americans find way too expensive and so think of as scarce. The current healthcare system is a jerry-rigged monstrosity from the 20th century. But the next 25 years provide a potentially game-changing opportunity to redesign a 21st-century system using the new capabilities of genetic understanding and new tools of artificial intelligence. For example, knowing the genetic disposition of every individual or in some cases even tweaking that upfront could dramatically drop

the costs of treating that individual downstream over his or her lifetime. Our increasingly nuanced understanding of the biology of the human body will inexorably lead to precision interventions that thwart illness and boost health — rather than our current relatively ignorant shotgun approach. The breakthrough approach of utilizing mRNA in developing vaccines during the pandemic gives just a taste of things to come. AI also holds the promise of hyper-personalized medicine at scale over time. Your body will be constantly monitored through all your devices and even clothes and you could get a daily — not yearly — checkup by a qualified health professional that happens to be a machine. Expensive human doctors would only need to be called in for higher-level problem-solving. Cheaper, more abundant healthcare may truly be on the horizon. Or take higher education, which has become prohibitively expensive. One of the main reasons is the mounting costs of human labor working in an ancient system that dates to medieval times. The institution has resisted almost any application of new technologies that have brought efficiencies and price reductions in other fields. The pandemic finally forced some tech adoption with interactive video, but much more needs to be done, and probably will with a more sophisticated metaverse that can truly scale the numbers of students to professors. This is another area where the coming iterations of AI may be able to help provide more personalized learning that can match or complement the effectiveness of humans and help bring down costs. Teaching the basics, answering common questions, checking homework for routine progress could all be done by increasingly

effective (and even personable) intelligent machines. That will leave humans to provide the critical and creative components of an education that will remain beyond machines, like mentoring, or inspiring, or socializing the next generation.

Genetics Gets Shut Down / We will need synthetic biology and the whole new world of biological engineering to help create sustainable everything and solve climate change. Fears about messing with Mother Nature or God could shut those efforts down. **Nuclear Bomb Explodes** / We've managed to avoid a nuclear explosion since Nagasaki, but nuclear proliferation continues. All it might take is an actual nuclear bomb going off to shut down the entire nuclear energy industry again and cut off the promise of nuclear fusion. We'll need both this century. **Desperate Oil States** / The rapid shift from carbon to clean energy could make the world's oil states increasingly desperate and lead to unpredictable gambles, particularly with a fading power like Russia.

Balkanized World / There's no way to solve climate change without the whole world evolving in common directions, and this gets much more complicated if globalization reverses and devolves towards uncoordinated localities. Let's hope we don't get more virulent global pandemics. **China Hot War** / The world arguably could survive and possibly even thrive from a competitive Cold War between China and America, but an actual hot war between these superpowers would be catastrophic. It's not impossible.

“The problem of the coming decades in America and throughout the aging West is going to be that there are **not enough people** to fill all the open jobs.”

But what about the loss of jobs! We spent the 2010s worried about how AI and robots were going to take away all the jobs. We're going to spend the 2020s (and the next 25 years) thanking AI and robots for saving our asses and helping fill all the open

jobs. This is the paradigm shift you need to go through when you cross over into boom times from bust times. The 2008 crash and the slow build out of the Great Recession put everyone in a mindset of scarcity. The long booms we're heading into are more suited to a mindset of abundance. Booms bring an abundance of jobs. The problem of the coming decades in America and throughout the aging West is going to be that there are not enough people to fill all the open jobs. We're already getting a taste of this new reality in the wake of the pandemic. This will only get worse, with maybe a blip in a temporary forced pause in growth to get a handle on inflation, which is a symptom of booms rather than busts. We will need AI to help with these pressures. We will want robots to do much of the tedious and dangerous work. And, frankly, we can expect America to open immigration back up, too. We'll soon welcome immigrants at the high end and the low end of the workforce. We'll need everyone.

The new progressive era

The big-picture view of all American history shows some patterns that are useful when trying to figure out the future. One is a pendulum swing back and forth between conservative and progressive eras, between the alternating dominance of those on the right and the left of the political spectrum. This yin-yang of politics shows up in other Western democracies and can be seen as a reasonable way for societies to revitalize over time. You can unpack the names themselves to understand the basic distinctions between the two approaches. "Conservatives" generally value

“conserving” the traditional way of doing things, sticking to the tried-and-true ways that work — going back to basics. This tends to slow down changes and focus on consolidation and regeneration, which can be a good thing for societies at certain times. On the other hand, “progressives” generally value “progress” or, more broadly, change. They are much more eager to experiment, try new approaches, and take risks. This makes them much better during transformative times when new systems are being built and no one really knows the clear way forward. They also value vigorous, effective government to force and guide changes. This approach also tends to open up opportunities and power to new actors, which benefits those on the bottom of the pyramid. You can see this back-and-forth pendulum swing with even a cursory review of American history. Americans flat out named one period “The Progressive Era,” which marked an explosive period of reform at the beginning of the 20th century in reaction to the previous conservative era of the late 19th century that we remember as The Gilded Age of the Robber Barons. The most recent progressive era came off the Great Depression and World War II and ran through the post-war boom all the way through the 1960s. (That era’s progressives were labeled “liberals” for reasons specific to that time.) And then Ronald Reagan marked the beginning of the most recent conservative era, which I would argue came to an end with Donald Trump’s defeat in 2020.

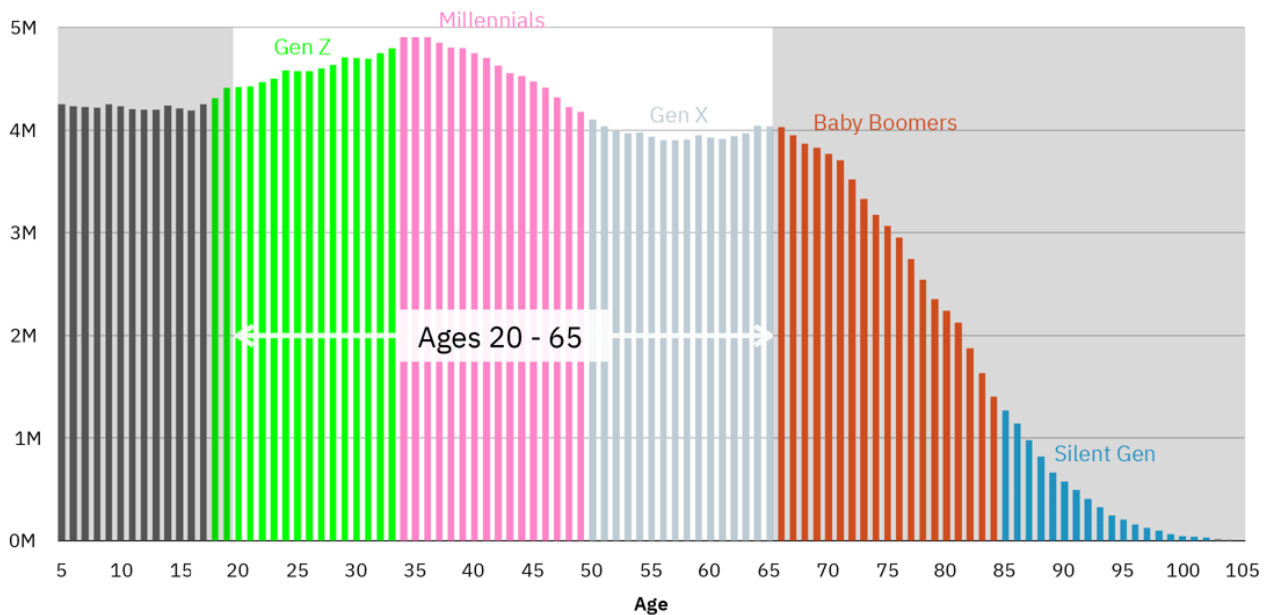
“What accounts for this **pendulum shift** between eras is a reconfiguration of the American electorate ... The **transition phase between eras**, when the electorate is roughly split 50/50, is marked by extreme political polarization and governmental paralysis. That’s America in the last decade.”

What accounts for this pendulum shift between eras is a reconfiguration of the American electorate with a 60-percent majority coming together for a time on the center/right and defining the overarching terms of that era. And then that approach gets outmoded, and a different set of challenges emerges, and a different 60-percent majority forms on the center/left that drives the next era. The transition phase between eras, when the electorate is roughly split 50/50, is marked by extreme political polarization and governmental paralysis. That’s America in the last decade.

America in the 2020s arguably will be a very different place, and over the next 25 years will be in another progressive era. You can make the case for this by lining up the numbers of the growing constituencies that are coming together in the coalition behind Blue America and the Democrats. You can start with the double-

barreled generations of Millennials and Gen Z who vote overwhelmingly Blue. Add to that the growing numbers of people of color, who are closing in on becoming the majority of all Americans as early as 2040. Add to that the college-educated and professionals who recently have shifted their support to the Democrats and are poised to grow their ranks as the knowledge economy burgeons in the years ahead.

