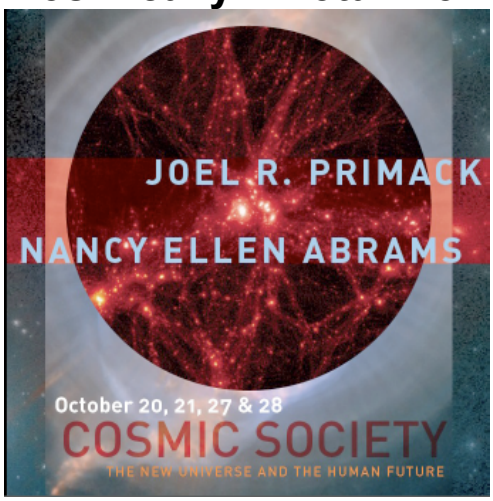
Lecture 3 – This Cosmically Pivotal Moment



NANCY – Welcome to the third lecture in our Cosmic Society series, This cosmically pivotal moment.

A moment is cosmically pivotal when the direction of the very long term future hinges on what happens in that moment. How likely is it that today really is a pivotal moment? The probability seems practically zero that in a 14 billion year old universe anything should be special about the vanishingly tiny window called 21st century Earth, so claiming that today is cosmically pivotal must be grandiose nonsense.

But don't look at the probability: look at the evidence.

The first thing we will do in this lecture is to outline how we today are in fact living at a pivotal moment, not only from the point of view of humanity but of the earth, the solar system, and the universe. Then we'll explore what the pivotal nature of this moment may mean and why it matters for all major political decisions being made today. Intentionally changing the course of post-industrial civilization has never been done before, but a cosmic society could do it. Joel and I are not arguing to use cosmology directly to reach better policy decisions. What we're advocating is using cosmology to develop an encompassing understanding of our planet – a new awareness of the cosmic context surrounding and to some extent controlling global human affairs and the human/Earth relationship.

In Lecture 1 we showed that the way people look at their cosmos is reflected in the way that they see their own culture, and if their cosmos is narrow and largely fictitious, their perspective on everything is narrow and largely fictitious. This is part of our problem today.

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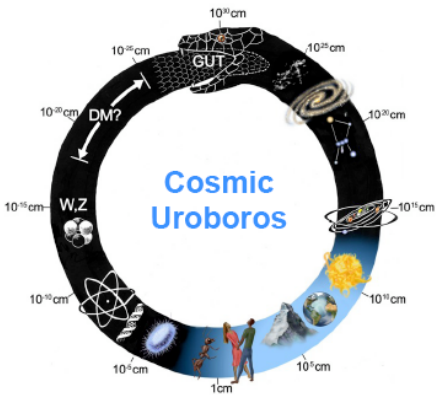

We showed that there is actually a largest and a smallest possible size permitted by the laws of physics, and they may be linked. We symbolized this with the Cosmic Uroboros, a serpent swallowing its tail, and in this finite but vast range of sizes, it turns out that we intelligent beings are central and couldn't be anywhere else. Our nature arises from the nature of the universe.

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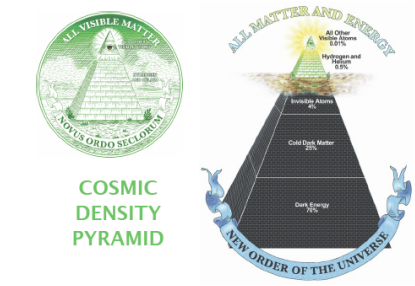

In Lecture 2 we showed that although we and everything we see, including the entire earth, are made of atoms, all the atoms except hydrogen and helium are very rare – and even hydrogen and helium make up a small fraction of the cosmic density. Most of the universe is made of dark matter and dark energy, whose dynamic interactions since the beginning of the universe have shaped the galaxies, the only possible homes where life could evolve. So we are made of the rarest material in the universe, but our existence is supported by a massive pyramid of invisible matter and energy.

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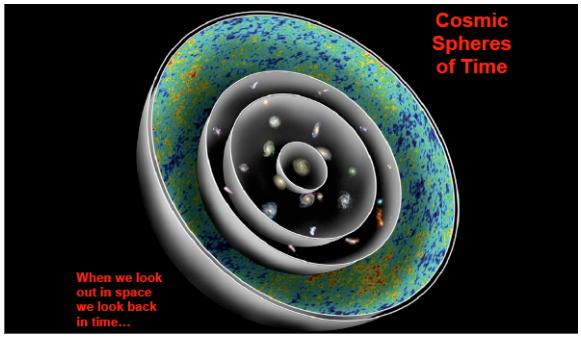

In Lecture 2 we also explained that, like all observers, we are located at the center of our cosmic horizon. We are surrounded by cosmic spheres of time, since as we look out into space we look back in time, and we are receiving radiation from all of these previous cosmic epochs.

In this lecture we focus on the pivotal nature of this moment in time because it turns out that by understanding the newly discovered larger universe we acquire new concepts that could give us the perspective we need to understand how our technologies are already having effects on the planetary and even cosmic time scales. But without these new cosmological concepts it will be very difficult to get a mental grasp on what we humans have to do to preserve ourselves and all our potential.

First, we have to start thinking cosmically about time, that is, on the time scales of the cosmos. The ability to think this way is new to our species – politicians certainly aren't using it yet, and in our daily lives it hasn't seemed useful to think much further into the future than next year, or when the kids go to college, or the family legacy. But this has to change, and it can. Let's look at how people's ideas of time have changed in the past.

For millennia it was assumed in the West, as Genesis implies, that human beings like us have been on the earth for its entire existence except for the first 5 days. Then in the 19th century the science of geology took off, and scientists tried to understand how mountains and river deltas formed. They were shocked to discover that some formations must have taken hundreds of millions of years! This was the beginning of the discovery of "deep time." Throughout the 19th century as excavation for railroads occurred across England and the United States, dinosaur bones and other fossils were uncovered, and the realization dawned on people that countless entire species had become extinct long ago. By the mid-20th century, scientists using radioactivity determined that Earth and the solar system itself are far older still – 4.6 *billion* years old. Compared to this vast age, we humans just evolved this morning. And we have appeared at a very particular moment – the Midpoint of Time.

