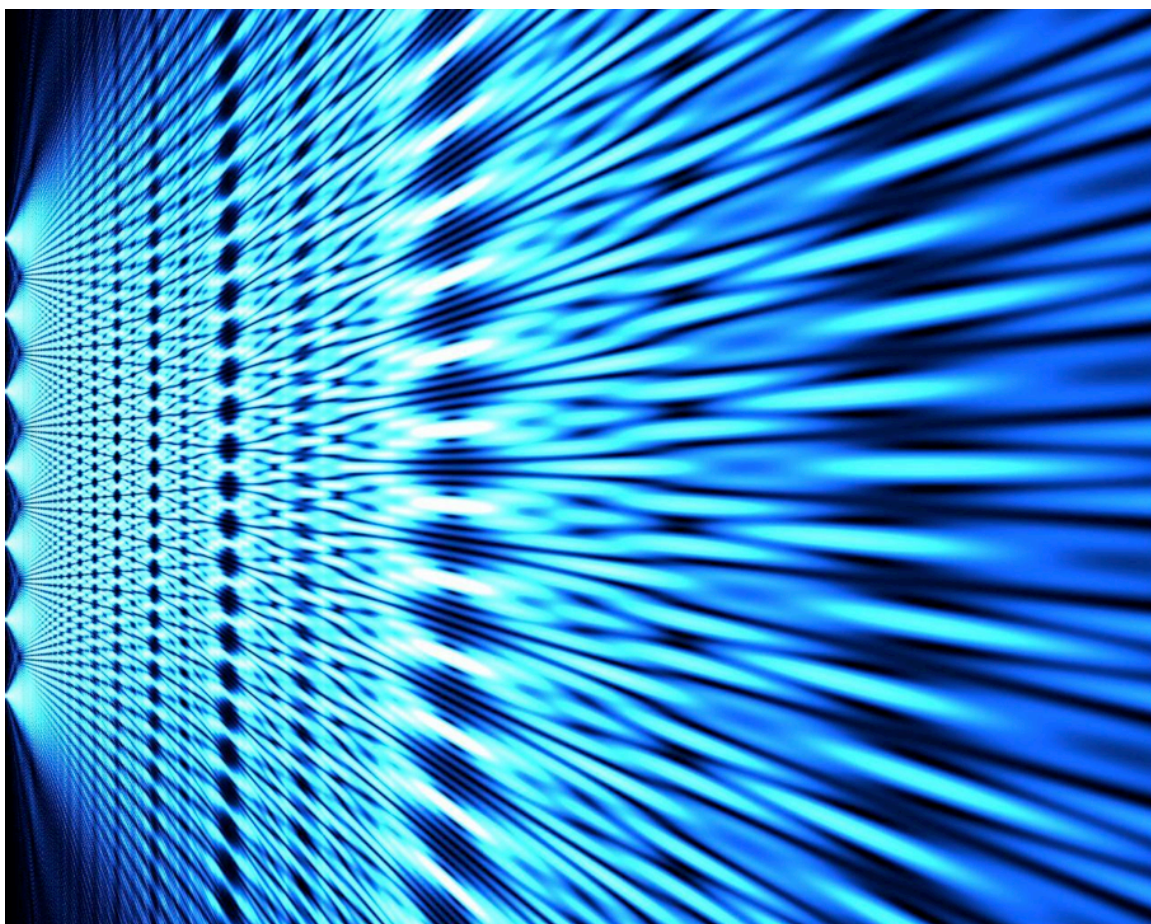


# THE SOURCE

A Scientific Search for the Changeless

A.W. Hill

Inspired by The Work and Thinking of  
Mani L. Bhaumik, Ph.D



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“The eye through which I see God is the same eye through which God sees me,” wrote the medieval theologian Meister Eckhart. “It is incontrovertible that the observer is a participant in genesis,” wrote the great 20<sup>th</sup> century astrophysicist, John Wheeler. Separated by nearly eight centuries, the conclusions are nonetheless essentially the same. We cannot see, hear, feel, smell or taste *The*

*Source*, and yet it abides with us, underlying and pervading everything, a constant well of creation. And perhaps the greatest boon for beleaguered mankind is that its existence no longer needs to be a matter of blind faith. Although it may never be quantifiable, it is undeniably *there*, at the place where all the forces and their fields meet.

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## THE LONGEST JOURNEY

### A FOREWORD

If you think about it, all science, religion, and philosophy since the dawn of human scholarship has been a search for the Source. Almost as soon as the threat of being eaten by a predator or speared by a member of a rival tribe was reduced by the shift from hunting to agriculture and the development of urban centers, we found ourselves with more time to think, and along with other subjects, we began to think about where things came from. Those with more analytical natures may have framed their inquiry in terms of science and engineering, while those whose minds hungered for meaning became philosophers. Others, who believed that understanding lay in knowing God's mind through scripture were drawn to theology. For a large part of human history, these three streams flowed into the same river. There were divergences, of course, but people such as Thomas Aquinas, Isaac Newton, and the Alexandrian scholar, Hypatia, would have considered themselves scientists, philosophers, *and* believers.

They were joined in the conviction that something *essential* underlay perceived reality. Things are made of other things, and ultimately—it seemed reasonable to think--all things are made of one thing.

Perhaps the very first fundamental principle that thinking creatures grasp is *cause and effect*. If I shake the branch, the fruit will come down. If I nudge the first in a long line of standing dominoes, the others will surely fall. Even at the dawn of science, people understood the universe to be in motion (although the question of what was moving and what was stationary elicited centuries of debate). From common experience, we know that for things to be set in motion, some force must act upon them. Naturally, we asked, “what force set the universe in motion?”

Going back at least to the ancient Greeks, philosophical conjecture has pointed to the idea of a *prime mover* or *first cause*, almost always identified with God. Someone had to have nudged the first domino. Now, from the beginning, there have been those (Aristotle among them) who believed that the universe had simply *always* been and

*always* would be, eliminating for practical purposes the need for a first cause. As recently as the mid-20<sup>th</sup> century, many formidable scientists (including, initially, Albert Einstein) held firmly to the belief in a universe that was closed, constant, and eternal rather than dynamic and finite-- with a beginning, and conceivably, an end. With the near unanimous acceptance of the big bang theory, however, the notion of a first cause has made a comeback. Again, something had to light the firecracker, didn't it? As we'll learn in coming chapters, physics has come up with *inflation theory* to explain how and why the universe underwent such a massive expansion, from its origins in a sub-microscopic point source to its present incomprehensible dimensions and ripe old age of 13.7 billion years.

Let me emphasize: it is now accepted science that our universe began as something smaller than the smallest subatomic particle, and is now so large and expanding so steadily that the light from its most distant stars will never reach us. However large it becomes, the laws of physics will hold everywhere. This suggests that the blueprint for the entire project was present in that very first seed.

Inflation theory does a good job of explaining how the universe went from being so tiny to so big in such a small amount of time. It does not, however, tackle the question of why or how the seed of the universe came to be sown. This matter—until recently—was always left to the philosophers and theologians. Three hundred years of scientific thinking and accomplishment have turned our minds away from the issue of first causes, but that does not mean the issue has gone away. In fact, as we will see, it has been waiting patiently in the background of our existence, constant, unchanging, and absolutely consistent from one end of the universe to the other.

From the early *atomic theory* of the Greek philosopher Democritus to the *electro-magnetism* of James Clerk Maxwell, from Gottfried Leibniz's *monad* to Einstein's unified field theory and beyond, the great minds have sought a single ground from which everything springs and to which everything must eventually return. For most purposes, they were in agreement that this ground should be referred to as God, in whatever language or form custom required, and that it was beyond understanding. In this book, and in my lectures and presentations as a peripatetic scientist, I call this ground of existence *The Source*. And the truly astonishing thing I want to share with you here is

that--although its nature is highly abstract and demands a new paradigm of perception--it is no longer beyond comprehension, nor is it beyond the reach of science.

In fact, science—whether it realizes it or not—has left itself no other conclusion than that something *primary* exists. An ultra-simplified scientific account of creation might look like this: a random fluctuation of the quantum vacuum encountered repulsive gravity and brought elementary matter (energy) into being, literally “from nothing” (ex nihilo), prompting a sort of chain reaction that produced the fundamental particles, and from them, hydrogen, and from hydrogen, stars, and from stars, everything else. For many people, this account will be sufficient. But a few will contemplate the phrase “a random fluctuation of the quantum vacuum” and say, “Come again?” What in the world is the *quantum vacuum* and what makes us so sure that its “fluctuation” was “random?”

*Randomness*, and its suggestion of the universe as a cosmic big casino, has in the last century or so become a new kind of golden calf. It makes it very easy for us to dismiss things like first causes and prime movers and conceive of all reality as purely probabilistic. But simple deductive logic tells us that if the vacuum “fluctuated” and brought a universe into being, then in some sense the vacuum must have been pre-existent, and not “empty” in the usual understanding of the term. It had, at the very least, a “potential to be.” And the likelihood that a truly random event would lead eventually to you and I, contemplating the meaning of it all, stretches probability to the breaking point.

Truly, the universe did come from “nothing,” but in this case, nothing is more than meets the eye. In this case, the egg really did come before the chicken. And moreover, the “nothing” that gave birth to the universe is co-existent and co-eternal with it, everywhere at once and everywhere the same, immanent, omniscient and, in a very real way, *omni-potent*, in the sense that it’s the gift that keeps on giving. It is the most fertile ground imaginable, and it has never for one cosmic instant ceased to germinate existence. And yet, when we look at it, we see only emptiness. The brilliant Austrian physicist and quantum pioneer, Walter Thirring, refers to it as “the underworld,” in the sense that it lies beneath and somehow nourishes material reality. The late, visionary scientist, David Bohm, described it as an “implicate order,” as contrasted with the



“explicate order” of material reality. I call it ***The Source***. It is where all things come from.

At the risk of stating the obvious, let me explain my use of the word ***Source***. The word enfolds both space and time. I am using it in a way that is more or less synonymous with “origin.” ***What is the source of that idea? Who is the source of that quotation? Where is the source of that signal?*** Often, highly difficult concepts can be at least glimpsed by way of simple analogies. The source of a river is always higher ground, often in the mountains. All rivers flow ineluctably to the sea, where they combine to form the soup from which all organic life emerged. Does the river “fall” to the sea or is it “drawn” to the sea? As we will see of gravity, both are true. The primary source of which we speak in this book likewise occupies a “higher ground,” although explaining what is meant by that would require some extremely knotty mathematics, and they are beyond our scope here. Let’s just say that it is of a “higher dimensional” nature and leave it at that for now. If we were to consult the Source like an oracle for clues about it’s nature, it would answer us with an inscrutability worthy of a Zen master.

***Question: When did you come into being? Answer: Before there was being to be.***

***Question: Where are you located? Answer: Everywhere and nowhere.***

***Question: How can I find you? Answer: (chuckles) Taste your own tongue.***

The Source takes the form of a ***field***, like those whose excitations generate electromagnetism, gravity, the nuclear forces, and all elementary particles, but deeper by many orders of sublimity, because it is the field that gives rise to all others. You can’t see it, touch it, or even experience its effect (as you can with gravity and electromagnetism) except possibly by way of one mechanism: ***consciousness***. Oddly enough, consciousness and the Source may be linked in ways that science is only beginning to glimpse. To paraphrase the late, great physicist, John Wheeler, ***it is indisputable that the observer is a participant in genesis***. In other words, consciousness is tied to creation itself.

Although consciousness, as such, is not the subject of this book, it colors every atom in every pixel of every word on every page of it. The book itself, and the questions it

asks, are the product of consciousness. And consciousness will be the lens through which we observe it.

The most singular attribute of the human animal is curiosity. Curiosity compelled us to leave our African homeland, to map both the heavens and the seas that reflected them, and eventually to navigate both. Curiosity killed the cat...Schrodinger's Cat, that is (Or did it? More on this in pages to come!) Above all else, curiosity drove humankind to explore the world. But what is there left to explore?

Science, engineering, and the brutal realities of shrinking budgets tell us that our *Star Trek* dreams of one day “boldly going” to explore neighboring galaxies—even the farther reaches of our own—are about as real as pixie dust. Yes, there may soon be commercial shuttle flights to the moon (for those few who can afford them), but the moon is a cold and sterile rock with little to offer once the novelty wears off. Until we are able to untangle some thorny problems of spacetime, no craft now imaginable will carry us to even our nearest galactic neighbor, Alpha Centauri. It's nearly 26 trillion miles distant, and even at the speed of light, that's better than a four-year journey. No method of transport currently on the drawing boards will come even close to the speed of light.

So where go the explorers of today? To what distant shore does a 21<sup>st</sup> century Christopher Columbus point his prow? Even the once “mysterious east” is now spiked with skyscrapers and conquered by Starbucks and MacDonald's. The great peaks of the world have all been climbed, the deepest jungles penetrated. Don't despair! Modern science, in collaboration with the most ancient spiritual practice, points us toward what may prove to be the greatest adventure of them all: the journey into consciousness, and thereby to the Source.

Over the last one hundred years, science has crept ever closer to the notion that there is a startling symmetry between the world of the very large and the world of the very, very small. Between outer and inner. Between what Enlightenment philosophers called “extended reality” (the world outside of and beyond us) and the perception of that reality as grasped by consciousness. Quantum mechanics has proven that the observer cannot be separated from the experimental result he or she observes, that the Cartesian cleavage between mind and matter is mostly illusory, and most tantalizingly, that at the ground of the universe, where things come into being, the cosmos may be able, in some

sense, to regard itself. If these suppositions are borne out, then it may prove that the key to understanding what is happening at the very edge of the universe lies within consciousness. That the journey within and the journey without are one and the same. Could it be that human consciousness, entangled with universal consciousness, is the craft that will at last get us to the other shore? That question is at the heart of this book.

