The Toll of the Clock

by James Gleick ***The New York Review of Books*, September 23, 2021**

Reviewed:

About Time: A History of Civilization in Twelve Clocks
by David Rooney
Norton, 271 pp., $28.95

> *Time is impassive, more animal than human. Time would not care if you fell out of it. It would continue on without you. It cannot see you; it has always been blind to the human and the things we do to stave it off, the taxonomies, the cleaning, the arranging, the ordering.*
>
> *—Lauren Groff*

And the clocks! The clocks, especially—they promise control, efficiency, or even power, but time doesn't care. And don't say time "marches on." We march on. Time just is.

When the first public sundial arrived in Rome, a trophy of war expropriated from Sicily in the third century BCE and mounted in the Forum for all to see, some Romans cursed it. "The gods damn that man who first discovered the hours, and—yes—who first set up a sundial here, who's smashed the day into bits," wrote Plautus. "You know, when I was a boy, my stomach was the only sundial, by far the best and truest." People have been complaining about clocks ever since.

Plautus, a comedy writer, may have been half-kidding, but David Rooney is not. "It changed everything," he tells us. "Romans were forced to live their lives by the clock. And this new temporal order was sweeping civilizations across the world." In his insightful, globe-spanning new book, *About Time: A History of Civilization in Twelve Clocks*, he sets out to show that this ancient device is neither simple nor innocent, that clocks are designed with hidden agendas and ulterior motives, and that their influence on human societies and the human psyche has been more profound than we usually imagine.

Do we need a definition for this ubiquitous object? A clock is a device that measures time, I would say. (Though some physicists, seconded by the Internet Encyclopedia of Philosophy, like to say that time is what clocks measure.) Clocks also transmit information. The word *clock* may come from an Old French word for bell, *cloche* or *cloque*. Rooney says, "We tend to use it to mean fixed devices, either electronic or involving intermeshing geared wheels, that keep time and show it to us." But he will define the word as broadly as possible to include anything that tracks the passage of time: sundials, hourglasses, kitchen timers, and all the rest, including the clock on your wrist and the other one in your pocket.

Rooney's own relationship with clocks is long and deep. When he was eight years old his parents, both schoolteachers, decided to start a business making and restoring clocks in their home on the northeast coast of England. They became horologists, practicing a specialty that combines mechanical engineering with scholarship and antiquarianism. "I picked up the language of clocks and watches," Rooney writes, "hearing discussions about the arcane technology of horology—fusees, escapements, oscillators—as well as the challenges of working with these complex machines."

Accompanying his parents to museums and country houses, he came to feel that every clock has a story. Perhaps it was inevitable that as an adult he would find his way to the Royal Observatory in Greenwich,

the very epicenter of the world's clocks. Besides being the origin point for what is now known as Coordinated Universal Time (UTC), Greenwich collects and preserves precision timepieces dating back to the sixteenth century. Rooney oversaw these as curator of timekeeping from 2004 to 2009. He has also served as steward of the Worshipful Company of Clockmakers, which has as its motto *Tempus Rerum Imperator* (Time, the Ruler of All Things).

J.T. Fraser, the influential twentieth-century scholar of time, often emphasized that the clock must be seen not only as a device but as a metaphor. Clocks don't just measure the time. They communicate messages about temporality that go beyond the number representing the present instant. Rooney understands this well. The clocks he reflects on (many more than twelve) are instruments of power, money, and faith. At the outset, he disclaims any intention to explore the nature of time itself as a scientific or philosophical problem; he will leave that "to the experts." For him, clocks convey a variety of meanings that flow from the people who make and deploy them.

