
CHAPTER ONE

A BIGGER PRIZE

In which we discover scientists of faith

Emerging from the limousine, Charles Townes might have paused for just a moment if his eyes, still sharp at eighty-nine, had caught the characteristic flutter of a butterfly's wings. Years of butterfly collecting trains the eye and the brain to pick out that distinctive movement among the clutter of images carried by the optic nerve—and Townes had collected butterflies since he was a schoolboy in South Carolina. It was early spring in London and it would not be surprising if a Camberwell beauty (*Nymphalis antiopa*) had sought a perch on the west face of Buckingham Palace, where it could bask in the afternoon sun. Butterflies generate too little internal heat to fly. They spend time basking in the sun with their wings spread to collect the heat needed for flight.

Usually the first large butterfly seen in the spring, *Nymphalis antiopa* stirs the heart of every lepidopterist. It's a signal to get out the net and keep it close at hand in case a good specimen is spotted. Called a mourning cloak in North America because of its resemblance to the traditional cloak worn at funerals, the dark wings of *Nymphalis antiopa* are bordered with ivory. Field guides list it among "black" butterflies, but up close in sunlight the dark wings are a deep reddish-brown with a row of tiny blue dots beside the ivory borders.

As a boy, Charles had imagined becoming an entomologist and collecting every butterfly on earth. His father was a lawyer, but the family lived on a small farm on the edge of Greenville, South Carolina, and when his chores were done, Charles often wandered the woods and fields with a butterfly net on his shoulder. However, as he approached college age, Charles recalls, he decided that “my older brother Henry was so much better at it than I that I thought I had to do something else.” Henry did go on to become a noted entomologist, while Charles turned to physics, inventing the maser, which in turn led to the laser. Although he still collects butterflies for pleasure, Professor Townes, already one of the most honored scientists in the world, was not at Buckingham Palace to collect butterflies, but for the formal awarding of the Templeton Prize by the Duke of Edinburgh. The Templeton Prize for Progress Toward Research or Discoveries about Spiritual Realities is the largest annual financial award given to an individual for intellectual accomplishment.

SPIRITUAL REALITIES

The monetary value of the prize, now about \$1.5 million dollars, is adjusted annually to ensure that it is always larger than the Nobel Prize. According to the John Templeton Foundation, that reflects Sir John Templeton’s conviction that research directed toward spiritual realities could bring even greater benefits to humankind than technology-directed research. It also reflects his conviction that money makes things happen.

It certainly works for Templeton. Frequently described as a humble man in spite of his staggering wealth, he can afford to be humble. He became a billionaire by pioneering the use of globally diversified mutual funds. He was born into a middle-class family in the Bible-Belt town of Winchester, Kentucky; his parents, devout Presbyterians, emphasized the virtues of thrift and compassion. He learned both lessons so well that in 1968 he renounced his U.S. citizenship and moved to the Bahamas,

becoming a British citizen to avoid the U.S. income tax. He was knighted by the Queen in 1987 for his philanthropies. Sir John Templeton still resides in the Bahamas, and of course he still pays no U.S. taxes.

MINORITY REPORT

Perhaps the most honored scientist of our time, Townes shared the 1964 Nobel Prize for fundamental discoveries in quantum electronics, culminating in the development of the maser and the laser—inventions that have had an enormous impact on science and society. He was awarded the National Medal of Science by President Ronald Reagan in 1982 and has gathered numerous other awards and prizes.

Born and raised in a devoutly Baptist household in a Bible-Belt town not unlike Templeton's home town, Townes, like Templeton, remained devout his entire life and still begins and ends every day with a prayer.

A graduate of Furman, a local Baptist college, Townes was from the beginning drawn to science. But the amount and quality of the science offered at Furman was limited, so he took a degree in modern languages and went on to Duke for an MA in physics. At Duke his extraordinary ability in physics was recognized, and he was encouraged to go on to Caltech for his PhD. At Caltech he endured a certain amount of teasing for his religious beliefs, not only from fellow students but from William Smythe, his thesis advisor. In an interview with Tim Radford of *The Guardian* sixty-five years later, he recalled being chided by Smythe, "Charlie you can't know that Jesus was the son of God." Townes resented it—and he still does.

