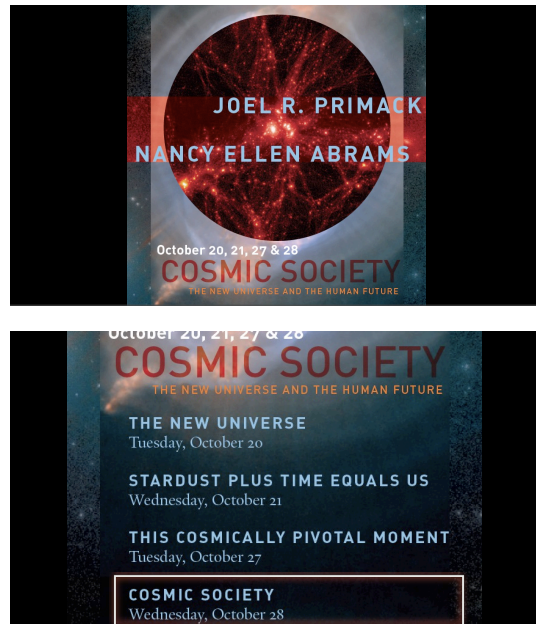


Lecture 4 with Graphics.docx



NANCY

In the modern West and many other countries, we have a gap in our thinking that may never have existed in human society before. We have no shared cosmology -- no meaningful sense of how we actually fit into the big picture. The countless complications of daily life distract us, so few of us ever stand back and notice that we have no coherent context in which to understand what we face together.

In the 3d lecture we emphasized that humanity is at a pivotal moment because we have been going through an unprecedented period of exponential growth not only of our population but our impact on the planet. Humanity is running out of fresh water and topsoil worldwide, destroying the forests, decimating fish stocks and many other species, pouring carbon dioxide and other greenhouse gases into the atmosphere, changing the climate, and in many other ways simultaneously hitting the limits of exponential growth. We explained that the early universe also hit the limit of exponential growth in what is called cosmic inflation. After

cosmic inflation the universe continued to expand but far more slowly, and this transition could be the model for the transition we need to make to a slow but sustainable period of growth. In this final lecture we want to look more deeply into the potential role of a meaningful cosmology in contributing to the kind of thinking that might actually allow this transition to happen in a sane way.

Dedicated people all over the world are working on solutions to individual global problems, and they're experimenting with new ideas and technologies. But even if there were a brilliant and complete blueprint for renewing the earth and building a sustainable, vibrant, and just worldwide civilization, it's still unlikely that people today could agree on implementing it.

A blueprint for saving the earth, fantastically useful as that would be, would not on its own convince the world that success is possible and therefore worth the cost today. What we need is a big vision – a new way of thinking, which, if enough of us shared it, would encourage us to act together. We need to feel and know in our bones that Something much bigger is going on than our petty quarrels and obsession with acquiring material things, and that the role we each play in it defines the real meaning and purpose of our lives. Lots of people, religious and non-religious, intuit this, but they can't agree on what the big picture is or what it demands of us because their individual views have no framework in which to contemplate the global size scale of our problems. But we are all playing a potentially cosmic role whether we know it or not.

The great mythologist Joseph Campbell, in his last book, *The Inner Reaches of Outer Space*, argued passionately that what the modern world needs more than anything else is a story that unifies.

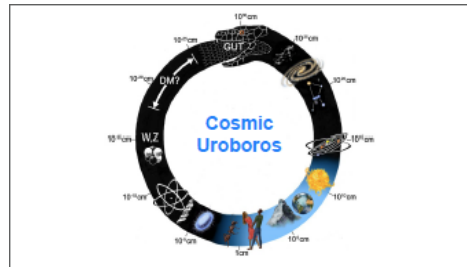


"The old gods are dead or dying and people everywhere are searching, asking: What is the new mythology to be, the mythology of this unified earth as of one harmonious being?"

Joseph Campbell, in his last book, *The Inner Reaches of Outer Space*

We humans are crossing right now from tens of thousands of years of imaginative origin myths to the origin myths that future generations will accept and live by, which will not only be verified by science but often *inspired* by science. A variety of people from scriptural literalists to corporate polluters to postmodern philosophers denounce or dismiss science, but if they ever take a modern medicine or fly on a jet, they're trusting their lives to science, and that's a much more reliable sign of what they believe than their soundbites are. Some groups will always cling to old ideologies, but science is now a worldwide collaboration, and its discoveries are available to everyone. The new cosmology is the only possible foundation for a globally unifying story of ourselves. It would not, however, impose a single way of thinking on everyone's lives. Humans are endlessly diverse, and this is our great strength.

[CLICK for Uroboros]



Remember that – as illustrated by the Cosmic Uroboros – on different size scales different laws control events. What this suggests here is that we can preserve diversity on the scale of humanity’s local lifestyles while finding consensus on the encompassing scales of the planet and the universe.

No one in an age of computers and other electronics based on quantum mechanics, and global positioning systems based on general relativity, can seriously argue that there is no reality beyond the visible. But how do we get a handle on the whole thing, and how could that help us? Cosmologies came into existence to do that. A cosmology is a language of metaphors and images that lets its believers feel they have a handle on reality beyond the visible, and helps them find inspiration in it. Every cosmology includes an origin story, which explains our place in time. In this final lecture, we are returning to a fundamental problem raised in the first one: that in the high places of human consciousness where cosmic mythologies took our ancestors, a narrative darkness enshrouds our bright little lives.

People who have no believable origin story for themselves rarely realize what they’re missing. Let’s look at this on a more local level.

[CLICK]

The origin story of our nation – [CLICK]



the Boston Tea Party,

[CLICK]



the ride of Paul Revere, the Declaration of Independence,

[CLICK]



[CLICK]



[DON'T CLICK AGAIN!]

the Revolutionary War, the Constitution,

the Bill of Rights, the brilliance of our Founding Fathers – all these are elements of the American mythology that binds our citizens together in a shared venture of upholding freedom and democracy, although none of us were actually there to witness any of these things. Even our name, “the United States of America,” tells a story.

In the same way but on a much larger scale, to bind a global community together in the shared venture of preserving and protecting the conditions for our children and grandchildren to thrive on this spectacular planet, we humans need to see that the through-line of our species back beyond our earliest ancestors, and back through the preceding cosmic events is *everyone's* origin story. This story explains how we intelligent beings fit into the universe, and how deep and ancient an identity we share with each other. We are part of a phenomenally rare and cosmically important event: the emergence of intelligence and civilization in a universe that was once nothing but particles and energy.