JOEL:

What does The Midpoint of Time mean? Well…

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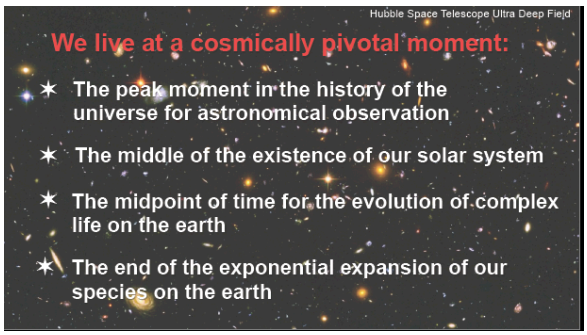
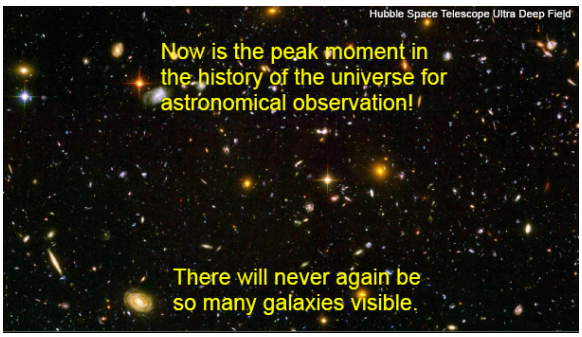


First, [CLICK] on the cosmic scale this is the peak moment in the past and future of the universe for astronomical observation. [CLICK]



How is this possible?

All distant galaxies are moving away from our Milky Way, and the farther away a galaxy is, the faster it is moving away from us. Because the expansion of the universe is accelerating, the most distant galaxies are beginning to disappear over the cosmic horizon. Meanwhile, in about five billion years our own Milky Way will merge with the Great Galaxy in Andromeda plus all their satellite galaxies, forming one big galaxy that we might call Milky Andromeda.

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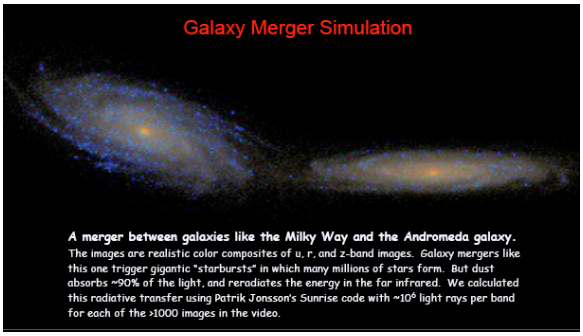


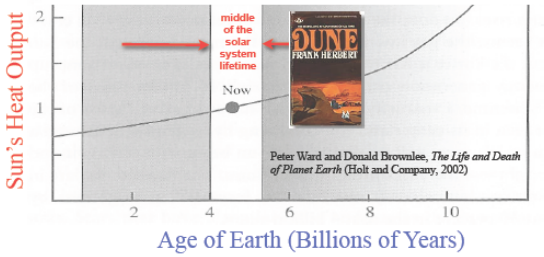
[CLICK]

First the galaxies pass by each other, with their gravitational interaction triggering a gigantic burst of star formation. Then their centers merge, and the surrounding stars form a big ball of stars without a disk, an elliptical galaxy. This process takes about two billion years.

When galaxies merge, almost no stars collide, because stars are so tiny compared to the immense spaces between them.

Far in the future, Milky Andromeda will be all that is visible to anyone living inside it, and it will be impossible forevermore to observe any other galaxies. It took billions of years of cosmic evolution to build up the stardust required for earth-like planets, and billions of years of biological evolution on Earth for creatures to evolve with the technological ability to see the distant galaxies, so such observations couldn't have happened much sooner than now. Thus this is the peak moment in the history of the universe for astronomical observation. There will never again be so many galaxies visible. So we astronomers are telling the funding agencies: Fund us quick!

Closer to home, we are living in the middle of the existence of our solar system. [CLICK]



In about six billion years the evolving sun will puff up into a red giant star that will swallow the inner planets of Mercury and Venus and possibly burn Earth to a crisp. Since, as I mentioned, the solar system is now about four and a half billion years old, this means we're close to the middle of the roughly ten-billion year lifetime of a star like our sun.

Third, on Earth we're living at the midpoint of time for the evolution of complex life. [CLICK] This is the middle of the approximately one billion year lush and habitable period of Earth's existence, when it has an oxygen-rich atmosphere and lots of water. **[CLICK]** The age of animals began about half a billion years ago when micro-organisms increased the oxygen content of the atmosphere to nearly its present level. But in another half billion years or so the increasing heat output of the sun will evaporate the oceans, the sun's ultraviolet light will dissociate the water vapor at the top of the atmosphere, and most of the hydrogen will be permanently lost. Earth will be come a "Dune" planet. [CLICK]

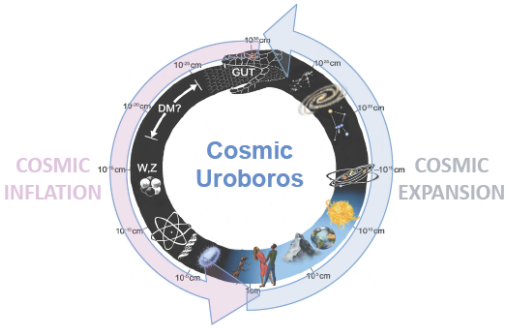
But **don't worry** – the sun will provide Earth with a perfectly livable amount of heat and light for at least several hundred million years – an almost unimaginably long time. Plus, as the sun heats up, our descendants will have plenty of time –

millions of generations – to move to another suitable planetary system, or move Earth farther from the sun. A way this could actually be done is by changing the orbits of large comets to borrow energy from Jupiter and transfer it to Earth. Every 100,000 years or so our distant descendents would need to do this – no rush. Carefully, of course.

[DON'T CLICK AGAIN!]

The fourth way that we are living at the midpoint of time is that this is a pivotal moment for humanity. Our collective behavior is mirroring the greatest pivot point in the history of the universe: the beginning. First let me explain what may have happened in the earliest instant of the Big Bang, and then we will get to the way humanity today is mirroring that instant.

There is substantial scientific evidence that a brief period called "Cosmic Inflation" may be what set up the initial conditions for the Big Bang. Cosmic Inflation caused the universe to expand exponentially, doubling in size again and again incredibly fast. This makes the universe have a very Euclidean geometry, as observed. [CLICK]



In that fraction of a second of cosmic inflation, the universe expanded from close to the Planck length all the way up to

the human scale. [CLICK] That is just as much, in powers of 10, as it has in the 13.7 billion years since. [CLICK] That's how fast exponential growth can be!

Quantum effects that were happening during the brief moment of Cosmic Inflation were also expanded exponentially. Then the exponential growth stopped, and those quantum effects froze into spacetime in a unique pattern of wrinkles, like the lines on your hand. Cosmic Inflation creates exactly the sort of fluctuations – small differences in the amount of stuff from place to place – that could grow with cold dark matter into the galaxy distribution we saw in the videos in Lecture 2 – the great chains, clusters, and superclusters of galaxies along the filaments in the cosmic web. This expanding cosmic web was the blueprint for our universe. It was created during the brief inflationary period, and the entire universe has been built on it. Thus the effects of the brief period of Cosmic Inflation can reverberate forever. That reverberation in some sense *is* our universe.

