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Skeptics and True Believers

Chet Raymo

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About the Book

Skeptics and True Believers is the inspiring culmination of Chet Raymo's quest to reconcile the miracle stories he learned as a child with the science he learned as an adult. At once passionate and ever-inquisitive it is a statement that science and religion can mutually reinforce the way we experience the world. Raymo provides compelling evidence that religion should embrace the reliable knowledge of the world that science provides and that science should also respect and nourish humankind's need for spiritual sustenance.

About the Author

Chet Raymo's books include *The Dork of Cork*, *Honey from Stone*, *The Soul of the Night* and *365 Starry Nights*. He writes a weekly column, 'Science Musings,' for the *Boston Globe*. A professor of physics and astronomy at Stonehill College, he lives in Massachusetts.

TO MAUREEN

*To invoke God as a blanket explanation of
the unexplained is to make God the friend of
ignorance. If God is to be found, it must surely
be through what we discover about the world, not
what we fail to discover.*

Paul Davies, physicist

*When it's over, I want to say: all my life
I was a bride married to amazement.
I was the bridegroom, taking the world into my arms.*

Mary Oliver, poet

Skeptics and True Believers

The Exhilarating Connection Between Science and Religion

Chet Raymo


V
V I N T A G E

Introduction

THERE'S A "GOD-SHAPED hole in many people's lives," says physicist and Anglican priest John Polkinghorne. He's right, at least about there being a hole in our lives. To call the hole "God-shaped" begs the question, for the affliction of our times is that we have no satisfactory image of God that rests comfortably with what scientists have learned about creation. As we approach the end of the twentieth century, many educated people in the Western world long wistfully for something akin to traditional religious faith, but they know there can be no turning back to a world of divine fiats and penny miracles. As Polkinghorne says, they can neither accept the idea of God nor quite leave it alone.¹

I am one of those people, trained in science, who cannot quite accept the idea of God nor quite leave it alone. I am less pessimistic than most, however, that science and religion must remain in conflict. It seems to me that science is part of the traditional religious quest for the God of creation.

A vital religious faith has three components: a shared cosmology (a story of the universe and our place in it), spirituality (personal response to the mystery of the world), and liturgy (public expressions of awe and gratitude, including rites of passage). The apparent antagonism of science and religion centers mostly on cosmological questions: What is the universe? Where did it come from? Where is it going? What is the human self? Where do we fit in? What is our fate?

Humans have always had answers to these questions. The answers have been embodied in stories: tribal myths, scriptures, church traditions. All of these stories have been derived from a primordial experience of the creation. All of them contain enduring wisdom.

But for many of us, these stories have been superseded *as public knowledge* by the scientific story of the universe.

In this book, I identify two intellectual postures we can adopt to questions of knowledge and faith. These two postures represent a fault line in our culture, an attitudinal chasm more profound than differences of politics or religious affiliation.

We are Skeptics or True Believers.

Skeptics are children of the Scientific Revolution and the Enlightenment. They are always a little lost in the vastness of the cosmos, but they trust the ability of the human mind to make sense of the world. They accept the evolving nature of truth and are willing to live with a measure of uncertainty. Their world is colored in shades of gray. They tend to be socially optimistic, creative, and confident of progress. Since they hold their truths tentatively, Skeptics are tolerant of cultural and religious diversity. They are more interested in refining their own views than in proselytizing others. If they are theists, they wrestle with their God in a continuing struggle of faith. They are often plagued by personal doubts and prone to depression.

True Believers are less confident that humans can sort things out for themselves. They look for help from outside—from God, spirits, or extraterrestrials. Their world is black and white. They seek simple and certain truths, provided by a source that is more reliable than the human mind. True Believers prefer a universe proportioned to the human scale. They are repulsed by diversity, comforted by dogma, and respectful of authority. True Believers go out of their way to offer (sometimes forcibly administer) their truths to others, convinced of the righteousness of their cause. They are likely to be “born again,” redeemed by faith, apocalyptic. Although generally pessimistic about the state of *this* world, they are confident that something better lies beyond the grave.

