

Isaac Newton's Actual Theory of Time: Primary Sources, Misreadings, and Metaphysical Depth

Introduction: The Thesis of True Duration

In the history of natural philosophy, few concepts have been as profoundly influential—and as thoroughly caricatured—as Isaac Newton's theory of time. Within the contemporary popular imagination and introductory physics curricula, Newtonian time is frequently reduced to the metaphor of a universal ticking clock. It is presented as a simplistic, unproblematic parameter that marches forward uniformly, completely severed from any metaphysical or theological grounding. This textbook simplification portrays Newton's universe as a secular, dead mechanical machine wherein time is merely an empirically accessible background feature. However, a rigorous engagement with Newton's primary texts reveals a substantially different and far more intricate framework.

The overarching thesis of this analysis is that Newton's theory of time was in no way a naive belief in ordinary clock-time. Rather, it was a deeply integrated mathematical, metaphysical, and theological doctrine of true duration. For Newton, time is an absolute order of succession that flows uniformly by its own intrinsic nature, existing entirely independently of physical motion, human perception, and material clocks. Furthermore, this absolute time is ultimately grounded in the eternal and omnipresent existence of a living God. Far from being a simple cosmic clock, Newton's actual doctrine exhibits profound metaphysical depth, theological vulnerability, and subtle philosophical engineering.

To reconstruct Newton's actual position, it is necessary to synthesize his published masterworks—most notably the Scholium to the Definitions in the *Philosophiæ Naturalis Principia Mathematica* (1687) and the *General Scholium* appended to its second edition (1713)—alongside his *Opticks* and the critical unpublished manuscript *De Gravitatione et Aequipondio Fluidorum*. Through this synthesis, the architecture of Newtonian time emerges not as a single concept, but as a composite of four distinct, albeit interdependent, layers:

1. **Mathematical time:** The ideal, uniform parameter necessary for formulating the laws of mechanics and the calculus (the method of fluxions).
2. **Measured time:** The pragmatic, sensible, yet inherently flawed temporal approximations derived from clocks, pendulums, and astronomical cycles.
3. **Metaphysical time:** The self-subsisting absolute duration that serves as an independent container of succession, continuing even in the total absence of physical change.
4. **Theological time:** The ontological grounding of duration as an emanative effect, or "affection of being," stemming from God's eternal existence and omnipresence.

By examining these four layers, evaluating Newton's rejection of Aristotelian and Cartesian relationalism, and situating his views against those of contemporaries like Gottfried Leibniz and

later critics like Immanuel Kant and Albert Einstein, the true subtlety of the Newtonian temporal framework can be recovered.

Primary-Source Reconstruction: The Scholium to the Definitions

The definitive articulation of Newton's theory of time appears early in the *Principia*, within the Scholium that immediately follows the work's eight opening definitions. Newton begins by noting that while words like time, space, place, and motion are universally familiar, their common usage is plagued by epistemological errors. He writes, "it must be noted that these quantities are popularly conceived solely with reference to the objects of sense perception"¹. To strip away these common prejudices, Newton formally divides these quantities into "absolute and relative, true and apparent, mathematical and common"¹.

Absolute, True, and Mathematical Time

Newton's foundational definition of time represents a bold ontological declaration. In the original Latin text, he states: "*Tempus absolutum, verum, et mathematicum, in se et ex natura sua sine relatione ad externum quodvis, aequabiliter fluit, alioque nomine dicitur Duratio*"¹. Every phrase in this formulation is engineered to establish the metaphysical independence of time:

- **"In and of itself and of its own nature" (*in se et ex natura sua*):** Time is not an artifact of human consciousness, nor is it a secondary property derived from the motion of physical bodies. It possesses an intrinsic, self-subsisting reality¹.
- **"Without relation to anything external" (*sine relatione ad externum quodvis*):** This explicitly severs time from the material contents of the universe. Even if the universe were entirely devoid of matter, absolute time would still exist and pass⁴.
- **"Flows equably" (*aequabiliter fluit*):** Translation choices for *aequabiliter* slightly alter the interpretive emphasis. Andrew Motte and Florian Cajori translate it as "equably," while I. Bernard Cohen and Anne Whitman use "uniformly"². The term "equably" carries a rich philosophical nuance: it suggests an evenness, fairness, and unperturbed smoothness that cannot be altered by physical forces. Time's passage is not subject to the accelerations, decelerations, or localized anomalies that characterize physical objects¹.

