"In the Grip of a Picture": The Persistent Myth of the Newtonian "Clockwork" Universe

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Abstract: I argue here that the "Newtonian" clockwork universe operates as a myth in two senses of the word. First, Newton did not originate this idea, nor did he ever use the term, and his own views were opposed to it. But a second, deeper problem is that this idea of the universe as a clock "running on its own" apart from any design or purpose has infected other disciplines. These "machinelike" processes in human institutions are sometimes called often called "invisible hand" accounts. What both mechanism and "invisible hand" accounts have in common is the absence of a Creator whose beneficent purposes and help can guide the workings of the "system." This "mechanistic" picture of the world has kept its hold up to the present day, and mechanistic "invisible hand" explanations remain popular in many disciplines. I argue that we would be better served escaping their continuing grip on our imagination.

T HERE ARE TWO PROMINENT SENSES of "myth." One is the more contemporary notion of a myth as a false story, as when someone says, "That's just a myth." The other, more classical understanding of a myth is a story that sums up a cultural worldview. Many ancient myths are stories of this sort. In what follows, I will suggest that the "myth" of the "Newtonian" clockwork universe is a *myth* in both senses of the term.

Constant references in contemporary culture to the "Newtonian" clockwork universe are "mythic" in the first sense. Newton did not originate this idea, nor did he ever use the term, and his own views ran were directly opposed to the very notion. Thus to call the "clockwork" universe "Newtonian" is "mythic" in the first sense. It is a false story.

But there is a second, deeper problem with the "clockwork" universe apart from whether we can trace its origins to Newton. The "machine" metaphor became one of the most powerful "myths" in the second sense; it is at the heart of the modernist worldview. Many things are now thought to operate "mechanistically," not only things in nature, but also humans and human institutions. These "machinelike" processes in human institutions are often called "invisible hand" accounts, but all such "invisible hand" accounts

were derived from the "mechanistic" accounts of the world that emerged in the sixteenth century. What both have in common is the absence of a Creator whose beneficent purposes for mankind could guide the working of "the machine" or "the system."

This "mechanistic" picture of the world has kept its hold up to the present day, and mechanistic "invisible hand" explanations remain popular in many disciplines. I argue that we would be better served escaping their continuing grip on our imagination. So too, there are important lessons to be learned here, I would suggest, about how an inadequate metaphysics can lead to serious misunderstandings about the relationship between nature and grace.

The "Newtonian" Clockwork Universe That Wasn't Newton's

The classic myth that haunts modern history textbooks is that, as Newton's laws came to replace the earlier Aristotelian-Ptolemaic conception of the universe, the workings of the cosmos came more and more to resemble the workings of a great clock. God increasingly came to be seen as the great "clockmaker" who, once He had made the clock and "wound it up," was able to simply walk away from His creation. Thus we have the origin, it is said, of *Newton's* "clockwork universe."

So, for example, in all the editions of Thomas H. Greer's *A Brief History of the Western World*—currently in its *ninth edition*—students can read the following description of "history" under the sub-heading: *A Revised Cosmology: "The World Machine."*

> [In the seventeenth century] Other supports for traditional beliefs collapsed. With Aristotle's laws of motion overthrown, no role remained for a Prime Move, or for Moving Spirits. The hand of God, which once kept the heavenly bodies in their orbits, had been replaced by universal gravitation. Miracles had no place in a system whose workings were automatic and unvarying. Governed by precise mathematical and mechanical laws, Newton's universe seemed capable of running itself forever.

> People had long been familiar with complex machines as watches and clocks. Was it not logical, after Newton, to believe that universe itself was a grand machine?[1]

Then, one paragraph later, in the first lines of the next section, entitled "The View of God: Deism," students find this:

> The 'enlightened' concept of the universe raised disturbing questions about religious convictions. What was to become of the beliefs of Christianity? Many scientists and intellectuals found it extremely difficult to bring together the

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[1] Quotations taken from the ninth edition: Thomas H. Greer, *A Brief History of the Western World* (Belmont, CA: Thomson Wadsworth, 2005), 426.

Newtonian system and Christian theology, to fit Christian teachings and practices into the new cosmology. The 'world-machine,' it seemed, had no *need* for supernatural guidance, prayer, priests, sacraments, or penance: these now seemed superfluous, if not contradictory.[2]

And Greer's book is no outlier. One can find book after book with a chapter or section entitled something like: "Newton and the Clockwork Universe." One recent example can be found in Peter Aughton's educational volume for younger readers: *The Story of Astronomy: From Babylonian Stargazers to the Search for the Big Bang*, in which readers will find on pages 80 and following a section with a large picture of Isaac Newton entitled "The Clockwork Universe."[3]

So too in Robert M. Hazen and James Trefil's 1991 book *Science Matters: Achieving Scientific Literacy*, we find on p. 17 the chapter heading "The Clockwork Universe," under which the authors say:

> With the law of universal gravitation, Newton closed the circle on his work. He had the force—gravity—that operated everywhere, and he had the rules—the laws of motion—that governed the operation of all forces. Suddenly scientists saw the universe in a new way, ordered and predictable as never before. . . . In the centuries following Newton's work, philosophers compared his vision of the universe to a clock. The visible phenomena in the world, like the hands of a clock, move in response to the actions of invisible gears—the natural laws. . . . For the Newtonians, in fact, the universe resembled a clock in other ways: once set in motion by God, the universe followed an inevitable course. The future was completely and comfortably predictable.[4]

This view has become something of a commonplace in both general history books and science writing meant for wide circulation, especially for high school and college students. So also, for example, in Robert S. Jones's *Physics for the Rest of Us*, he tells his readers that:

> Newton's theory of planetary motion is the veritable prototype for all mechanical models. It is the apotheosis of the mechanistic view of the world— the fulfillment of Descartes' dream. The whole cosmos operates like a machine—like a clock! . . . Now Newton had provided a metaphorical cosmic

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[2] Ibid.

[3] Peter Aughton, *The Story of Astronomy: From Babylonian Stargazers to the Search for the Big Bang* (London: Quercus, 2008), 80 and following, "The Clockwork Universe."

[4] Robert M. Hazen and James Trefil, *Science Matters: Achieving Scientific Literacy* (New York: Anchor Books, 1992), 17-18.

clock that, once wound up and set into motion (presumably by God), would run like a perpetual-motion machine with perfect but mindless precision.[5]

As these assumptions have filtered down into the more popular media, the have become unquestioned "facts." So, for example, we find physicist Michio Kaku on the History Channel series *The Universe* in a feature on "Beyond the Big Band" telling his audience that: "Newton believed that the universe was a clock. A gigantic clock—a machine—that God wound up at the beginning of time, and it's been ticking ever since due to his laws of motion."[6] And Johnjoe McFadden, a professor of molecular genetics at the University of Surrey, was so sure of this commonplace, he could claim without the least hesitation in an editorial in a major newspaper that, just as "Darwin and Wallace destroyed the strongest evidence left in the 19th century for the existence of a deity," so too "[t]wo centuries earlier, Newton had banished God from the clockwork heavens."[7]

The first thing to say about this little metanarrative about Newton and the "clockwork universe" is that not only did Newton *not* invent the "clockwork universe" metaphor—it predated him by quite a long time, as we will see—Newton himself never used it. Rather, the best evidence suggests Newton rejected the image precisely as too "mechanical" and an impermissible imposition on God's freedom to act in the universe according to His sovereign will.[8]

Although Newton himself never seems to have commented publicly on the "clockwork universe" metaphor, one of his followers, Samuel Clarke, did in an interesting reply to an objection to Newton's views posed by the German mathematician and philosopher Gottfried Leibniz—a reply likely seen and perhaps even suggested by Newton himself.[9] Leibniz had objected that:

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[5] Roger S. Jones, *Physics for the Rest of Us: Ten Basic Ideas of Twentieth-Century Physics That Everyone Should Know . . . and How They Have Shaped Our Culture and Consciousness* (Chicago: Contemporary Books, 1992), 101–02.

[6] "Beyond the Big Bang," *The Universe,* History Channel, 2007, video clip of extra feature available at: www.history.com/shows/the-universe/videos/playlists/beyond-the-big-bang#beyond-the-big-bang-sir-isaac-newtons-law-of-gravity (current as of August 12, 2011).

[7] Johnjoe McFadden, "'Survival of the Wisest': It Is 150 Years since Darwin Expounded the Theory That Illuminates Our World to This Day," *Guardian* (June 30, 2008).

[8] For an interesting and detailed article on Newton's theology and the "clockwork universe," see Stephen D. Snobelen, "Cosmos and Apocalypse," *The New Atlantis*, no. 44 (Winter 2015): 76-94.