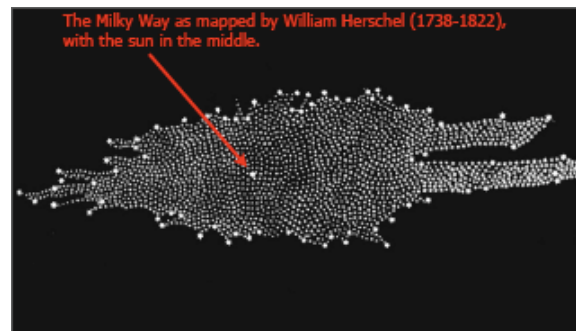
“In the beginning”is the way origin stories traditionally open. But now the phrase “In the beginning” **must** be followed by “of “ and then (something).”

A “beginning” is not something that exists in itself but a way people think about what may exist. It is a way of drawing a line. We can say, “In the beginning of Earth” or “In the beginning of the visible universe,” but “In the beginning of ‘everything’ ” is not a clear notion until you can define “everything” – which you can’t if you don’t have a convincing origin story.

What is the new origin story for our visible universe? Let’s construct it backwards, the way science discovered it.

JOEL

In the beginning.... of the twentieth century, most astronomers believed that the Milky Way was the universe. [CLICK] This slide shows the Milky Way as mapped by William Herschel, with the sun incorrectly located in the middle.



The blurry objects astronomers observed were called nebulae – that is, they were interpreted to be clouds of gas. But Edwin Hubble discovered in 1924 that some of the nebulae are actually galaxies far beyond the Milky Way. Suddenly the universe became incalculably vast and our Galaxy just one among many. Then in 1929 Hubble made an even more stunning discovery: the distant galaxies are all moving away from us, and the farther away they are, the faster they’re moving. Hubble had discovered the expansion of the universe. This had actually been predicted

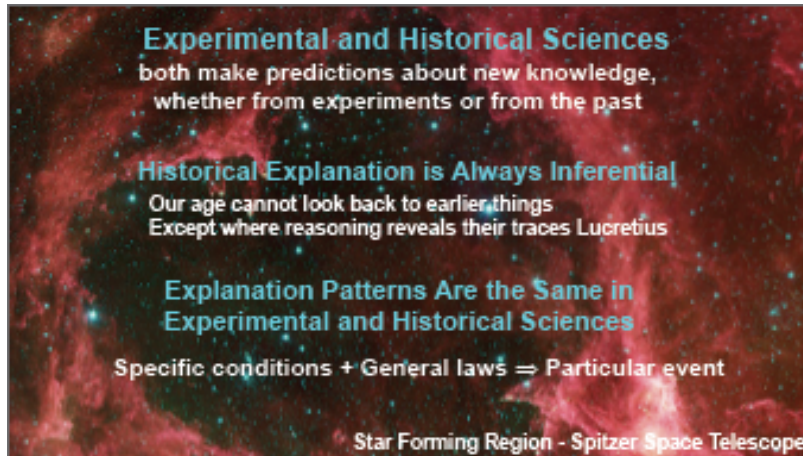
by Alexander Friedmann and Georges Lemaitre using Einstein's general theory of relativity, although Einstein himself resisted it. And reasoning backwards, there had to have been a time when everything was together – now called the Big Bang. But there was no direct evidence for that yet.

In the mid-twentieth century there was lively debate in astronomy between the Steady State theory and the Big Bang. The Steady State proponents argued that the universe is basically unchanging, with matter constantly appearing to form new galaxies as the old ones expanded apart. The Steady State theory was seriously undermined by the discovery in 1965 of the heat radiation of the Big Bang, and also the discovery that very distant galaxies aren't like nearby ones. This showed that the universe has been evolving since the Big Bang.

We explained in Lecture 2 that since the discovery of the accelerating expansion of the universe in 1998 all the evidence supports one cosmological theory, the Double Dark theory, in which galaxies and groups and clusters of galaxies are formed and held together by dark matter, while these gravitationally bound structures are being accelerated apart by dark energy.

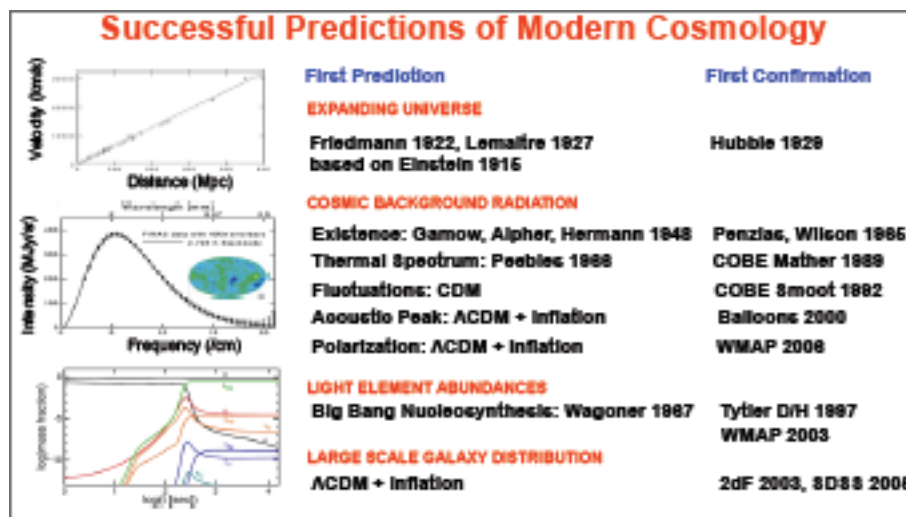
Cosmology is an historical science, like geology and evolutionary biology. These sciences attempt not only to understand the way the universe, the earth, and living systems work, but also the actual historical paths that led to the present. It is sometimes claimed that, because the actual past was unique, the historical sciences provide a lower grade of knowledge than the laboratory sciences like physics and chemistry in which the effects of changing conditions can be explored in experiments. This claim that the historical sciences are inferior is especially popular with

people who prefer Biblical or other traditional accounts of our origins. It is also popular with postmodern thinkers. But this is a serious misunderstanding. [CLICK]



The epistemology of the historical sciences is actually very similar to that of the laboratory sciences. Both are based on repeated successes of theoretical frameworks in accounting for existing knowledge and predicting new knowledge. In the historical sciences, new knowledge is constantly produced as new areas are explored by new techniques. Let's look at the record of cosmology as an example.

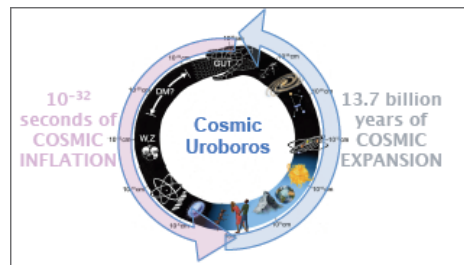
[CLICK and explain BRIEFLY]



This continuing pattern of prediction and confirmation is why modern cosmology is now a mature science and why we have great confidence in it.

