Introduction

> Newton's writings on biblical subjects seem to me especially interesting because they provide deep insight into the characteristic intellectual features and working methods of this important man. The divine origin of the Bible is for Newton absolutely certain, a conviction that stands in curious contrast to the critical skepticism that characterizes his attitude toward the churches. From this confidence stems the firm conviction that the seemingly obscure parts of the Bible must contain important revelations, to illuminate which one need only decipher its symbolic language. Newton seeks this decipherment, or interpretation, by means of his sharp systematic thinking grounded on the careful use of all the sources at his disposal.
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> —Draft of a letter from Albert Einstein to Abraham Yahuda. September 1940[1]

In 2006, archaeologists announced that the ancient Minoan kingdom on the island of Crete was a century older than had been thought. Radiocarbon dating of tree rings and seeds, coupled to statistics, placed the volcanic explosion of Thera, which likely ended the Minoan period, to between 1660 and 1613 BCE. This had disturbing consequences. It had been long held that the Minoan period overlapped the New Kingdom in Egypt, which began about 1550 BCE, and that contacts existed between the two civilizations. The revised dating made this impossible, since at the earlier time the Egyptians were ruled by Canaanite foreigners, the Hyksos. Nevertheless, the *New York Times* reported, "early indications suggest that proponents of the later chronology are not backing down. Their main line of defense is the Egyptian historical chronology, derived from its written records as well as pottery and iconography. They insist that a chronology tied to the Egyptian record could not be off by as much as 100 years." Evidence drawn from a source that knows neither culture nor history—the traces of radiocarbon—suddenly battled in 2006 with the remnant words and art of antiquity. Still, the proponents of text and relic held their ground, while an archaeologist argued that "the dates offered in the textbooks for these periods have always been interpretations and estimates with little evidence." The proper solution requires

[1] ALS, 1p. [AEA 39-602], Albert Einstein Archives, by permission of the Hebrew University and Princeton University Press.

"realigning the Aegean and Egyptian chronologies for the period 1700–1400." Equipped with statistical methods, scientific archaeology makes chronological claims with which ancient words and arts must contend.[2]

Disputes over chronology with overtones of a divide between the text and the laboratory or field, between the humanist and the scientist, have been raging since the sixteenth century. Though even in antiquity bits of astronomy had intrigued those interested in chronology, only after the Reformation did calculation begin to intersect fruitfully with philology. Anthony Grafton notes that in Rudolphine Prague, where Johannes Kepler lived and worked for a time, astronomy and chronology were "fused into a single pursuit not identifiable with any modern discipline." The barriers between humanistic scholarship and computational science had not then been fully erected, and considerable interaction took place between philology and astronomy. Nevertheless, signs of discord were already visible. The great humanistic scholar Joseph Scaliger, though not by any means the first to make use of astronomical "tidbits" to reset chronology's clock, corresponded with both Kepler and Tycho Brahe in his attempt to elicit satisfying results by means of an astronomical armamentarium. A century later, the relationship between the two disciplines turned decidedly frosty when Isaac Newton intruded calculations into the precincts of history and philology by virtually turning certain texts into numbers and tampering with others to fit his reckonings.[3]

Around 1700 (and concertedly so by 1704), the fifty-eight-year-old Newton—then Master of the Mint—began applying himself seriously to technical chronology, supplementing the historical studies he had been working on for the past decade and a half. The extensive notes he took ranged from excerpts of, and commentaries on, such classical sources as Herodotus, Clement of Alexandria, Diodorus Siculus, and Eusebius, to material extracted from Scripture, and elaborate astronomical and genealogical computations. The astronomical material was drawn for the most part from Denis Petau's *Uranologion*, which included a Latin translation of Hipparchus' critical *Commentary* on Aratus' third century BCE poem on the heavens. The *Commentary* provided Newton with a spectrum of remarks, many of which could, he thought, be transformed into numbers. The motivation for doing so derived from his concern with issues in antiquity that bore on the origin of civilization. Having first followed common tradition, in fixing the origin of kingdoms shortly after the Deluge, he became convinced that elaborate kingdoms and city life emerged only toward the beginning of the first millennium BCE. Gripped to a greater extent than his contemporaries by questions relating to the amount of time needed for the earth's population to recover from the devastation of the Flood, Newton convinced himself that neither Egyptian nor, certainly, Greek civilization could have existed much before the time of Solomon's reign.

