Chapter 1
What are science–religion debates really about?

In Rome on 22 June 1633 an elderly man was found guilty by the Catholic Inquisition of rendering himself 'vehemently suspected of heresy, namely, of having held and believed a doctrine which is false and contrary to the divine and Holy Scripture'. The doctrine in question was that 'the sun is the centre of the world and does not move from east to west, that the earth moves and is not the centre of the world, and that one may hold and defend as probable an opinion after it has been declared and defined as contrary to Holy Scripture'. The guilty man was the 70-year-old Florentine philosopher Galileo Galilei, who was sentenced to imprisonment (a punishment that was later commuted to house arrest) and instructed to recite the seven penitential Psalms once a week for the next three years as a 'salutary penance'. That included a weekly recitation of the particularly apt line addressed to God in Psalm 102: 'In the beginning you laid the foundations of the earth, and the heavens are the work of your hands.' Kneeling before the 'Reverend Lord Cardinals, Inquisitors-General', Galileo accepted his sentence, swore complete obedience to the 'Holy Catholic and Apostolic Church', and declared that he cursed and detested the 'errors and heresies' of which he had been suspected – namely belief in a sun-centred cosmos and in the movement of the earth.

It is hardly surprising that this humiliation of the most celebrated scientific thinker of his day by the Catholic Inquisition on the

grounds of his beliefs about astronomy and their contradiction of the Bible should have been interpreted by some as evidence of an inevitable conflict between science and religion. The modern encounter between evolutionists and creationists has also seemed to reveal an ongoing antagonism, although this time with science, rather than the church, in the ascendancy. The Victorian agnostic Thomas Huxley expressed this idea vividly in his review of Charles Darwin's *On the Origin of Species* (1859). 'Extinguished theologians,' Huxley wrote, 'lie about the cradle of every science as the strangled snakes beside that of Hercules; and history records that whenever science and orthodoxy have been fairly opposed, the latter has been forced to retire from the lists, bleeding and crushed if not annihilated; scotched, if not slain.' The image of conflict has also been attractive to some religious believers, who use it to portray themselves as members of an embattled but righteous minority struggling heroically to protect their faith against the oppressive and intolerant forces of science and materialism.

Although the idea of warfare between science and religion remains widespread and popular, recent academic writing on the subject has been devoted primarily to undermining the notion of an inevitable conflict. As we shall see, there are good historical reasons for rejecting simple conflict stories. From Galileo's trial in 17th-century Rome to modern American struggles over the latest form of anti-evolutionism, known as 'Intelligent Design', there has been more to the relationship between science and religion than meets the eye, and certainly more than just conflict. Pioneers of early modern science such as Isaac Newton and Robert Boyle saw their work as part of a religious enterprise devoted to understanding God's creation. Galileo too thought that science and religion could exist in mutual harmony. The goal of a constructive and collaborative dialogue between science and religion has been endorsed by many Jews, Christians, and Muslims in the modern world. The idea that scientific and religious views are inevitably in tension is also contradicted by

the large numbers of religious scientists who continue to see their research as a complement rather than a challenge to their faith, including the theoretical physicist John Polkinghorne, the former director of the Human Genome Project Francis S. Collins, and the astronomer Owen Gingerich, to name just a few.

Does that mean that conflict needs to be written out of our story altogether? Certainly not. The only thing to avoid is too narrow an idea of the kinds of conflicts one might expect to find between science and religion. The story is not always one of a heroic and open-minded scientist clashing with a reactionary and bigoted church. The bigotry, like the open-mindedness, is shared around on all sides – as are the quest for understanding, the love of truth, the use of rhetoric, and the compromising entanglements with the power of the state. Individuals, ideas, and institutions can and have come into conflict, or been resolved into harmony, in an endless array of different combinations.

The leading historian of science and religion John Hedley Brooke writes that serious historical study has 'revealed so extraordinarily rich and complex a relationship between science and religion in the past that general theses are difficult to sustain. The real lesson turns out to be the complexity.' Some of that historical complexity will be explored in subsequent chapters. There has certainly not been a single and unchanging relationship between two entities called 'science' and 'religion'. There are, nonetheless, some central philosophical and political questions that have frequently recurred in this context: What are the most authoritative sources of knowledge? What is the most fundamental reality? What kind of creatures are human beings? What is the proper relationship between church and state? Who should control education? Can either scripture or nature serve as a reliable ethical guide?

Debates about science and religion are, on the face of it, about the intellectual compatibility or incompatibility of some

particular religious belief with some particular aspect of scientific knowledge. Does belief in life after death conflict with the findings of modern brain science? Is belief in the Bible incompatible with believing that humans and chimpanzees evolved from a common ancestor? Does belief in miracles conflict with the strictly law-governed world revealed by the physical sciences? Or can belief in free will and divine action, conversely, be supported and substantiated by the theories of quantum mechanics? One of the answers to the question that is the title of this chapter – What are science–religion debates really about? – is that they are about these issues of intellectual compatibility.

What I especially want to emphasize in this *Very Short Introduction* to the subject, however, is that these contemporary contests of ideas are the visible tips of much larger and deeper-lying structures. My aim throughout this book will be to look historically at how we came to think as we do about science and religion, to explore philosophically what preconceptions about knowledge are involved, and to reflect on the political and ethical questions that often set the unspoken agenda for these intellectual debates. In the rest of this introductory chapter, I indicate the kinds of questions I think we should be asking about science and religion, both as sources of individuals' beliefs and as social and political entities, before also briefly introducing 'science and religion' as an academic field.

Encountering nature

Scientific knowledge is based on observations of the natural world. But observing the natural world is neither as simple nor as solitary an activity as it might sound. Take the moon, for instance. When you look up at the sky on a clear night, what do you see? You see the moon and the stars. But what do you actually observe? There are a lot of small bright lights and then a larger whitish circular object. If you had never learned any science, what would you think

this white object was? Is it a flat disc, like a kind of giant aspirin? Or is it a sphere? If the latter, then why do we always see the same side of it? And why does its shape change from a thin crescent to a full disc and back again? Is it an object like the earth? If so, how big is it? And how close? And do people live there? Or is it a smaller night-time equivalent of the sun? Finally, perhaps it is like one of the little bright lights but larger or closer? In any case, how and why does it move across the sky like that? Is something else pushing it? Is it attached to an invisible mechanism of some kind? Is it a supernatural being?

Now, if you are well informed about modern science, you will know that the moon is a large spherical rocky satellite which orbits the earth completely about once a month and which rotates once on its own axis in the same time (which explains why we always see the same side of it). The changing relative positions of the sun, earth, and moon also explain why the moon displays 'phases' – with either the entirety or only a small crescent of the illuminated half of the moon visible at a particular time. You may also know that all physical bodies are attracted to each other by a gravitational force in proportion to the product of their masses and in inverse proportion to the square of the distance between them, and that this helps to explain the regular motions of the moon around the earth and of the earth around the sun. You will probably also know that the bright little lights in the night sky are stars, similar to our sun; that the ones visible to the naked eye are thousands of light years away and those observable through telescopes are millions or even billions of light years away; so that to look up at the night sky is to look into the distant past of our universe. But however much of all this you know, you did not find it out by observation. You were told it. You possibly learned it from your parents or a science teacher or a television programme or an online encyclopaedia. Even professional astronomers will not generally have checked the truth of any of the statements made in this paragraph by their own empirical

1. The moon as engraved by the artist Claude Mellan from early 17th-century telescopic observations

observations. The reason for this is not that astronomers are lazy or incompetent, but simply that they can rely on the amassed authoritative observations and theoretical reasonings of the scientific community which, over a period of many centuries, have established these facts as fundamental physical truths.

The point is that while it is certainly true that scientific knowledge is based on and tested against observations of the natural world, there is an awful lot more to it than just pointing your sense organs in the right direction. As an individual, even an individual scientist, only the tiniest fraction of what you know is based directly on your own observations. And even then, those observations only make sense within a complex framework of existing facts and theories which have been accumulated and developed through many centuries. You only know what you do about the moon and the stars because of a long and complex cultural history (a small part of which is told in Chapter 2), which mediates between the light from the night sky and your thoughts about astronomy and cosmology. That history includes the successful challenging of the old earth-centred world view by Galileo Galilei, with the help of Copernicus's astronomy and the newly invented telescope in the early 17th century, as well as the establishment of Newton's laws of motion and gravitation later in that century, and more recent developments in physics and cosmology too. It also includes, crucially, the histories of those social and political mechanisms that allow for, and control, the dissemination of scientific knowledge among the people through books and in classrooms.

We should also notice, by the way, that what science often aims to show is that things in themselves are not as they initially seem to us – that appearances can be deceptive. The earth beneath our feet certainly seems to be solid and stable, and the sun and the other stars appear to move around us. But science eventually showed that, despite all the sensory evidence to the contrary, the earth is not only spinning on its own axis but is also hurtling around the sun at great speed. Indeed, one of the characters in Galileo's *Dialogue Concerning the Two Chief World Systems* (1632) expresses his admiration on just these grounds for those who, like Aristarchus and Copernicus, had been able to believe in the sun-centred system before the advent of the telescope: 'I cannot sufficiently admire the intellectual eminence of those

who received it and held it to be true. They have by sheer force of intellect done such violence to their own senses as to prefer what reason told them over that which sense experience plainly showed them to be the case.' In more recent times, both evolutionary biology and quantum mechanics have similarly required people to believe the most implausible things – that we share an ancestor not only with rabbits but also with carrots, for example, or that the smallest components of matter are simultaneously both waves and particles. People sometimes say that science is just a systematization of empirical observations, or nothing more than the careful application of common sense. However, it also has the ambition and the potential to show that our senses deceive us and that our basic intuitions may lead us astray.

But when you look up at the night sky, you may not be thinking about astronomy and cosmology at all. You may instead be gripped by a sense of the power of nature, the beauty and grandeur of the heavens, the vastness of space and time, and your own smallness and insignificance. This might even be a religious experience for you, reinforcing your feeling of awe at the power of God and the immensity and complexity of his creation, putting you in mind of the words of Psalm 19: 'The heavens declare the glory of God; the skies proclaim the work of his hands.'