A few years later, by now a faculty member at Columbia, Townes joined the Men's Group at the famed Riverside Church in New York. Since few scientists ever attend church, he was asked to talk to the group about his views. He titled his talk "The Convergence of Science and Religion." The editor of

Think magazine, published by IBM, heard the talk and liked it so much he published it in the April 1966 issue. The editor of the *MIT Alumni Journal* a nonscientist like the editor of *Think*, liked it so much he reprinted it. But while magazine editors may have liked it, many of their scientist readers did not, and it drew complaints from scientists and prominent MIT alumni. Half a century later, in a statement at the Templeton Prize news conference, Townes recalled these slights: “It reflected a common view among many scientists at the time that one could not be a scientist and also be religiously oriented. There was an antipathy towards discussion of spirituality.”

The antipathy has not softened. Indeed, with the rise of religion-inspired terrorism and antiscience religious fundamentalism around the world, antipathy toward religion among scientists has hardened into direct confrontation. By 2006 there was at least one antireligion title by a prominent scientist in the *New York Times* nonfiction best-seller list every week.

“The Convergence of Science and Religion” was cited by the judges in awarding the Templeton Prize. Their report quoted a single line: “Understanding the order in the universe and understanding the purpose of the universe are not identical, but they are also not very far apart.”

They are a universe apart. Science and religion are on divergent paths, growing ever farther apart as knowledge expands. Most religious scientists consciously partition their lives, relying on scientific reasoning on one side of the partition and revelation on the other. Townes appears to partition his life the same way, but without quite being aware that he’s doing it. On the science side he applies logic and reason to great effect. But on the religion side, since Scripture provides the answers, he ends up redefining words to make the two views of the universe appear to be coming together.

His phrase, “the purpose of the universe,” moreover is rather scary. “Purpose” conjures up images of fanaticism. Once people convince themselves that they have been put on Earth as instruments in some divine plan, there seems to be no limit to

the horrors they are willing to commit to carry out that plan. In his beautiful *Dreams of a Final Theory*, Steven Weinberg, another great Nobel-laureate physicist and an avowed atheist, expressed quite a different view: “The more the universe seems comprehensible, the more it seems pointless.”

Many nonscientists have criticized Weinberg for this line; scientists, however, generally find a purposeless existence to be wonderfully liberating—we are free to establish our own goals and to venture across any intellectual boundaries without looking for no-trespassing signs. Humans are free to decide what kind of world we want to live in, and science has given us the tools to set about the business of building that world. *Naturalism* is the idea that scientific laws are the only way to explain the world. As we enter the third millennium, naturalism is the dominant philosophy of scientists. But it is not the philosophy of Charles Townes.

THE FAITHFUL SCIENTIST

“Many people don’t realize that science basically involves faith,” Townes said in his Templeton Prize news conference. Townes had made that point many times before. On questions of laser physics I would happily defer to Townes, but this is a matter of the English language. Here we must defer to the dictionaries. He is confusing two very different meanings of the word “faith.” Pick your dictionary; they all list at least two quite different meanings. In the *Concise Oxford English Dictionary* that I keep on my desk:

faith n. 1 complete trust or confidence. 2 strong belief in a religion, based on spiritual conviction rather than proof.

Some dictionaries break it down into finer variations, but these two meanings are all I need to make my point: scientists use the word “faith” to express their confidence that the laws

of nature will prevail, beginning with the law of cause and effect. The religious use of “faith” implies belief in a higher power that makes things happen independent of a physical cause. This defines superstition. The two meanings of “faith” are thus not only different, they are exact opposites.

Science is conditional: when better experimental evidence becomes available, scientists revise their picture of the universe to fit the facts. Our senses may at times deceive us, as when we see a mirage in the desert. A scientist would say the way to avoid being deceived by a mirage is to understand the laws of optics, enabling us to invent instruments that let us see more clearly, perhaps a polarized lens. Much of the work of science consists of refining the methods of observation to avoid being deceived, including self-deception. Nature is the only arbiter. Religion, by contrast, may call on the faithful to deny the evidence of their senses if it disagrees with Holy Scripture. It’s hard to imagine that anyone as careful as Townes could have confused the two meanings of faith over and over again without consulting a dictionary.

