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*The Unknown Newton*

# The Book of Nature, the Book of Scripture

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In the popular imagination, the view of the natural world represented by modern science and developed by such towering figures as Isaac Newton conflicts with the view of the created world in the Bible. From debates about evolution and intelligent design to questions about human cloning, embryonic stem cell research, and even climate change, science and religion are often seen as fundamentally opposed to one another. Certainly, individual scientists might be religious—one thinks for instance of John Polkinghorne in physics or Francis Collins in biology—but most people would say that the work of these scientists is to be taken seriously because it is separate from, and thus unhampered by, their religious faith and practice. What happens in the pews on Sunday has no influence on what happens in the lab on Monday. So when contemporary readers learn that Isaac Newton was a deeply religious man, their way of incorporating this fact within their conception of him as one of the greatest scientists of the past four centuries likely involves imagining that his religious faith was intellectually separate from his work in mathematics, optics, astronomy, and physics. Never the twain shall meet.

That this image of Newton is profoundly inaccurate—that in fact separating God and science in this way would have been entirely foreign to him—has become apparent in recent decades of Newton scholarship. The reason this is significant is not just that it challenges the facile notion that science and religion are fundamentally at odds with one another. The case of Newton is even more interesting than that. The usual conception of how a scientist can also be religious is that he cannot take the Scriptures as "literally" true in every instance, especially in matters pertaining to the natural world. But Newton was committed to precisely such a reading of

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the text, which raises the question of how he reconciled potential conflicts between the claims of science and the Bible's claims about nature.

The single most famous incident in modern science that depicts its conflict with a literal reading of the Bible is of course the so-called Galileo affair. This series of events began around 1615, when Galileo wrote an open letter to a powerful Italian political figure at the time, the Grand Duchess Christina, and ended in 1633, when the Vatican placed Galileo under house arrest. Galileo had asserted the Copernican view that the earth orbits the sun, rather than vice versa, and had denied in tandem that the earth is the center of the cosmos. In his letter to the Grand Duchess and in his various publications, Galileo attempted to convince theologians in the Vatican, up to and including the Pope himself, that a Copernican conception of the cosmos need not conflict with the Bible, despite the depiction of creation in Genesis and the famous passage in the book of Joshua in which the sun is said to have stood still. Drawing on the writings of theologians such as Augustine, Galileo argued that the new cosmology and the biblical texts could be made compatible with each other if one developed the proper interpretation of the texts, whose meaning might not be literal in the way contemporary theologians thought. The Bible, Galileo pointed out, often accommodates its language to that of the unlearned, and as Augustine had warned, we should not presume that the biblical authors meant to teach us about cosmology. From today's point of view, we typically think that Galileo was fighting the strictures that religion placed on scientific inquiry. While this account is not entirely accurate, it is of course a compelling image. It fits into our ideas about how the emergence of modern science coincided with the increasing secularization of society and knowledge.

Like Galileo before him, Newton was convinced that a heliocentric conception of the solar system was correct. But perhaps unlike Galileo, Newton was fully committed to the literal truth of Holy Scripture. The potential for conflict is obvious: if the book of Joshua proclaims that on a particular day God ensured an increase in daylight by stopping the sun in the sky for a time, then that would seem to imply that the sun is otherwise moving—the very concern that prompted Galileo's letter to the Grand Duchess, who had been involved in conversations on these matters. If Joshua is literally true, then how could Newton endorse the idea that the earth, rather than the sun, is in motion? Similarly, how could the first three days of creation be actual *days* in the absence of a sun? And what about Noah's flood—was that a historical event? Newton was not the only person troubled by such issues. Indeed, they were immensely important

to scholars in his day. To use a metaphor popular at the time: God created two books, the book of Scripture and the book of Nature, and both books are true. The question is, can they *both* be *entirely* true?