What led to the Big Bang? Our best understanding is that it began in a moment of exponential growth called cosmic inflation, and in the third lecture we discussed it, but let me briefly remind you. What would become our present visible universe began as what we might call a sparkpoint – a region so tiny it is nearly at the tip of the serpent's tail in the Cosmic Uroboros.

[CLICK FOR UROBOROS with arrows]



[CLICK for first arrow]

In a mere 10^{-32} seconds of cosmic inflation, that sparkpoint inflated exponentially by at least 30 orders of magnitude.

In that minuscule fraction of a second, it inflated to the size of a newborn baby; that is, from the tip of the tail of the Cosmic Uroboros halfway around to the human scale. Cosmic inflation set up the initial conditions for the Big Bang and spawned all the quantum impulses that have shaped the cosmic web and will continue to do so effectively forever. Then suddenly the baby universe went through a phase transition called the Big Bang and the rate of expansion dropped from exponential to slow and steady. [CLICK for second arrow]

From then to now, the presently observable universe has expanded around the rest of the Cosmic Uroboros and grown to the size of the present-day cosmic horizon.

This science is the basis of a new origin story. The story will no doubt go through many revisions both in emphasis and accuracy, but this is the first cosmological story we have ever had that is supported by a tremendous amount of solid evidence.

NANCY

Now let's think of this as an origin story.

In the beginning of the Big Bang was cosmic inflation.

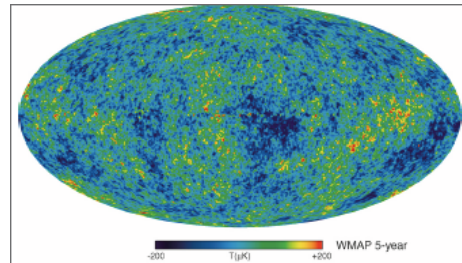
Spacetime came out of the Big Bang smoother than the smoothest lake, but not perfectly smooth. It had wrinkles perhaps as small as elementary particles, wrinkles as big as the universe, and wrinkles of every size in between. This was good for us, because if the universe had been absolutely perfectly smooth in the beginning, then it would still be smooth now, only much expanded, and there would be no concentrations of matter – no galaxies, no stars, no planets, and no life. It has been the imperfections in the universe – the primeval wrinkles – that have been the blueprint of our universe and developed into all the big structures from galaxies to galaxy clusters to superclusters.

When cosmic inflation ended, spacetime was filled with a hot, dense, incredibly smooth and non-turbulent expanding fog of particles – including quarks, electrons, neutrinos, and dark matter particles, all free and unbound. As the universe expanded and cooled, the particles swiftly revealed their distinctive natures, annihilating, interacting, fusing, or in the case of dark matter, only gravitating. Light from the Big Bang

was so intense it hammered the electrically charged particles.

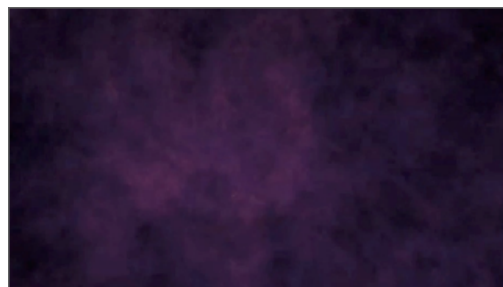
The early universe expanded at the same rate everywhere.

[CLICK]

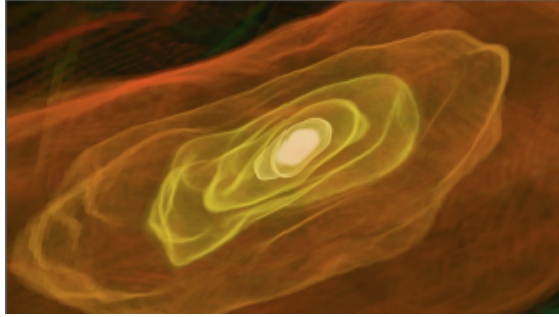


After 400,000 years the fog broke, the universe became transparent, and the light of the Big Bang streamed in all directions, carrying images of the infant universe at that moment. These images would be decipherable by intelligent lifeforms that might evolve billions of years in the future and learn to intercept this light.

Meanwhile dark matter everywhere kept moving sluggishly toward the wrinkles in space, pulling atoms along. [CLICK]



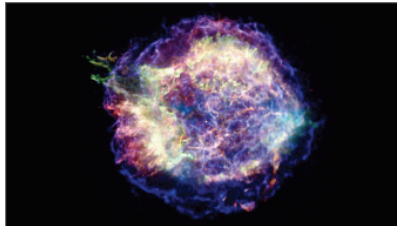
Great concentrations of dark matter collapsed because of their gravity into invisible halos, and deep inside them clouds of hydrogen gas [CLICK]



began falling together to become the first stars.

The burning stars produced the rainbow of other chemical elements

[CLICK]



and the energy that would eons later make life possible on planets that did not yet exist.

Gravity has been fighting against expansion since the Big Bang, and in denser regions gravity has won and created stable structures like galaxies and groups and clusters of galaxies.

[CLICK]

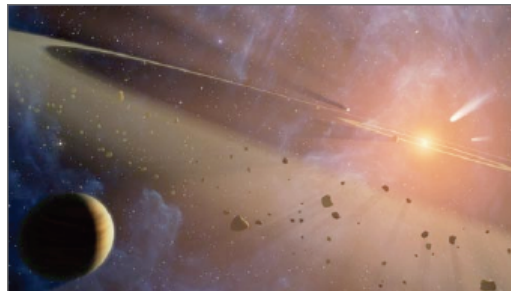


These are bound together gravitationally and will travel forever as a unit in the great expansion. Inside these structures, protected by their dark matter from the violence

of dark energy, planets slowly evolve, potentially into homes for intelligent life. But on large scales where the universe is less dense, expansion is already winning. Space and its dark energy keep increasing while the amount of dark matter stays the same.