[9] See Edward B. Davis, "Newton's Rejection of the 'Newtonian World View': The Role of Divine Will in Newton's Natural Philosophy," *Science and Christian Belief* 3 (1991): 112, who writes that: "surviving manuscript evidence indicates that

Newton and his followers also have a very odd opinion regarding God's workmanship. According to them, God's watch—the universe—would stop working if he didn't re-wind it from time to time! He didn't have enough foresight to give it perpetual motion. This machine that he has made is so imperfect that from time to time he has to clean it by a miraculous intervention, and even has to mend it, as a clockmaker mends his work. The oftener a clockmaker has to adjust his machine and set it right, the clumsier he must be as a clockmaker![10]

In his reply, Clarke denies the analogy between God's creation of the universe and the clockmaker's putting together of a clock from its various parts. According to Clarke, "Among humans, the maker of a machine is rightly regarded as skillful in proportion to how long a machine that he has made will work properly without any further tinkering by him," but this is because the human clockmaker "exercises his skill only in constructing, adjusting, or putting together certain moving parts—such as weights and springs—whose source of motion is a set of forces that are entirely independent of him; he arranges them in various ways, but he didn't make them." But regarding God, the case is different: "as well as assembling things into structures, he is himself the author and continual preserver of their basic forces or powers of motion. So the fact that nothing happens without his continual regulation and oversight is a true glory of his workmanship and not something that detracts from it."[11]

Newton was intimately familiar with Clarke's arguments, perhaps in some cases even suggesting them himself. There can be little doubt that Newton endorsed what Clarke wrote." He adds the following in n. 36 on the same page: "The relevant evidence, which is quite extensive, is evaluated in Alexandre Koyré and I. B. Cohen, 'Newton and the Leibniz-Clarke Correspondence with Notes on Newton, Conti, and Des Maizeau,' *Archives internationales d'histoire des sciences* 15 (1962): 63-126. In an earlier work, *From the Closed World to the Infinite Universe* (Baltimore: Johns Hopkins University Press, 1957), Koyré had remarked (p. 301) that he was 'morally certain that Clarke communicated to Newton both Leibniz's letters and his own replies to them.' In the article just cited, Koyré and Cohen observe (p. 67) that from their 'study of the Newtonian manuscripts, the "moral" conviction has been transformed into a demonstrable one.'"

[10] The letters between Clarke and Leibniz were first published by Clarke in 1717 after Leibniz's death under the title *A Collection of Papers, Which passed between the late Mr. Leibniz, and Dr. Clarke, In the Years 1715 and 1716. Relating to the Principles of Natural Philosophy and Religion*. A modern edition was prepared by H.G. Alexander, *The Leibniz-Clarke Correspondence* (Manchester: University of Manchester Press, 1956). Copies are also available several places on-line. I have quoted above from the version at http://www.earlymoderntexts.com/ pdfs/leibniz1715_1.pdf. See "Leibniz's first paper (November 1715)," 2.

[11] See "Clarke's first reply (26 November 1715)," 4. Leibniz's reply to Clarke is also interesting: "I agree," says Leibniz, "that the principles of the materialists

Thus according to Clarke, the clockmaker analogy needs either to be understood properly—in accord with God's continual care of creation—or rejected as an image that leads to atheism and impiety. "The idea that the world is a great machine," he complains, "that goes on without intervention by God, like a clock ticking along without help from a clockmaker—that's the idea of materialism and fate. Under cover of declaring God to be a supra-mundane intelligence, it aims to exclude providence and God's government from the world."[12] And it was this exclusion of divine providence that he and Newton wished to avoid.

And yet, once the modern picture of the "clockwork" universe took hold and God was seen as the divine "clockmaker," it was increasingly assumed that, after the act of creation, there was "nothing for God to do."[13] God can "walk away" from His creation and allow it to "run on its own." Indeed, later thinkers such as Jürgen Moltmann would prefer to envision God's creative act as a "withdrawal" by which "God makes room for his creation by withdrawing his presence."[14]

The myth of the "Newtonian clockwork universe" has been hard, if not impossible, to dismiss. But is it appropriate to attribute a worldview to a man if the man himself rejected it as contrary to the fundamental intentions of his work? If "the Newtonian worldview" is a "myth" created long after the death of the man himself, should we continue to call it the "Newtonian" worldview?

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contribute greatly to the spread of impiety. But I see no reason to add that the mathematical principles of philosophy are opposite to those of the materialists. Really they are the same, with just this difference: The materialists who follow Democritus, Epicurus and Hobbes confine themselves altogether to mathematical principles [i.e. to physics, with no admixture of anything else], and hold that nothing exists but bodies; whereas the Christian mathematicians [that is, Newton and his followers] allow that there are also immaterial substances. What ought to be set up against materialism, therefore, are not mathematical principles (taking this phrase in its usual sense) but rather metaphysical principles." It is worth noting that for Thomas Aquinas, the proper hierarchy of the sciences is organized in ascending order thus: natural philosophy, mathematics, metaphysics, and theology. We will have more to say in due course on why a proper understanding of metaphysics is essential to the dialogue between theology, on the one hand, and what we call the "natural sciences" (which is a "mixed discipline" combining mathematics and natural philosophy), on the other.

[12] Ibid.

[13] Carl Sagan, in an infamous introduction to the first American edition of Stephen Hawking's *A Brief History of Time* (New York: Bantam Books, 1990), x, wrote that with the discoveries of modern physics, there was "nothing for a Creator to do." The claim goes back centuries, however. The Marquis de LaPlace, a famous determinist, was by legend supposed to have replied to Napoleon's question about how "God" fit into his system: "Sir, I have no need of that hypothesis."

[14] See Jürgen Moltmann, *God in Creation*, trans. Margaret Kohl (New York: HarperCollins, 1991), 86-91, esp. 87.

Or should we perhaps, now that we know the historical truth from Newton's own writings, find some other name for it, such as "the *faux* Newtonian worldview created during the Enlightenment for anti-religious ideological purposes." A worldview it is; "Newtonian" it is not.

Now, although the popular metanarrative about the "Newtonian" worldview may not be truly "Newtonian" in the sense that Newton himself developed it, nor can it even be traced to Newton as a "logical outgrowth" of his thought, it is still *a* worldview, one that has been extremely influential in modernity. Indeed, as we will see, the influence of this "mechanistic" worldview has extended far beyond the realm of cosmology into a host of other disciplines, and machinelike mechanisms thought to operate apart from any conscious design or purpose are now said to function throughout society and are considered uniquely responsible for considerable social benefits.

So it will be the task in what follows to understand, first, how our current understanding of the "clockwork" universe and the "clockmaker" God developed. And second, we will consider some of the social and cultural consequences that have resulted from adopting a worldview that took the workings of Nature to be those of an un-designed, unpurposeful "machine."

The Clockwork Universe Metaphor and the Machina Mundi

The clockwork metaphor for the universe can be found among classical thinkers long before Newton and Leibniz, but its use to *deny* the existence of God is relatively recent. Indeed, one would be hard-pressed to find almost *any* example of its use for that purpose before the late nineteenth century, even in the works of hard-core Enlightenment *philosophes* such as Voltaire or Rousseau, both of whom accepted the clockmaker God analogy.

Thinkers have long envisioned the motions of the universe as the workings of a vast "machine," and often, that machine has been a clock. Rather than seeing this as evidence that the world had no creator, the "mechanical" character of the universe suggested to most exactly the opposite: that there must be a divine source of the order of the universe.

The Roman philosopher Cicero (106-43 B.C.), for example, in Book 2 of *On the Nature of the Gods* makes an argument that foreshadows the later "design" arguments of William Paley in the nineteenth century:

> When you see a statue or a painting, you recognize the exercise of art; when you observe from a distance the course of a ship, you do not hesitate to assume that is motion is guided by reason and by art; when you look at a sun-dial or a water-clock, you infer that it tells the time by art and not by chance; how then can it be consistent to suppose that the world, which includes both the works of

art in question, the craftsmen who made them, and everything else besides, can be devoid of purpose and reason?[15]

And then, again later in the same book:

> Who would not deny the name of human being to a man who, on seeing the regular motions of the heaven and the fixed order of the starts and the accurate interconnection and interrelation of all things, can deny that these things possess any rational design, and can maintain that phenomena, the wisdom of whose ordering transcends the capacity of our wisdom to understand it, take place by chance? When we see something moved by machinery (*cum machinatione*), like an orrery or clock (*ut sphaeram ut horas*) or many other such things, we do not doubt that these contrivances are the work of reason; when therefore we behold the whole compass of the heaven moving with the revolutions of marvellous velocity and executing with perfect regularity the annual changes of the seasons with absolute safety and security for all things, how can we doubt that all this is effected not merely by reason, but a reason that is transcendent and divine.[16]

In the following centuries, writers often made reference to the *machina mundi* ("the machine of the world"). Yet the term was never tied to atheist conclusions or to imply that "there was nothing for God to do." A few examples (among dozens) will have to suffice. In the late-fourth century, for example, we find the term *machina mundi* used no less than four times in a text written by the Christian monk and historian Rufinus (c 340/345-410 A.D.), one of which asserts that "the *machina mundi* would not be able to continue to exist without a creator and sustainer.[17] At roughly the same time, we find the late-fourth century bishop Maximus of Turin (d. between 408 and 423) praising God in a sermon as "the craftsman" who "fabricated the machine of this world" (*artifex huius mundi machinam*).[18] Also from the fourth century (c. 321), we find the term *machina mundi* used at least twice in Calcidius's influential *Translation and Commentary on Plato's Timaeus*, the first of which reads: "To finish the machine of the world, to designate the souls of the stars without number, placing them in suitable vehicles, to show forth the nature of the universe, to teach the immutable decrees, all these are

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[15] Cicero, Marcus Tullius, *On the Nature of the Gods*, trans. Henry Rackham (London: W. Heinemann; Cambridge: Harvard University Press, 1933), 2.34.87.

