

the HUMAN project

Erika Ilves & Anna Stillwell





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PREFACE 5

Think of the ongoing human project as an inter-generational relay. How is our generation—all of us living at the beginning of the 21st century—doing in our leg of the journey? Today we can't give a good answer. We are mostly making it up as we go.

But what if we put some serious thought into it? Our unprecedented connectivity and access to knowledge makes it easier than ever. So let's look as far into the future as our knowledge allows. Let's lay out all the known challenges to our existence and opportunities for our evolution. Then, let's step back and think: Where do we want to take the ongoing human project and why? What are the most important contributions our generation can make during our brief window of existence? And how do we get going?

These are the questions we take head on in this book. Our answers are based on 3 years of research spanning fields from cosmology to biology, from Big History to science fiction. We've studied scores of the global challenge lists put together by inter-governmental organizations, global fora, billionaire philanthropists, and former presidents. We've immersed ourselves in public debates on issues that are now well-understood and sought out lonely voices speaking about issues that have yet to register in the public's awareness. We offer our answers as a conversation starter.

If you are a concerned member of the human race wondering where to place your life's energy or your cognitive and financial surplus, this book is a good place to start. For a multimedia experience of the ideas contained in this book, please download our free multimedia book in the iBook Store or our free app in the App Store.

THANK YOU

The 21st century is truly a new world.

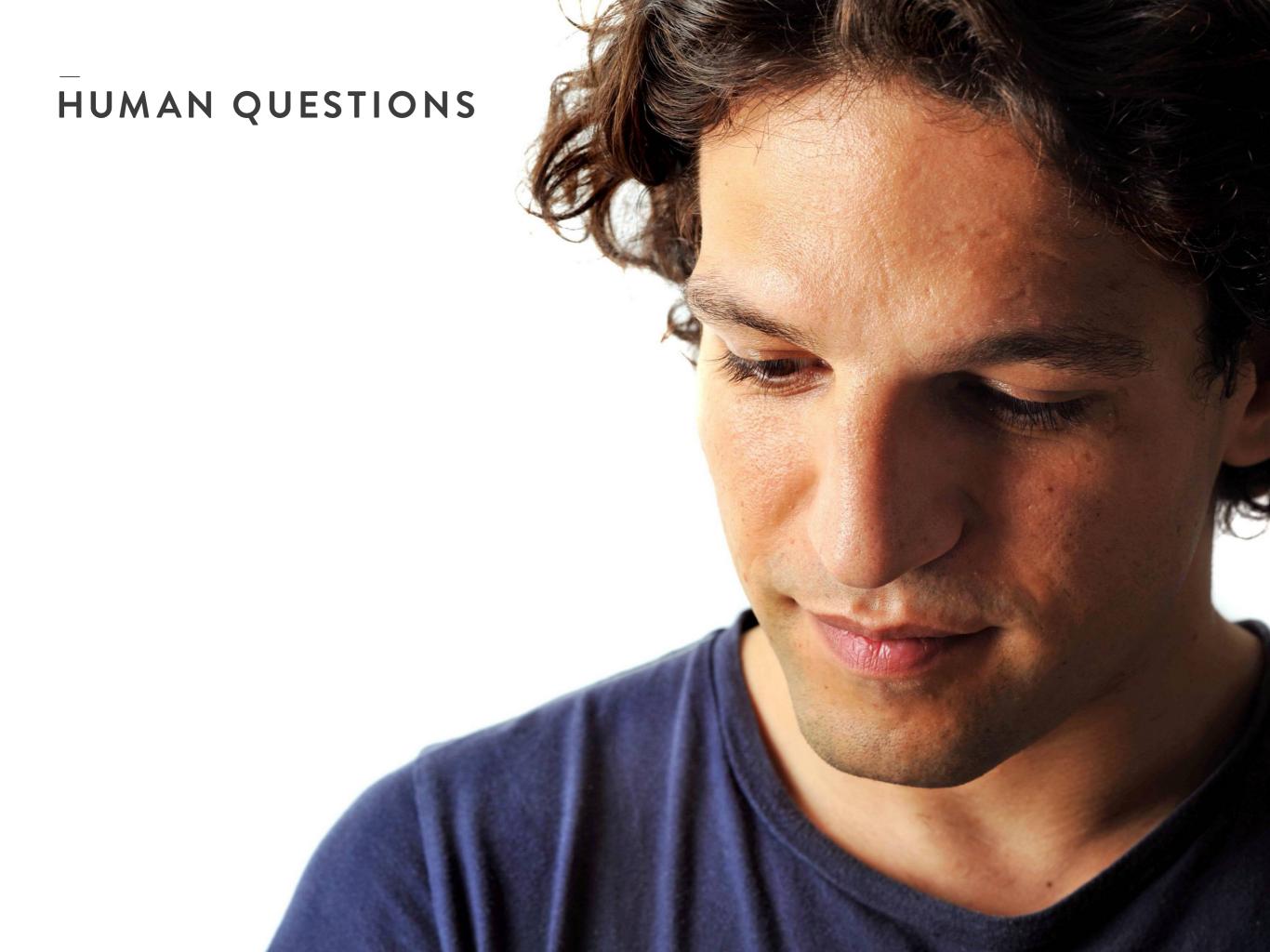
The idea behind THE HUMAN PROJECT started as a spark between the two authors and then quickly evolved into a collaboration among hundreds around the globe. 150 of us came together to run a crowd-funding campaign. We attracted 261 backers (most of whom we had never met!) and raised twice our funding goal, allowing us to turn what was going to be a simple digital book into a multimedia effort with video, original music scores and graphic design produced by a growing team of volunteers working across 4 continents. (If you're reading this format, you can check out the videos online at TheHUMANProjectTV channel on YouTube). To say that we are blown away by the generosity of our backers and the commitment of our volunteers is an understatement!

Taking on questions of species-wide significance requires a certain level of stamina and self-confidence. There were times when we found both in short supply. We've crossed our first finish line largely because we were surrounded by truly amazing people who egged us on, threw their weight behind us and stepped in when we needed them most. Zafer Achi, Ash Banerjee, Tim Smythe, Gail McEwen Miller, Terri Hinton, Lidia Bozhevolnaya Jason Silva, Amanda Gustafson, Marshrur Nabi, Ann Boothello, Irma Wilson, Giorgio Ungania, Natascia Radice, Glistening Deepwater—"thank you" doesn't even begin to cover it. Mahmoud Abu-Wardeh and Serge Lupas—your support was unrelenting and downright touching. Both of you went far beyond the call of duty.

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WHO ARE WE?

7 billion humans.

We are one species but we are not of one mind. Our shared biology is now a fact. Our shared identity is still under construction.

Some of us think our shared humanity is a given. If we only dig deep enough inside... all of us will find it. But what if it does not come pre-installed?

Others say we must raise our consciousness. Cultivate our compassion. That's how we'll realize we're all one. But how long will it take us?

Some of us want to talk issues, not identity: We're stuck on this planet together. So let's just deal.
But how inspired is a trapped soul?

To create an inspired future...
We need good stories about who we are already.
Look at us in the grand scheme of existence.
The 100 billion who came before. The 7 billion alive today.
What's the red thread?
We are a creative species!
We practice the most complex art in our universe:

CULTURAL LEARNING.

We are our own work in progress.



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WHAT SHOULD BE THE PURPOSE OF OUR SPECIES?

To be or to become?

We must choose carefully.

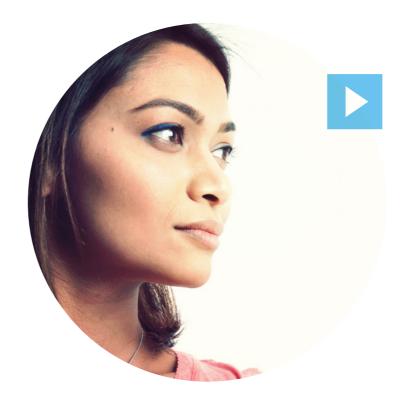
Any purpose with a final destination is shrink wrap on the human spirit. We are not built to arrive, we are built to journey.

Think of the stream of human existence as an ongoing human project. How long should it go on for? No end.

What should it accomplish? No limits.

Our purpose: Survive and ascend.

KEEP BECOMING.



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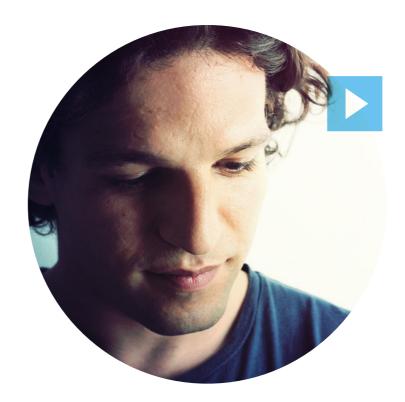
WHAT CAN ONE LIFE MEAN?

Think of a human life as a one-off, And you are walking down a blind alley.

Think of a human life as a contribution to the ongoing human project, And you may be surprised. Suddenly, infinity lies within a finite life.

Imagine your last breath filled with knowing:

Your ascendants...
Can know things you could not know.
Can go places you could not go.
Can become what you could only dream of.
Because you gave your everything.



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OUR STORY

Who are We?

13.7 billion years ago We were crammed into a single point.

10 billion years ago We were stars exploding into existence.

3 billion years ago We were bacteria. We were alive.

550 million years ago We were flatworms. We had hearts and brains.

400 million years ago We were fish. We had jaws.

15 million years ago We were great apes. We had arms, legs and bigger brains.

5 million years ago We were humans. We had voice boxes.

100,000 years ago We could talk but could not ask this question.

1,000 years ago We were all God's creations. Except the guys next door were heathens.

200 years ago We were British, French, American, Indian, Chinese...

100 years ago We had proof We're one species, descended from apes. Few of us were pleased.

60 years ago We declared We're all human, entitled to the same human rights.

10 years ago some started saying We are global citizens.

Today... We could tell a bigger story. We could be HUMAN. We could create a cultural identity that moves us. That takes us places. Tell a story that sticks

and...

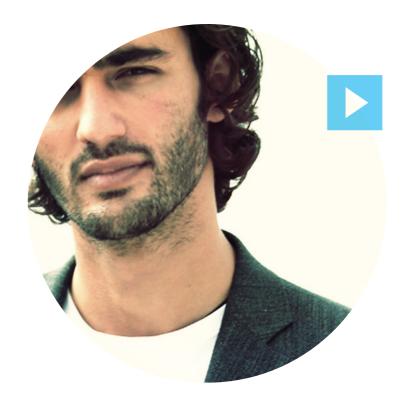
50 years from now We could be Martians.

1 billion years from now We could be Andromedans, living off new stars.

10 billion years from now We could be the creative force of our Universe.

Or not.

So who are We today? Here is a bigger story.



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WE ARE MATTER

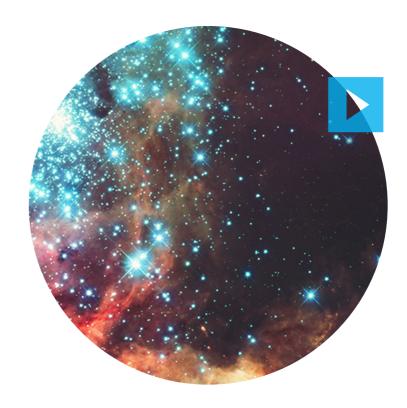
We are clumps of matter that exist in time and space. We—along with everything else—unfurled out of the same universal starter kit. All of it—matter, energy, time and space—banged into existence out of a single hot and dense point 13.7 billion years ago.

Ever since our Universe has been governed by the same forces predictably playing out over time and space, as if strictly following a script. Our universe has been expanding and losing heat. Within it, matter has been clumping into more and more complex structures—quarks clumped into subatomic particles that clumped into atoms. At first there were just two kinds of atoms, helium and hydrogen. Once they clumped into massive stars, more became possible. Within the furnaces of big stars the original two elements fused into heavier and heavier varieties like carbon, oxygen and the rest of the periodic table. Now there were more building blocks to play with. They clumped into molecules we are now made of. Hats off to cosmic evolution—it got us our universe and everything in it.

The cosmic script is simple enough that we can venture a prediction about the fate of our cosmic home. There will be plenty of time—the last 14 billion years are just an instant relative to the infinity of time that lies ahead. There will be plenty of space—the universe will keep expanding at an accelerating rate. The outlook is less upbeat for matter and energy. Entropy is set to wear it all down—planets, stars, even black holes. All matter will revert to simpler and simpler structures dispersing over ever expanding space. Our home will slowly grow dark and cold. There will be space and time but nothing much going on.

In cosmic terms, we are just tiny clumps of matter. Like all matter, we are subject to the forces of cosmic evolution. Is our fate then inextricably bound to the fate of our universe?

Not necessarily. After all, we are no ordinary clumps of matters.



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WE ARE LIFE

We are clumps of matter that live!

Just how widespread life is in our universe is still in question. For now, to talk about life we have to narrow our field of vision from the expanses of our universe to the outskirts of one of the hundred billion galaxies and zoom in on a smallish planet orbiting an average star. We call that planet Earth. That's where life as we know it took up residence 4 billion years ago.

We can't yet say for sure how life began and whether it began on Earth. The move from inanimate matter to live matter was likely gradual and slow, taking millions of years. We can, however, make a compelling case that life is not just more complex than other matter, it is an entire new way of being. In cosmic evolution mass is destiny. When a massive clump of matter like a star burns through all the matter within, it's done being a star. If life lived off only what's within, life spans would be measured in hours and days because in cosmic terms, all life forms are just tiny specks of matter. What life lacks in mass, it makes up for in sophistication.

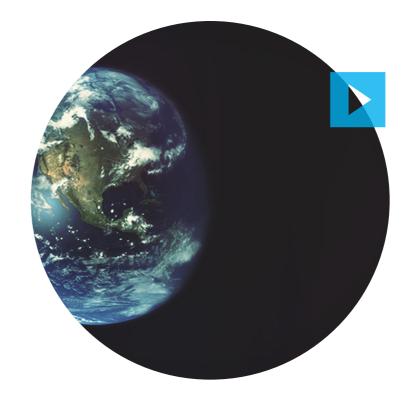
Life keeps itself going by harvesting matter and energy from the outside—it absorbs sunlight, it eats. What it stores inside is information in its DNA about how to do this, a template that allows it to reproduce. Life passes this information from generation to generation. And it does it almost perfectly. But once in a while random errors crop up. In biological evolution, imperfectly copying genes are destiny.

Life started off as the simplest form and evolved into millions of more and more complex forms. The creative exuberance of biological evolution was the result of the interplay between two ways of being: Cosmic evolution kept serving up changes in conditions on the planet. Life kept adapting by blindly generating imperfect copies of its templates. Some worked well, kept surviving and evolving. Other didn't and became evolutionary dead-ends. We are a product of the lineage that worked out.

Life adapts, so its fate is harder to predict. So far life has survived all the curve balls that cosmic evolution has indifferently hurled its way, from deadly asteroids to massive volcanic eruptions. But in the end the fate of all Earth-based life might be inextricably bound to the fate of our star. In a billion years the sun will get so hot, it will boil off all water from the surface of our planet, sterilizing it. Despite a 4 billion year track record of adaptation, life might not be equipped to deal with such a radical change. In that case, the life span of life would be just 5 billion years—a mere cosmic instant.

In biological terms, we are a complex form of life. Like all life, we harvest energy and matter from our surroundings, we rely on the energy of a star. Is our fate then inextricably bound to the fate of Earth-based life?

Not necessarily. After all, we are no ordinary form of life.



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WE ARE CULTURE

We are a form of life that learns and learns fast! How we came to distinguish ourselves from all other life is yet another story of gradual change that took a while to unfold. But in just a few million years, we developed nothing less but a new way to evolve.

Biological evolution takes thousands of generations to produce something new and useful. We can do it in a single generation. Our trick is cultural learning. To us, cultural learning is so habitual it may seem almost banal: we learn something new, we tell each other about it, we build on each others' knowledge, we pass on what we learn to future generations. Today we do this at unprecedented speed. Cultural information can now travel at the speed of light running through our fiber optic cables.

We did not become fast learners overnight. Like biological evolution, cultural evolution started slow and picked up momentum over time. We kicked off with practical ideas that led to incremental improvements in our lives—like turning a sharp stone and a stick into a spear that could kill prey at a distance. Over time, our inventions started to add up and helped us become a dominant species. But we did not stop there. We kept going.

We did not learn to merely adapt to the living conditions on Earth, we learned to transform them. Agriculture was our first pass at large-scale transformation. Instead of roaming vast distances in search of food, we found a way to stay put and grow it ourselves. Once we stopped moving around and started generating extra food, we could deploy our minds to invent smarter ways of doing other things. Fast forward 10,000 years. We now know how to transform matter and life, how to make use of forces that govern cosmic and biological evolution.

Cosmic evolution will keep posing challenges to our existence. Fragile biology might be the basis for our existence for a while. So what will become of us? We are specks of matter, but our body mass no longer determines our destiny. We reproduce according to a genetic template but it is no longer a random genetic error that determines who we will become.

We are a culturally learning species. Could we learn our way to the end of the 22nd century? Could we outlive our star? Could we prevail over entropy?

For a learning species, what's impossible?



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HUMAN FUTURE

CHAPTER THREE

- 3.1 OUR MENTAL FRAMES
- 3.2 HOW WE SUSTAIN OURSELVES
- 3.3 HOW WE RESOLVE CONFLICTS
- 3.4 HOW WE SPEND OUR LIVES
- 3.5 HOW WE CREATE KNOWLEDGE
- 3.6 HOW WE USE KNOWLEDGE
- 3.7 HOW WE SHARE KNOWLEDGE
- 3.8 HOW WE ORGANIZE
- 3.9 HOW WE EXPAND OUR PRESENCE
- 3.10 PANDEMICS
- 3.11 VOLCANOES & EARTHQUAKES
- 3.12 CHANGING CLIMATE
- 3.13 COMET & ASTEROID IMPACTS
- 3.14 AGING SUN
- 3.15 COSMIC RADIATION
- 3.16 GALACTIC COLLISIONS
- 3.17 ENTROPY



OUR MENTAL CHALLENGES FRAMES PROGRESS



The roller-coaster ride that culminated in the creation of this book started with a personal quest. We wanted to figure out what the two of us (Anna and Erika) should do to advance the ongoing human project. We did not want to merely follow our passions or just do something—both of these options seemed like a reckless way to decide on something as important as using up the only lifetime we get. A serious quest calls for serious research. As a first step, we were determined to wrap our minds around what really needs doing at this point in human history.

In other words, we wanted to have a complete overview of what's on our plate as a species. We went looking in all the places that promised an inventory of

global, grand, wicked and even super-wicked challenges. These challenges are now very much in vogue, with scores of intergovernmental organizations, ivory towers, global NGOs, former presidents, prominent scientists and technologists, billionairephilanthropists and thousands of less prominent but equally concerned members of the human race all keeping their own tabs. Having compulsively studied more than a hundred lists, we walked away with a massive headache. There was simply no way to construct a comprehensive metalist of our grand challenges without taking a gigantic step back and revisiting the delicate issue of our own identity and our world view. Who are we identified with? What is our overarching purpose? What are we leaving out of our own field of vision and why? Our relentless self-questioning led to strong determination: identify with the entire stream of human existence (past, present and future) and leave out nothing.

We've tried to convey the essence of our emerging world view in HUMAN Questions and HUMAN Identity videos. But we can sum our ideas up in a few pithy sentences:

We are all individual waves in the ongoing stream of human existence. Personally, we would like this stream to carry on and keep evolving infinitely into the future. In fact, we want to make it our explicit purpose. It may sound like a tall order but we believe that for a learning species nothing should be impossible. To keep the human project going as an infinite game, each generation needs to know the game we are playing and learn to play their round well.

From now on we will use HUMAN perspective as a shorthand reference to these ideas. They seemed innocuous enough at first. But as we let them sink in, they started to wreak havoc in our minds. We expected the HUMAN perspective to change what we saw once we returned to the issue of what's on our plate as a species. But we were entirely unprepared for what actually happened. A year back, had anybody showed us the preview of what we've put forward in this section, we would have dismissed it as out there. Now out there is where we've set up camp. This calls for a bit of an explanation of our mental journey.



So we were looking for all challenges that could significantly impact the survival and ascent of our species, both negatively and positively. Once we re-examined other people's lists through the lens of the HUMAN perspective, the cure for our earlier headache became obvious: To create a master list that would match the scope of our purpose, we had to tear down a few walls and punch through a ceiling inside our own minds.

THE EARTH WALL

So far all humans have been born on planet Earth. With the exception of a few hundred astronauts, that's also where all of us live out our lives. It is therefore unsurprising that when we think about our world, the radius of our thinking rarely extends beyond the geostationary orbit of our satellites 35,786 km above the equator. From the HUMAN perspective, our world is a whole lot bigger,

at least as big as the known universe. This radical extension of our field of vision is not a whimsical flight of fancy but a matter of existential importance—cosmic evolution is generating plenty of action that directly impacts our survival prospects. So we simply must look beyond our pale blue dot.

THE TIME WALL

We expanded our thinking in space but what about time? Most of us have a time horizon beyond which our active concern transmutes into a passive general interest and eventually decays into sincere indifference. All of the lists we have looked at were boxed inside a time wall—some as short as 1 year, most limited to the next 5 to 10 years, a handful focusing on the next 50 years or the 21st century, and a few noteworthy exceptions spanning the next 10,000 years. Having steeped in the HUMAN perspective, we found ourselves as consumed by the matters of the day as we were by the heat death of our universe. It seemed reckless and irresponsible to dismiss the known perils of the distant future on the mere hope that our ascendants will be smart enough to figure it out or, worse, on the resignation that our species won't last long enough to care. Since it is impossible to predict how long it will take us to create the requisite knowledge to take on challenges of cosmic proportions, we decided to adopt an a-temporal perspective.

Once we dropped the arbitrary limits of time and space, our thinking remained unavoidably bound by the ultimate limit: the periphery of human knowledge. The most humanly responsible thing we could do was to rely on the knowledge we have and keep updating our ideas as it continues to evolve.

THE ABSTRACTION CEILING

With the Earth Wall and Time Wall in ruins, we were up against a new problem: we were looking at an almost 100 item list—a sure recipe for mental disorientation. To create a manageable taxonomy, we had to push beyond the current conceptions of the challenges and punch through to the highest level of abstraction. We used the notion of cosmic, biological and cultural evolution as our organizing frame. Challenges arising from cosmic or biological evolution could be framed in terms of phenomena (e.g., "Aging sun"). Challenges arising from cultural evolution were fundamentally differtent, they had an agent—us! So instead of trying to organize the myriad of good and bad impacts of our existence, we traced them back to something we humans do (e.g., How we sustain ourselves instead of a long list of Ocean acidification, Biodiversity Loss, etc.) In the end, we were left with just 16 challenges—half of our own making, half served up by cosmic and biological evolution.



In of itself a master list of challenges is only a starting point for engagement. Its only utility is to raise the next batch of questions: What should we do about it? What's our vision?

Here, too, we started with a survey of what is already out there. Given the nature of the challenges on our list (from How we resolve conflicts to Entropy), we had to set our sights wide and go on a grand tour of ideas that ranged from current world affairs to science fiction. For some of the challenges we were able to line up dozens of visions scattered along time's arrow, pinned at different levels of ambition and motivated by different world views; for others we've come back empty handed. Fascinating as this patchwork of visions was, the goal of our quest wasn't to produce an exhaustive comparative study of other people's visions or dispassionately

report on the absence of such visions. Our goal was to figure out what visions we ourselves—as two aspiring contributors to the ongoing human project—considered to be worthwhile and why. We couldn't do it without first struggling with the very notion of vision. What's a vision made of?

At the end of a messy creative process we emerged with a practical idea: our visions should be a binary construction of an ultimate goal and a set of major milestones for 2050.

ULTIMATE GOALS

Visions typically take the form of describing our desired state of affairs at some future point in time. Having torn down the Time Wall and settled into an a-temporal perspective, we had deprived ourselves of the dubious luxury of picking an arbitrary point in time. We had to push ourselves all the way to an ultimate goal, the end-game or simply an ideal that we thought was worth setting our sights on. It was an unsettling process because it led us to question some of the visions that most of us now take for granted: is a sustainable, just and peaceful world here on Earth our ultimate goal or is it merely a stop along the way? By pushing our notions of desirable futures to the limit of our imagination, we were forced to lay

bare our fundamental values. In our books, that was a good thing because it now allows us to debate the future of our species at the most fundamental level without being completely swayed by what seems urgent at this very moment. Ultimate goals became a strong anchor in our minds, a lighthouse to illuminate the general direction in which we thought we should be headed as a species.

2050 MILESTONES

Once we were clear about our ultimate goals, we could get practical: What would our generation need to focus on to advance the human project in the general direction we were proposing? We decided to create a handful of milestones for 2050. In this case, the choice of the year was admittedly arbitrary. It could have as well been 2034 or 2111. But mid-century seemed like a nicely measured step—longer than most of our habitual planning horizons, short enough for many of us alive today to see them through.

A rather curious picture emerged.



PURPOSE: SURVIVE & ASCEND. KEEP BECOMING

CULTURAL EVOLUTION

BIOLOGICAL EVOLUTION

CHALLENGES

HOW WE SUSTAIN OURSELVES **HOW WE RESOLVE CONFLICTS HOW WE SPEND OUR LIVES** HOW WE CREATE KNOWLEDGE **HOW WE USE KNOWLEDGE** HOW WE SHARE KNOWLEDGE **HOW WE ORGANIZE** HOW WE EXPAND OUR PRESENCE **PANDEMICS VOLCANOES & EARTHOUAKES** CHANGING CLIMATE ASTEROID & COMET IMPACTS **AGING SUN COSMIC RADIATION GALACTIC COLLISIONS ENTROPY**

ULTIMATE GOAL

SMART HARVESTING PERPETUAL PEACE FREEDOM TO CREATE **EXPLANATION OF EVERYTHING INFINITE BECOMING** UNIVERSAL COMPREHENSION **WISE ACTION COSMIC CULTURE BIOLOGICAL DEFENSE MASTERY OF GEOLOGY** MASTERY OF CLIMATE **IMPACT DEFENSE NEW HOMES** RAD DEFENSE **GALACTIC SAFE HAVEN** VICTORY OVER ENTROPY



With a master-list of Challenges and Visions in place, we were getting closer to our goal of figuring out what the best use of our lives would be at this point in human history...but we were not quite there yet. The human project is not exactly standing still. There are many great bold initiatives underway on most (although, importantly, not all!) of the challenges on our list. So to decide how we could best contribute, we needed to wrap our minds around the Progress we were already making and get a sense of where we needed reinforcement. These days, the facts are relatively

easy to come by. There is no shortage of reports, in-depth studies and books laying out the facts and putting forward assessments of different dimensions of the challenges we face as a species. The difficulty of course lies in the judgments we make about these facts. When constructing Progress we were judging if what's already in the works would be sufficient to hit the 2050 milestones we set out in our Visions or whether we needed to add more minds, more human power into the mix to start tracking nicely.

At the end of a multi-year exercise, we did arrive at an answer, or at the very least at a hypothesis for what our generation in general and the two of us in particular need to do to advance the ongoing human project. From the outset however our answer was meant to run

into serious problems: it would only become meaningful if enough people found it worth their while. In this section, we are sharing our take on the 16 challenges with the intent to attract more minds to the exercise. We are first and foremost interested in pushing the quality of the thinking, rather than insisting on the particulars of our ideas. Do you think an important challenge is missing from our list? Do you disagree with how we framed a particular challenge? Do you have a better ultimate goal in mind? Great, have at it! HUMAN Future is a starting point, not a definitive statement. We can't wait to find out what you make of it and push this thinking forward together. Nothing less than our generation's contribution to the ongoing human project is at stake!