The first Roman sundial—"mounted up high, looking over the people, and standing for Rome's ruling classes themselves"—had power both symbolic and real. Sundials were followed by water clocks and then mechanical clocks, and clock towers used drums and bells to broadcast time to the populace. This was not just a convenience. From the first, rulers used the clock as a means of control or even subjugation. "By forcing a sense of *temporal* order on to the population, these public timekeepers stood for a wider sense of *civic* order," Rooney says. A clock in a high tower sends a message: *Here is the knowledge. Here is the authority.*

The most famous, most photographed clock in the world is surely the one at the Palace of Westminster in London, originally called Clock Tower when it was completed in 1859, renamed Elizabeth Tower in 2012, but universally known, for reasons no one seems to remember, as Big Ben. Its four faces each span twenty-three feet. The giant pendulum that regulates it is adjusted each year with the addition or subtraction of old pennies—a charming analog remnant in a digital world. The enormous bells strike on the quarter-hour and can be heard five miles away.

The largest clock in the world, however, is in Mecca. The Makkah clock, completed in 2012 atop a skyscraper and hotel complex overlooking the Great Mosque, is six times larger and higher than Big Ben. Its lights flash the call to prayer five times a day, visible at a distance of nineteen miles. Its resemblance to Big Ben is deliberate. "Putting Mecca time in the face of Greenwich Mean Time, this is the goal," said one official when the clock was finished. Rooney, who has traveled to clocks in many nations, tried to visit the Makkah but was forbidden as a non-Muslim.

"For all the major world religions, clocks and faith go hand in hand," Rooney tells us. For this purpose, *clock* includes calendar. Religious institutions were at least as eager as civic leaders to impose order on their followers. Establishing regular prayers, feasts, and holidays meant fixing their times in the day and the seasons, creating a routine and formalizing observance. Buddhists in Japan and China marked time with incense-burning clocks long before mechanical clocks became standard equipment at churches, mosques, and synagogues. Congregations were meant to understand that God's majesty and grandeur included mastery of the wheels of time. The clock behind the altar at St. Mary's Church in Lübeck, on the Baltic coast of Germany, was built and rebuilt many times; its ornate calendar dial, dating to the sixteenth century and accompanied by carved representations of the deadly sins and the Evangelists, served as a virtual almanac of solar and lunar dates and times. An inscription read:

> *When Thou regards in the Heavens the Shining Sun and then the light of the Moon, shining in their appointed courses; so then Thou canst perceive with the eye how the hours fly…. Think then of God who governs the Stars; and at the same time praise Him.*

British bombers pulverized the church and its clock in the spring of 1942.

Of course, clock number one—not counting the many biological clocks ticking away in and around us—was the sun, marking the earth's rotation. Long before Plautus protested, solar time already governed much of the human routine. Sundials just made it more obvious and exact. The moon's rhythms, too, have guided time-reckoning since the prehistoric era. Intricate and complex astronomical clocks like the one in Lübeck not only kept time, they did so by mimicking the heavens in machinery, copying and modeling celestial motions, orbs and planets driven by wheels and gears. Clockmakers and astronomers have been natural partners. By 1605 it was plausible for Johannes Kepler to say, "My aim is to show that the celestial machine is to be likened not to a divine organism but to a clockwork." The timekeepers at Greenwich occupy an observatory, the original headquarters of the astronomer royal.

In Jaipur, India, a far larger astronomical observatory and time center was built in the early 1700s for the ruler Jai Singh, who was determined to perfect tables of astronomical data in order to predict eclipses and other cosmic events. He sent to Europe for talent and records, including the much-treasured star atlas of John Flamsteed, England's first astronomer royal. And he built what remains the world's largest sundial, the Samrat Yantra. The gnomon rises to a height of seventy-five feet, and the time marked by its shadow is accurate to about two seconds. To Rooney, Jai Singh's motivation was clear: "He wanted to show the world that he was at the center of the universe." This may sound grandiose, but the Greenwich observatory was similarly motivated.