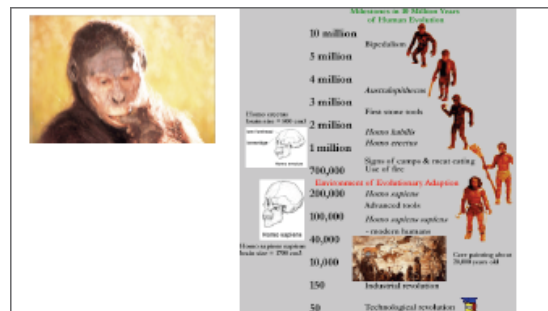
About 5 billion years ago the balance of power on the large scales shifted from dark matter to dark energy, and the expansion of the universe stopped slowing down and began to accelerate. What gravity has not already consolidated, it never will. By coincidence, at that moment of balance in the switch-over between the two great forces of the universe,

[CLICK for forming planetary system]



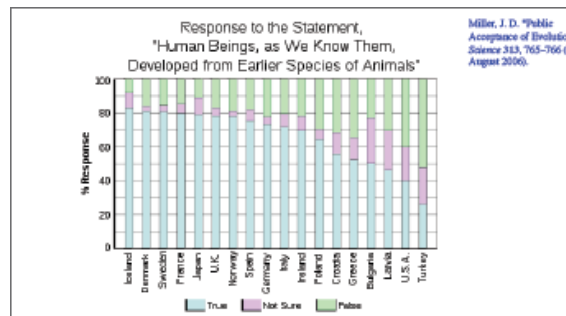
our solar system formed in the suburbs of the Milky Way. No sooner had Earth begun to cool than it acquired microbial life. Stars like the sun live ten billion years or so, and by the midpoint of its lifetime, which is now,

[CLICK FOR EVOLUTION PICTURE]



the microbes on Earth have evolved into a race of creatures with the intelligence and technology to discover the universe,

decode its history in the still-arriving light of the Big Bang, and begin to appreciate their awesome place in the cosmos. But with the same intelligence and different technology this complicated species has also overrun the planet and despoiled much of its surface, including the oceans, while scarcely understanding the implications of what it has been doing because, among other reasons, it has not yet learned to think in large enough terms. [CLICK]



Sadly, our own country is almost at the bottom of the heap of all these countries in accepting the theory of evolution because of a combination of widespread religious fundamentalism and the politicization of science.

Our species is now at a turning point in a struggle between despoliation and a big, new perspective. But unlike the power struggle between dark matter and dark energy, the victor here will not be determined by the laws of physics alone. An accurate cosmology could help us re-envision the world. If this re-envisioning is done with intelligence and empathy, it could shift the balance of power to the new perspective and energize our creativity while minimizing and eventually delegitimizing the forces of despoliation.

Our new origin story tells us that our ancestors are not just our grandparents and great-grandparents, not just our ethnic group, not just the human species, not just life or even Planet Earth, but stars, galaxies, dark matter, and all the

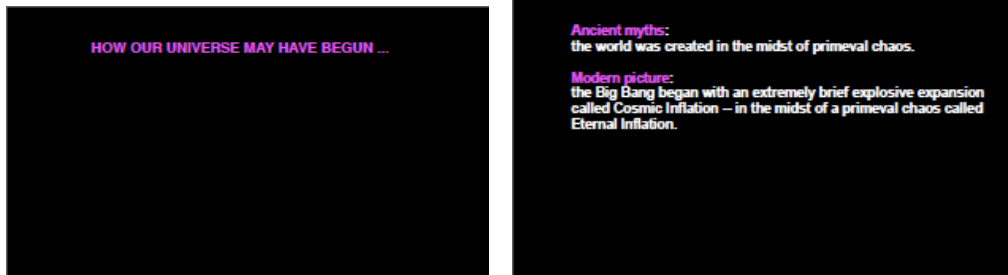
forces of nature, living and not, in an unbroken chain back to the Big Bang.

JOEL

The origin story Nancy just told began at the point called cosmic inflation, but the inevitable question always arises, what came before that? As I mentioned earlier, there is a certain distance back in time that we can explain with the Double Dark theory including Cosmic Inflation, but that's the end of the line for now. The instant of cosmic inflation is the current border between the physical and the metaphysical. To describe the likely **source** of cosmic inflation, we have only theoretical speculations. Are they about the real universe? We don't yet know.

But understanding that we are at this point stepping out of science into metaphysics, we can ask: What caused the cosmic inflation that opens our origin story?

It turns out that when we extrapolate the equations back to find the origin of cosmic inflation, the most likely possibility is that inflation is eternal. [CLICK] Let me put this in a bigger context. [CLICK]



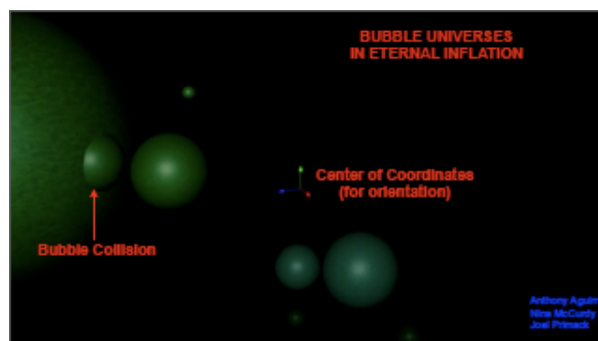
The theory of eternal inflation says there are two possible states of being: spacetime and inflation. The realm of eternal inflation is sometimes called the “superuniverse” or “multiverse” or “meta-universe.” According to the theory, once this state of being exists it goes on forever – although tiny pockets or bubbles form in it, which become big bangs

that evolve into universes. Our universe would then be a bubble of spacetime in eternal inflation.

Eternal inflation is hot and dense, and the expansion of the space between bubbles speeds up exponentially. In this slide [CLICK], Eternal Inflation is represented by what we call the “Cosmic Las Vegas” in the top half, where the laws of chance rule. **[CLICK and read words on the slide as they appear:]**



Here’s a different approach, represented by an animated visualization that we have made just for this lecture. You will see many universes coming into existence and expanding within Eternal Inflation. [CLICK]

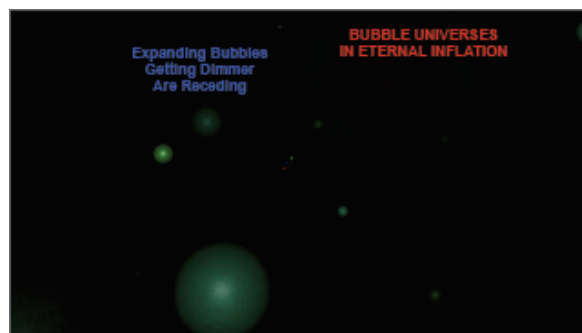


What we are about to see may be the first video that conveys an intuitive sense of Eternal Inflation, although it cannot be taken literally.

[CLICK FOR ARROWS EXPLANATION] There is a set of arrows in the middle representing three dimensions, which is there for orientation. The universes may at first seem to all flow toward the camera, but as the camera moves around, you begin to realize that universes are actually streaming equally in all directions. We have to use so many visual conventions to portray anything in video, like having the light appear to come from a source in a specific direction and having things that recede into the distance appear to get dimmer. These conventions are used to pull us viewers into the video.

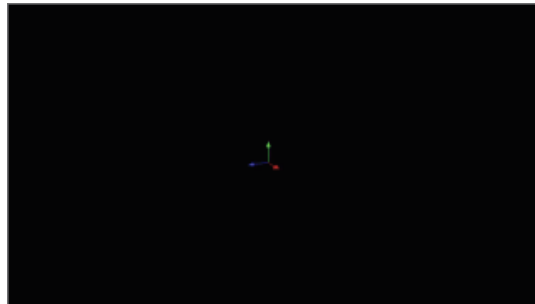
[CLICK] Several times during the video you will see bubbles that formed so close together that they have collided before they could move apart. If **our** bubble is like one of these, astronomers may be able to see the effects of the collision by a careful study of the Cosmic Background Radiation – especially using the observations by the new Planck satellite.