THINK KNOWLEDGE, NOT RESOURCES

When most of us think of sustainable development we tend to think about finite resources here on Earth and debate who should consume them and at what rate. Many of us end up referencing a fairly popular equation for an ideal steady state: a limited number of people consuming limited natural resources at a rate that does not exceed what the Earth can physically regenerate. If we follow that logic, then our challenge—nay, our moral obligation—is to keep our population and consumption rates within Earth's carrying capacity.

This challenge definition captures the predicament of most Earth-based life forms: make do with what you can find, and adapt through blind and slow genetic mutation. Multiply with too much enthusiasm, overtax your environment and everybody pays the price. But this is not our predicament.

We humans are no ordinary form of life. We live by a different equation. We have evolved into beings who keep finding ways to understand our surroundings. We then use our knowledge to transform matter and energy into resources to power our lives. So we've gone from living within the carrying capacity of our Earth to living within the carrying capacity of our knowledge.

We now know that there is an entire universe—perhaps universes—beyond our Earth. We now know that we have an

endowment not merely of planetary but of cosmic proportions. From our current vantage point the supply of matter and energy in our universe is near infinite. It's our knowledge that's limited. We are just beginners, crude hackers that produce too much waste heat, kill off other life forms somewhat indiscriminately, and destroy our surrounding beauty.

Right now we get most of our energy from burning dead plants and animals and wreak havoc on our climate. There are, however, plenty of other options close by. The amount of energy that our planet receives from the sun exceeds our current consumption of 18 terawatts by a factor of more than 20,000. We just haven't figured out how to harvest it yet. We're rapidly depleting our fresh water aquifers but they don't add up to even half a percent of all of the water here on Earth. We just haven't yet figured out



how to desalinate it at a global scale. In theory, we are well-endowed, even here on Earth. In practice, we have a lot to learn.

But hold on. It's not enough to merely reframe our challenge from living within the carrying capacity of our finite planet to living within the carrying capacity of our knowledge in a near infinite universe. We also need to let go of the idea that we will ever arrive at a steady state here on Earth or anywhere else. In a universe constantly hurling new challenges our way, we will need more and more energy, not less.

From the HUMAN perspective our challenge then is to keep creating the knowledge needed to power our ascent—keep expanding the carrying capacity of our knowledge.



WHAT'S AT STAKE? POWER AND BEAUTY

How we sustain ourselves determines nothing short of our role in the universe.

Will we humans remain a local phenomena in our Universe—a species that began its ascent, created significant knowledge, lived for a brief cosmic moment largely confined to Earth, and then were extinguished by a cosmic event (such as the death of our sun or a supernova) because we did not have the power to protect ourselves?

Or, will we become universal explorers and problem solvers—a species that began its ascent on Earth, created significant knowledge, comprehended where we were in time and space and the slew of challenges we faced, and found the power to press forward, to extend our minds and expand our

presence into our larger cosmic home to see what and who else we might find?

How we go about sustaining ourselves will also determine our identity in the universe—what kind of beings will we become? Will we become beings who disregard other life forms, pillage our cosmos, and lay waste to our surroundings in search of ever more power? Or will we become powerful artists who harvest or create matter and energy while admiring the diversity of life that has evolved in our space-time and sculpting sublime surroundings for us all?

These scenarios will require vastly different levels of power and qualitatively different ethics and aesthetics. So, which path will we choose?



ULTIMATE GOAL SMART HARVESTING

For any smart civilization to survive it would need to learn to harvest matter and energy at a rate and scale that outpaces the species threatening challenges in the cosmic calendar of our Universe. Think about the power we'll need to deal with the next ice age, prevent a supernova explosion, find a new home and evacuate Earth before our sun sterilizes our planet, and deal with the collision of our galaxy, the Milky Way, with Andromeda. To just stay in the game, we'll need to harness or create not just all of the energy of one star, but billions of them; and perhaps learn to make stars of our own. And as entropy begins to take center stage, we may need to probe the Planck energy,

the energy at which space-time itself becomes unstable. We might need that much power to find potential shortcuts through the fabric of space-time—wormholes to travel our Universe and portals that might lead to other ones.

But smart is more than just outpacing our problems. It's also about designing lives that are worth living—for all life. To do so, on top of learning to create, grow or harvest enough matter to support progressively more of us, we'll need to harvest our inner power—our appreciation of all life in the cosmos, the ethics to care, and the artistry to design beautiful environments, no matter where we live in the Universe(s).



2050 MILESTONES

In the next 40 years we'll need to undergo a massive mental shift. Today many of us think that all we need to do is replace fossil fuels with renewables, limit our numbers, and reign in our consumption to fit the carrying capacity of Earth.

We need to think way bigger. How do we solve our current problems within the context of our long-term needs?

ENERGY ROADMAP "POWERING OUR SPECIES"

We can make smarter energy choices if we make short-term decisions in the context of our long-term energy roadmap. We need to make one. Let's tap our best scientists, engineers, economists and anthropologists to create and iterate a long-term energy roadmap for our species. Should we make our own star-like generators (e.g., fusion) or go for space-based solar? Who should run our energy supply: should we create species-wide utilities? Although it can be difficult to plan for the long haul because we don't know which scientific breakthroughs will open doors or change the game and when, the iterative process of envisioning gets people thinking about the big picture (e.g., will it all add up in time for the challenges we face?), important trade offs and unintended consequences (e.g., might space-based solar be a big problem for space travel?) and could open promising new lines of research. By 2050, we should have gone through numerous iterations of envisioning the power we should create on different timescales: one billion, one million, 100,000, 10,000, 1,000 and 100 years and have our wits about us.

THE EARTH MANUAL

"You are human. Conduct yourself wisely." These could be the first words of our evolving Earth Manual. After 10,000 years of trial and error and our recent advances in Earth systems science, we know quite a bit. We can now use our understanding to design new sets of smarter practices with fewer unintended consequences, some to enable us to use Earth's physical and biological processes wisely (e.g., how much fish can we take without causing collapse in fish stocks in our oceans), some to create our own parallel systems (e.g., fish farming). Our Earth didn't come with a manual but now we're smart enough to make one. By 2050 we should have gone through quite a few major revisions.



KICKING INTO GEAR

Most of us got the memo. Burning fossil fuels is heating things up and some of our current practices run the risk of undermining the ecosystems on which we and other life currently depend... and we are kicking into gear.

We don't yet have a long-term Energy Roadmap for the species, but we can deduce how we're currently thinking based on regional and national energy roadmaps and investments. Some regional blocks and nations are planning longer than ever before, largely because they need to transition their economies off fossil fuels. Some now

have stated energy roadmaps to 2050 (e.g., EU, International Energy Agency, UK, Denmark), but these examples appear to be the exception, not the rule. And then there are investments in renewables, which are on the rise. Global investment (from R&D funding andventure capital for technology and early-stagecompanies, to public market financingfor projects and mature companies) topped \$257 billion in 2011. That's no pocket change. This investment does not include the roughly \$30 billion that a group of nations have invested over the last few decades in nuclear fusion facilities (ITER, HiPER and the American-backed NIF), some of which have stated plans to put fusion power in the grid by 2040. These are all critical and promising first steps, but so far we haven't come together to envision and plan for the long haul from a specieswide perspective.

As for the Earth Manual, the Stockholm Resilience Center has put forward the idea of planetary boundaries biophysical limits beyond which we should not push our Earth system. This could be a helpful concept as long as we recognize that we'll likely need to redefine, add, or subtract boundaries as we go. But we have not yet mashed any current boundaries up against the evolving carrying capacity of our knowledge and technological solutions to see which solutions could potentially scale and by when so that we can set R&D agendas, plan investment cycles and design clear sets of practices as we go.

ENERGY ROADMAP

THE EARTH MANUAL



WHO IS ALREADY ON THE CASE?

PEOPLE: ~HUNDREDS OF THOUSANDS **FUNDING:** ~HUNDREDS OF BILLIONS

KNOWLEDGE CREATION

There is an unknown number of technological innovators working on technological breakthroughs from desalination to biological replacements for oil, gas, and coal.

Scientists at think tanks and universities are working on everything from planetary boundaries to Earth systems science.

ACTION

International agencies and regional partnerships have formed to put forward plans, invest and collaborate on energy (e.g. International Energy Agency, EU, Major Economies Forum and Global Partnership, UNFCC's Clean Technology Fund).

Nation states are assembling plans and investments of their own. Developed economies represent roughly 65% of investments and many of the longer term plans; developing economies 35%.



WHAT IF?...

...we convened a conference to develop the first version of THE EARTH MANUAL?

We'll need the earth system scientists to give us a snapshot of our planetary boundaries. We'll need the technologists to give us an overview of the solutions that we already have and can scale, those that are in the lab but not yet proven, and define the ones that we need to develop. It's by putting the two pieces of the puzzle together that we can figure out the current carrying capacity of knowledge and what the contents of the manual should be.





THINK MEMES, NOT RESOURCES

Millions of years of living on the same rock and it's still not quite a bed of roses. Our history is punctuated by violent conflict, acts of war, terror and oppression. Last century we've had a few close calls, recklessly throwing the very survival and development prospects of our species into question. So far enough of us have always lived to tell the tale. But knowing us, that's no guarantee that it will always be the case.

Why do we humans destroy, oppress and enslave each other? Most of us default to thinking that all human conflict is ultimately about resources. After all,

we have seen other species fight over them: whenever there is one serving of food and two mouths determined to consume it, there is conflict. Like all life on Earth, we too are wired for survival. But biological instincts alone don't explain our behavior. We humans boast an added level of complexity: our ideagenerating minds. We can over-ride every hard-wired biological instinct for a mere idea. And we have ideas about everything, including resources. All large scale human conflict is ultimately a conflict of ideas that attract a broadbased or powerful followership—a conflict of *memes*. It's always *our* ideas against theirs. This land belongs to us because our ancestors lived on it. Against this land is ours because we have the army to conquer it.

Seven billion minds can produce a spectacular array of memetic conflicts. With billions of us now blogging, Facebooking and Tweeting the

contents of our minds, the extent of our disagreements is in plain sight for everyone to see. Some of our current differences run deep and may appear irreconcilable, unbridgeable, even hopeless. But step out of the present moment and look at the evolution of our ideas over the last ten thousand or just the last two hundred years, and you'll find a good case for optimism. Over time, we've successfully converged on many ideas that once were the subject of bloody disputes. Although the practice has not been completely eradicated, the physical enslavement of another human being is generally frowned upon. In many parts of the world, killing the opponent is no longer seen as the honorable way to settle a disagreement.

Conflicts of memes are both unavoidable and essential—we advance by improving or replacing an existing meme with a better one. Not every meme is a step forward, of course. There are plenty



of virulent legacy memes and their various modern incarnations that draw an uncrossable line between us and them—between an in-group and an outgroup—and then explicitly prescribe the destruction of the out-group: people who refuse to believe in our god are pagans and should be killed. Other memes, despite being designed to do good, turn out to be harmful to the people who adopt them: we can create a perfect society if we silence all dissent.

Our ongoing challenge is to keep negotiating our way through the myriad of memetic conflicts without undercutting ourselves as a species. It is no small feat in the interconnected world of the 21st century. We are more exposed to each other's ideas. We have more means to mass destruct and mass disrupt: from nuclear and chemical to biological and cyber weapons. More of us can acquire or engineer these weapons: terrorist organizations and even individuals of modest means are now in the game alongside governments. We have more and more moving pieces to pay attention to, with no time left to reminisce about how much simpler things used to be in a bi-polar post-World War II world.



WHAT'S AT STAKE? SELF-SABOTAGE

Human ingenuity channeled into destruction can be powerful, especially when fuelled by righteous belief. If we put our minds to it, we can undercut decades, even centuries of technological and social development. If we get compulsive about it, we can come close to annihilating ourselves as a species. Nuclear war, terrorism and authoritarianism are our most dangerous ideas for dealing with conflicts of memes.

NUCLEAR WAR. We have more than enough nuclear weapons to end our species. To those of us who were not

around during the Cold War, the prospect of a nuclear war may seem unlikely. Probably as unlikely as the prospect of getting embroiled in the first World War seemed to those of us who were alive at the start of the 20th century. Yet, the risk of an all-out nuclear war continues to be the darkest humanmade cloud hanging over our heads as a species. A nuclear war with as few as a hundred weapons detonated in densely populated cities could kill tens of millions of humans instantly, expose hundreds of millions to lethal radiation and cover our planet in smoke that blocks sunlight for years, leading to the shutdown of photosynthesis and below zero land temperatures. In other words, dark, hungry, oxygen-deprived, sick subsistence living for the survivors. But we don't just have a hundred nuclear war heads, we have about 19,000. The "Nuclear Club"—countries that own nuclear weapons and are party to the Non-Proliferation Treaty—has five

members: US, Russia, UK, France and China. And then there are those that are not in the club: North Korea, India, Pakistan, Israel and quite possibly Iran. Dangerous conflicts of memes are present in relationships between India and Pakistan, Iran and Israel/the West, North Korea and the West, China and the United States.

A nuclear war need not even start intentionally. In 1995, the Russian President had the nuclear suitcase opened in front of him after Russian military officials mistook a Norwegian weather rocket for a US ballistic missile. Fortunately, the president concluded his radars were in error and the suitcase was closed. We might not always be so lucky.

TERRORISM. Although a righteous lone-wolf or a small group wouldn't yet have the means to annihilate the entire species, they can cause mass disruptions and trigger a snow-ball



of chain reactions that change our developmental trajectory. 9/11 is arguably the first such terrorist attack. Its impact goes well beyond the death toll of that day and short-term economic losses. It has already led to two wars in Iraq and Afghanistan, around 150,000 deaths, over \$1 trillion in spending—and the tab is still running. Obviously, this tab is a function of both the dreadfully spectacular nature of the attack and the choices that several world leaders then in office made in response. Once the precedent is set, we can expect that more terrorist acts of this caliber will be attempted. Plausible scenarios include

detonation of multiple nuclear bombs and the release of deadly, possibly genetically modified bio-agents. In both cases, casualties could reach tens, conceivably hundreds of millions of humans. The species would go on but with an open wound in our polarized collective psyche. Those of us who survive would likely divert more and more of our time, energy and funds on protecting *us* against *them*.

and terrorism we seek to destroy the others. Under authoritarianism, we kill or silence our own because their ideas challenge our established memes. Authoritarianism is a group-wide submission to the authority of a single all-embracing ideology. Submission can be forced with brutality. In the last century alone, over 100 million humans were murdered by authoritarian governments in fascist Germany and communist China and the Soviet Union

in the name of their ideologies. But submission can also be voluntary. Some political and religious ideologies are so powerful, we embrace them of our own accord. From the HUMAN perspective, all forms of authoritarianism—whether forced or voluntary, malevolent or benevolent—put our species in danger because they outlaw critical and creative thinking. And when we stop questioning our ideologies, we stop improving or replacing our existing memes with better ones. There is no ascent, just stasis. In a changing universe stasis inevitably leads to demise.

All deep conflict is a test. We can selfactualize or self-sabotage, wise up or shoot ourselves in the foot.



ULTIMATE GOAL PERPETUAL PEACE

As a species, we need critical thinking and conflict. We do not however need war, terrorism and authoritarianism. Our ultimate goal for how we resolve our conflicts should be perpetual peace—a state where no conflict is allowed to devolve into destruction, disruption or stagnation of our species.

As with pretty much everything, we humans have a wide spectrum of ideas about how we might accomplish such a goal. There is the MAD theory: if we locked ourselves into a state of Mutually Assured Destruction, we would render war meaningless. There is the non-

interventionist (or even isolationist) theory: if we all focused inwards on our respective plots of land, minded our own business and only traded with each other or just cut ourselves off from each other, we would have no large scale wars. Then there is the equalization theory: if we re-distributed all of our resources fairly, we would have nothing to have a conflict about. The self-organization theory: if we decentralized power and created a self-organizing politico-economic social fabric, we would eliminate large scale wars. The global integration theory: if we keep integrating into bigger and bigger administrative blocks like the European Union, eventually we would integrate into a single world union and thereby eliminate the chances of war. The three magic bullets theory: if all of us took a three-part prescription of democracy, economic interdependence and international mediation, we would significantly reduce the chances of war. And then there is the idea of inner

peace—if only we realized that we are all one or found peace from within first, we would get there.

Some of these ideas have already proved to be dead-ends (MAD), some have become sources of conflict in their own right (isolation vs. integration), some are still too blunt in their simplistic projection of a single worldview on to the entire species (three magic bullets). None of our current ideas are sophisticated enough to have produced lasting peace. But it does not mean that one day we won't be able to arrive at a peace-creating memeplex.

Clearly, we won't get to perpetual peace overnight. Dropping the hard line between us and them is not easy, especially when they have stupid ideas. But putting our energy into drawing a new line around all of us could be a smarter way to proceed.



2050 MILESTONES

In the next 40 years, we should focus on the basics: introduce security locks, close the nuclear chapter and imagine what a planetary peace culture would look like in practice.

NO MEANS OF "SPECIES-WIDE DESTRUCTION"

We need a basic security lock: rule out the theoretical possibility for annihilating ourselves as a species. Today our agreements are inter-national and fragmented by weapon type. We need a species-wide and aggregate perspective: Our aggregate stocks of all types of weapons of mass destruction should never add up to a species-ending cocktail.

ZERO NUCLEAR WEAPONS

There is nothing inevitable about nuclear proliferation. 70 years ago we had zero nuclear weapons. 25 years ago we peaked at 70,000. Today we are down to 19,000. Surely by 2050 we could be down at zero again in terms of warheads and one up in terms of experience of how to deal with our suicidal inventions.

PLANETARY PEACE CULTURE

Peace is everyone's business. There is something for all of us to do—from controlling access to the means of mass destruction to generating peaceful pathways to solve current conflicts to undermining memes that call for the destruction of the other. So what would a species-wide peace culture look like? A culture is nothing other than a set of memes that lead their adopters to behave in similar ways. So what are the ideas that can lead to perpetual peace and what would it take for them to be widely adopted, given that we subscribe to conflicting world views? Not a no-brainer but we can surely have a proof of concept by 2050.



MORE PEACEFUL

We are living in the most peaceful time of our species' existence. This may be hard to believe given that we are embroiled in dozens of wars, keep a stockpile of 19,000 nukes, spend \$1.3 trillion on our militaries and commit atrocities that look gut-wrenching on the news. Yet, when it comes to murderous violence we've done worse in the past and our current predicament is in fact an improvement.

Zero nuclear weapons is a goal endorsed by several leaders in the Nuclear Club. We have already reduced our nuclear arsenals by two-thirds since the Cold War peak, with further reductions planned. Armed conflicts of all kinds and their combined death toll have gone down since the peak of the Cold War, too. Some of our military spending has produced military technology that makes destruction more precise and less brutal. Although the deployment of remotely operated drones makes it harder for the operators to feel into the dreadful consequences of their use.

The foundation for a planetary peace culture is still under construction. 100,000 UN peacekeepers are deployed in 15,000 missions around the world. We've learned from our past failures in Somalia, Rwanda and Srebrenica and we continue to get better at breaking up violence and keeping peace. Although in practice, our decisions to intervene in violent conflicts get bogged down in a meshwork of geopolitical and economic considerations, we are starting to get our theory straight. Coming out of a recent UN initiative, "Responsibility to Protect" lays out a clear basis for humanitarian interventions going forward. At its core is the idea that national sovereignty is not

a right but a responsibility to protect the local population from mass atrocities. If a government fails in that responsibility, the international community has the responsibility to intervene—diplomatically and economically first, and militarily as the last resort. So next time, we might hesitate less before crossing a national border to save human lives from the murderous few in power.

Our momentum towards peace however is not irreversible. As long as our allegiance to our national, religious or ideological identities is stronger than our budding allegiance to our species as a whole, we could find ourselves in reverse gear.

NO WEAPONS OF "SPECIES-WIDE DESTRUCTION"

ZERO NUCLEAR WEAPONS

PLANETARY PEACE CULTURE



WHO IS ALREADY ON THE CASE?

PEOPLE: ~100 MILLION **FUNDING:** ~\$10s OF BILLIONS on disarmament and peace programs

ARMIES

Worldwide, we have 20 million humans in the military, 50 million in reserve and 7 million serving in paramilitary units. Their deployment is decided by people across the world's national Ministries of Interior, Defense and Foreign Affairs.

THE UN

The United Nations was created to secure peace among nations. Today, 100,000 uniformed personnel are keeping peace in hotspots around the world.

PEACE MOVEMENT

Millions of humans and thousands of organizations like World Peace Council self-identify with the anti-war movement, anti-nuclear movement, and peace movement—enough for world public opinion to count as the "second superpower" after the United States.

THINK TANKS

Thousands of dedicated think tanks track our progress (e.g., Institute for Economics and Peace produces the Global Peace Index, SIPRI) and generate ideas for resolving specific conflicts.



WHAT IF?...

...we created a Peace Meme Collaborative?

Think of it as a network of people united by a shared goal: design new memes that have the power to alter or displace the current memes that lead to violent conflict or stasis. Admittedly, this may be more demanding than rocket science. Meme design requires an in-depth insider understanding of what the different humans involved in the conflict are thinking as well as tremendous creativity about what new ideas they might be willing to adopt. But the good news is, propagating new ideas in the 21st century is easier than ever. So we can quickly see which ideas fall flat and which ideas have that something something to become memes. Take an authoritarian nuclear-weaponed society like North Korea. What kinds of ideas would we need to open it up?





PRECIOUS

One thing all of us have in common: we all die. Death is our ultimate equalizer, but until the Grim Reaper shows up, our lives can differ so extremely it is as if we were living on different planets. To the 3 billion of us living on less than \$2 a day, the lives of the extremely wealthy are as distant and unrelatable as a magical fairy tale. To those of us who are extremely wealthy, the lives of the extremely poor are as distant and unrelatable as a bleak Dickensian novel. So what do we make of this?

At one end of the opinion spectrum, free market advocates see the unavoidable. There are have-nows and have-laters—that's how our economic development engine works. It's not perfect but it's

the reason why billions no longer live in absolute poverty. The challenge then is to accept the way things are and trust that rich governments and mega-philanthropists can smooth out the extremes through development aid. At the other end of the spectrum, antipoverty activists see an outrageous social injustice, a wrong that must be set right. In their minds, our challenge and our moral duty is obvious: we must eradicate poverty now once and for all. From the HUMAN perspective, it looks like we are failing to grasp the significance and urgency of the issue in both camps. To get to a more fundamental definition of our challenge we must first set aside the lens through which we are all looking.

The default lens of today is the economic one. We focus on our relative incomes or wealth: the top 1% vs. the 99%, the top vs. the bottom of the pyramid. Focusing on something that is easy to measure is convenient but unwise. Economic abstractions create an odd sense of detachment from the reality

of human lives. Human lives are unique, unrepeatable, and precious. Once they are gone, they are gone. So we should treat every lifetime with the utmost care—the time of our finite unique lives is the ultimate currency of our species. We shouldn't waste a single human life on problems to which we have long ago invented solutions. Our ongoing challenge is to make sure that all of us get to spend our precious lives as close to the edge of possibility as humanly possible while we keep investing our cognitive surplus into pushing that edge further out.

The challenge itself is a testament to our recent success as a species. 10,000 years ago, contemplating how we spend our lives would have made little sense: all of us lived remarkably similar lives, spending most of our waking hours on sustenance and reproduction. Then, following the end of the last ice age, we had a life-changing idea: instead of roaming vast distances in search of food, we stayed put and started growing our own food and breeding our own animals.



Once we started producing surplus food, we could afford to apply ourselves to new problems. We jump-started a stream of life-changing inventions, each incrementally or dramatically expanding the edge of possibility—at least for some of us. Fast-forward to the 21st century. Today we live in three distinct realms of possibility, or three different planets. Here is a quick tour.

THE TURBOCHARGED PLANET.

Population: ~1 billion.

Welcome to the edge of possibility. It's a post-sustenance world. We've minimized time spent on basic preoccupations like food, clothes, shelter and created an unprecedented cognitive surplus. Most of us have never plowed a field, milked a cow, or picked cotton but we

can easily get cheap bread, milk and a T-shirt at a corner store. The list of things we take for granted is getting longer by the year: great homes, fast cars, beautiful tablets, ubiquitous access to the Internet, advanced healthcare, graduate education. We've got the accelerative thrust—we expect to see more technological change in the next five years than in the last twentyfive. And yet, we are barely scratching the surface. Only a tiny fraction of our cognitive surplus gets reinvested in knowledge creation, learning, technology, art. We spend most of it on self-indulgent niceties and irrelevances. We like to accumulate possessions and be entertained, you see.

OFF-GRID PLANET.

Population: ~1 billion.

Welcome to how it's always been, with a few modern twists. Not enough food. No electricity. No cell phones. Few things have fundamentally changed here in hundreds of years, except for refugee camps, machine guns, aid packages and health missions from the Turbocharged Planet. We wake up hungry, we go to sleep hungry. We die young, right about the time people on other planets get to a mid-life crisis. The edge of possibility is more like the horizon: we can see it but can't ever get there. Our lives are a struggle to stay alive. It's the brave old world.

THE TRANSIT PLANET.

Population: ~5 billion.

Welcome to the land of uncertainty. Most of us here work hard for a one-way ticket to the Turbocharged Planet but for some of us it feels more like a fight not to get a return ticket to the Off-grid instead. Well, if we work hard enough, at least our kids will get to go. Our cognitive surplus may be limited but ingenuity is in abundant supply.

Most of us live out our lives far away from the edge of what is already possible. Whether out of necessity or out of self-indulgence, precious human lifetimes are being wasted on all three planets. That's a poor way to run the human project.



WHAT'S AT STAKE? ACCELERATE OR STUMBLE

Spend a human life wisely, and all of us benefit. Squander it on preventable hardship or questionable self-indulgence, and we end up holding ourselves back. How we spend the precious time of our lives determines our collective potential for ascent.

We ascend as a species because some of us have time to come up with good explanations about how everything from the cosmos to our culture works. We then use that knowledge to create life-improving technologies like high yield seeds and irrigation systems, light bulbs and electricity grids, smart phones and the internet, social networks and

mass-collaboration platforms, good governance, better values and higher ideals. The more time we wrestle back from basic sustenance, the more cognitive surplus we create. The more of our cognitive surplus we channel back into our continued development, the bigger the boost we get as a species. It's a wonderfully unpredictable and possibly infinite game of self-improvement that allows us to spend our precious lives in more interesting, creative, useful ways and become more interesting creatures in the process. But too few of us see ourselves as players.

We could definitely spend our hard-won cognitive surplus a whole lot better. Those of us who can afford to spend four hours a day glued to TV screens and pass around cute cat pictures, could be making existing life-changing technologies and ideas universal and pushing the edge of possibility even further.

But it's not just a matter of wasted opportunity. We humans cannot help but compare ourselves to others around us. When we deem the widening gaps between us to be undeserved, unfair or unjust, social cohesion crumbles. Stew in a chronic feeling of unfairness and powerlessness long enough, and the violent uprisings and bloody revolutions of the past start making some sense. Stand-offs between the top 1% (whether by wealth or power) and the 99% are already making news around the globe. It is not unthinkable that if left unresolved, tensions could escalate and we could stumble.

From the HUMAN perspective, there is no 99% against the 1%, there is no us versus them. There is only us. And all of us need to join in the infinite game of development. We need to keep expanding our collective cognitive surplus and re-investing it into advancing the ongoing human project.



ULTIMATE GOAL FREEDOM TO CREATE

If all we can see is economic divergence, then our ultimate goals tend to be about some form of economic convergence.

Depending on our political ideology, some of us make an emphatically rational case for equality of opportunity, while others make an emphatically moral case for equality of outcomes.

Our relative positions and, more importantly, our perceptions of the fairness of our predicaments are no doubt important for social cohesion. But equality alone is a poor ultimate goal: it only tells us where we aspire to be relative to each other, not what kind of lives we aspire to make for ourselves as a species. Reframe the question and we can dream at a more fundamental level.

