CHAPTER 3

The Fabric of the Universe

The Myth of Warfare

Recent headlines scream the conflict thesis: "God vs. Science" and "Religion and Science Will Always Clash" (Atkins, 1998; Van Biema, 2006). Sam Harris, in "Science Must Destroy Religion," writes, "The conflict between science and religion is inherent" (2006). One reviewer of Richard Dawkins's *The God Delusion* sketched out the cultural import of his book: "It was refreshing to see the publication of Richard Dawkins's book *The God Delusion*. It is not every day that one of the premier evolutionary biologists in the world publishes a text dedicated to the defense of atheism. Dawkins has done us a service, if only in making more acceptable the general proposition that religion and science are at odds with each other, and that it is science that should win out" (Kay, 2007). According to the conflict thesis, as science fills the cup of reason, irrational religion spills out. When the cup of reason is finally full, religion will have evaporated.

In spite of being widely held, the Conflict Thesis has been rejected by historians, philosophers, and scientists—theists and atheists alike. For example, when we look at the scientific revolution (the scientific developments that began in the sixteenth century and progressed through the seventeenth century), the place where science as most of us know it began, we discover that the scientists involved, people like Copernicus, Galileo, Robert Boyle, and Isaac Newton, were deeply and sincerely religious. Modern science sprang from religious believers and religious belief. Not only were these early scientists religious, their religious beliefs motivated and even informed their pursuit of science.

What was it about their religious beliefs that proved such fertile ground for the development of modern science? Why Christian belief and not the belief systems that preceded it? Why did modern science develop in the Christian West and not, for example, in the advanced culture of China?

While we can't answer all of these fascinating questions, we will examine three key thinkers—Francis Bacon (1561–1626), Robert Boyle (1627–91), and Isaac Newton (1642–1727)—who exerted a profound influence on the "new science." Bacon, considered the father of the modern scientific method, was not himself a scientist, yet he provided the philosophical foundation of

the scientific revolution. Boyle, the father of chemistry, put into practice the experimental philosophy advocated by Bacon. Newton, the father of physics, was one of the greatest scientific thinkers of all time.[1] Each of these thinkers was motivated in their scientific pursuits by their deeply held religious beliefs.

Bacon's Busy Bee

Francis Bacon (1561–1626) is widely praised for his influence on Britain's Royal Society for Improving Natural Knowledge (i.e., science), founded in 1660 for the advancement of "Physico-Mathematicall Experimentall Learning." The Royal Society was the first society of scholars devoted to the development of natural philosophy (we will use the term that was not used at that time—"science"). Its exclusive membership was astounding. Robert Boyle was one of the Society's founders and Isaac Newton one of its early members. Membership in the Society would subsequently include a who's who list of all-time great scientists: Charles Darwin, Ernest Rutherford (the father of nuclear physics), Albert Einstein, Francis Crick and James Watson (who cracked the DNA code), and Stephen Hawking. Among its current members are more than 70 Nobel Prize winners.

Bacon's impact on the particulars of science was slight; his general ideas, insights, and outlook inspired generations of followers to collect empirical (observational) data and to postpone theorizing until adequate evidence had been gathered. Consider Bacon's maxim: "What nature is or does must not be thought up or reasoned out but discovered." Bacon believed that the rational speculation and neglect of observation by his predecessors had proven a hindrance to the progress of science. His recommendation of proceeding on the basis of observation and experiment and not on, say, traditional authorities or metaphysical speculation, was captured in the motto of the Royal Society, "*Nullius in Verba*" ("On the words of no one"). Although not much of a scientist himself, his philosophy exerted an extraordinary and timely influence on the development of science in this significant period.

Bacon was born into a family with connections to the royal family of England (Bacon's father was the Lord Keeper of the Seal for Queen Elizabeth; Bacon himself was Lord Chancellor of England under King James). Bacon, who entered Cambridge at the age of 12, left his mark on a host of disciplines: he was a philosopher, lawyer, statesman, and writer. But he is most famous for his "invention" of the new, observational, and experimental method in science. This method would provide the light that "would eventually disclose and bring into sight all that is most hidden and secret in the universe." The new science would require a new method—Bacon's method.

