

Worshipping in the Church of Einstein

or

How I Found Fischbeck's Rule

by George Johnson

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As he headed into the last years of his life, Albert Einstein thought he had been given a bad rap. Admittedly he had spoken rather loosely in the past. "I can't believe that God plays dice with the universe," he once exclaimed, expressing his exasperation at the reprehensible randomness of quantum mechanics. And when he had wanted to convey his conviction that the laws of nature, though sometimes obscure, are orderly and understandable by the human mind, he put it like this: "The Lord is subtle but not malicious."

He had never suspected that people would take him so literally, and in such self-serving ways -- as a devoutly religious man, a kind of poster boy for a quixotic attempt to heal the rift between science and religion that began when Galileo was forced to recant his belief that the sun, not the earth, sits at the center of the cosmos.

"It was, of course, a lie what you read about my religious convictions, a lie

which is being systematically repeated," Einstein complained in a letter written the year before he died. "I do not believe in a personal God and I have never denied this but have expressed it clearly. If something is in me which can be called religious then it is the unbounded admiration for the structure of the world so far as our science can reveal it."

"God" was simply his metaphor for the laws that scientists had been discovering for hundreds of years. And it was the laws that reigned supreme. On the eve of a monumental experiment to test a surprising prediction of his theory of General Relativity -- that light has mass and can be bent by the gravity of the sun -- Einstein irreverently declared: "If it is *not* proven, I pity the Good Lord, for the theory is correct."

That was his bottom line: It was man, not God, who deserved the most profound respect. We live in a universe governed by a deep mathematical order, Einstein maintained, not the whims of a personal creator -- and we may just be smart enough to figure some of it out. "I am a deeply religious nonbeliever," he wrote to a friend, adding, "This is a somewhat new kind of religion."

Over the years the Church of Einstein has attracted some illustrious followers. At the end of his surprise bestseller, *A Brief History of Time*, Stephen Hawking, who otherwise doesn't appear to have a religious bone in his body, rhapsodized about science coming to "know the mind of God." What he meant was discovering a set of equations that unite all the forces of nature -- pure unadulterated physics. But he, or maybe his editors, suspected that mystical invocations of the Almighty would attract attention and help sell books.

Hoping to match Hawking's royalty statements, other scientists have picked up on the riff, using God not just metaphorically but sometimes, one suspects, a bit facetiously. Leon Lederman, a Nobel laureate at Fermilab, called his own book (a popularization of high-energy physics) *The God Particle*. This was the nickname he coined for the Higgs boson, a hypothetical speck that serves as the missing link in science's long-sought "theory of everything." (Physicists hope to discover it with the new Large Hadron Collider under construction at CERN.) Predicted by the equations, the Higgs would remove one of the last shreds of mystery in science's attempt to explain the universe.

Some of Lederman's readers must have been disappointed when they realized the title was just a joke. What the discovery of the "God particle" would emphatically *not* do is to prove the existence of a supreme being. Rather it would provide the cornerstone for an ambitious theory that seeks to remove the need for such mystical explanations. That is the whole point of science.

Judging from other titles in the popular science genre, God also has his hand in chaos theory (*Does God Play Dice?* by Ian Stewart, a mathematician and science writer) and quantum mechanics (*Sneaking a Look at God's Cards*, by the Italian physicist Giancarlo Ghirardi). A new book called *The God Gene* by geneticist Dean Hamer takes a different tack: explaining scientifically why people are instinctively driven to seek a prime mover -- because faith is hard-coded in our genetic software.

A quick sprint through Amazon.com's data base uncovers an ample supply of similar titles: *God's Equation*, *The God Experiment*, *The God Hypothesis*, . . . *The Loom of God*, *The Mind of God*, *The Fingerprint of God*, *God and the New Physics*. . . *God in the Machine*, *God in the Equation*. . . While some of these

writers (not all of them are scientists) put on theological airs only long enough to cook up a catchy title, others genuinely seem to believe that the purpose of science is to find evidence for the existence of a supreme being -- the last thing that Einstein intended when he unwittingly set this bandwagon careening down the hill.