Absolute time, which Newton also terms "duration," forms an unchangeable order of succession. Just as the order of the parts of space is fixed and immovable, the order of the parts of time is inviolable. All things in the cosmos are placed in time according to this objective sequence¹.

Relative, Apparent, and Common Time

In direct contrast to absolute time, Newton defines relative, apparent, and common time as "any sensible and external measure (precise or imprecise) of duration by means of motion; such a measure—for example, an hour, a day, a month, a year—is commonly used instead of true time"¹.

Absolute time is a metaphysical reality; relative time is merely the epistemological tool humans employ to approximate it. Newton explicitly warns against conflating the two. Relative time relies entirely on the observation of moving bodies—the rotation of the Earth, the swing of a pendulum, the progression of lunar phases. Because all physical motion is embedded in a universe governed by resisting mediums and complex gravitational perturbations, no empirical measure of time can ever perfectly map onto the flow of absolute time.

Absolute vs. Relative Time: The Distrust of Clocks and Imperfect Measures

A pervasive myth surrounding Newtonian physics is the belief that Newton equated time with the ticking of clocks. In reality, Newton harbored a profound distrust of ordinary measures of time. He recognized that the very instruments used to track time are fundamentally flawed because they are bound by the mechanical imperfections of the physical world.

In the Scholium, Newton highlights the necessity of the "astronomical equation" (mathematical correction) to deduce absolute time from relative observation. He observes: "In astronomy, absolute time is distinguished from relative time by the equation of common time. For natural days, which are commonly considered equal for the purpose of measuring time, are actually unequal"¹. Because the Earth's orbit is elliptical rather than perfectly circular, and its axis is tilted, solar days naturally vary in length. Astronomers must correct this inequality to measure celestial motions against a truer, mathematically idealized parameter¹.

Even if one were to use the most precise pendulum clocks or observe the moons of Jupiter, Newton understood that perfect isochronism (equal duration of motion) might not exist in the physical universe. He states astonishingly: "It is possible that there is no uniform motion by which time may have an exact measure"¹.

This single sentence shatters the myth of Newton as a naive empiricist regarding time. Newton did not believe that time *is* the ticking of a clock; rather, he believed that clocks are flawed, physical approximations attempting to track an invisible, mathematical ideal. Because "all motions can be accelerated and retarded, but the flow of absolute time cannot be changed," absolute duration must be logically distinguished from its sensible measures and mathematically reconstructed¹. Absolute time, therefore, is not directly observable. It is a theoretical necessity, posited to make coherent sense of the laws of dynamics.

Duration Without Motion: Severing Time from Aristotelianism and Cartesianism

By asserting that absolute time flows independently of anything external, Newton systematically dismantled the dominant paradigms of his era, specifically the relational theories of Aristotle and René Descartes.

For Aristotle, time was intrinsically linked to change. In his *Physics* (Book IV), Aristotle famously defined time as "the number of motion in respect of 'before' and 'after'"¹¹. Under the Aristotelian framework, time is ontologically dependent upon physical processes. If there is no motion, no

physical alteration, and no mind to perceive change, time simply ceases to exist¹¹. Time is merely the relational metric of physical unfolding. Similarly, Descartes viewed duration as a "mode of thinking"—an attribute conceptually tied to the existence and extension of created substances, rather than an independent reality¹⁶. In Cartesian natural philosophy, motion is defined purely by a body's change of position relative to its immediately contiguous surrounding bodies¹⁸.

Newton vehemently rejected these relational dependencies. In the Scholium, he declares: "The duration or perseverance of the existence of things is the same, whether their motions are rapid or slow or null"². This represents a profound metaphysical commitment: duration exists even in the total absence of change. If the entire physical cosmos were frozen in a state of absolute stasis, absolute time would continue its equable flow¹.