[16] Cicero, *On the Nature of the Gods*, 2.38.97.

[17] There had been some question as to the text's author, so it can be found in Pseudo-Clement of Rome, *Recognitiones*, bk. 8, chap. 15, par. 5. Cf. also *Recognitiones*, bk. 8, chap. 21, par. 3 and bk. 8, chap. 34, par. 4.

[18] Maximus of Turin, *Sermon 13a*, CCSL, 23, p. 45, nos. 47-50.

the offices of providence."[19] These and other early Church fathers would often use the image of the *machina mundi* to emphasize (as the example from Rufinus above shows) that God was both Creator *and* Sustainer. There was no sense among them that, now that the "machine of world" was working, it no longer needed God's providential care.

Rarely, if ever, did anyone who employed the "machine" metaphor for the universe before the nineteenth century ever do so with the notion that God could be an absent creator.[20] Rather the metaphor was most often used, first, to show that there *must* be a creator to account for the complex order of the universe. And second, during the great renaissance of natural philosophy in the late twelfth and early thirteenth centuries, the image of the *machina mundi* was used to describe the workings of "secondary causes" in the cosmos—causes that were always understood to be dependent at every moment on God's "primary" divine causality as the ultimate source of their existence and motion.

Aquinas on Divine and Natural Causality

The clearest and most discerning exponent of this perspective was the thirteenth century theologian, Thomas Aquinas. It was Aquinas who saw most clearly that *change* in the world, the *motion* of things from potency to act, required a Source of Being that was Pure Act. And it was Aquinas too who saw that the existence of things in the world that did not cause themselves to exist presupposed the existence of a Source of All Existence that did not *have* being from some other source, but was *Subsisting Being Itself*, the source of the *being* of whatever exists.[21]

On this account, God could not be *absent*, because his Subsisting Being was necessary at every moment for anything to have *being*. Yet God's "primary" causality as the ultimate source of being and change did not preclude the action of "secondary" causes in the universe. Rather, the existence and action of secondary causes *presupposed* that God was continually imparting being to them. Hence the "machine" of the universe

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[19] Chalcidius, *Commentarius in Platonis Timaeum*, pt. 2, chap. 147. My translation. Cf. also pt. 2, chap. 299: "ex qua et deo mundi machinam constitisse deo persuadente, necessitate obsecundante."

[20] Even the infamous comment by Pierre-Simon de Laplace, who is said to have replied to Napoleon when asked about God, "Sir, I have no need of that hypothesis," likely never happened. What is more likely is that Laplace was expressing his disagreement with Newton's view that God needed to "intervene" from time to time to adjust the machine of the world (*la machine du monde*), whereas he, LaPlace, was in agreement with Leibniz's view that this supposition would make God seem like a sloppy creator who ill made His creation. As he says in his *Exposition du système du monde*, "This is to have very narrow ideas about the wisdom and power of God."

[21] For the relevant texts in translation, see Steven Baldner and William Carroll, *Aquinas on Creation* (Toronto: Pontifical Institute of Mediaeval Studies, 1997).

could never *replace* God. Rather, Aquinas's account lent metaphysical support for the patristic claim that God often works *indirectly* (so to speak) *in and through natural causes*. Just as a doctor is said to "heal the patient," even though he or she does so *by means of* the "secondary causality" of an antibiotic, so too, God can be understood to carry out his will *in and through* and *by means of* "the secondary causality" of natural forces. We say that "God gave us this beautiful baby girl" and yet we know that the sexual act between the mother and father also in its own way (as secondary cause) produced this beautiful baby girl. We need not envision God "intervening" in nature to produce each child or to make trees grow. Rather the secondary causality of nature depends upon his primary causality as the Source and Sustainer of the *being* of all existing things.

Far from suggesting God can be "absent" from his creation, medieval Christian thinkers used the image of the *machina mundi* to propose his intimate *presence* at every moment. Thomas Aquinas helped to deepen the patristic notion of God as both creator and sustainer of the universe, by showing that God "sustained" the universe not merely by providing for it, but also by continuing to impart existence to it. In an important sense, if we take "creation" to be the imparting of *being*—making something to *be* rather than not *be*—then God is continually "creating" whatever exists.

Instead of the "either–or" frame of mind wherein which we imagine that if God is involved in creation or healing, then natural forces can't be, or vice versa, if natural forces are involved, then God cannot be, Thomas Aquinas helped clarify how both natural causality and God's divine causality can both be involved, but in different ways. This distinction was necessary to allow the development the natural sciences according to their own proper methods—the method proper to *natural* causes—while also motivating medieval Christian thinkers to search for an underlying unity, a coherent picture of the whole: a conceptual underpinning that was essential to the development of that momentous medieval institution, the *university*.

The Dynamics of a Closed System Lacking Design or Purpose

We can compare Aquinas's approach with that of the modern cosmologist Lee Smolin who argues that the universe cannot have been made by anything that exists outside of it, for by definition the universe is all there is, and there can be nothing outside it. And, by definition, neither can there have been anything before the universe that caused it, for if anything existed it must have been part of the universe. So the first principle of cosmology must be "'There is nothing outside the universe.' . . . The first principle means that we take the universe to be, by definition, a closed system. It means that

the explanation for anything in the universe can involve only other things that also exist in the universe."[22]

On this view, the universe is, *by definition*, a "closed system," and the "first principle of cosmology" *must be* "There is nothing outside the universe." But first, this is not a conclusion derived from empirical evidence, rather it is a presupposition one brings *to* the interpretation of evidence. And second, this means that one has stipulated in advance—"by definition"—that "the universe" *must be* a self-creating system because "the universe" is all there is.

Christians who understand Aquinas would have no reason to disagree with the claim that "the explanation for anything in the universe can involve only other things that also exist in the universe," properly understood in terms of the cause–effect relationship of secondary causality. The problem is that those cause–effect relationships, which in modern science, are generally assumed to involve fundamental particles being operated on by fundamental laws of physics, cannot by themselves account for their own existence. Even if the universe is (by definition) "all there is," this still leaves the question why there is something—anything at all (including whatever matter and laws there may be)—rather than nothing.

Aquinas understood that, if "the universe" includes all the things that have *being*, there must be some source, some principle, of that *being* that does not itself have some other source of its being but *is* its own being and is the source of all being for all things that are not the source of their own being. Since things in the universe that have *being* are not the source of their own being, then if they are to persist in being, that source of their being must be imparting *being* to them at every moment of their existence. Thus far from it being the case that "God" (if this is what we wish to call this principle of being) can be "absent" from creation, if God weren't imparting existence to the universe at every moment of its existence, then it would cease to exist. There would be no universe to explain and no "laws" to explain its movements.

Scientists such as Lee Smolin may not wish to address the question of the source of the *being* of the universe, questions that are indeed more appropriate to metaphysics than to his discipline of physics, and this is fine, so long as he does not dismiss the question altogether as illegitimate, and as long as he understands that he has merely waved the question off by his presuppositions and the way he has defined his terms. An obvious retort to Smolin's way of defining "the universe" would simply be to say that "if the universe is *all that is*," then yes, there can be nothing "outside" the universe, thus defined, but this does not preclude the existence of what Aquinas calls "Subsisting Being Itself." Rather, the existence of anything other than

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[22] Lee Smolin, *Three Roads to Quantum Gravity* (New York: Basic Books, 2001), 17.

Subsisting Being Itself presupposes the creative activity of Subsisting Being Itself. Or to put this another way, if "the universe" is "all there is," then before the original creative act when God began creating things *having* being, then God *was* "the universe." Before this act of creation, he *was* "everything that exists."

And yet Smolin's reductive approach to his discipline has been replicated across many systems; as, for example among social scientists who insist that politics or economics is a "closed system"—a closed system *in which* human beings operate, but always according to a predetermined set of "laws" articulated by some social theory.