As a historical chronologer, Newton seems hardly the person whose name would become an eponym for natural philosophy during the Enlightenment. Odd though it may seem for the modern observer, his pursuit of chronology is not the only seeming idiosyncrasy. As recent scholarship has demonstrated, Newton was thoroughly im-

[2] Kwan, 2006; Wilford, 2006. Archaeologist Sturt Manning of Cornell University.

[3] Grafton, 1991b, p. 186. See Grafton, 1993, esp. 3.4.

mersed in ancient prophecies, Church history, and alchemy. These investigations raise several questions: what links his interest in such matters to his investigations in optics, mechanics, and mathematics? Was Newton in his alchemical laboratory the same Newton who analyzed the passage of light through a prism and who measured the behavior of bodies falling through fluid media? What did the Newton who interpreted the *Book of Revelation* have to do with the man who wrote the *Principia Mathematica*? And how does the Newton who pored over ancient texts square with the author of the *Opticks*?

In several respects, Newton as natural philosopher differed little from numerous other early-modern observers, experimenters, and calculators who toiled incessantly in their workrooms and at their desks. Surviving manuscripts attest to the passion that drove them to formulate and to solve problems of nature and of mathematics. Galileo tangled intensely, and repeatedly, with questions of motion; the young Newton computed logarithms to dozens of places with evident joy; Boyle avidly probed the workings of air pumps, the combinations of "chymistry," and the complexities of colors. The sheer power of an irresistible need to observe, to experiment, to formulate, to grapple with a problem and crack it shines through their labors. And yet, whoever spends enough time with Isaac Newton realizes not only the pleasure he took in calculating and in experimenting (and in little else besides), but his conviction that the cosmos reveals the presence of an active deity. What unites the Newton who probed nature's secrets and delighted in the intricacy of computation with the Newton who hunted the secrets of prophecy and of divinely guided human destiny? Are these two different mind-sets in a single body? Is the Newton who pondered divine activity the "real" Newton, whose theological convictions informed the calculator and experimenter? Or is there another possibility? To us, this late seventeenth-century genius was not simply driven by *this* to do *that*; rather, his way of working reveals a mode of thought and practice which underpins both his efforts to unravel the workings of a deity in history and to grasp the innermost mysteries of mechanical nature.

Frank Manuel is the only one to date to have engaged seriously with Newton the chronologer, seeking always to forge a unity out of his apparently disparate life's work. Subsequent scholars have built on and extended Manuel's insights regarding the coherence of Newton's work and persona. Since the 1970s, several have placed particular emphasis on the character of Newton's theology and on his investigations into the Apocalypse.[4] Others have opened the way to serious consideration of his alchemical investigations.[5] In this context, Newton's procedures in the alchemical laboratory have been replicated in recent years, together with analyses that demonstrate how thoroughly his work there was grounded in a vision of matter composed of corpuscles, an understanding that has a long history among alchemists.[6]

Still, the nature of the connections between Newton the mathematician, the experimental philosopher, the corpuscular alchemist, the expositor of the Apocalypse,

[4] See, e.g., Iliffe, 1994, 1995; Snobelen, 1999, 2003a, 2003b, 2004; Mandelbrote, 2002; Delgado-Moreira, 2006b, 2006a.

[5] Dobbs, 2002; Figala, 2002a.

[6] Newman, 1998; Newman and Principe, 2001, 2002, 2003; Newman, 2006.

and the originator of a new system of chronology remains obscure. Manuel wondered what effect Newton's "scientific method" had on such matters, but at the time, the precise meaning of that "method"—if it ever existed—remained unclear. Since then, scholars have discovered that the Newton of the *Principia* did exploit a particular manner of thinking about and investigating nature, which has been termed the "Newtonian style." Analysis of that style has shown that Newton had a most specific way with data and conjecture.[7]