Nevertheless, the scientist in Townes is clearly dominant. He places Darwin’s theory of natural selection above Genesis as an explanation for the origin of humans. While he may think of himself as a Baptist, pray twice a day, and attend church every Sunday, as a scientist he recognizes that the authors of the Bible could not have understood the scientific implications of their words. To make the Bible agree with his scientific conclusions, Townes interprets the Bible metaphorically, as do virtually all religious scientists. Southern Baptists who are nonscientists, however, are inclined to interpret the Bible quite literally.

Townes was not the first physicist to receive the Templeton Prize. Before 2001, however, the name of the prize was simply the “Templeton Prize for Progress in Religion,” and the winners were mostly celebrities drawn from the religious world, beginning with Mother Teresa in 1973. Predictably, the evangelist Billy Graham was a winner, receiving the prize in 1982. Even Charles Colson, whose celebrity status came as a result of his conviction in the Watergate scandal, was awarded the

prize in 1993 as the founder of a prison ministry called the Prison Fellowship. The first real physicist to win the prize was Paul Davies in 1995. An Australian, Davies is best known for his science popularizations, including *The Mind of God: The Scientific Basis for a Rational World* in 1992.

Templeton's thinking about the prize seems to have been evolving. It went to another physicist, Ian Barbour, in 1999, and two years later the name of the prize was changed to the Templeton Prize for Progress Toward Research or Discoveries about Spiritual Realities. Most of the recipients since have been, as Richard Dawkins scathingly put it in *The God Delusion*, scientists who "say something nice about religion." Most of them have been physicists or cosmologists.

BUYING A DIALOG

Ian Barbour's PhD was from the University of Chicago, where he was a teaching assistant to Enrico Fermi, the great Italian physicist who fled fascist Italy with his Jewish wife at the start of World War II. Fermi carried out the first atomic chain reaction beneath the university of Chicago stadium, ensuring that the United States and not Nazi Germany would build the atomic bomb first. Barbour completed his PhD in 1949, and seemed headed for a career as one of the leaders of American physics along with other scientists from the Manhattan Project. But two years later he enrolled in Yale Divinity School, earning a divinity degree in 1956. He became a professor in both physics and religion at Carleton College in Minnesota, and was highly regarded in both fields. Like virtually all religious scientists, Barbour flatly rejects the literal interpretation of the biblical story of Genesis by the creationists, seeing it as clearly metaphorical. He is credited with having created the contemporary dialogue between science and religion.

The importance of Barbour's dialog was recognized by Sir John Templeton from the beginning. While Templeton may genuinely believe the Christian myth, he also respects science.

Why shouldn't he? The scientific revolution, after all, led to the fantastic growth in the world economy that made him a billionaire. Perhaps Templeton believes God has chosen him to show the world that, as he put it, theology and science are two windows onto the same landscape. It would follow that if scientists could be persuaded to delve into religion, it would benefit both religion and science. How then should he go about convincing scientists of this?

Why not just buy the dialog between science and religion? Templeton proceeded to do exactly that. After all, there's no point in being super rich if you can't throw your weight around. It was easier to buy the dialog than you might imagine. The machinery was already in place. The John Templeton Foundation had been created in 1987 to serve as catalyst for scientific studies into the "Big Questions." These are questions about such things as the nature of consciousness and the origin of life that seemed unanswerable in 1987. They form the basis of Barbour's dialogue. The Foundation now gives away about \$60 million in research grants each year. Recipients often feel moved to express their gratitude by inventing some sort of common ground between science and religion, thus reinforcing the myth of convergence. The Foundation even bought a magazine, *Science & Spirit*, and devoted it to publicizing the dialogue.

The biggest coup was to go directly to the staff of the American Association for the Advancement of Science with an offer of a million dollars to create The AAAS Dialogue between Science and Religion. The AAAS couldn't resist. One million dollars still sounds like a lot of money to scientists. Indeed, anywhere there is the sound of a dialogue between science and religion, it's a safe bet that Templeton's people are there handing out money. What he has bought with his money are elaborate sound effects meant to create an illusion that science and religion are finding common ground. However, it's an illusion that has been shattered by the muffled sound of explosions as religious fanatics blow up themselves and total strangers with the goal of replacing civilization with Islamic rule.