All the interesting parts of the story – the growth of galaxies, stars, heavy elements, planetary systems, life, and intelligence – happened after the exponential expansion of Cosmic Inflation.

How reliable is this theory of Cosmic Inflation? It makes six predictions, and thus far five have been tested and found to agree with observations. Cosmic Inflation is the only theory known that sets up the proper initial conditions for the big bang. It also appears to be compatible with modern particle physics theories. It is definitely a theory to be taken very seriously.

Now here is how our collective behavior is mirroring the beginning of the universe.

Humanity has recently been going through its own version of inflation, growing exponentially in population and in our impacts on the earth. Exponential growth occurs whenever the rate of growth of something is proportional to the amount of that thing. Compound interest works like that. A certain time T is required for the amount to double. After twice that time, the amount has doubled again. Another T and it doubles again. Let's illustrate this with hypothetical "pond scum" that can double each day.

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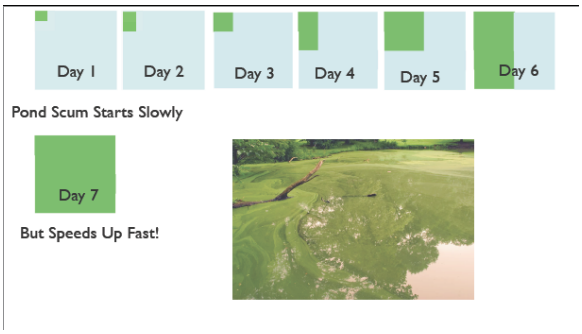

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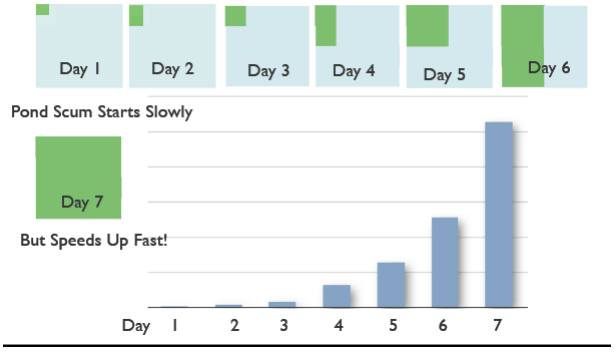
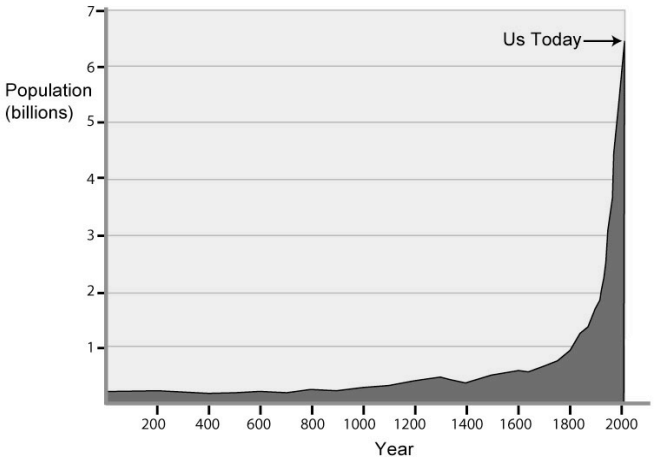
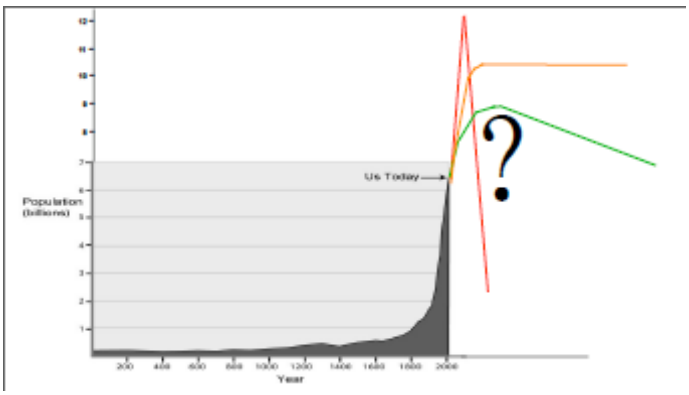


In any finite environment, exponential growth must end.



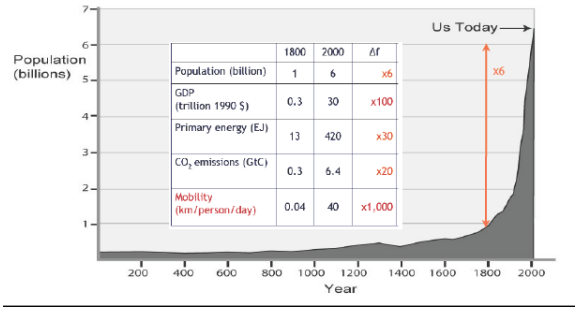
This is a graph of the human population over the last 2000 years. Exponential growth always ends, and this is true of the exponential growth of the human population over the past two centuries. In 1800 there were about a billion people on earth. In the past two centuries the population has increased by a factor of 6 [CLICK], with two doublings in the 20th century alone. Population experts agree that the earth cannot support another doubling of the human population. [CLICK]



In biology, inflationary growth occurs when a species gets into run-away reproduction. It over-consumes the resources of its ecological niche and then there is an abrupt die-off. Thankfully, we humans now know enough to be able to foresee such dangers. Are we smarter than pond scum?

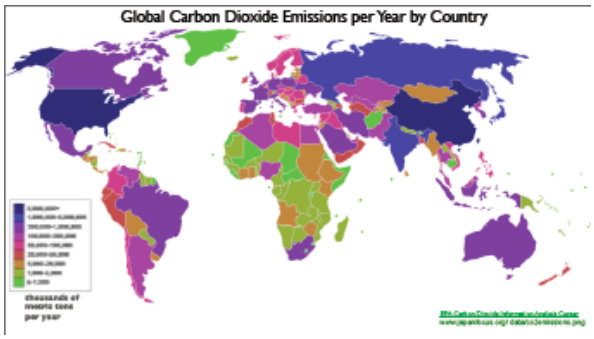
There has been even faster exponential growth in our use of natural resources. [CLICK]

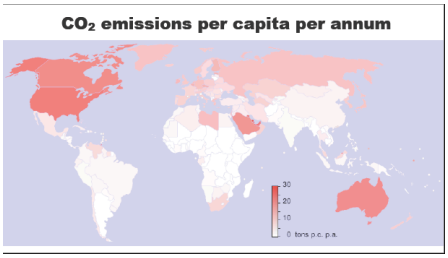
EXPLAIN GRAPH!