In the following pages, I will closely examine the cultural implications of these two frames of mind, specifically with regard to science and religion. Not all religious people fit into the category defined here as True Believers, just as not all scientists are Skeptics. If a Skeptic is one who is willing to live with a measure of doubt,

then Job, Jesus (“My God, my God, why hast thou forsaken me?”), Pascal, Graham Greene, Dietrich Bonhoeffer, Martin Buber, and many other great religious leaders, writers, and thinkers have been Skeptics. On the other hand, those scientists who are invincibly certain of the authority of their science must be counted as True Believers.

Yet science, as we understand it today, can only thrive among Skeptics. Some constancy of belief is essential for any way of knowing, but science is by definition driven by research, open to growth and even, on occasion, to revolutionary change. Einstein once remarked that the most important tool of the scientist is the wastebasket. A scientist must be skeptical of her most cherished theory; if she is not, then others within the scientific community will do it for her. Indeed, science is little more than organized skepticism. A successful scientific idea must run a fierce gauntlet of peer review. Our confidence in scientific knowledge is based on trial by fire: systematized doubt and persuasion. Generally, the competition of scientific ideas acts—as in biological evolution—to refine the status quo, sharpening the match between theory and perceptions. Sometimes, however, the perceptual landscape of science radically shifts—as with the invention of the microscope or telescope, or the discovery of electromagnetic waves—and new ideas suddenly emerge and triumph.

True Believers have low tolerance for changeable knowledge. They prefer stable truths of faith, even if those truths run counter to a preponderance of physical evidence. For example, a 1993 Gallup poll indicates that nearly half of Americans believe in the idea of a geologically young Earth, despite the fact that not a shred of reproducible empirical evidence can be adduced in favor of the idea and a mountain of evidence is arrayed against it.

The forces that nudge us toward True Belief are pervasive and well-nigh irresistible. Supernatural faith systems provide a degree of emotional security that skepticism cannot provide. Who among us would *not* prefer to believe that there exists a divine parent who has our best interest at heart? Who among us would *not* prefer to believe that we will live forever? Skepticism, on the other hand,

offers only uncertainty and doubt. What keeps scientific skepticism on track, against the individual's need for emotional security, is a highly evolved social structure, including professional associations and university departments, peer-reviewed literature, meetings and conferences, and a language that relies heavily on mathematics and specialized nomenclature. The point of this elaborate apparatus is to minimize individual backsliding into the false security of True Belief. Political, cultural, linguistic, and religious idiosyncrasies are suppressed in favor of the common endeavor.

Of course, a danger remains that the scientific community might lapse into True Belief—for example, that the theory of adaptation of organisms by natural selection might become unbreachable dogma. But the history of science suggests that even the most thoroughly entrenched ideas (absolute space-time or fixed continents, for example) can be made untenable by a recalcitrant mismatch of theory and observation. In a 1996 story in *Time* magazine, John Bahcall, a physicist at the Institute for Advanced Study in Princeton, New Jersey, expressed confidence in the reliability of current theoretical models for what happens at the center of the Sun; then he added, “But that’s why you do experiments. Because what you think you know might turn out to be completely wrong.”

FOR A DOZEN YEARS, I have written a weekly column about science and nature for the *Boston Globe*. In it, I have explored the ways that scientific knowledge impinges upon our personal and public lives. During those dozen years, no topic has evoked more reader response than the intersection of science and faith. I have received correspondence on this topic from hundreds of readers, the overwhelming majority of whom offered thoughtful, provocative, and helpful responses. One theme emerged from this exchange of ideas: We are a culture divided at its heart. We warmly embrace the technological and medical fruits of science, but often hold religious beliefs that stand in flat-out contradiction to the scientific way of knowing. We concede that science has proved spectacularly successful as a way of understanding the world, yet firmly reject one

of its clearest implications: *We are ephemeral, contingent parts of a silent universe that is vastly larger than ourselves.*

Some of us respond to this apparently deflating concept of who we are by embracing faiths that emphasize our personal cosmic importance—fundamentalist religions, New Age superstitions, pseudosciences—all patently at odds with empirical knowledge. Others seek a place for the doctrines of traditional faith in the gaps of science, in the supposed uncertainties of quantum physics, or in the mathematics of chaos. Still others talk about “complementary ways of knowing,” and so compartmentalize their minds that they are able to keep science and traditional religious doctrines from coming into conflict.