Perhaps the most ambitious dialogue was a three-day discussion in May, 1999, of “Cosmic Questions,” held at the Smithsonian Institute in Washington DC. It was cosponsored by the AAAS, but the money came from Templeton. Ian Barbour, however, was not there. He was on his way to Buckingham Palace to receive the 1999 Templeton Prize.

The featured event was an exchange between Sir John Polkinghorne and Steven Weinberg, presenting contrasting views on the question: Is the universe designed? Both are physicists who have contributed to particle theory, but the similarity ends there. Weinberg, who shared the 1979 Nobel Prize for the unification of electromagnetism and the weak force, is an avowed atheist. Polkinghorne, like Weinberg, was a theoretical particle physicist. He made significant contributions to the discovery of the quark. However, in 1981 he resigned his physics professorship at Cambridge to study for the ministry in the Church of England, and became an ordained Anglican priest in 1982.

Is the universe designed? “No” was the eloquent title of Weinberg’s talk. It came within one letter of being the shortest of all possible titles. The laws of nature, Weinberg said, are “cold and impersonal.” Noting that his invitation described the conference as “a constructive dialogue between science and religion,” Weinberg growled that “I favor a dialogue, but not a constructive one.” Although physicists generally agreed that Weinberg came out the clear winner, they didn’t have a vote. But Sir John Templeton did—the 2002 Templeton Prize was awarded to Rev. John Polkinghorne.

THE ANTHROPIC PRINCIPLE

Polkinghorne countered Weinberg’s naturalism by describing the universe as “shot through with signs of mind.” Had the fundamental constants that show up in the laws of physics been even slightly different, he argued, the universe as we know it would not exist. This is the so-called “anthropic principle,”

which is often defined as meaning that the universe has been fine-tuned to make life possible. But just how finely tuned is it? It's like saying the universe is big. Compared to what?

Six of the next seven recipients of the Templeton Prize would be physicists or cosmologists, beginning with Ian Barbour who, as we said, was on his way to Buckingham Palace to accept the 1999 Templeton Prize while Polkinghorne and Weinberg carried on the dialog. All eight Templeton Prize-winning physicists cite the anthropic principle as evidence, if not proof, that the universe was designed for life. The designer would presumably qualify as God.

Eventually, the Templeton Prize would be awarded to John Barrow, a British cosmologist who, with Frank Tipler, literally wrote the book in 1986 on the anthropic principle, *The Anthropic Cosmological Principle*. But what does the anthropic principle actually say? In his debate with Steven Weinberg, Sir John Polkinghorne used the most popular version, sometimes referred to as the strong anthropic principle:

The fundamental parameters of the universe are such as to permit the creation of observers within it.

I would be inclined to state it a little less pretentiously. Borrowing from the style of Yogi Berra, it might be written:

If things were different, things would not be the way things are.

If that doesn't strike you as terribly deep, you may not be suitable material for a Templeton Prize. Nevertheless, the anthropic principle is so widely invoked as evidence for intelligent design that we should take a few minutes to examine its logic little more closely.

THE INHOSPITABLE UNIVERSE

In their 2001 analysis of the anthropic principle, "Probabilities and the Fine-Tuning Argument: A Skeptical View," Timothy

McGrew, Lydia McGrew, and Eric Vestrup, writing in *Mind*, invoke “The Principle of Indifference: it is unreasonable to suggest that any one range of values for the constants is more probable a priori than any other similar range.”

If the universe was designed for life, it must be said that it is a shockingly inefficient design. There are vast reaches of the universe in which life as we know it is clearly impossible: gravitational forces would be crushing, or radiation levels are too high for complex molecules to exist, or temperatures would make the formation of stable chemical bonds impossible. Even in our own solar system it seems increasingly likely that Earth is the only outpost of life. The search for life to which we are not related—extraterrestrial life—is perhaps the greatest quest of science, but so far it has been disappointing. Fine-tuned for life? It would make more sense to ask why God designed a universe so inhospitable to life.