NANCY

The U.S. and a few other countries are producing far more than our share of carbon dioxide. [CLICK]





NANCY

But it's not just CO2. [CLICK]

As the figure shows, a typical person in the United States uses his or her weight in materials, fuel, and food *every day*.

For everyone in the world to reach present U.S. levels of consumption, as billions aspire to do, would – with present technology – require four more planet Earths. Increases in greenhouse gases are now causing worldwide climate changes, the effects of which we are already seeing in the form of record-breaking heat waves and the melting of the polar icecaps. We are running out of fresh water and topsoil worldwide. We have destroyed more than half of the earth's forests and wetlands, and we are appropriating for human consumption a large and increasing fraction of the biological productivity of the entire earth. Our actions are killing not just individual organisms but wiping out entire species at the greatest rate since the extinction of the dinosaurs and many other species after a meteor impact 65 million years ago. Clearly we are already beginning to hit material limits. We need to figure out *quickly* how to transition out of this current period of worldwide inflationary growth in our impact on the earth, but to do so as gently and justly as possible.

There is a strong parallel between the brief transition from cosmic inflation to steady expansion of the universe, and the brief transition on Planet Earth from human inflationary

growth to sustainability. We're living through that transition right now. By the time this kind of problem becomes obvious enough that everyone recognizes it and the detractors have shut up, it's too late. Sometimes a cartoon says it all.

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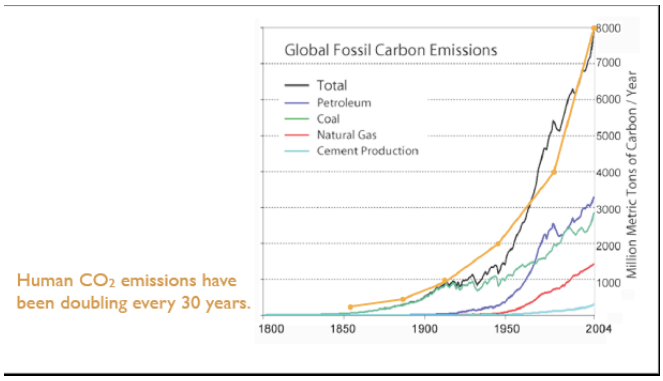
JOEL [CLICK]



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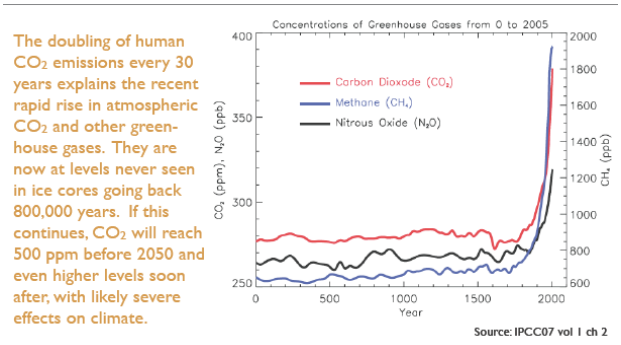

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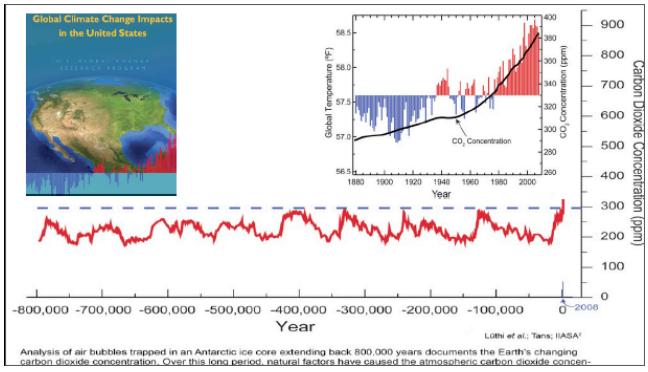

[DON'T CLICK AGAIN!!!!!!]

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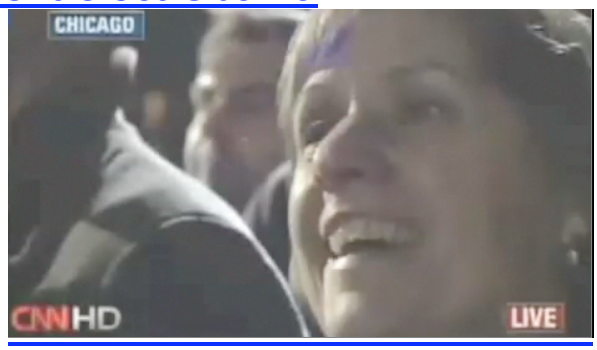
NANCY
In his election night victory speech, then President-Elect Obama told the story of a 106 year-old voter he had met named Ann Nixon Cooper and the momentous changes she had seen in her lifetime.

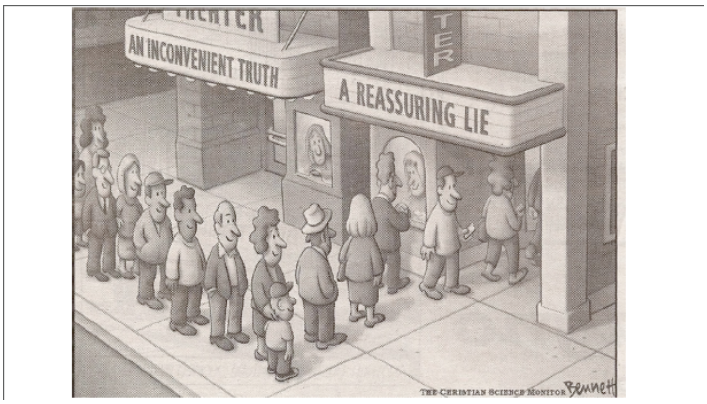
VIDEO: President-elect Obama



President Obama has challenged the nation to think 100 years ahead to a time when his daughters, Malia and Sasha, might be as old as Anne Nixon Cooper. Let's call that time – the year 2108 – the "Malia-Sasha Horizon": if our political leaders, business leaders, cultural leaders and voters simply

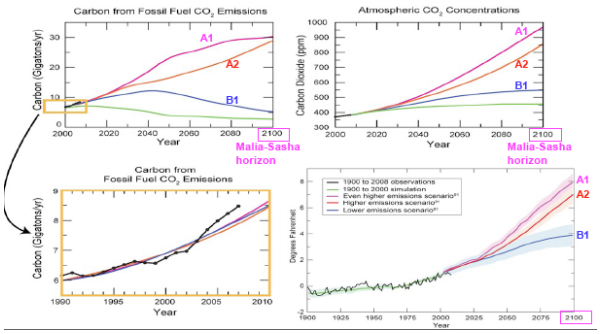
began today to consider as *real* the impacts of their own decisions just out to the Malia-Sasha Horizon, this would be a giant first step in expanding our practical consciousness to include cosmological time. The first step is the most important. It sets the direction and overcomes inertia.