So what kinds of lives do we want to aspire to? Some of us dream of Abundance, a world where we can meet and exceed the basic needs of every human being. Others dream of Happiness, a world where Gross World Happiness rather than Gross World Product becomes the measure of our success.

From the HUMAN perspective, both Abundance and Happiness are Sirens' calls—irresistible but dangerous. A single-minded pursuit of Abundance can lead us toward an endless proliferation of increasingly exotic needs. A single-minded pursuit of Happiness can lead us toward self-indulgence.

Ulysses had to bind himself to the mast to resist the Sirens' call. We too would be better off binding ourselves—to an ultimate goal that turns all of us into players of an infinite game of self-improvement. We could strive to minimize the number of waking hours we have to spend on merely sustaining



ourselves, and maximize the number of waking hours we can spend on creating species-advancing explanations and designs. Instead of dreaming of our freedom from fear and want, we could dream bigger—we could dream of our freedom to create. Imagine who we might become once all of us are free to spend our lives on advancing the ongoing human project. We could transform the very essence of what it means to ascend as a species. Perhaps it will be the wisdom and beauty of our universal creations that would become the measure of our advancement.

We could be hundreds, or thousands of years away from the universal freedom to create. We might discover that this ultimate goal is a perpetually moving target because the more we learn about our universe and beyond the more threats to our survival we discover: the more we tinker with ourselves and our cosmic and biological givens the bigger our challenges from unintended consequences. There might be plenty of new entries on our list of things we have to do to stay alive. We may never attain the universal freedom to create but the idea itself gives us a sense of direction for how we should transform the contents of human lives. In the beam of this light-house, prosperity or abundance for all is no longer our end-game but only the means to the goal beyond.



2050 MILESTONES

But before we get carried away, we must first close the urgent case: Evacuate the rest of us from the Offgrid planet where human lives are spent fighting to stay alive. We have a backlog of life-changing inventions that allow many of us to live a life beyond sustenance. We know how to share them through trade, fuelled by the logic of economic returns. But it's hard to get in that loop when you have nothing to trade. It's time to experiment with new regimes for sharing and action.

LIFE COMMONS

Certain inventions—whether technological or social—fundamentally change how we spend our lives. We should treat them differently from the rest. We already think of outer space, certain cultural sites and scientific knowledge as common heritage of humanity, certain online contents as creative commons and certain software as open-source, free for all to use. Let's start treating inventions that can dramatically reduce the time we have to spend on basic sustenance and increase our cognitive surplus as our Life Commons. Our explicit goal with regard to these inventions would be to create species-wide access as soon as possible. We would have to experiment with new ways to incentivize those of us who invent and those of us who can make the benefits of a good idea universal. Personal economic gain is one way but we humans are driven by a whole spectrum of motivations. Perhaps by 2050, the Life Commons Inventor will have become the most sought after label among the social inventors and entrepreneurs.

NO HUMAN LEFT BEHIND

The Millenium Villages showed that village-sized projects that bring together innovative NGOs, businesses, philanthropists and villagers themselves, can help people move beyond sustenance. The micro-lending movement demonstrated that small loans can change lives. Kiva.org even made it possible for those of us with a bit of spare cash to give life-changing loans directly to those of us in need. Now combine these ideas and scale them up—imagine a planetary clearing house where individuals can give money, ideas or their time, businesses can make in-kind contributions of the products, services or time of their experts, NGOs or social entrepreneurs can organize and manage development projects on the ground. Imagine a ticker in the center of the dashboard—the number of people still to be evacuated. It's 2050 and the ticker is at zero.



SUBSCALE AND WASTEFUL

The good news is we have a shared ambition. At the United Nations, we started this century with the resolve to end extreme poverty by 2015. Transforming the lives of a billion people is a massive undertaking without a silver bullet. At the moment, we rely on world trade, top-down aid to governments and on-the-ground philanthropy and social entrepreneurship. World trade is a dispassionate process—when the world economy is growing, new factories get opened, giving millions an opportunity to earn their way to a better life; but when the world economy slows down or goes into reverse, people lose jobs and return to the villages. In some countries factories don't get opened even during

the good times because it makes no economic sense without an educated workforce, roads, electricity grids. Top down development aid is meant to help the local governments build basic infrastructure and jump-start their local economies. The actual impact of top down aid is subject to a heated debate good use of aid is predicated on good governance which is often lacking in the recipient countries. Organizations that experiment with different strategies on the ground are the source of the most promising ideas. The global micro-financing movement has helped millions. The Millenium Promise that runs innovative village-sized projects has made a difference for half a million people. The Acumen Fund uses patient capital focusing on both social and financial returns to help grow local companies, affecting the lives of tens of millions.

We have a grand ambition and dozens of blueprints of approaches that have worked on a small scale. What we don't have is a plan for scaling our blueprints to reach our ambition. We are making progress but at an awfully slow pace.

Meanwhile, we continue to waste our collective cognitive surplus in the land of the plenty. Social entrepreneurship may have become a buzzword but it is buzzing in the culture where our brightest minds get more excited about engineering trivial toys like RunPee (an app that tells you the best time to make a bathroom run during a movie) rather than life-changing inventions like a personal medical diagnostic chip that would work with any smartphone. It's a long ride to scalability and wisdom.

LIFE COMMONS

NO HUMAN LEFT BEHIND



WHO IS ALREADY ON THE CASE?

PEOPLE: ~MILLIONS
FUNDING: ~\$150 BILLION IN DEVELOPMENT AID, 2010

WORLD MARKETS AND TRADE

So far the market economy remains the most powerful incentive to channel our cognitive surplus into pushing the edge of possibility while world trade remains our most effective mechanism for distributing the benefits of life-improving inventions.

TOP-DOWN GOVERNMENT AID

Most of top-down development aid comes from the 23 countries in the Development Assistance Committee. Once upon a time, the ambition was to give at least 0.7% of GNI (Gross National Income) but only a handful of countries in Scandinavia do in fact reach that goal. Most of development aid is given directly to the countries in need while one-third flows through the international organizations like the World Bank and the UN agencies like UNDP, UNICEF, UNAIDS. China is emerging as a noteworthy special case: its contribution

to the total overseas development assistance may be insignificant but its heavily subsidized companies are building infrastructure and industrial and trade zones in Asia and Africa in "mutually beneficial cooperation" with local governments.

PRIVATE AID

Non-governmental aid comes in many shapes and sizes, from high-profile organizations that move billions like Bill & Melinda Gates Foundation, to smaller sized operations like the Acumen Fund to millions of private citizens who have joined the micro-lending movement and hundreds of thousands of volunteers traveling to places in need to lend a hand.



WHAT IF?...

...we recruited more humans to this challenge?

We are seriously undermanned for this billion people evacuation project. We need the equivalent of 100x of Acumen Funds, kiva.org's, Millenium Villages...Collective impact starts with a common agenda. Today, it's defined by the UN's overarching goal to end extreme poverty by 2015, which is then broken down into eight Millenium Development Goals. These goals guide the efforts of those of us who are already part of the global development community but do they have the power to pull in more of us?

Maybe framing our common goal in terms of ending poverty is a poor way to mobilize millions to whom poverty is an abstract concept, not a first-hand experience. Few of us would go out of our way to experience what living a life of subsistence feels like but many of us watch feature films and documentaries. How many powerful motion pictures and global social impact campaigns would it take to get new people involved?

It will take time but we can certainly complete the evacuation and open a post-subsistence chapter in our species' history during our lifetimes.





THE UNKNOWN

It's a travesty. Too few of us are kept up at night by the big questions that remain unasked and unanswered about the grand scheme of our existence. Too few of us are haunted by what we don't know and what it might mean for our future prospects. Knowledge workers may number in the hundreds of millions, but only seven million of us are knowledge creators, just 0.1% of our total population.

We got into the knowledge creation business for different reasons: for some of us it was a matter of necessity (how do we lift more than our muscles allow?), for others it was a matter of curiosity (what's the distance from the earth to the sun?). Over time, our discoveries started to add up, shifting the trajectory of the ongoing human project so much that it started to diverge from the script of biological evolution.

Wrestling with the Unknown has come to define our very way of being. Along the way, we've also discovered that the universe is not the human-friendly place we hoped it to be, it's filled with formidable challenges to our existence. From the HUMAN perspective, unraveling the Unknown is now the single most important thing we humans do, it's our ticket to staying in the game. Yet we seem woefully under-invested in our knowledge creation enterprise. It's not surprising—the Unknown is an adversary that's all too easy to underestimate. With no specifics, no known attributes to peg our fears on, we meander without a sense of urgency and can be easily caught off-guard. Our best defense in the face of the Unknown is an all-out offence: we need to keep revamping our method and learn to move as fast as we

humanly can. So what's the problem with our current method and why the rush?

First, the method. In the simplest terms, human knowledge is a collection of explanations. We've been conjuring explanations about everything we see in the world around us probably ever since we started using our voice boxes. But for most of our history, our explanations were "creative junk": we could explain a lightning bolt in a hundred different ways but had no way to judge which explanation was closer to reality. In the last few hundred years we have made a monumental leap forward: we've developed the scientific method to judge and improve the quality and reach of our explanations. A lightning bolt is no longer an expression of god's anger, it's an atmospheric electrical discharge. The invention of the scientific method allowed us to expand our presence and shift our ascent into high gear. We've now been at it for a few centuries and created a formidable body of human knowledge. But, as is often the case,



success comes with a new set of headaches.

Our early universities like Bologna or Cambridge started with just four areas: philosophy, medicine, law and theology. It was just about possible for a single person to know everything there was to know. Over time we kept creating more specialized faculties, defining new disciplines and sub-disciplines of inquiry. By mid-last century there were about 1,100 known scientific disciplines in natural sciences alone.

Today reaching the cutting edge in a narrowly specialized field can take decades of study. With more than a million articles published in scientific journals each year, it is no longer humanly possible to know everything there is to know.

Hundreds of years of continued specialization in isolation have produced a peculiar knowledge landscape: thousands of increasingly sophisticated fragments float within the perimeter of our knowledge. Much remains to be known in the space between and beyond the disciplines. We've finetuned the scientific method to explain specific phenomena, but we don't yet have a method to explain the totality of existence. We need to figure out how we can generalize and specialize at the same time—how we can push our general explanatory framework of existence as we probe deeper and deeper into its different aspects. Once we figure that one out, a new set of methodological headaches might emerge. Our quest into the Unknown may turn out to be one methodological headache after another.

Now the rush: our challenge is to shift the enterprise of knowledge creation

into high gear and push the pedal all the way—to the limit of our collective capability. Are we being dramatic? No. We are up against the Unknown. If we are serious about surviving, it's the only defensible way to think.

There may come a day when we discover, for argument's sake, that we are living in a simulation where our minders have taken a liking to us. We may learn that they adjust the schedule of cosmic challenges to make sure we always have enough time to create requisite knowledge. What a relief it would be! But until that day, it's imperative we create knowledge—in particular the general kind of knowledge—as fast as we humanly can. The Unknown could blow our minds with its beauty or indifferently delete us.

But we won't know until we know.



WHAT'S AT STAKE? KNOW OR PERISH

Ah, the thrill of mucking about in the Unknown! Years of relentless poking at the edge of scientific inquiry ("I simply must figure this one out!"), hundreds of dead ends, a thousand and one sleepless nights... all culminating in that glorious moment of finally answering the question that has eluded everyone before. What a wonderful feeling! The need to satisfy our curiosity is a powerful driver of knowledge creation. But we now know enough about our universe to know that a whole lot more is at stake than merely indulging our insatiable curiosity. "Know or perish" is the tagline that best describes what's at stake.

Knowledge creation is truly our only hope to survive. Think about it: our universe does not appear to come with a special guarantee for our continued existence; it looks more like an existential obstacle course. Every threat to our existence can be defined as a deficit of knowledge: we either haven't yet created the knowledge needed to solve the problem or we might not even know about a problem lurking in the unexplained aspects of our space-time. The more we know, the more we understand how everything in our universe and beyond works, the better our prospects for negotiating the obstacle course. After all, black swans don't come out of nowhere. They fly out of the holes in our knowledge, out of the darkness of our ignorance.

Ignorance or unknowledge about a problem can be lethal. When we don't know that a supernova is about to go off in our cosmic neighborhood, we won't get busy creating the knowledge

we need to save our species from that cosmic blowtorch. When we know, at the very least we can give it the old college try, applying ourselves fully to negotiate that obstacle to our existence. Trying does not guarantee success, but not trying certainly guarantees failure.

The 16 challenges for the ongoing human project have been defined based on what we currently know (or, to be more precise, based on what the two authors have been able to wrap their minds around). But how different might this list look in five, a few hundred, a few thousand or a few billion years? As we claim more ground from the Unknown with the power of our explanations, how many challenges will we have solved, and how many will we have added to our list?

The curious thing about our ability to create knowledge is that it makes it possible for us to predict the future of our universe but virtually impossible to



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predict our own. Those of us who walked this planet ten thousand years ago had no way of knowing that by the start of the 21st century our population would have expanded a thousand times, that we would be living three times longer or that we would fly because they had no way of knowing the contents of our future discoveries. All of us alive today are in no better position to predict the

fortunes of our future ascendants. Yet we know what some of the current and future challenges are, we know that we are faced with a deficit of knowledge and it is within our power to do the best we humanly can to reduce the deficit before we pass on the baton.



ULTIMATE GOAL EXPLANATION OF EVERYTHING

Banish the Unknown, banish the Fear. Our ultimate goal should be to explain everything that is and perhaps everything that isn't.

Will we ever reach this goal? Will we ever arrive at a place where nothing incredible is waiting to be known? Or is this an ever-moving target where each new explanation dimly illuminates a new segment of the infinite Unknown, raising a new set of questions? Throughout time, we've been tempted to volunteer definitive answers. Yet these answers cannot be anything but pure speculation. To produce a definitive answer, we would need to... know the Unknown.

Are there limits to what we can explain? We rush to judge our knowledge creation prospects based on what we know today. Theories about our various handicaps abound. The universal laws of physics are often held up as the ultimate source of our limitations: we won't be able to build tools or run experiments that the universal laws of physics as we currently understand them don't allow. The most distant object we have ever seen with our Hubble Telescope is a proto-galaxy 13.2 billion years away, Hubble's future successor James Webb Space Telescope will allow us to peer at even greater distances, at earlier times, closer to the Big Bang. But that, some say, is about as far as we will ever be able to see. As time goes by and our universe keeps expanding at an accelerated rate, we will see fewer and fewer distant galaxies because the light those galaxies emit won't be able to overcome the ever-widening gulf between us. It all makes sense. Yet, without knowing the contents of our future discoveries and the tools they will allow us to build, these theories are also pure speculation

conjured inside the straightjacket of our current knowledge. We might discover that our current understanding of the forces powering cosmic evolution is too simplistic or off the mark. Or we might discover that our cherished laws of physics are merely local bylaws, just one possible set in the infinite variety of a multi-verse. We just don't know. At least not yet.

Our practical disposition toward the all important enterprise of knowledge creation should not be grounded in the facts of today. We must choose it against the backdrop of our Unknowledge. We are better off readying ourselves for an infinite game and being optimistic about our knowledge creating capabilities, than expecting that the final explanation of everything is just around the corner while we keep second-guessing our capabilities to get there. An infinite game with players of unbounded capability also happens to make our universe a much more interesting place to be. So here's to a never-ending quest for the **Explanation of Everything!**



2050 MILESTONES

In the next 40 years we need to put our quest for good explanations on better footing: a better reason for why we do it, better integration of what we know, faster progress through collaboration and a few cautionary speed bumps on the road to make sure we don't crash and burn.

UNKNOWLEDGE AGENDA

Imagine if we had a continuously evolving answer to a simple question: as a species, what must we explain next and why? Imagine an Unknowledge Agenda that at any point in time defines the horizon of our quest for knowledge and lists the biggest questions that we know we need to answer. This may very well be the most important to do list we can ever produce as a species.

BIG SCIENCE

Big Science is "hyper-specialization" running in the context of "hyper-generalization"—an evolving grand explanatory framework of everything. The output is an integrated stream of explanations at different scales and levels of existence. By 2050 we should complete the integration of our existing explanations and turn Big Science into standard practice.

MASSIVELY COLLABORATIVE DISCOVERY

Forget working on a problem in relative isolation, not knowing there is that other guy who holds the piece of the puzzle you are missing. Forget restricted access academic journals. Imagine perpetually refined open papers with thousands of

authors, distributed instrumentation and experimentation. By 2050 our quest for good explanations should be the most networked human activity on the planet. Imagine millions of knowledge creators on the same—or perhaps several competing—platforms finding collaborators online, asking each other questions, freely sharing papers, pushing into the Unknown together.

SPEED BUMPS

Knowledge creation itself is not entirely without peril. We can't always predict the outcomes of our scientific experiments indeed that's why we design them, to find out something we don't already know. The best we can do with extreme experiments in science is to treat these experiments with the best of human caution and get into the habit of convening global consultations on how we might proceed. No country has a monopoly on the best our species can offer in terms of cognitive and moral development. So we must cast our nets broadly, seek out the best relevant scientific minds regardless of their nationality, and bring people from across all relevant disciplines—not just from within the disciplinary community proposing the experiment.



GROWING CONNECTIVE TISSUE

We can see seriously awesome stuff. With our microscopes we can see at the scale of 0.01 nanometers, or the distance between a hydrogen nucleus and its electron. With our Hubble telescope we can see 13.2 billion lightyears away. What we don't yet see is the existential significance of our scientific capabilities. Many nations have scientific agendas but they are primarily powered by advancement of national interests and securing national competitiveness, rather than advancement of the ongoing human project. The foresight needed to make investments at the frontier of science is in short supply around the world. It's a systemic deficit.

We are singling out some disciplines as critical for challenges like creating new energy sources (the physics of fusion) or understanding how our activity impacts our biosphere (earth systems sciences). But other disciplines (take cosmology or theoretical physics) are seen—even by the leading scientists themselves—as just a matter of satisfying human curiosity. Few see the battle with the Unknown as a matter of life and death.

People talk about the totality of human knowledge, but in practice it's more of a heap—a sum total of explanations of different phenomena at different levels and scales of existence. The scientific integration project has barely begun. Many bridges are being built between and across two or more disciplines. But attempts at grand explanatory frameworks or methodology for transdisciplinary inquiry are still rare: A dozen people are courageously integrating the highlights of human knowledge into Big History narratives. A few hundred are stubbornly pushing to make space for trans-disciplinary inquiry within a

hyper-specialized world of academia, often to the detriment of their academic careers. The limitations of hyper-specialization are talked about but hyper-generalization is not yet an idea that's taken hold in academic circles.

Massively collaborative discovery, on the other hand, might not be too far out in the future. In addition to hundreds of platforms dedicated to specific issues, we now have Facebook for researchers—ResearchGate already has more than 1.5 million members, adding 50,000 each month. More than 10 million papers have already been uploaded. The academic world is growing its connective tissue, the mass-scale sharing has begun. Collaboration and integration may follow. Much, much work to do here. For all of us.

UNKNOWLEDGE AGENDA

BIG SCIENCE

MASSIVELY COLLABORATIVE DISCOVERY

SPEED BUMPS



WHO IS ALREADY ON THE CASE?

PEOPLE: ~7 MILLION
FUNDING: ~\$1.2 TRILLION or <2% of the world's GDP

THE SCIENTIFIC BENCH

Our scientific bench is astonishingly small—fewer than 10 million of us are scientists and most of us are busy pursuing increasingly narrow scientific interests. These curious beings can be found in academic, government, corporate and private research institutions. Freelance scientists are a rare breed. So are the Unapologetic Generalists.

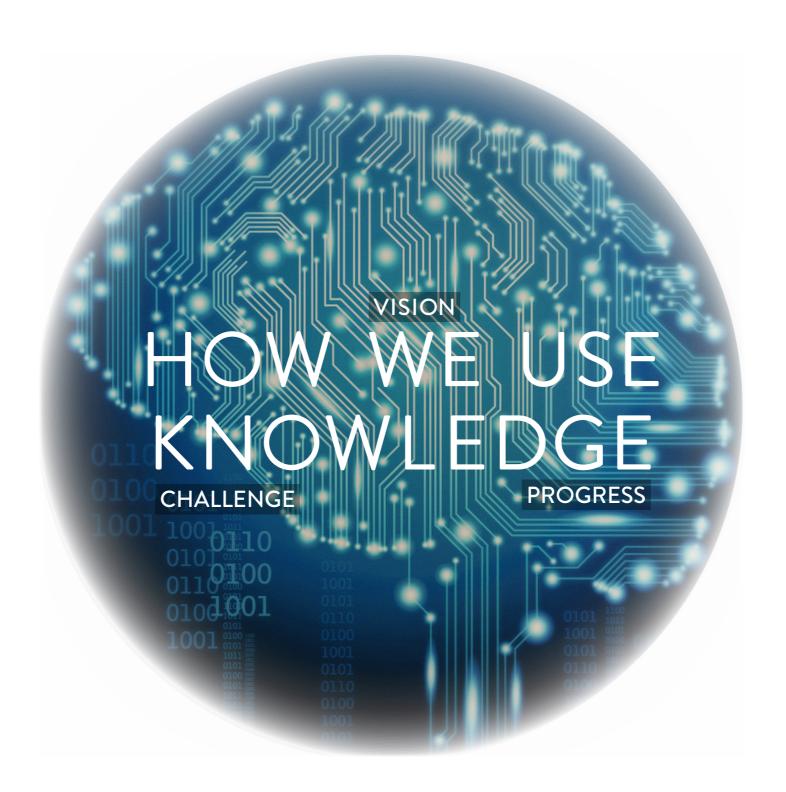
FUNDERS AND ADMINISTRATORS

Coordinators, unifiers, administrators and agenda-setters of our fragmented scientific pursuits are mostly found in national academies of science, various industry associations and international bodies like UNESCO, International Council for Science, International Science, Technology and Innovation Center, and AAAS. Many of them can be seen at big meetings like the OECD Global Science Forum and World Science Forum.



WHAT IF?...

...the Unknowledge Agenda 1.0.—our first stab at defining the horizon of our quest for knowledge, the biggest questions that we know we need to answer—became the flagship project for the ResearchGate community? There are more than 1.5 million members on this platform for researchers—between us, we probably have the entire heap of human knowledge covered. Can't think of a better place to get clear on what it is we need to explain next and why!





CREATIVE POWER

We use knowledge to create new realities. A jet airliner can take you to another continent in a matter of hours. A tablet can make your thoughts instantly accessible to billions of people. A 3D printer can print a new heart using your cells. A drone can find you in a remote location. Curiosity rover can stream video from Mars. What do we make of all this?

There is little doubt in the technooptimist's mind: *Technology will save us!* Our challenge is to keep charging forward as fast as we can. At the other end of the spectrum, the technopessimist sees a different picture: Pollution. Loss of biodiversity. Alienation. Technologically perfected violence. Playing gods. And now contaminating new worlds. The so called technological progress is a path of destruction.

Both techno-optimists and technopessimists have a point. Yet, a mere integration of these perspectives into a single challenge definition will leave us exactly where our technological discourse has been for the last few hundred years—trading off the benefits, costs and risks of our technological advances. To take it to the next level. we need to enlarge our frame: What is the cosmic Our technological history has largely been a self-serving enterprise—it's just us humans using our knowledge and imagination to better our lot. But in the process of advancing our own agenda, we might be unwittingly pulling off a feat of cosmic proportions. We might be adding a third and fundamentally different source of creativity in our universe.

Think about it: First came cosmic evolution. Over 13.7 billion years, the physical forces shaping matter and energy have generated an impressive creative portfolio—brilliant stars and matter gobbling black holes, massive galaxies and fragile snowflakes, almost a hundred unique chemical elements each with astonishing chemical properties. But arguably, the greatest accomplishment of cosmic evolution was laying the ground for the emergence of biological evolution. It got going only a few billion years ago (at least on Earth) and generated forms of such variety and sophistication, they make all non-biological forms look simplistic in comparison—a brilliant star is no match for a beautiful butterfly. Biological evolution proved to be a prolific force. Millions of biological species now live together on the third rock from the sun. Yet, the crowning achievement in the creative portfolio of biological evolution is arguably a mammalian species with an over-sized brain.



We humans have only just emerged on the scene of existence. Yet we already show incredible promise. Within a few million years, we've revolutionized the art of universal creation. Cosmic and biological creativity happens, human creativity is something we make happen. We introduced a creator into the creative process. Today this may seem cosmically inconsequential given our modest creative powers but this could change during our lifetimes.

Our creative power stems from the imaginative use of knowledge. And that knowledge is growing. Our grasp of cosmic evolution already allows us to make up new chemical elements and put our Curiosity machine on another planet, even if we can't yet fuse a new star or create a wormhole in the fabric of spacetime. Our grasp of biological evolution already allows us to breed new species and genetically modify existing ones, even if we can't yet create a purely synthetic life form of our own design.

Our foray into our own minds already allows us to discern the patterns of our creativity, even if we can't yet implement them in another substrate. But one day—quite possibly during our lifetimes—we humans will be able to do the incredible things we currently can't. And then some!

As we get closer to being able to program matter at sub-atomic scale, write synthetic genomes and create artificial minds, the warm-up era of technological tinkering is drawing to a close. We are entering the era of technological creation. Soon enough designs conceived in the human mind may outshine the greatest achievements of cosmic and biological evolution.

For millennia we've been trying to deduce the mind of god from the workings of the world around us. Now our challenge is to become the kind of creators we've always hoped our gods to be.



WHAT'S AT STAKE? GODS OR DINOSAURS?

Our budding technological creativity is a reason to believe we have a shot at surviving and becoming universal creators. It is also a reason to fear that we might fail big or leave a trail of destruction in our wake. Unfortunately, it is impossible to predict whether we will go the way of gods or dinosaurs.

For starters, we have no way of knowing whether our future technological creativity will be good enough to produce technological solutions to challenges hanging over our existence. We must of course do the best we possibly can. But failure of imagination will always be a risk—a risk for which we don't have a solution.

In addition, we are playing the game of survival and becoming with two serious handicaps: ignorance and ill intentions. Without perfect knowledge, our attempts at editing reality tend to create new problems, revealing things we did not know, think about or foresee. Introducing antibiotics saved human lives but now we are up against superbugs with antibiotic resistance. Burning fossil fuels powered the Industrial Revolution but now we are up against rising temperatures, rising sea levels and ocean acidification. Our growing creative power goes hand in hand with a growing potential for disaster.

Perhaps, one day we will exist in a reality of our own design, where we can make perfect predictions about the consequences of any editorial action—we'll then strike ignorance off the list of our handicaps. But as long as we inhabit and try to edit a reality we don't fully understand, we are doomed to have nasty surprises along the way. We can only hope none of them will be lethal.

Our second handicap is arguably even trickier, ingrained in the fabric of our minds and the web of our cultures. We draw a myriad of dividing lines between us and them. We then seek to protect ourselves from them and sometimes to dominate or even destroy them. A good deal of our technological creativity has been and continues to be poured into creating means of mass destruction and domination. Some truly dystopian possibilities are looming on the horizon, from killer synthetic life forms to mind control. Perhaps, one day we will have erased the dividing lines and upgraded our culture to run on universal care. not just for our own species but for all of existence. But as long as the devils of our nature continue to get the ear of a few, we will have to contend with the destructive power of our inner smallness.

Technological creativity is our shot at greatness. But to stay in the game we will need to power up our imagination, let the angels of our nature speak louder than the devils, and hope that Lady Luck will keep smiling on us.



ULTIMATE GOAL INFINITE BECOMING

Cosmic evolution set the stage for biological evolution. Biological evolution set the stage for cultural evolution. And now here we are—rookies on stage. So what's our gig?

Two very different paths are open to us: one with the ultimate creative climax and the other without, one final and the other infinite.

The first path leads toward a final Grand Artifact. Many of us imagine that the peak expression of our technological creativity will be smart, dexterous machines that can perceive, think, learn and move at inhuman speeds without a wink of sleep. They'll be "the

last invention man will ever need to make". Once we animate our robots with artificial intelligence, we retreat backstage and retire into the care of our last creation. Cultural evolution sets the stage for intelligent machine evolution. The human mind is but a chapter in a bigger story.