To be an ultimate explanation means that all explanations must fit the system. The system cannot be created by an agency operating outside the explanatory mechanism of the system, otherwise it would not be a complete system. It is not allowed for anyone to explain the system as the result of human agency or a design not in principle explainable by the terms set forth for the system. Thus, for the devoted political scientist, the only reason anyone would create a political system would be for political purposes explainable by the reasons available within her or his explanatory political system.

On this view, it would not be appropriate, for example, to explain the origin of an overarching political system based on something like *love* or the maintenance of *justice*, because love and justice are realities that must be reduced to and explained by the system. No modern economic theorist would be permitted to say, for example, that humans "created" the economic "law" of supply and demand out of love, or justice, or to better mankind. These laws are not *designed*; they just *are*. Granted, one might *use* the "laws" for justice or loving purposes, but justice and love do not *account for* the system, nor are they necessitated by it. Rather, one risks throwing a monkey wrench into the works by intruding into the workings of the "machinelike" system with elements alien to the system. In economics, such intrusions are sometimes called "market aberrations," and they can derive either from "irrational" charity or excessive greed.

It is an odd presumption about modern "machinelike" systems that, although they are supposedly not designed, it is assumed they can be controlled. Indeed, one wonders whether the intentions and purposes of anything outside the mechanism must be abstracted, *precisely so that* it can be controlled. If there is no "design," if there is no identifiable *purpose* to the system according to which those in the system must abide, then the laws are simply there to be understood and manipulated and controlled.

It is worth asking whether this is ultimately what is at stake in these debates over the lack of design or purpose in the workings of the universe. If nature has a design and purpose—if, in our relationship to nature, we owe adherence to some higher authority or some ultimate purpose—then nature is

no longer "material" to do with whatever we wish. Or, to put this more accurately, it gives certain people—those with intimate knowledge of how the machine works and an ability to manipulate it to their ends—more power to do with it and those subject to them more power to do what *they* want. As C. S. Lewis put the problem, "what we call Man's power over Nature turns out to be a power exercised by some men over other men with Nature as its instrument." Those who want that power and want to exercise it unbidden by constraints have a vested interested in portraying nature as primarily a "resource" whose value is only in its human use and portraying those who wish to set limits on these activities as somehow expressing an "unscientific" worldview as contrasted with the "neutral" perspective of the so-called scientific perspective. There is some doubt whether these perspectives are as "neutral" as is often claimed. At the very least, a supposedly "neutral" mechanism is not neutral if some can control its operations and others cannot.

Change of Clocks and the Meaning of Machines

But how, we might wonder, did the picture of the universe as a vast machine come to imply that God was "absent"? As we have seen, ancient and medieval thinkers did not draw this conclusion from the orderly, clocklike mechanics of the universe. Quite the contrary. So what changed?

There are undoubtedly many reasons for the change in perspective, but for our purposes, let me focus our attention on just one: the transformation in Western culture's understanding of the machine. And to illustrate the change, let's consider one machine in particular: the clock. And let me suggest that, as the technology of clocks changed, so did people's understanding of the clockmaker image. As clocks more often seemed to be self-moving, the implications and connotations of the "clock" analogy changed, as did, perhaps inevitably, our conception of time.

So, for example, since we in the modern world have more regular access to mechanical clocks and often have relatively little need to pay close attention to the precise motions of the sun, moon, and stars, it makes sense that we compare the motions of the heavenly bodies to those of a clock. But in the ancient world, the analogy would have been reversed. Since most clocks that existed in the ancient world "told time" according to the motions of the sun, moon, or the stars, it would have seemed to most people that the regularity of a clock was simply a reflection of (or a visible expression in a different medium of) the regularity of the motions of the cosmos.

Even the "hours" of the day were originally determined by the sun, with "prime" being one hour after sunrise; "terce," the third hour; "sext," the sixth hour; and so on. Students studying the life of medieval Benedictine monks will often ask, "What time did the monks celebrate prime?" To which the answer is: It depended on the season. It was celebrated one hour after the sun rose, whenever that was. It is we who think of the sun rising at different

"times," as though "time" was absolute and the motion of the sun something secondary, something happening "in time."[23]

Jews and Christians, and later Muslims, read in the first chapter of the Book of Genesis:

> Let there be lights in the expanse of the heavens to separate the day from the night. And let them be for signs and for seasons, and for days and years." This statement would have come as no surprise either to them or to anyone else in the ancient world. Clocks and calendars were understood to be a visible manifestation in number or in some measured medium of the regular passage of time. So too the regular dripping of the water clock or the passage of sand through an hourglass suggested that the regularity of nature was primary, and "time" was merely a function of or expression of those regularities. Indeed, many of the earliest mechanical clocks of which we are aware were machines that also showed the movement of the planets and passing of the seasons.[24]

Consider the difference it would make for someone to speak of "the clockwork universe" if he or she associated the "clock" primarily with a sun dial as opposed to someone who thought of a "clock" as something operated by cogs and gears. The first—the person who thought of time in terms of the sun dial or a similar mechanism—would be disposed to think of the time expressed on the clock as a function of motion, whereas the second person— the one who thought of time in relation to a mechanical clock—would be more likely to conclude that the time expressed on the clock was something *abstract*, largely or entirely distinct from the motions of particular bodies. The motion of bodies no longer "creates" what we call "time"; now bodies are thought to *move in and through* absolute time much as they "move in and through" absolute space.

Such a conceptual shift presents new challenges for the way people would likely conceive of the action of a Creator. Aquinas, as we have seen, brought an advanced metaphysics to the question of creation. But consider what would happen if this metaphysical understanding of creation were to be lost or disregarded. People would likely begin to imagine that what the Creator does is He creates the material *in* the universe and sets it in motion, after which, it runs "on its own." But this leaves out of the picture the creation of time and space, and perhaps even the fundamental "laws" of motion. We are left with the picture of a clockmaker God who is not the Creator of all

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[23] These notions of "absolute" time and "absolute" space in which the stars move as distinct objects is now being challenged, however, by current theories about the "time-space continuum." Bodies with mass alter space-time.

[24] One of the most famous was Richard of Wallingford's at St. Albans Abbey, built in the early fourteenth century. Even if the earliest clocks were not simply developments of these early planetaria, it seems clear that those who made them saw the two realities as fundamentally interrelated in ways we no longer do.

being out of *nothing*, but of a creator who is more like a demi-urge who brings matter into existence according to preexisting "laws," somewhat like the way a human clockmaker constructs a clock according to the preexisting "laws" of nature and physics. The God of *Being* becomes the "Designer God," who "arranges" things the way a clockmaker arranges the various pieces out of which he makes the clock. But since the clockmaker has used preexisting materials, and since time and space are entities that do not depend on him for their existence or motion, the clockmaker can finish his work and leave, whereas the God of all *being* cannot.

So too, consider the difference between thinking of a "machine" not as we commonly do today, but in terms of the six "simple machines": the wheel and axle, pulleys, levers, inclined planes, wedges, and screws. These "machines"—although we hardly think of them as "machines" or as "mechanisms" anymore—are characterized by the *transference* of a force that originates within a human agent. By themselves, they do nothing. When the human agent stops applying force, the effect stops.

Recall Leibniz's objection to Newton's theory, namely, that Newton and his followers held that "God's watch—the universe—would stop working if he didn't re-wind it from time to time"; that is to say, the problem with the Newtonian account was that God "didn't have enough foresight to give [the universe] perpetual motion."[25] Although no one now accepts the possibility of a "perpetual motion" machine (since all such machines would violate the second law of thermodynamics), the possibility of creating such a machine was still a lively question in the seventeenth century. Even today, we find in Robert S. Jones's *Physics for the Rest of Us* the comment (quoted above), that "Newton's theory of planetary motion is the veritable prototype for all mechanical models"—"the apotheosis of the mechanistic view of the world"—because "[t]he whole cosmos operates like a machine—like a clock! . . . Newton had provided a metaphorical cosmic clock that, once wound up and set into motion (presumably by God), would run like a perpetual-motion machine."[26] Perhaps we can at least say on behalf of Aquinas and Newton that neither man proposed a natural explanation for the motion of the universe that would have operated in violation of the second law of thermodynamics.

And yet, it should be clear after a moment's thought that "mechanical" clocks (in our sense of "mechanical") are no less dependent upon the constant application of a force than the six simple machines and they are no less an embodiment of the regularities of nature. Older "mechanical" clocks were driven by the stored force of a falling weight or a wound spring, which was then carefully modulated by gears to move the hands of the clock. But as the "mechanics" of the clock became more hidden in the interior, it was easy to get the sense that they ran "by themselves" and to forget that constant

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[25] See n. 10 above.
[26] See n. 4 above.

application of energy from outside the clock's "closed system" was needed to drive them. It has become common now to call these older clocks "mechanical clocks" to distinguish them from modern digital clocks. But modern quartz watches are no less "mechanical" and no less dependent on a continual power source to keep them moving.