At this point I can hear the voices of David O’Conner and Shaun McCarty sternly admonishing me in the course of one of our contemplative walks beside Northwest Branch that “God’s ways are not our ways. We cannot know his reasons.” (David and Shaun, I remind you, are the two Catholic priests who prayed for me as I lay pinned beneath that tree.)

David and Shaun were right. “God” is sometimes used by physicists as a collective term for the imperfectly understood forces of nature. But the fine-tuning argument is an example of the “Texas-sharpshooter fallacy”: The sharpshooter fires his six-gun at the side of a barn, and then walks over and draws a bull’s-eye around the bullet hole. We will encounter other examples of this fallacy in later chapters. Was it fine-tuning that caused that tree to fall as I ran by? This is not a very useful way to think about the world.

The only thing the anthropic principle makes clear is that we do not yet have a theory explaining why the fundamental constants are what they are. There are, of course, many things we can’t explain, but the list grows shorter daily. It might be well to remind ourselves that for 99.8% of the time that our species has existed, nobody on Earth knew or cared that such things

as fundamental constants even existed. The fundamental constants are now at the very heart of modern physics.

There are still great problems out there for physicists to solve. Sometime in the coming years I expect it will be found that the fundamental constants are not so fundamental—that they emerge naturally from more fundamental laws. They have the values they do, we will find, because they cannot have any other values. That’s exciting if you’re a young physicist looking to make a mark. It’s less comforting if you’re an aging physicist running out of time to find out how the story ends. Invoking a designer solves nothing. It only raises the additional question of where the designer came from.

DISSENT

Not everyone was happy about the American Association for the Advancement of Science (AAAS) selling its soul to Templeton. Why had the most important scientific organization in America, perhaps in the world, allowed the voice of antiscience to assume the guise of a dialog between science and religion?

AAAS occupies a unique position among scientific societies in that it fosters the entire spectrum of scientific research. The weekly journal of the AAAS, *Science*, covers an eclectic mix of technical scientific papers in virtually every discipline, along with news and opinion covering the interaction of science and society. Because *Science* is such a popular source of science news, and because subscribers are automatically made members of the AAAS, membership is huge and includes many interested laymen as well as many lapsed scientists. In addition to individual members, AAAS also has many powerful organizational members, such as the American Chemical Society, the American Physical Society, and the American Society of Cell Biologists.

In addition to special meetings such as the Cosmic Questions Conference, AAAS holds a huge annual meeting, which

is brilliantly arranged to coincide with the annual meeting of the Association of Science Writers, guaranteeing heavy media coverage. Because of its large membership, and the fact that *Science* is a major source of news stories for the media, AAAS wields substantial political clout.

The AAAS is precious to the scientific community. The fact that a single individual had been able to buy a major AAAS program for his own purposes was disturbing to many members. For whatever cultural reason, it was the physicists on the AAAS Council, of whom I was one, who seemed to feel most strongly that religion was playing far too great a role in the affairs of the AAAS. The outgoing president of the AAAS at that time was the late Stephen Jay Gould, a highly respected, even beloved, paleontologist whose position on the science/religion nexus would be best described as “separate but equal.”

DIFFERENT LANDSCAPES

Gould recognized the spiritual nature of *Homo sapiens* and argued that although religion and science are both necessary to a full life, by their nature they cannot be reconciled. He revived the archaic term “magesteria” to describe these nonoverlapping domains of human existence. The magesteria of science and that of religion view the world through different windows, but unlike Templeton’s analogy of windows that give you different views of the same landscape, Gould’s windows look out on totally different landscapes. Experiment is the window of science; the window of religion is revelation. They see very different universes. Both, Gould argued, are worthy of respect but our institutions must be structured to keep them separate; which, of course, is also what the First Amendment to the Constitution seeks to do. The principle of nonoverlapping magesteria is contrary to Townes’s belief that science and religion are converging, and a denial of Templeton’s dream that science will confirm his Christian religious beliefs. The AAAS Dialogue

between Science and Religion seemed destined to be unproductive and divisive—and so it has been.

Unfortunately, Stephen Jay Gould, who had the stature and personal charm to deal with both sides, also had to deal with cancer. He died in the spring of 2002. In the never-ending struggle against those who turn to religious myths instead of science to explain why things are the way they are, science had lost one of its most eloquent and beloved champions. Pain from the cancer that finally claimed his life never dimmed his sense of humor nor lessened his fierce determination to tell the story of evolution with such clarity and logic that people could not help but understand.