Such an emotional and religious response to the night sky would, of course, be every bit as historically and culturally mediated as the experience of perceiving the moon and the stars in terms of modern cosmology. Without some kind of religious education you certainly would not be able to quote from the Bible, and you would perhaps not even be able to formulate a developed concept of God. Individual religious experiences, like modern scientific observations, are made possible by long processes of human collaboration in a shared quest for understanding. In the religious case, what intervenes between the light hitting your retina and your thoughts about the glory of God is the lengthy history of a particular sacred text, and its reading and interpretation within a

succession of human communities. And, as in the scientific case, one of the lessons learned through that communal endeavour is that things are not as they seem. Religious teachers, as much as scientific ones, try to show their pupils that there is an unseen world behind the observed one – and one which might overturn their most settled intuitions and beliefs.

The political dimension

Among historians of science and religion there have been two interestingly different kinds of attack on the 'conflict narrative' favoured by Enlightenment rationalists, Victorian freethinkers, and modern-day scientific atheists. The first strategy is to replace the overarching image of conflict with that of complexity, and to put emphasis on the very different ways that science–religion interactions have developed at different times, in different places, and in different local circumstances. Some scientists have been religious, others atheists. Some religious denominations welcome modern science, others are suspicious of it. Recognizing that neither 'science' nor 'religion' refers to a simple singular entity is an important part of this approach too, as is acknowledging the existence of considerable national differences. To take just the most obvious example, debates about evolution and religion have, from the beginning of the 20th century and right up to the present day, developed quite differently in the United States than they have in Europe and elsewhere. As I will explain in Chapter 5, the debates about the teaching of evolution in schools that go on in America today emerged through circumstances very specific to that country, most importantly the interpretation of the First Amendment to its Constitution, which prohibits the government from passing any law 'respecting an establishment of religion'.

If this first approach to the conflict narrative is to change the plot, the second involves recasting the leading characters. This approach says: yes, there have been conflicts that seem to be between science and religion, and they are real conflicts, but they

are not between science and religion. The question then is: who or what are the real antagonists in this story? In a way, we are then just straight back into the messy details of historical complexity. There is certainly not a simple recasting that works for all cases, but the general idea is that the real conflict is a political one about the production and dissemination of knowledge. The opposition of science versus religion is then seen to be standing proxy for some classic modern political conflicts: the individual versus the state, or secular liberalism versus conservative traditionalism. It is interesting to note that in modern America, for example, campaigners both for and against the teaching of evolution in schools have portrayed themselves as representing the rights and freedoms of the people against an intolerant and authoritarian establishment which is controlling the educational agenda. In the 1920s that establishment was portrayed by defenders of evolution as Christian and conservative, but to some religious groups today it seems that a secular liberal elite have taken control of the education system. Debates about science and religion give certain groups an opportunity to argue their case for greater social influence, and greater control over the mechanisms of state education, a case that rests on quite independent political grounds.

These questions about the politics of knowledge will arise repeatedly in subsequent chapters. For the moment, let us consider just one other example – the philosopher and firebrand Thomas Paine. An unsuccessful corset-maker, sacked tax-collector, and occasional political writer, Paine left his native England to start a new life in America in 1774. On his arrival in Philadelphia, he found work as the editor of the *Pennsylvania Magazine*. A couple of years later, his polemical pamphlet *Common Sense* (1776) was a key factor in persuading the American colonists to go to war against the British government, and established Paine as the bestselling author of the age. An associate of Benjamin Rush, Thomas Jefferson, and others of the founding fathers of the United States of America, Paine's

democratic and anti-monarchical political philosophy shaped the Declaration of Independence. After politics, Paine's other great passions were science and engineering. He had attended popular lectures on Newton and astronomy back in England, and he spent many years of his life working on a design for a single-span iron bridge, inspired by the delicacy and strength of one of the great works of nature – the spider's web. His whole philosophy was a scientific one. He saw revolutions in governments paralleling the revolutions of celestial bodies in the heavens. Each was an inevitable, natural, and law-governed process. Later in his life, having had a hand in both the American and French revolutions, he turned his sights from monarchy to Christianity. The institutions of Christianity were as offensive to his enlightened and Newtonian sensibilities as were those of monarchical government. In his *Age of Reason* (1794), Paine complained of 'the continual persecution carried on by the Church, for several hundred years, against the sciences and against the professors of science'.

Paine's version of the conflict narrative makes most sense when seen in its political context. Paine was, indeed, a scientific thinker who was opposed to Christianity. He denounced the Bible, especially the Old Testament, with its stories of 'voluptuous debaucheries' among the Israelites and the 'unrelenting vindictiveness' of their God. To the shock of his friends, Paine wrote of the Bible: 'I sincerely detest it, as I detest everything that is cruel.' Paine also lambasted the 'priestcraft' at work in the 'adulterous' relationship between the Church of England and the British state. What he hoped for, though, was not an end to religion but the replacement of Christian religion by a rational religion based on the study of nature – one which recognized the existence of God, the importance of morality, and the hope for a future life, but did away with scriptures, priests, and the authority of the state. His reasons for this were democratic ones. National churches lorded illegitimate power over the people by claiming special access to divine truths and revelations. But everyone can

read the book of nature and understand the goodness, power, and generosity of its author. In the religion of Deism recommended by Paine, there was no need for the people to be in thrall either to priests or to the state. Science could help to replace Christianity by showing that every individual could find God by looking at the night sky rather than by reading the Bible or going to church. 'That which is now called natural philosophy', Paine wrote, 'embracing the whole circle of science of which astronomy occupies the chief place, is the study of the works of God, and of the power and wisdom of God and his works, and is the true theology.'

Paine's democratic ideals, including the separation of church and state, are enshrined in the founding documents of the United States. And in modern America too, it is competing political visions that come into conflict in debates about science and religion. American politicians who deny the truth of the theory of evolution and advocate the teaching of a religiously motivated concept of 'Intelligent Design' in schools do not do so for scientific reasons. They do so, rather, to send a signal – to indicate their general support for Christianity, their opposition to excessively secularist interpretations of the Constitution, and their hostility to naturalistic and materialistic world views.

A final interesting piece of support for the suggestion that what is really at stake in science–religion encounters is politics, is to be found in two mid-20th-century stage plays. Each dramatizes a famous clash between a heroic scientific individual and a reactionary and authoritarian religious establishment, and does so to make primarily political points. Bertolt Brecht's *Life of Galileo* was composed during the 1930s and early 1940s. Brecht was a German communist, opposed to fascism, and living in exile in Denmark and subsequently the United States. The play uses the story of Galileo to investigate the dilemmas faced by a dissident intellectual living under a repressive regime, and also to suggest

the importance of pursuing scientific knowledge for moral and social ends rather than purely for its own sake. Brecht saw in the well-known Galileo affair political lessons which could be applied to a world struggling against authoritarian fascism and, in the later version of the play, living in the shadow of the dropping of atomic bombs on Hiroshima and Nagasaki.

Jerome Lawrence and Robert E. Lee's play *Inherit the Wind*, first performed in 1955, and made into a famous film in 1960, was a dramatization of the Scopes 'monkey trial' of 1925. The historical events on which the play was based are discussed in Chapter 5; they centre on the prosecution of a Tennessee school teacher, John Scopes, for teaching evolution in contravention of state law. *Inherit the Wind* used the Scopes case to attack the anti-communist purges of the McCarthy era. Scopes, the heroic evolutionist standing up against a repressive Christian establishment in 1920s Tennessee, stood for the struggle for freedom of opinion, association, and expression by communist sympathizers in the face of a repressive American government machine. Among those sympathizers, incidentally, was Bertolt Brecht, who had been called to testify before the House Committee on Un-American Activities in 1947. In the case both of Brecht's *Galileo* and Lawrence and Lee's *Inherit the Wind*, it was questions of intellectual freedom, political power, and human morality that gave the conflict between science and religion its drama and its interest. The same is true in real life.

'Science and religion' as an academic field

So far we have looked at science and religion in general terms as two cultural enterprises which encounter each other both in the mind of the individual and in the political domain. There is an important further dimension to add to this preliminary picture, which is the recent development of 'science and religion' as an academic field in its own right.

Of course theologians, philosophers, and scientists have been writing treatises about the relationship between natural knowledge and revelation for centuries. Many of these works were very popular, especially in the 18th and 19th centuries. The most famous was *Natural Theology* (1802) by the Anglican clergyman William Paley, which argued from the complex adaptations of plants and animals to the existence of an intelligent designer. However, from the 1960s onwards 'science and religion' took on a more distinct existence as an academic discipline. In 1966 the first specialist journal in the field was founded in Chicago – *Zygon: Journal of Religion and Science*. The same year saw the publication of a very widely used textbook, *Issues in Science and Religion* by the British physicist and theologian Ian Barbour. Since that time, various organizations have been set up to foster this kind of work, including a European Society for the Study of Science and Theology, and an International Society for Science and Religion. There are established academic posts devoted specifically to the study of science and religion at several major institutions, including the universities of Oxford and Cambridge in the UK, and Princeton Theological Seminary in the US.

Academic work by scientists and theologians seeking to develop a harmonious interdisciplinary dialogue has been supported by a range of institutions, including the Roman Catholic Church, through the work of the Vatican Observatory, and also the John Templeton Foundation in America – a philanthropic organization particularly committed to supporting research that harmonizes science with religion. A recent large Templeton-funded project has been devoted to research on altruism and 'unlimited love', for example. One outcome of this has been a book explaining the improved physical health and mental well-being enjoyed by those who live an altruistic and compassionate life.

The John Templeton Foundation spends millions of dollars on research grants each year, including an annual Templeton Prize, currently valued at about $1.5 million, given to an individual

for 'Progress Toward Research or Discoveries about Spiritual Realities'. Former winners have included Christian evangelists, leading figures from non-Christian faiths, and also many individuals who have been prominent in the academic dialogue between science and religion, such as Ian Barbour, Arthur Peacocke, John Polkinghorne, Paul Davies, and George Ellis. Like many of those who have contributed to the creation of 'science and religion' as an academic subject, all of the figures just named fall into the category of religiously committed professional scientists (and in some cases ordained ministers). There are also many historians, philosophers, and theologians who have contributed significantly to the field. It is a topic that even attracts impassioned contributions from scientific atheists, such as Oxford University's Professor for the Public Understanding of Science, Richard Dawkins.