The second path comes without a retirement plan and an infinite amount of work. Instead of pinning our hopes on a Grand Artifact, we focus on the Grand Process. We play an infinite game of remaking the source of creativity remaking ourselves. Our ultimate goal is infinite becoming, refashioning ourselves into an ever better, wiser creative force. We sign up for an never-ending stream of self-upgrades and tireless practice of our art. It is easy to speculate about who we might become and what we might create tomorrow: We imagine genetically enhanced, materially augmented yet still recognizably "human" beings programming new forms of matter at subatomic scales, coding new forms of

life, terra-forming other planets in our solar system, designing warp-drives—all with the help of increasingly intelligent machines. But it's a real mind trip to ponder what our future self-perfecting selves might be like and what they would want to create, say a million or a billion years from now. Will we exist in postbiological substrates of our own design or turn ourselves into an all-permeating creative impulse? Will we redesign the forces that power cosmic and biological evolution in our universe? Will we spawn a brand new universe or a multi-verse? What story will our creative portfolio tell about who we keep becoming?

Right now the choice between the two paths seems simple. We've just arrived—thinking about retirement is a bit premature. Besides, the game of infinite self-transformation into a better and wiser creative force just seems like a more exciting gig by far!



2050 MILESTONES

We've pretty much stumbled into our creative power and have hardly had time to properly conceptualize the significance of our budding technological creativity or the direction we should be heading in. In the next 40 years we will need to get a whole lot more thoughtful and disciplined about what we use our knowledge for and how we manage our creative pipeline.

TECHNOLOGICAL METHOD

We should have a method to our creative madness. What should we be creating and why? What kind of morality and safety tests should our creations pass before we can unleash them into the world? The answers to these questions are neither straight-forward nor static: our practical and moral imagination is evolving, our judgments of safety are evolving as new knowledge trickles in. Today we tend to answer these questions within specialized communities of futurists, technologists and technocrats inside the walled-in administrative cells of our nations. But what we are creating should be everyone's business—many upcoming creations can alter our lives drastically and rapidly. Back in the 20th century, a species-wide discourse was practically impossible. But in the 21st century we have the infrastructure to experiment with taking on the big questions together. By 2050, we might be able to look back and conceptualize our Technological Method—or maybe by then we will simply think of it as our Creative Way.

TECHNOLOGY ROADMAP

We should get our immediate priorities straight. Without coordination, we end up with a mismatch between the technology we need and the technology our best minds are working on. We could use an Evolving Technology Roadmap—a minimum we must do to secure the survival and ascent of our species. By 2050 we will have probably gone through dozens of iterations.

HUMAN 2100

Fundamentally altering a human being is a whole new ball game—or so many of us think even though we've been changing ourselves for centuries. Suggestions that we might one day be modifying our genetic makeup, implanting chips into our brains, or uploading our minds into another physical form tend to run up against a mental wall, with many of us dismissing the very idea of human enhancement. A species-wide conversation on where we should be by 2100 could help us shift the sentiment. By 2050, let's publish an evolving collection of visions describing what it could be like to be human in 2100.



HAPHAZARD

The way we currently exercise our technological creativity can hardly be described as a method. It looks more like a haphazard application of human minds, powerfully skewed toward inventions that promise a military advantage or short-term financial gratification. We humans are capable of greatness but we are keeping ourselves busy thinking small. This situation has led some to speculate that we may be suffering from a doubly dangerous chronic condition: failure of imagination and failure of nerve. "Killer apps" seem to attract more bright minds than say fusion, warpdrives or augmentation of intelligence. The efforts to make sure that the technologies we do end up creating are moral and safe tend to be disconnected

from the rest of us. The general public tends to get the scoop in the format of whispers down the lane, often unrecognizably distorted. Furthermore, for a technological civilization, our technological literacy rates are shockingly low and many aspects of new technologies are misunderstood and feared. As a result, some potentially useful inventions end up smashing against the steely wall of public rejection while other potentially dangerous inventions slip through the cracks of ignorance and disinformation. That's a dicey state of affairs.

The idea of a technology roadmap is not exactly new. Technology companies make them. Many developed nations and a few ambitious developing nations make them. International organizations make them for their areas of specialization. But we don't yet have a technology roadmap for us as a species. So how would we know if we are prioritizing our efforts right if we don't sit down to think this question through at a species-wide scale?

Human enhancement has been a fixture of science fiction novels and movies for a while but only recently has it started to register in public awareness as a reallife prospect. We are getting used to cochlear implants that restore hearing and bionic eyes that restore sight. We've watched a double-amputee race on his prosthetic Cheetah legs along-side able-bodied athletes at the Olympics. We have marveled at a paralyzed woman drinking her first cup of coffee by controlling her robotic arm using only her mind. We are talking about drugs that enhance cognition and even morality. We've learned that scientists can now improve the thinking ability in primates by implanting a brain chip. Our technological capabilities are rapidly advancing on multiple fronts. But we still lack a coherent vision to guide our selftransformation.

TECHNOLOGICAL METHOD

TECHNOLOGY ROADMAP

HUMAN 2100



WHO IS ALREADY ON THE CASE?

PEOPLE: ~10S OF MILLIONS **FUNDING:** ~\$1.2 TRILLION OR 1.9% OF GDP IN GLOBAL R&D SPENDING

FUTURE CLUB

Our technological creations often start out as crazy ideas in the minds of science fiction writers, futurists and visionary technologists. What this club lacks in size it makes up for with the boldness of their ideas.

TECHNOLOGY BENCH

We have the professionals—millions of technologists and inventors scattered across public and private labs and product development departments. And now they are joined by the growing army of amateurs—as tools from 3D printers to biolabs become cheaper, DIY communities are springing up around the globe.

WATCHDOGS

Most developed nations have hundreds of specialized technology review agencies (e.g., the FDA in the US) and vocal public policy communities. In addition, social networking tools make it much easier for citizens to organize and rally for or against specific technologies (e.g., GMOs) and entire categories of technologies (e.g., human enhancement).

TECHNOLOGY EDUCATORS AND ACTIVISTS

In a handful of democracies like the USA and Finland, technological literacy is now viewed as a must. So a small group of technology educators are trying to inject technological literacy into K-12 education (e.g., standards proposed by International Technology Education Association). A handful of private institutions like Singularity University and a techno-progressive think tank IEET run programs to explore future impacts of advanced technologies and prepare the general public for what's coming.



WHAT IF?...

...we turned **HUMAN 2100** into our first global experiment in massive open online prototyping of our future selves? Imagine science fiction writers taking the lead and millions of people around the world contributing in iterative rounds of comments, ratings and reviews. The process would take a lot of structuring and outreach but it is well worth the effort.





SHARING MEMES

Consider what we've already accomplished in the grand scheme of existence: carbon-based life on planet Earth in the Milky Way galaxy has found a way to encode information in language and transmit it at the speed of light running through fiber-optic cables. Cultural transmission of knowledge is a big new idea in our universe. It sets us apart from purely physical and biological ways of being. Now we need to get good at it.

In biological evolution, "wisdom" accumulated over billions of years is embedded into every life form. It's in our genes. Genetic errors aside, we all "know" how to breathe and how to convert food into energy. We can breath without understanding how our lungs actually work. We are competent without comprehension. Cultural evolution is different. The carriers of our knowledge are memes. Unlike genes, our memes don't come pre-installed. None of us are

born knowing the laws of physics, let alone knowing how to use them to build a space rocket. This is something we must learn.

And learn we did! Like our primate cousins we started off by observing and copying each other—until we completely changed the game with language. It enabled us to create and share increasingly abstract ideas. Our next big problem was storage and transmission: our memories are fragile and our ability to pass on even a short message without errors is limited. Just try playing a game of telephone. We solved for that by learning to write our ideas down and print them. Books became the external repositories of our knowledge. Since we invented the printing press, we've written more than 100 million of them. But like a talking human, a book is a physical thing. To access the knowledge it contains, you have to be close by. Messengers and traveling learned men



carried an occasional book from one place to another, but for the most part, our knowledge has been fragmented across local repositories of human culture.

We now have a solution for that, too!
Digitizing our knowledge and sharing it over the internet holds the promise of creating universal access to everything we think and know. But with only a fraction of our cultural heritage online, 5 billion still without internet access and 800 million still unable to read and write, we are far from there. And even if we

were, universal access to all knowledge won't cut it all by itself. It does not automatically translate into universal comprehension and competence. Neither does it guarantee that we will learn to systematically select and share the good memes that propel us forward and weed out the bad memes that hold us back.

Our ongoing challenge is to keep designing better ways to select, share and comprehend good memes. We must keep learning to learn.



WHAT'S AT STAKE? THE SLOPE OF ASCENT

Most of us agree that sharing knowledge is a good thing. As individuals, we learn in order to satisfy our curiosity, broaden our minds, get a job and stay competitive in a rapidly changing world. As nations, we see a good education system as a prerequisite for national competitiveness. But elevate yourself to a species-wide perspective, and you can see what's at stake for all of us: how we share knowledge determines the slope of our ascent.

Keep our knowledge walled-in and fragmented, and it will grow slowly. Share it, and we can multiply it greatly. The more of us are able to learn our way

to the edge of our existing knowledge, the more of us can join the epic battle with the Unknown or dedicate ourselves to coming up with life-improving uses of our knowledge. Throwing more of us at contemporary scientific mysteries, technological challenges and moral dilemmas does not guarantee we can solve them faster, but it surely improves our odds. Knowledge creation has always been a collaborative sport. The larger and more diverse our mind pool, the more interesting and useful ideas we might be able to generate together.

But knowledge sharing is not just about recruiting more minds to the cause of knowledge creation. It goes to the core of how we make decisions as a species. When one of us comes up with a new scientific, technological or moral idea—how do the rest of us decide if it's worth pursuing? Should we settle Mars? Should we migrate our minds into another physical form? Which idea is more important? Our answers will

depend on what we know and what we care about. Do you know that our species must leave planet Earth or perish, and that our biological bodies are too fragile for life beyond Earth? And do you really care enough about the distant future to spend our collective resources on it now? What we learn throughout our lives has a formative effect on how we think, feel and act. When your explanatory framework of the world is radically different from mine, we will have very different opinions and priorities. The wider the divergence in our worldviews, the more energy we need to spend on reconciling our differences.

If all of us were familiar with the general outlines of everything we currently know as a species, would we agree on the way forward? Unlikely. But at least we would all be familiar with the existing frames of references—and that in of itself would help us along quite a bit!



ULTIMATE GOAL UNIVERSAL COMPREHENSION

Imagine every morning you wake up wiser. But not in a proverbial sense of having slept on some unresolved problem and waking up with a fresh take. Imagine you wake up a whole lot wiser—with all the new ideas that have been generated since your last sleep neatly embedded into your memory, as if they were your own.

The ultimate goal of how we share knowledge could simply be simultaneous universal comprehension of the entire idea stream of our species. The instant you've had a new idea, I would have it too—and the other way around. At any

point in time, all of us would have all knowledge fully metabolized—instant comprehension by each individual mind.

But we must make a crucial distinction—universal comprehension is not the same as universal brain-washing! Just because you comprehend my idea, does not mean you should adopt it. Universal comprehension comes with two strings attached: the assumption of Fallibility and the expectation of Creativity.

We cannot treat our knowledge as a collection of ultimate, final truths. They are a collection of scientific explanations, technological know-how and moral ideas all of which must remain open to challenge and improvement. That's the assumption of Fallibility.

We may all be genetically similar, and one day we may even live very similar lives. Yet, even small differences in our genetic code amplified by small differences in our environments can produce a powerful diversity of mind. The same data or idea can trigger very different thoughts in different minds. When that happens, something new can emerge from synthesis! That's the expectation of Creativity.

Interestingly, when we finally reach the ultimate goal of simultaneous universal comprehension we would eliminate the need for learning as we think of it today. There will be nothing for us to learn but plenty of knowledge to use and build on. Obviously, the number and magnitude of problems we need to solve to get there will probably keep us busy for decades if not centuries to come. Universal connectivity and braincomputer interfaces are probably the easy part. Understanding how our minds convert information into understanding will probably be the hardest.



2050 MILESTONES

In the next 40 years we should complete our ongoing project of creating universal access to all human knowledge and experiment with ways to move from universal access to universal comprehension.

UNIVERSAL LIBRARY. UNIVERSAL ACCESS

By 2050 we should have finally created our library of utopia. We should digitize all repositories of our knowledge from books to documentaries and put them all online for free. By then we might be 9 billion. If all of us are literate and have access to the internet, we will have created a specieswide platform for cultural learning.

LEARNING PATHWAYS

Just because everybody can access all that is known, does not mean we can make our way through the maze without a guide—at least not until we've all become autodidacts. By 2050 we should have many competing frameworks, models and providers of inexpensive knowledge sharing services. Would you like to study with a live teacher, your peers, with an algorithm that adapts to your learning style or some combination of these?

A service like this should be open, free, in every language, and anyone should be able to submit an alert from a mobile phone.

KNOWLEDGE COMPRESSION

A single human mind cannot internalize the entire growing body of human knowledge—at least not without serious augmentation. While we are working on developing augmentation technologies, we should also run a parallel track: we need to learn to compress and distill our knowledge into general explanatory frameworks. If we had to compress the totality of human knowledge onto mere 10 pages of text or 10 minutes of a documentary, what would they be like? By 2050, we should have a dozen competing knowledge compression systems that would allow us to wrap our minds around the general outlines of what we know at the depth we prefer, be it a 10 minute, 1 year or a 20 year version.

CITIZEN SCIENCE

Participation is a good path to comprehension, effectively blurring the line between knowledge sharing and knowledge creation. By 2050 we need to have tried and tested more models for public participation in science research. Some of these models could evolve into fundamental changes in how we do science and who the "we" is. Shrinking the gap between the scientist and the non-scientist would be a step in the right direction.



PROMISING

The idea of a universal digital library has been around for decades. Several million public domain books have been successfully digitized and are already freely available. However, large scale efforts to digitize our entire cultural heritage (e.g., Google Book Search, Digital Public Library of America, Europeana) keep running up against the walls of our stringent copyright laws.

Universal access is definitely within our reach by 2050. At our current adoption rates, 5 billion of us should have internet access by 2030. Ever since broadband access has been shown to go hand in hand with an uplift in economic growth, more governments are adopting

aggressive ICT policies, shooting for 100% internet penetration rates. The United Nations along with local governments and hundreds of NGOs are working hard to introduce reading and writing skills among the 800 million who can't read and write today.

In the meantime, the world's pioneering educators are making internet access more valuable. The world's best universities are putting their course curriculum online for free and now increasingly experimenting with massive open online courses for hundreds of thousands of students. Several recently launched educational ventures like edX, Coursera and Udacity are on a mission to make the best education in the world freely available to anyone who seeks it. And the numbers of seekers are growing. The days of one-off education are over. It is a brave new world of continuous learning, where the meta skill of learning is becoming more important than the contents of any given curriculum.

Compressing our knowledge into general explanatory frameworks isn't yet an idea that has caught on among the world's educators. But we have a noteworthy precedent: Big History Project has produced a free online course for high school students that covers history from the big bang to the present in an interdisciplinary way. It's a good start.

Citizen science is becoming a newsworthy if not yet large-scale phenomenon: amateur scientists are now searching for extraterrestrial intelligence (SETI@Home) and Earth-like planets, volunteering classifications for celestial objects (Galaxy Zoo) and even solving puzzles to design proteins (Foldit). It's all just the beginning!

UNIVERSAL LIBRARY. UNIVERSAL ACCESS

LEARNING PATHWAYS

KNOWLEDGE COMPRESSION

CITIZEN SCIENCE



WHO IS ALREADY ON THE CASE?

PEOPLE: ~ALL OF US. **FUNDING:** ~MORE THAN \$2.5 TRILLION OR ~4.8% OF WORLD GDP WAS SPENT BY THE WORLD'S GOVERNMENTS ON EDUCATION IN 2009.

ALL OF US

Every one of us is a learner with varying degrees of influence over what we end up learning throughout our lives. With many academic institutions putting their materials online and offering them for free, how much each of us will learn is increasingly becoming a matter of time and will, rather than access and money.

THE EDUCATORS

Worldwide, we have almost 60 million teachers in primary and secondary education alone. More and more of our teachers are turning to the internet to improve the quality of their instructional materials and expand their reach.

THE ADMINISTRATORS

There are almost 200 national ministries of education. All of them are struggling to adapt our existing systems of formal education to the changing world where information may be abundant but comprehension and creativity are scarce. Thankfully, not all of our educators and learners are sitting around and waiting for a formal educational reform to change the way we teach and learn.

THE INFRASTRUCTURE-BUILDERS

A universal library with universal access may sound like a simple idea but it takes millions of people to make it happen—from networking equipment and device manufacturers to internet service providers and the world's librarians.



WHAT IF?...

...we turned the idea of knowledge compression into an online game for learners and teachers alike? We've got the ingredients for an interesting infinite game:

An impossible challenge.

Can you distill the entire body of human knowledge into a coherent whole?

Different levels of difficulty.

Can you do it in 10,000 words? 2,000 words? 500 words? A 5 minute video?

Broad based participation. You can create your own, critique, rate and review other people's work.

In the process, everybody learns!





COLLECTIVE ACCOMPLISHMENT

If global problem descriptions were pop songs, then this tune would have now been topping the charts for at least a decade:

The bundle of intertwined complex challenges we face at the start of the 21st century cuts across our geographical and organizational boundaries—no single nation or organization can solve them. Our current global institutions and mechanisms for international cooperation cannot cope with these types of challenges. What we are dealing with is a global governance problem exacerbated by the crisis in global leadership. We need better leaders, enhanced international cooperation, reformed global institutions,

enlightened public policy and corporate action. Oh yes, more public engagement to prop up the legitimacy of our international institutions would be good, too.

This tune may be popular but popularity is a poor indicator of helpfulness. From the HUMAN perspective, it's a Hymn of Disempowerment. If all of us thought this way, we would be locking ourselves into a solution space that's too tight, too path-dependent on our past social designs and we would be saddling a handful of people with the entire burden of responsibility while subtly disempowering the rest of us. Ironically, many global leaders feel pretty powerless too: the issues are too complex, the number of stakeholders is unmanageable. All of us could use a reframe.

It's easy to slump into disillusionment when we repeatedly and spectacularly fail to accomplish what looks like a *no duh* goal with a clear course of action

like reigning in human-made climate change, something we have known about for over half a century. Yet, we need to treat our failures not as conclusive evidence of our irreparable flaws as a species, but simply as input into our ongoing learning process.

Over the course of our history, we've made quite a few radical innovations in our technology of collective accomplishment. There was a day when getting a band of guys together to hunt down big game was considered a revolution in human organization. Fast forward a few hundred thousand years: we've organized ourselves in thousands of cities and 200 nation states that cooperate through various international organizations. Millions of businesses work together in complex supply chains to cater to an increasing inventory of needs. Hundreds of thousands of NGOs are moving the needle on a broad range of worthy causes.



Our social technology is far from perfect. The idea of a geographically bound nation-state as a core building block in the world where we can easily forge connections across geographies is increasingly out of date. The thicket of our rule books can be paralyzing. Our business pursuits, when driven by a single-minded focus on maximizing shareholder value, can be counterproductive and even destructive. Our ability to bring together hundreds or thousands of organizations in service of solving a common problem is still weak at best.

We need a serious overhaul. But it all starts with how we frame the issue: How we organize to push the human project forward should be everyone's business. Our past social designs (nationstate, corporation, NGO, the UN) are not celestial bodies, we can change them. Identities and goals can be re-conceived. Governance can be reinvented. Rules can be rewritten. We are now an increasingly networked species—we can change the very basis for organizing. Our challenge is to take our social technology to a species wide scale and keep experimenting.



WHAT'S AT STAKE? GETTING THINGS DONE

How we organize ourselves may sound like a matter for high-minded academic discourse on global governance. But in practice getting things done at the right time and at the right scale can quickly become a matter of life and death for us as a species.

None of the challenges on our list can be solved by an army of one. All of them call for organizing the activities of hundreds, thousands, millions, billions and sometimes all of us. Our experiments in social design impact how much progress we make on all other challenges from defending ourselves from pandemics, asteroid impacts and cosmic radiation to creating enough energy to power

our ascent. The relative importance of our social technology varies depending on the challenge. Getting a few billion dollars in funding and designing a Planetary Defense Council to protect ourselves from asteroid impacts may be trivial when compared with the amount of organizational innovation required to change how 7 billion of us sustain ourselves. But it all starts with ownership and that's where we are running into serious trouble.

In theory, advancing the human project is everyone's responsibility, all of us influence where we are headed as a species. In practice, we need to organize and channel that influence into action. Contrary to a popular idea, 7 billion people—even once all of us are connected—don't spontaneously *self*-organize. All self-organization starts with very specific "selves": people who ring the alarm bell, people who frame the questions we must answer, people who design and build collaboration platforms, people who come up with new ideas,

people who amplify these ideas, people who turn them into reality through their personal or institutional power.

On some challenges like Pandemics and Asteroids we've been lucky. Small groups of concerned members of our species have voluntarily adopted these challenges. They've made it the purpose of their lives to defend *all of* us. That doesn't mean they'll succeed in attracting the necessary mind-power and funding, but at least we know dedicated people are on the case. Most of the challenges, however, remain either partial or complete "orphans", without a dedicated core group pushing the rest of us to rise to the occasion. This hardly bodes well for our prospects of taking action at the right time and at the right scale on challenges like sustaining ourselves or defending ourselves from cosmic radiation. But perhaps, the biggest orphan of all is the overarching purpose to secure the continued survival and ascent of our species. Do you feel ultimately responsible?



ULTIMATE GOAL WISE ACTION

What should be the ultimate goal of all human organizing? Organizing is a means to an end. We organize in order to accomplish something together, to move the present toward the future we envision for ourselves as a species. At the most fundamental level, the goal of our organizing is to arrive at a shared purpose (e.g., survive and ascend) and realize it. Good organizing is what turns a *stream* of human existence into an ongoing human *project*.

But the means are only partly defined by the ends. We can take different paths to arrive at the same destination. Some paths can even lead us astray: our history is filled with examples where we used our wonderfully utopian goals to justify seriously horrific means. We need a strong ideal to guide our experiments with social technology to make sure we don't go astray.

Contrary to the idea that has held some sway in Western intellectual circles for the last 20 years, we would be better off not to think of this ideal in terms of some Final Organizational Design that will end the history of our organizational evolution. Universal liberal democracy is not it. World Federation is not it. Selforganizing peer-to-peer networks won't be it either. We face a wide range of challenges requiring a wide repertoire of organizational responses. So we need to abandon our quest for that one perfect form of organization and instead think of human organizing as a creative problemsolving process, a social technology that we should keep improving based on what we learn from past experience and from anticipating future challenges.

Once we adopt this frame, the ideal we could strive for is simply wise action. What does wise action look like? At any point in time, the answer to this question will essentially be a distillation of our



moral knowledge, a snapshot of our moral development—who we include in our circle of concern and how. "Wise action" is a container for our evolving moral principles. Here is one way we could define wise action today:

Our goals advance the purpose of the human project. We've considered the interests of all humans and all life, the living and the unborn. We have drawn on all relevant human knowledge and gone to the limit of human imagination. We've included mechanisms to evaluate and improve the underlying organizational design.

By these standards, how much of human action today would be wise? Few of us ponder the purpose of the human project, let alone tie everything we do to that purpose. Perhaps we extend our care to our families, our communities, our nations, maybe even all of us alive today but forget about future generations and other life forms. We are each familiar with small fractions of human knowledge. We skimp on imagination. We get attached to and stuck in past organizational designs. But we humans are capable of greatness. Articulating an ideal is the first step towards realizing it.



2050 MILESTONES

Rather than focusing our attention solely on trying to reform, legitimize and retrofit our existing organizational designs to rise to the occasion of species-wide challenges, in the next 40 years we should take the creative license to experiment with entirely new ways to organize ourselves. We are an increasingly networked species. We need to figure out how we can make the most out of our expanding connections to take on the challenges that affect the trajectory of the ongoing human project.

WISE ACTION: PRINCIPLES

We've developed a whole body of principles and frameworks for the selfdetermination of nations. Now we need to think at a higher level and create a conceptual backbone for the selfdetermination of a networked species. But this time around, let's keep it informal and open to challenge, rather than enshrining it in a nearly immutable document. Imagine a simple document laying out the organizing principles for everyone involved in thinking and acting on a species-wide scale. In 2050 we should be able to line up all the iterations of the principles and see how our moral imagination has evolved over the decades. Hopefully at an accelerated rate!

COLLABORATIVE POWER

Unprecedented power lies in our connections. Social networks + crowdfunding platforms + massive scale collaboration platforms = unprecedented potential to accomplish shared goals. But we need a high-visibility precedent where an unlikely cast of characters takes on a

species-wide challenge and succeeds. Hopefully, the first project will break the mold of our current organizational designs. By 2050 we should have a Cambrian explosion of projects that draw on our collaborative power to make progress on challenges that impact the trajectory of the human project. Advancing the human project is everyone's business should become a description of fact, rather than mere wishful thinking.

THE HUMAN PROJECT

We need a custodian of the evolving big picture and a community-organizer at a species-wide scale, somebody to own the process of keeping the list of challenges and visions, keeping tabs on our progress and attracting more people to challenges that are understaffed. Perhaps, we need several custodians performing the same role and experimenting with different ways of accomplishing the task. Whether a single organization or several, by 2050 we should have them all up and running.



BETTER THAN IT LOOKS

Thousands of experts have filled tens of thousands of pages with analysis and ideas on how our global institutions largely conceived and frozen in the reality of 1945—should be redesigned to upgrade our ability to deal with global challenges. Most of these ideas fall into the bucket of "fundamentally the same but incrementally better": we should strengthen the state-based core of the international system, create more public-private partnerships, improve the legitimacy of international bodies through more direct outreach to civil society. The fundamental design remains heavily geared toward building consensus among leaders of organizations with differing identities and interests. In the absence of a

strong species-wide cultural identity, reconciling hundreds, sometimes thousands of diverging and often conflicting interests is proving to be a tall order. In several cases from human-induced climate change to nuclear proliferation, we are struggling to produce timely responses commensurate with the magnitude of the challenges—or that's what it looks like if we only track developments at the intergovernmental level.

G20 meetings and the UN conferences may get a lot of coverage, but real problem-solving action is now also happening elsewhere—in the meetings of the world's mayors, technologists and social entrepreneurs. Driven by the need to solve the local manifestations of global problems, they are making real progress on challenges from sustainable development to global security. Too bad some of our species-wide challenges don't have "local manifestations".

When it comes to collaborative power, we are just starting to flex our

networked muscles. We can get millions of people to sign a petition or take to the streets in protest. We are getting good at rallying around a "No" but we have yet to figure out how to use our collaborative power to solve a species-wide challenge. We do have awesome examples of small teams taking on projects of species-wide significance (SpaceX is working toward a space-faring civilization, the Internet Archive is creating universal access to all knowledge) but none of them have been crowd-funded, making it harder to create the "anybody could do this" ethos.

The HUMAN project is but a collection of ideas in a crowd-funded app. But these ideas could soon lead to an actual organization or inspire the creation of other organizations with similar goals.

WISE ACTION: PRINCIPLES

COLLABORATIVE POWER

THE HUMAN PROJECT



WHO IS ALREADY ON THE CASE?

PEOPLE: ~TENS OF THOUSANDS **FUNDING:** ~N/A

GLOBAL GOVERANCE REFORMERS

The world's thought leaders on international relations, world affairs, global governance and geopolitics contribute ideas to efforts like the Global Institutional Redesign Initiative facilitated by the World Economic Forum. Leaders of nations are to various degrees engaged in redesigning mechanisms for international cooperation, from G20 to 3G (The Global Governance Group). Most global institutions from the UN to WTO and World Bank have project teams working on internal reform.

