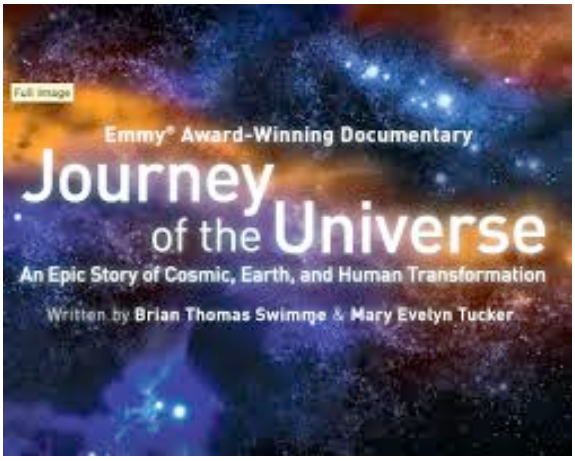
Journey of the Universe



A New Story

Many of the world's greatest stories begin with a journey, a quest to answer life's most intimate questions. Where do we come from? Why are we here? From the dawn of time all cultures have created stories to help explain the ultimate nature of things. Perhaps a new story is emerging in our time, one grounded in contemporary science and yet nourished by the ancient religious wisdom of our planet. What if the universe, even the Earth itself, has its own unique story to tell, one in which we play a profound role?

We're on the Greek island of Samos, just a mile off the coast of Turkey. We could tell the story of the universe anywhere. Each place would offer its own unique possibilities for the telling. But we choose Samos because it's one of the great cross roads of human history. Europeans, Asians and Africans all made their way here. By telling the story on an island, surrounded by the Mediterranean Sea, we will be reminded that we live on this shiny planet, sailing through the great ocean of the universe.

There is another reason why we have come to Samos, and that is that 2,600 years ago, Pythagoras was born here. Pythagoras, a mathematician and philosopher, was one of the first humans to realize that the harmonies and relationships in the universe could be given expression by using numbers. The current of thought he generated led eventually to all modern mathematical science. He was also a great teacher. In fact, legend has it that he invented the word philosophy, a love of wisdom. We'll spend a day here on Samos. Before the clock strikes midnight, we will have recounted the great events of our 14 billion years cosmic evolution. Our immense journey told in a single day on one of Earth's magical islands.

Beginning of the Universe

How did it all start? An awesome question certainly, but it appears that there really was a beginning. Some scientists refer to this as the Big Bang. I like to call it "the great flaring forth". Imagine the Universe beginning like this…a flame bursting into light, heat and energy. 14 billion years ago everything in the universe, all the bright matter of the stars and galaxies, as well as all the dark matter that no one has ever seen, all of it existed in a single point so energetic, that it was trillions of degrees hot. Instantly, this micro universe rushed apart even faster than the speed of light.

This discovery, that the universe expanded and is still expanding, is one of the greatest in human history. The common understanding had been that the universe is simply a vast space. A vast space in which things existed, large things like galaxies, and small things like atoms. Scientists knew that matter changed form in the universe but everyone assumed that the universe as a whole was not changing. But no! The universe is changing, and has changed dramatically. The universe has a story, a beginning, a middle where we are now, and perhaps in some far distant future, and end.

In the 1920's, the cosmologist Edwin Hubble trained his 100 inch telescope at the night sky. He was trying to determine if our Milky Way was the only galaxy in the universe. Not only did he discover that the universe was filled with galaxies, he also determined that all of them are rushing away from each other. With Hubble's work, humanity learned that the universe began with a massive explosion that has been carrying the galaxies apart for billions of years.

Another special quality about the universe is the rate of expansion. If the rate of expansion had been slower, even slightly slower, even a millionth of a percent slower, the universe would have re-collapsed immediately. That would have been it! After a million years, the universe would have imploded upon itself and formed a massive black hole. On the other hand, if the universe had expanded a little more quickly, even slightly more quickly, even, calculations show, a millionth of one percent more quickly, the universe would have expanded too quickly for structures to form. It would have simply exploded. There would have been no galaxies, no structure, no life, nothing but dust for all time.

So what we've discovered is that we're living in a universe that is expanding at exactly the rate necessary for life and structure to come forth. It could be then, that even though we can't call the early universe alive, we can understand it as life generating.

