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YOU ARE THE UNIVERSE

DISCOVERING YOUR COSMIC SELF AND WHY IT MATTERS

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AND

MENAS KAFATOS, PH.D.

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PREFACE

YOU AND THE UNIVERSE ARE ONE

There's one relationship in your life—in everyone's life—that has been kept a secret. You don't know when it began, and yet you depend upon it for everything. If this relationship ever ended, the world would disappear in a puff of smoke. This is your relationship to reality.

A huge number of things must come together perfectly to construct reality, and yet they do so completely out of sight. Think of sunlight. Obviously, the sun can't shine unless stars exist, since our sun is a medium-size star floating beyond the center of the Milky Way, our home galaxy. There are few secrets left to discover about how stars form, what they are made of, and how light is produced in the incredibly hot cauldron at the core of a star. The secret lies elsewhere. As sunlight travels 93 million miles to Earth, it penetrates the atmosphere and lands somewhere on the planet. In this case, the only somewhere we're interested in is your eye. Photons, the packets of energy that carry light, stimulate the retina at the back of your eye, starting a chain of events that leads to your brain and the visual cortex.

The miracle of vision lies in the mechanics of how the brain processes sunlight, that much is clear. Yet the step that matters the most, converting sunlight into vision, is totally mysterious. No matter what you see in the world—an apple, cloud,

mountain, or tree—sunlight bouncing off the object makes it visible. But how? No one really knows, but the secret formula contains sight, because seeing is one of the basic ways of knowing that an object is real.

What makes seeing totally mysterious can be summed up in a few undeniable facts:

Photons are invisible. They aren't bright, even though you see sunlight as bright.

The brain has zero light inside it, being a dark mass of oatmeal-textured cells enveloped in a fluid not terribly different from seawater.

Because there is no light in the brain, there are no pictures or images, either. When you imagine the face of a loved one, nowhere in the brain does that face exist like a photograph.

At present no one can explain how invisible photons being converted to chemical reactions and faint electrical impulses in the brain creates the three-dimensional reality we all take for granted. Brain scans pick up the electrical activity, which is why an fMRI contains patches of brightness and color. *Something* is going on in the brain. But the actual nature of sight is mysterious. One thing is known, however. The creation of sight is done by you. Without you, the entire world—and the vast universe extending in all directions—can't exist.

Sir John Eccles, a neurologist and Nobel laureate, declared, "I want you to realize that there exists no color in the natural world, and no sound—nothing of this kind; no textures, no patterns, no beauty, no scent." What Eccles means is that all the qualities of nature, from the luxurious scent of a rose to the sting of a wasp and the taste of honey, is produced by human beings. It's a remarkable statement, and nothing can be left out. The most dis-

tant star, billions of light-years away, has no reality without you, because everything that makes a star real—its heat, light, and mass, its position in space and the velocity that carries it away at enormous speed—requires a human observer with a human nervous system. If no one existed to experience heat, light, mass, and so on, nothing could be real as we know it.

That's why the secret relationship is the most important one you have or will ever have. You are the creator of reality, and yet you have no idea how you do it—the process is effortless. When you see, light gains its brightness. When you listen, air vibrations turn into audible sound. The activity of the world around you in all its richness depends upon how you relate to it.

This profound knowledge isn't new. In ancient India, the Vedic sages declared *Aham Brahmasmi*, which can be translated as "I am the universe" or "I am everything." They arrived at this knowledge by diving deep into their own awareness, where astonishing discoveries were made. Lost to memory are Einsteins of consciousness whose genius was comparable to the Einstein who revolutionized physics in the twentieth century.

Today we explore reality through science, and there cannot be two realities. If "I am the universe" is true, modern science must offer evidence to support it—and it does. Even though mainstream science is about external measurements, data, and experiments, which build a model of the physical world rather than the inner world, there are a host of mysteries that measurements, data, and experiments cannot fathom. At the far frontier of time and space, science must adopt new methods in order to answer some very basic questions, such as "What came before the big bang?" and "What is the universe made of?"

We present nine of these questions, the biggest and most baffling riddles that face science today. Our aim is not to put just another popular science book in readers' hands. We have an agenda, which is to show that this is a participatory universe that depends for its very existence on human beings. There is a

growing body of cosmologists—the scientists who explain the origin and nature of the cosmos—developing theories of a completely new universe, one that is living, conscious, and evolving. Such a universe fits no existing standard model. It's not the cosmos of quantum physics or the Creation described as the work of an almighty God in the book of Genesis.