As for myself, I was raised in a traditional Christian faith. I took academic degrees in science and found in science a compelling cosmological vision of the world. I did not turn science into a religion; science is too shallow a vessel to hold ultimate mysteries. At the same time, nothing I had been taught in my religious education seemed adequate to encompass the grandeur and mystery of what I learned in science. It became obvious to me that certain doctrines of the Judeo-Christian tradition, including such central tenets of faith as immortality and a personal God who answers prayers, were based on long-discredited views of the world that placed humans in a central position and ascribed human attributes to other creatures and even to inanimate objects. At the same time, I found within the Judeo-Christian tradition vital mystical and liturgical practices that nourished my quest for encounter with the Absolute.

I am today a thoroughgoing Skeptic who believes that words like *God, soul, sacred, spirituality, sacrament, and grace* can retain currency in an age of science, once we strip them of outworn overlays of anthropomorphic and animistic meaning. Like many others in today’s society, I hunger for a faith that is open to the new cosmology—skeptical, empirical, ecumenical, and ecological—without sacrificing historical vernaculars of spirituality and liturgical expression.

Science, too, can only gain from a reconciliation of science and faith. Science sometimes is aloof, arrogant, blind to the ambient mystery that animates knowledge. A fusion of knowledge with religious feeling need not weaken the rigor of scientific skepticism; it can, however, help stitch science back into the larger fabric of our emotional, intuitive, aesthetic, and sensual lives.

ONE

Miracles and Explanations

*See! I am God. See! I am in everything. See!
I never lift my hands off my works, nor will I
ever. See! I lead everything toward the purpose
for which I ordained it.*

Julian of Norwich

LIKE MOST CHILDREN, I was raised on miracles. Cows that jump over the moon; a jolly fat man that visits every house in the world in a single night; mice and ducks that talk; little engines that huff and puff and say, “I think I can”; geese that lay golden eggs. This lively exercise of credulity on the part of children is good practice for what follows—for believing the miracle stories of traditional religion, yes, but also for the practice of poetry or science.

Science is based upon our ability to imagine what we cannot see: nuclear reactions in the cores of stars, the spinning of galaxies, the dervish dance of DNA. Science, like the imaginative landscapes of childhood, is a world of make-believe. It is, however, a very special kind of make-believe. Science takes as given that a real world exists “out there,” and that it can be represented, albeit imperfectly, in the world of ideas. We struggle mightily to make the partition between the imagined world and the real world as transparent as possible. No scientist will dispute that “atom” is a made-up concept; however, the concept “atom” is the *most concise* way—perhaps the only way—to make sense of our detailed, quantitative experience of the material world. Without the concept “atom,” chemistry, X-ray crystallography, nuclear energy, thermodynamics, and other broad territories of external experience make no sense at all. Indeed, so

transparent is the partition between “atom” and experience that most scientists would say that atoms are “facts,” or at least so close to being facts that no quotation marks are called for.

In the Land of Make-Believe

It is because we retain as adults something of the child’s facility for make-believe that we can enthuse with the poet Gerard Manley Hopkins:

*Look at the stars! Look, look up at the skies!
O look at all the fire-folk sitting in the air!*¹

It is also because we retain something of the child’s facility for make-believe that we can imagine that the stars are vast spheres of hydrogen and helium, powered by nuclear energy, light-years away. Poetic metaphor (“fire-folk”) and scientific construct (nuclear-powered spheres of gas) serve useful functions in our lives, but we are confident the latter bears a closer affinity to reality—to whatever is “out there”—than the former. The poetic metaphor conveys a human truth; the scientific construct attempts to remove the human subject from the equation of idea and reality.

The biologist Richard Dawkins has suggested that the credulity of children—the willingness to believe whatever one is told by adults, especially parents—has been reinforced by natural selection for its survival value.² The child comes into the world knowing nothing, and must quickly learn how to navigate the perils of life. At first, “Don’t touch the stove” and “Be good or Santa won’t bring toys” are absorbed with equal credulity. The child is asked by an authority figure to behave as if the stove is hot, and to behave as if Santa exists, and so she does. The challenge of growing up is to learn which sorts of make-believe are useful reality constructs and which are poetic metaphors.