## Reconciling the Bible and Nature

Newton was a good Protestant, firmly believing that an individual could develop his own detailed interpretation of Scripture without the mediation of any institutional authority. In fact, he greatly doubted Church authority and rejected especially the orthodox doctrine of the Trinity. Similarly, on the basis of his reading of Scripture, Newton realized at an early age that there were many questions about how to understand the Bible's pronouncements about space, time, and motion consistently with the new discoveries of natural philosophy (the precursor of what we now call natural science). He showed interest in these topics even in his undergraduate days at Trinity College, Cambridge in the early 1660s. For instance, in his manuscript "Certain Philosophical Questions," written at that time, he wondered whether the verses at the beginning of Genesis about the creation of days "prove that God created time."

An important impetus for Newton's mature confrontation with these issues was his later correspondence with Thomas Burnet, a theologian who had been a proctor at Cambridge while Newton was still a student. In 1681, Burnet published an important book, *The Sacred Theory of the Earth.* Unlike Newton's *Principia*, which was published six years later and which only a handful of people were capable of understanding, Burnet's book became widely popular and generated a vociferous debate among scholars that continued until the century's end.

The reason for the controversy was Burnet's argument that we should emphasize reason rather than Scripture in understanding the natural world. Reason, Burnet wrote, would be his "first Guide; and where that falls short…we may receive further Light and Confirmation from the Sacred Writings." For instance, Burnet argued that Noah's flood of forty days could not have produced a sufficient mass of water to cover the world's mountainous regions, so he concluded that the early earth must have had a smooth surface, without mountains. This conclusion was the result of rational argument, supplying what Scripture did not explain.

When Burnet wrote to Newton, asking for his opinions about *The Sacred Theory of the Earth* after its publication, Newton criticized the attempt to accommodate the biblical description of the earth's creation with the current teachings of natural philosophy. Newton's letter is no

longer extant, but it apparently informed Burnet of various reasons that other theologians would resist his theory, especially on the grounds that it conflicted with the Genesis account. In early 1681, Burnet wrote a lengthy reply, arguing that if Scripture were interpreted correctly, it need not conflict with his theory after all. The six days of creation in Genesis are no "physical reality," he explained, because at least one of the days, the fourth, "is taken up with a non-reality"—that is, with the creation of sun, moon, and stars, which he thought must have been made sometime before all the rest, as the creation account as a whole is about the making of the earth from chaos, not about the entire universe. Neither could the firmament separating earthly from heavenly waters possibly be the seat of the heavenly bodies, as Genesis said. Burnet concluded that these passages described an "ideal" or figurative reality, and that if the creation account was ideal in some parts, "it may in some proportion bee ideal in every part."

Newton would not budge. In a similarly long and detailed letter back to Burnet, he explained his own view of the apparent tension between the creation account and natural philosophy. The author of Genesis, Moses, did not describe non-physical realities; rather, he

> described realities in a language artificially adapted to the sense of the vulgar. Thus where he speaks of two great lights I suppose he means their apparent not real greatness. So when he tells us God placed those lights in the firmament, he speaks I suppose of their apparent not of their real place, his business being not to correct the vulgar notions in matters philosophical but to adapt a description of the creation as handsomly as he could to the sense & capacity of the vulgar.

Later in the same letter, Newton elaborated: what the more "poetical" or "figurative" expressions—like the lights in the firmament or the floodgates of heaven—signify is "not Ideall or moral but true." They are in fact signifying actual, physical realities, but Moses, who is "accommodating his words to the gross conceptions of the vulgar, describes things much after the manner as one of the vulgar would have been inclined to do had he lived & seen the whole series of what Moses describes." Newton forcefully rejected Burnet's tendency to rely on figurative interpretations that leave open what, if anything, happened historically, arguing instead that Moses provides a historically accurate description of the creation in the way the real events would have *appeared* to a common person if one had been present when they occurred.

But what distinction is Newton really making here? At one point in his letter, he focused on the third day of creation, when God divided the land

from the waters under the heavens, calling the gathering of the waters the "seas." For Burnet, this need not be understood as a description of physical reality or of the appearances. This is what Newton rejected—that the text is true in *neither* sense. If Moses does not describe *reality* it is precisely because he describes its *appearance*, Newton thought.