Is Newton's time a substance, an attribute, a relation, a container, or a mere abstraction? In the unpublished manuscript *De Gravitatione et Aequipondio Fluidorum* (written circa 1684–1685), Newton rigorously engages this ontological question. He argues that space and time have their "own manner of existing which is proper to it and which fits neither substances nor accidents"²¹. They are not substances because they are causally inert and depend entirely on the existence of a primary being (God). They are not accidents or properties because they do not inhere in physical bodies—they persist even if bodies are removed²¹. Instead, Newton defines time and space as "affections of being" (*affectiones entis*) or "emanative effects" of the first existing being²². This unique metaphysical classification demonstrates that Newton viewed time neither as a material substance nor a mere mathematical fiction, but as an objective, structural feature of reality necessitated by divine existence.

The Spatial Analogue: Absolute Space and the Rotating Bucket

Newton's account of time cannot be fully understood without examining its structural counterpart: absolute space. In the Scholium, Newton pairs the two because they form the dual absolute framework of the universe. He writes: "For times and spaces are, as it were, the places of themselves and of all things. All things are placed in time with reference to order of succession and in space with reference to order of position"¹.

To justify the existence of this absolute background against Cartesian relationalism, Newton deploys several arguments based on the properties, causes, and effects of motion¹³. The most famous of these is the rotating bucket experiment. If a bucket filled with water is suspended by a twisted cord and released, the bucket initially spins while the water remains relatively stationary; the surface of the water remains flat¹⁸. As friction gradually communicates the bucket's motion to the water, the water begins to spin along with the bucket, and its surface becomes concave as it endeavors to recede from the axis of rotation²⁷.

Crucially, when the water and the bucket are spinning at the same speed, there is *no relative motion* between them. Yet, the water is concave. According to Cartesian physics, which defines motion strictly as translation relative to contiguous bodies, the water is at rest. Newton

proves this absurd: the physical effect (centrifugal force resulting in concavity) arises not from relative motion, but from the water's true, *absolute* circular motion¹⁸.

While the bucket experiment directly establishes the necessity of absolute space as the reference frame for true acceleration, it indirectly yet necessarily supports absolute time.

Acceleration is the rate of change of velocity over time ($a = dv/dt$). To define true, absolute acceleration (and the resulting inertial forces), one must possess not only an absolute spatial geometry but an absolute, equably flowing temporal parameter over which that spatial change occurs³. Thus, the mathematical architecture of Newtonian dynamics requires both components of the absolute framework.

God, Eternity, and Omnipresence: The Constitution of Duration and Space

To arrest the analysis at the mathematical and metaphysical layers is to miss the ultimate foundation of Newton's natural philosophy. For Newton, absolute time and space were not autonomous, secular entities; they were strictly grounded in theology. The physical universe was not a self-sustaining machine, but the dominion of a living, intelligent *Pantokrator* (Universal Ruler)³¹.

The most explicit articulation of this theological layer is found in the *General Scholium*, added to the 1713 second edition of the *Principia*. In a passage directly combating both Cartesian mechanical philosophy and the relational critiques of Leibniz, Newton states regarding God: "He is Eternal and Infinite, Omnipotent and Omniscient; that is, his duration reaches from Eternity to Eternity; his presence from Infinity to Infinity... He is not Eternity and Infinity, but Eternal and Infinite; he is not Duration and Space, but he endures and is present. He endures forever, and is every where present; and, by existing always and every where, he constitutes Duration and Space."³¹

The original Latin phrasing—*et existendo semper et ubique, durationem et spatium constituit*—is metaphysically dense³⁴. What does it mean for God to "constitute" duration? Newton carefully guards against pantheism. He explicitly rejects the notion that space and time *are* God, or that the physical universe is God's body³¹. God is a substantial, intelligent being; eternity and infinity are merely modes of His existence. Because God exists necessarily, His continuous perseverance generates the eternal flow of absolute time. Space and time are, therefore, "emanative effects" of the divine nature²². Absolute time is absolute precisely because the God who grounds it is eternal, immutable, and omnipresent.