GLOBAL PROBLEM-SOLVERS

The world's mayors get together to swap experiences and use informal networks to collaborate on a wide range of issues including how we sustain ourselves and how we resolve conflicts. Cause entrepreneurs are experimenting with new organizational designs in service of making a dent on their issue (e.g., catalytic philanthropy approach of

Carbon War Room or Bill & Melinda Gates Foundation). Crowd-funding platforms like Kickstarter and IndieGoGo help fund projects of species-wide significance (e.g., building a space elevator or launching a telescope to track asteroids). There is plenty of room to join.

ORGANIZATIONAL DESIGN PIONEERS

The Long Now Foundation is working on an organizational design that would last long enough to keep a clock for 10,000 years—the nature of the challenge may be symbolic, but the organizational design could be applicable to many of the challenges on our list.



WHAT IF?...

...you were the one to break the mold and demonstrate the power of collaborative action in taking on a species-wide challenge? Or be part of setting up the HUMAN project or another organization with a similar goal? If not you, then who? It's just us humans.





BEYOND DEMOGRAPHICS

Welcome to the Planet of Bacteria. There are about 5 million trillion trillion of them. They've been around for 3 billion years. Their biomass exceeds that of all plants and animals combined. By bacterial standards, we humans have only just emerged and our population growth, relatively speaking, has been a tad unimpressive. Nevertheless, the expansion of our presence impresses a lot of us, and worries more of us.

In just a few million years, we multiplied our population 140,000 times and lengthened our life spans three and a half times, thus expanding both the breadth and depth of our presence. Back in the day, we were a small band of 50,000. We could all fit into the ancient Colosseum or a modern football stadium. As long as we were hunters and gatherers, our ecological niche acted as a straight-jacket on our total numbers. Until the invention of agriculture,

our total population probably never exceeded 15 million. Our average life expectancy was only 20 years. Our brains don't even fully develop until we are 25! In theory, people could have lived to an advanced age but in practice most human lives were cut short by high infant and maternal mortality, disease and homicide. The elderly were rare.

Today we are 7 billion and our average life expectancy has jumped to 70 years. It took us millions of years to become 1 billion, over a century to become 2 billion, and a mere 12 years to add our 7th billion. Some of us alive today have watched our population triple and life expectancy go up by several decades. The rate of population growth is slowing but we'll still add another 3 billion before potentially peaking at 10 billion later this century.



So it's not surprising that our current demographic discourse is dominated by the ever-present concern about overpopulation and a brand new concern about aging. How will we feed 3 billion more? How will we support a ballooning population of longer-living elderly? Some of us believe that our challenge is that we keep expanding our population. On a planet with finite resources! What we have to do is obvious: reign in the expansion, get to a population size our planet can support. That's a bit of a problem since our current estimates range from 1 billion to 1 trillion we tend to make wildly different assumptions about our life styles and technological ingenuity. Others believe our challenge is to prepare for the demographic shifts we know are

coming (population cluster-bombs in Africa, population bust in the developed world, aging everywhere) and find good technology and policy solutions. In other words, Houston, we have an innovation problem.

From the HUMAN perspective, this demographic frame is too narrow. We must place our current worries in a bigger context and start asking fundamental questions: For our species to survive and ascend, can we afford not to expand our presence? How long do we need to live for? Is biological birth and death of individuals essential or a biological "baggage" we must drop? What about our biological form? In other words, Houston, we have an existential problem.



WHAT'S AT STAKE? OUR PLACE IN THE UNIVERSE

Do we want to remain an Earth-based phenomenon or do we dare dream bigger? It's a false choice. To survive and ascend, we must expand beyond our home planet and face the fact that in our current form we are ill-fit for that expansion. We can barely last a minute outside of our Earth's atmosphere. Some think it's a good thing: Look at the mess we've already made of this planet, our species simply does not deserve to expand! We do tend to make a mess. But has learning at the edge of knowledge ever been possible without it? The fact that we are learning—even if we don't do it fast enough to some of our liking is cosmically significant.

Compared to cosmic and biological evolution, cultural learning is a faster

and more promising creative force. We already synthesize chemical elements, design materials and even life forms that wouldn't otherwise exist—and we are just warming up. Should we discover that we are neither alone nor particularly advanced, the unique quirks of our evolutionary path could prove to be valuable contributions to the diversity of the universal mind-pool. Perhaps the expansion of our existence would eventually lead to the emergence of a new kind of creative force. So we owe it to ourselves... and the universe.

How our generation thinks about demographics could make a big difference. If we manage our current phase of expansion well, we could have incredible strength in numbers and longevity. A connected, learning species of 10 billion who live to a 100 in good health could be a massive boost for our trajectory as a species. On the other hand, a half-hungry, half-connected warring species of 10 billion is a danger to itself. So far, our dystopian visions about overpopulation have been pulverized by our ability to create new

knowledge and technology. Adding more people and living longer has not slowed us down. On the contrary, we can speculate that more breadth and more depth have been part of a virtuous cycle: new knowledge and inventions made it possible to accommodate more people who lived longer which meant we had even more mind power to create new knowledge and technology to propel ourselves forward. Had our population stabilized back in 1950 at 2.5 billion with a life expectancy of 48 years, would we have enjoyed the same rate of scientific and technological progress?

Our good historical track record is of course no law of physics, it doesn't predictably carry into the future. It's not inconceivable that we could fail to manage our demographic transitions properly and dig ourselves into a dystopian hole of reduced standards of living, monumental environmental damage and an inter-generational feud. It may take a while to dig ourselves out. But it's really up to us to make sure that's not how it goes.



ULTIMATE GOAL COSMIC CULTURE

So how should we think about our place in the universe? Clearly, it is not our energy-gobbling biomass per se that we should be scattering throughout space and time. Unlike bacteria, we can be somewhat more discerning.

Although some of us appear to be quite fond of our bodies, it's the minds that inhabit our bodies that differentiate our way of being and give rise to creative ideas. So perhaps what we should be aiming to expand is our creative capacity, the reach and depth of our idea-generating minds. Imagine our entire universe infused with creativity that can trace its humble origins to a few billion human beings from planet Earth.

Imagine we become part of a Cosmic Culture, a creative force that shapes the life cycle of our universe, or perhaps of all existence.

An analogy from biological evolution could be helpful: just like RNA was a step on the evolutionary path toward the emergence of DNA, a template that allows life to replicate itself before the end of an individual life cycle, our minds could become the seeds of a template for Cosmic Culture... that leads to the replication of our universe. We can imagine it—so maybe we could make it so.

It won't be easy. For starters, we'd need to square away the matter of our physical form and figure out whether we should be expanding into outer or inner space.

Our reliance on the perishable biological form could prove to be but a brief phase in our evolution as a species. We might start by making changes within our existing biological framework to further extend our lifespans and to understand how our biological form gives rise to our imagination. Then one day we would have sufficient knowledge to liberate our minds from the confines of our current biological bodies and open the doors to new, more adaptable and resilient ways to embody ourselves. New forms would make it possible for us to consider different expansion strategies.

So where should we go? Outer space tends to be our default answer. We imagine a space-faring civilization that excels at cosmic scale engineering, learns to harness the energy of entire stars and eventually entire galaxies, invents a way to travel at the speed of light and eventually masters some form of time travel. But some of us have pointed out that we could conceivably head in a completely different direction: There is plenty of space inside, too. We have 25 orders of magnitude between atomic size and the Planck scale to explore! Just as we've been cramming



an exponentially increasing number of transistors into our computer chips, we could compress ourselves into smaller and smaller scales of space. We could become a STEM (space, time, energy, matter) compressing civilization that excels at subatomic scale engineering and eventually compresses itself into a black hole like entity.

It is hard to believe that the emergence of biological and cultural evolution on Earth is a universal one-off. What if there are millions, perhaps billions of other creative civilizations? They would be subject to the same laws of physics, so they would probably be exploring similar options for expanding their presence. What if eventually we meet, be it through our adventures in outer space or through the mergers of black holes of our creation in inner space? What if by combining our knowledge, we would be able to re-engineer our cosmic scheme of existence or re-start our dying universe from the depth of inner space? Dream big or stay home!



2050 MILESTONES

Our tag line for the next 40 years could be "Dream big but don't drop the ball on our short-term challenges!" We need to make sure we negotiate the demographic shifts already under way while developing a moral, scientific and technological foundation for the continued expansion of our presence.

THE POPULATION-KNOWLEDGE EQUATION

We need to do away with our several hundred year old mental model that pits population growth against an inventory of finite physical resources and environmental destruction. We would have a better grasp of our predicament and make better decisions if we shifted to a more sophisticated equation: Our population is the demand side. The carrying capacity of our knowledge is the supply side. The basic question we should be asking is whether our current knowledge allows us to provide everyone with the standard of living we would like to have. When the answer is no. we must treat it as a missing knowledge problem rather than a population problem and channel our energy into creating the knowledge we need. By 2050, we should be able to look back and celebrate another 40 years of having solved this equation well.

HEALTHY 150

No human in recorded history has ever lived to be 150. Our current record is 122 years. Extending our life spans to 150 years of fine health would be a great milestone on our way to creating indefinite life spans. That's a feat that would require a whole lot more

than merely removing all the remaining causes that cut our maximum life spans short. We will need both, technological modifications in the inner-workings of our bodies as well as an ethical framework for sharing the benefits of our life extending technologies. So who of us alive today will be celebrating her 150th birthday in 2050?

FOUNDATIONS OF POST-BIOLOGICAL CULTURE

Imagine a learning culture that's unburdened by our biological baggage, uninterrupted by individual death. Creating indefinite life spans in our current biological bodies, let alone creating substrate-independent minds is a monumental task and a life-changing transition for our species. The development of the moral framework for such a transition should always be a few steps ahead of the development of our technologies. By 2050 the case for post-biological culture should be a matter of active public discourse and we should have a couple of major scientific and technological notches on our belts—a successful whole brain emulation, indefinite extension of life spans in a simple life form.



THE MALTHUSIAN SPELL

Our current discourse on population rages on under a strong Malthusian spell. Many of us would find the very suggestion that our challenge is to expand our presence rather irksome, if not altogether irresponsible.

The fact that our total population growth rate peaked back in the 1960s at 2% and is now down to 1% is largely regarded as a good thing. In several developed countries populations are now shrinking. The remaining clusters of population growth tend to be in places that are least equipped to cope. Slowing down population growth in the least developed countries continues to be a priority: the UN, thousands of NGOs and local governments are working hard to

accomplish just that through educating girls and providing easy access to family planning. However, our biggest challenge is to crack the supply side of the equation: we need another agricultural revolution and a step-change in our renewable energy and desalination capabilities. Without the Population-Knowledge Equation it is hard to gauge if the current rate of our technological progress is adequate to meet the needs of 10 billion.

Aging is now a big topic. In the next four decades the share of those who are 60 plus will rise from the historical 8-10% to 22%, a jump from 800 million to 2 billion. Only half a billion would be living in the developed countries. Despite an upbeat frame on global aging from the World Health Organization ("Active Aging: A Policy Framework" report, 2002) our public discourse on aging is tinged by the Malthusian fears too—dystopian visions of economies crippled by the tsunami of pension and healthcare costs abound. Fortunately, those of us approaching our 60s are

increasingly able to stay active longer. In the developed world, some are pursuing new careers, starting new businesses and even taking new degrees. Although the few governments that attempted to raise the legal retirement age were not received with welcoming cheers.

The moral foundations and theoretical research for post-biological culture is still largely an esoteric quest pursued by a handful of dedicated pioneers. Most of us are happy to live a few years longer but struggle with the idea of indefinite life spans in our current bodies, let alone considering existence in another physical form. But then again, it would be foolish to expect that we can drop a million year old habit of thinking that easily.

POPULATION-KNOWLEDGE EQUATION

HEALTHY 150

FOUNDATIONS OF POST-BIOLOGICAL CULTURE



WHO IS ALREADY ON THE CASE?

PEOPLE: ~ALL OF US

FUNDING: ~\$6.5 TRILLION GLOBAL EXPENDITURE

FOR HEALTH, 2011

ALL OF US

None of us get to choose when we are born, but most of us have varying degrees of influence over how many kids we have and how long we will live for. Our choices add up to our demographics.

UNITED NATIONS & NATIONAL GOVERNMENTS

Most governments with a few notable exceptions like China and India have been gently adapting to rather than strong-handedly shaping their "demographic destiny". Several governments with declining populations are now in the business of trying to nudge their birth rates upwards. As the oldest society that has ever lived, Japan is leading the way in figuring out how to make it work. The lion share of the international effort in the UN system is focused on defusing "population cluster bombs" in developing countries.

PHARMA INDUSTRY & HEALTHCARE SECTOR

None of us want to be sick and few would say no to a few extra years of good health—so healthcare is a big field already employing more than 60 million health workers globally, with an estimated shortage of about 5 million. The philosophical foundations of the entire enterprise as well as research funding are still heavily skewed toward curing disease rather than preventative health, rejuvenation and reversal of aging.

PIONEERS AT THE POST-BIOLOGICAL FRONTIER

As often is the case with pioneers, there is only a handful—a few moral philosophers (e.g., Nick Bostrom), theoretical gerontologists (e.g., Aubrey de Grey), neuroscientists (e.g., Randal Koene), Artificial Intelligence researchers (e.g., Ben Goertzel) and the broader community of cosmologists and futurists.

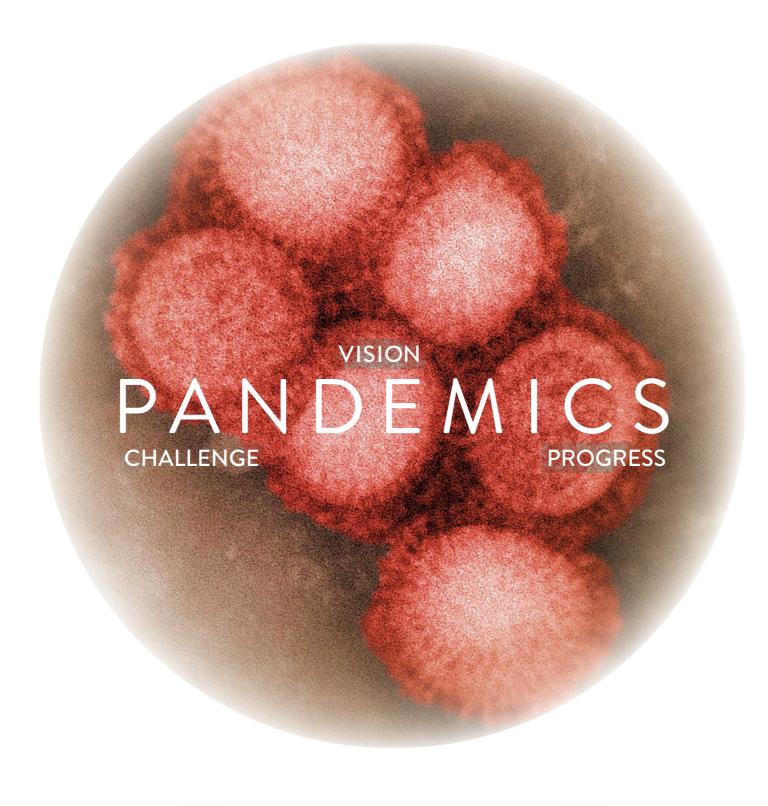


WHAT IF?...

...we banished the Malthusian spell?

It may be harder than it looks. In fact, Malthus' postulations at the end of the 18th century were but a modern manifestation of an ancient concern. Already Plato and Aristotle worried about over-population. In the 2nd century when our total population was not even 200 million, a prominent author Tertullian opined: "What most frequently meets our view (and occasions complaint) is our teeming population. Our numbers are burdensome to the world, which can hardly support us... In very deed, pestilence, and famine, and wars, and earthquakes have to be regarded as a remedy for nations, as the means of pruning the luxuriance of the human race." Some of us today would still nod in agreement.

So this is an ancient and powerful spell that requires serious mind-power! How can we discredit the ideathat population growth inevitably spells our demise by "misery and vice"? How can we introduce some form of Population-Knowledge Equation, or some cleverer version of the idea that continued expansion of our knowledge can enable a continued expansion of our population? Meme designers around the world, consider this your call to action!





THINK SPECIES-WIDE HEALTH SECURITY

In the story of life on Earth, bacteria and viruses are the old timers. They've been around for billions of years. Although we humans are far more complex, more sophisticated creatures, these invisibly small and resilient buggers can still spell real trouble for us as a species.

Pandemics are outbreaks of bacterial or viral infection for which we have no immunity. They spread like wildfire all around the world. Today many of us think of pandemics as a matter of national or personal health security, but from the HUMAN perspective it's a matter of species-wide health security.

Few of us alive today have a vivid cultural memory of the devastation a pandemic can leave in its wake, so it's important to get a sense of what we're up against. Let's take the Bubonic Plague, a bacterial infection we picked up from fleas, and the Spanish Flu, a viral infection we picked up from pigs.

Many of us think that the Bubonic Plague of the 14th century was a purely European affair. Nothing could be further from the truth. The Plague killed humans throughout Asia, Europe, and the Middle East. The death toll was between 75 and 100 million—nearly a third of all humans alive at that time. Imagine a third of humans alive today— 2.3 billion people. Now imagine them dead. It's intense.

We think the Plague started in Central Asia before it traveled west to Constantinople. From there it moved North and South at the same time. Through Alexandria to the Middle EastPalestine, Lebanon, Syria, Iraq, Yemen, Mecca. About the same time, the Plague swept Europe. Fevers. Lymph nodes swelling into buboes the size of eggs in the neck, groin and armpits. Vomiting blood. Skin blackening with gangrene. The victims were not just those who died that violent death. Those who survived feared that the apocalypse was near, or worse, that it had already come and they were left to live in its aftermath.

Here's an eye witness account: "And they died by the hundreds, both day and night and all were thrown in those ditches and covered with Earth. And as soon as those ditches were filled, more were dug. I... buried my five children with my own hands... And so many died that all believed it was the end of the world." Not good.

The 1918–1919 Pandemic Flu was just as deadly. It killed 50 to 100 million. It infected 550 million humans or nearly



one-third of the world's population. It was most deadly for people in their prime—the strong, the young. An Army private at Fort Riley in Kansas (U.S.) reported to the camp hospital before breakfast on March 11th, 1918. He was sick. A minute later, another soldier. By noon the hospital had over a hundred cases. A week later, 500. Then they shipped the soldiers off to battle in Europe. It exploded: Europe, Asia, Africa, South America. People fell sick just by breathing. That was part of the horror: everyone has to breathe.

As it spread, it mutated into a more virulent strain. Raging fevers. Nose bleeds. Faces turning blue. Hideous coughing. The cause of death? The lungs filled with fluid. The victims drowned. "There were so many people dying that you ran out of things that you'd never considered running out of before—caskets."

Planet Earth is a petri-dish where bacteria and viruses have been evolving for billions of years. So far there is nothing to stop them. Many viruses that are deadly to humans come from animals—SARS came from bats, HIV / AIDS came from monkeys, H5N1 came from birds. Although it may be counterintuitive to most city dwellers, today more of us hunt wild animals than ever before. In Africa alone we hunted and ate 700 million wild animals in 2009. As hunters carry and prepare their kill, they

are exposed to new viruses. And, as more of us raise and live next to chickens, pigs and cattle, it's becoming an ongoing virus exchange at a whole new scale. One or two unfortunate genetic mutations and millions, perhaps billions, of human lives are on the line.

Then there is the revival of the old. There are a few infectious bacteria that are developing antibiotic resistance (e.g., tuberculosis and "staph infections"). None of them yet classify for pandemic status, but that does not mean that it's inconceivable. Drug resistance is in some ways inevitable, it's biological evolution at work.



WHAT'S AT STAKE? LIVES AND LIVING

So what could it be like if a pandemic struck today?

There are more of us. We live in an interconnected world. An outbreak is a single plane or train ride away. It would be in every corner of the world within months.

Current influenza pandemic scenarios predict single-digit million to 150 million deaths. By comparison, World Wars I and II put together took 67 million human lives. We would likely be able to develop vaccines or antibiotics faster than ever, but we still couldn't scale treatment to the species.

The rumors and misinformation would likely be staggering. Fear has big eyes. Humans would be afraid to talk to one another because fellow humans are the

threat. That's a big community killer. It would wear down social togetherness, which is required for us to function. Hysteria, scapegoating, and looting could easily make an appearance, especially when people don't have access to medication.

The exchange of goods and services around the world would slow way down, as would human travel. Borders would tighten up. Some might close completely. There would be fewer people to work because some would die and many more would not show up for work because they were sick or afraid of becoming sick. To put some numbers on it: global output could shrink up to 15% in the first year alone; developing countries would be hit hardest—some speculating that their economies would shrink by half in the first year.



ULTIMATE GOAL BIOLOGICAL DEFENSE

Containment may seem like a good ultimate goal for dealing with pandemics. Unfortunately, in today's interconnected world, full containment might not even be possible. We've seen the movies—that one guy who doesn't know that he is sick walks into a pharmacy to get some aspirin and bumps into a woman at the entrance. He coughs on his hand as he passes the money to the pharmacist right before he collects his aspirin and catches a cab to get on a plane. And off we go. We could and should take containment to the limit, but if we only focus on containment our ultimate defense is shutting down borders.

There is plenty we can do before it gets to that. By moving closer to the source, we could prevent outbreaks in the first place. But should we stop there... for all eternity?

This is a grand battle between biological and cultural evolution. What if we could end it? Let's figure out the biological script so well that we declare that battle over.

We need an explanation of life on both sides of the equation. On the bacterial and viral side, we need explanations that can predict how different life forms will evolve and which interventions will prevent the more deadly expressions. On the human side, we need an explanation of how immunity works. Curiously, it just might rely on the 5 hundred trillion bacteria that already live inside the human body.

We might learn to prevent mutations for which we have limited immunity or we might learn to redesign human immunity altogether. That way when new bacterial or viral threats emerge we are one step ahead of them. Explanatory knowledge of life is our best immunity. It's the ultimate biological defense.



2050 MILESTONES

Explanatory knowledge of life may be a long way off. If we've learned anything from our study of the human genome, it's that life is vastly more sophisticated and complex than most of us thought. Knowing every single letter in the genetic alphabet isn't sufficient to speak the language. We are at the starting linet, not the finish line, and this might be a marathon without an end. So while we are pursuing a coherent explanation of life, we need to make sure that we don't get sideswiped by a pandemic that stalls our development or throws us back.

CONTAINMENT AT THE SOURCE

We need to monitor all the hotspots where humans come into contact with wild and domesticated animals to detect bacteria and viruses as they move from animals into human populations and stop them before they mutate and become human-to-human transmissible. The Global Viral Forecasting Initiative is doing just that in 23 countries, but we need more. Think: all hotspots reporting to an open–source map.

REAL-TIME SURVEILLANCE

If we don't catch it at the source, we need to move at the speed of contagion. The World Health Organization has a surveillance and response network in place, but they must go through official government channels first, and that's just too slow. We need almost faster than real-time surveillance. The Global Public Health Intelligence Network is a promising model. It trolls the internet looking for early warning signs—from word searches to newspaper reports—of potential outbreaks. They

spotted SARS three months before WHO officially identified it. A service like this should be open, free, in every language, and anyone should be able to submit an alert from a mobile phone.

SPECIES-WIDE COVERAGE

We need a plan with species-wide coverage. Speed in creating and distributing a vaccine is everything. You're not covered if the vaccine arrives when you're dead. We need a global network of template banks that keep a library of synthetically constructed templates ready to go into production the instant a new live strain is identified.

LIFE EXPLAINED

We may not have a full explanatory model by 2050 because we don't know what we don't know. But we will have created new knowledge as a result of our pursuit.



SUSCEPTIBLE

We are not covered.

We are monitoring hotspots where viruses can leap from animals to humans, but only in 23 countries. We do have a global surveillance and response network, thanks to the World Health Organization, but it relies on the capabilities and integrity of government officials in member countries. Reporting a national outbreak can be perceived by some officials as reporting a national failure that could undermine national reputation and stop the inflow of tourists or the outflow of goods and services. Nearly all countries have pandemic preparedness plans, but many

developing countries cannot yet execute on them without WHO's help.

Were an outbreak to happen, most of us would have to go without a vaccine. To supply enough vaccine to immunize the world's population in a pandemic would likely take four years. We can stockpile antivirals but they may not be effective on new strains. Every year WHO identifies new strains through its influenza virus exchange and works with manufacturers and regulatory agencies to develop vaccines and antivirals.

Furthermore, most countries—developing and developed—don't have "surge" capacity. We don't have enough trained medical staff; we don't have enough hospitals; we don't have enough beds.

When it comes to our ultimate defense, the explanatory model of life is under construction, but it is under construction in fragments. CONTAINMENT AT THE SOURCE

REAL-TIME SURVEILLANCE

SPECIES-WIDE COVERAGE

LIFE EXPLAINED



WHO IS ALREADY ON THE CASE?

PEOPLE: ~HUNDREDS OF THOUSANDS **FUNDING:** ~BILLIONS

THE WORLD HEALTH ORGANIZATION (WHO)

The World Health Organization (WHO) is where we coordinate as a species on all things pandemic. Through WHO's network of member states we track the movement of viruses globally, share strains so that we can all study them, pinpoint lethal strains, and warn when there is an outbreak. WHO also stockpiles antivirals and vaccines should the worse come to pass, but not nearly enough for all of us.

NATIONAL HEALTH CARE SYSTEMS

National health care systems (e.g., centers for disease control, ministries of health, national health services, research labs, universities, public and private hospitals) both coordinate with WHO and run their own deal. They identify strains, support or conduct research of their own including developing vaccines, and negotiate with drug companies to manufacture them.

PHARMACEUTICAL INDUSTRY

The pharmaceutical industry researches, develops and manufactures vaccines, antivirals and antibiotics.

PRIVATELY & PUBLICLY FUNDED INITIATIVES

Some privately and publicly funded initiatives conceived at a species-wide scale are stepping in to monitor hotspots where viruses are crossing the animal to human barrier (e.g., Global Viral Forecasting Initiative funded by Google and Skoll Foundation; The Global Public Health Intelligence Network funded by the Public Health Agency of Canada).



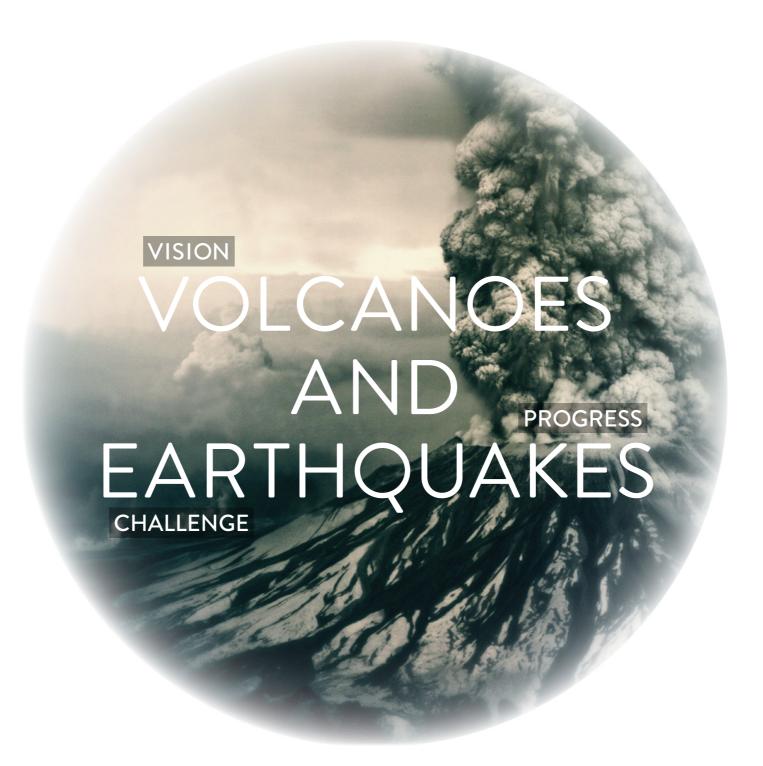
WHAT IF?...