One of the physicists who was reflecting on this was the celebrated Freeman Dyson. He mused that the more he reflected on the structures of the early universe, the more he became convinced that in some sense, the universe must have known from the very beginning that life was coming. The light from the beginning of time has been travelling for 14 billion years. Meanwhile, life has been evolving. With the recent emergence of advanced technology we are at last able to see the story these protons tell about the birth of the universe and where we ultimately come from.

The Formation of Galaxies and Stars

Morning on a Greek island is like the first day of creation. Wandering around here you feel like the first person. Inevitably, humans would ask, what gave birth to all of this beauty? What was the form of creativity that brought this forth? Consider galaxies. What brought the galaxies forth? Even a century ago, this is hard to imagine, we didn't know if there were two galaxies in the entire universe! That was the main focus of attention among scientists. Now we know that there are a hundred billion, maybe even a trillion galaxies. What is the creativity that brought forth a trillion galaxies? Let's consider our own Milky Way galaxy. It's a galaxy with huge spiral arms. Now, when we first began to discover galaxies, we thought maybe the spiral arms were composed of physical matter. But, actually, it's much more interesting. The arms are actually waves that are passing through the galaxy. They're called density waves, and as they pass through the clouds of hydrogen and helium, they ignite star birth. That's the way to picture the Milky Way galaxy, not so much as a thing, but rather as an activity. It's an ongoing activity of bringing forth stars. We live in the midst of this intense activity.

Come into this little church. The ceiling is filled with stars. The same is true of most of the churches on the island of Samos. The ancient Greeks, like Pythagoras, thought the stars were alive, even divine. Throughout history, every culture has been stunned by the presence of stars and the vastness of the night sky. So deeply moved by the majesty emanating from the brilliance of the stars, we have built our lives around them. We've even organised entire civilizations upon their beauty and order.

Here's the essence of the universe story: the stars are our ancestors. Out of them everything comes forth. Stars are dynamic entities. They're born, they develop. They even die. Star birth occurs when gravity squeezes together a cloud of atoms so tightly that nuclear fusion ignites in the centre. In the process, hydrogen fuses into helium. This nuclear energy expands outward and opposes gravity. So stars represent an amazingly creative balance between the powers of gravitational collapse and nuclear explosion. Once a star's nuclear fuel is spent, there's nothing left to prevent gravity from collapsing inwards, causing the death spiral to begin. This super concentrated dot of matter, which we call a supernova, explodes outward with the power of a hundred billion stars. As it expands it creates all the elements, phosphorus, oxygen, carbon, gold. These are spewed out into the Milky Way galaxy, and then the whole process starts again. They drift as a cloud, they collapse, give birth to star, the Earth. It's by this stupendous process that we can say the stars are our ancestors. It's just such an amazing discovery. The carbon atoms of a beet(root), and of a luttice, and of our brains, our skin, all of it passed through an intense explosion of a star.

In pondering the source of the sun's power, we can now reflect on something no earlier humans could know. The sun is converting four million tons of its mass into energy every second. All of life feeds on the roaring energy of the sun. Our solar system then is a self-energising womb of creativity. All of this had its start in a cloud of dust.

Birth of the Solar System

It was really difficult for humans to realize that we live on a planet circling a star. We were here for hundreds of thousands of years before Aristarchus, 2,000 years ago on the island of Samos, realised we are spinning around the Sun. That was such an amazing insight that it vanished actually. It wasn't until Copernicus discovered it again in the 16th century that humans really began to absorb the fact that we were on this planet.

If you used vegetables to explain our solar system, and you just have to us your imagination, you could have a cabbage as the sun. If it were to be in scale, the cabbage would have to be a million times the size of a pepper. What we have learned in the 20th century is about the composition of the planets. First we have the large outer planets: Jupiter - a green apple, Saturn - a red apple, Uranus - a pepper and Neptune - a tomato. These are large enough to hold on to all the lighter elements so that they actually are gaseous, too small to be a star, yet too large to be solid. The other kind of planets, the ones closest to the sun, Mercury - a rock, Venus - a rock, Earth - an egg and Mars - a rock, are the rocky planets, most of which are solid. But there's one special rocky planet, one that's not too small and not too big, one that's not too hot and not too cold, one that's not exactly solid but not exactly liquid. We call it home.

Earth is very much like an egg. The core of the Earth is like the yolk, the mantle of the Earth is like the egg white, and the crust of the Earth is like the egg shell. What happens is that, early on when the Earth is in a molten state, all of the really heavy elements like iron and nickel sink into the core, and the elements like magnesium form this outer layer around the core, the mantle. The crust is only 10 to 50 miles thick and that's the only solid part of Earth. All the rest is in motion. Plumes of molten rock will rise up from the mantle and harden into plates that form the crust. As these plates slide around the surface of earth they collide and crumple into majestic mountain ranges, or they are forced back down to where they melt and sink towards the centre of Earth.