The notion that there could be conflicting ways of explaining how the world works struck me at a tender age. As aspiring little scientists, my best friend, Ron Light, and I had already tried to convert aluminum foil into gold with a homemade cyclotron and create life in a test tube by mixing together the chemical ingredients listed in the *World Book Encyclopedia* -- carbon from a charcoal briquette, phosphorous from a match tip, hydrogen and oxygen from water. The high-point of every week was when our elementary school teacher wheeled in a black-and-white television TV set to catch a local public television show hosted by a funny man with a mustache and white lab coat named George Fischbeck. Albuquerque's own Mr. Wizard, Dr. Fischbeck would mix together flasks of strange substances causing spectacular chemical eruptions. Sometimes he would visit our classroom, cracking jokes, teaching us funny handshakes, and proselytizing for science.

Dr. Fischbeck later left us to become a TV weatherman in Los Angeles. But one thing he said has stuck in my mind. He was talking, I think, about cosmology -- the Big Bang, how the universe began -- or perhaps it was the theory of evolution, or the eons of time it took to form the Grand Canyon. Anyway, sensing that some of his young viewers might feel a twinge of discomfort, he gently cautioned us not to worry if anything he said seemed to clash with what we learned in Sunday school.

Science and religion, Dr. Fischbeck assured us, holding up an admonishing

finger, are two different things. You don't ever put one with the other. "Nooooooooo," he said dramatically, rapidly shaking his head to provide some vibrato and wiggling his mustache.

Even then, it seemed a bit of a cop-out. The Bible said the universe, Earth and animals and people included, was created in seven days. Science said it started with the Big Bang and took billions of years. How could both be right? And who or what was really in control -- God or the laws of physics? Dr. Fischbeck didn't go into the details: how you could choose to be a "deist," believing that God created the laws and then set the universe to run on its own like a giant clock. Or that, as many scientists do, you could compartmentalize, separating what you learned in the lab or the observatory from what you professed in church -- that unless you were a hardcore fundamentalist, believing in the literal truth of the Bible, there didn't have to be any conflict at all.

I'd learned a little about fundamentalists from watching a Saturday night rerun of *Inherit the Wind*, Stanley Kramer's fictionalized rendition of the "monkey trial," in which a Tennessee teacher named John T. Scopes was accused of teaching evolution. Spencer Tracy played Scope's lawyer (in real life this had been the great Clarence Darrow) and Frederic March was the attorney for the prosecution. Eating my popcorn, I rooted for Tracy, never imagining that years later these comical creationists would stage a comeback, as "creation scientists" asking for equal time in the classroom. Evolution was "just a theory," right? It was only fair that it be taught side by side with another theory: that everything started when God said, "Let there be light."

Dr. Fischbeck must have been appalled. Science is supposed to be about how the world works. Religion is about ethics and morality -- how people should

behave. Mix them together and, like baking soda and vinegar, they blow up in your face.

It wasn't always this way. Before Galileo there was just theology, the final word on everything to do with the here and the hereafter. With no perceived conflict between science and religion, it was perfectly natural for Copernicus, the first great promoter of the sun-centered, or "heliocentric" view, to hold a doctorate in canon law -- the law of the Church. He did astronomy in his spare time. Kepler, who refined Copernicus's theory into the one accepted today, had originally intended to be a theologian. He believed that his cosmology (with the planets circling the sun on elliptical orbits) was a reflection of the divine, a celebration of God.

Galileo was the one who insisted on pushing the limits. Rome had given him permission to write about the sun-centered cosmology, as long as he presented it as nothing more than a calculating device -- a tool, useful to astrologers, for predicting eclipses and charting the positions of the planets. To the Vatican, it was still Ptolemy's second-century geocentrism, with earth at the focus of the Creator's attention, that seemed more theologically correct. Starting with that assumption, the ancient philosopher had crafted a whirligig universe in which the planets and the sun orbited a stationary earth on complex curlicue paths, a dizzying array of "deferents" and "epicycles" -- circles atop circles that could be arbitrarily tuned to revolve at any speed. Adjust everything just so and you could account for any astronomical observation. The structure may have seemed unwieldy, but what of it? God could do anything he wanted. On the fourth day of creation, when he said, "Let there be lights in the heavens," the Great Interior Decorator was favoring a

rococo style.

The Church, unlike the blustering prosecutor in *Inherit the Wind*, was actually taking a rather sophisticated philosophical position -- that, in the end, both geocentrism and heliocentrism were nothing more than models, mere inventions of the human mind. All one could say for certain was that tiny lights traced paths in the night time sky. Most of the lights -- the stars -- indeed appeared to circle around the earth (which certainly didn't feel as though it were moving). A few others -- the planets -- wandered along complex trails, sometimes even appearing to reverse course and move the other way. Ptolemy and Galileo were simply accounting for the phenomena using different reference frames. That building these models was possible at all was a wonder to be celebrated. But Man, with his fallible senses and imperfect reason, could hardly expect to discern for himself how the stars and planets *really* moved. To do so one would have to step outside the universe, seeing it from God's privileged point of view.