A conscious universe responds to how we think and feel. It gains its shape, color, sound, and texture from us. Therefore, we feel the best name for it is the *human universe*, and it is the real universe, the only one we have.

Even if you are new to science or have little interest in it, you can't help but be interested in how reality works. How you view your own life matters to you, of course, and everyone's life is embedded in the matrix of reality. What does it mean to be human? If we are insignificant specks in the vast black void of outer space, that reality must be accepted. If, instead, we are creators of reality living in a conscious universe that responds to our minds, that reality must be accepted. There is no middle ground and no second reality that can be chosen because we happen to like it better.

So let the journey begin. Every step of the way we will let you be the judge. For every question like "What came before the big bang?" you'll read about the best answers modern science can offer, followed by why these answers haven't been satisfactory. This opens the way for entirely new explorations into a universe where answers come from everyone's experience. This is probably the greatest surprise of all, that the control room for creating reality exists in the experiences everyone is having every day. Once we unfold how the creative process works, you will arrive at a completely different view of yourself than before. Science and spirituality, the two great worldviews in human history, both contribute to the ultimate goal, which is to discover what is "really" real.

A disturbing truth is dawning all around us. The present-day universe has not worked out the way it was supposed to. Too

many unsolved riddles have piled up. Some are so baffling that even imagining how to answer them is in doubt. There's an opening for a totally new approach, what some call a paradigm shift.

A paradigm is the same as a worldview. If your paradigm or worldview is based on religious faith, a Creation needs a Creator, a divine agent who arranged the astonishing intricacies of the cosmos. If your paradigm is based on the values of the eighteenth-century Enlightenment, the Creator may still exist, but he has no business with the everyday workings of the cosmic machinery—he's more like a watchmaker who set the machine going and walked away. Paradigms keep shifting, driven by human curiosity and, for the past four hundred years, viewed through the lens held up by science. At the moment, the paradigm that dominates science posits an uncertain, random universe devoid of purpose and meaning. For anyone working within this worldview, progress is constantly being made. But we must remember that to a devout Christian scholar in the eleventh century, progress toward God's truth was constantly being made, too.

Paradigms are self-fulfilling, so the only way to cause radical change is to jump out of them. That's what we intend to do in this book, to jump from an old paradigm into a new one. But there's a hitch. New paradigms aren't simply pulled down from the shelf. They must be put to the test, and this is done by asking a simple question: Is the new worldview better at explaining the mystery of the universe than the old one? We believe that the human universe *must* prevail. It's not an add-on to any existing theory.

If the human universe exists, it must exist for you as an individual. The present-day universe is "out there," spanning immense distances and having little or no connection to how you live your daily life. But if everything you see around you needs your participation, then you are touched by the cosmos every minute of the day. To us, the biggest mystery is how human beings create their own reality—and then forget what they did. We offer our book as a guide to remembering who you really are.

The shift into a new paradigm is happening. The answers

offered in this book are not our invention or eccentric flights of fancy. All of us live in a participatory universe. Once you decide that you want to participate fully, with mind, body, and soul, the paradigm shift becomes personal. The reality you inhabit will be yours to either embrace or change.

No matter how many billions are spent on scientific research, no matter how fervently religionists keep faith with God, what finally matters is reality. The case for the human universe is very strong; it's part of the paradigm shift unfolding all around us. The reason we say "You are the universe" is that nothing less than that is the truth.

OVERVIEW

THE DAWN OF A HUMAN UNIVERSE

There is a photograph of Albert Einstein standing beside the most famous man in the world, who happened to be the great comedian Charlie Chaplin. In 1931, Einstein was touring Los Angeles, and a chance encounter at Universal Studios led to an invitation to attend the premiere of Chaplin's new movie *City Lights*. Both men are dressed in tuxedos and smiling broadly. It's astonishing to think that Einstein was the second-most-famous man in the world.

He didn't owe his worldwide fame to the fact that everyday people understood his theories of relativity.* Einstein's theories dwelt in a realm far above everyday life, and that in itself created awe. British philosopher and mathematician Bertrand Russell wasn't trained in physics; when Einstein's ideas were explained to him, he was astounded and burst out, "To think I have spent my life on absolute muck." (Russell went on to write a brilliant explanation for laymen, *The ABC of Relativity*.)