[CLICK]



[CLICK] When you see the video, you will notice that some bubble universes expand and seem mysteriously to fade out.

These universes are moving AWAY from us while expanding. **[CLICK to start movie]**

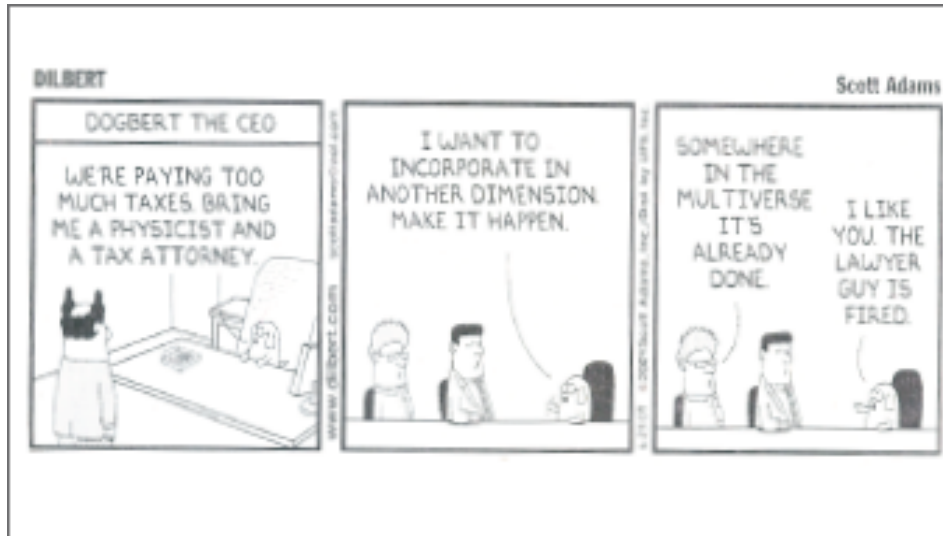


Our entire universe – the region created by our Big Bang – is a rare jewel: a tiny pocket in the heart of Eternal Inflation where by chance inflation stopped, time began, and space opened up for things to happen and complexity to grow.

Where did eternal inflation come from? Although we can, and do, concoct theories about this, it may be that we cannot know, because such events, if they can be called that, are lost *in principle* in quantum uncertainty. Knowledge depends on the preservation of information. In a pure quantum regime, nothing persists. Knowledge would not exist. We can't even imagine how we could find out about a "beginning for quantum uncertainty," if that is even a meaningful phrase.

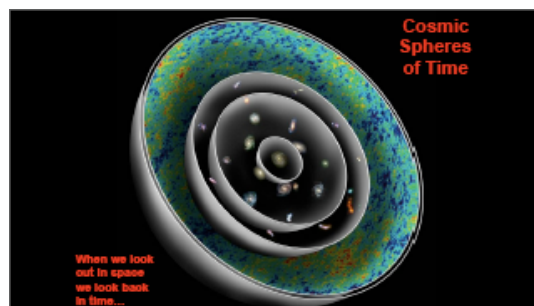
If anyone wonders if this theory of eternal inflation and the multiverse has any conceivable relevance to everyday life, the answer MAY BE YES, according to Dilbert:

[CLICK FOR DILBERT CARTOON]



Let's let the lawyer guy continue.

NANCY [CLICK]

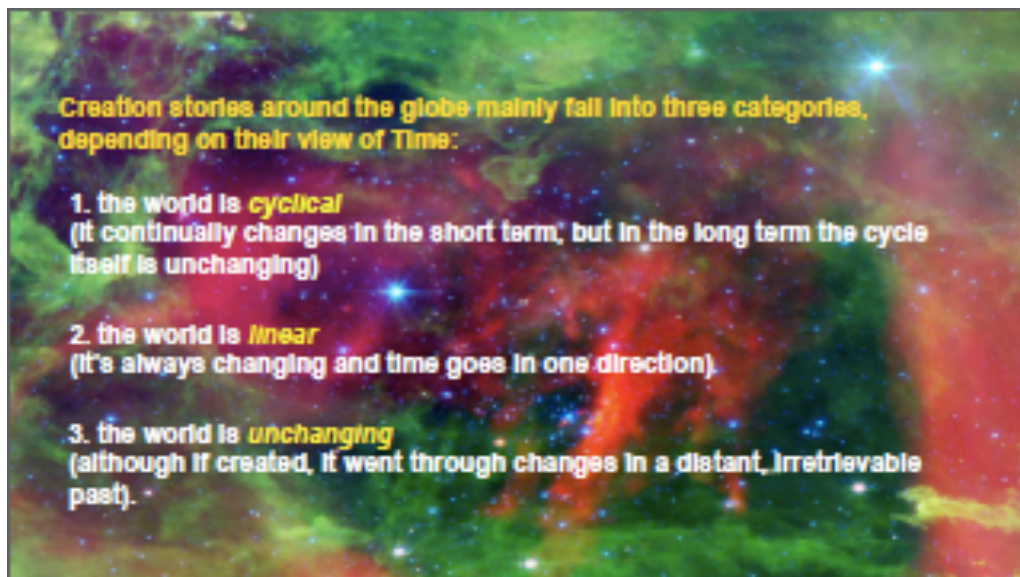


Origin stories have traditionally been told from beginning to end, or from beginning to the present. But that is no longer the only way. Origin stories of the future may also start with the present and move both forward and backward, just as the Cosmic Spheres of Time move outward as the past zooms away from us at the speed of light, and the future flows toward us. From the center outward is the way science learns about the past – first the nearby past: we see nearby galaxies as they were only a few million years ago. Then, as the instruments improve and we can see farther out

into space, we see further back in time, observing distant galaxies as they were billions of years ago. This lets us expand our story.

Rather than trying to imagine the "very" beginning, which may be a meaningless phrase, we can think of the beginning as being just as unknown as the distant future, and ourselves, as explorers, moving outward from the center.

[CLICK – once more for each number]



It turns out that all three of these modes of storytelling are part of our new story, because each applies on a different size scale. On the size scales of Earth for which humans have intuition, the seasons are **cyclical**, and so are the births and deaths of generations of living beings, the movements of the planets, and the return of comets. On the size scale of the Big Bang and cosmic evolution, the universe is changing **in one direction**: it's expanding faster and faster, and we know of no good reason why it would ever contract. But if the theory of eternal inflation is right,

then on that grandest of size scales, the meta-universe is **unchanging** because possibilities burst endlessly from every quantum sized region, yet on the whole nothing changes.