The millennials & gen-z vs. boomers in 2030



Source: US Census Data 2018; Pew Research Center

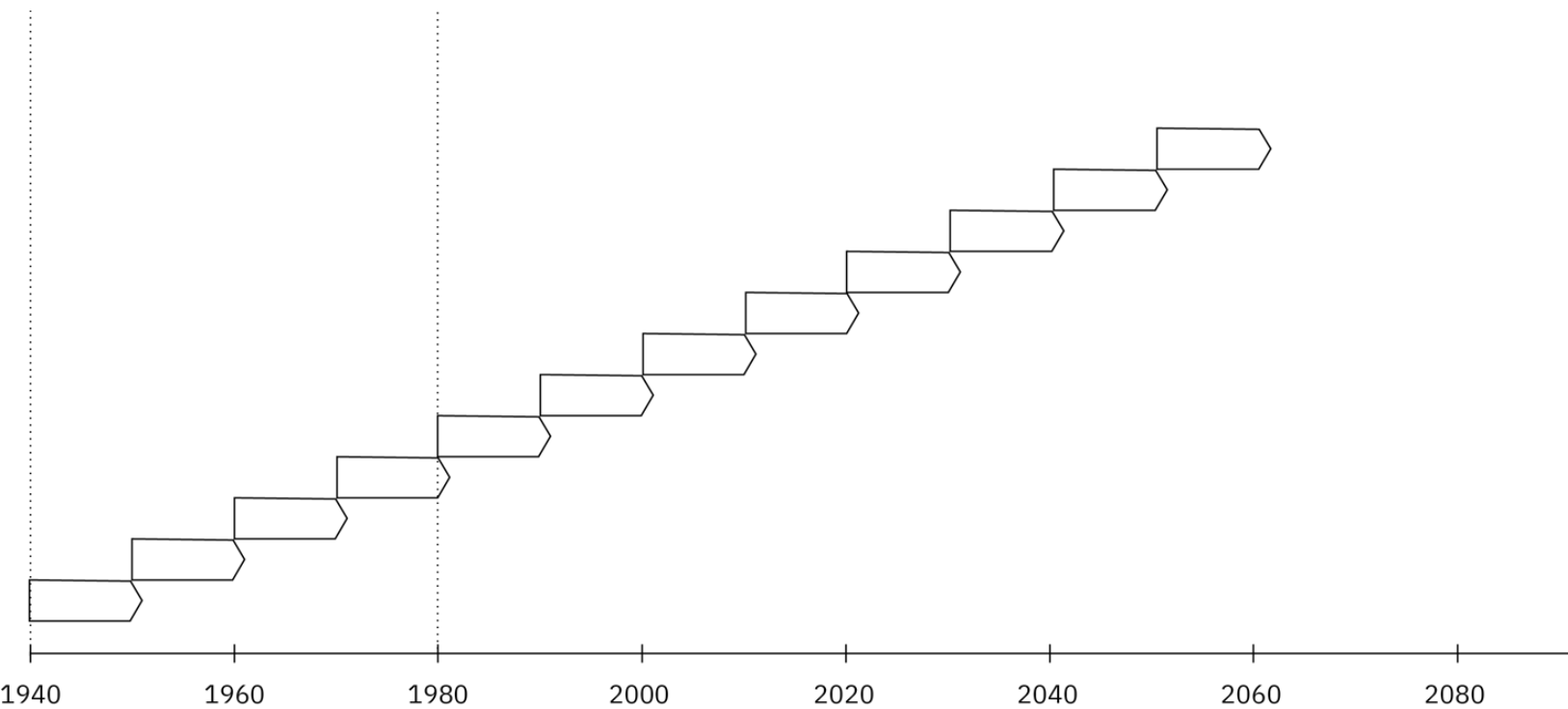
You can see it in the polling on myriad issues. A solid 60 percent or often 70 percent or more of Americans now want to see progress, serious change, in many different areas. Their positions tend to line up more on the side of Blue America and the Democrats. They want progress on climate change, not climate denial, progress on income inequality, not just the freedom to get rich, progress on gender equality (and now protection of abortion

rights), progress on racial issues, progress on gun violence. They also want progress on the affordability of housing, and education and health care for everyone. They want effective government that can get big things done. They want their democracy to work with everyone able to vote.

“American politics has **tipped.**”

American politics has tipped. That’s the most dispassionate and realistic analysis of American politics right now to my mind. Watch this endgame play out in the next few election cycles. Unfortunately, the process might get very traumatic and possibly devolve into sporadic violence from time to time. This has happened in similar junctures between eras in American history, like during the 1850s and 1930s when Americans were on the cusp of transformative times. But America will get through this juncture and be on the move again. Just watch.

Post-War Progressive Boom



Reagan to Trump Conservative Era New Progressive Era?

Source: Peter Leyden

The pro-progress realignment

There are two sides to all tipping points: a reaction away from what people don't want or need anymore, and an attraction to what they do want or need. A core ballast of roughly 60 percent of Americans needs to also be attracted to the side of the political spectrum that seems most able to solve the current set of challenges, most in sync with the future. I'd argue that's happening in America today with the emergence of what you could call a new kind of pro-progress movement or coalition that's forming primarily in Blue America under the big umbrella of the Democratic party.

“There are **two sides** to all tipping points: a reaction away from what people don’t want or need anymore, and an attraction to what they do want or need.”

Democrats today often call themselves progressives but there is a lot of confusion about what being a progressive means. Let me wade into the mosh pit of Democratic politics and sort out what’s really going on. One big category are the progressives primarily looking backward: These are traditional progressives who still largely think in terms of 20th-century solutions. They love ideas like the Green New Deal or Medicare for All that in their very names are building off the past. Some of them are rooted in the labor movement that harkens back to the economic solutions of the 1940s and 1950s and are often anti-business. Others are rooted in academia and look back even farther, still calling themselves democratic socialists or even Marxists. Then there are “movement progressives” who are most concerned with identity politics and social issues around race and gender and gay rights and the like. They often default to adopting traditional progressive positions but are most focused on extending the rights movement that took off in the 1960s. There’s now another growing category of progressives who primarily look forward: They are the ones figuring out 21st-century solutions. Because they are grappling with new solutions in real time, this category is harder to clearly define or even see. The best way to understand it is to watch what

is going on in California today. The state of California is at the heart of the modernization of progressive Blue America right now. The Democrats in California have wiped out the Republican party from relevance starting about 15 years ago and they now have a wide-open field to try out big ideas about how to solve new 21st-century problems. They have super-majorities in both state houses. They hold all state-wide offices. And they have a visionary governor in Gavin Newsom. Gavin Newsom comes much closer to embodying the new 21st-century progressive. He holds similar values to traditional progressives and appreciates the continued relevance of many of their preoccupations and concerns. But he is much more open to innovation and rethinking the path to progress on many different fronts. He's also much more appreciative of the transformative power of new technologies and the value of entrepreneurship in dramatically changing the game. As the former mayor of San Francisco, Newsom gets the tech world, the innovation economy, and understands the incredible potential that's now possible in the near future. Many California progressives do. A key factor behind the tech world's success is that it operates with a mindset of abundance, not scarcity. The digital economy of the last 25 years shows that the best way to succeed is not to make a scarce number of things and then charge top dollar for them. Much better is to figure out how to make vast numbers of abundant things and charge pennies, which add up to much more. The more you produce something, the more the costs drop. Ultimately, more people can afford to buy even more of those things, which lowers costs even more. Soon you enter the

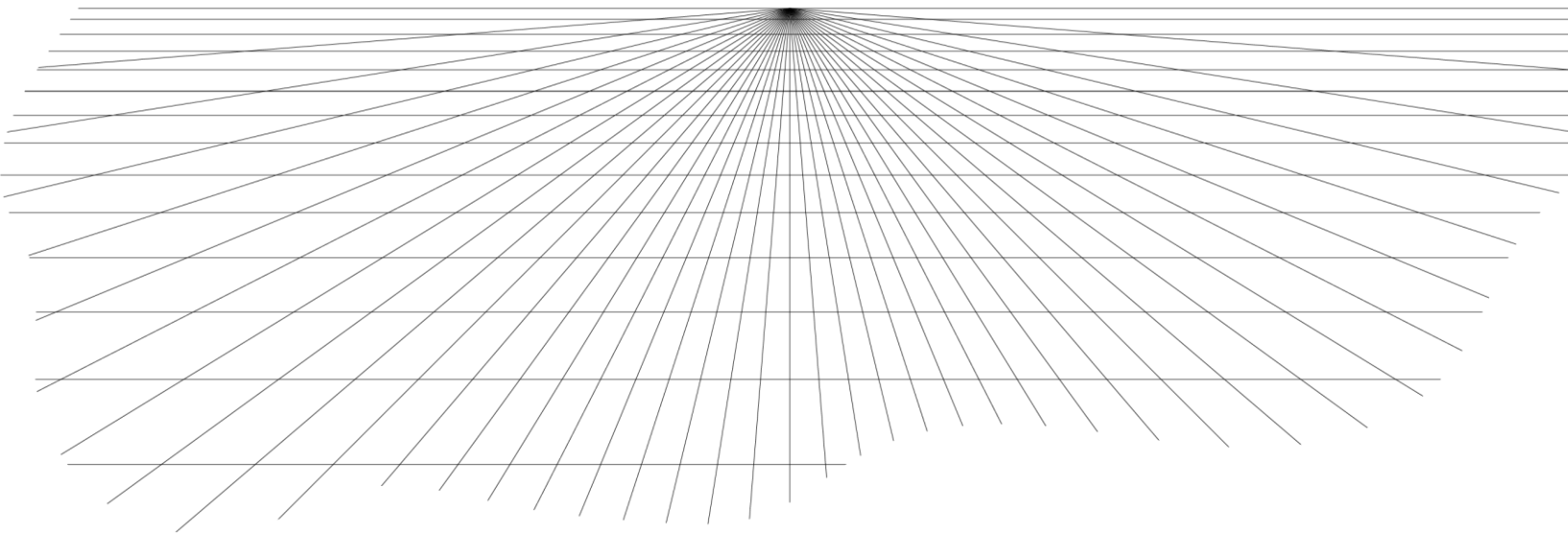
virtuous circle of economies of scale, with costs moving down and distribution going way up. Everyone benefits in a world of abundance — the consumers and the producers. This abundance approach has worked really well in a world of easily replicable digital products like software, and it's also now working in other physical tech fields, from solar panels to electric vehicles. Dramatically increase the supply to drop down the costs and you create a win-win world of abundance. And now this abundance approach is moving into progressive political thinking. Some are starting to talk in terms of “supply-side progressives” in distinction to traditional progressives. Or even “abundance progressives.”

“Innovation is messy, with much trial and error. But California, more than any other state, is fully engaged in solving those future challenges, from climate change (now phasing out the sale of gas autos by 2035) to dealing with the diversity of its population (now only 35 percent white).”

