Physics and faith: The luminous web

by Barbara Brown Taylor in the June 2, 1999 issue

Among the many compelling reasons for religious people to engage science is the human tendency to base our worldviews on the prevailing physics of the day. Our governments, our schools, our economies and our churches all reflect our understanding of how the world works, and when that understanding changes—as it is changing right now—all those institutions are up for revision. New discoveries in quantum physics are already changing the way some businesses are being managed. New discoveries in human brain research are changing education. Changes may be in store for the church as well.

The Bible gives us a worldview based on the physics of Aristotle and Ptolemy. In it the round earth sits at the center of the universe (and presumably at the center of God's attention as well). During the Dark Ages, the earth was hammered flat. Conservative clerics insisted that the planets were pushed around by angels, and that no other explanations were necessary. Having little else to do, science went to sleep.

When science woke up again, almost a thousand years later, there was a renaissance of learning in Europe. With the invention of the printing press, intellectual classics that had lain dormant for centuries suddenly became both available and affordable. A Pole named Mikolaj Kopernik could not get enough of them. He read his way from Krakow to Bologna and back again, returning home with volumes of Aristotle, Euclid, Archimedes and Ptolemy in his luggage. He also came home with the name most of us know him by—Nicolaus Copernicus, the man who changed our vision of the universe.

Through his observation of the seasons and his reading of the classics, Copernicus believed that the sun, not the earth, belonged at the center of things. He also guessed what trouble that swap might cause, which was why he delayed publication of his work until his death was imminent. Although the church was undergoing its own revolution at the time, both Protestants and Catholics agreed on Copernicus. "Who will venture to place the authority of Copernicus above that of the Holy Spirit?"

John Calvin howled, while Martin Luther simply called the man a fool.

In 1611 the King James translation of the Bible was published with a note to readers that creation had occurred on the evening before the 23rd of October in the year 4004 b.c. In 1616 the Catholic Church banned all books that suggested the earth moved at all. An Italian astronomer named Galileo Galilei, who believed Copernicus was right, continued his research in spite of the ban. After publishing a brilliant book on Aristotelian and Copernican cosmologies in 1632, he was ordered to appear before the Inquisition. In his defense, Galileo argued that the Bible was never intended to be a scientific document. "The Bible tells us how to go to heaven," he said (quoting Cardinal César Baronio), "not how the heavens go."

His inquisitors were not impressed. In 1633, when he was 70 years old, Galileo got down on his knees in the great hall of a Dominican convent in Rome and read the renunciation they had written for him:

> Wishing to remove from the minds of your Eminences and of every true Christian this vehement suspicion justly cast upon me, with sincere heart and unfeigned faith I do abjure, damn, and detest the said errors and heresies, and generally each and every other error, heresy, and sect contrary to the Holy Church; and I do swear for the future that I shall never again speak or assert, orally or in writing, such things as might bring me under similar suspicion.

Galileo spent the last eight years of his life under house arrest in his villa outside of Florence. While his daughter read him the seven daily psalms of penitence that were a part of his sentence, the old man sat by the window, where he could watch the planets through his telescope.

But the scientific revolution could not be stopped. It gathered momentum through the 17th century, fired by the work of a British mathematician and natural philosopher named Isaac Newton. With the publication of *Principia*, released in 1687, Newton planted the seeds of a new worldview. He laid down the laws of celestial dynamics. Reducing them to four simple algebraic formulas, he revealed a solar system that worked like a vast machine. The machine, he said, was made of parts—some of them as small as an atom and others as huge as the sun—but they all obeyed the same four laws. In this way, he not only vindicated Galileo but also unseated Aristotle, who had believed that the heavens and the earth were governed by different laws.

Apparently Newton never meant to unseat God too. At the end of his book he wrote, "This most beautiful system of the sun, planets, and comets could only proceed from the counsel and dominion of an intelligent and powerful Being." He gave God credit for the laws, in other words, but the laws themselves left very little for a deity to do. God may have designed the machine and thumped it into motion, but once the thing got moving it seemed to do just fine all by itself. As far as the universe was concerned, God's job was most like that of a night watchman: someone who dozed in a lawn chair while the stars spun in their courses overhead.

Human beings were so charmed by the illusion of control Newton's metaphor offered that we began to see ourselves as machines too. Believing that Newton told us the truth about how the world works, we modeled our institutions on atomistic principles. You are you and I am I. If each of us will do our parts, then the big machine should keep on humming. If a part breaks down, it can always be removed, cleaned, fixed and replaced. There is no mystery to a machine, after all. According to Newton's instruction manual, it is perfectly predictable. If something stops working, any reasonably competent mechanic should be able to locate the defective part and set things right again.