The Clock as the First Modern "Machine"

As author Lewis Mumford has pointed out, the modern tendency has been to define a "machine" precisely as something independent of human power. In his classic 1934 work *Technics and Civilization*, Lewis noted that modern definitions of a machine tend to leave out "the large class of machines operated by manpower."[27] So, for example, we call a gasoline-powered lawn mower a "machine," but not a pair of hedge clippers. And we call a Singer sewing machine a "machine," but not a hand-powered loom, even though the hand-powered loom is a complex mechanism requiring great skill to use and can produce various types of cloth with tremendously complex patterns. In modern linguistic usage, says Mumford, "[t]he essential distinction between a machine and a tool lies in the degree of independence in the operation from the skill and motive power of the operator: the tool lends itself to manipulation, the machine to automatic action. The degree of complexity is unimportant."[28]

So too, the clock was considered the paradigmatic "machine" for any number of reasons, its seemingly automatic character being just the first. Another was its precision. Even today, although clocks and watches have changed dramatically, one still hears the boast that a machine or process, when they are at their best, operate "with clocklike precision." This boast points to another notable fact about clocks: namely, their relationship to *time*.

"By its essential nature," claims Mumford, the clock "served to dissociate time from human events and helped create the belief in an independent world of mathematically measurable sequences."[29] If Descartes is, as many insist, "the Father of Modern Philosophy," and the "inventor" of "absolute time and space," then the clock would be the clearest and most influential embodiment of the Cartesian worldview. To live "by the clock" is to live concretely in a Cartesian universe, in "absolute time," the time measured out by the clock. Indeed, for many of us in the modern world, we

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[27] Lewis Mumford, *Technics and Civilization* (New York: Harcourt, Brace & Company, Inc., 1934), 9.
[28] Ibid., 10.
[29] Ibid., 16.

can scarcely think of "time" in any other way.[30] With the increasing "mechanization" of the clock, says Mumford:

> Abstract time became the new medium of existence. Organic functions themselves were regulated by it: one ate, not upon feeling hungry, but when prompted by the clock: one slept, not when one was tired, but when the clock sanctioned it. A generalized time consciousness accompanied the wider use of clocks: dissociating time from organic sequences.[31]

Living "by the Clock"

Mumford's *Technics and Civilization* was first published in 1934, but he was far from the only one, even then, concerned with the new developments in machinery and the mindset it had spawned. Consider, for example, the opening scene of Charlie Chaplin's famous 1936 film *Modern Times*. While the opening credits are running, Chaplin fills the screen with the image of a ticking clock. As the movie proceeds, we see the results of the absolutization of time. Instead of time being seen as a function of motion—of the heavens and of the seasons—now time is being taken as "absolute" and the motion in the factory is being regulated by it.

In another scene in *Modern Times*, the owner of the plant calls over to his plant supervisor (a muscular, shirtless man) telling him (in one of three

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[30] T. S. Eliot, by contrast, in his poem *The Dry Salvages*, one of the *Four Quartets*, contrasts the regular tolling of the clock measuring out "clock time" with the tolling of the bell on an ocean buoy:

> And under the oppression of the silent fog
> The tolling bell
> Measures time not our time, rung by the unhurried
> Ground swell, a time
> Older than the time of chronometers, older
> Than time counted by anxious worried women
> Lying awake, calculating the future,
> Trying to unweave, unwind, unravel
> And piece together the past and the future,
> Between midnight and dawn, when the past is all deception,
> The future futureless, before the morning watch
> When time stops and time is never ending;
> And the ground swell, that is and was from the beginning,
> Clangs
> The bell.

[31] Mumford, *Technics and Civilization*, 17. In this regard, one might compare the sense of time inculcated by the use of medieval bell towers that rang the "hours" for prayer—prime, terce, sext, and nones: the first, third, sixth, and ninth hour after sunrise—which depended upon when sunrise happened in that part of the world as contrasted with their replacement in later centuries with clock towers that called workers to work at 6 a.m. regardless of the season, whether the sun was up or not.

vocal parts in this otherwise silent film): "More speed!" Since Charlie's Tramp and his fellow laborers on the assembly line are already at the far limits of what they can humanly do, the results are both comic and tragic. Eventually—in what is undoubtedly the most famous single scene from the movie—Charlie is sucked into the machine itself where we see him spun around as though he were just another cog in the machine.

What Chaplin was parodying here was a twofold mistake. The first is that the automation of the machine can be extended to the human workers the machine is supposed to be "helping." This results in treating the workers as just another part, another cog, in the automated machinery. The second, and related, mistake was the misapplication of "machine time" to humans, thus failing to realize what ordering "More speed!" for the machine would mean for the workers on the assembly line.

When we interact with automated machines, we make related mistakes all too often, and it is important to notice that this is not a mistake one was likely to make in the same way before the age of the automated machine. Push an old manual lawnmower, and it won't go any faster than the one pushing. Its "time," its speed, is imparted to it by the operator. With automated machines, their speed is their own, and humans must do what they can to "keep up," and to fail to do so can result in serious tragedy, which is the grim message hiding behind the comedy in Chaplin's *Modern Times*. Machines, rather than serving as instruments and extensions of human labor, have become our master. Humans have become servants of the machine.

So, for example, our clocklike, clock-regulated mechanization has not brought about a more widespread experience of "more time," but much less. Many of us feel as though we don't have "enough time." "Time-keeping," says Mumford," has passed into "time-serving and time-accounting and time-rationing. As this took place, Eternity ceased gradually to serve as the measure and focus of human actions."[32]

Just as there have been deleterious consequences of "dissociating time from organic sequences"—hosts of people without enough sleep and schedules divorced from the healthy rhythms of the human body—so too there have been systemic evils that have resulted from divorcing human action from its measure in the eternal principles of truth, goodness, and beauty.

The Multiplication of the Machine Metaphor and "the Invisible Hand"

The centuries that have followed the genesis of the modern "Newtonian clockwork universe" idea have seen a host of thinkers re-envisioning reality in terms of self-sufficient, self-operating mechanisms, running (seemingly) on their own, apart from the continual guidance or intervention of a

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[32] Ibid., 14.

transcendent "mind." The "closed system" clockwork cosmology has been propagated into a truly clockwork universe.

In political theory, Thomas Hobbes proposed a form of mechanistic materialism and set out to describe the development of political regimes "mechanistically."[33] In economics, Adam Smith and his disciples spoke of an "invisible hand" that guided the machinery of the market.[34]

The key hallmark of such "invisible hand" explanations, as political theorist Edna Ullmann Margalit has noted, is that one can "delineate a mechanism that can show in specific detail how the actions of numerous individuals who pursue their own divergent interests may actually aggregate so as to bring about a well-structured yet undesigned social institution. And it is this sort of aggregative mechanism that is the heart of an invisible-hand explanation worthy of its name."[35]

As with the "Newtonian" clockwork universe that, contrary to anything Newton had in mind, resulted in the conclusion that there was "nothing for God to do," so too with invisible hand accounts: whatever religious principles

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[33] It is commonly said that, for Hobbes, "A mechanistic-materialistic politics is made to spring from a mechanistic-materialist universe." This quotation is taken from the famous introduction to *Leviathan* by Michael Oakeshott, reprinted in Michael Oakeshott, *Rationalism in Politics and Other Essays* (Indianapolis: Liberty Press, 1991), 235. Oakeshott himself disagrees with this assessment, but two pages later says this: "Philosophical explanation, then, is concerned with things caused. A world of such things is, necessarily, a world from which teleology is excluded; its internal movement comprises the impact of its parts upon one another, of attraction and repulsion, not of growth or development. It is a world conceived on the analogy of a machine, where to explain an effect we go to its immediate cause, and to seek the result of a cause we go only to its immediate effect" (ibid., 237). This certainly *sounds* like a mechanistic account. What is odd in particular is the failure to see that concern "with things caused" would *not* necessarily exclude teleology. For Aristotle and his heirs, "final causality" is simply another form of causality. It is precisely because "formal" and "final" causality had been removed from consideration in the physical sciences that "efficient" and "material" causality became the only causes, and "causation" was restricted to "pushes" and "pulls," or, to use Oakeshott's terminology, "the impact of parts upon one another," rather than "growth and development."

[34] For a good account of "invisible hand" explanations, see Edna Ullmann-Margalit, "Invisible-Hand Explanations," *Synthese* 39, no. 2 (October 1978): 263-91. For another, more critical perspective on invisible hand accounts, see Adrian Vermeule, "Liberalism and the Invisible Hand," *American Affairs* 3, no. 1 (Spring 2019): 172-97, esp. 178-82, where Vermeule lists prominent examples of invisible hand accounts: for example, in free markets, the "marketplace of ideas," the system of checks and balances, religious pluralism, federalism, and the adversary system in courtrooms.