Newton further explored this intimacy between the divine and the spatial-temporal framework in the Queries appended to his *Opticks* (1706 Latin edition; 1717 English edition)⁴⁰. Seeking an explanation for how God perceives and governs the cosmos without being a physical part of it, Newton suggested that God perceives all things intimately by being present to them "in infinite space, as it were in his Sensory" (*tanquam Sensorio suo*)⁴².

This language invited fierce criticism. Leibniz mocked the idea, accusing Newton of implying that God had physical sense organs and relied on space to perceive the world³⁹. Samuel Clarke,

defending Newton in the Leibniz-Clarke correspondence, clarified that the term was strictly analogical. Just as the human mind perceives images brought to its local sensorium (the brain), God immediately perceives the entire universe because infinite space itself serves as the unmediated arena of His omnipresence⁴⁶. Space and time are the immediate domain of divine presence and perception, framing Newton's worldview far closer to a mathematically rigorous theology than to a secular empirical science²⁴.

Dispelling the Myths of Newtonian Time

The profound nuances of Newton's doctrine have frequently been lost in textbook summaries. The following structured analysis addresses and explicitly corrects ten pervasive myths regarding Newtonian time, utilizing primary-source evidence to restore the original view.

Myth	Newton's Actual Position	Source Evidence & Explanation
1. Newton thought time was just what clocks measure.	Clocks provide "relative, apparent, and common" time. Absolute time flows independently of any mechanical device.	"Relative, apparent, and common time is any sensible and external measure... commonly used instead of true time." ¹ Clocks are flawed epistemological tools, not ontological reality.
2. Newton thought celestial motion creates time.	Time does not depend on celestial cycles. Natural days are unequal and require mathematical correction.	"Natural days... are actually unequal. Astronomers correct this inequality in order to measure celestial motions on the basis of a truer time." ¹
3. Newton's time is merely common-sense time.	Newton explicitly rejected the "vulgar" or common-sense understanding of time, warning against tying time to sensible objects.	"The common people conceive those quantities under no other notions but from the relation they bear to sensible objects." ¹
4. Newton had no metaphysical or theological theory of	Time is an "emanative effect" or "affection of being" generated by God's	"By existing always and every where, he [God] constitutes Duration and

time.	eternal existence.	Space." ³¹ <i>De Gravitatione</i> explores this deeply ¹⁰ .
5. Newton thought absolute time was directly observable.	Absolute time is imperceptible to the human senses. It is a mathematical/metaphysical parameter inferred through corrected observation.	"Time and Place in themselves do not fall under the senses." ¹⁰ It must be deduced through the "astronomical equation" ¹ .
6. Newton's universe was a dead mechanical machine.	The universe requires God not just as a first cause, but as the sustaining presence providing the arena of space and time.	God governs "not as the soul of the world, but as Lord over all." In Him all things are contained and moved ³¹ .
7. Einstein simply made Newton stupid or obsolete.	Newton's framework is a highly successful, rigorous limiting case for macroscopic systems at low velocities.	General Relativity reduces to Newtonian physics in weak fields and low velocities ($v \ll c$). It is incomplete at extremes, but practically robust ⁴⁷ .
8. Absolute time is the same as modern spacetime.	Newton treated space and time as strictly distinct, orthogonal absolutes. Modern physics fuses them into an interdependent continuum.	For Newton, absolute time flows without relation to spatial dimensions or motion ¹ . Modern spacetime links temporal intervals to spatial motion ⁵⁰ .
9. Newton believed time and space are literally God.	Newton vigorously denied pantheism. God is a substance possessing attributes; space and time are effects, not God Himself.	"He is not Eternity and Infinity... he is not Duration and Space, but he endures and is present." ³¹
10. "Absolute" means empirically accessible.	"Absolute" (<i>absolutum</i>) means unbound, unconditioned, and	Absolute time flows "without relation to anything external" (<i>sine</i>

	independent of relations to physical bodies, not easily measurable.	<i>relatione ad externum quodvis</i>) ¹ .
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A Tapestry of Rivals: Comparing Newton with Alternative Theories of Time

To fully appreciate the radical nature and philosophical vulnerabilities of Newton's theory, it must be situated against the major alternative philosophies of time spanning from antiquity to the twentieth century.