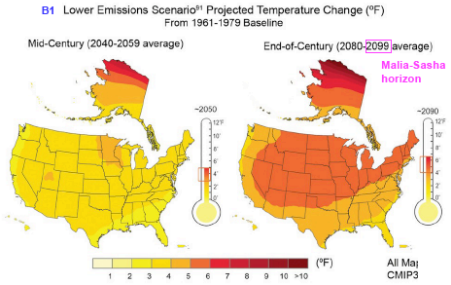
In 1976 I was a young lawyer at the Congressional Office of Technology Assessment, which provided independent science advice to the US Congress. It was abolished after the Republican revolution of 1994. My office already saw evidence in the 1970's that the earth was warming, that cheap oil was running out, that our health care system was unsustainable. The job of my own section was to think about the long term, but the longest anyone ever considered was 30 years. In Washington, where major decisions can be made with an eye to the current crisis or the next election, most people considered 30 years an absurdly luxurious and highly unrealistic timeline, and they didn't take it seriously. And the result is that now those 30 years have passed, and every one of those problems has only gotten worse. Now time is running out. We can't continue this exponential growth rate of resource depletion and degradation of the atmosphere. [CLICK]

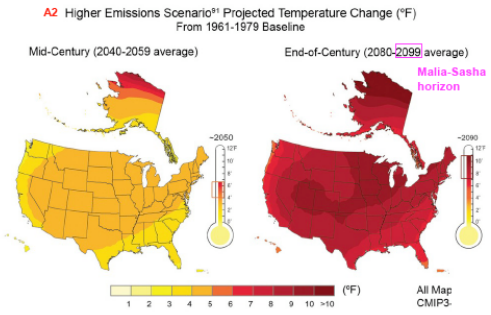


But simply knowing this, is clearly not enough.

JOEL
Now let me link all this to the Malia-Sasha Horizon.







NANCY

There is no question that we have to stop bingeing on carbon-based energy sources. But there are lots of questions about how best to do that. One of the big questions is the role of nuclear power. In the 1970's and

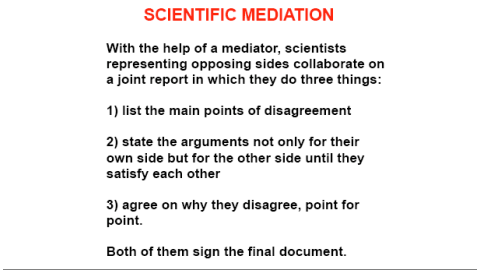
1980's the dangers of nuclear power combined with its huge expense convinced many of us that nuclear was not a long-term solution. Even today, our country still hasn't figured out how to dispose of nuclear waste in a way that will be safe for the tens of thousands of years it will remain radioactive. These are major negatives for nuclear power.

But on the other hand, we have a potentially much bigger crisis on our hands if humanity keeps pouring carbon into the atmosphere, the climate destabilizes, ocean currents change, and around the world there are extreme droughts, starvation, wildfires, floods, diseases spreading where they never appeared before, and countless climate refugees roaming the globe and fighting just for a place to live. So on second thought, if nuclear power could seriously help avoid this fate, we have to reconsider it with an open mind and ask, could it be made safe and economically competitive? How so? And which version would be best?

But whom can we trust to answer these questions? Not the utilities, whose goal is their bottom line. But the relevant government agencies, besieged by lobbyists and the media, and juggling economic, political, and social pressures, rarely have the ability to figure out what are the scientifically most responsible answers.

I invented a method to deal with this kind of situation when I was working at the Office of Technology Assessment. It's called "**Scientific Mediation**." It's never been attempted in the United States, but it was very successful when the Swedish government used it to help determine if their utilities' plan for nuclear waste disposal was "adequate." The result was so illuminating that Scientific Mediation became standard procedure in the Swedish Ministry of Industry.

To do a Scientific Mediation, a government agency basically only needs three people: one well-respected expert scientist on each side and a mediator. I played the role of the mediator in Sweden. Each scientist believes that the existing data favors his or her position. With the help of the mediator the opposing scientists must collaborate on a joint report in which they do three things: [CLICK]



1) list the main points of disagreement;
2) state the arguments not only for their own side but for the other side until they satisfy their opponent that they understand his or her position
3) agree on why they disagree, point for point.
Both of them sign the final document.

Scientists and other expert advisors to government are human beings like everyone else. They can mix personal biases into their official opinions, sometimes without realizing that they are doing it. But during this unusual procedure of scientific mediation, those biases surface and it becomes clear which of their policy recommendations, if any, are truly based on science. When their report is made public, anyone can understand the dispute and what is at stake – far better, in fact, than the scientists themselves did in the beginning.

If some government agency or private foundation sponsored a real scientific mediation on the question of whether nuclear

power could be made safe – or any fundamental scientific question underlying a current policy dispute – we the people would come out of it with the best understanding possible at this time, and one that would be fair to all sides. That alone would be invaluable. What the country decides to do about it – let's battle it out! That's what politics is for, and a cosmic society will still be a political society. But let's first demand that all options being fought over are grounded in reality. We're looking for a sharable picture of reality that is based on science and from which we can proceed to plan our future.

[click]

Cosmology is not necessary to diagnose our global predicament – many people see it – but cosmology could help us see a way out.

The universe's inflationary period ended with a Big Bang -- but this was good! Only after inflation did the universe enter its most creative and long-lived phase. Evolution requires time! The fundamental character of the universe has been to grow in complexity. This could be our future too. That pivotal moment when the universe transitioned from exponentially explosive growth to slow expansion could become a model for how to think about the transition to sustainability that we humans are about to make. Here's what we mean.

Like the quantum fluctuations that froze into wrinkles in spacetime when inflation suddenly stopped, political and social decisions made during these final years of human inflationary growth may end up getting frozen into the future of our species and our planet. Nothing could be less useful than to think that politics doesn't matter. Today's actions – and failures to act – may reverberate into the distant future far out of proportion to the thought that is going into them.

On the plus side, there are fine people genuinely trying to save the earth, but many of them assume that the only solution is that growth of population and of resource use must stop and then decrease. But if we take the universe as our model, we notice that at the end of cosmic inflation the universe in fact did not stop dead, like a truck hitting a brick wall. The exponential *rate* of growth stopped, but not growth itself. The universe slammed on the brakes, slowed to a crawl, and kept going for the next fourteen billion years with no wall in sight. Inflationary growth that is transformed to slow but steady expansion can go on for billions of years. For us this means that the end of exponential growth, which is approaching, is like the end of adolescence; it's a coming of age, and from then on the growth of complexity in human civilization won't be physical anymore but intellectual, emotional, artistic, relational, and spiritual.