... species-wide health security became everyone's business, not just the responsibility of our border challenged governments?

Global containment and real-time surveillance require borderless thinking. We need more minds with allegiance to the species, not to national governments: biologists to man the hotspots all over the world; hackers to code a single, open surveillance platform; philanthropists big and small to fund them.

... we created a CERN for biology?

CERN is one of the world's largest centers for research in fundamental physics. It has become a magnet for the world's physicists working to figure out what the universe is made of and how it works. They're drawn together because nations have to pool their research dollars to afford the multibillion dollar particle collider. The world's biologists may not need a collider, but they do need a magnet. Perhaps a shared challenge to come up with an explanatory model of life by 2050 could become the unifying force?





SOLUBLE PROBLEMS, NOT ACTS OF NATURE

The Earth's crust—the very ground we stand and build on—is moving around. For us humans, the earth moving and shaking and magma blowing through the crust is a considerable problem. Today we tend to think of volcanic eruptions, earthquakes, and the resulting tsunamis as acts of nature, givens, even fate... something we can't do anything about. From the HUMAN perspective, acts of nature is just another category of challenges for us to take on.

SUPERVOLCANIC ERUPTIONS. The difference between a supervolcanic eruption and an average eruption is the difference between shooting a gun and throwing a bullet—the former packs

a way bigger punch. Supervolcanic eruptions are hundreds of times larger than most volcanic eruptions.

They all start way down deep. The heat, largely produced from the radioactive decay of elements in the Earth's core, starts to melt the mantle rocks above. When it gets hot enough and the pressure is on, they turn into magma—a mix of molten rock, suspended crystals, dissolved gases and gas bubbles. If there is structural space to move, that magma rises toward the surface. When it pushes toward the Earth's crust but is unable to break through, pressure builds in a growing magma pool—actually, it's more like a magma lake. When the crust can no longer contain it—ready, set, blow.

It's difficult for most of us to get our minds around the the size of eruption we're talking about, so let's revisit a big blow from our past. Were our ancestors able to record their experience, it would have read like a horror story. Roughly 74,000 years ago, on the Indonesian

island of Sumatra, in a place known as Lake Toba, scalding hot lava, deadly gases, and volcanic ash blew through the Earth's crust—2,800 km³ of ejecta to be exact, containing enough lava to bury Manhattan in a layer more than 1 km deep. The pyroclastic flow, a fast moving current of superheated gas, traveled about 400 km per hour and covered an area double the size of Manhattan. Those flows were hot enough to incinerate any living thing in their path. The eruption alone destroyed 20,000 km² of the surrounding area. That's twice the size of Los Angeles—gone. Ash blanketed most of Southeast Asia, reaching as far west as the Arabian Sea and as far north as Southern China. On the eastern coast of India ash piled 1 – 6 meters high. Animals were poisoned from eating it. People struggled to breath. Plant life was suffocated. And then the winter came and stayed for 6 –10 years. Ash and gaseous aerosols blocked sunlight. The temperature dropped 1 to 5°C in lower latitudes and 15°C in higher ones. Many think that this volcanic winter caused



the big coinciding population drop—we were reduced to fewer than 10,000 humans and potentially only 1,000 reproducing women. Our species came close to an end.A considerable problem indeed.

Fortunately, super-eruptions appear to be very infrequent, potentially because it takes a "perfect storm" to create them: a huge magma chamber and a long time to grow an enormous lake of magma. Unfortunately, since one has not taken place in recent times, we have few observations on which to base predictions. We have identified more

than 20 super-eruption sites that have been active over the last 2 million years. We suspect there are more. We have no evidence to suggest that one will not blow again. And again.

MEGA EARTHQUAKES. The ground we stand on is far from static. When our planet formed 4.5 billion years ago it was a hot and gnarly place. Much of the Earth was molten—it was being bombarded all the time and in near constant volcanic activity. As the bombardment mellowed out and Earth cooled down, crust began to form. Fast forward a few billion years and that hot and tumultuous world is still very much alive right beneath the relatively thin surface we stand and build on. The mantle churns. The churning moves the crust. That crust is cracked into pieces, tectonic plates. These plates push into, over, under, and along side each other. When they collide, they push up mountains. When they pull apart,

valleys open or they split off into new continents. When one plate is pushed beneath the other, the pressure and friction melt the descending crust. In all cases the Earth quakes.

To get a sense of how destructive quakes can be, consider the one that rocked Shaanxi, China in 1556. Although there are stronger quakes on record, it was the deadliest. It killed 830,000 humans—crushed in collapsed caves and buildings, fallen through the cracks in the ground. In some places the ground suddenly jumped up and formed hills. In others it fell meters creating valleys. 20 meter deep crevices opened in the ground; water burst out and formed canals. Landslides everywhere. There were spots where the ground liquefied. Imagine standing on solid ground. Now imagine that ground turning to liquid. That's a serious problem.



WHAT'S AT STAKE? SHAKY GROUND

Unless we learn to solve the problems posed by volcanic eruptions and earthquakes, we'll live on shaky ground for the remaining time that we can stay on Earth. Our existence will continue to be punctuated by violent outbursts that threaten the survival of our species and destructive quakes that can really set us back.

SUPERVOLCANIC ERUPTIONS. What would be at stake were we to get a Toba-size blow today? The topline: it would not be one awful catastrophe, it would be a series of them. First the pyroclastic flow would pretty much instantly incinerate the surrounding area, including humans. That surrounding

area could be thousands if not tens of thousands of square kilometers. If it were Toba, for example, millions of people could be incinerated. Within hours. And we may not know what hit us at first. Was that a bomb? Is this war? Will there be retaliation? Against whom? How many are dead? Is there more to come?

Next, if an eruption were to cause a massive collapse of a volcanic flank into the ocean, a mega-tsunami would roll. Even though it's not a supervolcano, just to give you an example of the potential size of the kind of tsunami we're talking about, were the Cumbre Vieja volcano in the Canary Islands to lose its flank in one go, computer modeling suggests that the initial wave could be as high as 600 meters and travel 1,000 km per hour. By comparison the 2004 Indonesian tsunami was only 30 meters high. That wave would hit the African coast in an hour, the southern coast of England in less than 4, the eastern seaboard of North America in 6 at a height of about 30 - 60 meters. With or

without a tsunami, the immediate impact of a supereruption is in and of itself horrifying, yet it's the aftermath that should give rise to a species-wide panic.

A lot of ash would fall, killing crops and plants. Depending on where the volcano blew and where ash fell, it could do more than kill regional crops, it could disrupt the global food supply. If it were Yellowstone, for example, kiss the North American breadbasket goodbye. Mounting a rescue or getting food to the worst hit areas would be a near mission impossible because ash clogs engines air and ground travel would grind to a halt. Within the ash radius there would likely be mass starvation. Ash covered refugees, desperate and disoriented, would more than likely walk on foot in the hopes of finding their way out.

The bigger problem for the species would be the ash and gaseous aerosols that do not fall, but stay in the stratosphere and block sunlight. A decade long winter would set in.



Diminished sunlight would make growing food a real struggle. Our current global grain stocks would only last us all about 100 days. Dividing it up could get really ugly. Expect wide-spread starvation.

Fortunately, we have far more knowledge and technology than we did 74,000 years ago. We would move food production indoors, but even with our best efforts and funding it would be subscale for at least a year. By that time we would stop counting our dead and start counting our survivors. Given human ingenuity, the species would likely pull through, but civilization as we know it would take a serious beating.

MEGA-EARTHQUAKES. Since our earliest recordings in 856, about 5 million humans have lost their lives to earthquakes. Even though this number represents only .0046% of all the humans that have ever lived, quakes pose a recurring problem for our species. Although many of us do not think that these isolated events could change our trajectory, think again.

For at least the last three billion years, the landmasses of Earth have gone through cycles of forming supercontinents, breaking apart and then getting back together. First there was the supercontinent Vaalbara (3.6 billion years ago), then Kenorland (2.7 BYA), followed by Columbia (1.8 - 1.5 BYA), Rodinia (1.1B – 750 MYA), Pannotia (600 MYA), and Pangea (300 – 100 MYA). The movement kept changing up the distribution of land and water, raised and lowered sea levels, tweaked planetary albedo, and redirected currents in the ocean and atmosphere. They all had a decided impact on climate. And we

haven't stopped moving yet.

Some of us say in 250 million years the Atlantic Ocean will disappear and the Americas will slam into a united Euro-Africa. Others say the Pacific will disappear and the Americas will slam into Asia. The point is not precisely where all the landmasses will be, but rather that land is on the move. Aside from climatic impacts there will likely be some seriously violent shakings along the way, potentially in many places along a fault at once. And even though some of us struggle to imagine that events within a single nation can impact our trajectory, the 2011 earthquake in Japan should give us pause. It triggered a tsunami, which triggered a triple nuclear meltdown and a near melt through (when nuclear fuel melts through all containment vessels and burns into the ground and water table). Contamination can spread beyond borders, as can fears about the safety of an energy source, potentially changing our energy mix globally for decades to come.



MASTERY OF GEOLOGY

Ultimately, we must become geoengineers. Here's what we think it should mean in practice: we grasp how planets form and evolve; we can explain how the physical forces are playing out in relationship to one another on any given rock (Earth or elsewhere) in any given moment; we know why; we know what; we know how; we know when; and we know how to intervene. Each time we do, we grow ever wiser, learning to make subtler and subtler mistakes. We might learn to stop predicting volcanic eruptions and earthquakes and start scheduling them. We might learn to set the optimal rate of energy release from our Earth's core. It all depends on the knowledge we create and how we decide to apply it.

Today there are two strains of ideas in the global public discourse that stand in conflict with a vision of geo-intervention. According to the *it is too sacred* idea, this planet and the forces that created it are far more pure than us and must not be soiled by human intervention. Then there is the *it is too complex* idea—we live on a complex dynamic planet, systems upon systems of unforeseen interrelationships, interdependencies, feedback loops and tipping points. We are too ignorant to intervene without causing bigger problems than the ones we seek to solve.

From the HUMAN perspective, both of these ideas lead us down a blind alley—a dead end—because both, to varying degrees, uphold stasis. In an everevolving world in which we continually discover problems, stasis is our assured demise.

But what about those geological situations in which some of us suspect that the risks might outweigh the benefits? Shouldn't we then apply the precautionary principle and require proof that it is not harmful before taking action? We must weigh the science and ethics of special cases, no doubt about it. But buyer beware—the precautionary principle casts its own dark shadow and carries often unacknowledged dangers. Specifically, who might die or suffer alive or as yet unborn—due to our failure to tackle volcanoes and earthquakes? More generally, what risks do we face as a species if we fail to create new knowledge and improve our abilities to respond?

In most cases, progress—the pursuit of new knowledge and its application—is the greatest precaution we can take as a species.



2050 MILESTONES

In the next 40 years we need to study our world in a new way, look through an additional lens.

Geophysics is not just about studying what is and trying to predict what will be; it's also about imagining what should be. And geophysicists are not just detached observers and dispassionate describers; they are also designers engineering a safer planet for all life.

PRE-VENT

When it comes to supervolcanic eruptions, warning and evacuation can save lives within the blast and ash radius but will not stave off a decade-long, planet-wide winter. We need more than prediction. We need prevention. If we can learn to vent geothermal pressure in a controlled manner, we might be able to avert a blow. It will not be easy or without risk. Let's start by developing proposals and trying our hand on smaller, isolated volcanoes. Even though their size and structure are different, we likely can learn a great deal. By 2050 we have experimented on three and have conceptual prototypes for how to approach a big one.

OUT-FLANK

We need to do more than understand the structure and composition of volcanic flanks that can tumble into the ocean and push out deadly waves. We need to remove or reengineer them. Let's start with smaller flanks in isolated areas to see what we can learn. By 2050 we have reengineered the flanks of two small volcanoes and have conceptual prototypes about how

to reshape a big one. This is a risky and epic engineering project, but controlled experiments and potentially even scheduled evacuations will likely be better than waiting for an awful surprise.

WINTER-PROOF OUR PLANET

Even if we pre-vent and outflank by 2050, we could still get beaten back by a big blow in the meantime. We need a network of indoor vertical farms powered by artificial light so that we can mass produce food indoors. Should there be a super-volcanic eruption and subsequent winter, we would not be entirely dependent on the sun to grow food.

UNIFIED EXPLANATION OF MOTION

To help nail down the prediction game and keep getting better at intervening, we'll need to spell out the underlying physical processes that drive the movements of the plates and give rise to eruptions and quakes—all the driving forces and their relative contribution.



STILL REACTING

Today most of us—even geophysicists—assume that volcanoes and earthquakes are inevitable. At our worst, we'll get surprised and clobbered. At our best, we'll predict and evacuate. In other words, the best we can do is react. The idea that we should prevent them is almost entirely absent from the global public discourse. So it's not altogether surprising that we have few ideas and proposals, let alone experiments, for how to prevent eruptions, reengineer flanks, or relieve stress along fault lines.

Of course we are studying—each year we monitor and analyze more volcanoes and earthquakes with greater precision. Starting in the late 90s, we began to drill down into volcanoes and active faults

and chemical structures and processes. We've even accidentally tapped magma a few times and seen some live action. In 2012 an international collaboration began drilling into Campi Flegrei, a large, active volcano in Italy in the hopes of learning more about larger volcanoes. And we are identifying and recording the structure and composition of some volcanic flanks. But so far we largely frame our efforts as studying to predict. We don't yet seem to have prevention in mind.

Given that our focus tends to be on what to do once the inevitable has already struck, it's somewhat surprising that we are not at all prepared for a volcanic winter. The good news is that the glasshouse industry has more than a century's experience growing large crops indoors. We know how to tailor temperature, humidity, lighting, airflow and nutrient conditions to grow food year round, anywhere in the world. The bad news is that almost all of these solutions are predicated on natural

light (except for an outfit in Antarctica). Natural light would not be available in a volcanic winter. Indoor lighting—still prohibitively expensive—is a big hang up.

As for a unified explanation, we know the plates are moving. We think we know all of the forces driving that movement (e.g., convection, gravity, the Earth's rotation), but we don't yet have a good enough grasp of the role each of these forces plays and how they interact. A group of geologists is currently planning to drill 6 km beneath the seafloor to reach the Earth's mantle to better understand what it's made of and how it works. Provided they get funded, we could see our first samples in the early 2020s. It's a big step in the right direction.

PRE-VENT

OUT-FLANK

WINTER-PROOF OUR PLANET

UNIFIED EXPLANATION OF MOTION



WHO IS ALREADY ON THE CASE?

PEOPLE: ~TENS OF THOUSANDS **FUNDING:** ~TENS OF BILLIONS

SCIENTIFIC STUDY & WARNING SYSTEMS

International organizations and associations like the International Union of Geodesy and Geophysics, and the World Organization of Volcano Observatories coordinate how we monitor hot spots and how we generate warnings in the event of a big blow or quake. They often set research agendas, conduct research and experiments and publish results. But they do something more: they connect scientists around the world and get them talking and sharing ideas and data.

Most countries run a national Geological Survey focused on the geology of their country. But since few volcanoes and earthquakes respect national borders, a number of nations like the US and Japan study more than just national events, they study the world. Even if it is in service of national protection, programs like the US Geological Survey and the Geological Survey of Japan are advancing the frontier of our knowledge.

GEO-ENGINEERING

No one.

For our take on climate engineering, SEE: CHANGING CLIMATE.



WHAT IF?...

...we pooled some of the currently existing research dollars from national programs around the world to create a 5,000 person strong geo dream team—geophysicists, geologists, engineers and ethicists?

Together they could develop conceptual prototypes, select a site and begin experimenting on a relatively small and isolated volcano. A new generation of participatory-minded programmers could create a central sharing site for insights and lessons learned. A geological Facebook of sorts with rock-solid knowledge sharing functionality.





THE PROBLEM OF UPS AND DOWNS

When most of us think of climate change we tend to think of the latest round of warming caused by pumping greenhouse gases into our atmosphere. We then frame the challenge as reducing atmospheric CO₂ levels to what they were a hundred years ago. From the HUMAN perspective, this challenge is much, much bigger: How will we deal with wildly fluctuating climate during our stay on Earth? How will we learn to actively design climate that works for all life both here on Earth and beyond? To explain our view, let's start at the beginning and work our way to the end.

Climate, like everything else in our cosmos, has not and will not stand still. For starters, for the first half a billion years our planet was a molten fire ball, constantly getting slammed by other celestial bodies and in a perpetual state of volcanic activity. It was quite a climate. As the bombardment tapered off, the planet cooled. And then, starting about 2.5 billion years ago, our climate began to alternate between warmer and colder periods. So much so that looking at a chart of the history of Earth's temperature is like reading an EKG: up, down, up, down, up, down, up, down. There have been at least five major ice ages. During the most severe one—from about 850 to 630 million years ago ice sheets reached all the way to the equator. Our pale blue dot looked more like a white snowball. Within these ice ages, there were more mild and more severe periods, sometimes around the whole world, sometimes in just a

hemisphere, and sometimes in only a region. But outside of these ages the Earth seems to have been relatively ice free, even in higher latitudes. So we've gone from almost no ice to a lot of ice and almost everything in between many times over.

Occasionally, really abrupt changes have also happened. Just as an example, about 12,800 years ago the Northern Hemisphere was gripped by a serious cold spell—the "Big Freeze"—one that came on within just a year or two. Some parts of the Northern Hemisphere may have cooled as much as 15°C and the freeze lasted for about 1,300 years.

Now we're in an interglacial period, which means we're in a relatively short warm spell in the middle of a longer Ice Age. We've been in this state for about 11,500 years. The absence of more serious ice and our ideas about how to



take advantage of warmer conditions—starting with agriculture—helped us humans survive and multiply. It's easy to understand how a species that began its ascent in such relatively good conditions could think that this fair weather is forever. But this period, like all others, will end. We know that it will change.

Right now we know that pumping greenhouse gases into the atmosphere is heating things up. That's just basic physics. We know what to do to stop the heating. Clearly we're struggling to take action in time and on an appropriate scale, but at least we understand the underlying cause (greenhouse gas emissions) and therefore know what the solution is (stop emitting them).

But what are our climatic solutions to the next 10 million year Ice Age? How will we manage all of the climatic ups and downs for the remaining billion years that we have on our planet before the sun grows so bright and hot that it begins to cook all Earth-based life? Will we take advantage of this period of relatively fortunate climate to learn all that drives it so that we can continue to design suitable climate for all life when the good fortune ends and nature takes its course?



WHAT'S AT STAKE? TOO HOT, TOO COLD So far our development has been closely linked with our climate. Changes in temperature, the growing season, the level of the sea and rainfall will not only change habitats and affect species that live within them, it will also likely change where we humans can and cannot live, how many of us we can feed and who will have water and who will go without.

Right now man-made warming looks poised to really disrupt our way of life, put human lives at stake and accelerate species extinction. We have begun the new energy revolution and are developing fossil fuel replacements. Just how long it will take us to make the transition and the suffering we cause in the process still remains to be seen. Yet this challenging fluctuation is just one of many more to come.

Going forward, if we allow things to take their natural course, we and all

Earth-based life will be at the mercy of weather. In good times, however long they last, there will be greater diversity of habitats and life, more humans we can support, and a better quality of life. In bad times all of that will likely dwindle. Species that don't adapt well will die off. Many could go extinct. Humans living in the wrong place will likely go hungry and thirsty, or die. As a species if we don't learn to control such radical fluctuations, they will likely constrain our numbers and keep us busy managing the chaos and suffering. That is until these ups and downs give way to the ever-brightening sun and we need to evacuate. At which point the relevance of climate on Earth will cease to be our concern. However, if we do learn to design climate here on Earth, most assuredly, some of those principles will serve us well as we head off to other regions of our galaxy and beyond.



ULTIMATE GOAL MASTERY OF CLIMATE

Imagine that after a long while our understanding of climate became elegant and intricate. Our designs sublime. Our biosphere(s) abuzz with life. Although most of us today are perfectly comfortable controlling our climate indoors, the idea of mastering our outdoor climate requires a gigantic stretch of imagination. Yet, imagine we must...

...that in our quest for mastery we learned a great deal about climate from our stay on Earth. Once we wrapped our minds around all of the influences at play—from the core of our Earth to the edges of our Milky Way and beyond—we grasped climate as a whole and developed a unified explanation and model. Whether it was an influx of cosmic rays from exploding supernovae that led to increased cloud cover on Earth, variations in our Earth's orbit that

changed the amount and location of the solar radiation we received, a continent moving and altering ocean currents, or subtle changes in life and culture that added up to significant climatic shifts, we knew what was coming our way and when. And we learned to intervene in ever more nuanced ways—always finetuning our interventions and making better mistakes.

Slowly but surely, our knowledge became a new kind of protective atmosphere, buffering us and all life from harmful disruptions and radical ups and downs. What we learned on Earth we took with us as we set out to explore and settle many, many new worlds—always acclimatizing our understanding to new contexts and continually building and redesigning climates suitable for our evolving needs.



2050 MILESTONES

We've been unwittingly changing our climate for hundreds of years. In the next 40, we will need to warm to the idea of doing so by design—in the beginning to take the edge off of extreme weather events, and later on to deal with the future ups and downs. But to do so we need to first get a big picture grasp of climate.

For our take on the energy plan we'll need in the next 40 years, SEE: HOW WE SUSTAIN OURSELVES.

A UNIFIED THEORY AND MODEL OF CLIMATE

To change something wisely we need to understand it. By 2050 we should have a full explanatory model of all of the major drivers of climatic ups and downs here on Earth—cosmic, biological and cultural. It'll take a village: we need astrophysicists to paint a picture of cosmic drivers (e.g., solar activity, solar evolution, the role of cosmic rays in cloud cover); geophysicists, oceanographers and hydro-physicists to paint a picture of the role of oceans and land (e.g., ocean circulation, tectonics, glaciation); climatologists and atmospheric scientists to figure out what's happening in our atmosphere (e.g., atmospheric chemistry, radiation balance, energy transfer); biologists to explain the role of life (e.g., effect of photosynthesis/ respiration on the atmosphere, absorption of CO₂), scientists from across disciplines to figure out the impact of culture (e.g., greenhouse gas emissions, ocean acidification). Work is already under way on these topics, but we'll need to pull these strands of research together in a single explanatory model.

Given the urgency of our current manmade predicament, in the next couple of decades we must push ahead on simpler climate models focusing on the impact of greenhouse gas emissions. We'll have to narrow down the ranges of our current predictions: we still don't know how bad it's going to get and when it will get bad. We need a better understanding of feedback loops, tipping points and timelines.

CLIMATE DESIGN KIT AND LEGITIMATE USE

Once we let go of the idea that minimizing our climate impact is the only way forward, we have to face a whole new set of tricky issues: Which deliberate climate interventions are effective and which interventions will do more harm than good? Who should be allowed to carry them out and under what circumstances? By 2050, we should have a climate design kit with proven interventions that allow us to take the edge off of extreme weather events like hurricanes (for example, we can brighten clouds to suppress the intensity of the storms). In many instances, side effects of such interventions will be non-local so we'll need global agreements on their legitimate use.



GROWING RESOLUTION

Changing climate is on the global agenda. Yes, we are only thinking about the current man-made episode and our failure to convert our insights into action has many of us pulling our hair out. But the good news is there are now more and more of us working on this challenge. Efforts to simulate our climate now bring together climatologists, physicists, chemists, biologists, oceanographers, and geologists. The amount of data that goes into these simulations is exploding—NASA alone is feeding in 8 million observations per day from 17 satellites that are exclusively dedicated to climate. Our models are growing so complex they are getting downright real. Some of the pictures from the models are indistinguishable from satellite

photos. Ordinary citizens are getting in on the act too. Climateprediction.net, a program out of Oxford, has over 32,000 volunteers from 147 countries using their computers to help run a distributed global climate model developed by the Hadley Center for Climate Change. They have generated more data than any other climate modeling project thus far—over 100 million years of model data. The resolution of our picture is growing, as is our resolve to understand climate, even if we aren't yet shooting for a truly unified theory.

Given our failure to act, geo-engineering research is now being cautiously considered, rather than categorically dismissed. With our prospects of containing global temperatures within the 2°C guardrail currently looking dim, this type of research might come in handy to mitigate suffering and buy us some time. Current interventions in research include reflecting incoming sunlight by whitening clouds with seawater or injecting sulfatesat high altitudes to create a haze to extracting

CO₂ from the atmosphere and stashing it away deep within the Earth. All of these have side effects (e.g., sulfuricacid would reflect sunlight back into space, but it may nibble away at the ozone and decrease rainfall). So we don't yet have palatable candidates for a Climate Design Kit or global agreements on how to proceed, even on the experiments themselves. But geo-engineers are starting to get organized. A handful of them took the initiative a couple of years ago and put forward initial principles (The Oxford Principles).

We are still in the early phase of re-negotiating our relationship to climate. But the seeds for dealing with the ups and downs of the future have been sown.

A UNIFIED THEORY AND MODEL OF CLIMATE

CLIMATE DESIGN KIT AND LEGITIMATE USE



WHO IS ALREADY ON THE CASE?

PEOPLE: ~HUNDREDS OF THOUSANDS **FUNDING:** ~\$10s OF BILLIONS

CLIMATE RESEARCH

A good deal of our research is focused on understanding the current round of man-made warming. There is growing international coordination and we are slowly building the global infrastructure to observe, analyze, model, and predict climate. Organizations like the World Meteorological Organization, Global Atmosphere Watch and Global Earth Observation System are linking up all of our national and international observations systems so we can share findings and identify gaps in data. The IPCC works to integrate research findings into a coherent picture about what it means for our future.

Governments fund everything from original research to climate models (e.g., NASA Center for Climate Simulation, Hadley Center for Climate Prediction and Research, National Space Institute at the Technical Institute of Denmark).

CLIMATE ENGINEERING

Players studying the feasibility and risks of climate engineering are beginning to organize at various scales, from regional partnerships (e.g.,the European Implications and Risks of Novel Options to Limit Climate Change) to national governments (e.g.,Great Britain and Germany), to outspoken individual researchers who want to understand what's at stake sooner rather than later (e.g., Ken Caldeira, David Keith).



WHAT IF?...

...we kicked off the creation of the Unified Theory and Model of Climate with a massive scientific collaboration—astounding astrophysicists, cosmic ray buffs, solar savants, geological geniuses, creative climatologists, tectonic talent, geomagnetic giants, committed chemists, boss biologists, extraordinary ethicists, a couple of cognitive bias "cops" walking the beat, and a house comedian to help everyone keep their academic cool—all coming together to explain climatic ups and downs here on Earth. Once we get in the same room, we should figure out how far we are from the Unified Theory. Are we missing big pieces of the puzzle or is it just a matter of putting the pieces we already have together? A shared research agenda would be a great start.





THINK COSMIC WEATHER

Most of us know how to brave the elements, but then there is weather none of us are prepared for. Think ash-filled skies, a downpour of lava, and shock waves that level cities. That's the kind of "weather" we can get as a result of what happens in our cosmic neighborhood. From solar flares and cosmic rays to comets and asteroids, there is plenty for us to forecast.

From the HUMAN perspective, forecasting cosmic weather may be far more important than forecasting our local weather. Here we unpack asteroids and comets—big rocks and super-

sized hail. They're basically shattered remnants of celestial bodies that never accreted into planets. They move in different circles within our solar system. Asteroids mostly orbit between Jupiter and Mars—in the main asteroid belt that contains millions of them. Comets mostly orbit at the outer-most edge of our Solar System—in the Oort Cloud, some 30 trillion kilometers from the Sun. There may be a trillion of them.