This discovery which originated with Alfred Wegener, is called plate tectonics, and is one of the greatest of history. Earth became encircled by great tidal oceans and held by a thin layer of atmosphere. A churning volcanic Earth could now bring forth the next wonder of existence, a living cell.

Life's Emergence

How are we going to tell the story of life? How did it all begin? What theory shall we offer to explain this? The simple truth is that no one knows with full certainty. But even though the detailed explanation still eludes, scientists have begun to approach the whole question of life from a radical new perspective, that of self organization.

During the modern period we thought of the world as machine-like, and then life was an accident. But now, with the work of a number of scientists, notably Ilya Prigogini, who won a Nobel Prize for this work, we are beginning to discover the active patterning in matter itself. It's intrinsic to matter. From this new perspective, life is not an accident. Life is not inevitable. A planet reaches a certain complexity of its matter, and then life blossoms forth quite naturally. Consider whirlpools. The spiral swirling action can appear anywhere, so long as there is a body of liquid moving water. It is not the water itself that endures as a spiral because the water molecules are constantly flowing in and out of the whirlpool. It is rather the emergent dynamic structure that endures.

Such is the nature of life. The universe began as a great outpouring of cosmic breath, cosmic energy, that then swirled and twisted and complexified, until it could burst forth into flowers and animals and fish and all of these elegant explosions of energy. But it's not just energy. And it's not just living energy. This is energy that is aware.

By awareness, or sentience, we mean something that is more than what takes place in the realm of elementary particles, and yet less than full human consciousness. So where does such awareness arise? Some biologists are beginning to speculate that awareness has its foundation in the very self organising dynamics of the universe. For cell biologist, Ursula Goodenough, this awareness is a kind of primitive discernment, and it reveals itself especially in a membrane of each cell, that thin skin-like layer that covers every cell.

If we had microscopes for eyes we would see it all happening in tidal pools. There millions of cells are swimming about and they're encountering molecules over and over again, and with every encounter, discernment emerges. Why? Because a decision has to be made, an intelligent decision. Up in the cliff-side of Samos there's an ancient castle that will help to explain this. This church, which is called, Metamorphosis, is nearly 1000 years old. Above it is a castle that once guarded the entrance into the magical Potami Valley. The castle was built to do what membranes do, let your friends in and keep your enemies out.

The ongoing creativity of the universe is seen in the complex development of life itself. After it has circled the sun for hundreds of millions of years, Earth's most primitive organisms developed molecules that would resonate with the sun. How are we to picture this process involving Earth and sun bringing forth photosynthesis? As an engineering process? Maybe! But, using a new metaphor, imagine two lovers longing for each other. What is it they truly desire? The relationship is charged with energy and promise. There's the sun exploding with brilliance. There's the Earth basking in the

sun's rays. But earth is not passive. Earth's systems attune to the sun, changing their molecular structures in order to draw in light and convert it to food. As the complexity of life deepens, entwinement itself also deepens.

The Living Earth

How are we going to tell this story of the living Earth? In particular, how are we going to tell the story of Earth to our children? This is especially important because in the last couple of centuries we have learned more about the Earth than in perhaps the previous 100,000 years. So, the question is, how are we going to convey that, the essence of that, to the next generation?

One thing is completely clear, the Earth is very different than what we thought. The Earth is not a platform. It is not a background. In fact, the great discovery is this: life doesn't exist on top of the Earth. Life is a partner to the oceans, to the atmosphere, to the land. For instance, if we look at the atmosphere, it is 21% oxygen. This makes us unique among all the known planets. The only reason we have oxygen in our atmosphere is that life is pouring it forth each day, so the very composition of our air reflects the fact that life is here. In that sense, life is woven into the atmosphere.