I have already mentioned that much academic work in this area has been concerned with the plausibility (or lack of it) of the idea of an inevitable conflict between science and religion. This concern is partly driven by apologetic motives. Many of those involved in the field are religious believers committed to showing that science need not undermine faith. But the denial of conflict (or of any other one-dimensional relationship) is also motivated by more purely academic considerations, several of which will emerge in subsequent chapters.

Whether arguing for conflict or for harmony, it could be objected that any talk about 'the relationship between science and religion' obscures the true plurality and complexity of the terms. 'Science' and 'religion' are both hazy categories with blurry boundaries, and different sciences and different religions have clearly related to each other in different ways. Mathematics and astronomy were both particularly nurtured in Islamic cultures in the Middle Ages, for example, where they were used to calculate the correct times of prayer and the direction of Mecca, as well as for many more secular purposes. Islamic scholars working in academies such as

the House of Wisdom in Baghdad preserved, tested, and improved upon ancient Greek medicine and optics, as well as astronomy and astrology, between the 9th and the 15th centuries. The motto of these scholars was: 'Whoever does not know astronomy and anatomy is deficient in the knowledge of God.' Their works were to be crucial sources for the revival of European learning from the later Middle Ages onwards.

Excluded from more mainstream European academic institutions, Jewish communities formed a particularly strong connection with the science and practice of medicine in early modern Europe. The Roman Catholic Church, despite the high-profile difficulties caused by Galileo's ideas, was one of the most generous sponsors of scientific research during the Renaissance, especially through the investment of the Jesuit order in astronomical observatories and experimental equipment. The relationship between modern scientific knowledge – a characteristically Western system of thought – and the religious traditions of the East, is different again. Here we might think of the interest shown by Buddhists in neuroscientific studies of the state of the brain during meditation, or of Fritjof Capra's 1975 bestseller, *The Tao of Physics: An Exploration of the Parallels between Modern Physics and Eastern Mysticism*. There is, finally, a very particular story to be told about the relationship between evolutionary biology and modern Protestant Christianity – one which we will return to below. The point is that none of these particular relationships can serve as a universal template for understanding engagements between science and religion.

Some think that the extent of oversimplification, generalization, and reification involved in even using the phrase 'science and religion' makes it a non-starter as a sensible topic for academic study. I have some sympathy with this view. It is certainly true that in this book, as in most contributions to the field, the 'religion' under discussion is most often specifically Christianity. However, at least within the Abrahamic, monotheistic traditions of Judaism,

Christianity, and Islam, there is enough common ground, historically, philosophically, and theologically, for a more general discussion to take place. Whether it is possible or desirable to extend that discussion still further to include non-theistic or non-scriptural traditions is another question, and one which I will not explore further here. The monotheistic faiths, however, are all united by the idea that God is the author of two books – the book of nature and the book of scripture – and that the individual believer will find their understanding and their faith strengthened through the careful reading of both books. The intellectual, political, and ethical implications of that shared commitment to reading God's words and his works have developed in comparable, although far from identical, ways in the three major monotheistic traditions.

The fact that the phrase 'science and religion' names an academic field, as well as conjuring up vivid if historically debatable cultural stereotypes, is enough, I think, to justify its continued use as a category of thought (and in the title of this and many other books). Academics and journalists alike continue to write as if there were some ongoing general relationship between science and religion, in terms of which particular contemporary episodes might be understood. Even if that relationship really exists only in our imaginations, it is still important to try to understand how it got there. Since Galileo Galilei and his encounter with the Roman Inquisition takes centre stage in many popular accounts of that relationship, his story is an appropriate place to start our inquiry.

Chapter 2
Galileo and the philosophy of science

When Galileo recanted his Copernicanism in 1633, what did that signify? Was it a victory for religious obscurantism and a defeat for free scientific inquiry? Was it evidence that science and religion are inevitably locked in ideological and institutional combat? Unsurprisingly, there was more to it than that. On all sides of the Galileo case there was agreement that it was proper and rational both to seek accurate knowledge of the world through observation of nature and also to base one's beliefs on the Bible. The conflict was not between empirical science and authoritarian religion but rather between differing views within the Catholic Church about how to interpret nature and scripture, especially when they seemed to disagree. An appreciation of the exact context of Galileo's trial, the shadow cast over it by the Protestant Reformation of the previous century, and the politics of the Papal court at the time all help to explain how these issues took on the dramatic character that they did in 1633, almost a century after Nicolaus Copernicus had argued for a sun-centred astronomy in his book *On the Revolutions of the Heavenly Spheres* in 1543.

Before coming back to this retelling of the Galileo story as a disagreement among 17th-century Catholics about how to read the Bible, it will be useful to look at some general questions about the sources of knowledge. These will help to make sense both of what was at stake in Rome in June 1633 and also of general

questions about the philosophy of science that frequently recur in contemporary debates about science and religion.

How do we know anything?

We generally derive our knowledge of the world from four sources: our senses, our powers of rational thought, the testimony of others, and our memory. The first obvious thing to note about all these sources is that they are fallible. Our senses can deceive us, our reasoning can be faulty, other people can knowingly or accidentally mislead us, and most of us know only too well (and increasingly with age) how partial and distorted our memories can be. The whole project of modern science could be summarized as the attempt to weave these individually relatively feeble threads into a more resilient web of knowledge. So the sense experience of one person must be witnessed, corroborated, and repeated by many others before it is accepted. Simple observations of the properties of things must be supplemented by carefully designed experiments which test more precisely how they behave in different circumstances. Human powers of perception on their own may be limited, but the invention of the telescope and the microscope in the early 17th century, and of many other even more sophisticated devices since then, has enormously increased the scope and accuracy of the observations and measurements that can be made. But experiments could not be designed, and observations would not make any sense, without the use of reason. Theoretical hypotheses about the nature of reality, and reasoning about what experimental evidence is needed to support or refute them, are prerequisites of scientific knowledge. Finally, scientific experts must cite the sources of their knowledge and explain the chain of their reasoning if their testimony is to be accepted. And the publication of scientific results in treatises, books, specialist journals, and, now, electronic databases provides us with a collective and well-documented memory greater than anything that would be possible by relying on one person's memory alone.

The knowledge thus produced is a highly prized possession in human societies. It bestows on us the ability to manipulate not only the natural world but also each other. One of the most important advocates of science in 17th-century England, Francis Bacon, wrote that 'human knowledge and human power meet in one; for where the cause is not known the effect cannot be produced'. In other words, an understanding of the secret workings of nature would allow people to produce machines and medicines to improve the human condition. Bacon also wrote, to justify the new knowledge of the period, that 'all knowledge appeareth to be a plant of God's own planting', whose spread and flourishing at that time had been divinely ordained.

Natural philosophers in 17th-century England such as Robert Boyle and Robert Hooke – the new 'virtuosi' of the experimental method, the founders of the Royal Society – were perceived by some as a threat to orthodoxy. Their claims to be able both to discover and to manipulate hidden forces in nature seemed to verge on usurping the role of God. That was why it was important to reassure their readers that in reaping this knowledge they were collecting a harvest which was, in Bacon's words, 'of God's own planting'. In this image, God planted the seed of knowledge and natural philosophers harvested its fruit. According to another popular metaphor, God was imagined not as a kind of cosmic farmer but, as we have noted, as an author of two books – the book of nature and the book of scripture. This metaphor was based on the same idea – that the ultimate source of knowledge was God and that humans had to adopt certain techniques to acquire that knowledge.

One of the useful things about these metaphors of agriculture and of reading is that they draw attention to the fact that human knowledge (at least of the natural kind) is made rather than simply found. Seeds do not become plants and bear fruit unless they are sown in the right conditions, are watered and fed, and are harvested in the right way. Texts do not generally have

obvious meanings, but rather these must be teased out through the collective efforts of many readers using different historical and literary techniques. Even if one decides to approach a text in search of its 'literal' meaning, that is by no means a simple matter. It is also well known among literary scholars that the project of discerning an author's intentions in a text is a difficult and controversial one. The histories of science and religion reveal that these difficulties have been experienced in full measure in relation to both of God's books. Neither nature nor scripture offers a transparent account of its author's intentions. Some have gone further, of course, and denied that either is a work of divine authorship at all. Some read the book of nature as an autobiography and the scriptures as purely human works.

This brings us to the question of whether, in addition to the four sources of knowledge already mentioned – sense, reason, testimony, and memory – a fifth needs to be added, namely revelation. It is a belief shared by Jews, Christians, and Muslims that God's authorship can be detected both in nature and in scripture (the Torah, the Bible, or the Quran, respectively). While the natural world reveals the power, intelligence, and goodness of its Creator, the scriptures reveal God's plans for his chosen people and the legal and moral basis according to which they should live. Corresponding to this idea is the subtly different distinction between natural and revealed forms of knowledge. Natural knowledge is produced by the exercise of the natural human faculties of sense and reason (these faculties can be engaged in reasoning about scripture as well as about the natural world). Revealed knowledge is produced by a supernatural uncovering of the truth – either through the medium of scripture or by a direct revelation of God to the individual believer. Natural theology, then, as opposed to revealed theology, is a form of discourse about God based on human reason rather than on revelation. This includes theological works making inferences about God from the design apparent in the natural world – as in William Paley's famous *Natural Theology* (1802) – but it also includes more

purely philosophical works about God's existence and attributes. Modern books arguing for belief in 'Intelligent Design' on the basis of the 'irreducible complexity' of nature are within this same tradition, as we will see in Chapter 5.