In this age of electronics and information it should be possible for humanity to achieve sustainable prosperity without profligate resource use. In fact, only without it. If we take the universe as our model, we should plan for and seek a *stable* period in resource use, which can only happen with renewables. The universe, of course, made this shift naturally; for it, injustice, suffering, addiction, and fatalism did

not have to be overcome because they didn't exist, but for us they do. Nevertheless, we have the knowledge and internal resources to overcome them.

Only resource-heavy activities have to slow down. Our drive for meaning, spiritual connection, personal expression, and cultural growth can be unlimited. If those were valued above consumer goods – which they tend to be only after people lose them – then we would have a new paradigm for human progress. For our universe the most creative period came *after* inflation ended, and this could also be true for humanity.

A stable period can last as long as our creativity stays ahead of our physical impact on the earth. The key to sustainability is to find the ideal growth rate that allows human ingenuity to stay just ahead of resource use by foreseeing and minimizing consequences. People sometimes assume that to maintain a stable environment, innovation must be suppressed. But the opposite is the truth! Nonstop creativity is essential to maintain long term stability.

Those of us who are alive today, and especially you who are young, will determine whether this happens – or not. Either way is a huge choice that will determine the character, for better or worse, of the long term future.

This is what it means to be living at a cosmically pivotal moment.

JOEL

I want to give you an example that pulls together in a very practical way the idea that we are living at a pivotal moment with the idea from lecture one that different ways of thinking

are required on different size and time scales. In this example you will see a stark mismatch between today's very short term economic and political thinking, and potential long term consequences for the entire planet and all future generations.

Destruction of the space environment by space debris is the problem, and Nancy and I have been working for years to solve it. In 1988 Nancy and I traveled to the old Soviet Union in a collaborative effort of American and Soviet scientists and international lawyers. We were trying to end the practice of launching nuclear reactors into orbit to power satellites. Those reactors would eventually become radioactive space debris. The USSR had already launched about 40 of them, and two had fallen, one of them contaminating a 200 mile swath of northern Canada with radiation.
[CLICK]

NUCLEAR POWERED SPACECRAFT successfully deployed in Earth orbit by the U.S. and U.S.S.R. are estimated to number 42. (Two are in distant orbits not shown above.) All the spacecraft, or their jettisoned power supplies, are now in orbits high enough so that they will not reenter the earth's atmosphere until their radioactivity has substantially decayed. Most of them, however, orbit in a region populated with space debris. A collision could send a large number of radioactive fragments along trajectories that would reenter the atmosphere in a few years.

CLEANING UP AFTER *RORSAT*: a Soviet surveillance satellite (*Cosmos 954*) reentered the earth's atmosphere over the Northwest Territories in 1978, littering radioactive debris over thousands of square miles.

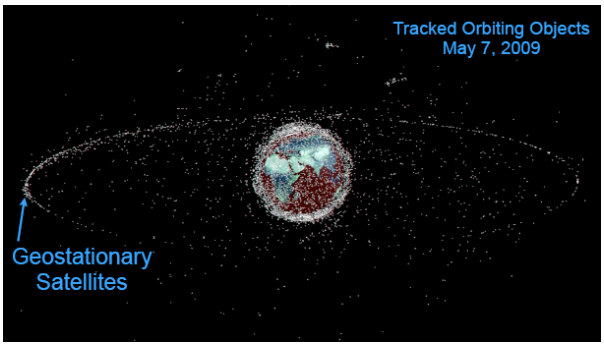
The U.S. meanwhile was planning to launch much bigger reactors to power missile defense, popularly known as Star Wars, and we thought that the USSR might be willing to stop if the U.S. would do the same. We actually got the Soviet government to agree not to launch any new reactors for two years, and by the end of that time the Soviet Union had ceased to exist and no additional reactors have been launched.

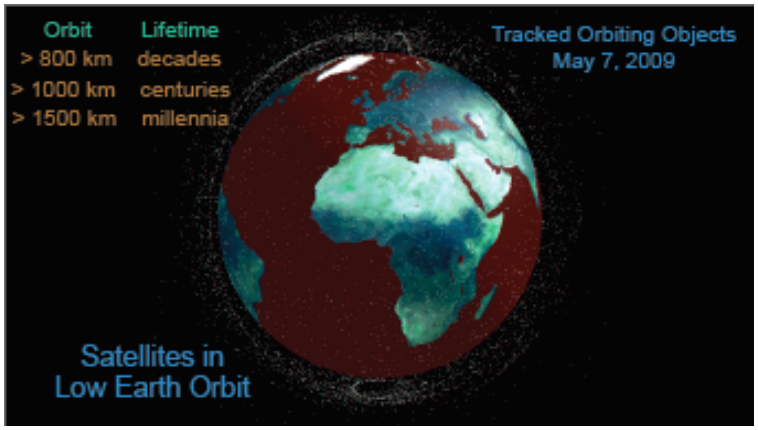
Many people heard about space debris for the first time on February 10, 2009, when an American communication satellite and a defunct Russian satellite, moving in different orbits at 17,000 mph, crashed into each other and broke up into countless pieces. When that kind of thing happens, it's not like the science fiction movies where there are big explosions and then space clears.

[CLICK] In this scene from the first Star Wars movie, you see a big explosion and then a moment later the pieces disappear and the view from the cockpit is completely clear.

What really happens in a collision in space is that some pieces fall toward Earth and burn up in the atmosphere, but the rest go into erratic orbits. They move at speeds ten times faster than a high-powered rifle bullet. As the number of satellites and pieces of satellites at a given altitude increases, eventually a chain reaction begins: with enough orbiting debris, pieces will begin to hit other pieces, smashing them into fragments, which will in their turn hit more pieces. This process may already have begun.

Over ten thousand pieces larger than 10 cm in size are now tracked, but countless smaller ones are not tracked. No one knows exactly where they are. [CLICK]





This issue matters because space is our most fragile environment – it has the least ability to repair itself. Only the Earth's atmosphere can remove satellites from orbit.

When the sun flares up in its eleven year cycle, it heats the upper atmosphere and makes it expand so that debris and spacecraft in low orbits are subjected to increased drag and start to come down. But the higher the original orbit, the less air there is to collide with, and with high enough orbits there is nothing that can bring them down.

Terrible as they are, millions of land mines left from earlier wars in Afghanistan and other countries can eventually be removed, but

[CLICK FOR WORDS]
Debris in orbit higher than about 800 km above the Earth's surface will be up there for decades
above 1000 km for centuries
and above 1500 km effectively forever.

There no known way to clean up space debris. Any bucket put up there to catch the pieces would just become debris itself.

NANCY
When you realize how long a civilization humanity could have and how much we have to do NOW to protect that future, you realize the importance of this issue. We're not going to want to give up satellites! If our future development is going to be based on improved cultural links rather than endless resource consumption, we have to protect the means of communication. We'll need satellites for a very long time, but we can't keep launching new ones indefinitely without bringing down the old ones. What are we thinking?