While religion resisted this metaphor for a while, the illusion of control proved too hard to pass up. Theology became increasingly specialized and systematized. Our "God view" came to resemble our worldview. In this century, even much of our practical theology has also become mechanical and atomistic.

Walk into many churches and you will hear God described as a being who behaves almost as predictably as Newton's universe. Say you believe in God and you will be saved. Sin against God and you will be condemned. Say you are sorry and you will be forgiven. Obey the law and you will be blessed. These are simple and appealing formulae, which make God easy to understand. Pull this lever and a reward will drop down. Do not touch that red button, however, or all hell will break loose. In this clockwork universe, the spiritual quest is reduced to learning the rules in order to minimize personal loss (avoid hell) and maximize personal gain (achieve salvation).

The emphasis on individual welfare is no mistake, either. It goes with the Newtonian worldview, in which the atom is the basic building block of the cosmos. In the physical universe, even something as huge as the sun is made up of tiny atoms, which is why it behaves the same way they do. All big things can be broken down into small things, and it is those small things—those single units of indivisible

matter—that count. No whole creation is more than the sum of its parts. To understand the whole, all you have to do is understand the parts.

When this model is transposed to the human universe, the individual being becomes the atom—the single unit of social matter that is the basic building block for all social groupings. Once again, all big things can be broken down into small things. Nations, communities, churches and families are all reducible to the individuals who make them up. If a child acts out, take the child to a counselor. Fix the child, without ever inquiring into the health of the family. If a poor woman sells crack, send the woman to jail. Punish the woman, without ever asking about the society in which she lives. There is nothing wrong with the whole that cannot be fixed by tinkering with the parts. In essence, there is no such thing as the whole. The individual is the fundamental unit of reality.

In January I spent a couple of days at a Benedictine monastery in California. It was a gorgeous place, with a courtyard garden full of fragrant orange trees and a retreat house full of antiques. When I first came through the door, one of the brothers glided up to me and said, "I know what you're thinking: 'If this is poverty, I can't wait to see chastity!'"

Four times a day, a bell rang in the courtyard. As soon as it did, the brothers stopped to pray. The rest of us were welcome to join them, but it was not required. If we did not show up then they would pray for us, as they prayed for everyone else in the world—for those who were present along with those who were absent, for those who were inclined toward God along with those who were not, for those who were in great need of prayer along with those who were not aware they needed anything at all.

Prayer was their job, and they took it seriously. They prayed like men who were shoveling coal into the basement furnace of some great edifice. They did not seem to care whether anyone upstairs knew who they were or what they were doing. Their job was to keep the fire going so that people stayed warm, and they poured all their energy into doing just that.

In their presence, I realized how atomistic many prayers are. So many of us pray chiefly as individuals. We confess our own sins, give thanks for our own blessings, ask God to address our own concerns. Even those with voluminous prayer lists can feel as if they are working alone, racing through the dark with their petitions like a midnight mail carrier.

There is another way to conceive of our life together. There is another way to conceive of our life in God, but it requires a different worldview—not a clockwork universe in which individuals function as discrete springs and gears, but one that looks more like a luminous web, in which the whole is far more than the parts. In this universe, there is no such thing as an individual apart from his or her relationships. Every interaction—between people and people, between people and things, between things and things—changes the face of history. Life on earth cannot be reduced to four sure-fire rules. It is an ever-unfolding mystery that defies precise prediction. Meanwhile, in this universe, there is no such thing as "parts." The whole is the fundamental unity of reality.

If this sounds like the language of Eastern religion, it is not. It is the language of quantum physics, which is causing a revolution in the way we see our world. My own introduction to it came five years ago, when I attended a clergy leadership conference at which Fred Burnham spoke. An Episcopal priest with a doctorate in the history of science from Johns Hopkins, Burnham is dedicated to holding peace talks between science and religion. He was at the conference to talk to us about chaos theory, and in particular about how the science of complexity might be useful to us as parish leaders. While I had read some physics before that, no one had ever suggested that it had anything to do with my life in the church.