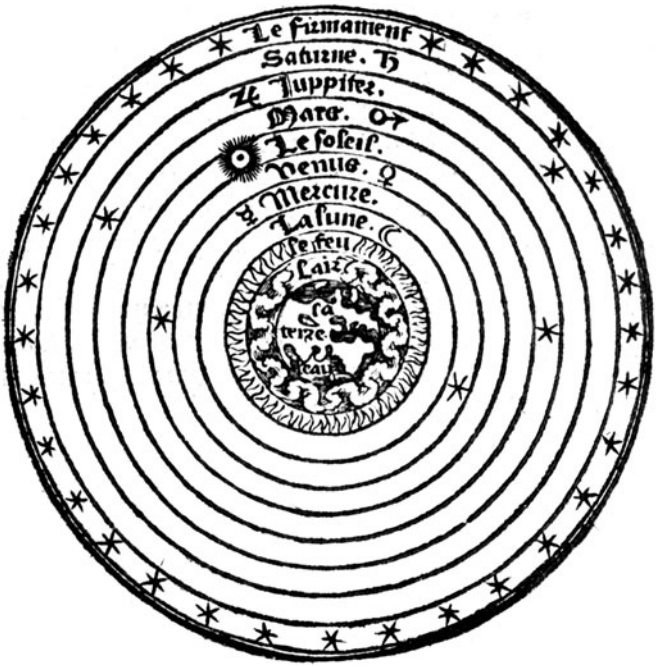
Debates about science and religion virtually always involve disagreements about the relative authority of different sources of knowledge. This is true of debates about the relative weight to be given to testimony and to experience when considering claims about miracles, as we will see in Chapter 3. It is also true of the 18th-century clash between Deism and Christianity. Thomas Paine's objection to Christian philosophers was not that they found God in nature – he did too – but that they thought they could also find God through his self-revelation in the Bible. For Paine, the only possible kind of revelation was from God directly to an individual. If God ever did act in this way, it was revelation 'to the first person only, and hearsay to every other'. The scriptures were therefore no more than mere human testimony and the rational reader was not obliged to believe them. Advocates of creationism in the 20th century took the opposite approach to Paine's. For them, the word of God as revealed in the Bible was the most reliable form of knowledge and anything that seemed to contradict their interpretation of scripture had to be rejected. This included mainstream scientific theories of evolution. Some creationists were even moved to re-read the book of nature and produce their own 'Creation Science' which harmonized geology with Genesis. While rationalists have rejected revelation altogether, and fundamentalists have insisted that all forms of knowledge be tested against the Bible, many more have looked for ways to reconcile their readings of God's two books without doing violence to either.

The rise and fall of Galileo

Galileo belonged to this last category of believers seeking harmony between the Bible and knowledge of nature. He endorsed the view

that the Bible is about how to go to heaven and not about how the heavens go. In other words, if you wanted to know about matters pertaining to salvation you should consult scripture, but if you were interested in the detailed workings of the natural world, then there were better starting points – namely empirical observations and reasoned demonstrations. This was not a particularly unorthodox view in itself, but Galileo failed to persuade the authorities that it was a principle that could be applied to his case. Although the church was certainly not opposed in general to the study of mathematics, astronomy, and the other sciences, there were limits to how far the authority of the Bible and of the church could be challenged by an individual layman like Galileo. He went beyond those limits. There were three central characters in the story of how he did so – the telescope, the Bible, and Pope Urban VIII.

At the beginning of the 17th century, Galileo was one of only a tiny handful of natural philosophers who thought it likely that the Copernican astronomy was an accurate description of the universe. The majority of those who took an interest in such questions, including the mathematicians and astronomers working within the Roman Catholic Church, held to the system of physics and cosmology associated with the ancient Greek philosopher Aristotle. There were two elements in this existing Aristotelian science which would be challenged by Galileo. First, there was the earth-centred model of the cosmos produced by the 2nd-century Greek astronomer Ptolemy. This was the standard astronomical model and, despite certain complexities and technical problems, it worked as well as the Copernican model as a device for calculating the positions of the stars and planets, and had the considerable advantage of according with the common-sense intuition that the earth was not in motion. The second Aristotelian principle that would come under attack was the division of the cosmos into two regions – the sublunary and the superlunary. The sublunary region consisted of everything within the orbit of the moon. This was the region of corruption



2. A 16th-century illustration of Ptolemy's earth-centred astronomical system. At the centre is the world, composed of the four elements of earth, water, air, and fire, surrounded by the spheres of the moon, Mercury, Venus, the sun, Mars, Jupiter, Saturn, and finally the sphere of the fixed stars. This Ptolemaic system had been endorsed by Aristotle and was still accepted by almost all natural philosophers at the start of the 17th century.

and imperfection and of the four elements of earth, water, air, and fire. In the superlunary region, the domain of all the celestial bodies, everything was composed of a fifth element, ether, and was characterized by perfect circular motion.

Galileo's great contribution to astronomy was to use a newly invented optical instrument – named the 'telescope' in 1611 – to provide observations with which to challenge this Aristotelian and

Ptolemaic theory. Galileo did not invent the telescope himself, but as soon as he heard of its invention he set about making his own superior version. The earliest telescopes, made in the Netherlands, magnified only by a factor of three. Galileo developed an instrument with magnifying power of about twenty times, which he turned towards the heavens with spectacular results. These results were published in two books, *The Starry Messenger* in 1610 and his *Letters on Sunspots* in 1613, which established his reputation as a brilliant observational astronomer and as one of the leading natural philosophers in Europe. These works also made it clear that Galileo favoured the Copernican astronomy.

Just a couple of examples will give a sense of how Galileo wielded his telescope against Aristotelian science. Perhaps the most telling single discovery made by Galileo was that Venus, when viewed through the telescope, could be seen to display phases. In other words, like the moon, its apparent shape varied between a small crescent and a full disc. This strongly suggested that Venus orbited the sun. If the Ptolemaic system had been true and Venus, which was known always to be close to the sun in the sky, described an orbit closer to the earth than the sun's, then it should have appeared always as a thin crescent. Secondly, Galileo was able to deploy a number of key observations against the strong commitment of the Aristotelians to the division of the cosmos into distinct sublunary and superlunary regions. His telescope revealed that the moon was a rocky satellite with craters and mountains – more like the earth than like an ethereal and perfect heavenly body. He also showed that Jupiter had four satellites or moons. This helped defeat a common objection to the Copernican theory. On the Ptolemaic theory, the earth's moon was treated as the closest of several planets, all of whose orbits centred on the earth. If Copernicus were right, then the moon would have to orbit the earth, while the earth in turn went around the sun. Was it possible that a celestial body could move in an orbit with a centre other than the centre of the cosmos? The discovery that Jupiter was accompanied in its orbit (whether that was around

the earth or around the sun) by four satellites established that such motion was indeed possible. Finally, Galileo's discovery of sunspots further undermined the Aristotelian distinction between perfect heavenly bodies and a changeable and imperfect earth.

It was largely thanks to Galileo's publications that Copernicanism became such a live issue in the 1610s. Galileo was aware that his advocacy of the new astronomy was arousing both theological and scientific objections. One of the reasons for the former was the apparent inconsistency between Copernican astronomy and the Bible. Several Old Testament passages referred to the movement of the sun through the heavens and the immobility of the earth. An often-quoted passage was from the Book of Joshua, which referred to God stopping the sun and the moon in the sky to light the earth while the Israelites took vengeance on the Amorites. Seeking to forestall biblical objections to the view that the earth moves, Galileo wrote his *Letter to the Grand Duchess Christina* in 1615 in which he articulated his views about how to deal with apparent conflicts between natural and revealed knowledge. He relied heavily on the views of the Fathers of the Catholic Church, especially St Augustine. The central idea was the principle of accommodation. This stated that the Bible was written in language accommodated to the limited knowledge of the relatively uneducated people to whom it was initially revealed. Since the readers of the Book of Joshua believed that the earth was stationary and the sun moved around it, God's word was couched in terms that they would understand. All agreed that biblical references to God's 'right hand' or to God's experience of human passions such as anger should not be taken literally but were accommodations to common understanding. Galileo argued that the same attitude should be taken to biblical passages referring to the movement of the sun. The other general principle Galileo adopted, mentioned above, was that the Bible should only be given priority in matters relating to salvation. In matters of natural knowledge, if the text seemed to contradict the best available science, then it would need to be reinterpreted.

All of this was indeed in tune with St Augustine's 4th-century approach to scripture. However, Galileo was writing at a time when more conservative views were in the ascendancy thanks to the crisis of the Protestant Reformation, which had started in the early decades of the 16th century in Germany and England, and continued to divide Europe both politically and religiously in the 17th century. One of the central tenets of Protestant forms of Christianity was the importance of scripture and the right of each individual to read the Bible in their own language, rather than encountering Christian teaching only through the mediation of priests and the doctrinal pronouncements of Church Councils. The Catholic Church's principal response to the Reformation came in the form of a series of meetings which comprised the Council of Trent (1545–63). One of the declarations of that Council was that, in matters of faith and morals,

> no one, relying on his own judgement and distorting the Sacred Scriptures according to his own conceptions, shall dare to interpret them contrary to that sense which Holy Mother Church, to whom it belongs to judge their true sense and meaning, has held and does hold, or even contrary to the unanimous agreement of the Fathers.

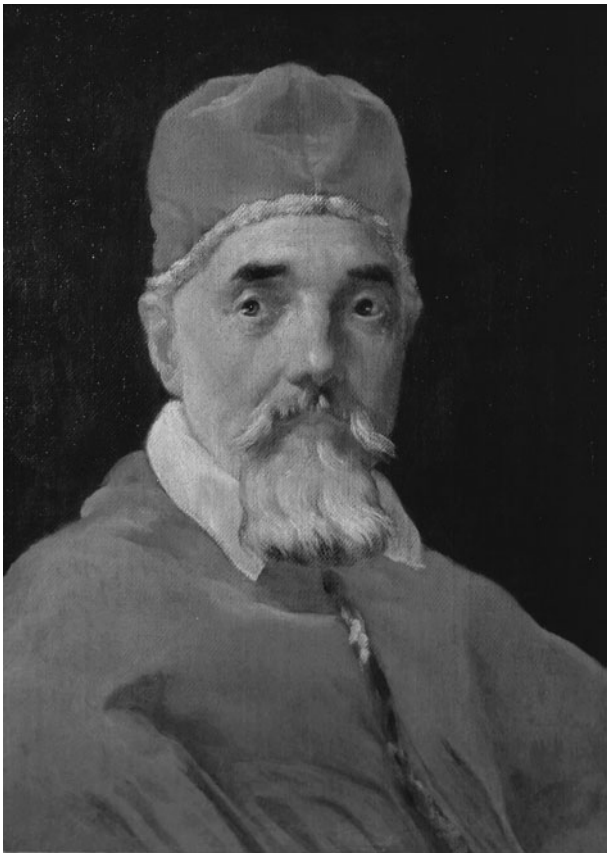
In the context of these Counter-Reformation teachings, Galileo's suggestion in his *Letter to the Grand Duchess Christina* that he, an individual layman, had the authority to tell the 'Holy Mother Church' which parts of scripture needed to be reinterpreted, and how, smacked both of arrogance and of dangerous Protestant leanings. The fact that in 1632 he would publish his *Dialogue* in vernacular Italian rather than scholarly Latin would add further to that impression.