But an even more radical hypothesis is beginning to emerge in the minds of some scientists. Perhaps Earth is not only an integrated system. Perhaps Earth somehow maintains itself so that life can flourish. Consider temperature. Life only exists in a very narrow band of temperature. So something like this temperature has been true of Earth for four billion years. Scientists originally thought this was because the Earth just happened to be 93 million miles away from the sun. But during the 1950's, we learned about the fusion process taking place in stars. So now we know the sun's temperature has increased by over 25% over the last four billion years. Which means, somehow, Earth has had to adapt itself to maintain that stable narrow band of temperature. How? We know some of the details. Early Earth had 1,000 times the carbon dioxide as present day Earth. So, during that time the Earth's system has drawn the carbon dioxide out of the atmosphere, forming for instance, the shells of marine algae. Then when the marine algae die, the shells go to the bottom of the ocean. So, more and more carbon dioxide is taken out of the atmosphere, which enables the Earth to cool down while the sun heats up. But the question returns: Is all of this being organised by the Earth as a whole so that life could flourish? If that's the case, then the atmosphere is not just stuff. It's something like a membrane. And we are not living on an Earth. We are actually participants in a vast intricate system that is something like a living cell.

Learning and Senses

A living cell has the power to learn through time. That is what distinguishes the first cells from all the other beings that existed prior to life's emergence. A star, for instance, has the power to organise itself for billions of years, but throughout that time it never needs to learn anything new. Life learns, for life can adapt itself to new situations by changing its form and by remembering these changes. Life remembers the past by storing information in its DNA molecules. It is this power of memory encased in each living cell that enables life to learn and thus evolve.

One of the ways in which to understand the nature of life's memory is by using the ideas of the mathematician and philosopher, Pythagoras. A number of his ideas were revolutionary and like a lot of revolutionary ideas, they weren't that popular. In fact, Pythagoras had to hide from the tyrant Polycrates, who was in charge of Samos. Tradition has it that he hid in a cave half way up the mountainside. One of Pythagoras's central convictions was that the essence of life is not air or water or fire, as the other Greek philosophers taught. Rather the essence of life is number, pattern. It seems such an odd idea. I mean, life is so sensuous. It's so complex, so rich. How can the essence of that be something abstract like number or pattern?

It is precisely this deep connection between life and pattern that enables life to remember its crucial achievements. That's what DNA does. In the precise sequence of the nucleotides, DNA holds the essence of life. Life did not hand down the actual molecules of my body. Instead, life handed their essence in the form of genetic information. Because of this, our bodies can come alive in a thousand different ways each day. Life has learned to learn.

One of the central ways of learning for our species involves seeing. Life has invented so many different ways of seeing; the amazing thing is that this process is not yet over. Billions of years ago the earliest cells began to develop sensitivity to light. They could sense it and move towards it. It was this capacity that led eventually to the development of the eye.

The first eye for which we have any fossil evidence is that of the trilobite, 500 million years ago. The trilobite, intent on piercing through the darkness, invented an eye using calcite, a mineral. The trilobite was able to see only in the direction of these rods, a primal form of seeing that proved so successful, we find it even now in the compound eyes of flies and lobsters. An entirely different form of seeing was invented by the worms and carried forward by the fish. This type of eye is the one we know best, for it's the one we inherited, the water based eye.

Even after 500 million years, eyesight continues to evolve. In humans, the power of seeing deepens with a new kind of sight, insight. We see on an inner screen of our imaginations. Life has learned yet another way of seeing, one with the power to transform everything. With this new way of seeing, we find ourselves blinking in a thrilling and yet unsettling light. Rooted in the centre of immensities, we open our eyes and see each thing anew, each thing ablaze with a cosmic creativity billions of years old.

With this insight made possible with conscious self-awareness, our vision now extends back through billions of years of evolution. We see not only the scurrying spider, but the entire cosmic journey layered into the spider's body, including even the distant stars, out of whose explosion its molecules were constructed.

Death and Passion

This capacity to see into the depths of time gives new meaning to death. The universe throughout space and time is filled with violence and chaos. Millions of galaxies have been destroyed. Trillions of animals have been killed. Death and suffering are woven into the very heart of the universe. Usually such destruction is massive and senseless. A volcano erupts and kills every living being in its vicinity. But it can also happen that dealing with death leads to more complex co-evolutionary relationships. For a rabbit, an eagle wears the face of destruction. But in this relationship the eagle develops accurate eye sight and the rabbit develops greater speed for escape. Interdependent communities arise out of suffering and death. The ultimate meaning of this escapes easy explanation. We are confronted with a fundamental mystery in which the small self of the individual dies into and nourishes the whole community. But living beings are not just linked together by food.