In some way relativity had toppled both time and space; the average person could grasp that much. $E = mc^2$ was the most famous equation in history, but what it meant didn't touch

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* Although commonly referred to as the Theory of Relativity, Einstein issued his revolutionary idea in two stages, first as the Special Theory of Relativity in 1905, then as the grander General Theory of Relativity in 1915.

everyday life, either. People went about their daily existence as if none of Einstein's deep thinking mattered, not in practical terms.

But that assumption has turned out to be wrong.

When Einstein's theories toppled time and space, something real happened—the fabric of the universe was torn apart and then rewoven into a new reality. What few understood was that Einstein imagined this new reality; he didn't work with mathematics on a chalkboard. From childhood he possessed a remarkable ability to picture difficult problems in his head. As a student he'd try to visualize what it would be like to travel at the speed of light. The speed of light had been calculated at 186,000 miles per second, but Einstein felt that light contained something quite mysterious that hadn't been discovered. What he wanted to know was not the properties of light or what light was like as a physicist studied it, but what the *experience of riding a beam of light* would be like.

For example, the foundation of relativity is that all observers measure the same speed of light, even if they are moving at different speeds, away from each other or toward each other. This implies that nothing in the physical universe can travel faster than the speed of light, so imagine that you are traveling at essentially the speed of light and you throw a baseball in the direction you're traveling. Would it leave your hand? After all, your speed is already at the absolute limit; no extra speed can be added. If the baseball did leave your hand, how would it behave?

Once he got a mental picture of a problem, Einstein looked for an equally intuitive solution. What makes his solutions so fascinating—especially for our purposes—is how much imagination was being applied. For example, Einstein imagined a body in free fall. For someone having such an experience, there would appear to be no gravity. If he took an apple out of his pocket and let go of it, the apple would float in the air beside him, again making it seem that there was no gravity.

Once Einstein saw this in his mind's eye, he had a revolution-

ary thought: maybe there *is* no gravity in such a situation. Gravity had always been considered a force acting between two objects, but he saw it as nothing more than curved space-time, implying that space and time would be affected in the presence of mass. And that curved space-time, in the vicinity of collapsed objects such as black holes, would result in time stretching to a stop as seen by distant observers. Yet someone located at the falling object wouldn't see anything out of the ordinary. Demoting gravity as a force was one of relativity's most shocking features.

We can see Einstein's visualization in action when astronauts are trained in weightless conditions inside an airplane. The camera shows them floating in midair, completely free of gravity and, exactly as Einstein predicted, any unattached object inside the aircraft is also weightless. What the camera doesn't show is that to achieve zero gravity, the plane is accelerating rapidly in free fall, enough to counteract Earth's gravitational field. As relativity predicted, speed turns gravity into a changeable condition.

If gravity as a force is mutable, what about other things we take for granted as fixed and reliable? Einstein made another crucial breakthrough regarding time. In place of absolute time, which was taken as a given prior to relativity, he discovered that time is affected by an observer's frame of reference and also by being close to a strong gravitational field. This is known as time dilation. The clocks on the International Space Station appear to an astronaut to be running perfectly normally, while in relationship to clocks on Earth, they are slightly fast. A traveler nearing the speed of light wouldn't notice that the clocks on his spacecraft are acting any differently, but to an observer on Earth, they would appear to be slowing down. Clocks positioned close to a strong gravitational field run slower as viewed from far away.

Relativity shows us that there is no universal time. Clocks all over the universe cannot be synchronized. As an extreme example, a spaceship nearing a black hole would be affected by the black hole's immense gravitational pull, so much so that to an

observer on Earth, the clocks on the spaceship would drastically slow down, actually taking an infinite time to cross the horizon of the black hole and be sucked inside. Meanwhile, for the crew falling into the black hole, time would run normally until in short order they would be crushed by its immense gravitational pull.

Although these effects have been known for a century, something new has occurred in our time—relativity actually matters in daily life. On Earth, clocks tick slower than in empty space far away from gravity. So, as clocks pull away from Earth's gravity, they speed up or, more correctly, they appear to, which means that the satellites used for GPS coordinates have faster clocks than the ones down here. When you ask the GPS device in your car to locate where you are, the answer would be off, if only by a little, unless the clocks on the GPS satellite were adjusted to match Earth time. ("A little" would be enough to mistake your location by several blocks, a disastrous error for a mapping and guidance system.)