When a committee was asked to report on the question of Copernicanism to the Inquisition in 1616, it declared it to be both false and absurd as scientific doctrine, and additionally to be contrary to the teachings of scripture and thus formally heretical. Galileo was personally summoned into the presence of Cardinal

Robert Bellarmine, who instructed him that he must not hold or defend the Copernican astronomy. At the same time, Copernicus's *On the Revolutions of the Heavenly Spheres*, which had been largely ignored since its appearance in print, was now suspended from publication, pending 'correction'. By drawing new attention to Copernicanism and to the Church's attitude to scripture, Galileo had succeeded in having the former declared heretical and in seeing the latter hardened and entrenched in a more conservative position.

The election in 1623 of Cardinal Maffeo Barberini as Pope Urban VIII must have seemed to Galileo like the answer to his prayers. Barberini was an educated and cultured Florentine. Even better, since 1611 he had been an admirer and active supporter of Galileo's work, even composing a poem, *Adulatio Perniciosa* ('In Dangerous Adulation') in 1620, expressing his admiration for Galileo's telescopic discoveries. In 1624, Galileo had several meetings with Urban VIII, during which he was assured that he could discuss the Copernican theory in his work but only as one hypothesis among others. Urban argued that God, in his omnipotence, could make the heavens move in any way he wished, and so it would be presumptuous to claim to have discovered the precise manner in which this end was achieved by the divine will. Galileo nevertheless left Rome reassured and was soon at work on the book that would be published in 1632 as his *Dialogue Concerning the Two Chief World Systems*.

This was when the real trouble started. Although the *Dialogue* was presented as an even-handed discussion among three characters – an Aristotelian, a Copernican, and a common-sensical everyman – it was perfectly clear to most readers that the arguments given in favour of the Copernican system were very much stronger than those made in defence of the old earth-centred astronomy, and that Galileo had in effect produced a pro-Copernican piece of propaganda, thus breaching the conditions of the 1616 injunction and the instructions given by



3. Maffeo Barberini, Pope Urban VIII, painted by Gian Lorenzo Bernini in 1632, the year that Galileo's *Dialogue* was published, in which the Pope's views were put in the mouth of the Aristotelian philosopher Simplicio

Urban in 1624. That was not all. The Aristotelian character was named 'Simplicio'. This was the name of a 6th-century Aristotelian philosopher but also one that hinted at simple-mindedness. Even more provocatively, one of the arguments put forward by simple Simplicio was the one that had been put to Galileo by Urban himself in 1624 – namely that God could have produced natural effects in any way he chose, and so it was wrong to claim necessary truth for any given physical hypothesis about their causation. This apparent mockery of the Pope added personal insult to the already grave injury delivered by Galileo's disobedience. And the timing could not have been worse. The *Dialogue* arrived in Rome in 1632 at a moment of great political crisis. Urban was in the midst of switching his allegiance from the French to the Spanish during the Thirty Years War and was in no mood for leniency. He needed to show his new conservative allies that he was a decisive and authoritative defender of the faith. So Galileo was summoned to Rome to be tried before the Inquisition.

As with the Scopes trial in America three centuries later, the trial of Galileo in 1633 was one in which the outcome was never in doubt. Galileo was found guilty of promoting the heretical Copernican view in contravention of the express injunction not to do so that he had received in 1616. It was for disobeying the Church, rather than for seeking to understand the natural world through observation and reasoning, that Galileo was condemned. Galileo's political misjudgement of his relationship with Pope Urban VIII played as much of a role in his downfall as did his over-reaching of himself in the field of biblical interpretation. Galileo's work was to be one key contribution to the eventual success of the Copernican theory, which, when modified by further scientific insights such as Kepler's replacement of circular by elliptical orbits, and Newton's discovery of the law of gravitation, was virtually universally accepted. However, in 1632 there was sufficient doubt about the relative merits of the Copernican system and the alternatives (including Tycho Brahe's compromise according to which the sun orbited the earth but all the other

planets orbited the sun) that an objective observer would have pronounced the scientific question an open one, making it even harder to decide how to judge between the teachings that the Church declared to be contained in the book of scripture and those which Galileo had read through his telescope in the book of nature.

Appearance and reality

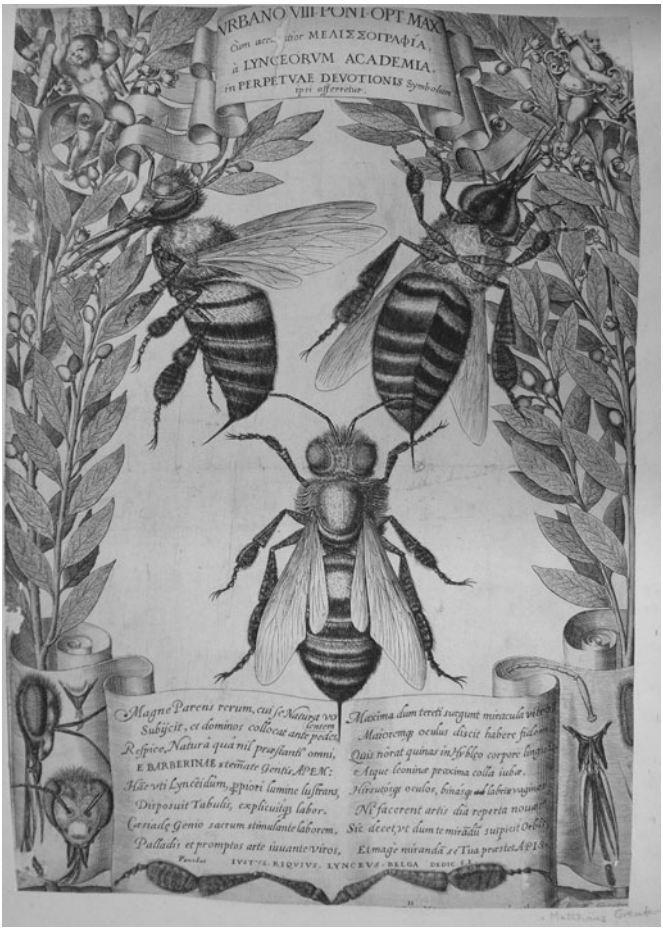
Historians have shown that the Galileo affair, remembered by some as a clash between science and religion, was primarily a dispute about the enduring political question of who was authorized to produce and disseminate knowledge. In the world of Counter-Reformation Rome, in the midst of the Thirty Years War, which continued to pit the Protestant and Catholic powers of Europe against each other, Galileo's claim to be able to settle questions about competing sources of knowledge through his own individual reading and reasoning seemed the height of presumption and a direct threat to the authority of the Church.

The case can also be used to illustrate one further philosophical question that has been central to modern debates about science and religion, namely the issue of realism. Arguments about realism particularly arise in connection with what scientific theories have to say about unobservable entities such as magnetic fields, black holes, electrons, quarks, superstrings, and the like. To be a realist is to suppose that science is in the business of providing accurate descriptions of such entities. To be an anti-realist is to remain agnostic about the accuracy of such descriptions and to hold that science is in the business only of providing accurate predictions of observable phenomena. Urban VIII was not alone among theologians and philosophers in the 16th and 17th centuries in taking an anti-realist or 'instrumentalist' approach to astronomy. On that view, the Ptolemaic and Copernican systems could be used to calculate and predict the apparent motions of the stars and planets, but there

was no way to know which system, if either, represented the way that God had in fact chosen to structure the heavens. Indeed, when Copernicus's *On the Revolutions of the Heavenly Spheres* was first published, it had attached to it a preface written by the Lutheran Andreas Osiander stating that the theory was intended purely as a calculating device rather than as a physical description.

Galileo, on the other hand, took a realist attitude – indeed, it was his insistence on arguing the case for the physical reality of the sun-centred system which resulted in his trial before the Inquisition. Galileo was a member of one of the earliest scientific societies, the Academy of Lynxes, founded in 1603 by Prince Cesi. The lynx was thought to be able to see in the dark and so to perceive things invisible to others. Using new scientific instruments such as the telescope and the microscope in conjunction with the power of reason and the language of mathematics, Galileo and his fellow 'lynxes' aimed not just to find useful models for predicting observable phenomena but explanations of those phenomena in terms of the invisible structures and forces of the universe. They seemed to be succeeding. In addition to Galileo's telescopic and astronomical discoveries, the microscope was opening up a different kind of previously unseen world. Using an instrument sent to him by Galileo, Prince Cesi made the first known microscopic observations in the 1620s. Cesi's observations of bees were recorded in engravings by Francesco Stelluti and used as a device to seek approval for the Academy of Lynxes from Urban VIII, whose family coat of arms featured three large bees.

Debates between realists and anti-realists continue to form a lively and fascinating part of the philosophy of science. Each side rests on a very plausible intuition. The realist intuition is that our sense impressions are caused by an external world that exists and has properties independently of human observers, so that it is reasonable to try to discover what those properties are, whether the entities in question are directly observable by us or



4. Francesco Stelluti's *Melissographia* (1625), produced using a microscope provided by Galileo, and dedicated to Pope Urban VIII

not. The anti-realist intuition is that all we ever discover, either individually or collectively, is how the world appears to us. We live in an endless series of mental impressions, which we can never compare with the nature of things in themselves. We cannot, even for an instant, draw back the veil of phenomena to check whether our descriptions of reality are right. We can have no knowledge of the world beyond the impression it makes on us, and so, the anti-realist concludes, we should remain agnostic about the hidden forces and structures which scientists hypothesize about in their attempts to explain those impressions.