The larger the past that our minds encompass, the larger the future we are capable of taking seriously, creating, and protecting.

Because people see from the center, a tiny consciousness of history will be mirrored in a tiny consciousness of the future, and the end result is a tiny consciousness unable to grasp, let alone appreciate, most of reality.

Many people who think the earth is only a few thousand years old have no compunction against ending it shortly. For some, this symmetric sort of closure gives the whole thing meaning.

[CLICK]



Look at the 65 million copies sold of the Left Behind novels, which are a series about the rapture, when earth and people like Joel and me will be violently destroyed while the saved watch from heaven, presumably with satisfaction. This kind of thinking has no place in a cosmic society. A single human life may seem a brief candle on the cosmic timescale, but each of us embodies our entire species' evolutionary past and potential future.

To achieve a very long-term future, we now realize that controlling and surviving the power of our own high technology is the hump to get over. We're facing this hump right now. If we humans don't make it, the universe has time to try and evolve intelligence again, but humanity will be sloughed off, as if we had never been.

[CLICK FOR ARK]



A cosmic society could be the Ark that can carry all of us, of every color and kind, through the transition from despoliation to cosmic perspective, and to the safer shore of a stable, long-term civilization. Building that Ark now may be what it takes to assure the future of intelligence in the visible universe.

Some people oppose the idea of space travel because they fear that if our human, or more likely humanoid, descendants have the chance they will run amok and wreck the Galaxy, the way European conquerors wrecked so many cultures they colonized. But there is no need to worry about that. Space pioneering would be impossible for the short-sighted, egocentric kind of people we are today. To explore and gradually move out into the Galaxy is a project that could only be successfully undertaken by a long-lived global civilization with a shared, unifying cosmology that accurately reflects the universe, a civilization stable enough to welcome home space travelers even generations after they left. So the good news is that probably the only kind of creatures that

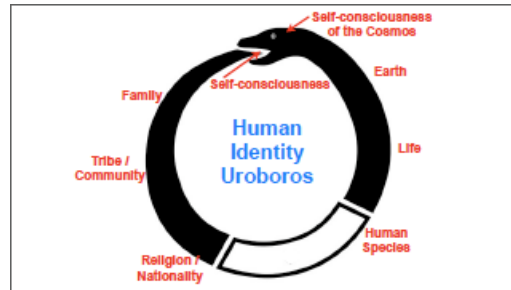
could successfully pioneer the Galaxy are the ones that should.

Maybe this is why no aliens are here. They may have the technology, but not the mythology. Maybe intelligence of the kind that develops mathematics and high technology is relatively common throughout the universe, but what is vanishingly rare is creative intelligence of a deeply artistic and philosophical bent – that conceptualizes its place in the cosmos as accurately as it can; that seeks harmony, rather than self-aggrandisement; and develops imagery that sweeps its members up imaginatively and lets them experience their cosmos ever more vividly through daring but accurate metaphor. This kind of intelligence is what created the mythologies that bind religions and nations together – but no such mythology yet exists that can bind our species together *despite* religions and nations.

The kind of cosmology that would make it possible in the long term to explore the Galaxy is the same kind that in the next few decades could help us solve the problems that threaten our civilization and possibly even our survival. We need a meaningful cosmology not only for the long term but for today! This is what could get us over the cosmic hump.

Figuring out how in practice to create this science-based living cosmology should be a goal of everyone who cares what intelligence could accomplish if it gets to have a long-term future.

As we said in lecture 1, each of us humans is practically an entire uroboros with a role to play on each of these size scales. [CLICK]



We are so diverse that the way to deal with global problems is not to impose global solutions but to cultivate the *common ground of a large scale goal based on principles* and encourage small scale, decentralized solutions, appropriate to different situations, created by different kinds of people but all inspired by that goal or vision. Rene Dubos, the French-American microbiologist and ecologist who coined the phrase “Think Globally, Act Locally,” pointed out that as more public activities and experiences become globalized, the counter-trend of identifying with a chosen neighborhood or community – what he called “local patriotism” – will increase, since people seek the comfort of small scale communities. This is exactly as it should be. We must learn to think on multiple size scales (although not all at once. That’s too hard and rather ineffective.) Our newly discovered identities at these different size scales must encompass, not overthrow each other. We can in this way let our roles on different size scales enrich and expand us. A common universe can provide common ground.

JOEL

But scientists must present it humbly, not arrogantly, to be successful.

For a science–based cosmology to reveal a meaningful universe requires that [CLICK]

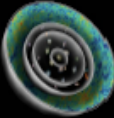
Science should be the foundation on which we build our sense of reality.

But ...


The crucial relevant concepts of science must be made understandable to nonscientists.

Scientists must never claim that science is all we need.


This is what Nancy and I are trying to do by presenting cosmology through fundamental principles visually expressed. Let me summarize:



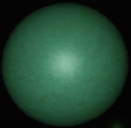
1) We live at the center of our Cosmic Spheres of Time. The finite speed of light makes this inevitable.



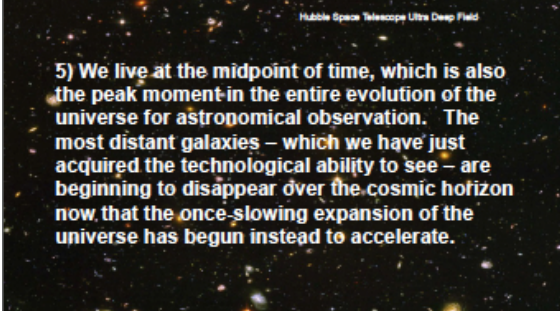
2) We are made of the rarest stuff in the universe: stardust.



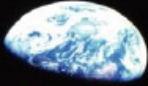
3) We live at the middle of all possible sizes – in Midgard, where the possibility of tremendous variety and complexity coming in small packages keeps life interesting. Life of our complexity could bloom nowhere else on the Cosmic Uroboros.



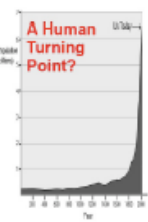
4) We live in a universe that may be a rare bubble of spacetime in the eternal superuniverse. Outside our isolated bubble, which we call the Big Bang, there is neither space nor time as we know them. But here inside there is time for evolution and history, and there is space across which connections can form and structures can develop.



5) We live at the midpoint of time, which is also the peak moment in the entire evolution of the universe for astronomical observation. The most distant galaxies – which we have just acquired the technological ability to see – are beginning to disappear over the cosmic horizon now that the once-slowing expansion of the universe has begun instead to accelerate.



6) We live at the midpoint in the life of our planet. It formed, along with the sun and the other planets, about four and a half billion years ago. It has about six billion years to go before it is roasted when our sun swells into a red giant star. Complex life evolved about half a billion years ago, and has about half a billion years to go until the warming sun overheats the earth. Or billions of years if our descendants move the earth farther from the sun.