Galileo gave lip service to the Church's equal-time doctrine, agreeing that he would write about present heliocentrism as though it was "just a theory." Then he proceeded to do as he pleased, writing his magnificent *Dialogue Concerning the Two Chief World Systems*, in which three Italian noblemen animatedly argue about astronomy, clearly coming down in favor of the Copernican point of view. It is still a good read -- Galileo was the first great popular science writer. But it is impossible to come away from the book feeling that he is presenting his sun-centered model as nothing more than an astronomical calculator, an equal rival, at best, to geocentrism. Presenting it that way would have been the easy way out. But in argument after argument -- using everything from rocks dropped from towers and galloping horses to the Moon-like phases of Venus and the satellites of Jupiter

-- he made a compelling case that the earth really moves, and is just one of many objects orbiting the sun.

He didn't get away with it, of course. His half-hearted arguments defending the status quo had, after all, been put in the mouth of Simplicio, who played the role of Galileo's fool. In the eyes of the Church, it didn't help matters that geocentrism, with enough fiddling, worked equally well for predicting planetary motions. It also didn't help that Galileo's particular version of a sun-based system was actually no less convoluted than the alternative. Stubbornly insisting that the orbits had to be perfectly circular -- that Kepler's idea of ellipses was nonsense -- he was forced to use as many epicycles as Ptolemy to make the calculations agree with reality.

Heliocentrism as championed by Galileo didn't have a whole lot going for it. The clinching argument -- that an earth-based cosmos doesn't make sense physically -- had to wait a generation for Isaac Newton. Astronomers in Galileo's time had only the dimmest notion of what might hold the solar system together. (Kepler toyed with the possibility that it was the attractive pull of sunlight.) Maybe, armed with a theory of gravity, Galileo would have argued his case more forcefully before his inquisitors. How, he might have asked, could something as massive as the sun and stars revolve around the little earth? Instead he recanted and apologized.

Somewhere in my collection of crank scientific literature is a paper, written by a creationist named James Hanson, called "A New Interest in Geocentrism." The centerpiece of his argument is the famous Michelson-Morley experiment of 1887. Using a clever arrangement of mirrors, the scientists sent out two beams of

light: one moving in the same direction as the earth, the other at a right angle to its path. They had assumed that the first beam, boosted by the earth's motion, would travel a little faster. To their great surprise, they found that the velocity of both beams was exactly the same, a phenomenon later explained by Einstein's special theory of relativity. Hanson, however, favored a different interpretation: Michelson-Morley proved that the earth is, in fact, standing still, just as one would expect from the Bible. Add in some epicycles and you can get the sun, stars, and planets to circle around us. It's a clever piece of ecclesiastical engineering, but an alien religious fundamentalist could just as readily devise a curlicue universe with Mars at the center, or Halley's Comet, or the Moon. Given a set of data, one can arrange it in any number of different ways. There is an infinity of rocks upon which to build.

Other creationists have reworked the equations of nuclear physics so that radioactive dating "proves" that the earth, as in the fundamentalists' Bible, is just 8,000 years old -- the number you get if you add up the generations (all that begetting and begetting) in the Old Testament. Play a little with electromagnetic field theory and you can change the speed of light, making it so the universe could have been created in seven days. One theory is as good as another. Let a hundred cosmologies bloom, and a hundred geologies contend.

But that would be cheating. A theory, as scientists use the word, is not merely an opinion, but a logically consistent thesis that has been tested and refined and tested again -- the best explanation so far of a particular phenomenon. If the Church of Einstein can be said to have a dogma, it would go something like this: that the universe is comprehensible, that it can be explained with precise mathematical laws (the simpler the better), that the laws prevailing in the vicinity

of earth are the same throughout the cosmos -- or, if they vary, that they do so because of some other law.

None of that can be proven. It is possible that everything our senses tells us about the world is an illusion, that the reason and logic in which we pride ourselves is as meaningless and arbitrary as the rules of a video game, that the true grand unified theory was conveyed to the authors of the Bible . . . or the Koran, or the Rigveda, or the Egyptian Book of the Dead.