Early on in our lives, we abandon Santa Claus and the tooth fairy as reality constructs because we recognize contradictions that are

difficult to resolve (the relative sizes of Santa's rotund belly and the chimney pipe, for example), but also because word gets around from other presumably reliable authorities, older siblings perhaps, that the stories are untrue. As for the stove, we learn to exercise a certain skepticism concerning whether or not it is hot, testing in doubtful cases by cautiously touching the surface with a fingertip.

We cannot live without some sorts of make-believe in our lives. Without made-up maps of the world, life is a blooming, buzzing confusion. Some elements of our mental maps (Santa Claus, fire-folk) satisfy emotional or aesthetic *inner needs*; other elements of our mental maps (hot stove, nuclear-powered stars) satisfy intellectual curiosity about the world *out there*. We get in trouble when the two kinds of maps are confused, when we objectify elements of make-believe solely on the basis of inner need. No one takes *fire-folk* literally; but many of us accept the astrological influence of the stars on our lives because it satisfies an inner need, even in the face of convincing evidence to the contrary (every objective test of astrology has proved negative).

The True Believer retains in adulthood an absolute faith in some forms of empirically unverifiable make-believe (such as astrology or the existence of immortal souls), whereas the Skeptic keeps a wary eye even on firmly established facts (such as atoms). Both Skeptic and True Believer use made-up maps of the world.

Is one map as good as any other? Since all knowledge is constructed, can the choice between two contradictory maps (fire-folk versus nuclear-powered spheres of gas, for example) be a matter of personal or political expediency? Not unless we are willing to erect partitions between what we believe to be true on the basis of unambiguous, reproducible evidence and what we merely wish to be true. Apparently, many of us are willing to do just that. A 1995 Gallup poll showed that 79 percent of adult Americans believe in miracles (interestingly, 86 percent of women believe in miracles, compared to 71 percent of men). About half of us are open to the reality of astrological influences. Nearly three-quarters of us believe in life after death. When teenagers were asked, "When scientific and religious explanations conflict, which explanation are you more

likely to accept?” the majority chose religion by a factor of two to one.

The Unmiraculous Shroud

A linen cloth preserved in the cathedral at Turin, Italy, the Shroud of Turin, bears the likeness of a man and is purported to be the winding sheet of Christ. The cloth has long been an object of veneration among Christians. In the late 1980s, Roman Catholic authorities allowed scientists to take tiny samples of the shroud for radiocarbon dating. This technique uses the precisely known decay rate of radioactive carbon atoms as a kind of clock to determine when organic substances—bone, wood, charcoal, et cetera—were alive.³ The method has enjoyed wide use among archaeologists, paleontologists, and historians. It has been calibrated against the ring count of ancient trees and tested successfully many times on historical objects of known age.

In the case of the Shroud of Turin, carbon dating shows when the flax plants were alive from which the linen was made. Three independent carbon-dating labs, in Zurich, Oxford, and Tucson, Arizona, participated in the test.⁴ Along with a sample from the shroud, each lab was given three control samples of cloth of known age: linen from a 900-year-old Nubian tomb, linen from a second-century mummy of Cleopatra, and threads from an 800-year-old garment of St. Louis d’Anjou. None of the samples was identified for the researchers. None of the labs communicated with the others until the results were in. After making their measurements, all three labs agreed on the ages of all four samples. All three labs correctly dated the control samples. And all three labs concluded that the Shroud of Turin is medieval, dating from the mid-fourteenth century. Significantly, this is the very time the shroud first appears in historical records.

It is to the credit of Church officials in Italy that they authorized the carbon-dating tests and accepted the results. Their actions are in keeping with a declaration by Pope John Paul II on the relationship

of science and theology: “Science can purify religion from error and superstition, and religion can purify science from idolatry and false absolutes.”⁵

Is the conclusion of the radiocarbon tests absolute? No, of course not. No scientific test can prove anything with absolute certainty. Is the conclusion convincing? Yes, if you are a Skeptic. No, if you are a True Believer. The person with True Belief in the shroud’s authenticity will dismiss any evidence to the contrary.