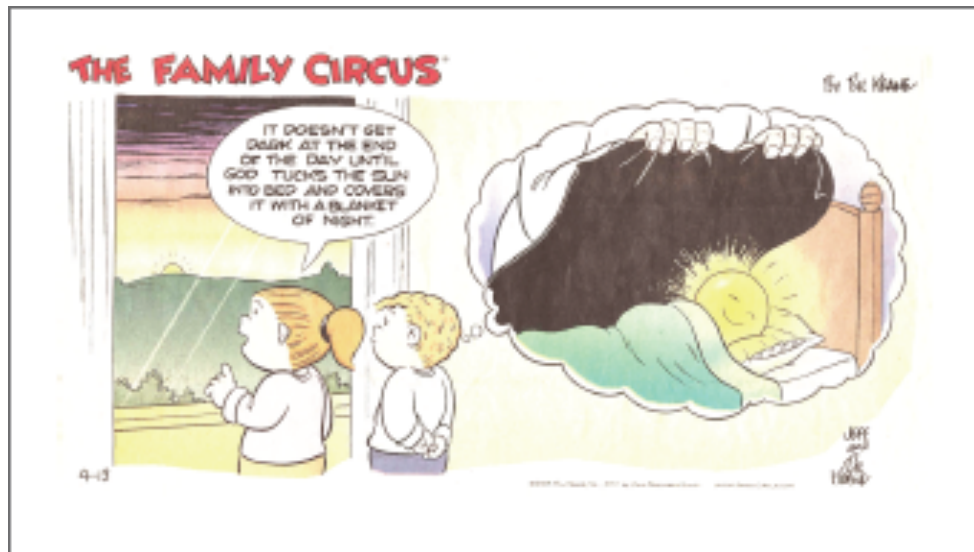
7) From the point of view of our species, today is late enough to have evolved to our present abilities while early enough to have a multi-billion year potential future. It is late enough that we are sobering up to the scale of our problems, but not so late that we have lost all chance to solve them. This is a very special time that will never come again.

NANCY

Our species is at a pivotal point, and time is of the essence. We need to crack open our imaginations! We have unlimited imagination but we are not using most of it! We are so bound by the reward structures of our professions and the peer pressure of this irony-tinged, short-attention-span society. But there's no need to reinvent the wheel. The use of imagery, metaphor, and story to make people feel part of their universe has been known for thousands of years. It's only the universe that has changed.

If taken literally, not only earlier cosmologies but our new scientific cosmology is completely misleading. There was no loud Bang at the Big Bang, and it wasn't big. (There was no size to compare it to.) Language was invented to describe earthly things and experiences and can only be metaphorical when applied to the universe as a whole. So let's accept this and not try to pretend, in a misguided attempt to defend science, that metaphorical descriptions are unscientific. The metaphorical nature of science is not a dirty little secret but an opportunity for creativity, not only in science but in the thought processes of the entire culture. We must get handles on these cosmological concepts or they will never serve us.

Today's children could be the first generation ever raised in the universe they actually live in. Don't teach them silliness like this [CLICK]



Don't teach them "the universe is so vast and we're so tiny" – that's not accurate either: we are in the middle of all possible sizes.

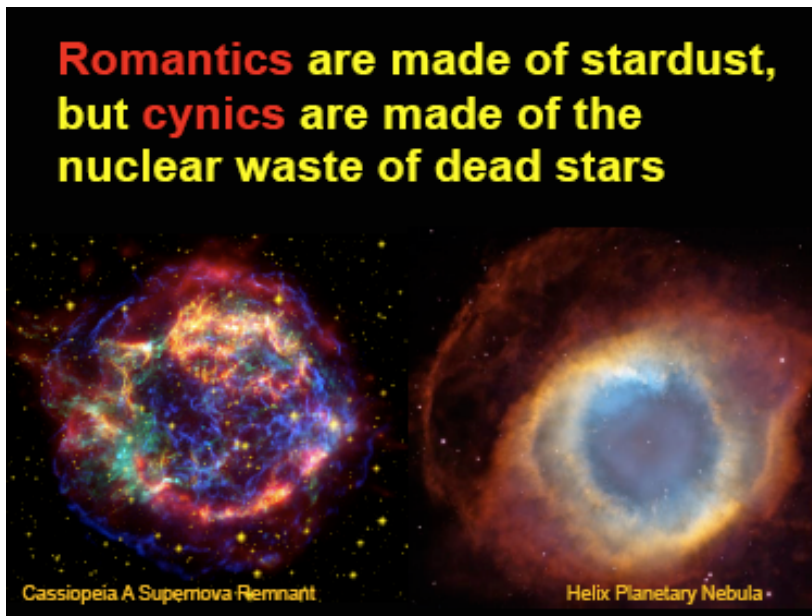


Childhood is when most people acquire the picture of the universe they will carry in their intuition all their lives. We have an obligation to teach children the real story as early as possible. And a surprisingly easy thing to teach children as young as 8 or 9 is the powers of ten. Easier than fractions and far more exciting to them! Joel and I have done it in elementary schools and seen how fast children can catch on. We may soon, if the funding comes through, be working with public school teachers to prepare short films to teach cosmology to middle school and high school students.

Global warming, extinction of species, and other problems we discussed in Lecture 3 can be terrifying to children, since they sense -- and rightly so -- that the mess is being left to them. It's our job to give them a realistic sense of empowerment, since the alternatives to empowerment are often cynicism or despair. We must teach them how far to believe and when to maintain skepticism, and this requires that they understand the role of evidence.

Cosmic education would teach children *to function intuitively in the real universe* -- to *believe* in the real universe, not just memorize facts and stick them on the outside of their brains like post-it notes, while nothing changes on the inside.

Cosmic perspective is partly a matter of knowledge and partly a choice of outlook.



Both views are equally scientifically accurate, but if you were a child, which one would you rather learn? Why should

anyone fight to save humanity if they've decided we're just nuclear waste?

JOEL [DON'T CLICK YET]

A new cosmology has the power to overturn the fundamental institutions of society. This is in fact what happened in the last cosmological revolution on the scale of this one, when the Copernican-Newtonian cosmology overthrew the medieval cosmology of the heavenly spheres. That revolution undercut the rigid social and religious hierarchies of medieval society that had been justified by their picture of the heavens. And soon the divine right of kings was challenged and kings of England and France lost their heads. [*CLICK]



This is the kind of practical consequence that can result from a change in cosmology.

It's crucial not to abuse the power of cosmology.