But what a gloomy possibility. With no reason or reward for curiosity, the universe would be a dull, depressing place to live. Oh well. There is always the afterlife.

In 1999 I was called upon on to participate in a symposium in Cape Town, South Africa, for the Parliament of the World's Religions. I knew I was headed for the right place when I got to the check-in counter for the flight from Miami. There were Hopi Indians with headbands and long braids, black southern Baptists in their Sunday best, African-Americans in dashikis, Sikhs in turbans -- all crowding onto the 18-hour flight, a kind of Noah's Ark of assorted beliefs. Similar scenes were unfolding at airports around the world, as thousands of people converged on Cape Town for this spiritual jamboree.

When I got therearrived the streets were coursing with Zulus, Hindus, Buddhists, Zoroastrians, Episcopalians, Muslims, Sufis, Catholics. . . . Everyone, Eexcept for a small group of fundamentalist Islamic demonstrators (who insisted that the ecumenical gathering was a plot of "the Great Satan") everyone seemed

determined to get along.

The science and religion "dialogue" -- I was sheepishly violating Fischbeck's rule -- was only a sideshow to the main event, but we gave it our best. There were presentations on "Jainism and Ecology," "Confucian Ethics and the Ecocrisis," "Cosmochemistry and the Origin of Life." And there was a string of talks on cosmology (mine was a fantasy about alien archeologists excavating the ruins of earth and piecing together a curious creation myth, something about a big bang).

Inevitably someone brought up what has become a staple of science and religion conferences -- the matter of the Amazing Coincidences. It seems that if the speed of light or the charge of the electron or a number from quantum theory called Planck's constant . . . if any one of these was had been just a tiny bit different, then the laws of physics would not have allowed stars to form, including our own sun. Stars work by cooking together hydrogen and helium -- the simple, lightweight elements -- into more complex ones, the carbon and phosphorous and so forth that Ron Light and I had mixed together to create life. If there were no stars, there would be no us.

So maybe we are special after all. That was the speaker's argument. If you start with the assumption that God created the universe for the benefit of his creatures and build your science around that, then the universal parameters were obviously fine-tuned to favor the emergence of life. Carefully setting the dials on his creation machine, the supreme being pressed the button and out popped the cosmological ant farm we've come to know and love.

But there is another, chillier interpretation: That it is just dumb, blind luck. Some scientists soften the blow by invoking the anthropic principle: If the universe hadn't turned out this way, then we wouldn't be here to theorize about it. Blessed be

the Holy Tautology. (Maybe, as a corollary, some entirely different intelligence, beings of pure energy, or pure number -- who knows what might be possible? -- would have emerged instead.) A few cosmologists even speculate that the Big Bang actually resulted in a multitude of different universes, each sealed off from the others and each with a different set of laws. We naturally find ourselves in one of the tiny fraction of universes that support life. The others are fathomless wastelands.

There is no experiment or observation that would favor one of these scenarios over the others. That is too much to ask of science. They are untestable speculations of metaphysics -- that which is beyond physics -- hardly even qualifying as theories. There will always be some residual mystery.

Once they have traced everything back to the Big Bang, all scientists can do is stand back in awe. No one can say what preceded it or why it occurred. Even if there was some plausible mathematical hypothesis, science would be left with explaining where mathematics itself came from. In the beginning God said, "Let their be calculus." It is at this point that science bottoms out and you are free to believe what you want to believe. There will always be some residual mystery.

It really is a little weird when you think about it, that the brain -- cobbled together by evolution for the purpose of surviving on the third rock from the sun -- should be capable of coming up with things like quarks and electrons and quasars and black holes, of understanding a little something about the universe. That is the leap of faith with which science begins.

"We are like a little child entering a huge library," Einstein wrote. "The walls are covered to the ceilings with books in many different tongues. The child knows that someone must have written these books. It does not know who or how.

It does not understand the languages in which they are written. But the child notes a definite plan in the arrangement of the books -- a mysterious order which it does not comprehend, but only dimly suspects."

The most incomprehensible thing about the universe, as he once put it, is that it is comprehensible at all.

George Johnson, the author of *Fire in the Mind: Science, Faith, and the Search for Order*, writes about science for The New York Times from Santa Fe, New Mexico and is winner of the AAAS Science Journalism Award. His seventh book, *Miss Leavitt's Stars*, will be published in spring 2005 by Norton.