Bacon felt that previous natural philosophers constructed theories prematurely and with little grounding in observable reality; he called their approach "Anticipations of the Mind." They proceeded top-down: they erected theories based on reason alone and then found illustrations (rationalizations) of the veracity of these theories in nature. Their method was to

spin a theoretical web, like a spider, entirely from within; Bacon writes: "For the wit and mind of man, if it work upon matter, which is the contemplation of the creatures of God, worketh according to the stuff, and is limited thereby; but if it work upon itself, as the spider worketh his web, then it is endless, and brings forth indeed cobwebs of learning, admirable for the fineness of thread and work, but of no substance or profit" (Bacon, 1605: Bk. I.5). Bacon contends that without observations of the world—that is, when the mind doesn't work on matter—the mind works upon itself producing empty but elegant constructions, spinning out ephemeral theories with no correspondence to reality.

Bacon emphasized a bottom-up approach: collect data (through careful and extensive observation), begin to theorize, do experiments (i.e., make more and highly specialized observations based on the theory), and then reassess the theory. Scientific theorizing must be based on observations: "Man, being the servant and interpreter of Nature, can do and understand so much and so much only as he has observed in fact or in thought of the course of nature. Beyond this he neither knows anything nor can do anything" (Bacon, 1620: Bk. I.1). Theorizing in science should be based on careful observations and experiments that are then judiciously interpreted to reveal the regularities in the world. Bacon's "bottom-up" approach to scientific theorizing begins on empirical *and* rational grounds rather than on rational grounds alone. From observed particulars, scientific knowledge would slowly rise up to the realm of general principles. Bacon argued, "Neither the naked hand nor the understanding left to itself can affect much. It is by instruments and helps that the work is done, which are as much wanted for the understanding as for the hand. And as the instruments of the hand either give motion or guide it, so the instruments of the mind supply either suggestions for the understanding or cautions" (Bacon, 1620: Bk I.2). Both observation and understanding, Bacon argued, are essential ingredients to human knowledge.

Proper science is not the simple, blind accumulation of observed facts. The mind must reflect on the facts to extract their significance or meaning. Consider, for example, these observations: ball fell to the ground, dead bird fell to the ground, I tripped and fell to the ground, a tree crashes to the ground, a feather gracefully glides to the ground, and so on. We can develop a long list of observations concerning falling down things, but we don't have a science of falling down things. Lists of observations, however complete, aren't good science.

In the passage below, Bacon discusses the deficiencies of those who rely on sense experience alone (men of experiment) as well as those who rely on reason alone (the reasoners). He writes:

> The men of experiment are like the ant, they only collect and use; the reasoners resemble spiders, who make cobwebs out of their own substance. But the bee takes a middle course: it gathers its material from the flowers of the garden and of the field, but transforms and digests it by a power of its own. Not unlike this is the true business of philosophy; for it neither relies solely or

> chiefly on the powers of the mind, nor does it take the matter which it gathers from natural history and mechanical experiments and lay it up in the memory whole, as it finds it, but lays it up in the understanding altered and digested. Therefore from a closer and purer league between these two faculties, the experimental and the rational (such as has never yet been made), much may be hoped (Bacon, 1620: Bk. I.95).

The Baconian method is the rational-empirical busy bee—while it begins with observations, it takes these accumulated observations into the mind for transformation into a significant scientific theory (which could then be tested through experimentation).

With respect to falling down things, we can see Newton's transformation of observations into a significant theory—the universal law of gravitation. On the basis of careful observations (and analysis of the countless observations of others), Newton determined that there was a constant relation between bodies (masses) in the universe: any two bodies are attracted to each other. Moreover, the closer they are to each other, the more they are attracted to one another; the bigger they are, the more they attract another. He calculated the universal law of gravity to be

$$F = G\frac{m_1 m_2}{r^2}$$

where

m_1 is the mass of one of the objects.
m_2 is the mass of the other object.
r is the radius of separation between the center of masses of each object.
F_G is the force of attraction between the two objects.

Now *that* is good Baconian science. This transformational and rational process begins with the incremental accumulation of observed facts, which are then taken up by the mind and developed into a rational principle.