Whereas Burnet's approach is highly flexible, enabling him to avoid conflicts between the biblical text and natural philosophy, Newton's approach is less accommodating, endorsing as it does the literal truth of Scripture, albeit in a slightly qualified manner. This does not mean that Newton believed he always knew what the real event exactly was, apart from its appearance. In answer to Burnet's prodding about what some of the parts of the creation account were supposed to be descriptions of, Newton wrote that "to answer these things fully would require comment upon Moses whom I dare not pretend to understand." Nevertheless, Newton put himself in the difficult position of affirming the truth of the book of Nature and the truth of the book of Scripture, while "truth" involved two distinct realms. For instance, the description in the book of Joshua is true in the sense that it appeared to people at the time that the sun stopped moving through the sky, but in reality it is also true that the sun does not move through the sky (it merely appears to do so), and therefore could not stop moving. One can understand why perhaps Galileo or Burnet would avoid insisting that the Bible's historical statements, when they conflict with natural philosophy, are still accurate and historical. But Isaac Newton never took the easy way out.

## Saving the Appearances

In the years following his exchange with Burnet, when Newton was working on the first drafts of what would become the *Principia*, he continued to refine his thinking on the language of the Bible and the language of natural philosophy. In one of several Latin manuscripts from the mid-1680s on the motion of bodies (available in English in John Herivel's *The Background to Newton's* Principia [1965]), Newton wrote that his reason for explaining in detail what we mean in physics by motion, time, space, and so forth is

> that the reader may be freed from certain vulgar prejudices and imbued with the distinct principles of mechanics may agree in what follows to distinguish carefully from each other quantities which are both absolute and relative, a thing very necessary since all phenomena depend on absolute quantities.

Parallel to the distinction Newton made when corresponding with Burnet between real and apparent sizes, he separates here absolute from relative quantities. The quantities or measures of physics are absolute (or real), while sense experience is relative to the observer (or apparent). Newton continues that

> ordinary people who fail to abstract thought from sensible appearances always speak of relative quantities, so much so that it would be absurd for wise men or even Prophets to speak to them otherwise. Hence both the sacred writings and theological writings are always to be understood in terms of relative quantities, and he who would on this account bandy words with philosophers concerning the absolute motions of natural things would be labouring under a gross misapprehension.

The Bible and theology are written in the language of common people and thus always employ apparent or relative terms for describing events. The conflict some see between natural philosophy and Scripture is the result of misunderstanding this simple fact, of failing to recognize the important difference between two ways of speaking about the same thing.

A few years later, in the first edition of the *Principia* in 1687 (and also its subsequent versions), Newton publicly explained this distinction, defining relative quantities as the "sensible measures…(whether true or erroneous) that are commonly used instead of the quantities being measured." But he adds the weighty remark that people who interpret common words—those related to time, space, place, and motion—as "referring to the quantities being measured do violence to the Scriptures. And they no less corrupt mathematics and philosophy who confuse true quantities with their relations and common measures."

All on its own, this is a striking and confusing passage. In the founding text of modern mathematical physics, we read a sentence about how to interpret Scripture! Why? An answer is only possible within the context of the other passages we have already encountered. In 1681, Newton understood the old trope that Scripture is written in the language of common people to mean that it speaks of apparent, rather than true, sizes and places. In the manuscript on motion of the mid-1680s, he adds the idea that Scripture describes relative motions (for instance of the earth), as they appear to the senses of common observers. In the *Principia* in 1687, he develops this view further, asserting that to confuse the Bible's relative account of motions and spaces with their absolute measures violates the Scriptures, presumably because it renders them suspect, if not false. Hence for Newton, the Joshua passage is not describing the motion of the sun in

the absolute terms of mathematical physics. Neither does the true understanding of the solar system demand that the text be read in a figurative sense, depicting something other than a historical event. Rather, the passage is describing the fact that on that day in history, it appeared as if the sun had stopped moving through the sky, such that the day seemed longer than expected. So Newton in effect thinks of natural philosophy as the true account of nature *in spite of* appearances, while at the same time affirming the truth of Scripture, including its statements about nature, precisely *because of* appearances.