When I entered the room, Burnham was pecking at the keyboard of a computer. The machine sat in front of the blackboard on a low desk. The screen remained blank as the group assembled. Then Burnham greeted us, pressed "Enter" and turned his back on the computer screen as he delivered his lecture. At first there was nothing but one thin green line snaking its way around the interior of the screen. First it made something that looked like a lopsided figure eight and then it doubled back on itself—roughly, not exactly—as if a young child had tried to trace the design twice.

Burnham was apparently oblivious to what was going on behind him. From time to time, so was I. I did not know one thing about chaos theory. I had always assumed I was incapable of understanding it, but as Burnham introduced us to fractals, complexity and nonlinear equations I had what I can only call a religious experience. I understood why my life would not run along straight lines. I understood why my ten-year plans never work. And rather than feeling miserable about those things, I began to glimpse a deeper level of physical reality at which my life was behaving exactly as it should.

By calling this a religious experience, what I mean is that I experienced salvation in it. All those fractured parts of myself—the math part, the verbal part, the physical part, the spiritual part—they all came together that day. I felt like someone whose multiple-personality disorder had been healed. I was rescued from my atomistic understanding of myself in ministry, in which I was the mechanic and my parish the machine I was supposed to run. The new science gave me new models for my life in community, which matched up with biblical models much better than the corporate CEO models I had adopted.

Another way of saying it is that science spoke to my spirit. As I watched the image on the computer screen develop into some beautiful butterfly kind of thing, I thought, "That is *math*. No one ever told me math could be beautiful." When Burnham finally named the thing—a "strange attractor"—and explained how it was the secret pattern underlying apparent chaos, I knew I had found a window on the universe that would occupy me for some time to come.

Since I am not a scientist, I am not always sure what I am looking at, nor do I have the theoretical background to discern all the implications of a particular phenomenon, but as a preacher-that is, someone who lives on stories-I find the stories rolling in from the frontiers of the new science as rich in meaning as any stories I know.

Albert Einstein did not like quantum theory at all. His objection to it was similar to the objection some Christians have to evolutionary theory: there was too much chance in it, too little design. Earlier in this century, at the Institute for Advanced Study in Princeton, he and his colleagues Boris Podolsky and Nathan Rosen tried to undermine quantum theory with something now known as the EPR experiment (for Einstein, Podolsky and Rosen). According to quantum theory, a subatomic particle that decays into two particles becomes a set of "twins"—a single system with two parts, spinning in opposite directions. No one knows which one is spinning up and which one is spinning down until a measurement is made, but according to the laws of physics they must always balance each other.

So far so good. Now imagine those two particles flying apart—one of them heading around the dark side of the moon while the other lingers in the laboratory above the nimbus of Einstein's hair. If Einstein could nab that one and reverse its spin, he theorized, then the other particle would have to reverse itself too—even if it was light years away. According to the laws of quantum physics, this is exactly what

would happen. Some unimagined form of communication, faster than the speed of light, would allow each particle to "know" and respond to what the other was doing. Since this eerie idea violated his own theory of special relativity, Einstein concluded that quantum theory is wrong.

Unhappily for him, subsequent experiments proved that there is indeed some kind of instantaneous, superliminal communication between quantum particles. Once they have interacted with each other, they have the power to influence each other, no matter how far apart they go. According to quantum physics, this relatedness goes beyond human beings to include the whole creation. Physical reality refuses to be compartmentalized. As hard as we may try to turn it into a machine, it insists on acting like a body, animated by some intelligence that exceeds the speed of light.

Scientists think it has something to do with field theory—fields being invisible, nonmaterial structures that may turn out to be the basic substance of the universe. You know about gravitational fields and electromagnetic fields. If you stand under a high power wire and hold a fluorescent bulb in the air, there is a good chance it will light up, because you are standing in a power field. Well, imagine another kind of field that knits the whole cosmos together, so that a shiver in the Milky Way gives us a shiver right here, faster than the speed of light.

This scientific fact offers a metaphor for the mother who sits bolt upright in her bed in the middle of the night, "knowing" something has happened to her child. It also says something about the strange communication between twins, who may end up making similar choices in their lives even though they have been separated at birth. What the EPR paradox suggests is that such communication occurs because the two are not really two but one. Each one "knows" what the other is doing not because they happen to be psychic but because they belong to the unbroken wholeness of the universe.