Bacon's work was motivated by his belief in the *Doctrine of the Two Books*—the belief that God revealed himself in two ways, the *Book of Scripture* and the *Book of Nature.* A full and complete understanding of reality requires careful readings of both books. He writes:

> For our Saviour saith, You err, not knowing the Scriptures nor the power of God; laying before us two books or volumes to study, if we will be secured from error; first the Scriptures, revealing the will of God, and then the creatures expressing his power; whereof the latter is a key unto the former; not only opening our understanding to conceive the true sense of the Scriptures, by the general notions of reason and rules of speech; but chiefly opening our belief, in drawing us into a due meditation of the omnipotency of God, which is chiefly signed and engraven upon his works. (Bacon, 1605: Bk. I.VI.16)

Through the *Book of Scripture* we can learn of God's will for our lives and God's character. Through the *Book of Nature* we can learn of God's power

and intellect as manifested in his well-ordered universes. A diet restricted to one book or the other is intellectually and spiritually impoverished. Bacon's friend, Thomas Browne, expressed the Doctrine of the Two Books in a way that Bacon would agree with: "The world was made to be inhabited by Beasts but studied and contemplated by man; 'tis the Debt of our Reason we owe unto God, and the homage we pay for not being Beasts . . . The Wisdom of God receives small honor from those vulgar Heads that rudely stare about, and with a gross rusticity admire His works: those highly magnify Him, whose judicious inquiry into His Acts, and deliberate research into His Creatures, return the duty of a devout and learned admiration" (Browne, 1974: 33).

Bacon was so persuaded of the Doctrine of the Two Books that he came to see natural philosophy (science) as a sort of theology and natural philosophers (scientists) as priests.

The task of scientific priests, according to Bacon, is to restore God's creation to its pristine pre-fall state. According to the dominant Christian (Augustinian) view, God created an unblemished world, a paradise, that was ruined by the sin of Adam (the fall). According to Bacon and to Christian tradition, Adam's fall from grace wreaked havoc on God's orderly creation. The fall also plunged humanity into a moral, spiritual, and intellectual darkness from which it had not yet recovered by Bacon's day. The fall disrupted God's perfect creation and put blinders on humans that prevented them from seeing God's natural order. In order to restore humanity to its pre-fall state, God had to forgive and redeem humans through the life, atoning death and resurrection of his son, Jesus; God could thereby transform us body, mind, and soul. We can then and only then get into the right relationship with God and God's world. In order to understand the natural world, Bacon is clear: it all begins with God. Thus restored by God, we can, following Bacon's methods, cooperate with God in the restoration of the world to its perfect, pre-fall state. God's restoration of our pre-fall intellectual capacities is crucial to our ability to truly understand the world. Only by understanding the world can we begin to recreate paradise.

When divine grace and Bacon's methods restore the powers of human understanding, we can comprehend the world. We can comprehend the world because God has created both an orderly world and human minds capable of grasping that order—the so-called *correspondence of mind and world*. It is astounding that our mental capacities are capable of grasping the world. There might have been problems on both ends—the world may have been disorderly and chaotic, and we might have been cognitively incapable of grasping order. A failure on either end, and science is impossible.[2] Our world is precisely mathematically ordered, according to Bacon, because it is a reflection of the mind of God. God's mind got melded into the order of this world.[3]

Successful science requires more than an orderly world—humans must also have the ability to grasp and communicate that order. Monkeys, slugs, and bananas, to name just a few, lack the capacities for a scientific understanding

of the world. Humans could have been really good at understanding whatever is necessary for human survival—gathering food, say, or seeking a mate—but lousy at understanding the ultimate structure of reality—for example, adducing the law of gravity or the structure of DNA. We are all familiar with the Peter Principle—every employee tends to rise to his level of incompetence. Natural science may have been one or two levels above humanity's competence. But it is not: we can understand the natural world. Like our orderly world, Bacon believed that human minds capable of grasping that order is a sign of divine handiwork. God put his mind into the world and then into humanity. Human minds and the natural world were, according to Bacon, made for one another. Mind and world match.[4]