Once we realize we are at the midpoint of time, it becomes common sense – a new common sense – to insist that every satellite launched by anyone in the world have a rocket on it that allows it to be brought down safely. Humanity only gets one chance to save space for all future generations, and now is it.

JOEL
But accidental collisions of space debris are not the worst threat to the space environment: the worst threat is war in space. The public debate over Star Wars has gone on and on in the United States for a quarter of a century already, since the Reagan years, and it has focused on the massive cost and the unlikelihood that the system could work. But

the debate has almost completely missed the most crucial point: even one war in space will create a battlefield that will last effectively *forever*, encasing our entire planet inside a shell of speeding metal shards. This will make space near the earth highly hazardous for peaceful as well as military purposes. No actual space war even has to be fought to create this catastrophe. Preparation for it is enough, because any country that felt threatened by some other country's lasers or other weapons in space would only have to launch the equivalent of gravel to destroy the sophisticated weaponry – but it would also destroy any civilian satellites at that altitude, like those we all depend on for weather information, global positioning systems, and communications.

NANCY

Political alliances are always shifting, sometimes drastically. Our deadliest enemies a mere 65 years ago, the Germans and Japanese, have been among our closest allies for decades already. It may seem that jazzy new weapons in space will give us a leg up over the arch-enemy of the day, whoever it may be, but in making this choice we become our

own arch-enemy. Any temporary military advantage would pale before the overwhelming, eternal immorality of imprisoning Earth for thousands of years in a halo of bullets – the most evil possible twist on the idea of a halo.

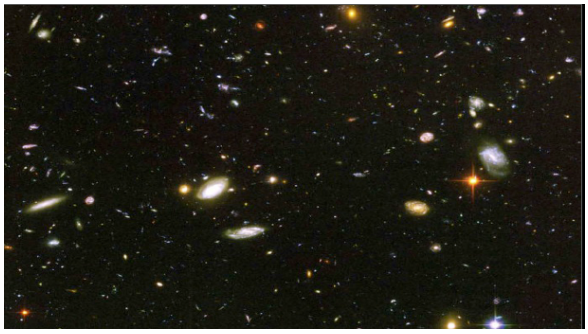
No one can predict what the country will be like when Malia and Sasha are old, but we have a moral obligation to take into account the likely impacts of our own current decisions out at least to the Malia-Sasha Horizon. And we have an intellectual obligation to base those projections on solid science, which will require new approaches like Scientific Mediation to get that level of science into the policy-making process.

How should we start thinking about the long term? Some Native Americans have the concept of responsibility "to the Seventh Generation," a wonderful impulse that I believe some paper towels have been named after, but the phrase is wrong for our time, because it makes it sound as if every generation has the same level of responsibility. But we who are alive today have a far larger responsibility than earlier, less knowledgeable generations or later, less pivotal generations. No one actually *chose* us; we happen to be the ones living at what must be the end of human inflation.

But the end result is that we and our children may be the most significant generations of humans that have yet lived.

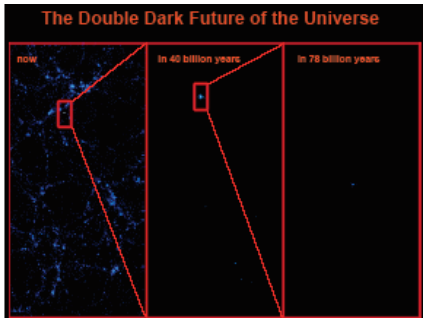
The real challenge of our time is to understand Nature *in order to harmonize our behavior with Nature*, not just to exploit Nature technologically while generating heaps of garbage and unhappiness.

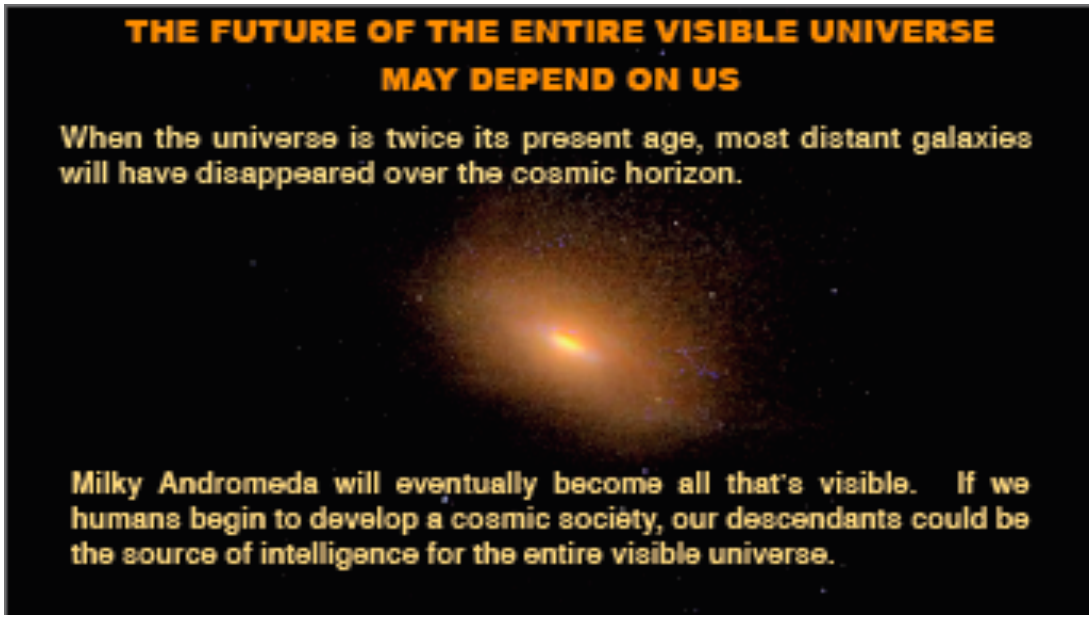
JOEL



How important is it to take a cosmic view *now*? It turns out that the entire future of the visible universe may depend on what we 21st century humans collectively do at this moment of transition. That's not an overstatement – here's why. We actually know something about the future of the universe.