Augustine and the Internalization of Time

While Newton projected time outward as an objective, mind-independent feature of reality, **St. Augustine of Hippo** famously internalized it. In Book XI of his *Confessions*, Augustine grappled with the unreality of the past (which is gone) and the future (which is not yet), concluding that time is fundamentally a psychological phenomenon—a *distentio animi* (distension of the soul)⁵³. For Augustine, time consists of memory (past), attention (present), and expectation (future) held together in human consciousness⁵⁵. Newton's framework completely rejects this psychological subjectivity. Absolute time flows uniformly regardless of whether any conscious observer exists to remember or anticipate its passage⁴.

The Leibniz-Clarke Correspondence

The most formidable contemporary challenge to Newton's absolutes was mounted by **Gottfried Wilhelm Leibniz**. In 1715–1716, Leibniz engaged in a bitter philosophical correspondence with Samuel Clarke, Newton's theological proxy⁵⁸. Leibniz defended a strictly relational theory: "I hold space to be something merely relative, as time is... an order of successions"⁷. If there were no created objects or events, Leibniz argued, there would be no time.

Leibniz deployed two powerful philosophical weapons against Newtonian absolutism: the Principle of Sufficient Reason (PSR) and the Principle of the Identity of Indiscernibles (PII)⁵⁸. If absolute time exists, Leibniz argued, every moment of empty time is completely identical to every other. Why, then, would God choose to create the universe at moment t_1 rather than exactly one year later at t_2 ? Because there is no sufficient reason for God to choose one identical moment over another, absolute time must be a metaphysical absurdity⁶⁵.

Clarke, defending Newton, countered that God's absolute free will is a sufficient reason unto itself. Furthermore, Clarke argued that parts of time are numerically distinct precisely because they are successive; t_1 is not t_2 , even if they are qualitatively devoid of matter⁶⁵. Clarke maintained that absolute time is a necessary consequence of the existence of an eternal God,

framing Leibnizian relationalism as a dangerous path toward Spinozism or atheism, as it seemed to subject God's creative acts to a pre-existing deterministic logic³⁹.

Kant's Transcendental Idealism

In 1781, **Immanuel Kant** offered a radical synthesis in the *Critique of Pure Reason* that rejected both the Newtonian and Leibnizian premises. Kant argued that if Newton were correct, space and time would be "two infinite non-entities" (*Undinge*) that bizarrely exist on their own without being substances or properties⁵. Conversely, if Leibniz were correct, time would be a mere empirical relation, making synthetic *a priori* knowledge (like mathematics) impossible⁶⁹.

Kant's solution was Transcendental Idealism. He proposed that space and time are not features of the mind-independent external world (noumena) at all. Rather, they are *a priori* pure forms of sensible intuition⁶⁹. Time is the necessary internal scaffolding the human mind imposes to process and sequence experience. Where Newton viewed mathematical time as a reflection of divine reality, Kant viewed it as a reflection of human cognitive architecture.

Mach's Empiricist Critique

In the late nineteenth century, **Ernst Mach** launched a devastating epistemological attack on Newtonian mechanics in his book *The Science of Mechanics* (1883)⁷⁴. Mach, a radical empiricist, argued that science should only deal with observable phenomena. He accused Newton of violating his own rule against feigning hypotheses (*hypotheses non fingo*) by inventing unobservable absolute space and time⁷⁴.

Mach directly attacked the rotating bucket experiment. He argued that the water's concavity did not prove rotation relative to absolute space, but rather rotation relative to the fixed mass of the distant stars in the universe²⁸. If the bucket remained stationary and the entire universe revolved around it, Mach posited, the centrifugal forces would still appear. For Mach, time was not absolute, but merely an abstraction derived from the changes of things⁷. Time must be defined relationally through the mechanical workings of physical systems (e.g., the Earth's rotation relative to the stars), discarding Newton's "equable flow" entirely⁷.