We are going into deep waters here—or, if you prefer, deep space. As with travel into any region with few signposts and little sense of direction, it will help to bring along some definitions. A definition can never be one hundred percent precise, but in spite of uncertainty, working definitions are a good thing to have. They provide a kind of cognitive home plate. When we do discover that something is not quite what it seemed to be, we can ask, “just how much does it differ from my working definition?” and adjust that definition accordingly. So what is the definition of **consciousness**?

Some will equate consciousness with **awareness**, but this is only a small part of the picture. Others will contrast it with the state of being **unconscious**, but this, too, is just the beginning. A squirrel is aware of every sound and movement in its environment, but does it possess consciousness in the human sense? Probably not. It is **sentient**, but not conscious. A tree’s leaves reach for the sun, and houseplants respond to music, but are they conscious? Not by our definition. Consciousness in the human sense begins with the awareness of one’s existence and individuality. It begins with the act of observing, and then unfolds like a marvelous fan, growing exponentially. ***I am aware of being aware of my existence. I am aware that this awareness allows me to make observations and judgments about myself, others, and other phenomena. I can inquire as to the nature of this awareness and how it may affect what I observe. I can ask which came first: my awareness or the things I am aware of?*** And on and on. Along the way, I can ask whether my consciousness is an individual thing—an emergent property of my brain function—or, in some sense, a primary, universal property, accessible to creatures once they have achieved a certain level of complexity. And if it is universal, what is its origin? Did it come into being with the universe? Did it come from the Source? Was it, in some manner, unified with the Source at the beginning of time?

We will address these questions from the perspective of science, and science, at least since the 18<sup>th</sup> century, has had very little to say about God. Yet, despite its self-imposed restrictions, science remains the most reliable foundation for conjecture since it insists that ultimately all ideas be *testable*. In the spirit of scientific inquiry, we will insist that all the major ideas presented in these pages have been or can be subjected to experiment. Of course, some of these will be experiments of a somewhat different nature, because the laboratory will be your own consciousness. We'll discover, as the great scientific explorers of the past one hundred years have, that science loops back upon itself when it acknowledges that this has, in a very real sense, always been the case! The observer and the observed are forever entangled.

Before we begin, the most important question: what's in this for you? Will your life be enlarged, enriched, and improved by your awareness of what I call the Source? If you are the sort of person who is inclined to draw very tight boundaries around your sense of self and reality, perhaps not. You may find yourself angry, frightened, and disoriented, just as no doubt some voyagers who signed on for perilous journeys in the past did. But if you are one of the curious—a true explorer—you may find the world a far more fascinating—and reassuring--place than you have ever imagined. Climb aboard.

The ship is leaving the dock.

## 1

## WHAT'S IN IT FOR YOU?

Imagine that you could wake up tomorrow and know—without a doubt--where everything in our universe comes from. How would that affect your life?

I say, “comes from,” not in the sense of a *location* or even of a “point,” but more in the sense of a *thought*. A thought “comes into” your head, but you don’t really think of it as coming from a particular place. “The sky is as blue as a sapphire,” you think, and you can be pretty sure that this thought was not “there” before you thought it. Likewise, the things of which our universe is made were not there before they were there.

I say “our universe” because it is the one we occupy and the only one we have cause to care about at present. I’m not going to lead you down the merry path of multiple or alternate universes, even though it is quite possible that such things exist. We’d simply have to ask the same questions about them, and we’d have a whole lot less evidence to go by. One universe, unimaginably large and incomprehensibly old, is quite enough for now.

To keep our frame of reference straight, let me state the obvious (but mysterious) fact that our universe exists *in time*, and that when we speak of “where things in the universe come from,” we are speaking of the universe that unfolds in time. Time did not exist before our universe came into being, nor did space. We cannot talk with any authority about what came before time. That does not necessarily mean that there was no pre-existing *something*. It is more a matter of boundaries, and as a scientist, the question of “what thing there was before there was anything” is like the backyard fence that I’m not allowed to play beyond. Do I look beyond the fence? Of course I do. And in the course of this book, we will probably break the rules now and again and climb over it.

As you’ll see, however, the universe that exists in time and space provides all the mystery and awe that the human mind can handle, and many of the matters we’ll discuss are things that were once in the province of metaphysics and mysticism.

So, to get back to the question at hand, how would your life change if you knew for certain that science--with incontrovertible evidence--could vouch for something as unchanging, omnipresent, omnipotent, and steadfast as the God of the Old Testament, the Allah of the Quran, or the Brahman of the Vedas? Something that is inside of you just as you are inside of it? Something that enfolds you as the sea enfolds a single drop of water? Something upon which you can rely without doubt, and which mounting evidence suggests may possess a self-awareness that is the foundation of consciousness? Something from which we come and to which we return?

Would you feel less anxious? More at peace? Less afraid of death?

If you are anything like me, I suspect the answer to all three questions is yes. And if it is, I also suspect that your life would have new meaning, new richness, a new (to borrow a Buddhist term) *suchness*, and that you would step through the field of life with a new confidence and sense of purpose.

In the chapters that lie ahead, I'll seek to lay out for you the evidence science has accumulated that such a constant and pervasive reality exists, a reality that I've called The Source. It will sound, in many respects, like God. In fact, I titled my first book *Code Name God* because of this resemblance. I'm going to try, however, to make limited use of *God* because it implies for many people a *personage*, even a concrete image, and for more rationalistic people (including most scientists!), it pushes buttons and signals a departure from scientific truth. Yes, I do believe that in many ways The Source is the modern man's antidote to atheism, but that does not mean it must be accepted as a matter of faith.

Science has always been concerned with *what we can know*. So have philosophy and religion, each according to its own precepts. In academia, the matter of what we can know is a study in itself, and is called epistemology. The original philosophers, like Aristotle, and their scholastic descendants in the Middle Ages, like Thomas Aquinas, were concerned with *universals*: things that are true everywhere, at every time, and for everyone. Nowadays, in what has been called the "postmodern age," the notion of universals is somewhat out of fashion, with many scholars preferring what are called relativistic truths, in dubious honor of Albert Einstein's theories of special and general relativity. But Einstein, as much and perhaps more than anyone before him,

spent his life seeking a scientific truth that corresponded absolutely with physical reality. The hitch was that the goalpost, so to speak, had been moved while he wasn't looking, and there was no longer general agreement about what *reality* was. Truth be told, this crisis had been coming for a long time. There is a schizophrenic split in the human condition between man the observer and the world he observes, and though its origins may lie in the mists of brain evolution, it will be convenient for our purposes to lay it at the feet of Rene Descartes.

We'll get a little more deeply into Descartes and his legacy in Chapter 4, but for now, let's simply summarize the psychological consequences of what is called Enlightenment thinking. Intentionally or not, Descartes left us with these conclusions:

1. I am not the world. I and the world are separate things.
2. I am only sure of my existence because I can think about these things.
3. I see the world as if from a tiny room inside myself, through fogged windows of imperfectly formed glass. I cannot leave this room. I am a prisoner, to paraphrase Nietzsche, of the language I use to describe things.
4. For the sake of comprehending the world, I must find a way to know objectively what is in the world, or be forced to conclude that I have imagined it. The latter possibility would quite possibly drive me insane.
5. I will comprehend the world by measuring it, and in order to do so, I will develop instruments which possess the objectivity that I, in my tiny room, lack.
6. I will trust what the instruments reveal, even over my own my own intuition.
7. I will thus form a complete, objective picture of the world, but the fact remains: I am not the world. I and the world are separate things.

Now, whether or not you have ever had a scientific thought in your life, this paradigm of reality has shaped your life. It affects the way we relate to our friends, our lovers, our children, our bosses, and all of nature. We see the world from a place called "me," and it is—ultimately and tragically—a very lonely place. This alienation has been the subject of much of what we consider to be the world's great art, literature, and drama, and I would contend that it is the source of much of the world's unhappiness and anxiety, too.

Suppose it could be demonstrated that Descartes' separation of mind and matter was not scientifically valid. Suppose it could be shown that the subatomic particles and "quantum states" that comprise you are "in touch" with particles and states on the edge of the universe. That not only are you a part of the world, but a participant in its creation. That at the level of quantum reality, there is no separation, only an unbroken whole, and that the fabric of this unbroken whole is what I call The Source.

That this description gives a truer picture of the nature of reality is the thesis of this book—its reason for being. It's a thesis that is the result of a hundred years of extraordinary progress in physical science, but its origins go back much farther. There are manifestations of energy inside of you and me that were in touch with manifestations of energy at the Big Bang, and it is vanity to think that we here in the 21<sup>st</sup> century are the first to have glimmerings of that. What *is new* in this book is the assertion that the quantum mechanical revolution of the last century has given us an entirely new vocabulary to use in making sense of the world—and God. It will take some getting used to. We are like shipwrecked passengers who find ourselves on a deserted island in the midst of a boundless sea. All familiar objects are gone, all that we once clung to. Yet, in their place is something infinitely more precious. We've been reintegrated with the world.

How would it feel to build a house, knowing that the wood was of the same unbroken whole as you?

How would it feel to make love with someone whom you knew to be part of the same unbroken whole as you?

How would it feel to raise a child whom you knew to be of the same unbroken whole as you?

Those rare few who have achieved mastery of spiritual disciplines, or are able to juggle a multitude of mathematical abstractions in their heads without getting dizzy, or have spent long, quiet periods in contemplation of nature's cycles, may have experienced the reality of the Source in a fashion. In the end, however, most had to return to life according to the old paradigm of separation. I'm going to make the radical proposal that we learn to embrace a "practical mysticism" based on science rather than revelation; that we "bring it home with us" and practice it 24/7. This will be no easy matter. The mind is a very stubborn commodity. But the change—the *metanoia*, or turning around, as the



Greeks called it—can be accomplished, and you'll no longer have to relinquish to "experts" in science and technology the maintenance of your own part of the great whole.

Have courage! The Source is with you.

## II

## THE CHANGELESS TRUTH

“How can you expect me to believe in God,” says the atheist, “when religion tells me that I will never be able to see Him?”

Take this question, and substitute *quantum physics* for *God*. Then substitute *science* for *religion*. Finally, remove the personal pronoun *Him* and substitute the impersonal *it*.

Both questions are valid. Both reflect the truth of our perception.

Now, the no-nonsense man of science will protest that quantum physics can be trusted because its underlying mathematics has been so astoundingly successful in predicting the outcome of rigorously conducted experiments. He will insist that the prophets of religion can't claim the same, and cite the fact that the world has been predicted to end on any number of occasions yet is still very much in business. But the fact remains that quantum physics, which is now accepted as canonical science, asks us to accept the reality of a world we will never, *ever* be able to see. Further, it asks us to accept that this world, by definition, *cannot* be seen, because to see it would be disrupt its processes. Its elements would quickly assume the likeness of more familiar and acceptable objects, like the naughty schoolchildren who scurry back to their desks at the sound of the teacher's footsteps and act as if nothing were ever amiss! These objects would, for the most part, be the things we call “particles,” but in some ways, they are as much a trick of the light as the magician's white rabbit. The underlying reality is far more magical.

An honest scientist will tell us that if we could, in fact, see the quantum underworld, we might not like what we saw. Until it presents itself for our inspection, it is a roiling, frenetic, ultra-high energy fog of chaotic uncertainty that looks nothing like the world we know. It would be as if we'd peeked behind the curtain at a theatrical show's rehearsal three weeks from opening night, and said to ourselves, “Oh, no! It's going to be

a disaster!” But you needn’t worry, because this particular show has a very skillful producer. In past times, even the greatest of scientists identified that producer as God, and referenced the words, “In the beginning, the world was without form, and void.” The hand and the will of God was credited with drawing order from (quantum) chaos. The truth hasn’t changed. There is still a producer, but it is an impersonal, abstract entity far more difficult to visualize. It is, by scientific description, a kind of *field* (see Chapter V), and it is totally self-regulating, *non-local* (see Chapter 7), and self-entangled in a way that strongly suggests the quality of *self-awareness*. By that definition, you may ask, can we not still call it God? Does it not, in some sense, have an “identity?” Well, yes you may, and yes, in a sense, it does, but I am going to ask you to go farther than that comfortable notion, because your ability to live and thrive in the coming new paradigm will depend on your ability to think more abstractly and to see things that cannot be visualized.

What science seems to be telling us—not only in the domain of theoretical physics but in the life sciences of microbiology and ecology—is that the “whole” of the universe is contained within its “parts.” Think about it. If you’re like most people, I have just turned your world on its head. Wholes are made of parts, not the other way around, right? Well, in the macro or “mechanistic” world, that’s generally true. But think about something like the DNA molecule. Although the analogy isn’t a one-hundred percent match, it will do for now. We’re made of DNA. All organic life is made of it. Is it not a “part” that contains the “whole” of a human being, right down to eye color, sexual preference, intelligence, and even creativity? One way to think of the Source is as the DNA of the universe, though of course, we’ll never be able to see it through a microscope.

This new way of looking at the world, as a living entity in which every part contains the whole, is—as radical as it seems—not truly “new.” In this chapter, I will attempt to give you some philosophical coordinates for the journey that lies ahead. You can think of these, if you like, as being similar to the navigational instruments on a plane or a ship. When the air or water gets turbulent, they may help you find your bearings.