For Bacon, knowledge is also power. Because of the fall, humanity had fallen from its proper place in nature. Humans had lost their dominion—their place of prominence, authority, and control—over nature. Through great effort (the sweat of their brows) and faith, humanity can be restored to its pre-fall place, and the world will then supply us with all human necessities. Bacon unites the themes of fall, restoration, dominion, and power into a single concluding paragraph:

> For man by the fall fell at the same time from his state of innocence and from his dominion over creation. Both of these losses however can even in this life be in some part repaired; the former by religion and faith, the latter by arts and sciences. For creation was not by the curse made altogether and forever a rebel, but in virtue of that charter, "In the sweat of thy face shalt thou eat bread," it is now by various labors at length and in some measures subdued to the supplying of man with bread; that is, to the uses of human life. (Bacon, 1620: Bk. II.52)

Bacon viewed nature as God's creation, which could be understood and even tamed through technological advancement. Bacon, like other modern scientists, believed that science has a practical function—of making life better for everyone by giving us some measure of control over nature. Consider all the practical ways in which knowledge of the world gained through experimentation and keen observation has led to an improvement in the quality of human life: home heating, indoor plumbing, electricity, pharmaceutical development, and advances in medical technology.[5] According to Bacon, such technologies constitute our partial recreation of paradise. Bacon believed that human beings working hand-in-hand with God would restore humankind's dominion over the earth and return us to Eden.

Instruments of Hand and Mind

Bacon imagined, rightly or wrongly, his predecessors sitting alone in their studies, thinking. The modern scientist, according to Bacon, walks outside and observes the motions of the planets and stars, or goes into the laboratory to carefully perform an experiment; only then does he sit back and reflect. The differences in approach, and hence results, couldn't be more obvious.

Very smart people started looking long and hard, carefully and closely at things and, lo and behold, a revolution in human knowledge—the monumental discoveries of Copernicus, Galileo, Boyle, and Newton.

One of the great innovations of this scientific revolution was the regular use of experiments to discover the world around us. Scientific knowledge comes from an engagement with the world: knowledge of natural objects is discovered, not deduced. Bacon complained about those who "hunt more after words than matter." He believed that the world would give up its secrets only if we put mind and hand together: "the instruments of the hand either give motion or guide it [understanding of the world], so the instruments of the mind supply either suggestions for the understanding or cautions" (Bacon, 1620: Bk. I.2). The mind alone spins meaningless webs, but the world alone is vast and incomprehensible. The world needs to be broken down into bite-size bits so that we can begin to understand it. Experiments break the world down into graspable bits.

We read the *Book of Nature* through experimentation. Bacon believed that experiments can break down the language of the world into the letters of its alphabet, and only then, through reflection, can those letters be put back together into scientific sentences (a theory) that we can understand. Boyle similarly claimed that through experimentation the philosopher is able "to read the stenography of God's omniscient hand" (Boyle, 166: 62–63).

Science uses mind *and* hands, theorizing *and* experimentation, speculation *and* observation. Science utilizes reason as it conducts experiments, gathers data, organizes the data coherently, and then theorizes by attempting to establish universal principles, which it tests and retests, repeating the entire process. Thomas Sprat, a seventeenth-century historian, bishop and member of the Royal Society said: "Philosophy will then attain to perfection, when either the Mechanic Labourers shall have philosophical heads, or the Philosophers shall have Mechanical Hands" (Sprat, 1722: 397).

Bacon believed that, God helping us, we can use the experimental method to understand the world. But without the agreement between our mind and the world, we should despair of grasping the world at all. Yet there is hope: God has equipped us with the capacities to read the *Book of Nature* and restore humanity to paradise.

Ironically, one of Bacon's experiments led to his premature demise. While stuffing a chicken with snow to determine the preservative effects of low temperatures, Bacon contracted pneumonia. He died a few days later. Bacon might just be the first martyr to the experimental method.

Boyle's Law and the Laws of God

Robert Boyle (1627–91), the founder of the field of chemistry, is immortalized for "Boyle's Law," which says that for a given amount of gas the product of its volume and pressure is constant. Boyle himself and his influence are often overlooked in discussions of the history of science and religion. This is unfortunate. Boyle, one of the greatest of modern scientists, was a clear

thinker on issues of science and religion and is representative of the mindset of an early modern scientist—committed to both experimental science and the Christian faith. He wrote that his chemical investigations of our wonderful creation were "a means of discovering the nature and purpose of God." Boyle's scientific achievements and natural philosophical insights shed light on the extent to which modern science was propelled by religious considerations. Boyle took Bacon's maxim to heart: "What nature is or does must not be thought up or reasoned out but discovered." So Boyle became perhaps the first genuine experimentalist in science.