Einstein's visual images began his journey to the Special Theory of Relativity, and for our purposes, that's critically important. He himself was amazed when his purely mental work turned out to match how nature really works. But everything the theory predicted, including black holes and the slowing of time in the presence of large gravitational forces, has come true. Einstein realized that time, space, matter, and energy were interchangeable. This single idea deposed the normal world of the five senses with its claim that nothing we see, hear, taste, touch, and smell is reliable.

You can do your own visualization to prove this fact to yourself. See yourself sitting on a train moving down the tracks. You look out the window and notice that a second train is traveling beside you on a second, parallel track. This second train isn't moving forward, however, so according to your eyes, it must be standing still. But your eyes are lying, since in reality your train and the second train are moving at the same speed relative to

the platform. Mentally, we all adjust to the lies our senses tell us. We adjust to the lie that the sun rises in the east and sets in the west. As a fire truck whizzes past, its siren rises in pitch as it approaches and decreases in pitch as it races off into the distance. But mentally we know that the siren's sound hasn't changed. The rising and falling was a lie told by our ears.

Each sense is equally unreliable. If you tell someone that you are about to stick their hand into a bucket of scalding water, but instead you plunge the hand into ice water, most people will cry out as if the water was hot. A mental expectation causes the sense of touch to deliver a false picture of reality. So the relationship between what you think and what you see works two ways. Your mind can misinterpret what you see or your eyes can tell your mind a false story. (We're reminded of an incident that happened to an acquaintance. When he came home from work, his wife told him that there was a huge spider in the bathtub and begged him to get rid of it. He marched upstairs and pulled the shower curtain back. From downstairs his wife heard him shriek when he saw what he thought was the world's hugest spider. But in fact, it being April Fool's Day, she had put a live lobster in the bathtub!)

If the mind can fool the senses and the senses can fool the mind, reality becomes suddenly less substantial. How can we rely on an external "reality" if it's affected by how we are moving or what gravitational field we are immersed in? Einstein did more, perhaps, than anyone else before the advent of quantum mechanics to contribute to the queasy feeling that nothing is as it seems. Take this quotation from him about time: "I have realized that the past and future are real illusions, that they exist in the present, which is what there is and all there is." It's hard to imagine a more radical statement, and Einstein himself was uncomfortable with how unreliable our acceptance of the everyday world actually is—after all, to accept that the past and the future are illusions would disrupt a world that runs on the assumption that the passage of time is totally real.

IS EVERYTHING RELATIVE?

The year 2015 marked the hundredth anniversary of Einstein's final version of relativity, known as the General Theory of Relativity, and yet the most radical implications of it haven't sunk in, not as it concerns what is real and what is illusion. We are all used to accepting relativity in our everyday life, though we don't use that label. When your toddler draws on the wall with crayons, throws food on the floor, or wets the bed, you are much more likely to be indulgent about his behavior than if your neighbor's toddler comes to your house and does the same things. We are also used to the mind's fooling us about what our senses are detecting. Let's say you are going to a party and are told in advance that Mr. X, who will be there, is on trial for multiple burglaries in your area. At the party Mr. X comes up to you and casually asks, "Where do you live?" The sounds arriving in your brain through the mechanics of hearing will produce a very different response than if someone else had asked the same question.

Einstein could see in his mind's eye that objects would not appear to travel at the same speed to someone riding a beam of light and to someone standing on another moving object. Since the speed of anything is measured by the time it takes to travel a certain distance, suddenly time and space had to be relative as well. Very soon Einstein's chain of reasoning became complicated—it took ten years, from 1905 to 1915, for him to consult mathematicians in order to find the correct formulation of his theory. In the end, the General Theory of Relativity was hailed as the greatest piece of science ever accomplished by a single mind. But it mustn't be lost that Einstein cracked the code of space, time, matter, energy, and gravity by using the *experience* of visual images.

Does this prove that you are creating your own personal reality according to your own experiences? Of course. Every moment

of the day you relate to reality through all kinds of filters that are uniquely your own. A person you love is disliked by someone else. A color you find beautiful is ugly to another person. A job interview that sends you into an immediate stress response poses no threat to a job applicant who happens to be more self-confident. The real question isn't whether you are creating reality—all of us are—but how deeply your interventions go. Is there anything that is real "out there" independent of us?