It isn’t possible in a primer such as this one to examine all the religious and philosophical antecedents of the new paradigm, so I’ve chosen three that appear to have been remarkably prescient in anticipating modern physics: 1) the ancient belief system originally known as *Sanatana Dharma*, but familiar to most of the world as Hinduism; 2)

the relatively more recent (but still ancient) body of thought called *Neo-Platonism*; 3) the *Perennial Philosophy* of the great 18<sup>th</sup> century mathematician, Gottfried Leibniz, revived in the 20<sup>th</sup> century by Aldous Huxley. In all three, you will be able to identify the hazy, ghostly outlines of the Source.

When a person of the West, without benefit of direct encounter or a course in comparative religion, thinks about Hinduism, he will most likely picture a “primitive” religion, brimming with household gods, exotic ritual, and sacrifice, or perhaps a Bollywood fantasy re-enacting a passage from the *Mahabharata* and set to throbbing rhythms and swirling gowns. These stereotypes have their basis in reality, but it is more in the realm of folklore and popular culture than high philosophy—a little like evaluating Christianity based on a night spent in a revival tent or at a Christian rock concert.

Hinduism, or as it was originally called, *Sanatana Dharma*, is the oldest of the so-called world religions, and one of the most ancient systems of religious thought in human history. It is a product, as is so much of history, of migration and cultural mutation; in this case, the movement of Indo-Aryan peoples from the steppes of Central Asia and what is now Iran into the northern part of the Indian subcontinent. The seeds of *Sanatana Dharma* were carried from the high, dry lands of the plateau to the fertile ground of India, where they took root and flowered into that collection of sacred wisdom we know as The Vedas.

The words “Sanatana” and “Dharma” are from the Sanskrit language, one of the parent languages of the Indo-European language group that ultimately produced, among other languages, English. *Sanatana* signifies that which has neither beginning nor end and is changeless and eternal. *Dharma* comes from the Sanskrit root *dhri*, meaning “to hold together or sustain.” In usage, dharma has come to mean duty or “that which must be done,” but a more genuine meaning might be “that which sustains me” or “that which is inseparable from myself.” In this sense, it comes closer to the English words “purpose” and “nature,” and so, *Sanatana Dharma* can be taken to mean “eternal purpose” or “changeless nature,” which is very close to the idea of “natural law.”

The foothills of the Himalayas in northwestern India are heavily forested, and in the second millennium BCE (we’ll say, for the sake of discussion, around 1200 BCE),

these forests provided sanctuary for the *rishis*, the holy men (and women) of *Sanatana Dharma*. Here they were in direct communication with Nature's God, the immutable, formless, all-pervading original principle they called *Brahman*. And from Brahman and its

manifestations in nature they received the collected wisdom that became The Vedas, wisdom that was passed from the mouth of the teacher to the ear of the student for generation upon generation until the time, centuries later, when it was finally written down. The Vedic teachings deal with everything from mythology and sacrificial practice to the conduct of life, but their most profound revelations are contained in the texts called *The Upanishads*, which are also known as Vedanta, or "the end of the Vedas." Among these, the *Katha-Upanishad* is especially prized, and here is an example of its language:

The wise person, who by means of the highest meditation on the Self knows the *Ancient One*--difficult to perceive, seated in the innermost recess, hidden in the cave of the heart, dwelling in the depth of inner being—he who knows *that* one as God is liberated from the fetters of both joy and sorrow.

The verse is speaking of God as something to be sought and found "in the depth of inner being." Here, the Isa-Upanishad describes that "Ancient One, difficult to perceive":

It moves and it moves not. It is far and it is also near. It is *within* and it is also *without* all that we see.

What is being described here is an *immanent* God, one that both *transcends* space and time and is also part of its fabric. How can this be—a God that is both "above" and "within?" It is a concept called panentheism, and it is common to many schools of mysticism. This God is not a lawgiver or a judge, and bears no resemblance to kings or prophets. It is utterly impersonal, and yet is to be found "hidden in the cave of the heart." Paradoxically, it is a God that occupies no "location," for it is woven through the entirety of the cosmos. In fact, in its *non-locality* and *indeterminacy* of nature, the Brahman of the Vedas sounds more like a feature of modern physics than ancient religion.

The Vedas comprise a vast body of thought, but all of this thought is built upon a single strand of linguistic DNA: ***Tat tvam asi***. Literally, ***That art thou***, but most often stated as “thou art That.” The logic, in this case, is commutative! It works either way.

The “thou” in this equation clearly refers to you: the student, the seeker, the mortal. Specifically, it refers to your soul, what is termed in Vedic Sanskrit the ***Atman***. But what is the “That” to which our souls are being equated?

***It is Brahman.***

The Vedic rishis teach us to say ***Aham Brahmasmi***. I am Brahman. Just as boldly as Albert Einstein, more than three thousand years later, posited the equivalence of mass and energy, the scholars of Sanatana Dharma posited the unity of ***Brahman*** and ***Atman***, of universal God and individual soul. They did not do this in order to puff up our vanity. They did it to remind us of who and what we ultimately are, and the appropriate response would not be conceit, but surpassing compassion. If I am Brahman, then you also are Brahman, and so are both the mighty and the wretched, my friends and enemies.

The goal of spiritual practice in Sanatana Dharma (or, if you like, ***Vedanta***) is ***moksha***, another Sanskrit word that means liberation. Moksha is attained when we receive direct knowledge of our ***oneness*** with the source, ***Brahman***. Direct knowledge is very different from intellectual knowledge. It is a different as eating a ripe strawberry is different from ***thinking*** about eating a ripe strawberry, but ***thinking*** about an experience, as we all know, often creates a desire to ***have*** the experience, so it is a good start!

The way to ***moksha*** is through ***yoga***, the hitching of our souls to Brahman in a way that gives us control over the five sensory organs and opens up “new organs” of perception. Put simply, yoga is designed to “open channels,” and if its worldwide popularity is any indication, we may all be ready for moksha in a generation or two!

Regardless of one’s spiritual orientation, the experience of oneness begins with what Einstein called “the cosmic religious feeling.” As a scientist, he felt obliged to explain himself, but he qualified the explanation by adding, “It is very difficult to elucidate this feeling to anyone who is entirely without it, especially as there is no anthropomorphic conception of God corresponding to it.” In the same article, published in the New York Times Magazine on November 9, 1930, he went on to say this:

“The individual feels the futility of human desires and aims and the sublimity and marvelous order which reveal themselves both in nature and in the world of thought. Individual existence impresses him as a sort of prison and he wants to experience the universe as a *single significant whole*.”

I suspect that Einstein would have had a lot to discuss with the rishis of Vedic India, and they would no doubt have been fascinated by him.

Before we inquire any further into the nature of Brahman, the “That” whose nature “thou” are said to share, I want to stop—as I will periodically in this book—and say a few words about *words* and the prejudices they trigger. I’ll begin by quoting a wiser commentator, the 9<sup>th</sup> century philosopher of *Advaita* (non-dualistic) *Vedanta*, Adi Shankara:

“The purpose of all words is to illustrate the meaning of an object. When they are heard, they should enable the hearer to understand this meaning, and this according to the four categories of substance: of activity, of quality and of relationship. For example, cow and horse belong to the category of substance. “He cooks” or “he prays” belongs to the category of activity. White and black belong to the category of quality. Having money or possessing cows belongs to the category of relationship. *Now there is no class of substance to which the Brahman belongs, no common genus*. It cannot therefore be denoted by words which, like 'being' in the ordinary sense, signify a category of things. Nor can it be denoted by quality, for it is without qualities; nor yet by activity, because it is without activity. Neither can it be denoted by relationship, for it is “without a second” and is not the object of anything but its own self. Therefore it cannot be defined by word or idea; as the Scripture says, it is the ‘One before whom words recoil.’”

*The one before whom words recoil*. Quite an image! In the course of this book, we will be exploring many aspects of modern physics “before which words recoil.” A word, as Shankara suggests, is only effective in communicating something insofar as you and I agree on what it “illustrates.” If I say “bird” to mean a bird of prey and you take it to mean a sparrow, then I will have failed to communicate. I will not have qualified the word properly. Likewise, if I say “God” and you picture a king-like patriarch who resembles the actor Charlton Heston in “The Ten Commandments,” or even a warm, enveloping blanket of white clouds pierced by sunlight, then we will go around each other

in circles. The God spoken of in this chapter's references—whether it is called Brahman, the One, or the Monad—is not only not *anthropomorphic* (in the form of a human being), it has no shape, color, or attributes at all! It is, to cite Leibniz (another one of this chapter's subjects), a *plenum*: a “that from which things come.” But since it is not “a thing” itself, it can have no “thingness.” For three centuries, the language of mathematics has been employed to describe things without “thingness,” and for most purposes, it has worked quite well. But not everyone is a mathematician, and it is high time that human beings set to work on the development of a common vocabulary to describe what cannot be visualized. It is quite possible that the nature of reality is beyond mathematics (but don't say that to a mathematician!)

Words also convey value judgments. To say that something is “higher” is often taken to mean that it is “superior to,” when it may simply mean “of a higher order of complexity or abstraction.” In Non-Euclidean geometry, there are higher dimensions, but they are not thereby “better” dimensions than our ordinary three. Similarly, to say, “I am Brahman” does not mean that I am “as great as God” or that I can take it upon myself to create a universe! It means that I partake of Brahman, and that Brahman is ultimately my true nature. It means that there is no true separation between me and the greater reality of the universe. It means that we are not alone.

Scientists get especially hung up on words, and this has, in part, led to a virtual war between Science and the Humanities, and an even larger schism between science and religion. Even words like *consciousness* can cause difficulty, not to mention things like *soul* or *psyche*. It is likely that many of my scientific colleagues will have problems with my use of the term *source*, because it will suggest the presence of a creator, and this is not something we'll ever be able to demonstrate in the laboratory. Nonetheless, I will use it, because it is—at least for the moment—the word that best describes what I mean.

When I am about to use a word that I think might carry some “baggage,” or be subject to misinterpretation, I will flag it in a sidebar. Words are, at best, stand-ins for reality. Perhaps, in reading this book, you will come up with some better ones.

Returning to the issue at hand, what connects the received wisdom of a three thousand year-old Vedic holy man to the most radical conclusions of quantum physics, some of which were reached using multi-billion dollar particle accelerators that the rishis



of Bronze Age India could not have imagined in their wildest visions? In order for you to appreciate my answer, it will help for you to be aware of a few of the most important discoveries of what has been called “the new physics.” I’m not going to go too deep at this stage, as this material will be covered extensively in chapters to come, so if you are left scratching your head after this quick summary, don’t worry.

Some, perhaps many of you will recall having seen a “model” of the atom on your high school science teacher’s desk or in the classroom. As strange as it may have been to learn that all things in the world were made of aggregates of these tiny, spinning solar systems, there was also something comforting about the clockwork precision with which the electron orbited the nucleus like a miniscule satellite, and the symmetry of protons and neutrons within the nuclear shell. The position and momentum of all the parts was well-defined, and we believed that if we just had a powerful enough magnifying glass, we would see that the microscopic world was simply a scaled-down version of the cosmos. This is a mechanistic view of reality that, in many ways, goes back to the ancient Greeks.

It is not, however, an accurate view of physical reality.

First of all, an atom consists mostly of space. One way to visualize the relative distance between the nucleus of, say, a hydrogen atom and its single electron is to imagine a speck of dust on the fifty-yard line of a football field as the positively charged nucleus, and another speck of dust on the farthest outskirts of the football stadium’s parking lot as the negatively charged electron. What fills the space between them? Now there is a mystery for another chapter. For now, just try to visualize the space.

Secondly, unlike your science teacher’s model, the electron is not in any common sense a “particle.” It has “particle-like” aspects, but according to Heisenberg’s now amply proven *indeterminacy principle* (often misnamed “uncertainty principle”), we can only know either 1) its position; or 2) its momentum, but never, *ever* both. That means that the electron exists only in a “cloud” of probability, and in fact, when we attempt to photograph an atom, this is pretty much what we see. A cloud. An electron exhibits what is called *wave-particle duality*. It can quite literally be either one or the other, depending on whether anyone is looking! But that is only the beginning of the weirdness.

Elementary particles such as the photon (a quantum of light) can be in two places at once, and furthermore, two particles, once *entangled* in the same quantum system,

remain forever entangled, even at opposites ends of the universe. We cannot affect one without affecting the other, and since all elementary particles have, at one time or another, operated within the same quantum system, every particle in the universe is entangled with every other, and the universe is therefore one seamless, interconnected whole.

This whole includes, by the way, the particles that make up *you*.

And as if this weren't enough, what we once thought of as the vacuum of empty space isn't empty at all. It is a frenetically active plenum that is continuously generating a "spray" of virtual particles and anti-particles, most of which annihilate one another, but a few of which manage to break through from the underworld and become real, that is to say, physical.

The new physics has given us a "fuzzy universe." Things are simply not either "this" or "that," and Aristotle's venerable *law of the excluded middle*—the first thing many philosophy students learn—is out the window! Nor are things locatable in the normal sense, since the universe has no north, south, east or west, no up or down, right or left. As it expands from its point of origin, space itself expands with it.

Finally, and most strikingly, the emerging picture of the universe as a single quantum system, an organic whole composed of elements which, in themselves, seem to possess some elemental awareness of the whole—to mirror it, so to speak--suggests a reality in which there is no "self and other," and in which we both contain and are contained by the ground of creation.