The message was that "time and astronomy held the secrets of the heavens." Earthly rulers wanted to flaunt their possession of those secrets. As early as 1259, the Mongol ruler Hulagu Khan, grandson of Genghis, created the great Maragha observatory in what is now Iran. Three hundred fifty years before the invention of telescopes, the astronomers there used sextants to track the movements of stars and record them in comprehensive tables. Nearly two centuries later and a thousand miles to the east, the sultan Ulugh Beg founded a giant observatory in Samarkand, which likewise amassed troves of data regarding star positions. When England built its own observatory in Greenwich in 1675, Flamsteed worked from the Samarkand tables, by then copied and translated many times. Isaac Newton, in turn, borrowed Flamsteed's data; he also built sundials and studied pendulums. Like Kepler, he conceived of the universe as a machine, its interacting parts linked by laws of cause and effect, ticking reliably onward, governed by "absolute, true, and mathematical time"—a clock.

Now we know, thanks to Einstein, that Newton was wrong about absolute time. Einstein observed clocks at railway stations and imagined them traveling at high speed on trains and spaceships; he proved that different observers, in different reference frames, mark the time differently. Each reference frame has its own clock, and there is no one clock to rule them all.

Yet here on earth, time is treated more than ever as absolute, true, and mathematical. No matter that Einstein says perfect simultaneity is impossible—we enforce simultaneity worldwide, with atomic clocks maintained in icy vaults at the United States Naval Observatory in Washington, the Bureau International des Poids et Mesures near Paris, and elsewhere. UTC has split from solar time; the earth's rotation is not consistent enough to serve as a reference when our financial markets and lightspeed communications networks depend on nanosecond precision. Scientists now define that venerable unit of measure, the second, with esoteric priestly authority, as "the duration of 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium-133 atom." And the day? Don't look to the sky. The day is nothing more or less than 86,400 of those atomic seconds. God's clock may not exist, but humanity has established a collective timescale that tolerates no dissent. How we got to this point is the most important part of Rooney's story.

Social scientists distinguish two kinds of time. One kind is fluid and inconstant. The other is exact and exacting. We're born with the first kind. There are time signatures in natural processes, rhythms that vary and intertwine, and our experience of time is notoriously subjective. "Time travels in divers paces with divers persons," as Rosalind says in *As You Like It*. It ambles, trots, or stands still. The second kind of time is abstracted from the tempos of nature. It enables rocket ships and factories. We can call it industrialized time or scientific time. Social scientists just call it clock time.

Clock time was not born all at once. It has crept up on us—or, I think Rooney would prefer to say, it has been imposed, along with the spread of empires and the development of capitalism. The sparkling twelve-foot time ball that drops in Times Square on New Year's Eve is a vestigial descendent of hundreds or thousands of time balls that served in the nineteenth century to synchronize clocks and distribute standard time around the globe, especially wherever there were ships. Marine chronometers had been essential for ocean navigation since the mid-eighteenth century, and before radio or the electric telegraph the accuracy of those clocks depended on signals that could be seen or heard. Greenwich established one of the first time balls, painted red, in 1833, and it has been dropping at 1:00 PM ever since.

European ships needed accurate time wherever they went, and wherever they went, they spread the power of empire. Individual chronometers inevitably gained or lost time, so they needed resetting. At the fortress overlooking the Cape of Good Hope, the first time signal was a cannon fired daily at noon. In the 1820s the English built an observatory at Cape Town—staffed largely by enslaved workers—and set up a time ball. Time guns and balls spread around the peninsula and, when technological innovation permitted, used electrical signals sent from the observatory. "All this infrastructure was built just in order to distribute accurate time from the observatory to the chronometers on board each of the ships in the bay," Rooney notes. "Time on the southern African coast must have been worth a fortune." It was the same wherever the ships of empire went.

We look back on this history from an era when the world's clocks are increasingly connected—synchronized—by wired and wireless networks, and we're learning to take this for granted as the natural state of things. Twice a year, victims of daylight saving time still need to set some clocks and watches forward and back by an hour—though many clocks (including those in smartphones) make the change themselves. It's worth remembering that the synchronization of clocks, and the standardization of time, are relatively new. Before electricity, London clockmakers used to send assistants to the Greenwich observatory with pocket watches to get the exact time and bring it back, like hot soup in a takeout container. In 1836, Rooney tells us, an observatory staffer named John Belville turned the process around and began visiting the clockmakers with his own timepiece on a weekly basis—for a fee. He guaranteed the time to within a tenth of a second. The business prospered, and it remained a Belville family enterprise for the next hundred years, up to World War II.