It was during Newton's earliest years at Cambridge that he developed the core of his method for generating and working with trustworthy knowledge—a core that carried forward directly into his chronology and indeed into his writings on the Apocalypse and the origins of civilization. We will not be asserting that a single, unchanging Newton can be followed through the nearly nine decades of his life. How could that even be? How could a man in his seventies and eighties be the same person in all respects as the youth who arrived at Cambridge in 1661? Changes certainly occurred over the years, as the introverted young man grew into the socially adept and ever-vigilant president of the Royal Society. Nevertheless, Newton's mature approaches to nature, history, and theology are rooted deep in his undergraduate career. Attitudes forged in those years evolved a way of trusting—and distrusting—evidence that produced a singular commonality among these apparently disparate realms. Critics of his chronology sensed this presence: hints of something inimical to, perhaps even dismissive of, the kinds of reasoning that philologists and theologians steeped in texts had long deployed. They were right to sense danger. Newton's ways with the past implicitly posed the questions: who has the right to command history? What sorts of evidence and reasoning should govern historical and theological understanding?

The old chronologer and the young natural philosopher deployed a complex conception of what is knowable, a conception that diverged radically from contemporary expectations of the knowledge that can be harvested from experiments—or from texts. We will see how Newton's scheme for human history is shot through and through with this structure, while his commitment to divine action in both nature and history cannot be separated from his understanding of how reliable knowledge in both domains can be gleaned or generated. Newton, we will argue, was not motivated by a conception of *divine action* to query *nature*; rather, a single conception of the probing character of *human knowledge* bound together a Newtonian triad of history, theology, and science.

In turning to chronology, Newton relied in the first instance on contemporary English work. Though the subject of technical chronology had not been extensively pursued in England during the seventeenth century, there was a rich native tradition in higher criticism, and a spectrum of ongoing controversies about the origins of language and of civilized life. These concerns had been greatly furthered by new reports of Chinese civilization, as well as by experiences of native cultures in the New World. Newton was certainly aware of such developments, but there is little evidence that he devoted much attention to them (except, in the case of China, when he briefly attempted to dismiss seeming countervailing evidence to his several claims). He re-

[7] Cohen, 1980; Smith, 2000a, 2002.

mained principally concerned with the chronologies of Egypt, Greece, and Mesopotamian empires. By the time Newton undertook extensive studies in the area, or in matters theological that were bound to ancient evidence, he had already developed his novel approach to what can be known through nature or through text.

We begin with the young Newton at Cambridge, where he grappled with new scientific ideas, subtly but distinctively transforming them. It was then that he developed a specific kind of skepticism concerning the reliability of the senses, one that powerfully governed his ways in the laboratory and in calculation. Convinced that the senses could not be relied upon to generate reliable knowledge, Newton developed a way to overcome this limitation by taking the extraordinary tack of increasing the number of measurements without discarding any. He alone forged a trustworthy resultant out of a discrepant set of numbers, each of which was inherently unreliable, by taking an average among them. Instead of discarding every measurement other than the one thought to be the very best, as his contemporaries usually did, Newton kept them all, thinking that a good number could be produced by combining a multitude of bad ones.

Newton's way to eradicate error passed strikingly, and seamlessly, into his theological and chronological works, shaping the particular forms of his reasoning. In his writings on the Apocalypse, Newton required multiple sources—each subject to various degrees of doubt—to be balanced against one another. Although that in itself was hardly a new procedure, Newton's skeptical attitude toward singular pieces of evidence resulted in a novel understanding of the significance of the remarks in the books of Daniel and Revelation. That understanding was directly connected to his conviction that the deity's activity followed an essentially law-like structure even in matters that engaged human affairs.

Newton's turn to chronology was stimulated in major ways by a concern that he shared with few contemporaries: namely the amount of time required to repopulate the earth after the Noachian Deluge. Difficult issues plagued discussions of these matters, and Newton grappled with them all. Increasingly convinced that regularities observable at his time must have prevailed among the survivors of the Deluge as well, Newton eventually developed a novel theory of the evolution of civilization, one that required chronology's clock to be radically reset. Human populations, he decided, expand according to certain rules that implicate specific stages in the development of civilization. Although ancient texts suggested to most interpreters a very different sequence and timing of developments, by the late 1690s, Newton had also decided that these sources could not be relied upon unless they had a particular pedigree—namely, unless they had come down through a trustworthy chain of transmission. The prime example of such a proper transmission for Newton was the Masoretic version of Scripture. Otherwise, he thought, texts—especially texts written in the form of poetry rather than prose—had to be treated with a great deal of skepticism, which licensed Newton's frequent, radical reinterpretations.