Our answer is no. Everything known to be real, from a subatomic particle to billions of galaxies, from the big bang to the possible end of the universe, is keyed to observation and as such to human beings. If something is real beyond our experience, we'll never know it. Let's make clear that we aren't taking a position that is nonscientific or anti-science. While Einstein was seeing images in his mind's eye that would overturn time and space, other pioneers in quantum physics were dismantling everyday reality even more radically. Whereas the theories of relativity were mostly the product of one person (with some help from colleagues), quantum physics was developed collectively by many physicists in Europe. Solid objects were now seen as energy clouds. The atom was observed to be mostly empty space (if a proton were the size of a grain of sand sitting in the center of a domed football stadium, an electron would be orbiting it at the height of the ceiling).

One by one, the quantum revolution that exploded in Einstein's lifetime took away every reliable bit of the world "out there." Intellectually, the consequences were devastating. There's a famous aphorism, uttered by astronomer and physicist Sir Arthur Eddington as he contemplated the peculiarities of the quantum domain: "Something unknown is doing we don't know what." These words are generally taken as a quip from a bygone era. Eddington, who offered some of the first proof that the theory of relativity actually matched reality, lived at a time before physics aimed its sights at a total explanation of the cosmos—a

Theory of Everything—which some believe is just around the corner.

But the quip (something Eddington had a knack for) should be taken seriously. Even a confident mind like Stephen Hawking's has more or less given up on a Theory of Everything, settling for a patchwork of smaller theories that will serve to explain how local aspects of reality work, not the whole. But can it really be true that reality is so mysterious that all of us have been mistaken about it since we were born?

THE QUANTUM AND THE APPLECART

Relativity was such a mind-bending theory that in the popular imagination, it seemed to go as far as physics could go. But this was far from the case. The story of what is real and what isn't took an uncomfortable turn known as the quantum revolution. This didn't happen totally independently of Einstein's work. A huge amount of knowledge is contained in $E = mc^2$, which applies to phenomena as diverse as black holes and splitting atoms. Yet, in a sense, the most startling aspect of $E = mc^2$ is the equal sign.

"Equal" means "the same as," and in this case, energy is the same as matter, or mass is equivalent to energy. As far as the five senses are concerned, a sand dune, a eucalyptus tree, and a loaf of bread (matter) are totally unlike a bolt of lightning, a rainbow, and the magnetism that moves a compass needle (energy). But Einstein's formulation has been proved correct many times over. The same cannot be said of the trouble that ensued from it. By portraying nature as endlessly transformable, with matter possibly turning into energy, $E = mc^2$, as in nuclear reactions, raised the question of how this behavior works.

It was realized, to the discomfort of anyone who trusts in the everyday world of sand dunes, trees, and rainbows, that the building blocks of nature, bits of energy or quanta, sometimes

behave like energy and sometimes like particles. The most common example is light. When it acts like energy, light behaves like waves; these waves can be divided into wavelengths, which is why rainbows and prisms prove that the sun's white light is actually an amalgam of many separate colors, each with its own signature wavelength. But light, when behaving like matter, travels in particles (photons) that are discrete packets of energy. In Latin, the word for "how much" is *quantum*, and this was the name chosen by physicist Max Planck, who originated the quantum revolution in December 1900 and won the Nobel Prize in 1918. The term denotes the smallest amount or packet of energy.

If $E = mc^2$ implies that nature could in principle be reduced to a simple equation—something Einstein believed until the end of his life—his breakthrough with relativity was headed for a collision with quantum theory, whose equations are not compatible with General Relativity. This collision plagues physicists even today, and it caused a rupture in the story of what is real and what isn't. The difficulty doesn't sound earthshaking on the surface. It's simply about big things versus small things. All the big things in the world, from Newton's apple to far-flung galaxies, behave as Einstein's General Theory of Relativity say they should. But the smallest things, the quanta, or subatomic particles, obey a separate set of rules, which turn out to be quite bizarre, or spooky, to use Einstein's term.