Passion. Our urge to merge. What could be more intimate to our souls? Our passion determines so much of our lives. They are the wild explosive energies of all of love and creativity. Such desire resides at the very centre of life. With fish, the female deposits her eggs and the male later fertilizes them. There's no contact between them. 100 million years later, when the lizards have evolved out of their fish and amphibian ancestors, the passion to merge has deepened considerably. With mammals and birds, passions reach yet a new crescendo. Not only are they able to commingle as one body, they can become so profoundly bonded, they remain in a relationship their entire lives.

We are not just similar to animals; we have been shaped by them. Our passions come from vertebrate evolution. Even our compassion can be understood as an expression of what took place hundreds of millions of years ago in the ocean with the early fish.

Biologists speculate that mutations led to a mother fish who scared away predators from her babies. This behaviour was new at that time. What was more common among fish back then was a mother who ate her young. With the emergence of the fish's descendants, mammals and birds, maternal care broadened. Now the offspring were not just protested form predators, but were nourished directly by their mother. This care even included transmission of survival information of their group. And in some cases, this required years of training. We see then the caring behaviour among vertebrates expanded for 500 million years before the emergence of Homo sapiens. Early humans intuited this deepening compassion and celebrated it with images of the divine feminine.

The Origin of the Human

As we enter into evening on Samos, we approach one of the deep mysteries at the centre of every traditional cosmic story, the nature and ultimate meaning of the human.

We humans have our origin in the birth of the universe 14 billion years ago. Thus we are composed of the same energy and quanta as that which composes everything in the universe. We follow from the first cell, emerging four billion years ago, so we're genetic cousins to every living being. So what is distinct about us? What is uniquely human? Our current best evidence suggests that something took place between six and seven million years ago in Africa. Something happened to ignite the human lineage in the primate world. A new line of energetic apes emerged that would, over several million years, bring forth massive brains and learn to dwell in a world saturated with dreams. Nothing like them had ever existed before. So, what gave rise to us? We don't really know. We don't have the detailed knowledge of that transformation yet. We're forced to speculate on the data. And perhaps that's entirely appropriate here in the night to be forced to dream about the origins of this dream-making animal.

One theory offered by the scientists is particularly fascinating. It suggests that humanity had its origin in the prolongation of childhood. The idea is that mutations took place which slowed down our development. Humans went along the same phases as say the chimpanzees, but they remained in each stage for a longer period of time. In particular, this meant that the children were child-like for more of their lives than other mammals. So, to understand what makes a human human, we can study the children of any mammalian species. They jump to play. They explore the world with their eyes and they taste the world with their mouths. Simple existence thrills them. Their actions are, in some sense, free. So, after nearly four billion years, an animal emerged that could remain free, spontaneous, curious, flexible, open, impelled to try everything. So what was going to happen now?

Early humans awoke to an incandescent consciousness. But where other animals were controlled by instincts, humans were liberated from such set reactions. Captivated by the thrill of movement, we could make dance or sports central to our lives. Astonished by the sounds of Earth, we could dedicate ourselves to the joy of making music, or making love.

Symbolic Consciousness

The greatest creation in human history was what enabled humans to plunge into and to share their super abundant consciousness. This new invention was language. More simply, the symbol. The symbols of language and art and mathematics opened up new depths of consciousness. Each human began to carry an entire universe within. This new form of consciousness, called symbolic consciousness, would soon change everything. A crucial step in the process of becoming human was learning to externalize consciousness, to represent in the physical world what we had experienced within.

We can see this in the archaeological museum on the island of Samos. By creating marks on bone or on wet clay, humans invented a way to fix their knowledge into an enduring form outside of themselves. The coding processes of life were bursting beyond the DNA molecule. So with human cultures, experience itself can be remembered and passed down for thousands of years. Not just successful mutations, but valuable understandings, even if expressed by a single human being, can become part of an enduring legacy. Works of the mind and spirit flowed into Samos from every direction of the ancient world, from Athens, and Mesopotamia, as well as Spain, Egypt and Persia.

In the early universe, concentrations of matter led to the emergence of galaxies, and something similar was going on here. In Samos, and in other cities, we find a concentration of symbolic constructions. What does this mean really? It means that rare insight and deep feelings from around the planet, and from different eras of time, are all folded together here. Out of this powerful alchemical mixing, human consciousness complexified into new forms. Just think of it. For billions of years, rocks were just rocks. And then in a geological instant all over the planet, they began to appear with these scratching on them. Even more amazing, these little marks were organizing entire civilizations.