For many years Gould had carried on a sometimes-sharp exchange with Richard Dawkins, the other great expositor of evolution in our time, over the role of what Gould called “punctuated equilibrium,” or the observation that evolution sometimes occurs in spurts separated by periods of relative stasis. The dispute was fairly technical and was only over the degree to which evolution occurs through punctuated equilibrium as opposed to gradualism. Although both Gould and Dawkins championed evolution, evolution deniers sought to use the dispute to argue that the evolutionists couldn’t even agree among themselves.

Actually, the open dispute between these renowned champions of evolution was a classic example of how science arrives at ever-closer descriptions of the truth. Science is a wide-open shoot-out in which the weapons are scientific data. The side with the best evidence wins. Nothing is sacred—faith is scorned. Dawkins disparaged Gould’s proposal to regard science and religion as nonoverlapping magisteria (often abbreviated as NOMA). In Dawkins view, any agreement that science and religion refrain from commenting on each others’ realm would simply provide cover for indefensible religious claims.

Unfortunately, the AAAS never dealt satisfactorily with the issues raised by the Dialog between Science and Religion. A compromise was reached under which the John Templeton

Foundation would supply less than half of the program's budget. That may have constrained the power of Templeton to dictate the agenda, but it did nothing to address the question of principle: should the American Association for the Advancement of Science solicit or accept large gifts designated for purposes other than the advancement of science? Many scientists believe strongly that it should not.

SHEDDING YOUR SKIN

The winners of the Templeton Prize and Templeton himself all seem to have been raised in strongly religious households. I generally find the same pattern among those of my physics colleagues who remain religious. Their religious convictions were being instilled in them even as they learned to speak. They are no more likely to shed their religion after puberty than they are to stop thinking in their first tongue. It happens, but not often. H. L. Mencken once grumbled that he could never trust an atheist who was raised as a Catholic—eventually they revert to their childhood faith. I doubt if Mencken had any hard data to back up his assertion, but everyone can recall anecdotes that illustrate the power of early childhood indoctrination. We can't help it—we are prisoners of our upbringing. But that's only part of the story: we are also prisoners of our genetic inheritance. The combination produces a few surprises.

Francis Collins, a geneticist at NIH and the director of the National Human Genome Research Institute, is such a surprise. Chosen in 2002 to replace James Watson, the discoverer of the structure of DNA, as head of the project, Collins does not fit the usual pattern. He grew up on a small farm in the Shenandoah Valley of Virginia that lacked indoor plumbing, but his parents were not farmers; they simply did not place a high value on material possessions. His father held a PhD in English and was a drama professor at Mary Baldwin College. His mother was a playwright. Together they produced summer

plays on a stage built on the farm, resulting in a stream of interesting and lively summer visitors. The summers were a joy for Francis, but it was not easy in the winter. There were stock to be taken care of and outdoor chores. Inside there were lessons.

Because she was not satisfied with the quality of the public schools, his mother schooled Francis at home through the sixth grade. Home schooling seemed to serve Francis well. He entered college at the University of Virginia at sixteen and went on to a PhD in physical chemistry at Yale, and entered medical school at the University of North Carolina.

Collins describes his parents as “nominally Christian,” but religion was certainly not an important part of their life. Indeed, Francis regarded himself as an atheist through college. After all, in a field like physical chemistry that’s the norm. Like his parents, religion had not seemed very important, and he never thought seriously about the evidence for or against belief. At age twenty-seven, in his third year of medical school and encountering patients who relied heavily on their faith to cope with their suffering, Francis Collins finally began to think about religion.

In the first chapter of his 2006 book, *The Language of God*, Collins relates a visit to a neighbor who was a Methodist minister to ask “whether faith made any logical sense.” By then in his late twenties, Francis Collins was clearly searching for something. Was he expecting to engage a Methodist minister in a debate? Having asked similar questions of Methodist ministers at a much earlier age, I would have warned him that it wasn’t going to happen. However, the minister handled it well, hearing him out and then giving him a copy of the C. S. Lewis book *Mere Christianity* to read. Perhaps all Christian ministers today are taught in seminary to refer the wavering to C. S. Lewis.