In fact, carbon dating of the Turin shroud seems only to have enhanced its reputation as the winding sheet of Christ. (Web pages on the Internet are devoted to its cult.) Since the test results were announced, many attempts have been made to explain them away. According to one critic, a burst of neutrons from the body of the risen Christ created extra carbon-14 nuclei, making the cloth appear younger than it actually is. (No mention is made of what might have caused this mysterious neutron burst, other than a miracle.) Another critic has suggested that the presence of bacteria on the cloth might have muddied the result by adding modern-day carbon-14, although no evidence is adduced that such bacteria actually exist on the Shroud of Turin. As I write, several Italian professors claim to have seen the image of a first-century Roman coin on the cloth. No test, no matter how carefully contrived, will dissuade a True Believer from his belief. Given a conflict between scientific and religious explanations, most of us are quite willing to go with the religious explanation if it confirms our deep-seated inner need for miracles.

Early in my education, the Shroud of Turin was offered to me as evidence for the risen Christ, and therefore for the truth of Christianity. I was educated in Roman Catholic schools, where miracles were as much a part of the curriculum as Dick and Jane and the multiplication tables. *The Shroud of Turin. The spinning Sun at Fátima. Having our throats blessed with crossed candles on Candlemas Day, thereby making us immune to choking on chicken bones. St. Brendan the Navigator taking refuge on the back of a whale during his sixth-century voyage to America (my teachers were Irish nuns). Et cetera, et cetera.* We lived within a vast and engaging landscape of miracles, as richly improbable (by empirical standards)

as the make-believe landscape of fairy tales, and including, of course, those constant miracles we had with us every day: the Real Presence of Christ's body and blood in the Eucharist, the efficacy of intercessory prayer, angels, devils, heaven, limbo, purgatory, hell, and life everlasting. I absorbed these things, mostly uncritically, because it is the nature of children to be credulous. I didn't ask for evidence; the miracles *were* the evidence.

In retrospect, it is easy to see that the entire panoply of miracles, including the most outrageously improbable—all those little unbaptized babies in limbo, for instance—were there to bolster the possibility that death is not final. St. Paul said (as we were frequently reminded), “If the dead are not raised, Christ has not been raised, and if Christ has not been raised, your faith is in vain.” (1 Cor. 15:17) The Shroud of Turin and all the rest were offered as evidence that our ultimate fate is not to be food for worms.

By the time I went off to the University of Notre Dame, many of the more fanciful miracles of my primary education had faded from the story, but the big miracles remained. The text we used for my freshman theology class was Frank Sheed's *Theology and Sanity*, the thrust of which was that any sane person *must* be a Roman Catholic, so persuasive is the evidence for the objective truth of that faith. Meanwhile, I was studying science and discovering a way of constructing mental maps of the world that allowed no place for miracles.

This is not to say that science proves miracles are impossible. One does not prove the invalidity of a miracle by showing that it is inconsistent with the laws of nature. It is the nature of miracles—the strength of their force as evidence—that they violate natural law. Science works by finding consistent patterns in nature; miracles, if they occur, are by definition one-time things. In my university science classes, I did not learn that miracles are impossible, but that there is no reliable evidence that they occur.

Every miracle, examined closely, has a way of slipping through the fingers. En masse the evidence for miracles looks impressive; but take them one at a time and they become frustratingly evasive. As I searched among the miracles of my faith, I found none that was not

contaminated with the likelihood of flawed testimony, fraud, or wishful thinking. Always there was the possibility of a natural explanation. The person whose illness abates after a trip to Lourdes might have been cured by the intercession of the Virgin, but the illness also might have receded on its own or have been ameliorated by positive thinking; both circumstances are recognized within the natural order. The Shroud of Turin might be the winding sheet of the risen Christ, but it might also be an ingeniously contrived fraud or work of art, both of which were common in the fourteenth century. Shine the fierce light of skepticism on the Lourdes cure or the Turin shroud and the “miracle” vanishes.

The Miraculous Red Knot

I learned something else in my study of science, something that had an even greater effect upon my religious faith: None of the miracles I had been offered in my religious training were as impressively revealing of God’s power as the facts I was learning in science. In one of his sermons, the poet John Donne writes: “There is nothing that God hath established in a constant course of nature, and which therefore is done every day, but would seem a miracle, and exercise our admiration, if it were done but once.”⁶ Consider, for example, the flight of juvenile red knots from the islands of northern Canada to Tierra del Fuego, at the southern tip of South America.