Modern debates about scientific realism have centred on the question of the success of science. Realists argue that the success of scientific theories – quantum physics, for instance – that posit unobservable entities in explaining physical phenomena, in intervening in nature to produce new effects, and in providing ever more detailed and accurate predictions, would be a miracle unless those entities, such as electrons, actually existed and had the properties scientists ascribed to them. Anti-realists have a couple of good responses to this. First, they can point out that the history of science is a graveyard of now-abandoned theories which were once the most successful available but which posited entities we now do not believe existed. This would apply to the 18th-century theory of combustion, according to which a substance known as 'phlogiston' was given off when things burned. Another example is the 'ether' of 19th-century physics – a physical medium that was supposed to be necessary for the propagation of electromagnetic waves. Since theories we now take to be untrue have made successful predictions in the past (including also Ptolemaic astronomy, which was hugely successful for many centuries), there is no reason to suppose that today's successful theories are true. Both true and untrue theories can produce accurate empirical predictions.

A second anti-realist argument was put forward by two influential philosophers of science in the 20th century – Thomas Kuhn

and Bas van Fraassen. Kuhn's book, *The Structure of Scientific Revolutions*, first published in 1962, has become a classic in the field and one of the most widely read books about scientific knowledge. The book focused on what Kuhn called 'paradigm shifts' in the history of science, when one dominant world view was replaced by another, as in the case of Copernican astronomy replacing the Ptolemaic theory, or Einsteinian physics replacing pure Newtonianism. Kuhn portrayed scientific progress as a Darwinian process of variation and selection. He did not think that the improved accuracy and predictive power of later theories showed that they had progressed further towards true descriptions of reality, but rather that they had been chosen by the scientific community from among the various proposed theories because of their improved instrumental power and puzzle-solving ability. Bas van Fraassen, in his 1980 book *The Scientific Image*, also made use of this 'Darwinian' explanation of the success of science. Since scientists will discard theories that make false predictions (as nature discards non-adaptive variations) and keep hold of those that make successful predictions, he argued, the fact that as time goes on their predictions get better is no surprise at all, let alone a miracle. They were selected for precisely that instrumental success, and there is no need for a further appeal to unobservable realities to explain that success.

Science and religion have a shared concern with the relationship between the observable and the unobservable. The Nicene Creed includes the statement that God made 'all that is, seen and unseen'. St Paul wrote in his letter to the Romans that 'since the creation of the world God's invisible qualities – his eternal power and divine nature – have been clearly seen, being understood from what has been made'. However, there are anti-realists among theologians too. The intuition here is similar to that of the scientific anti-realist. We have no way (at least not yet) to check our ideas about God against divine reality, and so propositions about God derived from scripture, tradition, or reason should not be treated as literally true but only as attempts to make sense

of human experiences and ideas. At one extreme, theological anti-realism can seem akin to atheism. There is also a more orthodox tradition of mystical and 'negative' theology which emphasizes the gulf between the transcendence of God and the limited cognitive powers of mere humans, and draws the conclusion that it would be presumptuous to suppose any human formulation could grasp divine reality. One problem with this is that if human reason is too weak to make any true statements at all about the attributes of God, then it would seem that the statement that God exists does not amount to much. For that reason, many have continued to try to look beyond the seen to the unseen, hoping to succeed in the apparently impossible task of drawing back the veil of phenomena to discover how things really are.

Among those who believe they have succeeded in seeing behind the veil, there are conflicting accounts of what is to be found there – an impersonal cosmic machine, a chaos of matter in motion, a system governed by strict natural laws, or an omnipotent God acting in and through his creation. Which should we believe?

Chapter 3
Does God act in nature?

Supernatural signs and wonders have historically performed an important social function, marking out individuals, movements, or institutions as endowed with special God-given authority. The ability to perform miracles has been ascribed to revolutionaries, teachers, prophets, saints, and even to particular places and physical objects. The apparent power to resist the most irresistible of all forces – the forces of nature – has provided inspiration and hope to many communities facing persecution, poverty, or natural disasters.

Take, for example, the story of an early Christian martyr called Agatha. This beautiful and chaste young woman was a member of a group of persecuted Christians in 3rd-century Sicily. She rejected the amorous advances of a local Roman official, who punished her by banishing her to the local brothel. The legend has it that when Agatha refused to give up either her purity or her faith she was subjected to further tortures and punishments, which included having her breasts cut off with pincers. In Roman Catholic iconography, Agatha is sometimes depicted carrying her amputated breasts on a plate. Although her wounds were said to have been healed miraculously by a vision of St Peter, Agatha was condemned to further punishments, including being dragged across burning coals and broken glass. During this final punishment, the story goes, an earthquake was sent by God,

which killed several Roman officials. Shortly afterwards Agatha herself died in prison.

The story of St Agatha, virgin and martyr, does not end there, however. After her death, Agatha was adopted by the people of Catania in Sicily as their protector and patron saint. According to local folklore, in the year after Agatha's death Mount Etna erupted, and when the martyr's veil was held up towards it, the volcanic lava was seen to change direction, leaving the city unharmed. The veil is reported to have protected the inhabitants of Catania from volcanic eruptions in the same miraculous way on several subsequent occasions. St Agatha's intercession is also credited by some believers with having prevented the plague from spreading to Catania in 1743. In these cases, the supernatural intervention of a particular saint was sought as protection against natural disasters which were themselves interpreted as acts of God. The supposed interactions between natural and supernatural agencies are not straightforward, but the message is clear: God cares for the people of Catania and, because of their association with St Agatha, will protect them.

The ability of God, either directly or through the intercession of specially chosen saints and prophets, to contravene the laws of nature in order to achieve his will is asserted by all the major religious traditions. God's various revelations of himself to Moses, to St Paul and the apostles, and through the angel Gabriel to Muhammad are themselves believed to be miraculous. The Bible records that Moses divided the Red Sea, that God sent plagues upon the Egyptians to punish them, and provided manna from heaven to feed his chosen people. The gospels assert that Jesus walked on water, healed the sick, brought the dead back to life, and was himself miraculously resurrected after dying on the cross. The Quran includes reports of miracles performed by Moses and Jesus, including an episode, not included in the Bible, when Jesus is said to have fashioned clay into the shape of a bird and miraculously breathed life into it to create a real bird.

5. St Agatha carrying her breasts on a plate, as depicted by the 17th-century painter Francisco de Zurbaran

Although there has been debate among Muslims about whether Muhammad himself performed any miracles, there is a reference in the Quran to the splitting of the moon, which was interpreted as miraculous confirmation of Muhammad's prophetic status.

Reports of miracles persist to this day. They frequently come in the form of miraculous cures of the kind sought by pilgrims to the shrine of the Blessed Virgin Mary at Lourdes in France, or by those who attend revivalist religious meetings presided over by charismatic preachers offering divine healing. From time to time there are reports of religious statues weeping blood or, as occurred in New Delhi in September 1995, drinking milk. When the story spread that statues of the Hindu deities Ganesh and Shiva had seemed to drink spoonfuls of milk, the phenomenon was soon being replicated in temples not only in India but all around the world, including in Britain, where some supermarkets experienced a sudden increase in demand for milk. In this case, as in most others, a rational and scientific explanation was soon offered – namely that the liquid was being drawn out of the spoon by capillary action (the same process that allows sponges and paper towels to absorb liquid), and was then simply running down the front of the statue. There was also a political explanation readily to hand. The ruling Congress Party in India claimed that the news of the alleged miracle was being spread by their Hindu nationalist opponents for electoral gain. The leader of one right-wing Hindu party, speaking in defence of the miracle, said: 'Scientists who dismiss it are talking nonsense. Most of them are atheists and communists.'

Signs, wonders, and miracles have a central place in religious traditions, whether as evidence of the special status of particular individuals, as proofs of the truth of particular doctrines, or as support for the broader secular and political aspirations of a movement. Although some believers welcome such things as apparent proofs of the reality and power of God, others are embarrassed by them. Reports of miracles seem, all too often,

to be the results of such human weaknesses as wishful thinking, credulity, or even fraud, rather than anything supernatural. They can make religion seem superstitious and primitive. Believers as well as sceptics ask themselves whether stories of the miraculous and the supernatural are really credible in a scientific age. And, as we shall see in this chapter, the theological, philosophical, and moral questions raised about miracles are every bit as difficult to answer as the scientific ones.

The theologians' dilemma

Pity the poor theologians! They are faced with a seemingly impossible dilemma when it comes to making sense of divine action in the world. If they affirm that God does act through miraculous interventions in nature, then they must explain why God acts on these occasions but not on numerous others; why miracles are so poorly attested; and how they are supposed to be compatible with our scientific understanding of the universe. On the other hand, if they deny that God acts through special miraculous interventions, then they are left with a faith which seems to be little more than Deism – the belief that God created the universe but is no longer active within it. If God is real, should we not expect to be able to discern at least some special divine acts? The theologian seems to have to choose between a capricious, wonder-working, tinkering God and an absent, uninterested, undetectable one. Neither sounds like a suitable object for love and worship.

The job of the theologian is to try to articulate how God can act in and through nature while avoiding the two unattractive caricatures indicated above. Various distinctions have been employed to try to achieve this. One of these differentiates between the basic primary cause of all reality, which is God, and the secondary, natural causes employed to achieve divine purposes. Another distinguishes between God's 'general providence' – the way that nature and history have been set up

to unfold according to the divine will – and rare acts of 'special providence', or miracles, in which God's power is more directly manifest. If those acts of special providence are restricted to a very small number – perhaps only those attested in scripture – or those associated with the lives of a very small number of important prophetic individuals – then God's interventions in the world might seem less capricious. Among both Christians and Muslims there are those who believe that the age in which God revealed himself in miracles and revelations has now passed.

As an example of the theologians' dilemma, consider the case of Lourdes. Millions of pilgrims flock to this town in the foothills of the Pyrenees each year – to the place where Bernadette, an illiterate and asthmatic peasant girl, saw an apparition of the Virgin Mary in 1858. Thousands claim to have been miraculously cured of physical ailments after drinking or bathing in the water of the spring uncovered by Bernadette. The Church is well aware of the potential natural explanations for such cures. Diagnoses can be mistaken. Diseases can go into remission unexpectedly. Psychosomatic cures are not uncommon. For these reasons there is an elaborate series of investigations that must be carried out before an alleged cure is declared miraculous. A panel of doctors appointed by the Lourdes International Medical Committee is required to study and confirm the reliability both of the original diagnosis and of the evidence that the cure at Lourdes was sudden, complete, and lasting. Those very few cases of cure for which the doctors are absolutely convinced that there is no possible natural or medical explanation are then put forward to the Church authorities, who have the power to declare the cure a miraculous 'sign of God'. Since 1858, the Church has declared only 67 miracles at Lourdes, out of the thousands of claimed cures. The most recent case added to the list was that of Anna Santaniello, who recovered suddenly from symptoms including severe asthma and acute arthritis during a visit to Lourdes in 1952. The Church had considered her case for 50 years before declaring it a miraculous cure.