Take the example of housing. A traditional approach on the left that saw the world in terms of scarcity would be to build public housing, or intervene in the market with rent controls in order to look out for working people. The supply-side approach goes: The

problem with affordable housing is we need to dramatically increase the supply of housing to make it abundant, and therefore affordable. And so for the last five years the California legislature has passed a barrage of laws making it much easier to build homes, increase the supply, and drop the prices (which may take a decade to fully play out). They are doing this for the working people who need that housing, but the developers benefit too. The mainstream California progressives like Newsom in that way are pro-business, pro-entrepreneur, pro-technology, pro-innovation — pro-progress. To be sure, they understand that tech companies that have exploded in size and other big businesses need a healthy counterbalance from government representing the interests of all people. But they appreciate the transformative power of these companies and these technologies, seeing them as essential to building the next generation of our economy and society. California is still in the early stages of figuring out how to solve the many new challenges of the 21st century, and it's far from perfect. Innovation is messy, with much trial and error. But California, more than any other state, is fully engaged in solving those future challenges, from climate change (now phasing out the sale of gas autos by 2035) to dealing with the diversity of its population (now only 35 percent white). California is the future when it comes to technology, the economy, society, and culture. It's long played the role of prefacing America's future. California is the future of American politics too. The state has played that role on both sides of the political spectrum. Ronald Reagan honed his modern form of conservatism as governor of California 15 years before he

became president. The 21st-century form of progressivism has been developing in California for the last 15 years and has been steadily moving out into blue states throughout the country, and even into the urban hubs of Red States. The 2020s will see it go fully national. We'll soon see.



It's time for grand strategy

The America that could emerge in the next 25 years realistically could create the world of abundance described above. Abundant good jobs working in industries of the future that are on a mission to solve the big challenges of our time like climate change.

Affordable housing in reinvented cities, affordable state-of-the-art

healthcare, and affordable higher education for all family members to pursue the 21st-century American dream. When you create those conditions of abundance, you foster social cohesion rather than strife. You generate trust rather than cynicism. Rather than widespread pessimism, you get optimism again.

When you create those conditions of abundance, you foster **social cohesion** rather than strife. You generate trust rather than cynicism. Rather than widespread pessimism, you get optimism again.

This is an America that is reminiscent of the burgeoning one of abundance that was built in the post-war boom of the 20th century, during that last era of great progress, our last progressive era. The people back then took their era's relatively new technologies like the internal combustion engine and built out ambitious new infrastructures like the interstate highway system. They created a modern industrial economy that more broadly spread the ample wealth generated to benefit the majority of workers. They created a society of upward mobility through widespread public investment into higher education. To be sure, minority groups did not benefit from all this progress on an equal basis, but by the end of that era in the 1960s, the majority tried to rectify that too. That post-war America not only worked internally but led the new way forward for the world in that transformative

time of change. Our success in building new models that worked on the domestic front, after floundering as recently as the 1930s during the Great Depression, inspired others grappling with similar challenges in other parts of the world. We helped design and build the new international institutions of that time that were figuring out a new form of coordination between nations. And this revitalized democracy became the critical counterbalance to the world's other option of that time: the authoritarian Soviet Union and communism. The resulting Cold War led to even more technical progress and social cohesion. We're in another one of those transformative times in history and there are many parallels we can learn from. A big one is that in transformative times you have to think in terms of what is called grand strategy, like they did back then. This is a game that is played another level up on the proverbial three-dimensional chess board. You must step back and think big-picture and long-term. You must clearly see what's really happening, what's probably coming, and what's truly possible. You must think big and act bold. And you must take risks that meet the moment.

“...in **transformative times** you have to think in terms of what is called grand strategy, ... You must step back and think big-picture and long-term. ... And you must take risks that meet the moment.”

You have to think differently in transformative times because you are dealing with fundamentally new challenges like climate change, and you are designing new systems to cope with the new realities. That takes a different mindset of innovation and openness to change. The old ways don't work anymore. The old strategies don't apply because the game has changed. You're playing a bigger game for much bigger stakes at the level of historic change. Even the old rules don't necessarily apply. Never say never in these explosive periods of progress. Transformative times of progress and system change also can bring a level of desperation because some people think in existential terms and can't see beyond what they're losing. Those rooted in the old systems often will desperately try to hold on because they clearly see what they will lose, and they can't see what they ultimately stand to gain. This is one way to see the pervasive climate denial and delay tactics coming from the leaders in Red States with industries based on coal and oil. This is why we're seeing increasingly apocalyptic talk of political violence and even civil war. America has seen that rhetoric before at similar junctures, and once even went well beyond talk. America always gets through these high-stakes junctures, and we will do it again. We'll do it in ways similar to what we have done in the past. The new pro-progress majority that forms on the other side will welcome people from both parties and be less partisan, less focused on what divided us in the past, and more focused on what unites us as Americans in the future. Watch for progressive Republicans to start showing up. You can already see a young cohort of

intellectuals in that camp who could be classified as pro-progress if not progressive. It's worth a reminder that the Republican party began as the progressive force in America during the Civil War and drove transformative changes for decades afterwards. Republican Teddy Roosevelt kicked off The Progressive Era. Both American political parties always eventually adapt to the times and learn to play the new game in the new era. President Bill Clinton led the so-called New Democrats and largely played within the broader context of conservative politics that defined the recent era. President Dwight Eisenhower was a liberal Republican who did the same in the last progressive era.

“When old systems start breaking down, and new systems are not yet fully formed, people all over the world desperately look for answers.

Authoritarian states provide a sense of certainty in the very uncertain times of transformation.”

Consider one final analogy to the past progressive era of the post-war boom: We may be heading into a new Cold War with China. The implications of transformative times do not stop at American borders but are convulsing throughout the world. When old systems start breaking down, and new systems are not yet fully formed, people all over the world desperately look for answers. Authoritarian states provide a sense of certainty in the very

uncertain times of transformation. Their centralized control of power allows them to act quickly and decisively compared to the messy processes of liberal democracies. (Even within liberal democracies authoritarian leaders and parties tend to thrive in these times.) China has been and will almost certainly continue to push big initiatives that will aggressively deal with climate change and other big challenges mounting in the world. China can be expected to showcase a model that will be attractive to developing nations and even any country that wants to emulate their success. But Chinese President Xi Jinping is doing what almost every authoritarian regime and certainly every totalitarian regime ends up eventually doing. He is hanging onto power and getting the Chinese Communist Party to break with their tradition of rotating leadership at the top every 10 years. And as part of that process, he's cracking down on all dissent, ramping up surveillance and social control, and fanning the flames of nationalism. The next decade is going to be a dangerous one. The good news is that authoritarian closed societies always lose to open democracies in the long run — and this next 25 years should be no different. Historical periods of transformation and progress play to the strengths of societies that can correct course through frequent leadership changes. Open societies that encourage free thinking and are tolerant of dissent thrive in these periods dependent on widespread innovation. The process of democracies may be messy and relatively slow but in the long run they inexorably move forward and ultimately succeed. This happened in the last Cold War that ended in the collapse of the Soviet Union, and it most

certainly will again if China gets increasingly totalitarian and mounts another Cold War. One other bonus if a Cold War is forced on America and the West: External threats tend to accelerate social cohesion and progress. Serious external threats coming from a Cold War with a comparable power can be expected to bring Americans together behind a common purpose again and thrust us back into global leadership. A Cold War can be the rationale for channeling massive amounts of resources into research, science, new technologies, new infrastructure, and expanded education — all the elements that historically have led to more progress. An undesirable and unwanted Cold War could be yet another historical development that supercharges The Great Progression.

The moment is now

We're living through an extraordinary moment in the history of America and the world, one that will be remembered for a long time to come. In the next 25 years, humans are going to figure out how to significantly slow global warming, adapt our economies and societies to the changes already baked in, and prepare for more to come.

“...humans are going to have to work at a planetary scale with a level of **global coordination** that we have never done before.”

To do that, humans are going to have to work at a planetary scale with a level of global coordination that we have never done before. We may have to pull off that global effort with two competing coalitions of democratic and authoritarian states. Hopefully, we will have a more seamless evolution of global governance with all people of the world reasonably getting along and staying roughly aligned.

We're going to have to leverage the full capabilities of advanced technologies in three fields that will have world-historic repercussions. In infotech, we're going to get all 8 billion people on the planet connected and eventually connect literally trillions of things. We're going to need to take advantage of the full superpowers of artificial intelligence and advanced robotics helping humans do things that we alone could never do.

In biotech we're going to master genetic engineering and even the much broader biological engineering in order to redesign as many products and materials and foods as necessary to be fully sustainable and more closely in sync with nature, meaning low-impact and biodegradable. We're going to jumpstart the new industries of synthetic biology and begin in earnest the Biological Age. And in energy tech, of course, we're going to do something that's never been done: Transition as many people as possible as fast as we can from one foundational source of energy based in carbon to an array of energies that will from now on be clean. Part of that world-historic effort may be to finally cross the threshold of nuclear fusion and harness the energy that powers the sun and all stars. In the next 25 years humans will have crossed several

fundamental thresholds that presumably any sufficiently intelligent species on other planets in the universe only cross once. We will be well on our way to being sustainable, living within the environmental bounds of the planet, with many more challenges ahead. We will have learned to operate in much more sophisticated ways at a global level on a planetary scale, with much more to come. This epic story is starting to unfold around us today. The demographic shifts, the cultural changes, the economic evolutions, even the counter-intuitive political breakthroughs — the whole transformation has begun. The bulk of everything laid out here is the probable through line of what will happen over the next 25 years. Like any informed look into the future, not all elements will follow the first-pass trajectory across the next 25 years that I laid out here. But most seem likely to play out. This generally positive, pro-progress story is actually much more likely than the current conventional wisdom — from the right or left, from the vast majority of media or academics — that says we're caught in an unfolding disaster and heading into a dystopian future. The gloom-and-doom naysayers have always been the main chorus in previous times of transformation, and so far, they have almost always been proven wrong in the long run. They will be proven wrong again.