In light of all this, consider Paul's metaphor of the church as Christ's body. As different as we are and as many functions as we serve, we are far more than a collection of parts. We may act that way sometimes, with the left side pulling against the right and the feet refusing to take a step until the hands have apologized, but there are also times when we clearly participate in some form of communication—or better yet, communion—that puts us in touch with a head much more capable than our own. The more in tune we are, the better we respond. This is not something that only happens to us person by person but something that happens to all of us at

once. There is no explanation for it in terms of cause and effect. This head of ours, this guiding mind, does not speak into a tape recorder or send directions by fax, but plenty of us have experienced the communication as real.

In quantum physics, this mysterious action at-a-distance is known as nonlocality, but it is only one of the phenomena that give scientists bad headaches. Another is Heisenberg's uncertainty principle, which asserts that it is not possible to know both where a particle is and how fast it is moving. If you fix its location, you cannot measure its momentum, and if you clock its momentum, you cannot say for certain where it is. In between your measurements, it exists as a probability wave—a combination of all the possible ways it could go, which all remain possible until you focus on it. When you take your measurement, the probability wave collapses. It assumes an actual value, but only because you asked it to.

The only possible sense I can make out of this is by way of the game of musical chairs I learned as a child. While the music plays, everyone is in motion around the ring of chairs. Since there is one less chair than there are children, it is best not to wander too far away, but while the music plays, anything is possible. You could end up on that chair, that chair, that chair or the ground. There is no telling how it will end until the music stops. When that happens, everyone runs shrieking for a chair. There may be a brief struggle over who got there first, but the probability wave has been collapsed. The measurement has been taken, leaving one person without a chair.

In quantum theory, there is no way to predict the outcome of this game. The same child will end up on a chair one time, and on the ground the next. One time she will be a particle and the next time she will be a wave. So which is she, really? Quantum theory answers: she is neither; she is both. In a tenet of the new science that sounds more like Zen Buddhism than physics, a thing cannot even be said to be one thing or another until someone interrupts it to find out what it is. Plus, the interruption itself has to be taken into account. In an uncanny exercise called the double-slit experiment, particles of light seem eager to please the experimenter. If you ask them a particle-like question, they will respond like particles, and if you ask them a wave-like question, they will respond like waves.

One is left with the weird impression that quantum particles are playing practical jokes on quantum physicists, like a cabin full of second grade campers short-sheeting their counselor's bed.

If you are feeling a little disoriented right now, let me assure you that you are in very good company. The people who discovered all this stuff did not like it any better than you do. Werner Heisenberg, the originator of the uncertainty principle, remembers late-night discussions with Niels Bohr that ended almost in despair. Recalling one of them, Heisenberg wrote, "When at the end of the discussion I went alone for a walk in the neighboring park, I repeated to myself again and again the question: Can nature possibly be so absurd as it seemed to us in these atomic experiments?"

Bohr himself said, "Anyone who is not shocked by quantum theory has not understood it." Erwin Schroedinger, a fellow physicist, was even more blunt than that. "I don't like it," he said, "and I'm sorry that I had anything to do with it."

The reasons for their dismay are manifold. In the first place, the physical world seems to obey two different sets of rules. At the macro level of trees and rocks, Newtonian mechanics works just fine. A tree can be said to have a definite position in time and space, and a rock dropped from a window will fall at a predictable rate to a predictable spot on the ground. Everything in this world happens for a reason and can be explained in terms of cause and effect.

At the micro level of quantum particles, however, these rules no longer apply. A photon may be said to be both particle and wave. If you know where an electron is, you cannot, by definition, know where it is going. If you know where it is going, you cannot know where it is. Furthermore, you cannot know any of these things without interacting with them, which means that you will never know how they behave when you are not watching.

How can this be? How can the big, visible objects in our world obey different rules from those of the tiny, invisible stuff they are made of? How can the participation of a conscious observer change the very nature of reality? David Bohm, a prolific quantum physicist, says that the new science requires a radical change in how we conceive the world. It is no longer possible to see it as a collection of autonomous parts, as Newton did, existing separately while interacting.

The deeper revelation is one of undivided wholeness, in which the observer is not separable from what is observed. Or, in Heisenberg's words, "The common division of the world into subject and object, inner world and outer world, body and soul is no longer adequate."

Is this physics or theology, science or religion? At the very least, it is poetry. As far back as the 13th century, the Sufi poet Jelaluddin Rumi wrote, "You think because you understand *one* you must also understand *two*, because one and one make two. But you must also understand *and*."

David Bohm spent most of his time on something called relativistic quantum field theory—which I cannot understand, much less explain. I do know that in this study he caught a glimpse of reality in which the universe neither occupies space and time nor contains many different things. Rather, he says, it is one interwoven thing that takes time and space seriously but not too seriously—perhaps by treating them as idioms that the universe finds necessary in order to communicate itself to observers.