Changes in the orbit of our Sun, planets, or even the gravitational pull of the Milky Way can knock asteroids and comets out of their orbits and send them into the inner planetary system. Inevitably, some of them end up bumping into other celestial bodies. On the near side of the moon alone we can see roughly 10,000 impact craters. Throughout Earth's 4.5 billion years, it too has been bombarded by these rocks and super-sized hail. So far we have discovered about 200 craters, likely only

a small fraction of the total impacts to date. Most of them must be hidden at the bottom of the ocean or worn away by weathering, erosion, and tectonic shifts.

We can be certain that more comets and asteroids will come our way. In 2036 we'll have a close fly by from the 350 m Apophis. In 2880 we might get hit by a 1 km rock. There might be more surprises in between or sooner. Fortunately, we can predict and take on this kind of cosmic weather. After all, it's governed by the laws of physics that are already within our grasp.



WHAT'S AT STAKE? KILLER WEATHER

Size matters. And in this case, bigger is not better.

Small stuff—asteroids and comets that are 5 to 10 m across—vaporizes in the upper atmosphere, so we don't have to worry about it. Hundreds of smaller rocks hail down on us every year and don't even make the news. Things start to get serious in the 50 m category. Take the one that exploded above Tunguska, Russia in 1908. It released about 1,000 times more energy than the A-bomb dropped on Hiroshima. Eyewitnesses 65 km from the scene said that it looked like the "sky split in two." The explosion

laid flat 80 million trees covering an area four times bigger than New York City. We were lucky it hit in the middle of the Siberian forest.

In the 1 – 2 km range we are talking about a global catastrophe. The explosion would waste an area about the size of Mexico, trigger earthquakes and add on a mega-tsunami if it plunged into the ocean. When these rocks get bigger than 2 km, we are no longer faced with just a global catastrophe; we're looking at a civilization disrupter. In addition to a bigger explosion, bigger earthquakes and bigger tsunamis, it would throw so much debris, dust and ash into the atmosphere that it would block the Sun's light for years. Prepare for a long, dark, planetwide winter. Without sunlight, growing food would be a struggle. There would likely be mass starvation.

In the 10+ km league, we're talking about a species ender. The last known impact

of that size was 65 million years ago and it wiped out the dinosaurs and most other species. When a rock that size slams into the Earth's crust it penetrates the molten matter within a second and releases energy equivalent to 10 Hiroshima-size nuclear bombs dropping on each square kilometer of the Earth's surface. Crust and mantle blow into the atmosphere and the atmosphere itself burns. Shock waves ripple through the crust triggering planet-wide earthquakes, volcanoes and tsunamis waves thousands of meters high. None of us would be around to see what happens next.



ULTIMATE GOAL IMPACT DEFENSE

Severe weather events on Earth are often considered a matter of national security. From the HUMAN perspective, dealing with cosmic weather—and with cosmic, super-sized hail in particular—is a matter of species-wide security. Our ultimate goal should be nothing less than foolproof impact defense. Failure is not an option.

Here is what it might look like:

We have space-based infrared surveys scouring the solar system tracking the movement of asteroids and comets. We know where they all are. We know which ones are headed our way—toward Earth or any other planet we might be living on. We mobilize early, while they are still far out in space, and divert their

trajectory. We have several options, we could use our gravity tractors to saddle up next to these rocks and slowly nudge them into a new orbit or we could impact the impactor—hit it hard to push it off the collision course. The decision-making process is clear so we decide quickly.

Asteroids and comets are no longer bad news. We use them as stepping stones to explore our solar system(s) and beyond. Because we know how to manipulate their orbits we have even moved some of them closer into orbits around our planet(s). They now function as mini bases for our space exploration. We mine them for precious metals and minerals, as well as hydrogen and oxygen to make rocket fuel.



2050 MILESTONES

This is the one potential species ender that we can move from the challenge category to a routine operation in the next 40 years.

OPEN SOURCE DATABASE

Our first line of defense is detecting where all the asteroids and comets larger than 50 m across are. We need a complete, open source database.

DEFLECTION: PROOF OF CONCEPT

Our second line of defense is deflecting the asteroids and comets that come our way. This line of defense simply cannot fail, especially if we are talking about an asteroid or comet larger than 1 km across. Given that the future of the species potentially hangs in the balance, we need to test our deflection strategies now. It's not at all a good idea to wait until we have a real threat to see if we can actually move it out of our way. We need a number of dress rehearsals with rocks that pose no threat to us to gain an understanding of how quickly we can mobilize and how far we can move these things.

COSMIC SECURITY COUNCIL

The farther out asteroids and comets are, the easier they are to deflect. It only takes a small nudge to move them off the collision course. The closer they get, the harder it gets. Our best strategy is to spot them as early as possible and act quickly. To do that we need to set up a cosmic security council and iron out the decision-making process now so that we don't lose precious time once we have a civilization disruptor in sight.



UNDEFENDED

We do not have Impact Defense.

To begin with, we don't have tabs on everything that's out there. We believe that we have mapped out 90% of the really big rocks (1 km across or greater), one-third of the mid-size variety (100 m - 1 km), and almost none of the smaller ones (50 m).

We have practical ideas about how to deflect asteroids and comets—from gravity tractors and kinetic impactors, to explosive blasts—but we have not tested them yet. We do have accidental experience, NASA once hurtled a

space probe into a comet to study it and ended up moving it a bit. We also have experience landing spacecraft on asteroids so we know we can deliver the load if we need to blow it up. Many think that's not a good idea because a lot of fragments headed in all directions could do a lot of damage too.

The good news is that in early 2012, we launched a project to study the best deflection methods. It's a collaboration between European, American and Russian space organizations involving 13 research institutes, universities and industrial partners. By 2015 we might be in a position to launch a mission to test our deflection methods.

We have no species-wide protocols for who should intervene and how. In 2008 scientists urged the UN to establish a network that would be responsible for detecting and deflecting, but it has yet to be implemented. We could have used it in 2009 when the Russians believed that Apophis would collide with the Earth in 2029 and planned to dispatch a spacecraft to move it. After calculating the orbit, NASA disagreed. So what was the problem? Fiddling with the asteroid's trajectory could push it in our direction. In 2010 NASA proposed a Planetary Defense Coordination Office, but it has yet to be funded.

OPEN SOURCE DATA BASE

DEFLECTION: PROOF OF CONCEPT

COSMIC SECURITY COUNCIL



WHO IS ALREADY ON THE CASE?

PEOPLE: ~THOUSANDS FUNDING: ~\$30 MILLION

EUROPEAN, AMERICAN & RUSSIAN SPACE ORGANIZATIONS

European, American and Russian space organizations are working on deflection methods.

NATIONAL SPACE AGENCIES

A broader circle of national space agencies are involved in spotting, studying and landing on asteroids (e.g., NASA, Japanese Aerospace Exploration Agency, Russian Federal Space Agency).

NGOs: SPACEGUARD, B612 FOUNDATION

In addition, NGOs like Spaceguard and the B612 Foundation have been established to spot and track asteroids and comets. B612 recently announced their Sentinel Mission. They plan to build, launch and operate the first private space telescope. Unlike ground-based surveys, Sentinel will orbit the sun, so its search will not be confined to one hemisphere. Plus it's infrared, so small asteroids that don't reflect much light can be seen. They plan to launch it in 2017.



WHAT IF?...

...this were the first challenge of species-wide concern that we took care of together?

Citizen scientists could pitch in to help hunt down the rocks and a billion of us could crowd fund Impact Defense. There is only so much citizen scientists can do because rocks that can be spotted with low-powered instruments should have already been spotted. However, the Minor Planet Center at Harvard has developed a guide to set up citizen observation centers and Dynamic Patterns Research, a citizen scientist group, is figuring out how to build low-cost backyard observatories for citizens.

As for crowd funding, we would need to raise between \$100 - \$300M every year for the first decade. That's less than Obama raised online in 2008. Here is how it could work: Get some seed money (under \$1M). Film an inspiring 15 minute documentary about the threat posed by asteroid and comet impacts and what we can do to stop them. Trusted astronauts from all over the world each tell part of the story and egg us on to do our part. Translate it into all languages. Create an online campaign. Ask one billion humans to donate \$3 each.





THE SUN IS NOT FOREVER

Nothing in our universe remains the same forever. Five billion years ago our sun did not yet exist. It emerged from the collapse of a giant molecular cloud. Six billion years from now it will no longer exist. It will have burned through all of its mass. From the HUMAN perspective, that's a bit of a problem.

All life on Earth relies on the energy from our Sun. Without sunlight, there is no photosynthesis. Without plants producing oxygen, there is no breathable air. Without the sun's warmth and energy, there is only the endless cold night. We are used to taking our sun for granted. Every morning we see it rise without fail. So we understandably assume it will always be there. But it won't. It's going to go and with it our source of energy and our home.

Today many of us worry about the human impact on the planet and Earth's biodiversity. Some of us say once we humans get out of the way, the planet will self-heal, balance will be restored. Some even suggest that the Earth would be better off without us. Yet, in the long run, humans might be life's only chance to survive. Biological evolution might not cope with such a fundamental change as the loss of a star. Self-healing is a non-starter when the sun sterilizes our planet dead. Earth-based life would need a more creative force to lift it off Earth and take it to a new home. Humans are currently the only life form poised to become that creative force.



WHAT'S AT STAKE? ALL LIFE FROM EARTH & EARTH ITSELF

The aging of the sun is a gradual process. Things are likely to already start sliding off the rails within the next billion years. Every billion years our Sun grows 10% brighter and hotter. The rise in solar radiation will lead to the breakdown of silicate minerals which will in turn cause a decrease in the level of carbon dioxide in our atmosphere.

In about 600 million years, there won't be enough carbon dioxide for trees to sustain themselves through photosynthesis. As the levels of carbon dioxide keep dropping, all plants will die. As plants disappear, the oxygen

they produce will decline. The humans and animals of today would struggle to breathe, though it may well be our ascendants can adapt or create temporary workarounds. In about a billion years, the sun will boil the oceans off the surface of the planet, spelling the end for most complex life forms. Some life forms might evolve to live through this. In roughly 3.5 billion years, solar radiation will destroy our Earth's biosphere, likely putting an end to all surviving life.

The fate of the planet itself does not look good either. It is set to be engulfed by the aging sun in about 6-7 billion years. As the sun burns up all hydrogen, it will eject material from its outer layers. Its core will expand, first growing large enough to engulf Mercury, then Venus. As it expands, it will lose mass so surrounding planets, including Earth, will then be held less tightly in their orbits. The dead Earth's orbit will likely move

outward about 60 million kilometers, and then experience enough orbital decay that it will be dragged back into the Sun and vaporized, becoming no more than a feedstock of elements for new formations of celestial bodies, (that is, if our Sun's orbit is not radically changed by the collision of our galaxy, the Milky Way, with the neighboring galaxy, Andromeda. SEE: GALACTIC COLLISIONS).



ULTIMATE GOAL NEW HOMES

Today many of us think that space exploration is about satisfying the human itch to wander. From the HUMAN perspective, it's ultimately about our survival. We must become a space-faring civilization to survive.

There are two strains of ideas in the global public discourse that are in direct conflict with this perspective. According to the *first things first* idea, we should not waste our time and money on space exploration until we have created a just, peaceful, prosperous and sustainable society here on Earth. Then there is the

it's absurd! idea—it is absurd to worry about things that are going to happen one billion years from now.

From the HUMAN perspective, both ideas are indefensible in the face of a sure, scheduled demolition of our home planet and loss of all Earth-based life. When would be a good time to start tackling a challenge of this magnitude? We have no way of knowing how long it will take us to organize a planetary evacuation.

Consider this:

Where are we going to go? So far we have found hundreds of Earth-like planets in habitable zones of our galaxy. The closest candidates are more than 20 light years away. How are we going to get there? We don't yet have the technology. NASA's Voyager 1 is the piece of human-made equipment that

has travelled farthest into space, to the edge of our solar system. It is not fit for manned flight but if it were, it would take us 250,000 years or 12,500 human generations to get to the closest potentially habitable planet just to see if we could make it work there. And this is just reconnaissance, not an evacuation. Terraforming new planets or building new floating homes may take thousands of years. Organizing mass-transport for billions of humans and other life forms is something we have not even started thinking about, so we don't have a way to give even a conceptual estimate of the time it might take.

The fundamental question we must answer is do we want our species and other life from Earth to go on living? If the answer is yes, we must start now.



2050 MILESTONES

In the next 40 years, we must learn to see space exploration in a new light. Settling Mars is not about frivolous "geographical" expansion, it's our first evacuation pilot. Searching for habitable planets is not just about finding other life, it's about finding planets we ourselves could live on. Building conceptual prototypes for floating worlds is not an exercise in science fiction, it's an exercise in mass transport.

LIVING ON MARS

We need to learn to push human transport over longer distances and gain both settlement experience and cut our teeth on designing climate favorable to life. Mars is the obvious candidate—it has frozen water and it is about 9 months of travel time away. But it's not for everybody temperatures ranging from -143°C to +27°C, planet-wide dust storms, non-stop bombardment by micrometeoroids and high energy particles. We would have to live in caves. Fortunately, we have found a few that can be hermetically sealed. But first we will need to get back to the Moon or an asteroid. From the asteroid belt, we will need to get to the moons of Mars and then on to our final destination: Mars itself.

KEPLER X 20

We need to get systematic about our search for planets we can live on. Kepler, a space born telescope and dedicated planet hunter, has been searching about 1/400th of the sky for planets since September 2009. We need 20 more Kepler-like telescopes by 2050 to get a fuller survey of our options.

BATTLESTAR GALACTICA FOR REAL

This is not a mega-project, it's a gigaproject. Imagining things that don't exist is the hardest first step. We should gather the astrophysicists, science fiction writers and psychologists to construct prototypes of artificial floating homes that we could use as transport or even permanent habitats.



BIG PLANS, WEAK REASONS

Our plans are grand but our reasons are weak.

We do plan to land on Mars in the next 25 years and we do coordinate our space activities—or at least the representatives of the 14 space agencies participating in the development of the Global Exploration Roadmap do, including NASA, the European Space Agency and the Russian Federal Space Agency. But space agencies are not alone in making plans. Elon Musk, the founder of space transport company SpaceX, is planning to get to Mars too.

We do plan to carry on the search for habitable planets—ESA, ESO and NASA are keen to add to our current catalog and investigate the planets we have already found.

Battlestar Galactica is still just a movie. However, the Defense Advance Research Projects Agency in the US has launched the 100 Year Starship (100YSS) study to develop a model for long-term private-sector investment into the myriad of disciplines needed to make long-distance space travel doable. It's a start.

Whether any of these plans will materialize in the next 40 years depends on two things—human ingenuity and funding. Both ultimately depend on the strength of our convictions about why we are venturing into space in the first place.

Today, government-funded space

exploration is routinely pitched as a general interest undertaking in scientific exploration with a promise of technological spin-offs like GPS or flame retardant pajamas. It is therefore unsurprising that when national budgets get allocated, space exploration rarely rises to the top of national priorities. It might very well be that the first base on Mars will be established by Elon Musk's team—his big why is turning us humans into a space-faring civilization.

LIVING ON MARS

KEPLER X 20

BATTLESTAR GALACTICA FOR REAL



WHO IS ALREADY ON THE CASE?

PEOPLE: ~TENS OF THOUSANDS **FUNDING:** ~\$50 MILLION in government space programs

PUBLICLY FUNDED EFFORTS

Five agencies (the Americans, the Russians, the Europeans, the Japanese and the Canadians) are running the International Space Station, an artificial habitable satellite that allows us to test spacecraft systems and equipment for missions to the Moon and Mars.

14 space agencies are coordinating their activities through the International Space Exploration Coordination Group.

More than 60 countries have space agencies but only three of them have manned spaceflight capability (the Russians, the Americans and the Chinese).

PRIVATE ENGINEERING GROUPS

Several private engineering groups are working on space systems but only one has its eye on Mars and beyond: SpaceX.



WHAT IF?...

...we re-conceived of the role of space exploration in the ongoing human project?

We need a bigger story. Let's gather space explorers, epic storytellers and branding virtuosos for a species-wide campaign to capture people's imagination about why we are going into space. For a symbolic start, why not rebrand the *International* Space Station to the *Human* Space Station?





COSMIC BLOWTORCH

Most of us know what the aftermath of a nuclear explosion looks like. There is a blast and then there is fallout. The blast levels the city, vaporizing and scorching human bodies. Fallout brings radiation sickness and tortuous death. We won't be so lucky with a cosmic blast.

There are plenty of events in our cosmic neighborhood that can cause one: exploding supernovae, merging neutron stars, a black hole swallowing a neutron star—just to name few. The resulting blast can vaporize everything within light years. The radiation burns vast regions of galactic real estate. From the HUMAN perspective, cosmic blasts are the ultimate catastrophe, a near instant species annihilator.

Many of us are fascinated by the majestic beauty of these cosmic events. We marvel at pictures captured by the Hubble Telescope or images generated by computer models. Too few of us, however, stop to consider their potential implications for the ongoing human project. That kind of blind spot could get usburned, so let's unpack an example to better understand what we're up against.

Let's look at supernovae. Most supernovae happen when really big stars—at least eight times bigger than our Sun—die. Once their cores exhaust all of their nuclear fuel they can no longer hold out the gravitational pressure from the outer layers. Gravity wins. The core collapses. There is a humongous explosion of its outer layers. They can also happen when smaller stars in their final evolutionary state accrete matter from a nearby star or merge with it, leading to runaway nuclear fusion. Again, a humongous explosion. The brilliant beauty of their explosive death is mind-blowing—in just a few weeks they radiate as much energy as our Sun

will over its 15 billion year lifespan. Some of the most beautiful pictures our telescopes have taken in space are of these dying stars. But it's best to keep this kind of beauty at a distance, because it can devastate millions of planets within 25,000 Light Years (LY). To explain how and make it real, let's use our planet as an example.

Were a supernova to go off within 30 LY from our solar system, the blast would unleash hard-core radiation—cosmic rays, gamma rays, UV rays and X-rays—that would take out our ozone. Without the ozone to filter UV radiation we would literally get burned to death. A sunburn like no other. UV radiation would pour in, damaging DNA and RNA and killing many of the species on this planet within days or months, including us.

Sometimes it can get much worse.
Every now and then, when some supernovae blow, twin jets of incredibly powerful energy shoot out of that star in opposite directions at nearly the speed of light. They're called Gamma



Ray Bursts and they're one of the most powerful explosions that we know of in the Universe. Anything within 1,000 Light Years that lies within their path is vaporized. But even within 25,000 LY, if we were sitting in the direct path of these rays they would blow out our ozone, trigger huge shocks in our atmosphere and ignite global fires. And then, if any of us survived that, we're left with DNA and RNA destroying radiation.

On average up to 30 supernovae explode per second in our observable Universe. Since we don't know if there is other life out there, we don't know if any of these explosions are decimating intelligent

civilizations. In our galaxy we suspect that one blows every 50 – 100 years (though we haven't actually seen one in the Milky Way in 200 years). None so far have gone off close enough to end our ascent, though some of us suspect that Gamma Ray Bursts from a supernova may have already caused mass extinction on Earth 440 million years ago at the end of the Ordovician period.

We don't yet have a full inventory of upcoming events, but we've already spotted a few threats. As an example, there is a binary star system in the constellation Sagittarius. It's called Wolf-Rayet 104. It looks like it will blow within the next few hundred thousand years. Some of us suspect that it will unleash a Gamma Ray Burst. And it looks like planet Earth is directly in its firing line.

Unfortunately, that's not the end of it. Supernovae are not the only source of cosmic radiation in our Universe.

There are active galactic nuclei, for example, all of which are very far away from our current home but pack quite a punch. One type of active galactic nuclei is a quasar, which happens when supermassive black holes direct some of the energy and matter of their gravitational collapse back out in jets that have the brilliance of a trillion suns. Their energy makes a supernova look quaint. Sometimes radiation bursts are also produced in mergers and collisions, like when a black hole swallows a neutron star or two neutron stars merge. There are still other known sources and those we have not yet discovered. We've only just begun our search.



WHAT'S AT STAKE? **EXPOSURE**

It's ironic, to say the least. The stars that create the elements—the building blocks of life—and scatter them throughout the Universe through their explosive death, are the stars that can torch us and everything that we have built at nearly the speed of light.

Protecting ourselves won't come easy. According to some physicists the radiation from a supernova can kill a human at a range of billions of kilometers, even if that entire distance were filled with lead shielding. If we don't find a way to protect ourselves from cosmic blasts and their resulting radiation, sooner or later

we will be exposed, unless we perish before that comes to pass. Whether it is an unanticipated blast that catches us by surprise, a scheduled torching a few hundred thousand years from now, a blast that we encounter when we settle new planets or galaxies, or the allpervasive lower level cosmic radiation that we will be exposed to as we travel to them, exposure is unavoidable.

However, if we learn to protect ourselves from blasts and radiation we can rest easy for the remaining time we have here on Earth and travel with growing confidence through our galaxy to settle new star systems.



RAD DEFENSE

Ultimately we must become astroengineers. We must know our galaxies like the backs of our hands—a profile on every black hole, active galactic nuclei, and star. We must know which ones will threaten us and when and we must know how to intervene to protect ourselves from the blast and radiation.

We might learn to prevent some supernovae by removing some of their matter before they explode (what's known as stellar engineering or star lifting). We might learn to actually move

dangerous stars, perhaps even using their own energy to do so (e.g., stellar engines). Or we might learn to shield ourselves, maybe even reconfigure our biology so that radiation no longer damages or destroys us. It's difficult to say exactly what form our defense will take, as we still have so much to learn. Knowledge will expand our options and help us decide.



2050 MILESTONES

Though we have come a long way, we are still in the beginning stages of our exploration of our cosmic neighborhood. In the next 40 years we need to further narrow in on all of the sources, build a single, coherent map of our galaxy, and begin to seriously vet ideas about how we might protect ourselves from deadly cosmic blasts and radiation.

A GALACTIC CATASTROPHE MAP

We need to identify all sources of cosmic blasts and radiation and pin them down on a single, working map of our galaxy. With each identified source we should catalog the underlying process, when and if it will pose a threat to us, the impact it might have on life on Earth, and how long our action window is.

STELLAR ENGINEERING 101

Although we do not yet have the technology or command the energy needed for stellar engineering, we can further develop our underlying ideas and explanations about how to do so. Such cognitive exercises help shift our frame of mind from merely studying the phenomena in a detached manner to working toward

coming up with actual solutions, which can give rise to promising new research directions. By 2050 we have a provisional consensus among the top stellar minds about which directions seem most plausible and use them to establish the new research directions necessary to either affirm or tear down our working ideas and build the next generation of ideas: Stellar Engineering 201.



HIGHER ENERGY

In astroparticle physics the study of cosmic radiation is now moving into the mainstream. We're putting progressively more energy into tracking where the high energy cosmic particles are coming from and understanding how they come to pack so much punch. We have dedicated space telescopes scouring the sky (e.g., SWIFT, INTEGRAL, Fermi's GLAST) and increasingly sensitive ground-based telescopes, detectors, and observatories (e.g., H.E.S.S., MAGIC, VERITAS, The Pierre Auger Observatory).

In 2008 ASPERA, Europe's network of national governments who coordinate

and fund research in astroparticle physics, set forth their vision and seven priorities for the decade. High energy particles made their list. Given their priorities, they decided to back the Cherenkov Telescope Array (CTA) with locations in both the Northern and Southern hemisphere. It's a system that will be 10 times more sensitive than what we have now and is set to pinpoint at least 1,000 sources of high energy gamma rays and explore their spatial structure and energy spectra. The U.S., who originally had separate plans, decided to merge their efforts. If all goes according to plan, they'll begin building in 2015.

We also have several projects underway todetect fiendishly hard to spothigh energy cosmic neutrinos. We are building skyscraper-sized neutrino detectors deep underwater (IceCubeis deep under a sheet of ice in the South Pole and KM3NeT is deep under the

Mediterranean Sea). Kilometers of water help filter out the lower energy noise created by the rain of cosmic rays on our atmosphere. Everybody is coordinating research and sharing data, but we do not yet have a single working source map.

As for stellar engineering, with the exception of a few initial ideas from a handful of serious scientists, many of the ideas appear in science fiction, which is not terribly surprising. Truly rigorous sci-fi has always pushed the envelope forward and helped us imagine more.

GALACTIC CATASTROPHE MAP

STELLAR ENGINEERING 101



WHO IS ALREADY ON THE CASE?

PEOPLE: ~THOUSANDS **FUNDING:** ~HUNDREDS OF MILLIONS

GOVERNMENTS, UNIVERSITIES & RESEARCH INSTITUTIONS

Almost all of the telescopes and observatories are some form of partnership between governments, universities, and research institutions. For example, the cost of building the \$50M Pierre Auger Observatory where they look into ultra-high energy cosmic rays—was shared by 15 countries and a couple of international institutions (UNESCO, The European Union, Argentina, Australia, Brazil, Czech Republic, France, Germany, Italy, Mexico, Netherlands, Poland, Portugal, Slovenia, Spain, United Kingdom and the United States). Today 500 physicists from 55 institutions go there to analyze the data they collect, or maintain or upgrade the site. This kind of cost sharing and collaboration is the rule, not the exception.



WHAT IF?...

...we launched a prize for stellar engineering?

In 2011 the Defense Advanced Research Projects Agency (DARPA) and NASA launched the 100 Year Starship Study to find an organization—proposed or real—that had a vision for interstellar travel and a business model that could carry it forward for the next 100 years. The prize was relatively insignificant seed money (\$500,000). This prize would be slightly different. We would be on the look out for a research institution that could establish credible research directions for stellar engineering and a plan to support those studies for the next 100 years. Who would put up the prize? An international partnership? ASPERA? A private philanthropist?





QUAKES OF GALACTIC PROPORTIONS

Most of us know what happens when land masses collide: they push up mountains and the earth under our feet quakes. But what happens when galaxies plow into each other? The distances between stars and planets are so vast that physical bodies very rarely hit one another, but the gravitational fields of each galaxy's stars and dark matter twist, tear and pull things around. Stars are scattered into new orbits. Entire solar systems are tossed about. Interstellar gas collides and compresses and new stars burst into existence. From the HUMAN perspective, galactic quakes could shake us up.

It's best not to think of galaxies as nouns. Instead, think of them as verbs—interactions of energy and matter held together and pulled around by gravity within an ever-expanding space-time.

Even though our Universe is expanding, galactic clusters have enough mass for gravity to bind them together in relatively isolated neighborhoods of interactions. Within those gravitybound neighborhoods, they run into each other quite a bit. Most galaxies, in fact, side swipe or collide with one another a few times over their lifespans, resulting in anything from a localized tremor to a full-blown, all-galaxy quake. At this very moment, for example, our own Milky Way is colliding with two smaller galaxies—Sagittarius and Canus Major. Because the mass of our galaxy is much bigger, it's basically shredding and assimilating them. For us, it's barely a tremor. But in about four billion years

we'll get to experience an all-galaxy shake down too, one that will end in a merger.

Here's the deal: our Milky Way and another spiral galaxy of a trillion stars, Andromeda, are headed toward one another at 400,000 km per hour. They're set to collide in four billion years—we now know for sure.



WHAT'S AT STAKE? GALACTIC CIVILIZATION

In four billion years we will have long since left Earth (SEE: AGING SUN). We will have become a galactic civilization: Milky Wayans. And here comes Andromeda.

Just imagine the night sky filled with a galaxy twice the diameter of ours. Although the view as we fall toward it will likely be spectacular, it could very well disrupt our civilization. Think about it: the spiraling Milky Way has roughly 300 billion stars and probably at least as many planets. It has a mass of 1.5×10^{12} solar masses. Andromeda has roughly 1 trillion stars and about the same mass

(more stars, less dark matter). Once their respective masses, gravity, and disks of gas and dust—their interstellar mediums—collide at 400,000 km per hour, there's going to be some fireworks and quaking.