Now of course, we would like Newton to explain exactly what he takes the Joshua passage to mean: How could the motions of the earth around the sun produce an appearance of a longer day? He disappoints us in that respect. But we *do* know what his approach would be. We should attempt to understand Joshua just as we would interpret any description of astronomical events based on how they appear to ordinary people. For instance, one might describe a solar eclipse as the sun disappearing for a time, or the sky going dark; to describe comets, one might speak of great streaks of lightning across the sky; and so on. The point is that the true motions of the earth, sun, moon, and comets are irrelevant to the biblical writer. They fall under the purview of the natural philosopher.

It can be helpful to think about how we today still talk about more regular natural phenomena like sunsets. Newton's reading of Scripture as literally true is much like our everyday assessment of a statement such as, "The sun set in Washington last night at 7 p.m." Given Newton's distinction between true and apparent motion, this statement can be literally true if it is interpreted as describing apparent motion, the way the sun appeared to people in Washington last night, and nothing more. The corollary is that it is not to be read as a false or misleading statement about the true motion of the sun or the earth; it must not be understood as a statement about true motion at all. Confusing the two ways of speaking, Newton warns, not only leads to misunderstanding common language—doing violence to the Scriptures—but also corrupts mathematics and philosophy (that is, science). It is in the interest of both theology and science that the two ways of speaking remain distinct.

Of course, statements concerning relative motion, space, and time, and the way objects appear to be moving from a given vantage point, can themselves be either true or false. It would be false, for example, to say that the sun set in Washington yesterday at 2 p.m., as it did not appear that way. Newton's parenthetical remark in the passage above—"whether true or erroneous"—is easily missed. The statement about the sun setting

in Washington at 7 p.m. is either true or false depending on how in fact it appeared to people at that place and time. But the statement's truth does *not* depend on whether or not the heliocentric model of the planetary system is correct.

Newton's view becomes even clearer if we disentangle two sets of distinctions he has made, the first between appearance and truth, and the second between literal and figurative truth. The different ways of speaking about truth are easily conflated; to make matters even more difficult, *appearance*, too, can be true in Newton's understanding of it. The first distinction—between appearance and truth—shows the difference between ordinary experience (like a sunset) and the scientist's abstractions from it that result in absolute measures (the earth's daily rotation on its axis). The second distinction—between literal and figurative truth—shows the difference between a plain understanding of a statement ("the sun set last night at 7 p.m.") and a more metaphorical or perhaps allegorical or moral statement ("the sun set on the British Empire"). With these two distinctions in mind, it becomes clear that Newton's point in saying that the Bible's descriptions of natural events are literally true is that they are to be read in their plain and ordinary sense as true statements about how the events would have appeared to people at that time and place.

## Motion and the Bible

What was Newton's real achievement in his attempt to reconcile natural philosophy with the claims of Scripture? As with many natural philosophers in the seventeenth century, not least Galileo, Newton grasped the fact that ordinary people think about space, time, and motion differently than astronomers and philosophers do. This fact, in the very least, can hamper the latter's efforts to convince the former of the truth of the new cosmology. Newton's important maneuver was to emphasize the essential connection between the old slogan *Scriptura humane loquitur*—"Scripture speaks in human language"—and the new idea that the theory of motion must distinguish apparent from true motion. In analyzing and cementing this connection, Newton argued that the new cosmology could in fact be rendered consistent with Scripture after all. In this way, Newton's theory of motion could promote the new cosmology even while saving the truth of the Scriptures that Newton took so seriously and spent so much of his life studying.

To be sure, this sketch of Newton's biblical literalism still leaves some important questions open, for instance how he thought about miracles

and whether they are real or apparent phenomena. Nevertheless, what we can say with certainty is that the all-too-convenient distinction we might be tempted to make between public science and private religion does not apply to Newton. Even a single sentence in the *Principia* shows that such a distinction is foreign to his mind. He spent many years—both in his correspondence and in his publications—grappling with the question of how to understand the relation between the book of Nature and the book of Scripture, and he thought, perhaps for good reason, that his approach ensured the truth of both books.