Our friend the astrophysicist and popular writer Lawrence Krauss (and others) have argued, for example, that this is “the worst of all possible universes.” Krauss’s reasoning starts from the possibility I have explained, that in tens of billions of years dark energy will inflate the space between our Galaxy and all the distant galaxies so much faster than the speed of light that they will disappear from the visible part of the universe. Krauss concludes that since our Milky-Andromeda galaxy will be left alone, this is the worst of all

possible universes. This is a self-defeating reaction to our new scientific knowledge, and not called for by any scientific evidence.

The truth is that the distant future is unknown, like the distant past, and it's self-sabotaging to let our emotions and attitudes toward life in the 21st century be dampened by such outrageously distant speculation. Permanent changes are inevitable in an evolving universe. Rather than feeling sorry for our very distant descendants and judging our entire universe today based on what it may be like for them, we need to appreciate our cosmically central place and the huge power the universe has entrusted to us to affect the distant future. Let's focus on the center, our time, and extend it as far as knowledge lets us. Rather than concluding that this is the worst of all possible universes, we should realize that if we have protected and nurtured Earth and not destroyed our descendants' chances to expand beyond it, then we humans – us, with all our flaws – could be the beginning of the whole future of intelligence in the visible universe.

NANCY

[CLICK]



We humans and our planet are stardust evolving into awesome complexity over billions of years in an expanding universe shaped by dark matter and dark energy.

It's now possible to re-envision this reality and truly want to be part of the whole story and live fully and responsibly in cosmological time, but it's not possible for anyone to do this alone. Reality is communal. A person who is confident of a reality no one else sees is considered insane. Reality is a social consensus. A cosmic society would anchor the social consensus in the truest universe of our time.

And thus the cosmic society needs a group of willing humans from anywhere and any background on the planet to start this crucial, creative work, a group that could be called the "Cosmic Society".

Since most people will remain in denial as long as the society around them lets them, this is an age for heroism – for people willing to start believing the evidence that *we are at the center of a new universe*, and to act accordingly. Yes, it's a strange universe at first, but this is our real home. People will inevitably get used to it – but hopefully soon enough to reap its benefits while there is still time to right the mistakes we made in our earlier ignorance.

Both non-scientists and sciences need to wake up and see that as a community develops that recognizes the new universe and strives to understand its meaning for our 21st century lives, the techniques that all earlier cultures employed to share and develop their cosmologies – language, imagery, story, ritual, mystical experience and other artistic expressions – will be essential. Without them cosmology will be incomprehensible beyond a narrow circle of experts, and so such techniques will flourish in that community.

The meaning of life is determined by how we think about it. What is the meaning of life to Earth? The planet is after all the one that's had to deal with all of it. We humans,

however, are the ones who must articulate this *for* Earth because we're the only ones who can – we're the thinking part of Earth. To do so we have to think on Earth's scale. And until we discover aliens capable of sharing the mind of the universe, thinking on the cosmic scale is our job too. As the intelligence of the universe, we have a responsibility larger even than our responsibility to Earth. Having a responsibility to the universe doesn't mean we have to actually do anything directly for the larger universe, since there really isn't anything we can do on that scale, but it expands the meaning of what we humans are, *here and now*.

When we push our imagination in these ways and consciously step outside our individual viewpoints into our larger roles as the consciousness of Earth and the cosmos, we are bringing our mental world into harmony with the Double Dark universe, learning to encompass multiple size scales, re-training our intuitions, and helping create a cosmic society.

[CLICK FOR GALILEO]



In 1633 the Church, in a rearguard effort to uphold the medieval cosmology of earth as the unmoving center of the universe, used the threat of torture to force Galileo to publicly recant his teaching that the earth moves around the sun. But even as they sentenced him to life imprisonment in his home, Galileo is said to have muttered under his breath,

“Eppure si muove.” (It still moves.) In the same way, people today in a rearguard effort to uphold an obsolete cosmology may mock or deny that we are cosmic phenomena living at a cosmically pivotal moment, but we still are! Mockery and denial don’t change scientific facts.

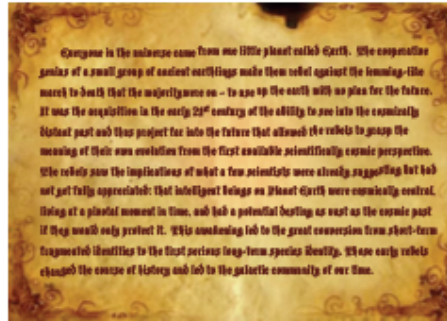
The power of our technologies is already propagating through cosmological time, affecting our species and many others in the long term. Cosmological time is what we are part of, whether we believe it or not. Political decisions no one pays much attention to today can silently prune out entire worlds that might have been, on every size scale from depriving a child of an education to wiping out intelligence in the Galaxy. “Cosmological time” may at first seem hard to imagine or ridiculously abstract, but it’s as real as anything can be, and we need huge imagination to figure out how to present it to each other – accurate and alive, expanding our consciousness, captivating the young – so that our culture will begin to think in it and begin to see its influence.

Could the idea of a cosmic society end up being a religion? No. It’s too free-thinking. It’s more an ethic. It requires faith not despite the evidence but *in* the evidence – and in the possibilities that that evidence suggests for our species. It allows us the shared experience of actually belonging to the cosmos that the evidence says exists. Above all, it allows us a way to elevate our thinking to what our times demand.

Can we do it? You cannot know what is possible or impossible until you know what universe you’re living in.

Here is a hypothetical fragment of an origin story from the distant future.

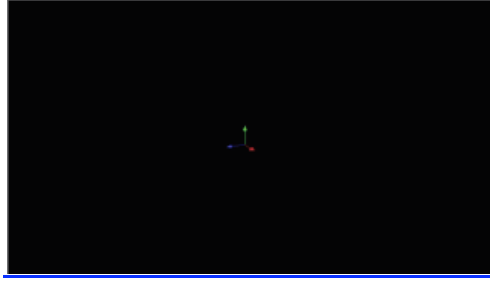
[CLICK]



Everyone in the universe came from one little planet called Earth. The cooperative genius of a small group of ancient earthlings made them rebel against the lemming-like march to death that the majority were on – to use up the earth with no plan for the future. It was the acquisition in the early 21st century of the ability to see into the cosmically distant past and thus project far into the future that allowed the rebels to grasp the meaning of their own evolution from the first available scientifically cosmic perspective. The rebels saw the implications of what a few scientists were already suggesting but had not yet fully appreciated: that intelligent beings on Planet Earth were cosmically central, living at a pivotal moment in time, and had a potential destiny as vast as the cosmic past if they would only protect it. This awakening led to the great conversion from short-term fragmented identities to the first serious long-term species identity. Those early rebels changed the course of history and led to the galactic community of our time.

Let's keep that story possible!

We have a game-changing opportunity right now. We can have a cosmic society right here on this beautiful planet if we try as a community to bring the universe home – in our thinking – to Earth. [CLICK]



Thank you.