I have no more than a glimpse of his glimpse, but what it suggests is that the universe has a memory that predates the Big Bang. Back before that explosion sent energy racing every which way at speeds faster than light, there was the egg of the universe in which all places were one place and all things were one thing. I would call it the garden of Eden, only the beauty of the garden lay in its diversity. The beauty of this reality I have no image for was its unity, its total coherence. Mind, matter and time were not different yet. They were all floating in the same yolk. Then the universe was born and the one became many.

Quantum particles became planets, galaxies, clusters and superclusters. Atoms became blue-green algae, toads, palm trees and swans. Space became here or there, as time became then or now.

But deep down in the being of these things remains the memory of their being one, which makes them behave in ways that torture scientists. Space and time are not separable. Light is both particle and wave. A particle way over there responds instantly to a particle way over here, as if each could read the other's mind.

If I understand my glimpse of Bohm's glimpse, then our mental torture comes about only because we insist on conceiving reality as many when it is truly and deeply one. All appearances to the contrary, "the universe remains as it was in the beginning, when all places were one place, all times one time, all things the same thing." Explaining Bohm's work, Timothy Ferris suggests that "the universe began as a hyperdimensional bubble of space, all but four of the dimensions of which campacted to form what we today call subatomic particles. Those particles look to us like zillions of individual things, but that is merely their appearance in the four

dimension of spacetime. In hyperspace they could very well still be one thing."

Once, during a discussion between John Wheeler and Richard Feynman, two great physicists, Wheeler said, "Feynman, I know why all electrons have the same charge and the same mass."

"Why?" Feynman asked.

"Because they are all the same electron!" Wheeler replied.

The writer of Ephesians put it like this: "There is one body and one Spirit . . . one Lord, one faith, one baptism, one God and Father of all, who is above all and through all and in all" (4:4-6).

This is a very different picture of divine sovereignty than the one most of us were raised on. In the classical scheme, God is indeed above all, with a throne so high it cannot even be seen from this earth. The throne room is in heaven, which for most people is way up and out there somewhere. God sits above creation, above time, above space, above us. But we come next! As creatures made in God's image, we claim our own sovereignty, which places us above the rest of creation (with disastrous results, I might add). We sit above animals, trees, rocks, earth. This is a pyramid-shaped scheme, in which beings are ranked from greater to lesser with all the power on the top.

But what about the rest of that phrase from Ephesians? What about God who is not only above all but also through all and in all?

When I am dreaming quantum dreams, the picture I see is more like that web of relationships—an infinite web, flung across the vastness of space like a luminous net. It is made of energy, not thread. As I look, I can see light moving through it like a pulse moving through veins. I know the light is an illusion, since what I am seeing moves faster than light, but what I see out there is no different from what I feel inside. There is a living hum that might be coming from my neurons but might just as well be coming from the furnace of the stars. When I look up at them there is a small commotion in my bones, as the ashes of dead stars that house my marrow rise up like metal filings toward the magnet of their living kin.

Where am I in this picture? All over the place. Up there. Down here. Inside my skin and out. Large compared to a virus and small compared to the sun, with a life that is

permeable to them both. Am I alone? How could I ever be alone? I am part of the web that is pure relationship, with energy available to me that has been around since the universe was born.

Where is God in this picture? All over the place. Up there. Down here. Inside my skin and out. God is the web, the energy, the space, the light—not captured in them, as if any of those concepts were more real than what unites them, but revealed in that singular, vast net of relationship that animates everything that is.

It is not enough for me to proclaim that God is responsible for all this unity. Instead, I want to proclaim that God *is* the unity—the very energy, the very intelligence, the very elegance and passion that make it all go. This is the God who is not somewhere (up there, down here) but everywhere, the God who may be prayed to in all directions at once. This is also the God beyond all directions, who will still be here (wherever "here" means) when the universe either dissipates into dust or swallows itself up again. Paul Tillich's name for this divine reality was "the ground of being." The only thing I can think of that is better than that is the name God revealed to Moses: "I Am Who I Am."

This does not sound like the self-identification of a deity who stands over reality and sometimes stirs it with a stick. Instead, it sounds like the singular utterance of the only One who ever was, is or shall be, in whom everything else abides. For the moment, we see through a glass darkly. We live in the illusion that we are all separate "I ams." When the fog finally clears, we shall know there is only One.