We'll get into the details of this spooky behavior soon, but for the moment, the big picture is what matters. By the late 1920s, everyone agreed that relativity and quantum theory were incredibly successful in their own right, and everyone also agreed that the two didn't mesh. The hot-button issue was gravity and its incredible nonlinear (curved) effects. Einstein had revolutionized gravity by the use of visual images to pose new answers. Besides the image of a body in free fall, mentioned above, here's another. Einstein imagined a passenger standing in an elevator as it accel-

physicists fully expected them to exist. The cosmos didn't gain a new phenomenon.

Most physicists will acknowledge that there is still a rift in the story of reality. As it happens, this rift leads to a remarkable possibility. Our minds, including the stream of everyday thoughts that run through our heads, might be influencing reality "out there." This could be why small things don't behave the way big things do. For example, visualize a lemon in your mind's eye. See its nubbly yellow surface and oily rind. Now see a knife cutting the lemon in half. Tiny droplets of lemon juice spritz out as the knife cuts through the lemon's pale flesh.

As you did this visualization, did you find yourself salivating? That's the predictable reaction, because simply seeing the mental image of a lemon creates the same physical response as an actual lemon. This is an example of an event "in here" causing an event "out there." The molecules that send a message from the brain to the salivary glands are no different from the molecules "out there" in lemons and rocks and trees. The body, after all, holds the same status as a physical object. We pull similar feats of mind over matter constantly. Every thought requires a physical change in the brain, all the way down to the activity of our genes. Microvolts of electricity fire along billions of neurons while chemical reactions take place across the synapses (or gaps) that separate brain cells. And the pattern of these events isn't automatic; it shifts according to how you experience the world.

Mind over matter upsets the applecart of physics through this discovery, that the act of observation—mere looking—isn't passive. If you look around the room you're sitting in at this moment, the things you observe—walls, furniture, light fixtures, books—don't get altered. Your gaze seems completely passive. But as far as what's going on "in here," no gaze is passive. You are altering the activity in your brain's visual cortex as your eye falls upon different objects. If you happen to see a mouse in the cor-

ner, a riot of activity may be set off in your brain. What we take for granted, however, is that seeing things is passive "out there." This is where the theory of quantum mechanics caused an upset.

If you move from big things to small things, observing photons, electrons, and other subatomic particles creates a mysterious phenomenon known as the observer effect. We already mentioned that photons and other elementary particles have a wave-like aspect and a particle-like aspect, but they can't have both at the same time. According to quantum theory, as long as a photon or electron isn't being observed, it acts like a wave. One feature of waves is that they spread out in all directions; there is no pinpoint location for a photon when it is in its wave-like state. Yet, as soon as the photon or electron is observed, it behaves like a particle, displaying a specific location along with other features like charge and momentum.

We will leave until later the specifics of complementarity and the uncertainty principle, two formulations that are critical for quantum behavior. The thing to concentrate on for now is the possibility that very tiny things "out there" can be altered simply through looking, which is a mental act. Common sense finds this hard to accept, because we're so used to assuming that gazing is a passive act. Go back to the mouse in the corner. When you happen to see a mouse, it often freezes and then quickly scurries away in an attempt to survive potential attack. Your gaze caused this reaction for the simple reason that the mouse sensed you looking at it. Can a photon or electron sense a scientist looking at it?

The very question sounds preposterous to scientists who maintain, as the vast majority do, that mind isn't present in nature, at least not until a series of happy accidents caused human life to evolve on earth. Nature is both random and mindless, according to a scientific credo assumed for centuries to be true. So how could a prominent contemporary physicist like Freeman Dyson say the following?

Atoms in the laboratory are weird stuff, behaving like active agents rather than inert substances. They make unpredictable choices between alternative possibilities according to the laws of quantum mechanics. It appears that mind, as manifested by the capacity to make choices, is to some extent inherent in every atom.

Dyson's statement is daring on two counts. He is claiming that atoms make choices, which is a sign of mind. He is also saying that the universe itself exhibits mind. In one stroke this bridges how big things and small things behave. Instead of atoms behaving totally differently from clouds, trees, elephants, and planets, they only *appear* different. If you look at dust motes dancing in a beam of sunlight, their motion appears totally random, which is how the physics of bodies in motion would describe them. But another visualization helps to make the situation clearer.