We can let this computer simulation run into the future, and what happens is that the universe empties out as the dark energy takes over. [CLICK FOR SLIDE AND EXPLAIN BRIEFLY]



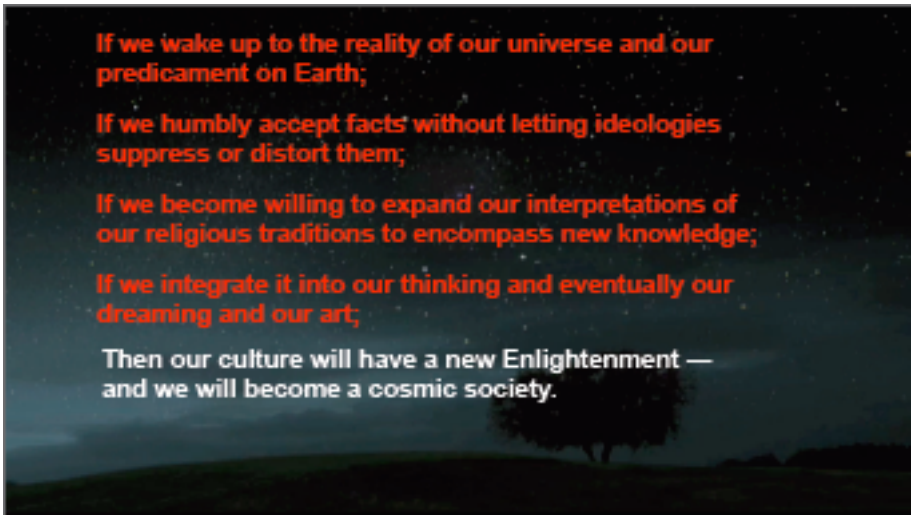


[CLICK AND READ BOTTOM PARAGRAPH ON SLIDE] When Milky Andromeda has become, for our distant descendants, the entire visible universe, our descendants could have radiated life and intelligence throughout it. In short, our descendants *could* be the source of intelligence for the entire future visible universe!

Alternatively, today's humans could keep thinking small, refuse to face reality, and over the next few decades destroy the necessary conditions for our kind of life to survive. The vast majority of Earth's species have gone extinct. There is no special dispensation for our branch of the primates.

But the fate of other species is no excuse for giving up on ourselves, because the very fact that we can understand this and discuss the options proves that we have the huge advantage of foresight.

NANCY [CLICK FOR TREE – WORDS COME LATER]



There may be microbial life on many other worlds, but it took an outrageously improbable series of events on Earth plus multiple cosmic catastrophes to earlier species like the dinosaurs before humans could evolve. Earth is our only example of the evolution of life. If those low probability events are essential, then our level of intelligence (and higher) may be extremely rare. Of course, we're all interested in discovering intelligent aliens out there, but we may actually be the only intelligence of our kind. Will there be consciousness and meaning in the future universe? Or will there just be sound and fury signifying nothing? That could be what's at stake in this cosmically pivotal moment.

Several times I have heard people say that Earth would be better off without humans because we're wrecking the environment. They claim that human extinction might not be such a bad thing. But from the point of view of *the universe as a whole*, intelligent life may be the rarest of occurrences and the most in need of protection. We, and in this "we" I include all intelligent, self-aware creatures that may exist – we are the universe's only way of reflecting on itself. Together we are the consciousness of the universe. The entire universe is meaningless without us. I'm not saying the

universe doesn't exist without intelligent beings. Something would exist, but it wouldn't be a universe, because a universe is an idea, and there would be no ideas.

Earth's problem is not the presence of intelligence: it's that perhaps we're not intelligent *enough* to take a cosmic perspective – yet.

Our challenge is to break through and *see* the truest universe of our time not just as physics but as our shared mental homeland – a homeland where cosmological time is a normal perspective and global threats that may not spin out of control for another generation are nevertheless as *real* as a hurricane that will hit your home tonight.

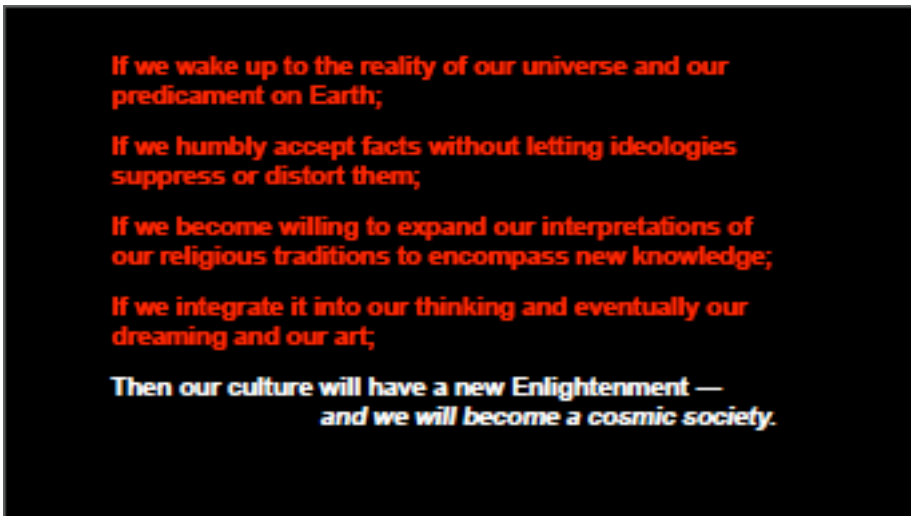
Our challenge is to develop a cosmological vision that can be widely understood and shared, irrespective of religion, and is grounded in scientific understanding of both the universe and human behavior, since our reality is an interaction of the two.

A coherent, shared cosmology like this was for earlier cultures a source of bonding power that enabled people to cooperate in ever larger groups, and this is what made civilization possible. A global civilization will need to cooperate in much larger numbers.

The rapidly growing countries like China and India must be included in this consensus. Our scientific understanding of our human predicament may be the most important thing that we all have in common.

Will we rise to these challenges? One thing is certain: if we create this vision, if we commit ourselves to implement it within the known laws of the universe, and if in doing so we create a de facto community that supports and loves the

vision, we will dramatically raise the probability that the answer will be yes. [CLICK FOR RED WORDS]



SLIDE

If we wake up to the reality of our universe and our predicament on Earth;

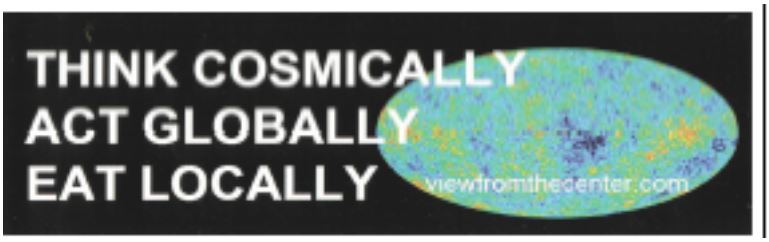
If we humbly accept facts without letting ideologies suppress or distort them.

If we become willing to expand our interpretations of our religious traditions to encompass new knowledge;

If we integrate it into our thinking and eventually our dreaming and our art; [CLICK FOR CONCLUSION]

Then our culture will have a new Enlightenment: and we will become a Cosmic Society.

[CLICK]



[CLICK]

Please join us tomorrow for the last lecture in this series, Cosmic Society. THANK YOU.