Are you beginning to see some similarities? *Far and also near? Everywhere and nowhere? Moving and not moving? Within and also without?* The nature of quantum reality is far more like the nature of Brahman than it is like the clockwork universe of our fathers and forefathers. And who is to say that the rishis of ancient times did not glimpse this? After all, the truth is changeless.

The great goal of science, going back to the medieval alchemists and possibly beyond, has always been unification. Unification of forces into one force, of causes into one cause, of matter into a single *prima materia*; unification of knowledge into a single "theory of everything." This desire for unity is more than simply scientific. It is—though

most scientists would bristle at the word choice—almost religious.

It is, at the very least, a philosophical and aesthetic posture. Science always seeks the simplest and most elegant explanation for phenomena. And the last hundred and fifty years have seen extraordinary progress toward putting the universe, to paraphrase one very prominent scientist, “in a nutshell.” Whether or not the universe will ultimately cooperate is a matter of debate. The chapters to come will familiarize you with the most significant strides toward unification. In physics, it is a matter of faith that the closer we can come to the instant of the Big Bang, the closer we will come to seeing perfect unity. We even use the term symmetry to describe the unblemished perfection of this original state, and then characterize the steps leading to the formation of gross matter as “broken symmetry,” almost as if describing a fall from grace. We cannot recreate the Big Bang in the laboratory—not yet at least—but one thing almost everyone agrees on is that the physics of the very, very small replicates the conditions of the very, very early universe, as if all of space were a multi-dimensional mosaic in which each unimaginably tiny tile was a universe coming into being. This is, I think you’ll agree, quite an elegant solution!

When I say very, very small, you can take my word for it. We are talking about things on the scale of Planck’s Length, which is about  $1.6 \times 10^{-35}$  meters. It is literally the smallest measurable distance, and the seed of our universe was smaller still. As we scale down to smaller and smaller tiles of space, things get more and more “blurry,” until theoretically, we reach a point where everything becomes one. I’ll repeat that: *where everything becomes one.*

It is at this stage that we are in the territory of the Source, because the only way to go beyond one is to go to zero.

Plotinus, Plutarch, Porphyry, Hypatia, Boethius, Al-Farabi, Avicenna, Averroes, Erigena, Eckhart, Ficino. These are giants of philosophical enquiry whose names will come up again and again should you choose to take this book as a starting point rather than an end. They are also all what philosophy terms Neo-Platonists. Their common mentor, of course, is the Greek philosopher Plato of the fourth century BCE, whose signature idea was that beyond the world of matter is a realm of ideal forms that are the “virtual versions” of all material things, and beyond this there is a unity, synonymous with God, which he called “the One.”

Does it not strike you, even at this early point in our discussion, that religion and philosophy have “set the stage” for science’s quest for unification?

If we have to pick one representative Neo-Platonist, it would be Plotinus (205-270 CE), the Egypto-Roman philosopher whose *Enneads* describe in six beautifully written books the *emanation* of the material universe from the immaterial One. The first stage of emanation is called the *nous*, a sort of universal mind or cosmic consciousness wherein Plato’s idealized forms—the “blueprints” of all things to come—abide. Next comes the *world soul* in which we all share, and finally, matter itself, a kind of gross facsimile of the ideal forms. Matter may be multiplied into an almost infinite number of parts, but each part embodies the One, and yearns to return by cosmic ascent to its perfect source. Because it is natural for human beings to think in terms of hierarchy, ascent, and flight, this source was envisioned as being “up,” but it might just as well have been down there at  $1.6 \times 10^{-35}$  meters. After all, the very idea of emanation suggests an outward movement from a point of origin. Here is how Plotinus himself paints the picture:

The One is all things and no one of them; the source of all things is not all things; all things are its possession, so to speak. But a universe from an unbroken unity, in which there appears no diversity, not even duality?

Are we to think that a being knowing itself must contain diversity, that self-knowledge can be affirmed only when some one phase of the self perceives other phases, and that therefore an absolutely simplex entity would be equally incapable of introversion and of self-awareness?

No: a being that has no parts or phases may have this consciousness; in fact there would be no real self-knowing in an entity presented as knowing itself in virtue of being a compound--some single element in it perceiving other elements--as we may know our own form and entire bodily organism by sense-perception: such knowing does not cover the whole field; the knowing element has not had the required cognizance at once of its associates and of itself; this is not the self-knower asked for; it is merely something that knows something else.

Paragraphs 2 and 3 are rough sledding at first for anyone but a philosophy major, but I think you may find yourself coming back to them later on when we begin to examine the evidence that the universe itself may—in some way we may never entirely understand—possess the faculty of consciousness. All Plotinus is saying is that multiplicity and complexity do not “give rise” to consciousness (as the *emergent property* theorists would argue). A single, undivided whole, such as God, or an elementary particle, may

possess awareness of itself. The monad may contain the all.

And with that reference, we'll move on to this chapter's final section.

*Each small portion contains, in an infinity of ways, a living mirror expressing the whole infinite universe that exists with it; so that a sufficiently great mind, armed with a sufficiently penetrating view, could see here everything everywhere.*

The writer is Gottfried Leibniz (1646-1716), the brilliant polymath (i.e., a person who studies and becomes an expert in many disciplines) and, with Isaac Newton, inventor of the calculus. This last fact has no small relevance to the broader subject of this book, which is what the latest developments in quantum physics and cosmology mean for you. Differential calculus is concerned with determining the degree to which changes in one quantity affect changes in another, related quantity. For example, the **position** and **velocity** of an electron. If Leibniz had never formalized calculus as a means for calculating such things, then Heisenberg would never have been able to conclude that—in the case of an electron—it can't be calculated! Most of the remarkable discoveries discussed in these pages are grounded in higher mathematics, many in what are called **differential equations**. This is because the objects under discussion are simply too small to be seen. And this underlines another Leibniz contribution, which is that he invented his calculus as a means to quantifying **infinitesimals**—things too small to be seen or measured by standard means.

Calculus allows us to calculate any conceivable rate of change in the macro world, and most in the micro world, but it hits a wall when it reaches the quantum level. Things begin to blur. Distinctions begin to evaporate. We encounter what even sober scientists call—with a straight face—**quantum weirdness**. Now Leibniz did not, of course, use the word **quantum** to describe subatomic reality. Quanta are literally the smallest quantifiable units of matter. The protons and neutrons that comprise the atom's nucleus are made of them, Quarks, leptons, muons and bosons are all kinds of quanta, and you'll be introduced to them in chapters to come. Quanta are presumed to be indivisible, though we may never know that for sure, since they exist in an abstract, mathematical realm that we cannot see. They are the “particle-like” aspects of subatomic reality, but more on that later.

Leibniz was extremely interested in what is indivisible in nature, and knew that at some point, all the dividing and subdividing had to stop and give way to a single, unitary reality, the only higher expression of which was God Himself. He called these fundamental building blocks of reality *monads*, and posited that they existed outside of time and space. They were *monads* because each one was a complete microcosm in itself, and in some way reflected upon all the others. And yet, like snowflakes, no two were exactly the same. They possessed a kind of “free will” and *intentionality*, just as quanta seem to.

Keep in mind that men like Leibniz drew no hard line between physics and metaphysics, and so a construct like the monad led him to conclusions that we might now describe as mystical:

*But all these wonders are surpassed by the envelopment of what is infinitely above all greatnesses in what is infinitely below all smallnesses. That is, our pre-established harmony, which has only recently appeared on the scene, and which yields even more than absolutely universal infinity, concentrated in the more than infinitely small and absolutely singular, by placing, virtually, the whole series of the universe in each real point which makes a Monad or substantial unity, of which I am one.*

The whole...universe in each real point...a substantial unity...of which I am one.

I would recommend you read that a few times and let it sink in. Two hundred years before Max Planck, Albert Einstein, or Neils Bohr, Gottfried Leibniz was suggesting that the fabric of the universe was an unbroken whole of which he was a part. This is stunningly similar to the descriptions of the universe as having a “holographic nature” offered by modern thinkers like Brian Greene. Every point in space contains every point in space—at least in terms of “information”—and we are made of such points.

Furthermore, although Vedanta, Neo-Platonism, and the cosmology of Leibniz all aim toward the same “singularity” as our point of origin, Leibniz may be intuitively the most prescient in his depiction of the fabric of this reality. Whereas the first two posit a unitary One from which all multiplicity emanates, Leibniz’s monads more closely resemble the physics of the quantum vacuum: an infinite number of “Ones,” each reflecting and entangled with the others, each a microcosm of the whole. Once again, we see that human consciousness seems to be designed to perceive the true nature of things, regardless of century, culture or technology.

The system of thought that both informed and arose from the philosophical and mathematical exertions of Leibniz was one he called *The Perennial Philosophy*. He was not the first to use the term, nor would he be the last, but he was its most erudite spokesman, at least until Aldous Huxley picked up the banner in the mid-20<sup>th</sup> century. A perennial philosophy, by definition, is one that has been around “from the beginning,” and recurs eternally in different forms and under different names. The gist of it is this: that the universe and all its inhabitants issue from a single source, a source that interconnects all of us and to which we ultimately return. There is no real separation between God and man, or if you’d prefer to avoid naming the deity, between the generative power of the universe and the material forms it generates, and the final goal of human existence is to experience this oneness and live in its reality until the day it is ready to bring us home.

In differently expressed but strikingly similar ways, the mystical branches of all world religions give voice to the perennial philosophy of emanation and return, descent and ascent. Through words born of their respective cultures and mythologies, each speaks of the spiritual and psychological benefits derived from its message. And each prescribes some sort of spiritual discipline, whether it be yoga, contemplative prayer, or union with nature, through which we can open doors to its realization.

It has been said—and not always enthusiastically—that the religion of our time is science. The analogy is actually truer than many scientists would like to suppose, for although science prides itself on demonstration of truth through experimental proof, we’ve seen that in the case of quantum mechanics, tangible proof is not always readily available, and we must rely upon the “belief system” known as higher mathematics. For those who don’t speak the language of the mathematical priesthood, the leap of faith is just as great! Believe that the subatomic elements that constitute *me* are quantum entangled with the subatomic elements that constitute a being living in a galaxy a hundred million removed from mine? Who are you kidding here? Where’s the proof?

But it appears to be the case. “Not only is the universe stranger than we imagine,” goes a quote attributed the great astrophysicist Sir Arthur Eddington, “it is stranger than we *can* imagine.”

Eddington, the man who proved Einstein's General Theory of Relativity by showing the bending of starlight by gravity during an eclipse, also said this, and it's a quote we'll come back to in later chapters: "The stuff of the universe is *mind stuff*."

I mentioned earlier that the holy grail of physics is *unification*. If, in fact, it were to be shown that the essence of the perennial philosophy held true from one end of the universe to the other, it would be one magnificent unification!

I will close this chapter with another quote, this one from the 20<sup>th</sup> century novelist, essayist, and scholar, Aldous Huxley, who wrote in *The Perennial Philosophy*:

PHILOSOPHIA PERENNIS. *The phrase was coined by Leibniz; but the thing--the metaphysic that recognizes a divine Reality substantial to the world of things and lives and minds; the psychology that finds in the soul something similar to, or even identical with, divine Reality; the ethic that places man's final end in the knowledge of the immanent and transcendent Ground of all being--the thing is immemorial and universal.*



### III

## MASTERS OF THE UNIVERSE

With each major leap forward in human understanding of how nature works, we have had to adapt ourselves to facts that at first seemed highly counterintuitive. We laugh now at those who held on tenaciously to the belief that the earth was flat, or that it was the motionless center of the universe, but imagine how mind-bendingly difficult it must have been to get used to the idea that the earth was orbiting the sun and rotating at a speed of more than one-thousand miles per hour—and yet, we were not flying off into space! We aren't *aware* of its rotation, except in the change from day to night, which even today we refer to as “sunrise” and “sunset,” and we have always had a hard time believing in things we don't perceive directly. Be grateful that nature shields us from this perception! If we *were* aware, we'd grab hold of the nearest tree and hang on for dear life. But we aren't, and we don't need to hang on. Gravity takes care of us. Einstein described planet earth as being like a spaceship, and he was right. Just as you would move around freely on a spaceship, going to dinner, for example, or using the exercise room, we are free to move about the earth, because gravity and our minds speak the same language.

Gravity is a *force*, one of four fundamental forces that govern the universe. The existence of *force* is not only at the heart of physics, it's at the heart of reality. It takes work to make a universe, and force is required to do work. Force is anything that will cause an object to move, whether that object is a two-ton truck or a quark. All forces are manifestations of energy, which is, of course, the basic constituent of the universe. Strange to say, we do not know what energy *is*. We just know that it *is* and how it works, and that everything is ultimately made of it. In this book, there is really no important distinction between “energy” and “the Source.” They are primary, and something that is primary

cannot be subdivided. Like the Vedantist's *Brahman*, the Neo-Platonist's *One*, and Leibniz's *monad*, it is a *unity*. By the fundamental scientific axiom that the simplest explanation is always the best one, it is thought that all forces were once a single force, and still are at the deepest level of reality.

Force is the expression of energy, and *fields* are the mode of that expression. A field is a "condition of space." Even in what we identify as the vacuum, where there is no matter, there is still *field*. We have all heard of electromagnetic fields and gravitational fields, and if all forces are ultimately one force, then it stands to reason that all fields are ultimately one field, and that this field is the source of them all. What we call elementary particles are now thought of as *excitations*, or perturbations, of their respective field. But before we get carried away, let's establish some clarity of definition. What exactly is a force and how is it carried by a field?