Robert Boyle was the fourteenth child of the Earl of Cork, at that time one of the wealthiest men in Britain. The Earl had come to wealth through his own gumption and hard work, purchasing estates at cheap prices at just the right time. He impressed the Queen enough that he was appointed Clerk to the Council in Ireland. As is often the case for self-made men, the Earl of Cork decided that his children should be brought up without excessive material comforts, luxuries, and privileges. For the Earl's sons, this meant being sent away to live with a family in the country as a baby and returning around age 5. All of the Earl's children were expected to take their studies seriously, and Robert especially excelled.

While traveling through Italy with his brother and their tutor, Boyle heard the news of the great astronomer Galileo's death. His curiosity piqued, Boyle decided to read Galileo's writings and began to develop an interest in science. An Irish rebellion in the early 1640s and civil war thereafter altered the family's financial position. Boyle's father passed away before Robert turned 18, and, although he died a far less wealthy man than he had been only a few years earlier, the Earl of Cork was able to leave a small manor in the country for Robert.

In the early 1650s, the political climate in Britain stabilized, and Boyle reestablished his father's estate and fortunes. After a few years, Boyle earned sufficient rental income from these estates to afford to live a comfortable life. Boyle moved to Oxford to be part of its exciting intellectual and scientific climate. There he hired a number of assistants to help him perform experiments in chemistry and physics.

Boyle's scientific experiments, especially in the fledgling field of chemistry, contributed greatly to the development of science in this period. It is Boyle's interest in science and religion, however, that is of interest to us here. His groundbreaking book, *The Skeptical Chymist*, was followed by three books defending the Christian faith, concluding with his book, *The Christian Virtuoso.* His Baconian experimental outlook was closely allied with his Christian beliefs. Consider, for example, the following: "It more sets off the wisdom of God in the fabric of the universe that he can make so vast a machine perform all those many things which he designed it should by the mere contrivance of brute matter, managed by certain laws of local motion and upheld by his ordinary and general concourse, than if he employed from time to time an intelligent overseer—such as nature is fancied to be—to regulate, assist, and control the motions of the parts" (Boyle, 1996: 11).

Boyle's mission "was to formulate a view of nature that allowed us to understand and marvel at the wonder of the created order, so that we might better appreciate the glory of the Creator" (Ashworth, 2003: 80). This goal could be achieved, he believed, through the mechanical philosophy. His mechanical philosophy was not a form of deism (a view that holds that God creates the cosmos and then leaves it alone to run on its own), but one in which God is intimately involved in the ongoing operation of his creation. Boyle writes, "And it is intelligible to me that God should at the beginning impress determinate motions upon the parts of matter, and guide them as he thought requisite for the primordial construction of things; and that since, he should by his ordinary and general concourse maintain those powers which he gave the parts of matter to transmit their motion thus and thus to one another" (Boyle, 1996: 24–25). God, according to Boyle, is continually active in sustaining the world.

Rather than conflict or tension, we find in Boyle's writing the peaceful coexistence of science and religion.[6] Boyle's life shows that religious beliefs can encourage the development of science. The integration of science and religion is not only possible, it actually happened. Boyle argued that science likewise can and should encourage the development of religious belief. The new "Experimental Philosopher" was "dispos'd to make use of the knowledge of the Creatures to confirm his Belief, and encrease his Veneration, of the Creator" (Boyle, 1690: 7).

Standing on the Shoulders of Giants

Isaac Newton (1642–1727) discerned the law of universal gravitation not because of that pesky apple but "By thinking on it continually." Along with Galileo, Newton had perhaps the most indelible impact on the development of modern science. It seems fitting then that Newton was born in 1642, the same year Galileo died. Although he was no orthodox Christian believer, Newton was a devout theist and a firm believer that the study of nature was at the same time the study of God.