Newton's especial vehemence in this regard was likely furthered by his work in the London Mint, where he had for some time been in charge of prosecuting coin clippers and counterfeiters. His experience in taking testimony exacerbated his skepticism concerning the reliability of words, especially words that could not be turned into numbers or balanced against corroborating testimony. As he saw it, words from

the past resembled the sorts of stories that he had heard from clippers and counterfeiters who could not be trusted. In tackling chronology, Newton accordingly rejected ancient remarks that struck him as "poetical fancies," thinking poetry to be, *sui generis*, a form of fictive storytelling. Nor could singular remarks even in prose be relied upon—unless they could be transmuted into numbers. That could be done by creatively manipulating Hipparchus' *Commentary*. From it Newton extracted statements concerning the parts of constellations passed through by the *colures*, the great circles that pass through the poles and, respectively, the equinoxes and solstices. After considerable effort turning text into numbers—work that required him to engage creatively (and, his critics claimed, arguably) with images of the constellations—Newton produced a set of discrepant numbers out of which error was drained by means of the average. Although he eliminated the computations from his published *Chronology*, Newton's extensive manuscripts, which were written and rewritten over more than two decades, have enabled us to reconstruct his reasoning.

The astronomical remarks that Newton used pertained, he believed, to the very first stellar sphere, which had been passed down to Eudoxus through the centuries. The result of his calculations gave him precisely what he sought: traditional chronology was too long by five centuries. In particular, the expedition of the Argonauts must have occurred ca. 939 BCE, and not in 1467, as one of his French critics maintained. Egypt fared similarly in Newton's hands. Here his argument relied principally on identifying the Egyptian pharaoh Sesostris with the Biblical Sesac—an identification that he found in the work of John Marsham—which enabled him to contract Egyptian history by six hundred years.

Newton's iconoclastic chronology generated antagonistic reactions in both England and France, several years prior to its posthumous publication in 1728. In France, a storm of controversy greeted his claims and methods, as they made their way there through various intricate paths that Newton himself may have had a hand in clearing. French reactions were especially pointed as the erudite members of the *Académie des Inscriptions et Belles Lettres*, who fought enough among themselves, perceived that Newton's *Chronology* attacked more than their elaborately constructed dating systems: it undermined the very foundations of their methods grounded for the most part in texts. During the seventeenth- and early eighteenth centuries, skepticism concerning the reliability of texts, and historical Pyrrhonism, had become rampant, and attempts were made to establish criteria for judging the reliability of evidence from the past.[8] Material relics were used increasingly to challenge or to buttress ancient texts. However, since Newton scarcely relied on inscriptions, medallions, or coins—his main periods of interest predated these forms of evidence—even those Academicians who had turned to these relics from the past to grant a competitive philosophical luster to their work felt threatened. In England, Newton's scheme for ancient history elicited powerful critiques, not least from the verbose but accomplished William Whiston, furious that Newton had not publicly avowed the Arianism that Whiston so vehemently preached. For almost a century, the immense reputation of the

[8] Though published more than six decades ago, Momigliano, 1950 remains a formidably readable and informative account of these developments, about which a great deal has since been written. See especially the several essays in Grafton, 1991a, 2001b.

great Newton forced historians, chronologers, and theologians to come to grips with the challenges that his *Chronology of Ancient Kingdoms Amended* posed. In the process, new foundations for the study of ancient history, archaeology, and Biblical exegesis were laid, rapidly eclipsing the venerable domain of chronology, which increasingly remained the preserve of orthodox theologians.

The Newton that is the subject of this book differs in striking ways from any scientist of the twenty-first century. But he differed as well from his contemporary natural philosophers, theologians, and chronologers. That difference is both our subject and our method, as we investigate its origin and then use it to produce a new understanding of Newton's worldview and its historical context.