[35] Ullmann-Margalit, "Invisible-Hand Explanations," 183.

Adam Smith may have had, many who have followed him have used the idea of the invisible hand mechanism to denude these systems of any governing relationship with either divine providence and, often enough, explicit human intentionality.

As for the first, the absence of a divine creator and guide, Edna Ullmann-Margalit contends, for example, that previous generations were "in the grip of a picture":

> [T]he theological picture, within which one is held in the grip of the "argument from design." The liberating role from the grip of this picture is assumed by an invisible-hand explanation that succeeds in showing, through spelling out the workings of an appropriate mechanism (or process), how the institution in question could have come about "as a result of human action but not of human design." This liberating role firmly establishes the notion of the invisible hand as a cornerstone in the secular, rationalist worldview that we associate with the Enlightenment.[36]

Thus, concludes Ullman-Margalit, "we may take the notion of the invisible hand as expressing a major antireligious intuition. This notion was meant to replace that of the 'Finger of God,' or 'Divine Providence.' It was to play a central role in forging modern, secular sensibility."[37]

Indeed, the mechanism of the invisible hand has not only replaced the action of divine providence, it has often enough replaced the role of human intentionality and the need for virtue. Not only is there no *divine* designer, there is no human designer either. And the character and agency of the human persons operating within the mechanism have become suspect as well.

As Adrian Vermeule has pointed out, invisible hand mechanism produces goods *indirectly*, at the systemic level, not because those goods are directly willed by the individuals within the system; rather "system-level goods emerge without anyone necessarily intending that they do so."[38] "The triumphalist version of the liberal faith," says Vermeule, "is that, having finally transcended the great fallacy that ordered liberty requires a Designing

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[36] Ibid., 183-84. "It is in this sense, and in this context that we may allude to Wittgenstein's notion of being 'in the grip of a picture': the picture is the theological picture, within which one is held in the grip of the "argument from design." Although she does not include a citation, the passage Ullmann-Margalit likely has in mind is from *Philosophical Investigations*, §115: "A picture held us captive. And we could not get outside it, for it lay in our language and language seemed to repeat it to us inexorably." See Ludwig Wittgenstein, *Philosophical Investigations*, trans. G. E. M. Anscombe, 2nd ed. (Oxford: Basil Blackwell, 1958).

[37] Ullmann-Margalit, "Invisible-Hand Explanations," 182.

[38] Vermeule, "Liberalism and the Invisible Hand," 175.

Hand, we can now see how ordered liberty and its resulting goods arise indirectly, but not by anyone's design."[39]

This shift from a "providential design" to "an indirect, emergent structure" is an indispensable trick,"[40] claims Vermeule, which allows liberalism "to reconcile the seemingly irreconcilable—to square the purposive pursuit of social aims, some good or aggregate of goods, with liberalism's horror of authoritative direction."[41] Persons are allowed (even encouraged) to pursue their own private good, which, by the magic of the mechanism of the invisible hand, are transformed, "by a kind of substitute miracle," into social goods.[42] Bernard Mandeville (1670-1733), for example, the Dutch-turned-English doctor, in his highly influential *Fable of the Bees* (1714), subtitled "Private Vices, Public Benefits," spoke of "institutions that ensure that men's divergent interests are reconciled."

Private Vices, Public Benefits?

We might trace the patrimony of this idea to Machiavelli, specifically his brilliant satire, *La Mandragola* (*The Mandrake*), in which young Callimaco wants to sleep with Lucrezia, the young and beautiful wife of elderly Nicia. Nicia desires a son and heir, but still has none. Lucrezia is determined to be true to her marriage vows. Counseled by the Machiavellian Ligurio, Callimaco masquerades as a doctor and convinces Nicia to drug Lucrezia with mandrake, claiming it will increase her fertility but adds that the mandrake will undoubtedly kill the first man to have intercourse with her. Ligurio then suggests to Nicia that an unwitting fool be found to be this doomed first man and suggests Callimaco. Lucrezia, although reluctant at first, is eventually convinced by her mother and a corrupt priest to comply with her husband's wishes that she have intercourse with Callimaco. By the end, the ingenious Ligurio has arranged it so that "all the divergent interests are reconciled," and all are satisfied. Callimaco has sex with another man's wife. Nicia gets a son, but it is not his son because he has been cuckolded. Lucrezia's admirable devotion to her elderly husband is compromised, but she believes it is all for the good. Replace the ingenious Machiavellian Ligurio with a self-operating mechanism, and you have the modern "invisible hand."

Critical to any invisible hand system is the claim that its operations are, like those of any machine, value-free. Value or purposes that would constrain those within the system would need to come from a designer. But if there is no designer, then there can be no such constraining values or purposes. These systems simply *exist*; how they came about is largely irrelevant unless it

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[39] Ibid., 193.
[40] Ibid., 173.
[41] Ibid., 178.
[42] Ibid.

illuminates how the system works *now*. As Vermeule points out, even if one could locate some original designer, it is necessary for the system to operate effectively that the designer of the system stop short "of using his own substantive judgment about the appropriate goods for the agents, instead leaving them to autonomous action within the designed system."[43] Machiavelli's Ligurio cannot "judge" the virtues or vices of the characters he manipulates, ostensibly for their own "good," although their "good" is understood merely as the satisfaction of their interests or desires.

It is not that Lucrezia's marital chastity is ridiculous, it is simply inconvenient to resolving everyone's interests. It is like an overly firm part of a belt in the machine that doesn't allow the mechanism to work smoothly. Ligurio either needs to work around it or "lubricate" it sufficiently to allow things to move forward so everyone gets (or seems to get) what they say they want. Whether what they want is what they *should* want—whether their desires are in accord with their flourishing and the flourishing of the community of which they are a part—is not subject to critical evaluation. The only value is that everyone gets (or seems to get) what they say they want and that peace and contentment reigns in the city. The ultimate *success* of the "arrangement," however, depends on a deception, and all parties will only remain "content" as long as they remain deceived. If the deception should ever be uncovered, this fragile peace would be destroyed, resting as it does on a thin tissue of lies. So too, if invisible-hand explanations depend on a deception, we might wonder whether they too broker only a fragile peace and no real, lasting contentment. When citizens begin to suspect that the "invisible hand" is really the hand of a manipulator, or that the *claim* of an "invisible hand" is being used by some to privilege themselves over others, the likely results will likely be rebellion and lasting enmity.

"Invisible-hand explanations," Ullmann-Margalit assures us, "are ideology free." They are, it is claimed, "value neutral." But are they? Do they, as is often claimed, allow everyone to act freely in what each understands to be her or his best interest? Or might they serve instead as masks for an aggressive will-to-power? The problem is not merely that invisible hand mechanisms sometimes let rewards go to vicious agents, it is rather that invisible hand mechanisms are often said to be *driven by* the vices of the agents. The public benefits occur not in spite of private vices, but because of them. And this, as much as anything else, distinguishes them from the "providential" accounts that preceded them, in which the providence of God was seen to inspire human virtues and act in and through human virtues (although it was not limited to them), rather than acting contrary to them.

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[43] Ibid., 176-77.

Divine Providence:
Inspiring Human Virtue or the Transvaluation of Human Vice?
Consider, in this regard, Giambattista Vico's claim in *The New Science* (1725), written in the decade after Mandeville's *Fable of the Bees*, that

> [o]ut of ferocity, avarice, and ambition, the three vices that lead all mankind astray, [society] makes national defense, commerce, and politics, and thereby causes the strength, the wealth, and the wisdom of republics; out of these three great vices which would certainly destroy man on earth, society thus causes the civil happiness to emerge. This principle proves the existence of divine providence: through its intelligent laws the passions of men who are entirely occupied by the pursuit of their private utility are transformed into a civil order which permits men to live in human society.[44]

Not only does Vico claim that social benefits arise from private vices, he attributes this to the workings of divine providence. This is to transform grace from a power that transforms human lives into a mechanism whose input, like iron ore into the blast furnace, is human vice and whose output, like glittering sheets of useful steel, is social good. Given such a view, it is not clear why the vices should be prohibited if God will simply "take care" of the problem anyway. On this view, the vices are not a "bug" in the machine, they are the fuel that feeds it.