By then, the clock as a personal and portable device—the watch—was standard equipment, not just a status object for the very rich. The manufacture of clocks had been one of the first and most lucrative manifestations of the Industrial Revolution, preceding even the textile industry. "The very term 'clockwork,'" as Rooney says, "became synonymous with industrial machinery." In 1800 half the world's watches, 150,000 a year, came from England. That was about to change. Switzerland's booming industry soon left England far behind, with specialist firms importing technologies from France and crafting fine, luxury timepieces. And so did the United States, in a different way, by mobilizing mass production.

But it was a linked pair of new technologies that put the world on its path to standard time: the telegraph and the railroad. Trains needed exact time, and electric signals by wire could deliver it. Trains carried people across the earth rapidly enough to expose a problem: the time as reckoned by the sun varied in every town and village. When it was noon in London, it was only 11:54 in Leeds and 11:47 in Barrow. High-speed transport made this untenable. The first standard time was Railway Time, defined in Britain

by an act of Parliament as Greenwich Mean Time. In the United States, where the east–west distances were so large that local times varied by hours, standard time led by necessity to the creation of distinct time zones.

Standard time became a product—a commodity of value. London entrepreneurs in 1876 founded the Standard Time Company; the Standard Electric Time Company started in Connecticut eight years later. They had no shortage of customers: traders at banks and financial exchanges gained an edge from speed and depended on exact timing. (They still do, only now they deal in microseconds.) Early subscribers to the Standard Time Company also included pubs, because they were under pressure to enforce strict licensing hours. Inexorably, exact time became embedded in law and regulation. The Factory Acts, meant to provide the first small protection for children working in the mills, required that "the hours of the work of children and young persons…shall be regulated by a public clock, or by some other clock open to public view." For Rooney, all this falls under the heading of the public clock as "an instrument of moral control."

Tempus Rerum Imperator: "Time-keeping passed into time-serving and time-accounting and time-rationing," wrote the sociologist and critic Lewis Mumford in 1934. He believed the clock was the crucial machine of the modern age, responsible for the dehumanizing rhythms of industrial work, and Rooney agrees. Ultimately he deplores these devices to which his parents devoted so much of their lives. He sees them as exploiters and tyrants—words usually applied to humans—rather than as desirable appliances or conveniences. They "wormed their way through societies," he says. They "disciplined the masses." They "became our overseers and landlords, our managers and supervisors."

By keeping time down to nanoseconds, clocks also fix our location in space. Satellite navigation systems like GPS depend on orbiting atomic clocks, first American but now also controlled by Russia, the European Union, China, Japan, and India. These satellites continually transmit the exact time, and receivers triangulate their position based on the slight discrepancies caused by the delays in the lightspeed signals. "The night sky is a museum of old clocks, if we could see that far," Rooney says. Navigation has been transformed. If the system had been in place in September 1983, Korean Airlines flight 007, carrying 269 people, would not have strayed into forbidden airspace and been shot down by a Soviet MiG. Rooney does not exaggerate when he says that these clocks "have changed the world, not just technically, but politically and culturally." By next year there will be as many GPS receivers as humans.

The totality of our network infrastructure, all our linked computer systems, relies on this near-perfect synchronization. "These are the networks and systems that keep us alive, with food on our plates and roofs over our heads," he says, but he doesn't have to like it. "They are clocks placed above our heads by a military superpower. The service they provide is not—was never—benign." He fears we have made ourselves all too vulnerable to technological failure or even catastrophe.

There is a clock for that too, of course: the Clock of Doom, a symbolic dial created in 1947 for the *Bulletin of the Atomic Scientists* to indicate the time left until Armageddon. Originally it was set at seven minutes to midnight. Now, owing to climate change and Covid-19, the *Bulletin* gives us a hundred seconds. It's just a metaphor, of course.