A force is a manifestation of energy that is capable of doing *work*. Pushing, pulling, attracting, repelling, bonding and obliterating. This understanding of force is at the core of Sir Isaac Newton's Laws of Motion and Universal Gravity. Newton derived the famous equation quantifying force that every student learns:  $F = MA$ . Force equals mass x acceleration. From this, we all perceive the now commonsensical awareness that the more massive and fast-moving something is, the greater force it has. Try stopping a truck rolling downhill when its brakes have failed, or for that matter, a planet in its yearly orbit around the sun. It required a force, of course, to set these objects in motion, and this is the essence of Newton's First Law of Motion. If not acted upon by a force, the object remains as immovable as a boulder, but once it is moving, it will take a force just as strong to stop it. In either state, the object has what Newton called *inertia*.

The Second Law of Motion contains the equation relating force to mass and acceleration, but it's the Third Law that seems counter-intuitive. Newton concluded that for every force applied, there is an equal and opposite force applied in response. This concept is easy enough to understand with two tractors of equal horsepower playing tug-of-war, but it's little trickier to grasp the fact that when you push on a wall, the wall pushes back. Yet this is the way it is: the wall's force is the force of its inertia.

All of this came out of Newton's interest in what kept the planets in regular and unchanging motion, and this led him eventually to formulate his Universal Theory of

Gravity. (When you are Sir Isaac Newton, your theories rate capital letters!) The Laws of Motion explained what kept the moon, for example, moving, and even its rate of motion, but they did not explain why, on one of its many orbits around the earth, it didn't simply slingshot into space. Keeping the moon in its orbit required another kind of force, a force that Newton called **gravity**, from a Latin word that simply means "weight." He reasoned that a mutual attraction existed between all objects in the universe, and the more massive the object, the greater gravitational force it could exert on objects in its vicinity (and, based on the Third Law of Motion, the greater reciprocal force). It was as if the earth, in its own rotations, scooped out a circular trench in space, and the moon simply slipped into the trench and stayed there. (How apt an analogy this is wouldn't become clear until Einstein) It's tempting to think of the earth's pull on the moon as akin to magnetism, but gravity is something else. What, exactly, is still very much a matter of study.

Newtonian gravitation established how gravity works, if not what it is, with another famous equation. It's more abstract, so rather than write it out, I'll summarize: every "point mass" in the universe attracts every other "point mass" in the universe with a force that is directly proportional to the product of their masses (one's mass multiplied by the other's). The force is exerted along a line connecting the **centers** of the two masses, so that when a larger object (the earth) and a smaller object (the moon) enter a gravitational dance, it's not the smaller object "captured" by the larger, but both objects orbiting around a **common center of mass**. The attraction is mutual, and that's important.

For Newton and his contemporaries, gravity was an example of "action at a distance." Whatever it was, it was something that could be thrown across the empty reaches of space, like the silk of a cosmic spider's web, to draw together bodies near and far, with the qualification that its strength diminished in inverse proportion to distance. Newton's gravity was, and still is, a very good way of understanding why things "stick together," but the theory had a flaw, and the flaw would remain unchecked for more than two hundred years. Though Isaac Newton may well have been the most brilliant physicist yet to walk this earth, he never considered that the gravitational force might be carried by a **field** that was an element of space itself. A **gravitational field**, occupying each point in space and mediating the attraction between bodies. He couldn't have, really, because no one had yet conceived of a field. That required a paradigm shift.

Paradigm shifts take time, so we'll have to fast-forward nearly a century and a half to get to the next one, and to the next two giants of physics, Michael Faraday and James Clerk Maxwell. Faraday's discoveries preceded Maxwell's by about forty years, but they are part of the same shift in thinking, and the way we think of forces was changed forever. Faraday perceived that there were "lines of force" issuing from both magnetic and electrical sources (the most graphic example being the way metal filings line up around opposite poles of a magnet), and that these lines might extend indefinitely into space. At the time, electricity and magnetism were conceived of as entirely separate forces, but Faraday found that electrical currents could be induced by magnetism and vice-versa. It took Maxwell to put it all together a generation later in the form of *electromagnetic theory*.

Electromagnetic theory is embodied in four differential equations (once again, we see that the language of mathematics is used to describe the nature of reality). If you were going to teach a class on the subject, or conduct an elaborate experiment, it would be an advantage to understand the math, but to grasp the shift in thinking, you need only to know the following: 1) Maxwell asserted that electricity and magnetism were, in fact, manifestations of the same fundamental force, *electromagnetism*; 2) this force was manifested through an *electromagnetic field* and expressed as *waves* propagated at the *speed of light*; 3) light itself was a form of electromagnetism. James Clerk Maxwell was thus credited with what has been called "the second great unification in physics" (Newton gets credit for the first, since the phenomena he grouped under the heading of gravity had also been thought of as disparate forces). But just as importantly, Maxwell gave mathematical and experimental foundation to the idea of a field as a *physical* thing, present at every point in space and characterized by *wavelike* motion. It was only a matter of time before people began to think of reality itself as having a "wavelike nature." Maxwell also enshrined the speed of light as a *constant* in nature. These shifts in our description of reality led, as we will see, to all sorts of interesting developments a mere half a century later.

The simplest way to picture a wave, of course, is in water, and water was (and still is) used as an illustration of how electromagnetic waves are propagated. Drop a pebble in a still pool and watch the waves spread in all directions until, with distance, they begin to

dissipate. Light a candle in a dark room and watch the waves spread in all directions until, with distance, they fall into darkness. Up to a point, the analogy works. But water is a tangible medium through which waves can be propagated. Water molecules are set in oscillating motion when the pebble is dropped. What is the medium through which the electromagnetic waves of starlight move in space? Maxwell conjectured that all of space was filled with a “luminiferous aether,” a sort of metaphysical gas capable of carrying the electromagnetic waves in the manner of a vast interstellar ocean. It’s easy to understand why he felt the need for such a medium, but we now know (thanks, again, to Einstein)

An interesting sidebar before we proceed. Keep in mind that the fundamental constituent of the universe is energy, and that both gravity and electromagnetism are forms of it. In a sense that is both deeply scientific and deeply spiritual, the most basic expression of energy seems to be light. “Let there be light!” says the Lord in the Book of Genesis...*and there was light*. The great contemporary physicist Steven Weinberg has put together a timeline of the early universe he calls “The First Three Minutes.” At .02 seconds after the birth of the universe in the Big Bang, Weinberg’s scenario says, “the universe is mostly light.” Ordinary matter (baryons), to the degree that it existed at all, was a “negligible contaminant” (one baryon for every  $10^9$  photons of light). The next time you light a candle, think of yourself as bringing a universe into being!

that no such thing exists. Light, and other forms of electromagnetic radiation, are perfectly capable of traveling in a *vacuum*. (Of course, we have also learned that the vacuum isn’t as empty as the word implies, and with *dark matter* comprising the vast majority of “stuff” in space, perhaps the luminiferous aether will make a comeback!)

With *gravity* and *electromagnetism* firmly established by the end of the 19<sup>th</sup> century as fundamental forces, each carried in wavelike motion through fields with infinite range, science was close to understanding how forces that operate on the “macro” scale—in the big world you and I inhabit—go about their business. The next major paradigm shift would be the determination that these waves of force could be quantized, i.e., parsed up into ultra-tiny chunks with a “particle-like” nature. With this shift came the most counter-intuitive revelations yet. But we’ll skip over that for now in order to bring in

the remain-ing two fundamental forces in nature. For them, we have to go to the “micro” level.

The four fundamental forces are a bit like the Marvel Comics superheroes we know as the ***Fantastic Four***. Each one has strengths—and weaknesses—that are unique to its character. Gravity and electromagnetism have infinite range, but relatively modest strength, with gravity by far the weakest—even though it’s the one that seems to affect our lives the most. The other two forces are found in the domain of the atom, and specifically, in the atomic nucleus itself. You’ll recall from grade school science that the atomic nucleus is a densely packed kernel composed of positively charged protons and neutrally charged neutrons. Protons and neutrons have no trouble getting along in close quarters, but as every schoolchild learns, like charges repel, and when you try and pack two or more protons into the space of an atomic nucleus, you can bet they’ll do everything within their power to get away from one another. What holds them together? What keeps the nucleus (and with it, all matter) from blowing apart?

The ***strong force***, naturally. It is far and away the strongest of the fundamental forces, and if it were a Marvel Comics superhero, it would be capable of binding absolutely anything in the universe. To give you an idea of its magnitude, if the force of gravity is represented by the number 10, then the strong force is  $10^{38}$ —a number almost unimaginable to us mortals.

If not for the strong force, there would be no matter. It’s as plain as that. There would be no Periodic Table of the Elements, because there would be no elements. No water, no trees, no you, and no me. At the beginning of time, the strong force had to “break” from the “symmetry” of the unified field in order for the first atoms to form. To be precise, the strong force is really ***the strong interaction***. (We’ll soon see that all of the forces are, in truth, interactions that involve the ***exchange of particles***). To understand how and why this is, let’s look at the most basic of elements, hydrogen, whose nucleus is composed of a single positively charged proton, orbited by a single negatively charged electron.

You might think that a hydrogen atom has no need of the strong force, since a single lonely proton has no one to fight with and therefore no need for a mediator. But a proton, as small as it is, is not as small as things come. It is not an ***elementary particle***.

Protons are made of those whimsically named subatomic specks known as **quarks**—three of them, to be exact—and it is no easier to bind quarks together than it is to contain protons in the nuclei of the heavier elements. The binding of quarks is accomplished by the exchange of **gluons**, possibly the easiest name in the subatomic lexicon to remember, since their function is to “glue-on” one quark to another and keep the nucleus intact.

The mechanism of exchange isn’t something the informed layperson needs to understand precisely, but in the language of quantum chromodynamics (QCD), we say that the strong force is **mediated** by gluons. It’s a little like a marriage: if I give you my ring and you give me yours, we are bound in wedlock. You and I are the quarks and the rings are the gluons that mediate our vows. Of course, since it takes three quarks to make a proton, the arrangement is a bit more like a **ménage à trois!** In any case, it can be said quite seriously that the ordinary matter of the universe—the stuff from which you and I and everything we touch is made—is held together by gluons. And the strong force continues to exercise its might as atomic nuclei fuse in the furnace of the stars to form the heavier nuclei of elements like helium, oxygen, and carbon, and on through the **nucleosynthesis** that produces the rest of the ingredients of our living universe.

Is the strong force, like gravity and electromagnetism, carried by a field? Yes, although it’s a field of a somewhat different nature, and more difficult to visualize. Every particle and every quantum interaction in the universe arises from a field, which makes fields the primary fabric of physical reality. It should go without saying that the fields overlay and interweave one another, like a lattice of golden threads interconnecting every point in the universe with every other point. Some fields exist to engender the building blocks of reality, while others exist as “messenger fields,” whose function is to mediate interactions among those building blocks. If we could see the fields, it might be like “seeing the sound” of a huge cosmic orchestra playing in perfect concert, or floating amid the rapidly beating wings of a multitude of tiny angels--a continuum of vibration. In fact, Leibniz’s **monads** were envisioned as angels occupying every point of space and time, which allowed him to reply to the medieval query, “How many angels can dance on the head of a pin?” with the answer: **as many as you can imagine.**

The fields are the world behind the world, the living bit stream that produces the marvelous rendering that begins as a **virtual** reality and becomes physicalized when it

emerges from the underworld and the arrow of consciousness is directed toward it. We will never be able to part the curtains and look upon this ultimate reality. Our consciousness isn't designed for that. But we can describe it with the language of mathematics, and if our awareness is sufficiently developed by exercises like those in this book, we may occasionally glimpse—and feel--the afterglow of its presence.

There is one more fundamental force essential to the smooth operation of our universe, and it is known as the ***weak force***. It is weak only in comparison to its complementary strong force, but it is stronger than gravity by an exponential factor of twenty-five. The latter comparison isn't entirely fair to gravity, since gravity must range over vast cosmic distances and govern the behavior of massive bodies like the planet Jupiter, while the ***weak force***, like its opposite, operates within the nuclear domain and with commensurately short range. It is the least understood of the four forces, and the most poorly explained. All that most physics primers will say is that the weak force governs "certain types of radioactive decay." But since those "certain types of radioactive decay" are an important part of what keeps the sun burning, it's high time that the weak force got some respect. The weak force governs the decay of protons to neutrons that produces the element ***deuterium***, releasing a whole bunch of energy in the process as ***neutrino emission*** from the sun. The warmth that reaches us is what keeps our planet habitable.

Like the strong force, the weak force is an ***exchange force***, only in this case the currency of exchange is ***vector bosons*** that go by the names of W and Z! It's only important that you know this because in 1983, it was discovered that at the extremely high temperatures characteristic of the very early universe (and of space at the smallest level), W and Z particles are essentially identical to the ***photon***, the quantum particle associated with light and the ***electromagnetic interaction***. Hence, under these conditions, the weak force and the electromagnetic force join and become a single force: the ***electroweak***. This discovery represents the "third great unification in physics." We have now united electricity, magnetism, and the weak force at the beginning of time. That leaves just two: the ***strong force*** and ***gravity***.