With the appearance of the human, the coding process of life burst beyond the DNA molecule and began carving its information into stone. Symbols not only enabled humans to accumulate knowledge through millennia, they also offered a final and explosive possibility for human emergence. Symbols enabled humans to concentrate their consciousness upon consciousness. This was a development with magnificent and yet unexpected consequences. Like a magnifying glass focusing the sunlight upon a leaf, symbols set fire to human possibilities that had slumbered for 100,000 years.

As we imagine and look at colossal human forms, say15 feet high, we can imagine dozens of such statues. As the Greeks moved and lived among them, their self conceptions would be changed. They would begin to imagine they were god-like, capable of anything. Such systems were called in science, self-amplifying loops, consciousness giving birth to symbols, which then magnified consciousness.

In this way, humans were not simply evolving. They were consciously participating in giving birth to themselves. And what was coming forth was a planet-altering species. For this activity was taking place not simply here on the ancient island of Samos, but actually throughout the planet in every

civilization. Super charged with confidence coming from reverberations of such symbols, human presence burst forth and altered the very face of the planet.

Pyramids rose up from the African desert. Ancient rivers were diverted. Land as large as the eye could see was watered by irrigation systems. Even the forest scattered cross the oceans in the form of sailing vessels. For the first time in Earth's history, seeds were not subject to the vagaries of climate but received their watery nourishment with the precision and inevitability of logical thought. Soon even the inner order of the seeds was captured by the science of genetics. What does it mean when even the seeds begin to live not just in the Earth, but in an Earth shaped by human consciousness?

With their equations and their measurements, the early scientists discovered truths none of the classical scholars had known. In astronomy, chemistry, physiology, humans began to understand the world with their numbers and patterns.

Controlling Nature

The defining characteristic of this new modern form of consciousness was the decision to employ our science and technology to control nature for our own use. The widespread conviction of the industrial world was that nature was inferior to us. Such a world view in which only humans had sentient feelings, allowed all of nature to become nothing more than a resource we could exploit in any way we wished.

Even Rene Descartes, the most significant philosopher of the modern age, believed that when animals made crying sounds, they were not suffering. They were simply malfunctioning machines.

Humans were gaining control of Earth's processes, and to what purpose? To create a better world, to eliminate hunger, to provide for our children, to have fun. To fulfil this dream, we poured forth all of our energies, all of our technologies, and with stupendous results. In the blink of an eye, we exploded to seven billion humans. The irony of it all: Housing and feeding this many humans has already gutted our oceans and forests. We've ended up achieving something like the opposite of what we dreamt of. It's not just that we're using up all the energies of Earth. It's much deeper than that. We're changing life's dynamics and in an irreversible way.

We're just beginning to realize that over the last few decades, we have profoundly altered the evolutionary dynamics of Earth. The air, the climate, the rivers, the oceans, even the DNA. We live on a different planet now, a planet where not biology but symbolic consciousness is the determining factor for evolution. This great reversal has taken place. In the far distant past, life drew forth symbolic consciousness. But now, symbolic consciousness has seized control of life.

With our language and our machines, we have become as powerful as the planet itself. Because of us, ice caps are melting. Because of us, coral reefs the size of mountains are bleaching white. But, nothing shows this disaster more clearly than life itself. Because of us, thousands of species are going extinct each year. Nothing this devastating has taken place on Earth since the extinction of the dinosaurs 65 million years ago. We are faced with a collective challenge no previous generation ever contemplated.

Our Journey Forward

How are we to use this symbolic consciousness to create a human presence that will enhance the wellbeing of the Earth community? We are beginning to understand the profound powers of the universe. And just as these powers have brought forth galaxies, stars and life itself, perhaps the universe is now unfolding towards some new destiny. What if our ultimate destiny is to experience the universe so deeply we came to realize that we are in some sense the mind and heart of the universe?

Our deepest yearning is for a wholehearted participation in this flourishing. As we float in the midst of such mysterious immensities, is there any deep wisdom that might help us align our consciousness with the grain of cosmic evolution? Wonder will guide us. The human species has a genius for becoming astonished by almost anything in the universe. What can this mean? The body of the universe gave birth to our bodies. The self organising dynamics of the universe gave birth to our minds. We belong here. We've always belonged here.

These deep discoveries of science are leading to a new story of the universe. It's a story that can be summarised in a single sentence. Over the course of 14 billion years, hydrogen gas transformed itself into mountains, butterflies, the music of Bach and you and me. And these energies coursing through us may indeed renew the face of the Earth.