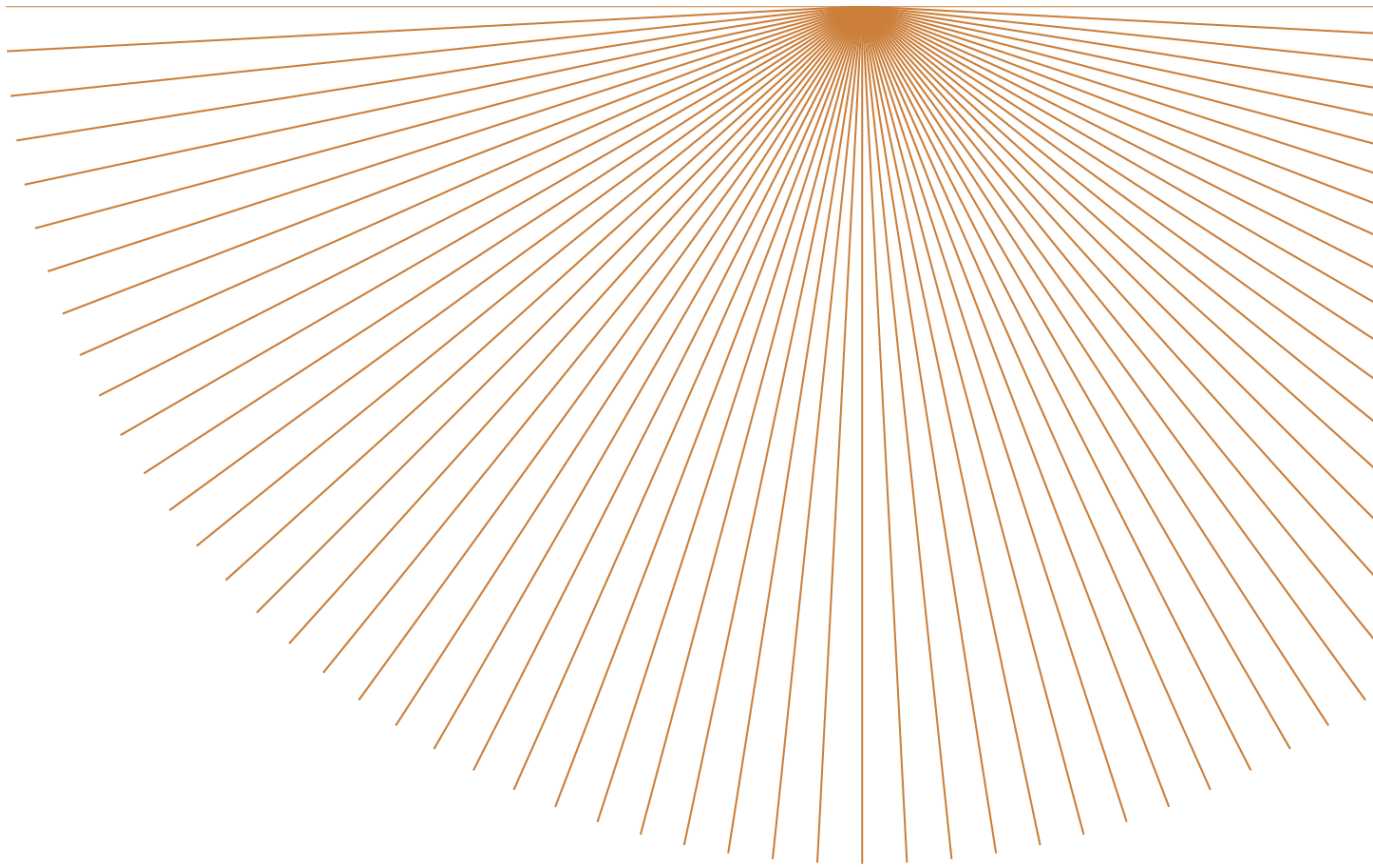
“The Great Progression is **not inevitable**. We will have to make this, or something roughly like this, actually happen.”

Do not fall for the inevitable setbacks to this generally positive, pro-progress story. For every two steps forward, there will be one step back. And sometimes there will be two or three steps back before we move forward again. This is the way progress works; this is the way history works. The dotcom crash did not stop The Long Boom, as critics were quick to pronounce, but marked a pause, and some rethinks in strategy, before the digital transformation inexorably picked up again. The same will happen this time, so don't just focus on the exact outcome of this year's midterm election, for example, or whatever else might temporarily counter this narrative. Keep your eye on the horizon. Keep thinking long-term. All that said, The Great Progression is not inevitable. We will have to make this, or something roughly like this, actually happen. This pro-progress narrative of the next 25 years is certainly possible, and arguably is even probable, but what really matters is whether enough people see it as preferable. You can start with a clear vision, but you need to then shift to broad strategies, and then detailed plans. We must make it so. Humans at this juncture in history have everything we need to pull this off. We have developed amazingly powerful tools that can look back through vast distances in space and see what happened at the beginning of time, 13 billion years ago. We have greatly expanded the reach of knowledge in every imaginable field, including how our own brains work. And now we have designed thinking machines that can help us learn even faster and know far more. Never bet against human ingenuity. Human beings are incredible problem-solvers. We've gotten particularly good at

problem-solving over the last couple centuries, and the pace of innovation has only been building decade after decade, year after year. Our tools keep getting better and better. Our knowledge keeps inexorably expanding in every direction. We are steadily mastering the game of progress. We might be up against some complex challenges, but we have all the capability we need to pull off another leap forward in progress.

“We are steadily mastering the game of progress. We might be up against some **complex challenges**, but we have all the capability we need to pull off another leap forward in progress.”

We may not yet see what's really happening around us now, and what actually will happen in the next 25 years. But people in the future, and maybe for a long time into the future, will look back and fully appreciate what we are about to accomplish. People in 100 years, or 500 years, or even 1,000 years from now, will look back on our era and credit us with several world-historic accomplishments. They'll say: That's when the world went fully digital, that's when the world became mostly sustainable, that's when the world started working on a truly planetary scale. What an amazing time that must have been to live through The Great Progression.



WE NEED A NEW PHILOSOPHY OF PROGRESS

WE HAVE BEEN NAIVE ABOUT PROGRESS IN THE PAST, BUT THAT DOESN'T

MEAN WE HAVE TO BE CYNICAL ABOUT PROGRESS IN THE FUTURE.

PROGRESS IS NOT INEVITABLE BUT THAT SIMPLY MEANS IT'S UP TO US.

ARE WE UP FOR THE CHALLENGE?

Jason Crawford

Two hundred years ago, **almost 90% of people** still lived in what is today considered extreme poverty: many subsisted on manual labor in the fields, lit their homes with candles, cooked with wood or coal, and hauled their water in buckets from the well. But by the mid-19th century, per-capita incomes in the West started rising consistently for the first time in history. Soon ordinary people would have plumbing and electricity, own refrigerators and washing machines, travel in cars and airplanes, and live or work in skyscrapers.

This unprecedented progress engendered an optimism that lasted into the mid-20th century. The title of the 1933 Chicago World's Fair was "A Century of Progress"; the 1939 fair in New York featured "The World of Tomorrow," and people came back from it proudly sporting buttons that said "I Have Seen the Future." In the same era, DuPont unironically used the slogan "better things for better living... through chemistry."

In the 1950s and '60s, people looked forward to a future of cheap, abundant energy provided by nuclear power; Isaac Asimov even **predicted** that by 2014, appliances "will have no electric cords, of course, for they will be powered by long-lived batteries running on radioisotopes." A **1959 ad in the Los Angeles Times** sponsored by a coalition of power companies referred to "tomorrow's higher standard of living"—without explanation, as a matter of course—and illustrated the possibilities with a drawing of a flying car.

Today, the zeitgeist is far less optimistic. A 2014 editorial in The Atlantic asked “Is ‘Progress’ Good for Humanity?” Jared Diamond has called agriculture “The Worst Mistake in the History of the Human Race.” Economic growth is referred to as an “addiction”, a “fetish”, a “Ponzi scheme”, or a “fairy tale.” Some even advocate a new ideal of “degrowth.” We no longer assume that tomorrow will bring a higher standard of living. A 2015 survey of several Western countries found that only a small minority think that “the world is getting better.” The most optimistic vision of the future that many people can muster is one in which we avoid disasters such as climate change and pandemics. Young people are not even that optimistic: in a recent survey of 16- to 25-year-olds in ten countries, more than half said that “humanity was doomed” from climate change. What happened to the idea of progress?