First the two galaxies will pass through each other, then the core of each galaxy will stretch in opposite directions until gravity pulls them right back into each other and they settle into an elliptical galaxy. Welcome to Milkomeda. In the process orbits will be rearranged and in some cases, stars will just scatter.

Because these two galaxies will collide long after our Earth has been sterilized by our Sun, there is no point in worrying about the fate of our planet of origin. It does, however, give a useful reference point for the kind of movement we can expect. Right now our solar system is about 27,000 light years from the galactic center of the Milky Way—the life-friendly suburbs of our galaxy. During the merger our solar system will likely be swept out three times further away from the new center, to the remote rural outskirts. Quite a relocation.

We should expect deadly fireworks too. Even though both galaxies are aging and thus have relatively less interstellar gas than younger galaxies, when their gas clouds compress they will still send out shock waves, heat and new stars will burst forth. As gas funnels into the center of the newly formed Milkomeda, more massive stars will be born sending out potentially life-annihilating bursts of cosmic radiation (SEE: COSMIC RADIATION).

This inter-galactic quake could really shake up the neighborhood and tear down some nodes in a networked galactic civilization.



ULTIMATE GOAL GALACTIC SAFE HAVEN

A safe haven is a place of refuge, a protected zone. A physical location is implied. But in an ever-changing cosmic landscape filled with galactic quakes, birthing and dying stars and shuffling orbits, where exactly would that physically safe place be?

Our ultimate safe haven will likely be of a different kind: knowledge and the means to apply it. Imagine the knowledge it will take to master this one. At the most basic level we'll need the ability to travel really far through space to settle the galaxy in the first place (SEE: AGING SUN). We'll need to

map the areas of these galaxies that will undergo violent change and decide what we should do given our knowledge. Should we avoid settling those areas and hope that we properly map the "no settle zones"? Should we live in those areas and evacuate before a star blows or before a star or planet get chucked off their orbit? Will settlement actually come to mean constructed mobile worlds? Or will we stay put and prevent, contain, or shield ourselves from explosions and cosmic radiation? The more we seek refuge in knowledge the more options we will have.



2050 MILESTONES

In the next 40 years the astronomers amongst us should do even more than discover, classify, describe and chart the trajectory of celestial bodies and the larger galaxies they are a part of. They should become urban planners of galactic proportions with an eye for the neighborhoods that would be good to live in.

MILKOMEDA HEAT MAP

It will be our first. Simulating the collision of the Milky Way and Andromedawill no longer be a matter of scientific curiosity, it will be an act of urban planning. We will need aheat map, with areas to move to and areas to avoid, plotted along the timeline of the collision.



FORGING AHEAD

We now frequently simulate galaxy collisions on computers, with all the realistic physics. You can even find a library of thousands of simulated collisions at the Paris Observatory website, GALMER: GALaxy MERgers in the Virtual Observatory.

We're getting better at tracking Andromeda's march. We've suspected that Andromeda will hit us for a long time, but after using Hubble for seven years to repeatedly observe select regions of the galaxy, in 2012 we removed all remaining doubt. It will be a direct hit.

Meanwhile the European Space Agency's Herschel telescope is busy taking detailed images of Andromeda in the infrared wavelength, giving us a picture of where stars are forming and XMM-Newton's X-ray telescope is showing us the stars that are dying. Put it all together and we're developing a picture of stellar location and evolution in Andromeda—getting one step closer to being able to predict the deadly fireworks.

In 2013, the ESA (European Space Agency) is launching Gaia, a massive stellar census, with an ambitious mission to create the largest and most precise three dimensional chart of our own galaxy. It will provide unprecedented positional and radial velocity measurements for about one billion stars in our galaxy. It will provide the detailed physical properties of each observed star: characteristics, luminosity,

temperature, gravity, elemental composition, and motion. And finally it will make direct measurements of Andromeda currently creeping across the sky. We'll feed it all into our simulations. Our ability to map our place within our galactic cluster is moving forward, just as our galaxies are.

MILKOMEDA HEAT MAP



WHO IS ALREADY ON THE CASE?

PEOPLE: ~HUNDREDS FUNDING: ~MILLIONS

SCIENTISTS FROM ALL OVER THE WORLD

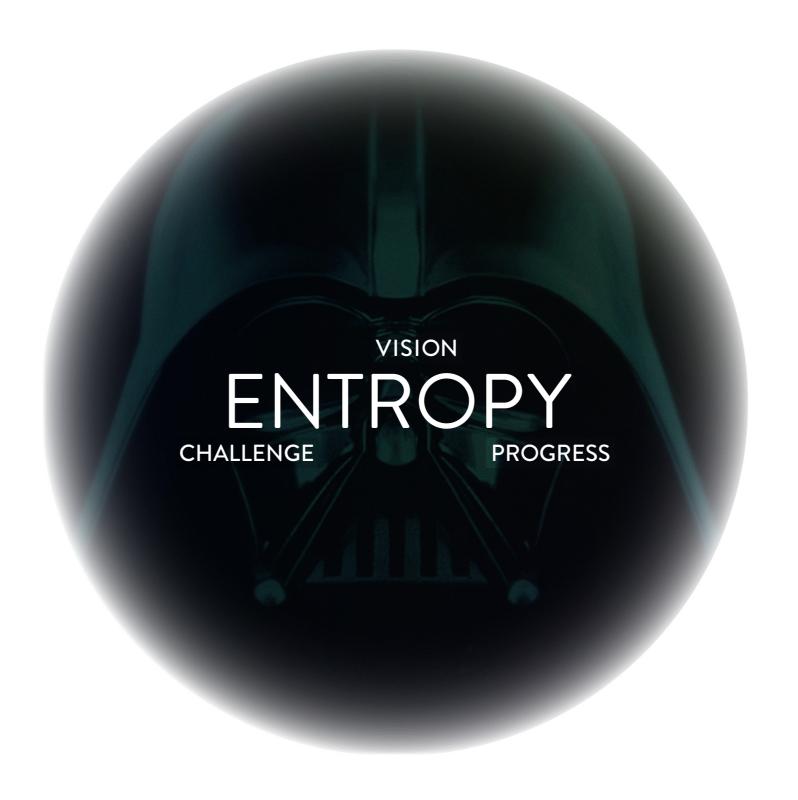
Scientists from all over the world sponsored by regional partnerships (e.g., European Southern Observatory, European Space Agency), national governments (e.g., NASA) and universities and research institutions analyze the data collected from telescopes (e.g., Hubble, Herschel, XMM-Newton, Kepler, Chandra X-ray observatory).



WHAT IF?...

...we recruited the Milkomeda 500? A new generation of young astronomers who will dedicate their lives to helping our species understand galactic evolution in general, and the collision of the Milky Way and Andromeda in particular?

Today we count our astronomers in thousands—the International Astronomical Union has about 10,000 members; there are likely more astronomers out there who are not members but not a lot of them. Only a small fraction of those work on galactic evolution, a smaller fraction still on galactic collisions. None of them think of themselves as urban planners. We can do better.





OUR UNIVERSE WILL WIND DOWN

13.7 billion years ago when our Universe banged into existence, it was hot and simple. 100 trillion years from now it will be simple once again, but it will not be hot. Our home will turn into an infinite expanse of coldness and darkness. From the HUMAN perspective, entropy is the ultimate universal challenge.

In the most basic terms, entropy is the dispersion of energy. We owe our existence to it and yet it threatens to undo everything. It has been at work since the very beginning. Since the instant our Universe banged, it has been expanding and losing heat—energy has been dispersing over ever-increasing space. Initially, this process allowed for the rise of complexity. Cooling allowed matter to differentiate from energy and clump into more and more complex structures.

But as entropy carries on, all complex structures will ultimately come undone. All matter and energy will decay and disperse. There will be infinite time and ever-more space, but it will be very cold, very dark and nothing much will be going on.

Fortunately, there's a twist in the plot. In the relatively brief window of time in which entropy cooled the cosmos just enough to allow for the rise of complexity, a curious life form emerged on the scene. We humans developed a knack for explaining our Universe and solving problems. Will we wind up our minds and refine our explanations in time to solve for our Universe winding down?



WHAT'S AT STAKE? ALL THAT IS

Today many of us believe we should respect the natural world and be good stewards of all life on Earth and the Earth itself. From the HUMAN perspective, the natural world is much bigger—it contains all life, energy and matter in the Universe (and beyond if we live in a multiverse). Entropy will put it all at stake.

We won't have to wait 100 trillion years to catch a chill. The era of star formation in the Milky Way is already coming to a close. About 90% of the material from which stars are formed has already been used in our galaxy. In about a trillion years the lights in our galaxy will begin to dim.

The Milky Way is not an exception.

Over trillions of years, all galaxies will slowly run out of hydrogen and new star formation will end. The lights will grow dim and then turn off. When the Universe is about 100 trillion years old, the stars

will finally stop shining. It will be dark. There will be no visible radiation to warm the planets. It will be cold. Entropy will take center stage. The most complex entities around will be brown dwarfs, dead planets and black holes. And then these remnants of matter will decay, too.

The only structures left will be black holes and subatomic particles. Our universe will then enter the era of black holes, in which black holes will be the brightest objects in the sky. But even they can't escape entropy's grip. They too, will decay over an infinity of time. Low-level energy is all that will remain.



ULTIMATE GOAL VICTORY OVER ENTROPY

Today we think that theoretical physics is just about satisfying scientific curiosity and science fiction is there for our entertainment. From the HUMAN perspective, both are a matter of survival. When it comes to theoretical physics, there is still so much we need to understand. What happened before it banged? How did it bang? What is time? What is the relationship between the laws of the indivisibly small—the quantum—and those of the astronomically large—general relativity? What are dark energy and dark matter? How many dimensions are there? Is our Universe the only one? Answers may yield ideas for how to prevail over entropy. We might learn to manipulate the laws of physics in our own Universe. Or, if there are multiple Universes, we might be able to create portals that lead to other ones.

Sound like science fiction? That is what we need: more minds that can imagine things most of us can't. But perhaps we'll need more than our own minds—a fresh perspective, data we don't have, the wisdom of someone who has been around longer than we have.

Today we think that the search for intelligent life is about understanding our place in the universe. But what if it were about finding intelligent partners to help solve for the universal decay of matter and energy? Just as global problems require global solutions, universal problems may well require universal solutions, and we need to see if there is any intelligent life out there that can lend a hand.

Our collective know-how and creativity may just turn out to be a stronger force than entropy.



2050 MILESTONES

In the next 40 years, we must learn to see the role of astrophysics and the search for intelligent life in a new light. It's our first step in prevailing over entropy.

THE UNIVERSE(S) EXPLAINED

To get our minds around our conceptual options, we need to understand all the laws that govern our cosmic home and how they function. Physicists call it a unified theory—one theory that can describe every fundamental feature upon which the universe is constructed and how it works. A theory that underlies all others, one that does not require or even allow for a deeper explanatory base. This is one foundation upon which all conceptual solutions and strategies can be built.

SETI 2.0

The search for intelligent life (SETI) is an exploratory science that looks for evidence of life in the universe by looking for signatures of its technology. We've listened to and looked at thousands of stars with our radio and optical telescopes. We're set to search billions more. But we need more minds on the case. Let's expand our search four-fold by 2050 and double down on infrared—even if a more advanced civilization didn't send a signal, we would be able to detect the waste heat.



NO MEANINGFUL ANSWER

In a short story, "The Last Question", written by Isaac Asimov in 1956, humans and their ascendants repeatedly ask a computer, how can the net entropy of the universe be massively decreased? Essentially, how can we prevail over entropy? The computer's response after much "thinking" is: "Insufficient data for meaningful answer." It is still true today. We do not yet have an explanatory model of how our Universe works but we're working hard to figure out what's going on. Between running experiments to detect new particles and even dark matter at the Large Hadron Collider and scouring the sky to look for signatures

of what happened immediately after it banged, we'll either find clues about how to unify the quantum with general relativity, or we'll scrap part or all of it and head back to the drawing board. In the process we might just figure out how many dimensions there are and whether we live in a multi-verse. Which ever way it goes down, we're advancing our understanding—even if many of us don't yet see these efforts as a matter of existential importance.

As for our search for intelligent life, we've been at it since 1960. We've listened to thousands of stars. Between the private SETI Institute, the University of California at Berkeley, SETI Australia, and a collaboration between Harvard-Smithsonian and Princeton we're scheduled to listen and look at billions more. We also have 180,000 active citizen scientists who have joined the search volunteering over 290,000 computers. Is there intelligent life?

If so, would it communicate with us? As of yet, we do not know. There are still no signs, but at the privately funded SETI Institute in California, they keep champagne on ice just in case ET phones from home.

THE UNIVERSE(S) EXPLAINED

SETI 2.0



WHO IS ALREADY ON THE CASE?

PEOPLE: ~HUNDREDS OF THOUSANDS **FUNDING**: ~TENS OF BILLIONS

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

The European Organization for Nuclear Research (CERN) functions as an international magnet for testing our theoretical ideas about what the Universe is made of and how it functions.

INTERNATIONAL ORGANIZATIONS

International organizations like the OECD and ASPERA are working to coordinate a scientific vision and fund research for major research projects that require large investments that no single nation can afford alone.

NATIONAL UNIVERSITIES AND LABS

National universities and labs around the world advance our understanding through theoretical work, experiments, and observations.

PRIVATE INSTITUTES

Private institutes (e.g., SETI), national universities and citizen scientists are working on the search for intelligent extra-terrestrial life.



WHAT IF?...

...we created a provisional working agenda for theoretical, particle, astrophysics and cosmology for the entire 21st century?

Get the scientists together. Figure out what makes sense to them first, then go looking for funding. The agenda—shall we call it Existential Agenda v1.0?—becomes a living document that we revisit and evolve every two years as we make breakthroughs and develop new understanding. Let's make sure there's a small team on hand to film and properly edit the gathering. We should put the movie online with the agenda to see if we can further inspire an entire new generation of young minds, not just to marvel at the vastness of our cosmic home, but to work on problems that they may not see solved in their lifetime as a contribution to the ongoing human project.



HUMAN PROJECT

CHAPTER FOUR

- 4.1 PURPOSE
- 4.2 AGENDA
- 4.3 ORGANIZATION



The human project...
we've used it as a metaphor.
But what if we took it literally?
What if it were an actual project?
Here's an initial concept.

THE HUMAN PROJECT

PURPOSE

Secure the survival and ascent of our species

AGENDA

CHALLENGE		ACTIO	N WINDOW	ULTIMATE GOA
	7.7			2.0

ORGANIZATION

HUMAN Discourse HUMAN Culture

HUMAN Ventures

PURPOSE

Secure the survival and ascent of our species

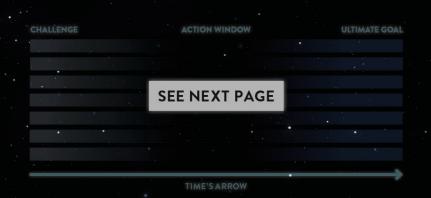
Millions of people across thousands of organizations are already pursuing goals that advance the ongoing human project in wonderful ways.

So what would be the point of creating yet another organization? We believe that while many of us are spending our lives on making a real difference on specific issues, too few of us take the time to think about the ongoing human project as a whole. Where are we headed and is that a good direction? Do we have all the bases covered? Are we prioritizing our efforts in a good way? Are we making enough progress given the action windows of our challenges?

We believe we need a custodian of the big picture and a community-organizer at a species-wide scale. So why not call it "the HUMAN project"?

We envision an open community of people committed to a single overarching purpose—secure the survival and ascent of our species. In practice, our task would be to get the ball rolling on the grand vision for our species and make sure our generation makes the best possible contribution during our leg of the inter-generational relay. As with anything worthwhile, this takes hard work. A good place to start would be to get on the same page with regard to what should be on the Agenda.

AGENDA



Given the purpose we've proposed for the HUMAN project, our Agenda should obviously narrow in on the issues of species-wide concern. If a challenge or an opportunity is big enough to impact the survival and ascent of our species, it goes on the Agenda. In the HUMAN Future section we've described all the big issues we currently think fit that criterion. But now that we are getting into action mode, a simple laundry list of these challenges won't cut it. We need a bit of organization.

Here is our first pass.

SURVIVE VS. ASCEND

Not all challenges are equally important. Some of the challenges on our list could do more than just challenge us. They will wipe us out — that is, unless we figure out how to solve problems of planetary and cosmic proportions. So all challenges to our survival as a species should always be our top priority. If we are dealing with a speciesender, failure is simply not an option.

This may sound like common sense but it's not the sense we rely on today. If we were to make survival our top priority, it would radically shift what we focus on today. For example, we would be much more worried about 10 km asteroids and supernovas going off in our cosmic neighborhood. We don't see these issues on top of global agendas because of the misguided use of the notion of probability. A nearby super-nova probably won't go off in the next 50 years, so we don't pay much attention. Yet it may take us hundreds, perhaps thousands of years to engineer our defense against annihilating bursts of cosmic radiation. We simply can't afford to put off survival challenges.

ULTIMATE GOALS

We could have built our Agenda around 2050 milestones. Yet at this point in time, we believe it's more important to tear down the time wall inside our minds and anchor to the notion of ultimate goals that span generations, sometimes indefinitely into the future. It's all too easy to lose the plot when you are running an intergenerational relay. So let's think through the plot first before we busy ourselves with action.

ACTION WINDOWS

How much time do we have to act on each of these challenges? Many of our survival challenges come with a sharp deadline (even if we can't predict it yet) while all ascent challenges are infinite games. The entire stretch of time's arrow becomes personal—it's a series of action windows for our species!

Is this a good Agenda? It's a start. We've taken crude looks at the ongoing human project and put some stakes in the ground. We hope this will compel more minds to get involved and make it better. It's a conversation-starter.

THE HUMAN PROJECT AGENDA

CHALLENGE	ACTION WINDOW	ULTIMATE GOAL			
HOW WE SUSTAIN OURSELVES	URŞELVES We will always need power.				
HOW WE RESOLVE CONFLICTS	HOW WE RESOLVE CONFLICTS As long as there are memes of mass-destruction, we'll have to self-police.				
PANDEMICS	As long as we are biological beings, we'll be susceptible.	BIOLOGICAL DEFENSE			
VOLCANOES & EARTHQUAKES	Without better geophysics, we can't predict the next event with certainty.	MASTERY OF GEOLOGY			
ASTEROID & COMET IMPACTS	• IMPACT DEFENSE				
CHANGING CLIMATE	Without a complete model, climate could keep surprising us.	MASTERY OF CLIMATE			
COSMIC RADIATION	Without a complete inventory, we can't predict the next exposure with certainty.	RAD DEFENSE			
AGING SUN	We have one billion years.	NEW HOMES			
GALACTIC COLLISIONS	GALACTIC COLLISIONS We have 4 billion years until the Milky Way and Andromeda collide.				
ENTROPY	We have 10 ³⁰ years until our universe comes undone.	VICTORY OVER ENTROPY			
HOW WE SPEND OUR LIVES	This is an infinite game.	FREEDOM TO CREATE			
HOW WE CREATE KNOWLEDGE	This is an infinite game.	EXPLANATION OF EVERYTHING			
HOW WE USE KNOWLEDGE	This is an infinite game.	INFINITE BECOMING			
HOW WE SHARE KNOWLEDGE	This is an infinite game.	UNIVERSAL COMPREHENSION			
HOW WE ORGANIZE	This is an infinite game.	WISE ACTION			
HOW WE EXPAND OUR PRESENCE	This is an infinite game.	COSMIC CULTURE			

TIME'S ARROW

ORGANIZATION

So how should we organize to get the HUMAN project going? We think that operationally this organization should have a head, a heart and some limbs. We need the head to think critically about the future of our species (HUMAN Discourse), the heart to expand our circle of care and concern to the entire species including the stream of our ascendants (HUMAN Culture) and we need the limbs to render our visions into reality (HUMAN Ventures).

HUMAN Discourse

HUMAN Culture

HUMAN Ventures

A DIGITAL PLATFORM AND LIVE EVENTS WHERE WE THINK CRITICALLY AND DREAM UNAPOLOGETICALLY ABOUT THE FUTURE OF OUR SPECIES.

Yes, we believe we need a new platform for digital and live discourse dedicated exclusively to the future of the ongoing human project. Think about it: where does the conversation on the future of our species as a whole take place today?

At the United Nations, we look at the world through the lens of national sovereignty and inter-national cooperation. At the World Economic Forum, we look at the world through the lens of our sector affiliations (public, private, civil society). At the Clinton Global Initiative, we focus on a sub-set of global issues. There just isn't really a place where we look at everything from a species-wide perspective.

We can of course broadcast ideas at TED, Big Think, Google Zeitgeist Minds, World Economic Forum's IdeasLab; the problem is broadcasts fragmented across hundreds of channels don't add up to a structured, ongoing discourse. That's why we believe we need to create HUMAN Discourse, a 21st century platform that can become the default destination for all of us who are interested in advancing the HUMAN project. A place where we imagine better futures, set our agenda, keep tabs on our progress.

How many of us would want in today? Personally, we know of thousands. But we suspect we may number in the millions. We just need a way to find each other.

ORGANIZATION

HUMAN Discourse

HUMAN Culture

HUMAN Ventures

, A CULTURE LAB WHERE WE CREATE CONTENT THAT INSPIRE PEOPLE TO DREAM DREAMS THAT SPAN GENERATIONS.

So how do we find each other and inspire more and more people to see themselves as contributors to the ongoing human project? Big ideas packaged in engaging ways can be our beacons flashing in an ocean of mass-media.

This app / book is our first attempt to create a flash. We hope it can help us attract other creatives (you, perhaps?) interested in deploying their talents to produce media that gets more of us to spend our lives advancing the human project. One day there could be enough of us to produce a growing stream

of viral videos, apps, feature films, documentaries, trans-media campaigns, experiential live events, you name it.

Over time, we might be able to catalyze a cultural movement of people who see their lives as contributions to the ongoing human project, who are willing to pursue ideas that they will never see realized in their own lifetimes. And then... the values and ideas underpinning this movement just might become the cultural norm. What a wonderful day that would be!

ORGANIZATION

HUMAN Discourse :

HUMAN Culture

HUMAN Ventures

AN INCUBATOR FOR NEW WAYS TO ORGANIZE OURSELVES TO GET TRACTION ON THE HUMAN AGENDA.

How do we render our visions into reality?

There are many things we can accomplish through existing organizational forms like inter-governmental bodies, governments, businesses, academia, NGOs. Yet in many cases, to get traction on a species-wide challenge, we will need to conceive of entirely new ways to mobilize humans all over the planet to accomplish shared goals. Admittedly, it's hard to think outside of our existing organizational concepts while most of us are embedded in them.

We need to free our minds from the constraints of our past social inventions, many of which were designed to solve smaller scale issues on shorter timelines. That's where HUMAN Ventures comes in. We like to think of it as a launch pad for initiatives and projects that are difficult to get off the ground within our existing governance framework. Here we would have the freedom to experiment with new ways to make decisions and make things happen at a species-wide scale. And maybe one day our experimentation would lead to an evolving new paradigm for organizing ourselves. This is exciting stuff!

	THE HU	MAN PROJEC	CT
PURPOSE	[Secu	 re the survival and ascent of	
AGENDA	CHALLENGE	ACTION WINDOW	ULTIMATE GOAL
		TIME'S ARROW	•
ORGANISATION	F — — — — HUMAN Disco	Durse HUMAN Culture	F — — — — ¬ HUMAN Ventures L — — — J

We believe that turning the metaphor of the ongoing human project into an actual project is worth spending our lives on. But obviously, without a strong community of people who share this belief, our initial concept will remain just that—a concept.

With a good group of committed people, on the other hand, almost nothing is impossible. We could make this concept better or re-conceive of it entirely. We could design our dream platform to turn a conversation-starter into vigorous global discourse—who knows how different our Agenda would look 2 years from now! We could bring together the best visionaries of our times and get them to showcase their ideas in a live Battle of the Visions. We could pick up where Jacob Bronowski left off in his amazing BBC series The Ascent of Man and create a series exploring how we might continue our ascent and what it would take. Ah... the exciting possibilities!

If you find yourself moved by any of this, we should talk!

LET'S TALK

CHAPTER FIVE



FELLOW HUMANS,

Without human connections there wouldn't be an ongoing human project. We ascend through connection!

What we have tried to do with this book is to create a magnet of sorts—a reason for us to connect. We've got the WHY and our first take on the WHAT. There are a few extras in the iPad app, iBook and our website. But overall, what you see is all there is to it so far.

We don't know what this project can become before we find out who else resonates with the WHY. We are still a very small team without any infrastructure. We will build out as we go along.

For the time being, let's connect here:



Like









Watch



CREDITS

CREDITS

CHAPTER SIX

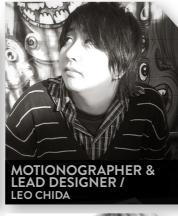
- 6.1 CREATIVE TEAM
- 6.2 AMAZING BACKERS
- 6.3 CREATIVE INFLUENCES







ERIKA ILVES







































THE 21ST CENTURY IS TRULY A NEW WORLD.

150 OF US MET ON FACEBOOK.

TOGETHER, WE LAUNCHED A CROWD FUNDING CAMPAIGN.

WE ATTRACTED 261 BACKERS; RAISED TWICE OUR FUNDING GOAL.

WE DO NOT KNOW AND HAVE NEVER MET MOST OF OUR BACKERS.

TO SAY THAT WE ARE BLOWN AWAY BY THEIR GENEROSITY IS AN UNDERSTATEMENT.





























CREATIVE INFLUENCES

We, the authors, learned from many members of our great species. In their turn, they learned from the millions who came before them. Here are some of the humans and organizations who have informed or influenced our thinking....

IPCC **CLIMATE CHANGE CONGRESS** CLUB OF ROME CARBON WAR ROOM DAVID FRAME NICHOLAS STERN STEWART BRAND MICHAEL R. RAMPINO

USGS

IUGS

NASA SPACEX INTERNATIONAL SPACE **EXPLORATION COORDINATION GROUP** RUSSIAN FEDERAL SPACE AGENCY RICHARD FEYNMAN SPACEGUARD FOUNDATION **ESA**

CARL SAGAN

NEIL DEGRASSE TYSON

FRED C. ADAMS WILLIAM NAPIER CERN BRIAN GREENE

ITER ISAAC ASIMOV

NIF MICHIO KAKU

WILLIAM C. POTTER GARY ACKERMAN **PUGWASH CONFERENCES PROLIFERATION** SECURITY INITIATIVE

DAVID DEUTSCH JACOB BRONOWS MILAN CIRKOVIC VACLAV SMIL

INTERNATIONAL COMMISSION ON INTERVENTION & STATE SOVEREIGNTY UN WORLD BANK JOSEPH NYE CARNE ROSS
PARAG KHANNA THOMAS BARNETT

WTO PAUL COLLIER WEF

OXFORD MARTIN NICK BOSTROM **BRIAN ENO SCHOOL**

XUETONG YAN MATT ROBERT WRIGHT

GLOBAL VIRAL FORECASTING INITIATIVE NATHAN WOLFE WHO LARRY BRILLIANT

> GLOBAL PUBLIC HEALTH INTELLIGENCE NETWORK

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CYNTHIA STOKES BROWN

FRED SPIER

INSTITUTE FOR ECONOMICS & PEACE UNDP JEFFREY SACHS MILLENNIUM VILLAGES CGI **BILL & MELINDA GATES**

INSTITUTE FOR ETHICS & CRAIG VENTER EMERGING TECHNOLOGIES ANDREW MAYNARD LIFEBOAT FOUNDATION ALI NOURI CHRIS PHOENIX MIKE TREDER CHRISTOPHER CHYBA ERNEST BECKER AUBREY DE GREY

IMAGINE

CHAPTER SEVEN



This is the end of this book but it could also be our beginning.

We are all contributors to the HUMAN project. What we do with our lives determines where it goes next.

If we learn well, one day we'll be looking for a new label and a new story.

HUMAN

would simply become too small, too tight to capture who we will have become.





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