The quest for the mother field that spawned these four masters of the universe at the beginning of time is the holy grail of physics. The universe as we know it now is an



immensely diverse and complex organism, but the driving idea behind unification is that if we could “reverse the frames” (i.e., go back in time), things would become increasingly simpler, until ultimately, the universe would “fold into itself” and wink out of physical existence, returning to its original state. It’s logical to ask why science seeks this simplicity. Is there anything intrinsically better about a single fundamental force than four of them? Well, in a word, yes. There is something in human nature that seeks “oneness.” From every duality, we attempt to derive a unity; from every branching river, we are driven to find a common source. We saw this drive operating in the religio-philosophical realm with Sanatana Dharma, Neo-Platonism, and the Perennial Philosophy of Leibniz, and we could, in truth, find evidence of it in every religious and philosophical tradition. It is curious—and by no means coincidental—that the same desire for oneness that drives contemplatives and mystics to attain *samadhi* or *nirvana* also drives physics toward unification of the fundamental forces. The goal, in both cases, is complete comprehension of where we have come from, and ultimately, where we are going. The objective, in both cases, is—to borrow a phrase from Stephen Hawking—“to know the mind of God.” In the first case, the understanding is *intuitive*. A “knowing from the inside-out.” In the second case, the understanding is *analytical*. A “knowing from the outside-in.” But in the end, the two kinds of understanding, like the forces themselves, merge into one, and this is the “peace which passeth understanding.”

That is the peace (*Shanti* in Sanskrit) that I wish to share with you, and the reason I’m asking you to put up with some hard science is to demonstrate that its existence is a reality based not only in spiritual tradition, but in the design of Nature itself.

Earlier in this chapter, I alluded to Nobel laureate Steven Weinberg’s “First Three Minutes” scenario. Weinberg takes it down to .02 seconds—two-hundredths of a second—at which point electrons and positrons are created from light and destroyed in almost equal measure. But even at this very, very early stage, the fundamental forces have not yet congealed. We must “reverse the frames” even further. Although we are now in the realm of things which cannot be observed experimentally, there is a growing body of theoretical work that suggests that at about  $10^{-6}$  seconds (.0000001 seconds), the strong force causes quarks to begin to adhere and form protons and neutrons.

Going still farther back, to around  $10^{-12}$  seconds, electromagnetism and the weak force merge in the ***electroweak unification***. At the beginning of this micro-epoch, around  $10^{-36}$  seconds, the infant universe is described as a “sizzling sea of quarks,” and the strong force is folded into what is known as the ***grand unification*** of forces. The only holdout is gravity. The universe is no larger than a grapefruit, but size is a relative thing! Nothing else existed, so it was still the biggest game in town. And it was very, very, very, very hot.

Now we get down to the nitty-gritty. At  $10^{-43}$  seconds, a stage known as ***Planck Time*** after the great German physicist and credited founder of quantum theory, Max Planck, the gravitational field folds up into the others and we achieve the theoretical ***unified field***. Planck Time, by the way, is the amount of time it takes light to travel across the ***Planck Length***, which is precisely  $1.616199 \times 10^{-35}$  meters. Is that small? Indeed, Planck Length is our standard for the smallest measurable distance possible. Anything smaller would simply cease to exist in a measurable sense. Is there anything before  $10^{-43}$  seconds?

Here is the truly mind-bending thing. Try to stay with me, and if you can’t, rest assured that I will come back to this point many times before we’re through. We achieved theoretical unification of all the forces at Planck Time,  $10^{-43}$  seconds, and obviously, we can’t go back there. Does this mean that unity is irretrievable? That the unified field is a will o’ the wisp, no more real than a unicorn? Does it mean that the original creative impulse—God, Brahman, or whatever we choose to call it—has long since vanished from our midst and left us alone in the void? That the Source exists only in the past tense?

No. It does not.

Science postulates that the physics of the universe at its very earliest and hottest stage is indistinguishable from the physics of the present universe at its very smallest dimension. As we scale down into the microworld of the atom and below, the energy increases exponentially, until it begins to approach the quantum frenzy of those first seconds. If you penetrate the fabric of space deeply enough, you’ll still find a “sizzling sea of quarks,” and other exotic particles, as well. In other words, what happened at ***Planck Time*** continues to happen—even at this very moment—at ***Planck Length***. Right there in the elementary particles that constitute the hand with which you hold this book.

How can the energy of the infant universe exist in the atoms of your own flesh? It can because of the equivalency of mass and energy, another paradigm shift we'll examine in Chapter 5. For now, I'll leave you with this thought:

The beginning of time is, in a sense, still with us.

Hopefully, gaining the knowledge that the power that made a universe is still present in the atoms of your own being will have made this trip through basic physics more than worth your while! The source of everything is present in the minutest stitch of the fabric of space and time.

## IV

## COGITO, ERGO SEPARATUM

In the clouds (of thought), all sorts of rules are violated which in the core (of physical reality) are kept. Extensions there can be indefinitely located; motion there obeys no Newton's laws.

—William James, *Does Consciousness Exist?*

Isaac Newton got people thinking. He was one of those whose ideas opened the doors to what would become known as the French Enlightenment. But a generation before Newton, another scientist-philosopher—a Frenchman, in fact—had established the framework within which all this thinking took place. His name was Rene Descartes, and the revolution in thought he initiated in 1637 (a revolution that established the scientific method and the very notion of “objectivity”) began with an attempt to prove the existence of God and ended with the alienation of man from God’s creation.

If anyone deserves the description “game changer,” Descartes does. His philosophy shaped three hundred years of science and scholarship with its contention that we can “stand apart” from the objects of our perception and know them as they truly are, and it was not seriously questioned until quantum physics put the observer and the observed back in the same loop, a paradigm shift whose implications still haven’t filtered down to our everyday perception. We still live very much in a Cartesian world.

*I think, therefore, I am.* In Latin, *Cogito, ergo sum.*

This was the conclusion first reached by Descartes in his *Discourse on the Method* (1637) and elaborated upon in his *Meditations on the First Philosophy* (1642). Almost all of us have heard the expression, and when it comes down to it, few of us would question the truth of it. But how many of us really understand where it comes from? In common with just about every philosopher, Descartes’ overriding interest was in *what can be known*, the specialty of a field we’ve identified as *epistemology*. As he

launched his quest to discover which truths we could be certain of, he began with a basic but profound question—*what am I?* He replied with an equally basic but profound answer: *I am a thinking thing.*

As I've mentioned, Descartes set out to do no less than prove the existence of God through pure reason. In his day, the first stirrings of atheism were being felt, and Descartes, a pious man, felt obliged to put them down. His reasoning was **deductive**, but he employed a method that has since become known as “Cartesian doubt.” That is to say, he began by assuming that he knew **nothing** and doubted **everything**, and then proceeded to determine **what could be known**. Along the way to God, he encountered a sort of impasse. He realized that anything he could describe as “real” was filtered through the lens of his own thoughts, and that therefore the only thing he could be entirely sure of was **thought** itself! Objects in the world, everything “out there,” existed in what he called **extended reality**. The term “extended” simply means that things like trees, houses, cats and dogs have **extension** in three dimensions of space (and in **time**, as well, though he did not think of time as a dimension). In contrast, he wrote, the thinking mind is **unextended**. It had no dimension and no materiality. It was a **point**. Descartes did not differentiate between “mind” and “rational soul,” so what he was really talking about was the immaterial essence of who we are, and in this sense, his thinking was in the lineage of classical philosophy. But the consequence of his deductive reasoning was to draw a very sharp distinction between the **observer** (“in here”) and the **thing observed** (“out there”), and this was something new. This hard separation between mind and world became known as philosophical **dualism**, and introduced to the human thought stream the curse that has since been called “the mind-body problem” or the “subject-object paradox.”

When we consider someone's philosophy, it's never a bad idea to also consider his life, and the personal factors that may have influenced his thinking. Of course, all great thinkers try their best to rise above personal concerns, but in practice, this is never entirely possible. Now, Descartes was in poor health for much of his life, and had the habit of doing most of his serious thinking in bed. In contrast with the forest-dwelling rishis of Vedic India, he was not what one would describe as “engaged with Nature.” At one time or another, we have all been told by a friend or relative to “get out of our own

heads” or advised not to “overthink” a problem. Descartes was clearly a man who spent a great deal of time “in his own head.” Could this have influenced his perception that the mind occupied a separate sphere from the body, and from “extended” reality at large? We will never know for sure, but when a single person’s perception shapes three hundred years of Western intellectual history, we have a right to ask! As commonplace as it has become to conceive of the mind as a thing apart from what it experiences, this notion isn’t really intuitive. It has to be learned. Parents say to children, “What is going on in your mind?” or “Get your mind off that nonsense!” While it’s true that we recognize from an early age that *thinking about swimming* is different from *swimming*, it doesn’t necessarily follow that the thinking is going on in a separately constituted reality.

Some have argued, and I am inclined to agree, that the Cartesian divide opened a crack that invited in all sorts of modern mental maladies, from common depression to schizophrenia and other dissociative disorders. This doesn’t make Descartes one of history’s villains. He simply wanted to know if it was possible to gather more information about the nature of reality that what his five senses provided, and this is a fundamentally scientific impulse. The consequence of his inquiries, however, has been to take us farther from reality, and the ultimate expressions of Cartesian doubt can be *solipsism*—the belief that the world is a product of your mind—and *nihilism*, the belief that nothing is real and therefore nothing has intrinsic value or meaning. This is a long way from a proof of God.

The chief objection to Cartesian dualism arose not only from his contention that mind and matter were formed of entirely different “substances,” but his quite logical hypothesis that in order for thought/consciousness to occur, these two separate worlds had to somehow *interact* in the human brain. (Descartes believed that only the human species possessed consciousness; he did not even think animals capable of experiencing pain, hence his now unthinkable experiments with live vivisection!) This theory of *interactionism* forced Descartes beyond philosophy and into neuroscience, a then very young field. He posited that the interaction between mind (unextended reality) and body (extended reality) occurred in the *pineal gland*, a tiny endocrine gland (about the size of a grain of rice) located at the very center of the brain. We now know that its key function is to produce *melatonin*, a hormone that regulates patterns of waking and sleeping.

Descartes called it “the seat of the soul,” and reasoned that since it is only possible to think “one thought at a time,” there must be a single place where external experience is converted to internal experience, and vice-versa. This turned out to be a major flaw in his thesis.

It won’t be necessary here to cover three centuries of philosophical discourse about the nature of mind and matter. Let’s just say that Descartes has always had his defenders (mostly on the side of science and *rationalism*) and his detractors, from near-contemporaries like Spinoza, who insisted that mind and matter were of the same divine substance, to men like the pioneering psychologist, William James (1842-1910), who contended, similarly, that nature and experience were an inseparable whole, and whose *radical empiricism* anticipated quantum theory by asserting that the act of observation (i.e., the mind of the observer) is entwined with the thing observed. Further, James argued that reality is experienced in a continuous *stream of consciousness*, and that we can’t simply stop the stream to observe a single aspect of it, an insight that was to prove strikingly close to Heisenberg’s quantum “uncertainty” principal of nearly two generations later.

The transition from Cartesian dualism to the more holistic thinking that characterizes the cutting edge of science today was a gradual--in some cases, painful--process. Historically speaking, we could point to any number of places where the fabric began to fray, or more accurately, where the wound began to heal. Even our friend Leibniz, who was born just about as Descartes was saying goodbye, argued for the idea of mind and matter as part of a more unified system. Just as with his concept of the *monad*, he was ahead of his time. His theory, later known as *parallelism*, was that mind and matter, interior reality and exterior reality existed in a “pre-established harmony” that was every sentient being’s birthright: like two clocks, separated by an apparent ocean and yet running in perfect synchronization.

But William James, quoted above, may have delivered the *coup de grace* in 1907, twenty years before quantum mechanics closed the deal. Speaking of subject and object/observer and observed in his compilation, *Essays On Radical Empiricism*, he wrote:

“Just so, I maintain, does...experience, taken in one context...play the part of a *knower*, of a state of mind, of 'consciousness'; while in a different context the same undivided bit of experience plays the part of a *thing known*, of an objective 'content.'”

The implications of this statement are actually quite profound, for James is describing an essentially undivided reality, where knower and known are part of the same “system.” This perspective has now been validated by “hard science” in things like the *delayed choice experiment* and *Bell’s Inequality*, which will be addressed in pages to come. But in our everyday existence, we still partake of the Cartesian Kool-Aid. Deep down, we still believe that with a powerful enough centrifuge, the stuff of mind and the stuff of matter could be separated, like pigment from oil in a paint. All this comes from the distinction of *thought* and *thing*. But what if one day science, philosophy and religion were to strike a “grand bargain” over their agreement that the basic stuff of the universe is *thought*? This, in fact, is what no less a scientist than Sir Arthur Eddington has argued, and we will also ponder his words in future chapters.

To give Monsieur Descartes his due, the worldview of what we call *Classical Physics*—the worldview of Isaac Newton—of the Enlightenment and Rationalism and events that led to the American and French Revolutions is almost inconceivable without his *Cogito, ergo sum*. In verifying existence by way of thought, he also elevated the value of thinking. During the first two centuries or so of scientific endeavor, it was necessary for scientists to believe that the object of their observation could be frozen, isolated, and examined like an insect pinned on an entomologist’s board. In a manner of speaking, we had to “pretend” that the world worked this way in order to learn the things we needed to learn about it. Thanks to Cartesian inventions like the scientific method and the coordinate grid, we were able to learn almost everything there is to know about the “macro” world of solid objects and three-dimensional space, and in that world, these tools will always remain valuable.