When Isaac's mother was pregnant with him, Isaac's father passed away. His mother remarried when Isaac was 3 years old, and young Isaac was sent to live with strict yet caring grandparents until he was 10, at which time Isaac returned to his mother who was again widowed. Isaac was an excellent student, demonstrating an aptitude for designing and constructing elaborate models, such as a working model of a windmill. Although he excelled at school, it was not until he failed at managing the family farm that Isaac enrolled at university. At Cambridge University, Newton often ignored the prescribed curriculum in favor of pursuing his own scientific interests. Spending little time studying the curriculum sponsored by the university, however, did not prevent Newton from winning a competitive fellowship to stay on at Cambridge.

Newton's best-known scientific and mathematical achievements were the development of the calculus and his discernment of the law of universal

gravitation. It is our interest in this chapter, however, to explore Newton's views on science and religion, especially how Newton's religious views influenced his approach to science. Few people know that Newton spent more time in serious study of the Bible than he did in his scientific ventures. Newton scholar James Force writes, "Newton's universe is *not*, and for Newton can *never* be, stripped of 'metaphysical considerations' because its creator, owner, and operator is the Lord God" (Force, 2000: 268). These metaphysical-religious considerations were the roots of Newton's scientific views.

In his preface to Newton's *Principia*, Roger Cotes writes:

> Without all doubt this world . . . could arise from nothing but the perfectly free will of God . . . From this fountain . . . [what] we call the laws of nature have flowed, in which there appear many traces indeed of the most wise contrivance, but not the least shadow of necessity. These therefore we must not seek from uncertain conjectures, but learn them from observations and experiments. He who is presumptuous enough to think that he can find the true principles of physics and the laws of natural things by the force alone of his own mind, and the internal light of reason, must either suppose that the world exists by necessity, and by the same necessity follows the laws proposed: or, if the order of Nature was established by the will of God, that himself, a miserable reptile, can tell what was fittest to be done. (Newton, 1687)

This passage reveals the foundational principles of science that were held not just by Newton but by his contemporaries as well. Among these principles are

1. God voluntarily created the world.
2. God freely established laws of nature.
3. We can learn about these laws through observations and experiments.

From this modest theological foundation, Newton would erect his remarkable scientific edifice. He had learned the lessons of Bacon and Boyle (and others) well. Bacon cleared the ground upon which Boyle, Copernicus, and Galileo walked. Newton gave them due credit, confessing, "If I have seen further it is only by standing on the shoulders of giants."[7]

A perfect and simple god, Newton thought, would make a simple world. A passage from one of Newton's manuscripts states: "Truth is ever to be found in simplicity, and not in the multiplicity and confusion of things. As the world, which to the naked eye exhibits the greatest variety of objects, appears very simple in its internal constitution when surveyed by a philosophic understanding, and so much the simpler, the better, it is understood, so it is in these visions. It is the perfection of all God's works that they are done with the greatest simplicity" (Newton, 1974). Newton viewed mathematical formulas as examples of simplicity in which "truth is ever to be found."

The view that mathematics could be applied with such precision to the natural world is one of the lasting insights of the scientific revolution. Modern-day developments in physics—relativity theory, quantum mechanics, and

string theory, to name a few—are the fruits of this idea. Newton believed that precise mathematical formulas could be used to describe nature because God created the world, organized it by his laws, and established building blocks of perfect simplicity. According to Newton, God speaks to us in the *Book of Nature* through the language of mathematics.

Newton viewed his work in *Principia* as a long and complex argument for design, which, in turn, leads irresistibly to the Designer. This conclusion, he claims, follows as surely from his natural philosophical principles as his physical laws. He concludes his discussion of the theological implications of his physics with the following: "And thus much concerning God; to discourse of whom from the appearances of things, does certainly belong to Natural Philosophy" (Newton, 1729: 546). God, so he argues, is the ultimate conclusion of physics. For Newton the thought that science could be opposed to religion would seem most odd: theology and physics, for Newton, jointly constitute natural philosophy.