The modern idea of progress

The idea of progress is a modern phenomenon. Many ancient cultures viewed history as a cyclical pattern of ups and downs, or even as a story of decline: the past as a golden age, from which we have fallen. Europeans in the Middle Ages, looking upon the ruins of coliseums, aqueducts, and pyramids, understandably thought that their ancient ancestors must have been the greatest people

ever to have lived. As they rediscovered ancient texts, some thought that those ancestors must have possessed all knowledge of consequence as well. They—the “moderns”—thought themselves unable to surpass those achievements or that learning. Economic historian Joel Mokyr, taking a phrase from historian Carl Becker, calls this “**ancestor worship**,” and it is the antithesis of the idea of progress. Ancestor worship in Europe, **Mokyr says**, began to weaken around the end of the 1400s, with the voyages of discovery. An entire continent was discovered that had never been mentioned in the classic texts: apparently the ancients had not possessed all knowledge of consequence. Those ancestors also didn’t know about the compass, gunpowder, or the printing press. Francis Bacon, for one, took inspiration from this: in *Novum Organum*, he wrote that “Noble inventions may be lying at our very feet”—that is, if these possibilities lay undiscovered for so long, what else might be out there, just waiting to be found? From these early examples, Bacon and his contemporaries extrapolated out a vision of a scientific and industrial revolution—perhaps the most powerful vision to ever come true, although its realization would take centuries. If by the late 1600s there was any doubt about the ancients vs. the moderns, Isaac Newton laid it to rest. His theory of universal gravitation and explanation of the solar system were so clearly superior to anything that had been offered before that there was no question left: the moderns had surpassed the ancients. The pattern of history was neither endless cycles nor a long decline: it was an upward trend. Progress was possible. In the era that followed, an unbridled optimism was expressed by

leading intellectuals, such as the French Enlightenment thinker Nicolas de Condorcet. In 1794, he wrote *Sketch for a Historical Picture of the Progress of the Human Mind*, in which he forecast virtually unlimited progress in every dimension—not only in science and technology, but in morality and society. He spoke of the equality of the sexes, and peace among nations. And he believed that all forms of progress went together, **saying** that prosperity naturally disposes people to “humanity, benevolence, and justice,” and that “nature has connected, by a chain which cannot be broken, truth, happiness, and virtue.” Amazingly, he wrote these words while hiding out from the French revolutionary government, which was hunting him down to execute him because he had dared to criticize the Constitution of 1793. Unfortunately, he could not hide out forever: he was captured, and died in jail soon after. Evidently the moral perfection of mankind was slow in coming. But technological progress was racing ahead. The century that followed saw a series of inventions that transformed the world, including the railroad, the telegraph, the telephone, and the light bulb. Progress was no longer a possibility for philosophers to theorize about, but a reality being brought daily into the homes and lives of ordinary people.

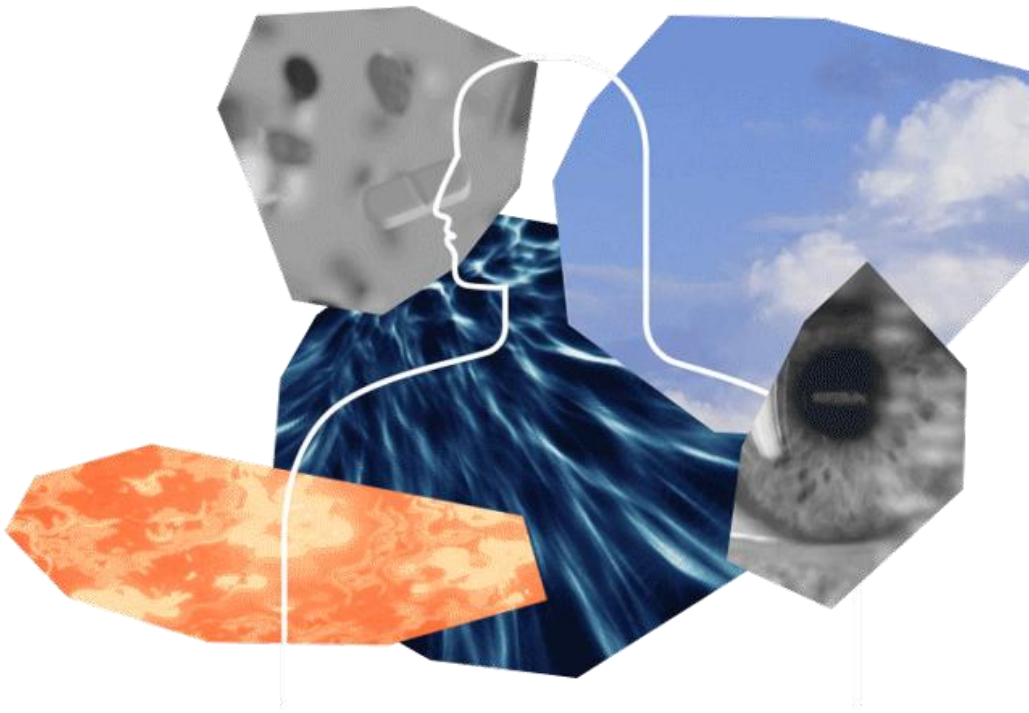
“The moderns had surpassed the ancients. The pattern of history was neither endless cycles nor a long

decline: it was an upward trend. Progress was possible.”

And the world started to laud as heroes those who discover, invent, and build. Samuel Smiles, a 19th-century biographer of industrial figures, **said** that although kings and warriors had so far monopolized the pages of history, “some niche ought to be found for the Mechanic... there is a heroism of skill and toil belonging to the latter class, worthy of as grateful record—less perilous and romantic, it may be, than that of the other, but not less full of the results of human energy, bravery, and character.” A statue of James Watt, who invented a more efficient steam engine, was erected at Westminster Abbey; **the inscription read**, “to show that mankind have learned to know those who best deserve their gratitude,” and called Watt one of “the real benefactors of the world.” Great industrial achievements were met with ecstatic, jubilant public celebrations. When the transcontinental railroad was completed in 1869, Sacramento and San Francisco held enormous parades and partied for three days. When Edison demonstrated his light bulb to the public in 1879, thousands of people converged on his Menlo Park laboratory to see it, and the New York Herald **proclaimed** it “The Great Inventor’s Triumph.” When the Brooklyn Bridge opened in 1883, more than ten thousand pieces of fireworks were set off, and speeches were given calling the bridge a monument to “enterprise, skill, faith, endurance,” a symbol of “peace,” and an “astounding exhibition of the power of man to change the face of nature.” In 1899, the

naturalist Alfred Russel Wallace (who worked with Darwin on the theory of evolution) published a book, *The Wonderful Century*. In it, he attributed twenty-four “great inventions and discoveries” to the 19th century—as compared with only fifteen for all of human history prior. The *New York World* expressed the sentiment of the era on January 1, 1901, with **an editorial that stated**: “The World is optimistic enough to believe that the twentieth century ... will meet and overcome all perils and prove to be the best this steadily improving planet has ever seen.” It seemed, then, that the optimism of the Enlightenment had been justified. And if the scientific and technological progress prophesied by Bacon could come true, maybe the moral and social progress prophesied by Condorcet could be realized as well. After all, democratic republics and representative government were beginning to replace monarchy, slavery had been ended in the West, and new inventions such as the telegraph were connecting far-flung peoples, improving communication and hopefully promoting mutual understanding. The most optimistic thinkers at the time hoped that the growth of industry and prosperity, and the expansion of trade between nations, would lead to an end to war—a new era of world peace. They were wrong. The World Wars of the 20th century violently shattered those naive illusions. Technology had not led to an end to war: it had made war all the more horrible and deadly. It had given us the machine gun, chemical weapons, and the atomic bomb—the most destructive weapon the world had ever seen, a product of modern science, technology, and industry. On top of the wars, the West had been

through an economic crash and depression. Totalitarianism was on the rise around the world. It was getting harder and harder to believe in the rationality of human beings, or in the predictability and controllability of nature. By 1935, historians such as Carl Becker were **saying** that “the fact of progress is disputed and the doctrine discredited,” and asking “What, if anything, may be said on behalf of the human race? May we still, in whatever different fashion, believe in the progress of mankind?” What had gone wrong? How had the world reached such a state—just when everything seemed to be going so well?



How we lost our way

The idea of progress had always had detractors. As early as 1750, Rousseau declared that “the progress of the sciences and the arts

has added nothing to our true happiness,” adding that “our souls have become corrupted to the extent that our sciences and our arts have advanced towards perfection” and that “luxury, dissolution, and slavery have in every age been the punishment for the arrogant efforts we have made in order to emerge from the happy ignorance where Eternal Wisdom had placed us.” In the mid-20th century, though, attitudes like these became more influential. The critics of modernity pointed not only to war and depression, but to a whole host of problems associated with material progress.

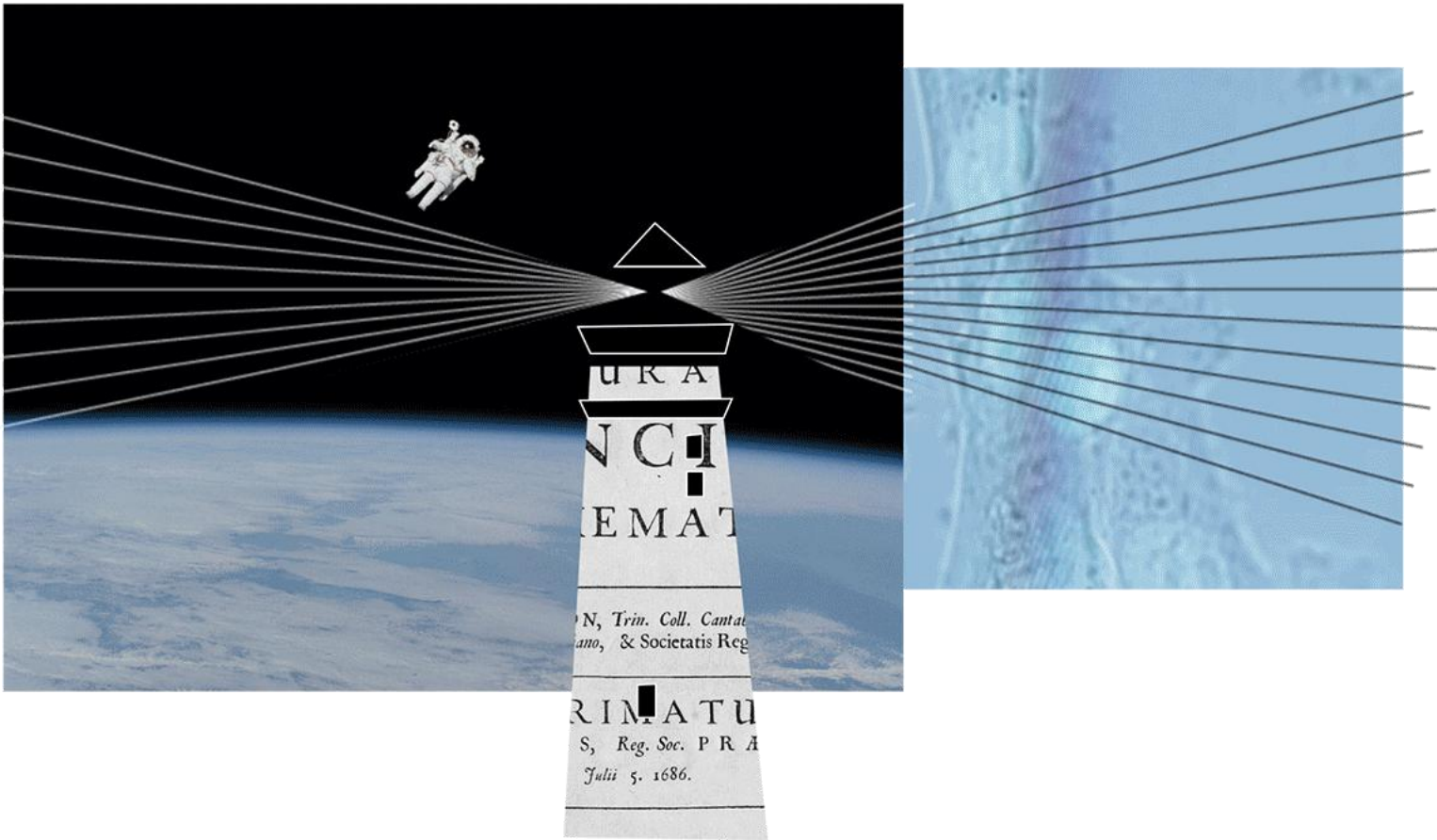
“The most optimistic thinkers at the time hoped that the growth of industry and prosperity ... would lead to an end to war—a new era of world peace. The World Wars of the 20th century violently shattered those naive illusions.”