Newtonian Time in the Shadow of Modern Physics

Mach's relational critique deeply influenced **Albert Einstein**, who fundamentally overturned Newton's paradigm with the Special Theory of Relativity (1905) and General Relativity (1915)⁷⁷. Einstein demonstrated that the speed of light is constant for all inertial observers, which logically dictates that time is not absolute⁵¹. Because of time dilation, a clock moving at high velocity ticks more slowly than a clock at rest⁵². Most critically, Einstein shattered the concept of absolute simultaneity. In Newton's universe, if an event happens "now" on Earth, it happens at the exact same "now" across the entire infinite universe⁸². In relativity, observers in different states of motion will disagree on whether two spatially separated events occurred simultaneously²⁸.

Subsequently, **Hermann Minkowski** fused space and time into a single, four-dimensional spacetime continuum⁵⁰. In Newtonian mechanics, space and time are strictly orthogonal; an

object's motion through space does not affect its passage through time¹. In Minkowski spacetime, space and time are deeply interdependent. Under General Relativity, this spacetime is not a passive, rigid container, but a dynamic field that curves and warps in the presence of mass and energy¹¹.

Despite this paradigm shift, it is a gross oversimplification to declare Newton simply "wrong" or obsolete. Newtonian mechanics, utilizing the parameter of absolute time, remains an incredibly powerful and mathematically rigorous limiting case for modern physics⁴⁷. In the domain of low velocities ($v \ll c$) and weak gravitational fields, the predictions of relativity seamlessly reduce to Newtonian equations⁴⁷. We still navigate spacecraft through the solar system using Newtonian dynamics, not General Relativity (with exceptions like GPS satellite timing adjustments)⁴⁷. Newton's absolute time succeeded spectacularly as an idealized mathematical model for macroscopic mechanics, even if it failed as an ultimate metaphysical description of the cosmos.

Conclusion: The Coherence and Vulnerability of the Four Layers

Isaac Newton's theory of time was a monumental intellectual achievement that transcended the simple image of a ticking cosmic clock. To assess it accurately requires viewing it through the synthesis of its four layers.

1. **Mathematical time** provided the pristine, continuous parameter (t) necessary to invent the calculus and formulate the universal laws of motion.
2. **Measured time** acknowledged the pragmatic reality that human instruments—clocks, pendulums, and celestial cycles—are inherently flawed and require constant astronomical correction.
3. **Metaphysical time** established an absolute, self-subsisting container of succession, severing time from the Aristotelian requirement of physical motion and providing the unmoving theater required for true acceleration and inertial forces.
4. **Theological time** provided the ultimate ontological anchor. Time flows equably not by magic, but because it is the emanative effect of an eternal, immutable, and omnipresent God whose continued existence constitutes duration itself.

Did these layers cohere? For Newton, they formed a perfectly unified system. Mathematical time is a conceptual abstraction of Metaphysical time, which in turn is an emanation of Theological time; Measured time is our flawed, empirical attempt to glimpse the Mathematical truth.

However, deep unresolved tensions remained embedded in the system. The fundamental epistemological gap between the absolute reality of time and humanity's inability to observe or measure it perfectly left Newtonian physics vulnerable. If absolute time is empirically inaccessible, how can science be certain of its uniform flow? Newton's answer ultimately rested on a theological guarantee: the uniformity of time is assured by the immutability of God. When nineteenth and twentieth-century physics systematically stripped away the theological

layer, the metaphysical layer of absolute time was left exposed, possessing no empirical defense against the critiques of Mach and the relativistic revelations of Einstein. Yet, while the philosophical and theological foundations of Newton's absolute time have been overturned, the conceptual architecture he built remains profoundly compelling. Newton recognized that to understand the mechanics of the changing physical world, one had to posit an unchanging mathematical ideal—a doctrine that was subtle, strange, deeply theological, and foundational to the modern scientific enterprise.

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