See yourself perched on the observation deck of the Empire State Building with a physicist next to you. You are both gazing down at the street below. At each corner some cars turn left and others right. Is this a random pattern? Yes, the physicist replies. A statistical array can be charted to show that over a period of time, just as many cars turn right as left. In addition, no one can reliably predict if the next car coming to a corner will turn right or left—the odds are 50/50. But you know that this is a case where appearances are deceiving. Every driver inside those cars has a reason for turning right or left; therefore, not a single turn is random at all. You just have to know the difference between choice and chance.

In science, the notion of chance is so dominant that mentioning the possibility of choice, as it pertains to physical objects, verges on the absurd. Consider our own planet: all the elements that are as heavy as iron or heavier—including many common metals and radioactive elements like uranium and plutonium—originated in the explosion of giant stars known as supernovas.

Without such explosions, even the incredible heat inside a regular star like our sun isn't enough to bond atoms into the heavier elements. Once a supernova explodes, these heavy elements become interstellar dust. The dust gathers into clouds, and in the case of our solar system, these clouds eventually coalesced into planets. The molten core of Earth is made of iron, but there are currents inside it that carry some of the iron close to the planet's surface. A bit of iron even leaches into the oceans and the upper layers of soil. From it, you got the iron that makes your blood red and allows you to breathe by picking up oxygen from the air.

Even though the floating dust motes in a beam of sunlight are exactly like the star dust that randomly floats among the galaxies, the fate of some star dust was unique. Some dust turned into a vital aspect of life on Earth. You, a human creature, act with purpose, meaning, direction, and intention—the very opposite of randomness. How did something random become something nonrandom? How did meaningless dust produce the human body, which is your vehicle for pursuing everything meaningful in our lives? The answer, if Freeman Dyson is right, is mind. If mind links little things and big things, then dividing the universe into random events and nonrandom events misses the point. The point is that mind may be everywhere, and our lives happen to reflect this fact.

A POET FINDS AN ESCAPE ROUTE

Because Einstein is almost the symbol of a staggeringly great mind, most people don't realize that after the great triumph of General Relativity, which took place when he was just in his mid-thirties, Einstein bet on the wrong side of modern physics, because he couldn't accept its conclusions. When he famously said that he didn't believe that God played dice with the

universe, Einstein was stating his opposition to the uncertainty and randomness of quantum behavior. He placed his lifelong faith on a unified creation that operated without rifts, tears, and separations.

The notion that there is one reality and not two was something Einstein strove to prove until his death in 1955, but this quest was so far from the mainstream of physics that he was considered an incidental thinker after the 1930s—in their franker moments, even his greatest admirers shook their heads over such a great mind spending decades chasing a will-o'-the-wisp. But on one occasion he was given a clue about how to escape the trap posed by relativity and quantum mechanics. The escape route wasn't scientific, however, but came from a poet.

On July 14, 1930, reporters from around the world gathered outside Einstein's house in Caputh, a village outlying Berlin favored by the well-to-do as an escape from the hustle and bustle of the city. The occasion was a visit by Rabindranath Tagore, a great Indian poet then at the height of his fame. Born to a prominent Bengali family in 1861, almost twenty years before Einstein, Tagore had leapt into the Western imagination by winning the Nobel Prize for Literature in 1913. He was also a philosopher and musician, someone the West viewed as an embodiment of Indian spiritual traditions. The purpose of Tagore's visit with "the world's greatest scientist," as Einstein was popularly—and probably rightly—known, was to discuss the nature of reality.

As science raised serious doubts about the religious worldview, readers felt that Tagore enjoyed an uncanny and very personal connection with a higher world. Reading even a few snippets of his writings creates the same impression today.

I feel this pang inside –
Is it my soul trying to break out,
Or the world's soul trying to break in?

EINSTEIN: I cannot prove that my conception is right, but that is my religion.

It was astonishingly modest for Einstein to say that he couldn't prove that truth is independent of human beings, which is of course the cornerstone of objective science. Human beings don't have to exist for water to be H_2O or for gravity to attract interstellar dust and form stars. By using the tactful word *religion*, Einstein said, in effect, "I have faith that the objective world is real, even though I can't prove it."

This once-famous meeting between two great minds is now largely forgotten. But in a startling way it was prophetic, because the possibility of a human universe, one that depends upon us for its very existence, now looms large. The most fantastic of possibilities, that we are the creators of reality, is no longer fantastic. After all, belief and disbelief are human creations, too.

PART ONE

THE ULTIMATE MYSTERIES