New technologies cause job loss and economic upheaval. As technology wrought its “creative destruction” in a capitalist economy, entire professions from blacksmiths to longshoremen became obsolete. As early as the 1700s, angry groups of workers such as the Luddites smashed and burned the new textile machinery in protest. The new industrial economy was also seen

as concentrating wealth and power in a new elite: Rockefeller, Morgan, Carnegie. Their wealth came from business, not inheritance, and their power was more economic than political. To many people, however, they looked like a new aristocracy, little different than the old. In America especially, the people—who just a few generations ago had fought a war to throw off monarchical rule—were suspicious of this new elite, even as they celebrated rags-to-riches stories and praised the “self-made man.” At the same time as these magnates were getting rich from industrial ventures, however, poverty and inequality persisted. Many people were still living in dilapidated conditions, without even toilets or clean water. And even the prosperity that had been created could not obviously continue, as it was based on consumption of finite resources. Long before “peak oil,” William Stanley Jevons was **warning of peak coal**. Others predicted **the end of gold** or other precious metals. Sir William Crookes (more accurately) sounded the alarm that the world was **running out of fertilizer**. Even as people celebrated growth, they worried that the bounty of nature would soon be used up. Industrial growth also brought pollution. Coal was blackening not only the skies but the houses, streets, and lungs of cities such as London and Pittsburgh, both of which were likened to hell on Earth because of the clouds of smoke. Raw sewage dumped into the Thames in London led to **the Great Stink** as well as cholera epidemics. Pesticides based on toxic substances such as arsenic, dumped in copious quantities over crops, sickened people and animals and poisoned the soil. As the economy grew more complex and people were living more

interconnected lives, new risks and harms emerged. For instance, households that once were largely self-sufficient farms began buying more of their food as commercial products, from increasingly farther distances via rail. Meat packing plants were filthy; milk was transported warm in open containers; many foods became contaminated. (In the US, these concerns led in 1906 to the Pure Food & Drug Act and ultimately to the creation of the FDA.) New technologies also created unimagined and unforeseeable hazards. For instance, no one expected that X-rays could be harmful to health, as they could neither be seen nor felt, and initially they were used as novelties at parties and carnivals. But within a few years, it became clear that they were causing burns and sickness, and that their use needed to be minimized. Progress, it turns out, is messy. But instead of seeing poverty, pollution, and safety as problems to be solved through economic growth and technological development, the radical social movements that came to prominence in the 1960s were based on a deep distrust of technology and industry as such. Activists said that we were becoming “disconnected” from nature and our communities, that progress was not making us happier or healthier, and that there were inherent **limits to growth**, which we exceeded at our peril. This view of progress as harmful was soon reflected in law and regulation. A **1971 court ruling** enforcing the new National Environmental Policy Act (NEPA) against a proposed nuclear plant foresaw “a flood of new litigation... Several recently enacted statutes attest to the commitment of the Government to control, at long last, the destructive engine of

material ‘progress.’” By 1991, historian Christopher Lasch was wondering how belief in progress was even still alive, **writing**: “How does it happen that serious people continue to believe in progress, in the face of massive evidence that might have been expected to refute the idea of progress once and for all?” In the face of both moral and legal opposition, it is unsurprising that in recent decades, material progress shows signs of slowing down. In *The Rise and Fall of American Growth*, economist Robert Gordon says that growth in the metric of output per labor hour has slowed from an average annual rate of 2.82% in the period 1920–1970, to 1.62% in 1970-2014. Another key metric of progress is total factor productivity (TFP), a measure of the amount of output we can generate per unit of capital and labor inputs. Increases in TFP—getting more from the same inputs—are generally assumed to come from advances in technology, organization and management. Annual TFP growth was 1.89% from 1920-1970, but it has averaged less than 1% in every decade since. Some areas, to be sure, have continued racing ahead, such as computers and the internet. But other areas have lagged behind: manufacturing, construction, transportation, and energy have seen no new general-purpose technologies since the 1960s. Nuclear power was stunted; the Concorde was grounded; the Apollo program was canceled. And the flying cars we were promised never arrived.



The way forward

The 19th-century philosophy of progress was naive, perhaps hopelessly so. But the 20th-century reactionary movement against progress was a mistake—and the fatalism and defeatism that arose in that era are not a way forward. We need a new philosophy of progress for the 21st century. One that reaffirms the reality and value of progress, and reminds that we possess the agency to shape the future. But we must also avoid the mistakes of the past. First, progress is not inevitable: it does not, as some

optimists once thought, unfold according to a divine plan or cosmic will. Progress depends on choice and effort. It is up to us. Second, progress comes with costs and risks, which we must control: pollution, health hazards, economic upheaval, war. And future technologies, such as genetic engineering or artificial intelligence, may pose greater risks still. Safety must be considered a key goal of progress, even as it forces tradeoffs with development speed and cost. Third, moral progress does not automatically go hand in hand with technological progress. One of the darkest lessons of the 20th century was how technology could be used to enable empire, wars of conquest, and totalitarian oppression. We must continue to fight against these evils, lest 21st-century technology be used to make them even worse.

“We need a renewed vision of the future: a bold, ambitious, technological future, one that we want to live in and are inspired to create.”

Above all, we need a renewed vision of the future: a bold, ambitious, technological future, one that we want to live in and are inspired to create. A future of cheap, abundant, reliable, clean energy from nuclear fusion. A future where we return to space and create permanent settlements, both for recreation and for industry. A future where we cure diseases through genetic

engineering. A future where we cure aging itself, giving everyone as many years of healthy life as they choose. A future where we don't just end poverty, but create new levels of wealth so fantastic that they make today's wealth look like poverty in comparison—just as was done over the last two hundred years. To reverse decades of anti-progress reactionism may seem daunting. But Francis Bacon inspired generations after him with a vision of useful knowledge leading to practical improvements in human life—and he had only a handful of inventions to point to as examples to prove his case. Today, the case is far stronger: progress is not a theoretical possibility for the future, but the established reality of the past and the living present. Its examples are literally all around us, from the paved roads and concrete foundations beneath our feet, to the steel girders and plate glass windows surrounding us, to the electric lighting overhead. And to communicate our vision, we have not only the printing press, but the internet. If Bacon did it, so can we.

Jason Crawford is the founder of The Roots of Progress, where he writes and speaks about the history of technology and the philosophy of progress. Previously, he spent 18 years as a software engineer, engineering manager, and startup founder.

LIFE — OCTOBER 20, 2025

The next revolution in biology isn't reading life's code — it's writing it

It's time to write the human genome, argues microbiologist Andrew Hessel.



KEY TAKEAWAYS

- Two decades after the Human Genome Project taught us to read life's code, scientists are now learning to write it.
- In this op-ed, Andrew Hessel, cofounder of the Human Genome Project—write, argues that genome writing is humanity's next great moonshot, outlining how DNA synthesis could transform biology, medicine, and industry.
- He calls for global cooperation to ensure that humanity's new power to create life is used wisely and for the common good.

For most of human history, we could only imagine what made us who we are. Then, just over two decades ago, the Human Genome Project — the

international scientific effort to decode the three billion letters of human DNA — changed everything.

Critics at the time called it too expensive, too ambitious, too abstract. And they weren't wrong. It was the largest biology project ever proposed, and scientists hadn't even managed to sequence the smallest bacterial genome yet. But the organizers knew that big plans — moonshots — inspire people and attract funding.

Today, nearly every advance in modern medicine rests on its foundation. The project transformed biology into an information science, spawning ancestry testing, virus tracking, precision cancer therapies, the first personalized medicines, and more.

Now, a new generation of scientists wants to take the next step: not just *reading* the code of life, but *writing* it. That's the mission behind the Human Genome Project-write (HGP-write) and SynHG, the Synthetic Human Genome Initiative.

HGP-write, a nonprofit I cofounded in 2016, is building the technological, ethical, and social infrastructure for large-scale genome writing. SynHG, a UK-led academic consortium announced in 2025, is focused on engineering, developing the pipelines and tools needed to construct chromosomes from scratch. Although different teams, they share the same audacious goal: to one day build a complete and functional human genome. Together, they're helping to launch the next great revolution in biology, one that I believe will far surpass the impact of the original Human Genome Project (which I'll call HGP-read from now on).