The red knot is a sandpiper that twice each year visits the eastern shores of the United States. Every year, these tough little travelers wing more than 18,000 miles, from the southern tip of South America to the arctic islands of northern Canada and back again, stopping briefly along the way on the beaches of Delaware Bay and Cape Cod.

During our northern winter, red knots feed on the sunny beaches of Tierra del Fuego. The birds take advantage of the austral summer to replace their tattered feathers in a long molt, which ensures their flight equipment is in top condition when, in February, they lift off in flocks of hundreds or thousands for the journey north. Up the

coast of Argentina, across the hump of Brazil, stopping occasionally along the way to fatten up. They know exactly where to find food, returning each year to the same stretches of sand or marsh. From the northern coast of South America, they strike out across the Atlantic on a weeklong nonstop flight that brings them in mid-May to their usual feeding grounds on the marshy shore of Delaware Bay, just as horseshoe crabs are laying eggs by the millions.

For a few weeks the red knots gorge themselves; a single bird might consume 135,000 horseshoe crab eggs. Then, fat and fit again, they take to the air for a nonstop flight to islands of the Canadian archipelago north of Hudson Bay. Here, in the boreal summer, they mate and breed, each female red knot laying four speckled eggs, which she and her mate incubate in turns. Baby knots are up and about as soon as they hatch, growing rapidly and replacing natal down with juvenile feathers in preparation for flight. By mid-July, the female adults abandon their new offspring and head south; male adults follow a few weeks later. The juveniles fend for themselves until late August, when they too commence the 9,000-mile journey to Tierra del Fuego.⁷

Now here is the astonishing thing, and the reason I have told the story. The young red knots, by the thousands and *without adult guides or prior experience*, find their way along the ancient migration route. From northern Canada to New England's Atlantic shore, across the Atlantic Ocean to Guyana and Suriname, then down along the eastern coast of South America, arriving precisely at those feeding grounds along the way where they are sure to find food. At last they join their parents and others of their species on the beaches of Tierra del Fuego for the southern summer.

How do they do it? How do the young birds make their way along a route they have never traveled to a destination they have never seen? How do they unerringly navigate the long stretch of their journey over featureless sea? We know exactly *what* the red knots accomplish—where they go, when they arrive; dedicated ornithologists have banded the birds by the hundreds, watched for them at way stations, counted their comings and goings. But *how* the uninstructed young birds accomplish their epic feat of

navigation remains mysterious. The Sun, the stars, the Earth's magnetic field, angles of polarized light—all of these have been shown to be part of the navigational skills of one animal or another (birds, fish, or insects), and singly or in combination these clues must keep the red knots on course.

This much is certain: A map for the journey and the instrumental knowledge to follow it are part of the red knot's genetic inheritance. Each bird begins life as a single fertilized cell. Already, that microscopic cell contains the biological equivalent of a set of charts, a compass, a sextant, and maybe even something akin to a satellite navigation system. This must be true, for every bird is born with the instinct to make its journey.

How can a map of the globe and the skill to follow it be contained within a cell too small to be seen with the naked eye? Medieval theologians are said to have debated how many angels can dance on the head of a pin; in the flight of the red knot we are engaged with a mystery more immediately present but no less marvelous. We can call it instinct and let it go at that. But human curiosity will not let it go. We ask: How? The need to find answers is deep within us, anchored at the root of our being. Of all species of life on Earth, we are the one that *wants to know*. We want knowledge that is reliable, public, and universal, based upon unambiguous, reproducible experience that is (or can be) common to all of us—in a word, knowledge that is scientific.

In the case of animal navigation, the answer to our question turns out to be quite incredible. The urge to make the red knot's planet-spanning flight, the map of the journey, and the skills to follow it, are written into a DNA molecule in a language of stunning simplicity. The molecule is shaped like a spiral staircase—the famous double helix. The side rails of the staircase are linked sugar and phosphate molecules. The treads are paired molecules called nucleotides. There are four kinds of nucleotides: adenine, guanine, cytosine, and thymine, designated A, G, C, and T. Adenine always pairs with thymine, and guanine always pairs with cytosine, so that there are four kinds of treads along the DNA staircase: A-T, T-A, G-C, and C-G. It is the sequence of these treads that is the genetic