Even more, Newton believed that his natural philosophy would and should move us to obedience to God and love of one another. By leading us to God, natural philosophy leads us to the source and authority over our lives: "If natural Philosophy in all its Parts, by pursuing this Method [i.e., experiment], shall at length be perfected, the Bounds of Moral Philosophy will be also enlarged. For so far as we can know by natural Philosophy what is the first Cause, what Power he has over us, and what Benefits we receive from him, so far our Duty towards him, as well as that towards one another, will appear to us by the Light of Nature" (Newton, 1704: 405). The study of the *Book of Nature* is devotionally and morally uplifting: it leads us to love of God and humans alike.

Christianity and the Rise of Modern Science

Francis Bacon, Robert Boyle, and Isaac Newton—three of the greatest thinkers of the scientific revolution—were keenly attuned to the role their theological beliefs played in their investigations of nature. Through their hard work and brilliant insights, modern science was born. Far from being antagonistic toward science, their faith motivated and even informed the development of science. In his *Principia,* Newton would write: "This most beautiful system of the sun, planets, and comets could only proceed from the counsel and dominion of an intelligent and powerful Being. And if the fixed stars are the centers of other like systems, these, being formed by the like wise counsel, must be all subject to the dominion of One" (Newton, 1713). The religious beliefs of these early scientists provided a foundation—a God-created cosmos and a God-created mind—for investigating nature. This investigation was carried out with the confidence that a world created by God is orderly and regular. By experimentation and observation we can attain to an understanding of the created world.

Science found fertile ground in the Christian West.[8] As contemporary physicist Paul Davies reminds us: "Science began as an outgrowth of

theology, and all scientists, whether atheists or theists accept an essentially theological worldview" (Davies, 1995: 138). Science arose among natural philosophers who believed the world to be the design of God. In their quest for *scientia*, a complete and full understanding of reality, they perused God's two books—Scripture and Nature—to learn the mind of God. Kepler, for example, conceived of astronomers as "priests of the most high God, with respect to the book of nature." Robert Boyle regarded the activities of natural philosophers as intellectual worship of God. This is the theological worldview within which modern science blossomed.

Exclude God from the definition of science and, in one fell definitional swoop, you exclude the greatest natural philosophers of the so-called scientific revolution—Kepler, Copernicus, Galileo, Boyle, and Newton (to name just a few).

Methodological versus Metaphysical Naturalism

While religion was there nurturing modern science, contemporary science can and should proceed without consideration of supernatural entities or forces. Most contemporary scientists believe, and I concur, that *science should proceed as if there were no God*. Science, at least nowadays, should restrict itself to the natural world and the natural laws that operate within the natural world. The claim that science should not appeal to the divine, sometimes called "methodological naturalism," is the dominant assumption of scientific practice in our day and age. *Methodological naturalism* holds that, in the practice of science, supernatural entities or forces (like God, ghosts, or *qi*[9]) are not allowed; scientists should restrict their explanatory theories to those that invoke or involve only natural entities or forces (like atoms and planets, or gravity and electromagnetism). Physicist Steven Weinberg puts it as follows: "Science should be taught not in order to support religion and not in order to destroy religion. Science should be taught simply ignoring religion" (2000). The days of scientific appeals to God are over.

Like simplicity and beauty, values that inform scientific decision making, methodological naturalism is an assumption; one I think warranted, but it is an assumption nonetheless. Why accept this assumption?

The biggest reason to think methodological naturalism appropriate for contemporary science is the remarkable success of science when scientists grew increasingly dissatisfied with "God did it!" explanations and sought natural explanations. Invocations of the divine—to explain thunder, say, or valleys—were usually little more than theologically veiled ignorance (if we didn't know how something was done, then we presumed that God did it). Our understanding of the weather advanced when people stopped appealing to the gods of thunder and started appreciating the dynamic and interactive forces of, for example, heat conduction and convection. Astronomy yielded its secrets when people stopped believing that God was the prime mover of the planets and began understanding planetary motion in terms

of inertia and gravity. Modern geology developed when slow, gradual, natural forces replaced Noah's flood as the movers and shakers of the earth's surfaces. Science, human knowing, dramatically progressed when it was no longer satisfied with "God did it" explanations and sought the underlying natural causes of the phenomena in question. The remarkable progress of science, when theologically veiled ignorance is conceded and natural causes are sought, is the biggest reason in favor of methodological naturalism. The continued success and progress of science demand methodological naturalism.

