Timepieces

The clock is always slow.
It is later than you think.

Robert W. Service (1921)
It Is Later Than You Think

Few sounds are more soothing yet more disturbing than a clock. Perhaps the human breath: the first gasp of a newborn child, the last of a dying parent. And in between, our own steady breaths, whispering like second-hands on a clock, synchronized with the silent cogs deep inside, ticking without winding for seventy or eighty years – more if you're lucky, less if you're not. Soothing but disturbing, the clock keeps a pulse on our mortality.

A mantel clock soothes us, especially in the evening when the fire beneath it glows. Its rhythm seems natural as the embers die and crumble through the grate.

But a bedside clock is more apt to rattle us. It keeps some awake, with every tick or tock pulsating perturbation – *Where, where could she be?* It awakens others, with every bell or buzzer shattering slumber.

I wake up as many people do, while the alarm sleeps. My movement is almost clockwork. I turn and look at the clock, face to face, knowing it's just a matter of time before the alarm goes off. Then I roll back and unwind, with hands folded on my chest, elbows symmetrically set at five and seven o'clock. Sometimes I listen for my heart, but only hear the clock. They're never in sync anyway. The body might mirror a clock, but the mind reflects time.

Time is to clock as thought is to brain. Timepieces don't really keep time; they just keep up with it, if they're able. So it is with the brain and thought. The clock and the brain somehow contain time and thought, respectively. Yet time and mind refuse to be bottled up like a genie stuffed in a lamp. Whether they flow as sand or turn as wheels, time and thought escape irretrievably.

With eyes closed I listen to that timepiece that each of us carry, the ticking mind. I know I have enough time for praying, so I pray, the same prayer, every morning, like clockwork. Oddly enough, I can't say how long it takes. I could time it, but the thoughts behind the words are timeless. To measure the speed of thought, if one could, assumes thought travels. But that implies thought comes from somewhere. Where? Is it secreted (out) from the brain or radiated (in) from the heavens? Just thinking about thought gives a migraine. Praying is my anodyne.

You might find this alarming, but clocks[1] were invented for just that reason, praying. It was not farmers or sailors, nor merchants or craftsmen who needed mechanical measures of time, but religious persons anxious to perform their duties promptly and regularly. Back then, monks needed to know the times for their appointed prayers. And their prayers were answered: the clock was invented.

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[1] Not sundials, water clocks and hourglasses, but mechanical clocks.

In Europe the first clocks were not designed to *show* time but to *sound* it. The visible gradual flow of a shadow across a dial, of water from a bowl, of sand through a glass… showed time. But the mechanical clock was designed for a decisive audible act, the stroke of a hammer on a bell. If it doesn't strike, some insist, it's a timepiece not a clock. Regardless, the first true clocks were alarms. In fact, the monastic origin of the word "clock" meant bell.[2] Making a machine to sound the canonical hours required, and achieved, mechanical novelties. (One spin-off was the metal lathe.) The time for precision tool-making had finally come – and not an *hour* too soon.

For the first time in history "hour" took on a precise, year-round, everywhere meaning. There were few greater revolutions in human experience than this movement when man declared independence from the Sun. This mechanical staccato sounded new proof of man's mastery over his surrounding. Sun time was translated into clock time. Oddly, nobody knows when the idea chimed, but around 1330 is a good estimate.[3]

If God had created the universe with solar heartbeats – so that the Sun could flash or tick with regular pulses – the clock might have been nothing more than a solution looking for a problem. But that intelligent design slipped off His drawing board. Instead man had to think up the day's heartbeat. And he came up with the arbitrary, unpredictable number twenty-four. A 10- or 100- hour day makes more sense today, but keep in mind the decimal system wasn't invented until about 250 years after the clock, though nobody was keeping track of the time.[4]

So, why twenty-four? Historians don't help much, but you could say it's another timely problem from the Middle East. The Egyptians divided their day into twenty-four hours, and that blame goes to Iraq (which ought to please some people). The Babylonians developed a sexagesimal (60) number system, based on multiples of six, but we have no explanation why. The number sixty apparently had nothing to do with the movement of celestial bodies. Nevertheless, the sexagesimal unit explains the division of minutes and seconds. It also reveals the nexus between time and space.

The revolving Earth is a cog in the clockwork universe, and the Egyptians fixed 360 days as the regular days of the year: 12 months of 30 days (both multiples of 6) supplemented by 5 additional days at the end of the year. So, 60, being 1/6 of 360, became a convenient subdivision of time – a "degree" of each hour. They also marked off 360 degrees in a circle, perhaps by analogy to the yearly circuit of the sun. This might explain the tiny circle we now use to designate a spatial degree: it's a hieroglyph for the Sun.

Another relic is the 12-hour system (by which Americans, unlike much of the world, still count hours). Even after the arrival of the mechanical clock the Sun left its mark on the measuring of hours. Daylight hours were measured and subdivided separately from nighttime hours, which explains the origin of the word "hour": it comes

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[2] The Middle English *clok* came from the Middle Dutch word for bell and is cognate of the German *Glocke* and French *cloche*.