6. A 19th-century image showing pilgrims to Lourdes praying at the place where Bernadette had her vision of the Virgin Mary. The grotto houses a statue of Mary; the crutches of those who have been cured hang in front of it.

The implementation of this cautious and highly selective process by which only a small proportion of claimed cures at Lourdes are declared miraculous is indicative of the need for the Church to retain credibility while also maintaining their traditional belief in special providence. Hasty claims of numerous spectacular miracles might give the impression of undue credulity or of an unacceptably meddlesome God. On the other hand, the hope that the supernatural can somehow break into the everyday lives of the faithful is a cornerstone of the Catholic faith, and the claim that it has done so lends support both to the doctrinal claims and to the worldly authority of the Catholic Church. The growth of Lourdes as a pilgrimage site in the 19th century was itself partly an expression of popular support for the Catholic Church in

France at a time when it was confronted by many secularist and rationalist detractors.

'As if God lived in the gaps?'

Protestant theologians have traditionally been somewhat more suspicious than Catholics about miracles (other than those recorded in the Bible). At the time of the Reformation, Protestants used the Catholic cult of the saints, especially of the Blessed Virgin Mary, and belief in the miraculous powers of holy relics, to portray the Church of Rome as superstitious and idolatrous. In more recent times, evangelical and Pentecostal forms of Protestant worship have involved wonders and miracles such as healings and speaking in tongues. However, there has been a continuous tradition of Protestant thought asserting that the age of miracles has passed and that divine activity is to be perceived in nature and history as a whole rather than in special interventions.

Two Protestant theologians illustrate this reinterpretation of the miraculous. The German thinker Friedrich Schleiermacher went so far as to redefine 'miracle' as 'merely the religious name for event', rather than as a happening which violated the laws of nature. In other words, a miracle was in the eye of the believer. In a series of lectures delivered in Boston in 1893, almost a century later, the Scottish evangelical theologian Henry Drummond, engaging the question of the proper Christian attitude to the theory of evolution, told his audience that a miracle was 'not *something quick*'. Rather, the whole, slow process of evolution was miraculous. Through that process God had produced not only the mountains and valleys, the sky and the sea, the flowers and the stars, but also 'that which of all other things in the universe commends itself, with increasing sureness as time goes on, to the reason and to the heart of Humanity – Love. Love is the final result of Evolution.' Drummond's point was that it was this product – love – rather than the particular process, natural or supernatural, which was the real miracle.

It was in this same lecture that Drummond introduced the idea of the 'God of the gaps'. He spoke of those 'reverent minds who ceaselessly scan the fields of Nature and the books of Science in search of gaps – gaps which they will fill up with God. As if God lived in the gaps?' God, he said, should be sought in human knowledge, not in human ignorance. He pointed out that if God is only to be found in special and occasional acts, then he must be supposed to be absent from the world the majority of the time. He asked whether the nobler conception was of a God present in everything or one present in occasional miracles. Drummond concluded that 'the idea of an immanent God, which is the God of Evolution, is infinitely grander than the occasional wonder-worker, who is the God of an old theology'.

The Medical Committee at Lourdes which finds signs of God only in those cases where a natural and scientific explanation is lacking, and proponents of 'Intelligent Design' who base their arguments for a designer on alleged inadequacies in evolutionary science, all seem guilty of advocating a God who resides only in gaps in current knowledge. As Drummond asked his audience, 'Where shall we be when these gaps are filled up?' On the other hand, what are we to make of Drummond's immanent God, and of the God of those contemporary theologians who see divine activity in the emergent complexity of the natural world? If God is in all natural processes equally, and even in all human actions and historical events equally too, then how can it be claimed that God is good, rather than bad or indifferent, or that God takes any special interest in human lives?

The whole history of modern science could be read as a parable designed to reinforce Drummond's warning against placing God in the gaps in current knowledge of the natural world. Isaac Newton, to take one very famous example, when confronted with questions such as why the planets in our solar system remained in their orbits rather than gradually slowing down and being drawn towards the sun, or why the distant stars were not all drawn

towards each other by gravity, was prepared to hypothesize that God must intervene from time to time in order to keep the stars and planets in their proper positions. Newton's German rival and critic G. W. Leibniz attacked this hypothesis on theological grounds. Newton's God, Leibniz wrote in a letter of 1715, lacking sufficient foresight to make a properly functioning universe at the first attempt, apparently needed 'to *wind up* his watch from time to time' and 'to *clean* it now and then' and 'even to *mend* it, as a clockmaker mends his work; who must consequently be so much the more unskilful a workman, as he is oftener obliged to mend his work and to set it right'. Leibniz preferred to see God's involvement in the universe as one of perfect and complete foresight. As the theoretical and mathematical models of the solar system became even more accurate during the 18th and 19th centuries, there were increasing numbers who went even further. When asked by Napoleon about the place of God in his system, the French physicist Pierre Simon de Laplace allegedly replied that he 'had no need for that hypothesis'.

The histories of geology, natural history, and biology reveal a similar pattern of special divine actions (floods, volcanoes, and earthquakes; separate creations of the different species; intelligent design of each individual adaptation of creatures to their environments) gradually being pushed out of the scientific picture to be replaced by more gradual, uniform, and law-like natural processes. As we shall see in the next chapter, Charles Darwin's *On the Origin of Species*, published the year after Bernadette had her vision at Lourdes, made references to God, but only as the author of the laws of nature – those 'secondary causes' which seemed to be able to achieve the most wondrous results when impressed on matter, without any need for further interventions by the Creator.

The laws of nature

It was never the intention of the pioneers of modern science – men such as Isaac Newton, Robert Boyle, or René Descartes – to

undermine religious belief. Far from it. They envisaged nature as an orderly system of mechanical interactions governed by mathematical laws. And they hoped that people would see in this new vision the strongest possible evidence of divine power and intelligence. In 1630 Descartes wrote to the Catholic theologian Marin Mersenne: 'God sets up mathematical laws in nature as a king sets up laws in his kingdom.' Most early modern scientists also took it for granted that God, who was responsible for determining the regular way in which nature would normally operate, was also quite capable of suspending or altering that normal course of nature whenever he so chose. Nonetheless, the method they adopted was one that has favoured a view of God as designer and lawgiver rather than as interventionist wonder-worker. The collaborative enterprise inaugurated by these scientific pioneers has proceeded on the assumption that natural phenomena are indeed governed by strict laws, which can be given precise mathematical expression. A further assumption made by many is that these laws will ultimately be reduced to a single unified theory. Does the success of science in explaining nature in terms of such laws amount to proof that God cannot act in nature?

Not necessarily. There are different ways of thinking about laws of nature. They need not be seen as entities or forces that somehow constrain all of reality. Instead, they can be interpreted in a more modest way as the best empirical generalizations we have so far arrived at to describe the behaviour of particular systems in particular contexts (often highly restricted experimental conditions that can be created only in laboratories). Nor are we obliged to believe that the laws of, say, physics are more 'fundamental' than the knowledge acquired through biology, sociology, or everyday experience. Although quantum theory provides exceedingly accurate empirical predictions when dealing with atomic and subatomic entities, it is not applicable to larger and more complex systems such as volcanoes, veils, or virgins, the behaviour of which can be more successfully explained by geology,

materials science, and psychology, respectively. Furthermore, two of the most successful physical theories – general relativity and quantum mechanics – are both supposed to apply universally and yet are not compatible with each other. As the philosopher of science Nancy Cartwright has put it, what modern science seems to show is not that we live in a world governed by a single systematic set of natural laws that apply at all times and in all places, but rather that we live in a 'dappled world' in which pockets of order emerge, or can be made to emerge, using a patchwork of different scientific theories (from physics, to biology, to economics), none of which is applicable across all domains.

Another assumption behind the claim, made by some polemical atheists, that modern science has shown that miracles are impossible is the belief that the natural world is deterministic – in other words, that if we had perfect knowledge of the current state of the material world and of the laws that governed it, then in effect we would also have perfect knowledge of the future of the world (and that future would be as fixed and unalterable as the past). Again, these are not things that can be proved by experience or by science (not least because there is no prospect of our ever reaching the position of omniscience required in order to test the hypothesis). Belief in determinism rests on a range of related assumptions about such basic concepts as matter, causation, and laws of nature. It is, however, as professional philosophers have repeatedly and frequently proved, in the nature of such basic concepts that they rapidly start to crumble when subjected to attempts at clear and uncontroversial definition.

Quantum mechanics

In addition to the considerable philosophical perplexities involved in articulating, let alone defending, any kind of determinism, an important scientific challenge to the doctrine arose in the early 20th century in the form of quantum mechanics. Quantum

theory resulted from physicists' attempts to understand the world of the very small – the behaviour of atomic and subatomic particles. Max Planck and Albert Einstein showed that light, then understood as an electromagnetic wave, also behaved as if it were made up of discrete particles, which came to be known as 'photons'. The implications of the theories later developed in the 1920s by quantum pioneers such as Erwin Schrödinger and Werner Heisenberg were wide-ranging, and their interpretation is still the subject of controversy. Einstein himself was unhappy with the probabilistic and indeterministic interpretations of quantum theory that came to predominate, saying that 'God does not play dice with the universe'. Some philosophers and physicists still share Einstein's unease. Having an instinctive preference for deterministic explanations, they hope to find a different interpretation of the laws of quantum physics.

The main reason, then, that quantum theory is controversial is that it seems to overturn many of the basic assumptions of classical Newtonian mechanics. It suggests that physics can no longer be reduced to a series of deterministic interactions between solid particles of matter. According to quantum theory, entities such as photons and electrons are simultaneously both particles and waves. Whether they seem to behave like one or the other depends on how the experimental apparatus interacts with them. Heisenberg's uncertainty principle further dictates that the momentum or the position of a quantum entity can be known, but never both. Finally, the observer has a key role in quantum theory, not just as a passive recipient of data, but as an active contributor to it. Quantum systems are governed by probabilistic 'wave functions' which do not take on a determinate value until they are observed. The act of observation is said to lead to the 'collapse of the wave function' and to resolve the system into one determinate state or position rather than another. Prior to observation, the system is held to be a 'cloud' consisting of all the possible observable states, each with a different probability assigned to it.