I must tell you straight out that I am no fan of C. S. Lewis, although I do admire the way he employs the English language to tell entertaining children’s stories. We even gave a copy of

Narnia to our grandsons. After all, they enjoyed Harry Potter without being corrupted into believing in magic. They like stories, but they learned early that they're only stories.

A close friend we have known since college remained single and devoted her entire life to teaching elementary school. She was very smart, very caring, and totally dedicated to opening the children's eyes to the world. They were incredibly lucky to have her for a teacher, but a lifetime of talking to first graders left her handicapped in talking to adults. Lewis has the same problem. His logic is better suited to children than adults. He likes to put his arguments in the form of multiple-choice questions with no right answers. Because an animal is neither a sheep nor a goat, does not mean it's a cow. And even if every straw man set up by Lewis is an idiot, that's not evidence that Jesus was God.

The important idea that Collins took away from *Mere Christianity* was the concept of the "moral law." C. S. Lewis was certainly not the first to observe that people instinctively know right from wrong, nor, as we will see, was he the last.

BEING HUMAN

Toward the end of his book Collins relates a very moving experience in the summer of 1989. Just a year shy of forty, he had traveled to Nigeria as a volunteer to a small mission hospital, freeing the hospital staff to attend their annual conference. While treating a young African farmer suffering from advanced tuberculosis, Collins had an overwhelming religious experience. He interpreted it as a vision of God's purpose. A PhD chemist with a medical degree besides, Francis Collins must surely be aware of the extent to which our emotions are influenced by hormones secreted in response to instructions from the brain. That this brilliant scientist would not recognize his own religious experience as a hormone rush is evidence of the controlling power of our brain chemistry. While we may

recognize the role of hormones in others, it is much harder to make the connection when it happens to us. It seems that hormones have the power not only to turn on your emotions, but to turn off your critical faculties at the same time. Little wonder that we humans are virtually helpless in the face of a concerted hormone assault.

My students are uneasy when the chemical manipulation of emotions comes up in class. They are having their own hormonal problems. I try to reassure them that this is perfectly normal. We share many of our hormonal responses with pre-human and even pre-mammalian ancestors. It's perfectly normal and even essential to our survival. It's important for them to recognize, however, that these responses evolved to aid survival in a Pleistocene wilderness. As members of a civilized society we have an obligation try to understand our impulses and not follow them blindly.

As an example, I share with them that I have been married to the same woman for fifty-seven years. I have no doubt that at our first meeting in a college library our pheromones matched receptors in each other's olfactory system. Pheromones are nature's panderers, but they are not completely promiscuous. To keep you from getting excited by your own pheromones, they do not attach to your own receptors. Nor do they attach to the receptors of closely related people such as siblings, who produce similar pheromones. This adaptation has the effect of discouraging inbreeding.

You are not conscious of "smelling" pheromones because the signal from your pheromone receptors is routed straight to the amygdalae, bypassing the cerebral cortex. The amygdalae respond by calling on the hypothalamus to release arousal hormones, testosterone and estrogen, as well as adrenalin, into the bloodstream. If the person smiles at you, the hormone mix you generate may include norepinephrine, which is so hard to pronounce that it's often called noradrenalin. Noradrenalin synthesizes the formation of synapses in the brain, thereby enabling you to remember everything that's going on, including a

lot of irrelevant detail. From that time on, merely thinking about the other person or hearing the other person's voice on the telephone produces an effect similar to the pheromones. The amygdalae are reminded of the original encounter and instruct the hypothalamus to release a cocktail of hormones that mimics the mix of hormones during that memorable meeting. Noradrenalin is responsible for the vivid memories you retain of everything that was going on around you when you heard the news about 9/11 or that the Chicago Cubs had won the Series, if that's what's important to you.

As the relationship develops, the hormone mix may begin to include oxytocin, a tiny peptide molecule that plays a large role in human emotions related to reproduction, particularly emotions other than simple lust, such as mothering. Each time there is a satisfying interaction with the person, the level of oxytocin tends to rise. Oxytocin induces the deeper feelings of love and loyalty associated with lasting relationships.