Does methodological naturalism entail metaphysical naturalism—the view that there are no supernatural entities or powers?

James Watson, the co-discoverer of the structure of the DNA molecule, contends that the increasing success of science counts decisively against the existence of God; he writes: "Every time you understand something, religion becomes less likely" (Highfield, 2003). The more successful science is at explaining, Watson argues, the less intellectual space there is for God. The very success that motivates the assumption of methodological naturalism supports, Watson claims, metaphysical naturalism.

While this narrative is all too common, it is flawed. Scientific explanations are restricted by their method to the material world. So it shouldn't come as a surprise that scientific theories say nothing about the immaterial world (should it exist). If God should exist, God is beyond the physical and, therefore, lies outside the domain and methods of science. In 1960 Soviet cosmonaut Yuri Gagarin, the first human to venture into space, confidently declared that his atheism was confirmed because when he peered into space, he didn't see God. But Gagarin's confidence was misplaced. God isn't out there, in space. God isn't in the world at all. Gagarin couldn't find God because he was looking in the wrong place.

Believing that supernatural explanations have no place in science does not require an affirmation of metaphysical naturalism. Methodological naturalism—understanding the natural world without appeal to the supernatural—is neutral with respect to the existence of God. Even if the weather is best understood in terms of heat conduction and convection, and even if dinosaurs died out because a meteor crashed into the earth, God might still exist. Imagine how odd it would be if someone based their atheism on science's ability to explain the switching on of a light in terms of electricity. Understanding the natural world in natural terms implies nothing about the existence or nonexistence of a supernatural God.

Bacon, Boyle, and Newton commended methodological naturalism *and* believed in God. They were inspired to methodological naturalism by their belief that God acts in natural, law-like ways. According to this view, God's dominant mode of action is through natural law, not through sporadic and miraculous divine interventions. If you want to understand how God works, you have to understand the natural laws that undergird God's world. That is how God did it.

When doing science—explaining how things work in the natural world—one should not go beyond the natural world; one should seek to understand

the physical laws that operate within the natural world. Contemporary scientists, theists or not, should not bring God into their labs or theories. Scientists should follow methodological naturalistic principles: "Leave God and god-like entities out of science." God's existence is an independent, non-scientific question (one scientists are not any better equipped to answer).

Conclusion

We have discovered the profound influence of religion on the origin of modern science. Without exception, the first great modern scientists were devoutly religious. Yet they also affirmed some sort of separation between science and religion. Kepler, for example, repeatedly asserted that it is not the purpose of the Scriptures to instruct men in natural things. Like Kepler, most of these scientists affirmed something like the Doctrine of the Two Books, but believed that the two books should be kept entirely separate.[10] Bacon seemed likewise concerned that theology should not intrude on science; he wrote that "natural philosophy [science] has, in every age, met with a troublesome and difficult opponent: I mean superstition, and a blind and immoderate zeal for religion" (1620: Bk. I.89). We must be careful readers here. He is not claiming that religion has a negative effect on science—he denounces superstition and blind and excessive zeal. He leaves open the possibility that true religion might have a positive effect on science. While it is not clear that true religion will have much to add to the mathematical formulae for plate tectonics or the kinetic theory of gases, it may have a great deal to say about the reliability of our cognitive faculties, or the match between mind and world, or, perhaps, many other things that are essential assumptions for the practice of science. True religion may serve, as it did for Bacon, Boyle, and Newton, to justify the presuppositions of science (the scientific values discussed in the preceding chapter).

Of course, *claiming* no conflict between science and religion, and there *being* no conflict between science and religion are two entirely different stories. Christian slaveholders might have blithely maintained their convictions about Christian beliefs and the rightness of slavery, but Christian belief is in deep conflict with slavery. So people can hold beliefs that are in conflict. Perhaps Bacon, Boyle, and Newton were simply self-deceived. They held religious beliefs and they held scientific beliefs, but those beliefs are fundamentally in conflict (and perhaps they should have known better). We need to examine particular religious beliefs and particular scientific beliefs and then determine if they invariably conflict.