Consider, for example, David Hume's essay "On the Rise and Progress of the Arts and Sciences" (1742), written seventeen years after Vico's *New Science*, in which he links "the rise and progress of commerce in any kingdom" with "avarice" and "the desire for gain," which he describes as a "universal passion, which operates at all times, in all places, and upon all persons," as compared to "curiosity, or the love of knowledge," which has a "very limited influence." As Alasdair MacIntyre has noted, "[s]entiments that Hume takes to be near universal and natural among humankind," such as avarice, desire for gain and esteem for riches and for the rich, would have been considered by Christian thinkers such as Thomas Aquinas to be "symptoms of failures as a rational agent."[45] They were vices to be avoided, not motivations to be encouraged. "The contrast with Hume," says MacIntyre, "is obvious." "And in this respect Aquinas's view contrasts not only with Hume's but also with that of Hume's contemporary and friend, Adam Smith."[46]

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[44] Giambattista Vico, *New Science*, trans. Dave Marsh (New York: Penguin, 1999), 132, 7.
[45] See Alasdair MacIntyre, *Ethics in the Conflicts of Modernity: An Essay on Desire, Practical Reasoning, and Narrative* (Cambridge: Cambridge University Press, 2016), 91.
[46] Ibid.

Adam Smith and the Deception that Allows
the Invisible Hand Mechanism to Work

Smith is widely recognized as the originator of the notion of the "invisible hand, although he only used the term twice. In book 4, chapter 2, of *The Wealth of Nations* (1776), Smith claims that when a person directs his industry "in such a manner as its produce may be of the greatest value, he intends only his own gain"; and yet "he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention"—namely, the end of greater wealth for all. By pursuing his own interest, claims Smith, he often promotes the good of the society more effectually than when he intends to promote the common good.

Perhaps more revealing, however, is Smith's use of the term years earlier in part 4, chapter 1, of *The Theory of Moral Sentiments* (1759), where he argued that, even when wealthy persons are only pursuing their own interests, by employing others to labor for them and by spreading their excess to others, they are "led by an invisible hand to make nearly the same distribution of the necessaries of life, which would have been made, had the earth been divided into equal portions among all its inhabitants," and thus they, "without intending it, without knowing it, advance the interest of the society, and afford means to the multiplication of the species." Not only is the whole society better off if each individual pursues his own interests, nearly the same distribution of goods is achieved that would have occurred otherwise.

It is important to note, however, that in Smith's work, the mechanism of the "invisible hand" depends upon a deception. What deception is this? At first glance, Smith seems to be in agreement with his friend David Hume, who had earlier in his *Treatise on Human Nature* (1740) claimed that "Nothing has a greater tendency to give us an esteem for any person than his power and riches" both because of "the satisfaction we take in the riches of others, and the esteem we have for the possessors."[47] In a similar vein, Smith claimed that, when we are not sick, "in times of ease and prosperity," our imagination "expands to everything around us." "We are then charmed with the beauty of that accommodation which reigns in the palaces and economy of the great; and admire how everything is adapted to promote their ease, to prevent their wants, to gratify their wishes, and to amuse and entertain their most frivolous desires."[48] Hume considered this desire for gain and esteem for riches and for the rich to be "near universal and natural among humankind." But Smith claims about the common esteem for riches and the rich that "it will always appear in the highest degree contemptible and trifling." The problem, says Smith, is that we rarely view the matter "in this abstract and philosophical light." More often, the pleasures of wealth and

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[47] Hume, *Treatise on Human Nature*, 2.2.5.
[48] Smith, *Theory of Moral Sentiments* 4.1.

greatness . . . strike the imagination as something grand and beautiful and noble, of which the attainment is well worth all the toil and anxiety which we are so apt to bestow upon it."[49]

Hence, according to Smith, the effort that drives the mechanism of the invisible hand is based on a deception about the value of wealth, one of which Smith himself remains undeceived. He knows—or at least tells us he does—that riches are "in the highest degree contemptible and trifling." Yet he continues to believe that "it is well nature imposes upon us in this manner, for "[i]t is this deception which rouses and keeps in continual motion the industry of mankind: "to cultivate the ground, to build houses, to found cities and commonwealths, and to invent and improve all the sciences and arts, which ennoble and embellish human life." Thus:

> [w]hen Providence divided the earth among a few lordly masters, it neither forgot nor abandoned those who seemed to have been left out in the partition. These last too enjoy their share of all that it produces. In what constitutes the real happiness of human life, they are in no respect inferior to those who would seem so much above them. In ease of body and peace of mind, all the different ranks of life are nearly upon a level, and the beggar, who suns himself by the side of the highway, possesses that security which kings are fighting for.[50]

Rather than God operating as an illuminating force, imparting his wisdom through the Holy Spirit so that human beings can, in cooperation with his gifts, come to know and understand their true good in common with others, on Smith's account, human understanding and human agency are not enabled by God's grace; instead, God's grace operates "mechanistically" by manipulating human intentions or the system of which they are a part. This view of divine providence as working by deception would seem more characteristic of Homer's Zeus in his dealing with the Greeks than the Christian tradition of a God who reveals himself as *Logos*-made-flesh.[51]

On Aquinas's account, by contrast, God's divine causality does not conflict with human agency; rather, God's grace strengthens and ennobles human agency. God can impart a new governing principle to the human principle, a new *form*, an infused virtue, by which our nature is healed, renewed, and elevated. With its help, we are enabled to love more fully and selflessly and in this way reach our full human flourishing, which can be achieved only in a loving communion with God and neighbor.

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[49] Ibid.

[50] Ibid.

[51] I have in mind in particular the scene in book 2 of the *Iliad* in which Zeus sends "an evil dream" to Agamemnon telling him that Troy will fall if the Greeks attack immediately. Upon awakening, Agamemnon abides by what he has been told, and the consequences are disastrous for the Greeks. This deception is part of Zeus's overall plan to give glory to Achilles, as he has promised to Thetis, his mother.

Formal and Final Causality:
Considerations about Human Nature and Human Flourishing

Stripped of the conceptual resources provided earlier generations by an understanding of the role of "formal" and "final" causality, early modern "mechanistic" accounts were left with only "material" and "efficient" causes. And with only the conceptual resources of "matter in motion" at one's disposal, it seems that if I move the chair, God does not. But if God moves the chair, I do not. The best we could do would be to say God moves me to move the chair, like one billiard ball hitting another that in turn hits a third.

But if we say that God moves me to move the chair *the same way* I move the chair, then this would seem to negate my free will, just as if someone pushes my hand onto someone else's face, we do not say I "slapped" that person freely or voluntarily. Not surprisingly, many early modern thinkers found it necessary to free themselves from this sort of divine interference in order to secure their freedom.

A conceptual framework for scientific investigation stripped of any consideration of formal and final causality was something Newton inherited from his sixteenth-century forbears, so he can scarcely be blamed for proliferating it. He himself strove mightily to keep the divine Creator part of the cosmic "system." But with the exclusion of any consideration of the "formal" or "final" causes so focus could be given solely to "material" and "efficient" causality, this perspective could scarcely have led to any other conclusion than that the operations of Nature were those of a gigantic "machine," with various "pushes" and "pulls," cogs in a vast machine operating on other cogs. An analysis solely in terms of efficient and material causality simply *is* an analysis of matter in motion, things pushing or pulling other things. It is not concerned with who gave the *form* to the "mechanism" or for what reason. I need not know anything about the life of the clockmaker to understand the workings of the clock.

More profoundly, however, all notions about the purposes of an external "designer" of Nature became not only unnecessary in the modern world but had to be ruled out of consideration from the very outset, and this for two reasons. First, one need not know who made the machine to understand how it works. And second, considering the *purpose for which* the machine was made might hinder my using it for *my* purposes. I don't care if the jet plane was created to carry people safely from one place to another if my purpose is to use it to crash into a crowded building in downtown Manhattan. For the latter, one need only know how the plane works, not who made it or what it was for.[52]

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[52] I do not mean to be cavalier in making this comment about the suffering that occurred due to the terrorist attack on the World Trade Center in New York. Nor do

Although natural science may have become increasingly estranged from any consideration of *telos* or flourishing, one could still often enough fall back on the moral sentiments inherited from society's earlier embrace of the Christian gospel. When there was still a great deal of agreement on basic moral principles and precepts, the presumption was widely shared that *of course* the advances in science and technology would be used only (or mostly) for "beneficent" purposes. But as the conceptions of the human flourishing that had provided the justification for the moral rules and disciplines began to fade, so did the conviction with which those rules were held. A simple farmer or miller might not have needed to understand the moral rules in terms of our distinctively human nature and *telos* as long as he continued to believe that those rules were ultimately *willed by God* and were necessary for him to *get to heaven*, but as that faith in the divine origin of the moral rules diminished, so too did the conviction with which the rules were held.[53] Increasingly, when moral conviction became something more like moral *sentiment*, men turned more often to more utilitarian considerations—the maximization of efficiency, profit, or "social utility"—which were more easily quantified and, not unimportantly, often fit better with the dispositions of their fallen human character.[54]

The *telos* of a machine is set by the managers who use it. It might be used to relieve the burden of the workers, or it might be used simply to maximize efficiency and profits. Who is to decide, and on what basis would we privilege the first goal over the second if the process is not governed by a view of human nature and human flourishing? In Chaplin's *Modern Times*, the machine was used to maximize profits, but it had the reverse effect of relieving the burden on the workers. For many "managers," the *telos* is determined by forces beyond and/or above them. As Alasdair Macintyre has noted, "[i]t is . . . a central responsibility of managers to direct and redirect their organizations' available resources, both human and non-human, as

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I mean to imply that all uses of mechanisms are evil as was that attack. The two points I wish to make, however, are that, first, it is not necessary to know who made a mechanism or why to understand how it works. And second, if we rule out of court considerations about *why* a thing was made—its purpose—then we are left with the question of how to judge the purposes to which the thing is put, whether it is a plane, a gun, a surgical scalpel, or an atomic bomb.