For my money, the most revelatory of clocks is the 2010 movie by Christian Marclay, titled *The Clock*. It's not in Rooney's compendium, but I suppose he had to draw the line somewhere. *The Clock* tells the time nonstop in a twenty-four-hour loop. It is composed of snippets, about 12,000 of them, from films of many eras and languages. If you happen to walk into a screening of *The Clock* at 10:30 PM, you will see the actor David Strathairn as Edward R. Murrow delivering the news at 10:30 PM in *Good Night, and Good Luck* and, an instant later, Dustin Hoffman in *Tootsie* watching television at 10:30 PM.

Clocks are seen center screen or glimpsed in shadowy corners, on night tables, on wrists, on walls, in shop windows, grandfather clocks, clock radios, hourglasses, metronomes, and time bombs. When Ilsa leaves Rick waiting at the train station in *Casablanca*, it is 5:00 PM. At 5:43, Celeste Holm as Karen in *All About Eve* asks the time and Hugh Marlowe as Lloyd says, "When you asked a minute ago it was 5:42. It is now 5:43. When you ask a minute from now it will be—" Twenty minutes later, David Tomlinson in *Mary Poppins* sings, "It's 6:03 and the heirs to my dominion/Are scrubbed and tubbed and adequately fed." The time in *The Clock* and the time in the real world advance together.

The Clock is never boring, in my experience, but it is often frustrating. No sooner does a storyline draw you in than it jumps away. Narratives have no time to develop, and characters have no continuity. Everyone seems obsessed with time—waiting, worrying, racing the clock, punching the clock, clocking in or clocking out. "There's no time," they cry, or "I just don't have the time." For the viewer, suspense is never relieved, only restarted; as Zadie Smith wrote in these pages, "you miss clips the moment they're gone, and cling to the aural afterglow of what has passed even as you focus on what is coming, what keeps coming."*

The atomizing of time is deliberate. Marclay smashes the day into bits. He creates a continuous fragmentary present. We might say that's what all clocks do. Clock time is one instant replacing another. The philosopher Henri Bergson, who resented the encroachment of scientific time, wrote in 1889:

When I follow with my eyes on the dial of a clock the movement of the hand which corresponds to the oscillations of the pendulum, I do not measure duration, as seems to be thought; I merely count simultaneities, which is very different.

Far from anchoring us in time, clocks cast us loose from the past, dislocate us from our natural sensation of continuity.

And still we welcome them into our lives. If exact timekeeping exploits us, we crave it nonetheless. In the early days of telephones, operators discovered that people were phoning them up just to ask the time. The telephone companies realized that customers would pay to hear the time announced by a disembodied voice. In London in 1935 there were 100,000 time queries a month, and a nationwide competition was announced to find "the Girl with the Golden Voice" who would speak the time with a pure tone and a pleasant inflection. The "Speaking Clock," as the service was named, eventually received tens of millions of calls each year. Introducing it, Postmaster General George Tryon declared, "Here we have the latest and most wonderful of clocks," adding, rather oddly, "It only speaks when spoken to."

In its era, the Speaking Clock was a beloved feature of the cultural landscape. Many celebrities lent their voices to it over the years. Tom Stoppard made it (or her) the protagonist of his 1966 radio play *If You're Glad I'll Be Frank*. "The authority of my voice," she muses, "the voice of the sun itself,/more accurate than Switzerland—/definitive/divine." She pities her callers

> and their dialling fingers,
> their routine-checking, schedule-setting time-keeping clockwork—
> luminous, anti-magnetic,
> fifteen-jeweled self-winding,
> grandfather, cuckoo, electric
> shock-, dust- and waterproofed, chiming;
> it counts for nothing against the scale of time.

Hardly anyone uses the Speaking Clock anymore, but that's not because we've stopped caring what time it is. It's because we always know. Or if we don't, then, as Rooney notes, we can just ask Siri.