For the next great step in human knowledge, however, we will have to leave behind the Cartesian divide. Having it around will only confront us with a chasm when what we need is a bridge. Fortunately, the history of human thought has provided us with many such bridges. One of them, and the last great thinker we’ll consider in this particular chapter, is Alfred North Whitehead, a British mathematician/philosopher



whose life from 1861 to 1947 encompassed both the revolution in psychology of James, Freud and Jung and the revolution in physics of Planck, Einstein, and Bohr.

Whitehead delivered another blow to the Cartesian worldview by positing that objective and subjective reality (and experience) were part of an organic whole, and that the interface between the extended world and the world of experience was a *process* rather than an isolatable point. His ideas are relevant to the thesis of this book not only because, like James's, they reflect the blending of Western and Eastern thought that undergirds the new paradigm, but because they have recently been adopted and carried forward into the 21<sup>st</sup> century in a striking new theory of consciousness authored by Roger Penrose and Stuart Hameroff (see Chapters 9 and 10).

If there is a single phrase that captures Whitehead's description of reality, it would be that *all things flow*. Like William James, he understood that reality is processed as an uninterrupted stream of consciousness that carries "occasions" of experience and extends both backwards and forwards in time and space. These occasions, whether the deep red of a rose or the diffraction of sunlight are ultimately underpinned by quantum events, and can be isolated and analyzed as such, but this is not the way we experience them. Our experience of them possesses *simultaneity*. It is a "slice" of spacetime that enfolds all events occurring at that instant. Whitehead referred to these slices as *durations*, and was careful to say that durations—no matter how apparently instantaneous—had temporal "thickness."

*"The general fact is the whole simultaneous occurrence of nature which is now for sense-awareness. This general fact is what I have called the discernible. But in future I will call it a 'duration,' meaning thereby a certain whole of nature which is limited only by the property of being a simultaneity.... Our sense-awareness posits for immediate discernment a certain whole, here called a 'duration'; thus a duration is a definite natural entity."*

Like Russian nesting dolls—and like music—each duration received the one before it and contained the one after it. Thus did Whitehead both quantize experience and account for its appearance of continuity. His durations, as we will see, were a little like Leibniz's monads, except that whereas the "monads had no 'windows'," the durations had windows that looked both ahead and behind.

*A duration can be all nature present as the immediate fact posited by sense-awareness. A duration retains within itself the passage of nature. There are within it antecedents and consequents which are also durations which may be the complete specious presents of quicker consciousnesses.”*

Being a mathematician and well-aware of contemporary science, Whitehead knew, of course, that at the fabric of this simultaneous reality, an astounding number of individual quantum events were occurring, involving physical processes and entities that we would never be able to perceive. He knew that this was the “real” reality, and that science had so far failed to account for how and why we perceive it as we do. His observation both reflected and anticipated the current discussion of *quantum entanglement*.

*“In a certain sense, everything is everywhere at all times. For every location involves an aspect of itself in every other location. Thus every spatio-temporal standpoint mirrors the world.”*

Let me repeat the last sentence: “Thus every spatio-temporal standpoint mirrors the world.” This is a statement that bridges *Sanatana Dharma, Gottfried Leibniz, and Stephen Hawking*. And if it is borne out by the science of our time, it may be the greatest seismic shift in human thought since the rise of monotheism. But Whitehead went farther, and again, his assertions find support in both the ancient past and the cutting edge present. He argued that consciousness—or at least, the foundation of consciousness—is an elementary property of Nature. That even at the nuclear level, there exists an elementary form of awareness, and that this accounts for how we are able to assemble the myriad pieces of reality into “occasions” that present a complete picture of the world. Does this mean that subatomic particles can “think?” Not exactly. We humans have evolved fabulously complex “processors” that can interpret the inflow of information in a way that allows us to survive, reproduce, and even to imitate the handiwork of God. A quark does not have this much going for it, and thus, Whitehead contended that its “experience” would be quite dull in comparison. But what it *does* mean is that “the stuff of thought” is embedded in the fabric of the cosmos, and has been since the beginning.

This is a way of looking at things that links Whitehead with thinkers from John Wheeler and Sir Arthur Eddington all the way back to Plato!

A more generous, and admittedly speculative way to think about the “experience” of a quark might be to say that it possesses ***cosmic consciousness***. That it has “a sense” of itself as being a part of the cosmos and a connectedness with all other parts of the cosmos, and that is probably quite enough for a quark! Of precisely what nature this “sense” might be, we do not know. Could it be similar to the state of mystical oneness that the Vedic rishis sought and that Einstein identified as “the cosmic, religious feeling?”

The notion of “soul in Nature” is a philosophy that is often called ***pan-psychism***. As an explanation of consciousness, it is contrasted with both Cartesian dualism and the theory of ***emergence***, which holds that the brain is essentially a super-computer whose operations reach a level of such sophistication that they fold back on themselves reflexively. We’ll look much more closely at these ideas in chapters 9 and 10. For now, I’d like to think of this chapter as a sort of “staging ground” for the rest of the book. We are in the base camp at ten thousand feet, preparing for an ascent of the sixteen thousand foot summit, and we must get our bodies and our minds used to much thinner air. If we are to truly leave the Cartesian divide behind, we’ll have to learn a skill that I call “thinking from both sides.” Thinking simultaneously as subject and object. Let’s pause for another word from Mr. Whitehead, referring to the philosopher Immanuel Kant:

***For Kant, the world emerges from the subject; for (my) philosophy of organism, the subject emerges from the world.*** And this: ***“The end result is that “nature is a structure of evolving processes. The reality is the process.”***

Learning to think simultaneously as if “we emerge from the world” ***and*** “the world emerges from us” will be tricky. It means thinking on your feet, and it means thinking with your whole self. But it is possible, and in the years and epochs to come, it may also be essential.

## V

## EINSTEIN'S DREAM

*“I am a deeply religious nonbeliever.... This is a somewhat new kind of religion.”*—Albert Einstein, in a letter to Hans Muchsam, March 30, 1954

His face, especially as it appeared in his last decade on earth, became iconic: a map of the human heart etched with the topography of the mind. His eyes were so wise and soulful that Hollywood director George Lucas famously gave them to the gnomish character of Yoda in the *Star Wars* trilogy. His thinking delved more deeply into the nature of reality than that of any scientist before him, confounding nearly everyone, and yet he asserted steadfastly that science was merely the formulization of common sense. His thoughts roamed to the edges of the universe, and yet he believed that man’s most pressing concern was the matter of how we treat one another on planet earth.

It is important to bear in mind, as we review Albert Einstein’s great discoveries, that the universe he perceived during his *annus mirabilis* of 1905—the year he presented the four papers, including *special relativity*, that altered the course of history—was a different universe from the one we know now, a little more than a century later. In 1905, we knew nothing of galaxies beyond our own. The Milky Way appeared, for all intents, to be the entirety of the universe, and however infinite it might be, it also appeared to be “closed” and highly organized. In 1917, Einstein proposed a *static universe* (since known as an “Einstein Universe”), with no beginning and no end, and in which the space-curving properties of gravity postulated in his *Theory of General Relativity* were perfectly balanced by a *cosmological constant* which maintained cosmic equilibrium and kept the universe from either expanding uncontrollably or collapsing in upon itself.

The fact that in the years 1922-29, astronomer Edwin Hubble's observations through the giant Hooker Telescope at Mt. Wilson, California revealed galaxy upon galaxy in an ever-**expanding** universe did not really shake Einstein's faith in cosmic balance, which was, in some ways, as much a philosophical position as a scientific one. Whether the universe consists of one galaxy or (by some current estimates) as many as five-hundred billion, its laws apply from end to end, and it appears to be a self-regulating organism of astounding stability, despite the chaos and fury that reigns in both its largest and smallest aspects. For all of his life, Einstein fought the notion of the universe as "accidental" or ungoverned by the steady rule of some original principle, and in this sense, he was a "religious" man. His religion, however, and his undying quest for a unifying order in the cosmos, was decidedly non-sectarian and non-anthropomorphic. His God, as he stated many times and in many ways, was nature itself, and this God came closest to what he called "Spinoza's God." Before we proceed, let's take a look at what that might mean.

*"By God I understand a being absolutely infinite, i.e., a substance consisting of an infinity of attributes, of which each one expresses an eternal and infinite essence."*

Baruch Spinoza was a true monist, in the sense of believing that reality (or Nature) is ultimately a unity, and that this uncreated, infinite, and all-encompassing unity is none other than God. He has also been labeled a pantheist and an atheist, mostly because ordinary men are inclined to misinterpret (or, at least, take far too literally) the pronouncements of philosophers. This was certainly the case in Spinoza's banishment from the synagogue of Amsterdam in 1656 for the crime of "free thought," an excommunication which left him a wanderer on the edges of society for the rest of his life.

Spinoza has been called "the God-intoxicated man," but the God with whom he was enthralled was not a God recognized by the orthodoxy—either Christian or Jewish—of his time, and even today fundamentalists of all stripes would call him a heretic. Spinoza's God was the wondrous fact of Nature itself, the original impetus from which all creation and all **modes** of creation flow as necessarily as rivers flow to the sea. In his philosophy, there is no need for a transcendent Creator with human-like attributes who brings the world into being as an act of will. He believed that the world simply **had to** be,

and that the world has no purpose other than *to exist*. For those convinced that God had a plan for mankind, and would judge us by our ability to follow it, this was apostasy. But a closer look reveals a profoundly religious nature, in the sense of Einstein's "cosmic religious feeling," and a point of view that is not far from our own in the 21<sup>st</sup> century.

It isn't at all difficult to see why Albert Einstein felt an affinity for this prescient Jewish philosopher. To quote from the Stanford Encyclopedia of Philosophy regarding Spinoza's take on the "relativity" of motion: "Thus, the actual behavior of a body in motion is a function not just of the universal laws of motion, but *also of the other bodies in motion and rest surrounding it* and with which it comes into contact." As we shall soon see, this statement is in many ways the intellectual ancestor of Einstein's thought.

Spinoza also weighed in strongly on the mind-body problem raised by Cartesian dualism. In effect, he denied that the problem existed, because, he argued, mind and matter were *of the same substance*. (two centuries later, William James would assert that they were part of a single *process*) On the parallel nature of matter and mind (thought), he wrote: "*a mode of extension and the idea of that mode are one and the same thing, but expressed in two ways.*" Quoting again from the Stanford Encyclopedia, "*(In Spinoza's philosophy), the human mind and the human body are two different expressions—under Thought and under Extension—of one and the same thing: the person. And because there is no causal interaction between the mind and the body, the so-called mind-body problem does not, technically speaking, arise.*"

The upshot of Spinoza's radical epiphany was to say that the goal of scientific inquiry and the goal of religion were *one and the same*: the pursuit of wisdom and the "intellectual love of God." Einstein said much the same thing. With that as our philosophical ground, we can now look at how Einstein was able to make the prodigious leaps of thought that resulted in his theories of *special* and *general relativity*. Einstein made a multitude of contributions to modern science, but these two were the most world-shaking, and the most closely linked to both his dream of unification and the purpose of this book.

To understand the significance of a breakthrough, we need to know what set of circumstances or assumptions it “broke through” from. This is especially true of breakthroughs in our perception of the nature of physical reality. You’ll recall that when James Clerk Maxwell (with help from Faraday) developed his theory of electromagnetic force as something propagated in wavelike motion and at the speed of light, it was assumed by everyone that these waves, like waves in water, had to be moving through something. Otherwise, what would be waving? That something was identified as the ***luminiferous aether***, or simply, the ether, and it was presumed to fill the entirety of what we perceive as empty space. Like the breath of God, it was thought to be exceedingly light but nonetheless ***substantial***. If the ether existed, then the precise speed of any object moving through space could be calculated with reference to the stationary ether, like that of a duck moving across a still pond. But in experiment after experiment, the ether failed to materialize. The most famous of these experiments, designed with great ingenuity, was the Michelson-Morley Experiment, which hypothesized that the motion of the earth through space (and thus, through the ether) should produce evidence of an “ether wind.” The failure, at the close of the 19<sup>th</sup> century, of this experiment to reveal the ***luminiferous aether*** set the stage for the new century to open with a bang. Einstein, from his humble desk in the Swiss patent office, was watching, listening, and occasionally, daydreaming. For if light was a wavelike phenomenon that could move through nothing, there was nothing to impede its speed.

Men like Spinoza and Einstein are indeed extraordinary geniuses, but this does not mean that they pull ideas from their brain fully formed, like the goddess Athena born from the skull of Zeus. They read, they study, and they absorb the genius of others, ever modest about the singularity of their own contributions. In Einstein’s case, the prime influences on his thinking, in addition to Spinoza and the Michelson-Morley experiment, seem to have been the mathematicians Poincare and Lorentz, and the unusual Austrian philosopher/scientist, Ernst Mach, whose signature notion we’ll examine below.

But there is one way in which the Spinozas and Einsteins of the world differ from other great thinkers. They are the sort of people a stern, inflexible school-master might refer to as “troublemakers.” Not only do they question authority and orthodoxy as a matter of course, they are somehow able to turn the world over in their hands and

perceive it from an entirely new **orientation**. There's a certain mischievousness in the way they offer up their newfound perspectives, as if aware that they will boggle the minds of most people. Einstein had a twinkle in his eye, and one imagines Spinoza did, too.