Sequencing let us read the book of life, our instruction manual. Synthesis will allow us to write new chapters, if not entirely new books.

Why write a human genome?

When HGP-read finished in 2003, it had taken 13 years and more than \$3 billion to sequence a single human genome (or sequence about 92% of

one, since the technology to close all the gaps didn't exist at the time — the whole genome wouldn't come until April 2022). Today, sequencing a person's DNA costs a few hundred dollars and takes a few hours. Few technologies have become so inexpensive and powerful so quickly.

The advancement of sequencing technology has made Moore's Law — the idea that computer processing power doubles while costs fall roughly every two years — seem like a slow crawl. This breathtaking drop in price and time has spawned entire industries, millions of jobs, and hundreds of billions in economic value. But the fact that sequencing is not yet a consumer technology, in every home, like TVs and phones, suggests we're still nowhere close to the financial or technological bottom yet.

Writing DNA holds even greater promise — the potential to cure any disease. DNA synthesis already underpins the engineering of new proteins, vaccines, and CRISPR-based therapies in the clinic. Writing the human genome in its entirety could enable correcting any genetic condition, regardless of its complexity. And writing small genomes could power a modern Cambrian explosion of new creatures of all shapes and sizes.

Synthetic genomics is not new. In fact, the first synthetic genome was built over two decades ago. In 2002, scientists at Stony Brook University in New York, led by Eckard Wimmer, constructed the poliovirus genome entirely from digital sequence data. In 2010, J. Craig Venter's team created the first synthetic cell — a living organism whose DNA contained hidden “watermarks,” including quotes from James Joyce and physicist Richard Feynman, a web address, and the researchers' own names. By 2019, Jason Chin's group at the MRC Laboratory of Molecular Biology re-engineered *E. coli* with a fully synthetic four-million-base genome. And in 2025, Jef Boeke and his international consortium of yeast scientists completed the ten-megabase yeast genome, a giant milestone on the path to writing larger, more complex genomes like our own.

Whole genome synthesis is not speculative science; it's a branch of genetic engineering that has been quietly simmering away under the radar, growing cheaper and more sophisticated in recent years.

Like AI systems before GPTs arrived in late 2022, most people remain entirely unaware that DNA writing can be done at all, let alone that thousands of labs and companies around the world are using it.

While human genome-writing efforts won't lead to designer babies or supersoldiers anytime soon, they do force society to confront an undeniable fact: Like amateur gods, we are beginning to author living organisms. We aren't very good at it yet. The genomes that we've written are small and uncomplicated, and mostly lightly edited copies of what nature has produced.

The bigger question is whether we'll proactively organize as a species to do this engineering responsibly or wait on the sidelines until commercial, military, or geopolitical forces compel us to face reality and establish some rules of the road.

Writing drives creation, understanding, and security

Both HGP-write and SynHG are aiming to make genome-scale synthesis possible, affordable, and, importantly, safe. This is a grand challenge. Moving from short DNA fragments to entire chromosomes or genomes demands new instruments, enzymes, software, and standards — a completely new “synthetic biology stack.” It also requires that we create effective biosecurity systems, as some of the smallest genomes to engineer, those of viruses, are potentially the most dangerous.

All this won't be cheap to develop, but it will pay dividends long before a human genome is written.

Every incremental advance in writing technology will accelerate progress across the entire spectrum of life science, from agriculture to pharmaceuticals, and from materials science to planetary defense; DNA

synthesis is, after all, the foundational tool for engineering biology and biomanufacturing. Meanwhile, improved biodetection and biodefense technologies, accelerated by genome writing efforts, will enhance global health while better protecting us from the next outbreak or pandemic.

Writing complete genomes is powerful. Editing existing DNA lets us tweak code, but changes must be verified by whole genome sequencing, considering that off-target changes are common. Building a genome from scratch means that software tools similar to word processors can be used to easily search and replace strings of letters, or cut and paste code blocks. Genetic engineering becomes a lot like software engineering. It empowers scientists to explore transformative questions like, “What happens if we remove ancient viral remnants from human DNA?” or “Can we program this cell so that it won’t age?”

Increasingly, it will be AI-based tools that do this coding, just as we’re seeing in computer software. This is already happening. Almost all protein engineering is now done with AI tools. And recently, the California-based Arc Institute combined its Evo AI tools with genome synthesis to make dozens of novel PhiX174 bacteriophages, the viruses that infect bacteria. The success of this experiment suggests that, in the near future, defeating a deadly superbug could be as simple as sending a document to an inkjet printer.

As megabase-scale synthesis becomes available — a stepping stone to the gigabase synthesis needed for human genome synthesis — we’ll be able to design virtually any single-celled organism from scratch. All of microbiology becomes as much engineering as science. These “designer” microbes could transform biomanufacturing, producing medicines, fuels, and materials with unprecedented efficiency.

Just as the transistor ignited the digital revolution, fast, inexpensive, and scalable genome design and synthesis will ignite a biological one. Life becomes a platform technology, a programmable medium for solving the world’s most challenging problems.

The scientific dividends here will be profound. Cellular genomes are spaghetti code, with functions all intermingled and scattered through the chromosomes without rational organization, the only filter being that it works. Constructing complete synthetic organisms is the only way to untangle all the various functions evolution mixed together over billions of years. Starting fresh, scientists will be able to illuminate the mysteries of metabolism, development, and perhaps even consciousness in ways that editing genes cannot support. As the physicist Richard Feynman famously noted, you can't truly understand what you can't create.

The world needs another biological moonshot

But any project that aims to create life must confront serious ethical questions: What kinds of genomes should we build? Are any off limits? Who decides? How do we prevent biological weapons from being developed?

Both HGP-write and SynHG recognize that the same tools that can cure or create life can also be misused to cause suffering and death. That's why transparency, open science, and public dialogue are central to their missions. They want to ensure that the decisions about life's code are a shared global responsibility, not the province of any single corporation or nation.

In this sense, genome writing is as much about governance as genetics. It's about learning how to collaborate safely on planetary-scale, potentially planet-changing technology. And, in the short term, if history is any guide, a little friendly rivalry between teams will only accelerate progress. The US effort got an early start out of the gate, but the UK has quietly taken the lead with steady, consistent progress – and a “care-full” mandate that prizes responsibility as much as speed. But this is a race where, like sequencing, no matter who crosses the line first, all humanity wins.

We could all use something big to cheer for — something that reminds us this planet is our home, not just a launchpad to the Moon or Mars. It's

been nearly 25 years since the world last united around a biology-based moonshot. The first Human Genome Project inspired a generation to see life as code that could be read and understood. Writing the human genome can inspire the next generation to see DNA as something that can be composed, unlocking possibilities that evolution has never explored.

The question is no longer whether we can write a human genome, but whether we can do it wisely — and for everyone’s benefit.

BOOKS — OCTOBER 17, 2025

How neuroscience is rewriting the art of war

In “Warhead,” neuroscientist and national security adviser Nicholas Wright explains how the brain navigates warfare and why it is our ultimate weapon (and instrument for peace).



KEY TAKEAWAYS

- The human brain has been the central “weapon of war” for centuries, shaping both how conflicts are fought and prevented.

- Modern warfare increasingly depends on neuroscientific findings to help determine the best ways to train soldiers, defend populations against disinformation, and manage deterrence strategies.
- Neuroscience also reveals how collective memory and leadership dynamics can steer a society toward increasing aggression or maintaining peace.

When military historians attempt to make sense of a conflict like the Second World War, they tend to examine the external conditions of battles, such as which army possessed the most advanced weapons, experienced generals, favorable terrain, and reliable supply lines.

Nicholas Wright, a neuroscientist and longtime national security adviser for the British and American militaries, prefers to focus on the internal conditions: What's happening inside people's brains. How do people respond to fear and stress? How do soldiers assess risk or make life-or-death decisions?

As he notes in the introduction of his new book, *Warhead: How the Brain Shapes War and War Shapes the Brain*, common explanations for why the Allies managed to defeat the Axis often boil down to some combination of "Russian manpower and American manufacturing." But this familiar story leaves many important facts: "Germany almost won; Britain didn't lose; Russian will didn't collapse; and Americans learned from ingenious and effective adversaries."

According to Wright, "none of that can be understood without the central weapon of war, the human brain." The same is true of modern warfare. While no longer waged exclusively with rifles and rockets, but also AI, drones, and cyberattacks, today's wars nonetheless influence how we think, feel, and act on the battlefield.

In *Warhead*, Wright explains how armed conflict impacts every part of our brain, from the instinctive reflexes of our reptilian brainstem to the cognitive and metacognitive functions of the prefrontal cortex. He also reveals how this knowledge has been leveraged in past and present wars,

and how it could be leveraged in the future to enhance the offensive capabilities of soldiers or protect civilians from foreign threats.

I recently spoke with Wright to discuss the extent to which violence and conflict are intrinsic to our evolutionary history, whether humans can ever achieve world peace, and how authoritarian regimes arise from a biological fondness for strong, efficient leadership.

(The following interview has been edited for length and clarity.)

Big Think: What motivated you to write this book, and what makes the intersection between neuroscience and national defense so relevant today?

Wright: Nowadays, many people want to know why there are so many wars, and what we can do about them. To help answer these questions, we can use the latest research on what has always been the central weapon of war — and instrument of peace — the human brain.

Consider May 1940. The German army had fewer men, guns, tanks, and planes than France's defenders. But in the 1920s and 1930s, German military professionals had studied how they could harness the human brain's capacities for shock, creativity, guile, willpower, daring, and skill to win wars by surprising and deciding faster than the enemy.

Big Think: How has the scientific understanding of the brain in conflict developed over time?

Wright: The brain has always been central to the most insightful thinking on warfare, whether that's ancient China's Sun Tzu, who prized deception and self-knowledge, or early 19th-century Prussia's Carl von Clausewitz, for whom war was a clash of wills. That said, the scientific study of the brain really took off in the late 19th century.