[3] D. Boorstein *The Discoverers: A History of Mans' Search to Know His World and Himself.* Random House, 1983

[4] Simon Stevin offered the decimal system in a 36-page booklet, *The Tenth* (1585). Earlier systems for handling fractions had been cumbersome. Stevin's solution was to treat all fractional units as integers. Why not, Stevin asked, simply treat the quantity 4 and 29/100 as 429 items of the unit 1/100? Why not America?

from Latin and Greek words meaning *season*, or *time of day*. Long before it meant 1/24 part of the day, hour meant 1/12 part of sunlight or darkness. And before the clock arrived, the hour was truly temporary: it varied with season and latitude.

With latitude (of thought) the clock navigates us back to space, because, to a certain degree (of precision), it plots longitude. In short, if you're at sea, and have enough time on your hands, you can figure out where you are by looking at the Sun, a map, and a clock.

If you think we live by the clock today, you should have been a sailor in 1762. That's when John Harrison's *chronometer*[5] solved the problem of determining longitude. When his clock arrived at Jamaica on January 19th, everyone gawked. It had lost only 5 seconds after 81 days at sea! That might not impress you now, but back then the best timepieces were accurate to within six seconds a day. And seconds were as important to mariners then as they are to marathoners today: they determine who wins the prize. An explanation is in order.

For seamen, it was straightforward knowing the ship's latitude, the position relative to mapped *parallel* lines that girdle the globe from the Equator to the poles in a series of shrinking concentric rings. Sailors gauged latitude by the day's length, or the Sun's height, or known guide stars above the horizon. The problem was longitude, the *meridian* lines that loop from the North Pole to the South and back again in great circles of the same size. The measurement of longitude, in comparison to latitude, is tempered by *time*. To determine longitude at sea, one needs to know what time it is on board ship and also – at the same moment – the time at home port (or another place of known longitude). The time difference is then converted to space difference.

Since the Earth takes 24 hours to revolve of 360 degrees, 1 hour marks 1/24 of a spin, or 15 degrees (east or west). Consequently, a degree of longitude equals four minutes the world over. In terms of space, however, the distance varies. A degree shrinks from 60 nautical miles (68 geographical miles) at the Equator to 0 at the poles.

Conceptually, longitude was easy to solve; in practice it was a tough nut to crack, even for wizards like Newton. The brightest minds and daffiest cranks of the eighteenth century were working on a solution, in part, because the Longitude Act of 1714 offered a £20,000 prize. All one had to do was prove a method to determine longitude to an accuracy of a half degree, which took a half century.[6]

Astronomers, like Newton, tried to solve the problem by measuring the distance between the stars and planets. Unfortunately, Newton died four decades before the prize was awarded to a self-educated clockmaker. Harrison was a carpenter by training and for his early clocks he came up with the clever idea of making self-lubricating gears out of oak, exploiting the wood's natural oil. Wood also avoided the metals' problems at sea: corrosion, contraction in arctic regions and expansion in the tropics, thus altering the speed of the mechanisms. But his later timekeepers were too complex for woods (and words); some had as many as 15,000 parts, with wheels within wheels within wheels….

His chronometer was complex because it could not lose or gain more than 3 seconds in 24 hours. Why so accurate? Arithmetic makes the point. A daily error of only 3 seconds, compounded over a 40-day voyage from England to the Caribbean, adds up to

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[5] An instrument for measuring time accurately in spite of motion or varying conditions.
[6] The quest to solve the longitude problem, and of Harrison's obsession with building his perfect timekeeper, is well told in D. Sobel's (1996). *Longitude.* Walker Press.

2 minutes of error by journey's end. Translated to distance, that would keep the islands over the horizon, and consequently out of sight. Harrison's last timepiece proved accurate to within one-third of a second.

Harrison constructed five chronometers (H-1 – H-5) over his lifetime.[7] It took others almost a lifetime to figure out how he did it. He was a clever clockmaker but a clumsy writer. The first sentence of Harrison's booklet *Difference that should & will be betwixt ye Longpendillom & ye Sun if ye Clock go true* runs on, virtually unpunctuated for twenty-five pages. Coincidentally, his clocks still run on, virtually punctual for the past 234 years. If you have the time, you can watch them tick at the Royal Observatory in Greenwich. I've seen them and they really are exquisite machines, with their movements rocking like ships at sea, save H-4, which is frozen in time. But their beauty goes beyond the polished brass and silver, the engraved scrolls curling endlessly, the delicate hands with filigree fingers. It's the moving thought behind them.

The sublime nature of clocks, other than their complex movement, is their simple stasis. For a fleeting moment time stops; just long enough for their hands to touch our minds. In a way, a clock thinks for us: organizing, categorizing, and structuring to reveal relationships, which is the heart of mind. Clocks reveal time the way maps reveal space, by simplifying relationships between our finite world and the infinite entities that define it.

But a clock tells more than time. It also tells us who we are, by the way we react to its waving hands and chiming voice – making us feel more than we think.

[7] H-3 took nineteen years to build, which is more time than it took to carve Mount Rushmore (fourteen years), excavate the Panama Canal (ten years) or get *Apollo* off the drawing board and on the Moon.