Orientation is a key word here. Many of us have had the disorienting experience of dozing off on a train waiting to leave the station or a plane waiting to be cleared for take-off, only to wake up and notice that the world outside the window is in motion. Because we know where we are, we quickly re-establish our **frame of reference** and process the fact that it is *we* who are in motion. But the odd feeling remains, and with it, a sense that perhaps our point of view was not uniquely privileged. Once the train reaches its prevailing speed or the plane its cruising altitude, we relax back into our seats just as we might in a familiar armchair at home, and that sense evaporates. If we toss a ball into the air, it will land in our hands or our laps just as it would in a room at rest, even though we are traveling at a high speed **relative** to the world outside. Scientists, however, must question assumptions. Galileo gets the credit for postulating the first **principle of relativity**--that there is no state of absolute rest and no uniquely privileged frame of reference--but he did not go as far as Ernst Mach did, or Einstein after him.

Imagine that instead of a moving train or airplane, with trees, houses, or clouds to gauge your motion against, you are on a spaceship moving through the void of space. At one moment, you are able to detect the faint glimmer of a distant galaxy and plot your position relative to it, just as ancient mariners once navigated by the pole star. But suddenly, that faint glimmer disappears, and there are absolutely no points of reference. In this situation, would up, down, north, south, east or west have any meaning? Would motion itself have any meaning? How, indeed, would you know you were moving?

Ernst Mach argued that these things would be meaningless in what has since been referred to as **Mach Space**. And if the coordinates of the universe enfold time, as well, then even might be fluid and relative. Mach's Principle, so-named by Einstein himself is that **every motion, uniform or accelerated, has sense only in reference to other bodies**. We live, as has been said earlier in these pages and will be said again, in a **relational universe**. Einstein wrote the following to Ernst Mach, and it is a reminder of how different the pre-Einstein and post-Einstein worlds are: "...it turns out that inertia originates in a kind of interaction between bodies..." Inertia, you'll recall from Newton's



First Law, is the resistance of any body to a change in its state of motion. “Stationary” objects remain stationary until something causes them to move (think of large boulders or certain old uncles!) and moving objects remain in motion *in a straight line and at a constant speed* until their course is altered by some force (on a universal scale, this would be the force of gravity). Einstein’s Special Theory of Relativity applies to what he called *inertial frames of reference*, i.e., those not affected by gravity, and this theoretical framework is what makes it “special.”

The theory states two postulates:

1. That the laws of physics apply equally in all frames of reference.
2. That the speed of light is constant in all frames of reference.

Simple postulates with profound implications. If my frame of reference is no more privileged than yours, but the laws of physics and the speed with which information (light, or any form of electromagnetic radiation) can be conveyed remain constant, then whose measurements of space and time should be taken as accurate? Einstein showed that if you and I were in separate rocket ships traveling past one another in opposite directions and at constant speed, we would perceive and measure the same event quite differently, and the implication of this is that *there is no such thing as absolute simultaneity*. The resulting measurement depends entirely on the observer’s frame of reference! It is really no wonder, if you think about it, that the Nazis denounced Einstein’s theories as “decadent science.” He was arguing that one’s perception of reality depends upon one’s perspective, whereas the Nazis (and all tyrants) argue for a single, unbending perception of reality.

Furthermore, if “inertia originates in a kind of interaction between bodies,” then even bodies at rest must possess energy, and this led Einstein in the same paper to its most stunning conclusion, and the most famous equation of all time:  **$E=mc^2$** . *E* is energy; *m* is mass; and *c* is the speed of light (186,000 miles per second), which makes *c* a very large number! After Einstein, so-called “solid objects” would never be seen in the same way again. The *Special Theory* yielded all sorts of strange and counter-intuitive new realities, most of them coming into play at velocities close to the speed of light. Fortunately, we don’t travel at anywhere near that speed, so these effects aren’t noticeable to us. If you

wish to study some of them, research the twin paradox, time dilation, and space contraction. You may understand how Einstein inspired a century of science-fiction.

An analogy may be helpful in understanding relativity. If you own anything with a volume control (a stereo receiver, radio, iPod, etc.), then you know that we have the perception that “turning up the volume” *creates* more sound. But this is not how a volume control operates. In truth, it is an *attenuator*, i.e., a control that attenuates or limits the strength of a signal. All of the signal (sound) is there to begin with. The volume control simply determines how much of it is revealed. Similarly, the universe *is* motion. Everything is moving all the time. You are sitting still right now only in relation to the things moving around you. Relativity is like a volume control that reveals all of this motion. Feeling dizzy? Imagine how it must have felt to be Einstein!

It took another eleven years and a world war before Einstein sprang his next great revelation on the planet. Even geniuses have to accommodate themselves to the disruptions of war and dislocation, but in 1916, he published the *General Theory of Relativity*, and it was worth the wait. You’ll recall that the Special Theory specifically excluded gravitational effects and circumstances where one object is accelerating with respect to another. These things had to be taken into account in order for the theory to operate on a cosmic scale.

The General Theory of Relativity took the form of ten *field equations*. A field equation, as you may remember from the chapter on the fundamental forces, describes mathematically how any of these forces interact with and affect *matter*. Now, it’s important to keep in mind two things as we examine what Einstein did. First, the prevailing theory of gravitation in 1916 was still Isaac Newton’s, and its precepts remained essentially as they had been in 1687. Gravity was related to mass, and its force diminished in inverse proportion to distance. Massive objects attracted less massive objects, and the attractive force was manifest as “action at a distance.” Newton was never able to explain how this force arose or what it consisted of, and to his dying day, he openly doubted his own conclusions. Gravity was *not* like magnetism. The sun does not “attract” the earth like a giant electromagnet, nor are they attached by any sort of ethereal bungee cord.

And yet the earth remains, aeon after aeon, in the sun’s orbit. Why?

It is important to say at the outset that what Einstein's equations describe is a *new geometry* of spacetime. We are familiar with the geometry of two-dimensional surfaces. We learn as schoolchildren the rules governing the measurement of triangles, rectangles, and circles. Later, we learn to “pull out” the third dimension and represent pyramids, cubes, and spheres on paper or on a computer using the tools of perspective and algorithms that replicate them. We find that the same rules apply, albeit with new coordinates. But how do we represent a geometrical object in four-dimensional spacetime? What happens to space when the dimension of time is introduced?

Well, nothing much happens in the absence of *matter*, but as soon as we drop objects that possess mass into the spacetime soup, we begin to see the effects. Spacetime, which was before utterly flat and featureless, begins to “warp.” Drop a crouton into a bowl of tomato soup and it will form a momentary dip, or vortex, where it lands. If we could induce the crouton to spin, this vortex would be maintained as it drew the surrounding soup into its field. A nearby speck of black pepper would find itself caught up in the crouton's field of influence and begin to “fall” toward its center of gravity, but because the field is itself in motion, the pepper speck would follow the nearest thing to a straight line, which is—in fact—an orbit! And so, Newton's mysterious “action at a distance” is actually the action of less massive objects *falling* toward the spacetime “dimples” created by more massive objects which are themselves in rotation.

Spacetime, Einstein said, is therefore *curved* by mass. Newton's laws, for the most part, continue to hold up because they reflect accurate observations of *how* objects move in space and in relation to each other, but for the first time, Einstein showed *why* they behaved this way. Fortunately, the mathematics required in order to illustrate Einstein's realization had come into being a half a century earlier courtesy of Bernhard Reimann, whose *Reimannian geometry* dealt with curved surfaces and geodesics—the same geometry that is used to plot the shortest distance point-to-point for an airplane to travel. (if you've ever flown, say, from New York to London, you may have noticed that the plane does not fly “straight across” the Atlantic Ocean, but up and over Greenland and the polar regions. In Reimannian space, this is actually the closest thing to a straight line).

And speaking of that airplane, why is it that we feel the force of gravity keeping us in our seats even though we are far from the earth's surface? This is the other ingredient in Einstein's epiphany. All of the objects that exert or are subject to gravitational force are *moving* objects. There is nothing in this universe that is *not* in motion, and in order to understand relativistic gravity, we must factor in *momentum* and *acceleration*. Let's go back to our bowl of tomato soup for a moment. The crouton will not draw the pepper speck into its orbit if it simply sits soggly and motionless in the soup. Nor would the earth draw the moon or the sun the earth if these were stationary objects as in a child's model of the solar system. It is the momentum of objects, as well as their mass, that creates gravity.

Let's consider, for a minute, the phenomenon of *freefall*.

Einstein was famous for his "thought experiments." In the thought experiment that led more or less directly to his formulation of general relativity, Einstein imagined a scenario that most of us have had nightmares about. We are in an elevator ascending to the top of a tall building when the cable snaps and we begin to plummet. We are in freefall. What happens? The gravity that had, just a moment ago, held our feet firmly to the floor vanishes, and we are suddenly weightless with respect to the earth and drawn instead toward the roof of the elevator (more strongly as the elevator accelerates its downward plunge). In the absence of momentum, this is what happens. If a safety cable is engaged and the elevator begins once again to ascend, we hit the floor and the familiar (and comforting!) force of gravity is restored. Precisely the same sort of thing happens if we put the elevator in the vacuum of deep space, far from the gravitational attraction of any large heavenly body like the earth or the sun. The momentum of this "rocket-propelled elevator" will create its own "fictitious gravity" and keep our feet on the floor.

From this realization, Einstein posited his *equivalence principle*, which states, essentially, that the gravity experienced by a subject in an accelerated frame of reference (such as a rocket ship) is no different from the gravity produced by a massive body such as the earth. They are the same force. The combination of mass/energy (remember that under special relativity they have their own equivalence) and momentum is what produces gravity. The earth exerts gravitational force on its inhabitants because it is hurtling through spacetime that has been curved by the mass of the sun, which is itself

orbiting the galactic center. Hold your breath: we are *falling* into the sun. Now exhale: but because space is curved by mass, we don't fall in a straight line, but in a Reimannian geodesic that puts us into a regular and highly stable orbit.

As the great 20<sup>th</sup> century physicist John Wheeler (whose own genius we will have reason to explore later) summed it up, "Spacetime tells matter how to move; matter tells spacetime how to curve."

Visualizing curved space is not easy. The internet and science texts offer a host of artist's renderings, most of them resembling a tightly stretched cosmic hammock into which balls of various sizes and weights have been tossed. The more massive balls make greater dents and draw the lighter balls in their vicinity toward them. But this is not even a three-dimensional model, much less a four-dimensional one. On a hammock—no matter how tightly stretched—the lighter balls would soon enough roll into the larger ones and come to rest. To understand why this doesn't happen in space—why we don't fall into the sun—we have to join Newton's laws of motion to Einstein's stunning vision of general relativity. The universe is a four-dimensional clock that never runs down.

Einstein had solved Newton's puzzle. We now understood why massive objects exert gravitational force. Space itself is a participant in the dance of gravity. And because Einstein's equations apply even to atomic particles, we even understood more about motion and cohesion on the microcosmic scale. Remember: it's all relative! Einstein predicted that even the path of light would be bent by the curved space of gravity, and he has since been spectacularly proven right. But we still do not know precisely what bendable material "space" is made of, or how gravity relates to the other three fundamental forces: the strong nuclear force, the weak nuclear force, and electromagnetism. For that, we need a *unified field theory*, and this was Einstein's next challenge—the dream that was to occupy (and haunt) him for the rest of his life.

Nearly everyone curious enough to be reading this book will by now have had the experience of entering coordinates into *Mapquest* or *Google Maps* in search of directions to a restaurant or birthday party. Some of you may own smartphones with GPS applications, and have found your way home from the middle of nowhere by following the little blue dot. GPS devices, of course, plot our location by bouncing signals

off an array of satellites in orbit around the earth and using a geometrical technique called *trilateration* to calculate highly accurate (at least most of the time!) results.

But let us imagine that it's 2029 and your *iPhone 16* or *Android AI* is able to access a powerful quantum computer placed aboard the mother satellite, making the plotting of your whereabouts accurate to within less than a nanometer. Imagine further that you decide to engage in a little cyber-mischief and challenge this supposedly infallible computer by entering as your destination the address: *my consciousness*. As a starting point—and with a smug grin on your face—you use the default “current location.” You hit “directions” and wait while the digits crunch, certain that the location of the destination will be identical to that of the starting point. After all, your consciousness is located within your brain, isn't it? And your brain is located within the body that sprouts the hand that holds the GPS device.

How surprised would you be if, instead, the satellite's computer went into overdrive, and after eleven hours of ceaseless crunching (and bringing worldwide satellite communication to a standstill), came back to you with directions leading to every point in the universe and a map display that is, in effect, one giant blue dot? Assuming that neither the device nor the computer had malfunctioned, what would such a result indicate? Your first conclusion would probably also be the most accurate: the GPS device is telling you that your consciousness is not located in any particular “place,” in the usual sense of that word. It is, in some confounding way, *everywhere*.

The story, of course, is fanciful. No GPS device will ever be able to plot the location of something it can't bounce a signal off. The conclusion, however—that consciousness is not a localized phenomenon—is very much in discussion these days, and is one of the possibilities raised by what is known in general philosophy and in the field of consciousness studies as “*the subject-object paradox*.” A paradox occurs when we consider two statements that seem to be equally true and yet mutually contradictory, as in:

**I, the conscious *subject*, perceive *objects* in the world “around me” as separate from myself.**

**I also perceive myself “from the outside” as one of the objects in that world.**

**How can I be both subject and object? And if it is possible to perceive myself contemplating this question, who or what is doing the perceiving?**

This question goes to the heart of the broader question that is the title of this chapter: *Who Are You?* It goes to the question of soul (*psyche* in the original Greek). It may even go to the question of God. It certainly goes to the question which is the basis for this book: *what is the nature of consciousness?*

In this chapter, we will present a review of what some of the brightest minds in philosophy, science, and religion have had to say about *the self*.