[53] For the definitive account of the difficulty faced by modern moral philosophy after the loss of faith in the divine authority of moral principles, see Elizabeth Anscombe, "Modern Moral Philosophy," *Philosophy* 33, no. 124 (January 1958): 1-19. Also Alasdair MacIntyre, *After Virtue*, 3rd ed. (Notre Dame, IN: University of Notre Dame Press, 2007), esp. 51-61.

[54] On the popularity of thinking in terms of "moral sentiments" rather than moral principles in the early modern period, see especially Hume, *Treatise of Human Nature*, esp. 2.2.2–8 and 3.3.1.7–8, and Smith, *Theory of Moral Sentiments.*

effectively as possible toward [predetermined] ends. [55] Managers and employees in such organizations are not customarily asked to reflect on the ends they serve. The problems they notice are usually those intrinsic to the system itself. A good worker will note whether the machinery of the system is producing good potato chips rather than rancid ones; they will not customarily ask whether eating potato chips is a healthy diet. A good worker is required to note whether the machine is producing good metal sheets; they are not required to ask whether the metal they are manufacturing is being used in bombs that kill or maim children.

The *telos* of any premodern system and the purposes of those who managed it were to be set by reference to an ultimate *telos*, namely, God's wisdom and will, which also demanded respect for each worker. I am not suggesting that all pre-modern people *respected* those restrictions. What they had, however, were intellectual resources to challenge the legitimacy of a system we now often lack. Economists will now talk about worker's wages in terms of "market forces," "contractual arrangements" regardless of the results to workers and their families. A premodern thinker, or someone like Pope John Paul II, could speak of "the infinite dignity of the human person," made "in the image and likeness of God." She or he could point to the fact that "the Word made flesh," "Son of the Father," spent the bulk of his life as a worker. He could speak of the "purpose" for which God gave the world to us "as a gift" and our consequent responsibilities to one another. Those who make use of the "machine" metaphor lack these resources.

Stripping natural philosophy of form and final causes in this way leaves us with nothing but the machinery of efficient and material causes, not only in our relationship with God, but also in our relationship with each other. On the Christian view represented by Aquinas, and by Aristotle before him from whom he learned the language of formal and final causality, it was easier to envision conceptually how a group of human beings could be motivated by a common goal understood by them to be a common good. Individuals within the group could realize, because of this understanding of their common good, how they would need to alter their individual dispositions and desires so they might become capable of "doing their part" in achieving the common good, which they realize is necessary for achieving their own personal good.

Christian teleology encourages agents to think of their common life together and their directedness to a common end. Whatever challenges or mistakes those who accept the demands of Christian teleology might make as they consider the relationship between their ultimate end and the lives they ought to live now—and they have been many—they are at least prodded to consider that end and their lives as a narrative whole. Lacking that goal, human agents are often enough left to consider their place within various

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[55] MacIntyre, *After Virtue*, 25.

"systems," consisting of various "rules" whose justification is to keep the system running smoothly.

What agents in such mechanistic systems are not encouraged to do is to think of their lives as a narrative whole; rather, they are taught to think of moral choices as individuals acting in response to a particular challenge. Often the challenges they must face are those having to do with conflicts between the various "systems" within which they must operate or conflicts between the values and principles with which they were brought up and those being thrust upon them by the demands of modern politics or commerce. Agents in such systems are rarely encouraged to develop the virtues that would allow them to achieve their ends as communal beings; rather, they are allowed, even encouraged, to act in ways that are self-regarding, even selfish, with the expectation that acting this way will lead in the end to social benefits—indeed *more* and *better* social benefits than if they acted selflessly.

Who Runs the Clock and For Whose Benefit?

And yet living in a "clockwork universe" with no "God" should prod us to ask who or what controls the clock? Who runs the machine? Is it really *reason* that controls the whole system, or merely self-interested passion and desire? Is the machine really "neutral" or does it rather privilege those with more pronounced desire for personal gain and a greater knowledge of the workings of the machine? And is the "machine" a social construction preferred precisely because it allows commercial interests of a certain sort and because it relegates moral concerns to some back alley? On the classic, premodern view, we were to imitate the cosmic order and order our desires in accord with it. Now, the idea of the mechanistic world and its "invisible hand" gives us leave to unleash those desires.

A providentially ordered cosmos is teleological and common, an ordered whole with each part playing its role according to a standard of excellence appropriate to that role. In the "mechanistic" universe, agents no longer can understand "the common good" as anything other than an aggregate of individual goods. The problem here is twofold. First, if several people have billions and many have next to nothing, the aggregate is still high. And second, many of the goods people value most and have been shown to lead to higher levels of human flourishing are those shared in common with others.[56] Lacking any shared notion of the common good makes such good shared in common increasingly invisible to us.

On the Christian account of God's providence, the divine order demands order from and among God's creatures. From human beings, that order is brought about by the use of human reason and human free will.

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[56] For a good overview, see T. J. VanderWeele, "On the Promotion of Human Flourishing," in *Proceedings of the National Academy of Sciences* 114, no. 31 (2017): 8148-56.

Although God's order ultimately transcends the work of agents and is not dependent on them, God does not encourage personal greed or leave people in their vices. God encourages personal selflessness and a concern for the whole. He encourages more people to understand the needs of the rest, because they know the proper human order will not simply emerge unintended by the work of an imminent system. Agents are called upon to be conscious of the needs of others and wise in their judgments about the common good. They must use the reason and love with which they have been gifted by God to determine the common good, having concluded by reason and faith that, as "social, communal beings," their personal good and the common good are intertwined in essential ways.

In the modern world, however, under the influence of a mechanistic account of the world, a view of divine providence that requires and enables human understanding and moral virtue based on the selfless love of neighbor and care for others has been replaced by a mechanism whose social benefits are supposedly obtained by being deceived about human good and acting in ways traditionally considered moral vices.

Technology and Our Linguistic Pictures of the World

In 1965, in the Second Vatican Council's Pastoral Constitution on the Church in the Modern World (*Gaudium et spes*), the Council Fathers noted that "the intelligence and creative energies of man" were bringing about "profound and rapid changes spreading by degrees around the whole world." In and of themselves, many of these technological changes were positive developments—reflections of man's creative genius. But there was another side to these advances, warned the Council Fathers: "These changes recoil upon man," they suggested, "upon his decisions and desires, both individual and collective, and upon his manner of thinking and acting with respect to things and to people."[57] In the relationship between technology and human concepts, the mechanisms we make often re-make us and recast the way we look at the world.

This tendency is often fostered by the way we construct concepts with which we can understand the world. When we come upon realities we cannot fully grasp or describe, we make analogies using images of things more clearly known to us. When trying to describe realities that operate at the far edges of our understanding, we search for images from the most complex technical advancements we have so far achieved. In the early modern period, the dominant image was that of the "self-moving" machine. The influence of this image has continued down to the present day, far beyond its original use in discussions of cosmology. It is a basic principle of human culture that the way people view the world in which they live will in large part determine the

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[57] *Gaudium et spes*, 4.

way they view their lives. People who conceived of the universe in mechanistic terms will likely come to view themselves and their institutions in mechanistic terms.

Were our medieval, patristic, and classical forebears caught "in the grip of a picture," as Ullmann-Margalit contends, or are we? Or would it perhaps be more accurate to admit that we both are "in the grip of pictures" because this is simply the way human beings envision their world and make it comprehensible to themselves? If so, perhaps there will always be limitations to every "picture" and dis-analogies to every analogous comparison. Perhaps the art of various "language games" is to be conscious of the ways in which the terms one uses can both reveal and conceal the reality one means to represent. What is to be avoided is not the *use* of the pictures, for this is unavoidable, but not to be "held captive" by them.[58]

We can be thankful for the many benefits bequeathed to us by those who employed the picture of the clocklike machine to help unveil many of the mysterious operations of nature. But pictures, images, and metaphors are only helpful if they disclose reality to us. But if a picture, image, or metaphor is no longer revealing the world *to* us, but is rather *concealing* important realities *from* us, then we should have the intellectual self-awareness and humility to ask ourselves whether that picture has outlived its usefulness and is now blinding us to truths we might prefer not seeing.

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[58] See the quotation from Wittgenstein's *Philosophical Investigations* in n. 36 above.