One idea that greatly advanced our scientific understanding is that the brain employs models that link senses to actions, thereby helping us achieve our goals. Knowledge of these models can challenge what seems

common sense. It seems common sense that light hits your retina, is converted into signals, and is then processed by the brain into images. However, that's not completely true: Our perception is controlled by our expectations. However objective our perception may seem, we can only ever perceive part of reality.

Carl von Clausewitz famously described the “fog of war.” As societies industrialized, scientists applied their understanding of perception to enhance that fog. As a psychology manual for the U.S. Armed Forces from 1943 put it: “Take advantage of another man’s brain, use its own rules to deceive it, to make it perceive something that is not real.” Exploiting our brain’s expectations was the core target, and it remained so as militaries digitized.

Big Think: What are some of the most profound and effective ways our understanding of the human brain has shaped the way we conduct warfare, and how the brain may shape warfare in the future?

Wright: I can give you three items from my own direct experience advising the Pentagon. First, enhancing “information operations” to defend populations from attack by those seeking to sow discord. What are the features of audiences, messages, and messengers on social media that are most effective at influencing people? The brain helps us list them.

Second, nuclear weapons. While writing this book, I met with analysts from U.S. Strategic Command, which runs the U.S.’s nuclear planning. What they often find most useful is insight about how humans think, as their job is essentially to understand the brains of key individuals like Xi Jinping, Vladimir Putin, and Kim Jong Un.

Third, how humans and machines (including AI) can work together. You can have the best tech in the world, but if it doesn’t work well with the humans who have to use it, you’ll lose. If an AI and a human are working together, they must communicate effectively, and that requires understanding the human side as much as the AI side.

We can reduce the chances of conflicts and wars escalating. [To do so], we need to understand why humans fight, lose, and win. Wisdom is seeing the bigger picture of ourselves in the world, so our chosen actions help us live better.

Big Think: Could you explain the neuroscience behind the “will to fight,” a concept often discussed in literary and philosophical contexts as opposed to scientific ones?

Wright: Fear is so powerful because almost no human wants to die. Self-preservation is a basic feature of life. And yet, running away is often not the best way to succeed or survive, and so humans, like most other animals, evaluate and manage risks.

Risk assessment involves not only the amygdala but also the insula, which lies next to it. The insula helps explain another reason why soldiers remain in the fight: the powerful social bonds with members of their unit, who they don't wish to leave or let down.

A good analogy is that of a concert orchestra. The orchestra's sections — strings, percussion, and so on — work together, and the output of any one section alone cannot produce a symphony.

In the brain, “bottom-up” systems give the “orchestra” abilities, such as reacting to pain, vital drives like hunger, and visceral instincts like the emotions of anger or fear. More cognitive, “top-down” systems, arising from higher brain areas like the prefrontal cortex, give abilities such as control and reflection, or [the ability to] think about thinking. Humans need both.

Big Think: Are qualities that would be helpful on a battlefield, such as fear management and risk assessment, inborn or acquired?

Wright: Qualities like fear management can be developed by training. For example, soldiers who were studied during parachute training showed dramatic stress responses within minutes of their first jump, but in later

training jumps, that stress changed to thrill. That's why training is crucial. [It helps] avoid the kind of moral collapse that occurred among French soldiers in 1940 and helps people cope with the unexpected.

Overall, training is probably more important than selective recruitment, although recruitment can be necessary for specialists with specific areas of expertise. Such expertise requires an innate ability, thousands of hours of practice, and the ability to learn effectively. All three are necessary and none is sufficient on its own.



Paratroop field surgeons ready for a training jump at the Fort William Henry Harrison training center of the joint U.S.-Canadian First Special

Service Force during World War II, 1943. While the first training jumps were stressful for the paratroopers, later ones became more thrilling.

(**Credit:** Signal Corps Archive / Wikimedia Commons)

Big Think: If perfectly peaceful societies are incompatible with human nature, what practical steps can nations take to foster peace and avoid war? Instead of chasing utopias, how can we use self-knowledge to build something more durable?

Wright: A prime reason for my optimism is that human self-knowledge is cumulative. Self-knowledge can help us avoid oversimplistic ideas that are wrong or incomplete. Steven Pinker was probably right when he argued that the arc of history tends towards peace. But that's not enough to keep us safe because wars do happen, and they don't win themselves.

Other thinkers, like Robert Sapolsky, hope that we can stop wars by persuading enough people that they are bad and pointless. Reconciliation is as natural as conflict — but pacifism, or being completely unwilling to defend yourself, while aiming for peace as an end, provides no means of getting there.

Others still focus too exclusively on building ever more powerful militaries, or using them ever more aggressively, regardless of the risks they run.

We can reduce the chances of conflicts and wars escalating. [To do so], we need to understand why humans fight, lose, and win. Wisdom is seeing the bigger picture of ourselves in the world, so our chosen actions help us live better.

Big Think: Some argue that the centrality of conflict and aggression in human evolutionary history is overstated and even misconstrued. How do you respond to that line of thinking, both as a neuroscientist and a Pentagon advisor?

Wright: Is the human story one of relentless violence only? No. There is art, beauty, love, happiness, construction, invention, wonder. But violence is part of us, too. Our closest ape relatives, like chimps and bonobos, show a fair amount of violence, as did many groups of hunter-gatherers. Since states first popped up, history has been full of wars.

Wiser people don't just look away from things that are unpleasant, especially not when the stakes are high. Some overstate the role of violence, others understate it. As I warn in the book, both can be dangerous.

Big Think: Warfare evolves. If the brainstem helps us understand conflict in its most primitive forms, which regions of the brain will shape how we navigate the wars and military technologies of the future?

Wright: I would push back a little and say our entire brain will shape our military and technological futures.

Take the hypothalamus. Located at the top of the brainstem, it's crucial for sleep, thirst, hunger, warmth, and sexual reproduction, and work on this organ could yield huge prizes for humanity. Astronauts traveling to Mars will have to survive for months on a tiny spaceship with minimal food, endure microgravity where their bones and muscles waste away, and suffer from cosmic radiation bombardment. The hypothalamus helps with all those challenges in animals.

The higher parts of the brain will be crucial, too. For example, human-machine interfaces will increasingly use augmented reality that superimposes information on our vision to help us act — not because augmented reality is a Silicon Valley fad, but because it's a natural extension of how we perceive.

The book's journey through the brain ends at the frontal pole, a region involved in self-reflection — thinking about thinking. How self-reflection operates matters because it will always be needed to make wiser choices about our toughest challenges. [For instance], no human or AI can be

infinitely wise. But the more we discover about our brain's machinery for wisdom, the more pathways open up to building wiser AI.



A picture of soldiers in a 2015 parade in Beijing honoring the Chinese people's victory in the War of Resistance against Japan and the end of World War II. Since Xi Jinping assumed power, the narrative of the country's role in World War II has become increasingly nationalistic, focusing less on the efforts of other allied countries such as the U.S. (Credit: The Russian Presidential Press and Information Office / Wikimedia Commons)

Big Think: You've written about the neuroscience of war. What about the neuroscience of authoritarianism? How do such regimes exploit certain brain functions or cognitive tendencies?

Wright: Most social species self-organize into social hierarchies because doing so can help decrease aggression and conserve energy in the group. Strong leadership also enhances effectiveness: a group of doctors treating an emergency trauma patient needs someone to lead them, or things might get missed.

The challenge for free societies is that the effectiveness of leadership and social hierarchies always affords the possibility for authoritarianism. Charismatic and successful military leaders like Douglas MacArthur, who refused to follow President Harry Truman's orders during the Korean War, will always hold considerable power due to the prestige and dominance that militaries bring.

Big Think: You mention that the hippocampus — linked to memory and spatial navigation — shapes how humans fight over territory and historical grievances. How do you think collective memory operates on a geopolitical scale? When people in power rewire a society's collective memory, are they literally rewiring our brains?

Wright: Yes! And it's not just people in power who shape the contents by which our societies function. We all shape human memories that are physically encoded in our brains. I have seen patients where specific brain disorders affect specific types of memories. Losing memories leaves us adrift because we remember not for the sake of the past, but for the future, so we can create a landscape of possibilities to navigate.

To be useful, our memories are dynamic rather than static, which is why forgetting is an active process, a feature and not a bug. Collective memories are dynamic, too. The stories we tell about ourselves and events, including war, are shaped by our social interactions: talking, reading, watching TV, or movies.

In Britain and the U.S., we have largely forgotten what many who actually fought or led in World War II knew: The Germans fought better on land than the British and Americans until near the war's end. French collective memories altered considerably after World War II, converting a story of collaboration after June 1940 into one of resistance.

Chinese memories of World War II have changed even more, and these changes matter today. In the book, I describe how China's involvement in World War II was part of a series of civil wars, and how, during

Communist leader Mao Zedong's rule, the war was told as a story of communism's rise.

Since Xi Jinping assumed power in 2012, Chinese stories have increasingly included nods to Chinese nationalist (not just communist) soldiers fighting bravely, thus placing a strong, victorious, and morally righteous China at the forefront of the postwar global order.

We have to put ourselves in the other's shoes, to anticipate how the other will decide to act (or not act), so that we can better make peace with them, deter them, and — if we must fight — outwit them.

Big Think: Deterrence theory in geopolitics assumes people act rationally. Yet neuroscience shows us that perception is biased, emotions hijack reasoning, and threat-detection systems, like the amygdala, can overreact. As such, should we rethink assumptions behind, say, nuclear or cyber deterrence?

Wright: No Western country can destroy all of Russia's or China's nuclear weapons, meaning that — whatever others do to them — they can strike back and kill millions. What we can do is influence their decision-making to deter them from using nuclear weapons and to influence their escalation if war happens.

That's why U.S. Strategic Command officials are interested in cognitive insights, how humans think. They want to influence how others think, as societies or as individuals. We have to put ourselves in the other's shoes, to anticipate how the other will decide to act (or not act), so that we can better make peace with them, deter them, and — if we must fight — outwit them.