Even this brief and inexpert summary of some of the findings of quantum physics is hopefully enough to give a sense of how far we have come from the world of classical materialistic determinism. Quantum mechanics suggests that at the most basic level material reality is not deterministic (nor does it even seem to be 'material'). We are in a world of clouds, of wave functions, of probabilities – not the reassuringly picturable clockwork universe of the Enlightenment. Quantum theory also undermines the idea that the physical world exists objectively and independently of human observers, since it is the act of observation, or measurement, that collapses the wave function. The solid physical world of our everyday experience and of Newtonian physics in some sense comes into existence only by being measured.

Quantum physics is an absolutely central part of modern science, and the fact that the picture of physical reality that it offers is so strange and indeterministic has unsurprisingly proved of great interest to philosophical and religious thinkers. The prospect of a new and more holistic philosophy of nature in which the observer is integrally involved and in which determinism is denied is one that appeals to proponents of many different world views, from traditional religions to more modern 'New Age' ideologies. Attempts by theologians to make use of quantum physics as a more permanent source of 'gaps' in which God might be able to act have had a mixed reception. Such attempts do not help to answer the sceptic's question of why God would act on some occasions rather than others; nor do they satisfy those religious believers who hold that, as the author rather than the slave of the laws of nature, God can override or suspend them at will without needing to tinker with the states of quantum systems.

The first cause

But perhaps the fundamental laws of the physical universe themselves – rather than isolated suspensions, violations, or

manipulations of those laws – provide the strongest evidence of divine purpose. This is to return to the simple idea suggested by many philosophers, theologians, and scientists through the ages that, although we might generally explain natural phenomena in terms of other secondary natural causes, we must, to avoid an endless regress, at some point posit a first cause, a 'prime mover', and that what we know of the world suggests that this prime mover is that same God whom many have encountered through sacred texts and religious experiences.

We cannot expect the natural sciences to help us with the question of a first cause. Science is unable to tell us why there is something rather than nothing. Cosmological theories can try to explain how the something that does exist works and how it is related to other cosmic somethings that have existed in the past, present, or future, or even in numerous parallel universes or extra dimensions. That is what is attempted by theories about big bangs and big crunches, about superstrings and membranes, and about quantum fluctuations and multiple universes. But physical science cannot go beyond that to explain why the things that we call matter-energy and laws of nature ever came to be. Here we have an unclosable gap in our scientific knowledge, and one which all theists agree is filled by God.

Atheists respond that even if we suppose the universe to have a creator or a designer, that does not answer the question of who created the creator or who designed the designer. This is true, but not very surprising. Every explanatory journey has a terminus. That terminus might be matter, or mystery, or metaphysical necessity. It might be a featureless first cause or it might be God. Wherever one decides to end the explanatory journey, there will always still be the possibility of asking 'Why?' or 'But what caused that?' The answer in all cases – whether religious or secular – is that something or other just is. A much more serious problem for the theist is how to close the large gap between positing a first cause for the universe and identifying that unknown cause with

the personal God of Judaism, Christianity, Islam, or any other religious tradition.

Fine tuning

For those who see God in the arrangement of the laws of nature rather than in their occasional violation, it is notable that the universe seems to be 'fine tuned' for carbon-based life. If the physical constants of the universe had been very slightly different, then such life (including human life) would not have been possible. If the Big Bang had banged only slightly more vigorously, for example, matter would have been blown apart too fast for stars and planets to be formed. If the force of gravity had been even infinitesimally larger or smaller, then life-sustaining stars such as our sun could not have come into existence. Does this show that, to quote the physicist Fred Hoyle, 'a superintellect has monkeyed with physics' and that 'there are no blind forces worth speaking about in nature'? Some think that this fine tuning is indeed best explained by supposing that a creator with an interest in producing intelligent life designed our universe. Others are more persuaded by the idea that our universe is just one of countless universes in a 'multiverse' or a 'megaverse'. If that were the case, then at least a small proportion of those multiple universes would have the right conditions for producing life and, inevitably, we would find ourselves in one such universe.

What people on both sides of this argument agree about, but which should not be taken for granted, is that there is something here to be explained – whether by God or by multiverses. Both sides start with the premise that the values taken by the fundamental constants in our universe are surprising, improbable, and in need of explanation. But how do we know the probability of any given configuration of physical constants? Surely any specified combination of infinitely variable constants is equally, infinitely improbable? How, in any case, can we be confident that these constants are free to vary in the way these arguments

assume they are, and are not simply fixed by nature or linked to each other in a way we do not understand? And should the actual existence of trillions of other universes, as opposed to their merely possible existence, really make us any less surprised about the existence and physical make-up of our own? As the character Philo put it in David Hume's *Dialogues Concerning Natural Religion* (1779),

> having found, in so many other subjects much more familiar, the imperfections and even contradictions of human reason, I never should expect any success from its feeble conjectures, in a subject so sublime, and so remote from the sphere of our observation.

Not seeing and yet believing

Hume was also the author of the most famous expression of rationalist scepticism about miracles. In a 1748 essay 'Of Miracles', Hume argued against miracles on the basis of the relative weakness of the evidence in favour of them. Since the laws of nature are, by definition, generalizations that conform as closely as possible to the universal experience of humanity, Hume said, then they are as empirically well grounded as any statement can be. However generous we wish to be about the strength of the evidence in favour of miracles – that is, the reports of supposed eye-witnesses to the events, such as those recorded in the scriptures and in lives of saints – that testimony will never be as strong as the evidence that supports the laws of nature. Which, Hume asked, would be the greater miracle – that the laws of nature had actually been overturned or that those attesting to the miracle (possibly even including yourself) were mistaken? A rational person, Hume concluded, would have to answer that the falsity of the testimony was the more likely option. In short, a rational person could not believe in miracles. To put this in terms of the different sources of knowledge discussed in Chapter 2, Hume's argument was that collective sense experience trumps testimony.

For those accepting the empiricist spirit of Hume's approach, even if not his conclusions, the evidence of one's own senses must indeed be the final court of appeal. No matter what your beliefs about physical science, the laws of nature, or the strength of the testimony of others to miracles, your own experience will override all of these. If you have never witnessed a miracle, that will probably be the most significant obstacle to your believing that such a thing can occur. If, on the other hand, you had witnessed with your own eyes St Agatha's wounds being instantaneously healed, or a flow of lava suddenly and inexplicably changing direction when a veil was held up to it, you would have to admit that you had seen something truly extraordinary, which, in spite of Hume, you might well consider a miracle.

Even then, however, there would be a gap between the observation that something had happened which was contrary to the normal course of nature, and the belief that you had witnessed a supernatural or divine event. A more scientific attitude would be to treat the event as an unexplained anomaly – like an experiment in the laboratory that does not produce the result predicted by your theory. Such anomalies might lead to new discoveries about how the natural world works, or they might remain recalcitrant and unexplained. They need not take on religious significance, however. It is the experience of remarkable and unexplained phenomena in a specifically religious context that turns an anomaly into a miracle.

One religious response to the rationalist's demand for better evidence for miracles is to suggest that religious truths are to be accepted not on the basis of empirical evidence but through faith. The importance of faith is strongly emphasized in the New Testament – most famously in the story of the apostle Thomas, who says that he will not believe Jesus has risen from the dead until he sees him in the flesh with the marks of the nails in his hands and the wound in his side. Thomas then encounters the

7. Caravaggio's *The Incredulity of St Thomas* (1602–3)

risen Jesus, and believes. Jesus says to Thomas: 'Because you have seen me, you have believed; blessed are those who have not seen and yet have believed.' In his anti-Christian polemic *The Age of Reason* (1794), Thomas Paine remarked that if Thomas could refuse to believe in the resurrection until he had 'ocular and manual demonstration', then so could he, 'and the reason is equally as good for me, and for every other person, as for Thomas'. More recently, Richard Dawkins has described Thomas as the 'only really admirable member of the twelve apostles', because of his scientific demand for empirical evidence.

Divine inaction

The rebellious and sceptical Ivan, one of the brothers in Dostoyevsky's novel *The Brothers Karamazov* (1880), like doubting Thomas, demands evidence. He is disgusted by the human cruelty and suffering that he sees all around, and does

not accept that the promise of a future life in which all will be well is a satisfactory recompense. 'I want to see with my own eyes the lion lie down with the lamb and the murdered man rise up and embrace his murderer', Ivan tells his brother. 'I want to be there when everyone suddenly finds out what it has all been for.' But until that happens, Ivan cannot believe that the suffering of innocent children at the hands of torturers and abusers can ever be made up for by any future heavenly rewards. If that is the price of eternal truth and of admission to heaven, Ivan says, then the price is too high, and 'I hasten to return my ticket of admission.'

Ivan's rejection of Christianity is one that has been echoed by countless other critics of religion. If God exists and has the power to intervene in nature, and on occasion apparently uses that power, they ask, why does God fail to intervene in so many other cases of horrific injustice, cruelty, and suffering? Why, for example, did God allow Agatha to be tortured, abused, and mutilated before miraculously healing her through a vision of St Peter? Why would God allow some to be killed by volcanic eruptions and plagues, while bestowing special protection on the inhabitants of Catania? Why, in any case, does God need to use the powers of an object such as St Agatha's veil to achieve this protection, rather than acting directly to prevent the eruption or the disease in the first place? More generally, why is one person miraculously cured while another of equal faith and virtue suffers and dies? We might say that God moves in a mysterious way – which certainly seems to have been the case if we are to believe the many religious tales of wonders and miracles through the ages – but is that a good enough response? If God created us and our moral sense, then why do God's own ways of acting in the world seem to us not to meet our own standards of what is just and good?

These are among the most difficult questions with which religious believers have to grapple. As Henry Drummond put it, 'If God

appears periodically, He disappears periodically. If He comes upon the scene at special crises, He is absent from the scene in the intervals.' Science and philosophy certainly do not require us to believe in determinism or to deny the possibility of miracles. However, the theologians' dilemma will not go away: divine inaction is just as hard to explain as divine action.