By this point my students are squirming. I have just reduced the most meaningful parts of their lives to chemistry. "No matter," I reassure them, "you will discover that understanding what is actually going on won't make it any less wonderful; if anything it will enrich the experience. You will marvel, as every scientist should, at what natural selection can accomplish. Just enjoy it." It's the complex interaction of many factors working together—sensory input, synaptic connections in the brain, memory storage, the endocrine system, and conditioned responses. Together they make the experience uniquely personal. Does all this raise questions of free will? Of course it does.

SACRED DISHONESTY

Although Francis Collins cannot be unaware of the power of a hormone rush to induce a religious experience, he has chosen to compartmentalize his world, as religious scientists must. Scientific interpretation of religious experience is left outside the

door, lest it intrude on spiritual explanations. Interviewed by *New York Times* writer Cornelia Dean, Walt Ruloff, producer of the creationist-inspired movie *Expelled* commented that genome researchers who find evidence suggestive of design in their research may be afraid to report it because it conflicts with the mainline view. He cited Dr. Collins as an example. It's difficult to imagine Francis Collins being afraid of anything, so Dean called Collins and asked him directly about Ruloff's statement. He was not afraid to tell her that Ruloff's remarks were "ridiculous."

They were more than ridiculous. Ruloff appears to have been engaging in the all-too-common practice of "sacred dishonesty". But lies in the name of God are still lies. "From a biologist's perspective," Collins wrote in *The Language of God*, "the evidence in favor of evolution is utterly compelling. Darwin's theory of natural selection provides a fundamental framework for understanding the relationships of all living things. The predictions of evolution have been borne out in more ways than Darwin could have possibly imagined when he proposed his theory 150 years ago, especially in the field of genomics."

Speaking to a national gathering of Christian physicians, Collins suggested that evolution might have been God's elegant plan for creating humankind. Some of the attendees angrily walked out. On questions of how nature works, Collins, like Charles Townes and virtually all scientists of faith, unhesitatingly sides with science. Why then, at the late age of twenty-nine, had Francis Collins become a Christian?

THE CONVERSION ARGUMENT

In the final chapter of his book, Collins summarizes the basis for his religious conversion. It comes down to two points:

- *The anthropic principle*: nature's laws were designed to support life.

- *The moral law*: humans know the difference between right and wrong.

We discussed the anthropic principle at length earlier in this chapter. There is no denying that changes in fundamental constants such as the gravitational constant could make life as we know it impossible. All that tells us is that we don't yet understand why nature's laws are the way they are. Naturalism advises us to be patient. The limits of our understanding are marked with chalk, and will in time be erased by the advance of science. As the frontiers of science advance, seemingly unfathomable mysteries that were once seen as proof of God's existence turn out to be the inevitable consequence of more fundamental laws. Will we ever get to a "final theory" that explains everything and can, as Nobel Prize-winner Leon Lederman put it, "be written on a T-shirt"? Perhaps we never will, but what a magnificent quest.

Even if you accept the anthropic principle as evidence of a creator, it only raises additional questions. The most obvious question is "who created the creator?" And if I try to get around that by arguing that God has always existed, I'm confronted by the next question: "Why the Christian God?" Why not make up a new God? There have been thousands of gods throughout history. What special insight did the authors of the Bible have that leads much of the Western world, thousands of years later, to continue following their god? Even if you see the anthropic principle as implying the existence of a creator, it tells us nothing about that creator except perhaps that he wanted there to be life. The rest is all guesswork and merely tells us what our ancestors wanted their god to be like. The God of the Christian Bible is the God most familiar to the Western world. Unfortunately, this God comes with a lot of baggage including a bunch of preposterous myths. We will examine some of those myths in the following chapters.

Collins' second point, that there is a "moral law," identifies an important research question. The observation that humans

have an innate sense of right and wrong goes back thousands of years. The task of science is to understand why. In the two years since Collins called the moral law “the strongest signpost to God,” the challenge has been taken up by scientists using some of the latest tools of science.

In chapter 11 we will return to the moral law and its implications for the modern world. But before we can talk about the way *Homo sapiens* should be, there is much to be learned about the way we are and how we got to be that way, beginning with Charles Darwin’s theory of evolution by natural selection.