De geschiedenis van de tijd

'The Time Machine'

In the introduction to his book *Technics and Civilization* the American philosopher Lewis Mumford sketches an important interdependence between the changing notions of time, the mechanical clock and the development of the machine for the emergence of the modern world. *Technics and Civilization*, originally published in 1934, is one of the classic surveys of the influence of technological developments on the culture of 'Modernity'[1]. Mumford describes it himself as "a history of the machine and a critical study of its effects on civilisation". The importance of Mumford's work is made clear by the numerous references that can be found in contemporary writings on the history and philosophy of technology.

Mumford makes an important distinction between a *tool* and *the machine*; "The 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 for automatic action." (p. 10) He then asks the question where the machine first took form in modern civilisation, to which there can be no unambiguous answer. However, Mumford writes, "the first manifestation of the new order took place in the general picture of the world: during the first seven centuries of the machine's existence *(roughly from the late 13th century onwards -E.K.)* the categories of time and space underwent an extraordinary change, and no aspect of life was left unchanged by this transformation. The application of quantitative methods of thought to the study of nature had its first manifestation in the regular measurement of time..."[2]

The invention that would provide the 'regular measurement of time' was the mechanical clock, and Mumford stresses its importance for the development of the modern industrial societies. The origin of the mechanical clock provides one of the great paradoxes of modern civilisation, since it was within the monastery, and under the strict regulation of worldly life by medieval scholasticism, that the mechanical clock came into being. According to my philosophical dictionary "the scholasticism of the western Christian civilisation is characterised by the fact that the foundation for Science and Philosophy was provided by the truths of the Christian dogmas."

Mumford: "Within the walls of the monastery was sanctuary: under the rule of the order surprise and doubt and caprice and irregularity were put at bay. Opposed to the erratic fluctuations and pulsations of the worldly life was the iron discipline of the rule. Benedict added a seventh period to the devotion of the day, and in the seventh century, by a bull of Pope Sabinianus, it was decreed that the bells of the monastery be rung seven times in the twenty-four hours. These punctuation marks in the day were known as the canonical hours, and some means of keeping count of them and ensuring their regular repetition became necessary."[3]

Looking upon the Benedictines, "that great working order", as "perhaps the original founders of modern capitalism", Mumford maintains that "one is not stressing the facts when one suggests that the monasteries - at one time there were 40.000 under the Benedictine rule -

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[1]The term *Modernity* has been the object of much discussion (can it be defined as an epoch, where does it begin, where does it end ?). For a general discussion see: Jürgen Habermas, *Modernity - An Incomplete Project*, in: Hal Foster, *The Anti-Aesthetic*, Bay Press, Seattle, 1983.

[2]Lewis Mumford, *Technics and Civilization*, New York, Harcourt Brace Jovanovich, 1934/'63, p.12.

[3]Mumford, p. 13

helped to give human enterprise the collective beat and rhythm of the machine; for the clock is not merely a means of keeping track of the hours, but of synchronising the actions of men."[4]

The Development of the Mechanical Clock

In two beautifully written essays the Dutch philosopher Douwe Draaisma has described the development of the mechanical clock and what he calls the 'uniformation of time'[5]. Draaisma also relates the origin of the mechanical clock to the monastery, placing it at the end of the thirteenth century. To regard the strict regularity of the Benedictions and their canonical hours as the heralds of the rhythm of the industrial age, as Mumford does, he considers exaggerated. Nonetheless he also feels that the regularity of monastic life has prompted the need for a uniform measurement of time.

Avril

The transition from a natural to an artificial regulation of time is reflected in the character of the chronometers. The first, oldest and slowest of all clocks, the calendar, followed the repetition of natural events, the cycle of seasons, the twelve new months in each year and the change from day to night. In analogy to the twelve new moons of each year the Babylonians divided the day up into twelve 'hours' measured by a sun-dial. It is significant to remember that the length of each day, in other words the duration of each light-period varied throughout the year and consequently the duration of each 'hour' pointed out by the sun-dial varied proportionally. Nonetheless, the time registered by the sun-dial, that has existed over ten times longer than the mechanical clock, was perceived as the real time. This view was still expressed by writers on the sun-dial up until the eighteenth century, stressing the need to adjust mechanical clocks to the time registered by the sun-dial.

Other non-mechanical means of time-measurement were the water-clock (or clepsydra), and to keep track of the nightly hours candles and oil-lamps. The hour-glass was not invented till after the first mechanical clocks, and its first representation can be found on a fresco in the Palazzo Pubblico in Siena, dating ± 1337. Aside from their sensitivity to external influences (heat, cold, wind, etc..) there is one important disadvantage to these elementary chronometers; they could only register the duration of an event, not its exact position in the day. It was the mechanical clock that made it possible to register the precise point of time of both beginning and end of any event in the course of the day.

To make a uniform measurement of time possible it was necessary to introduce a 'digital' notion of time. Instead of considering the passing of time as a continuously flowing process, there had to be a smallest and constant unit of duration in terms of which the duration of any

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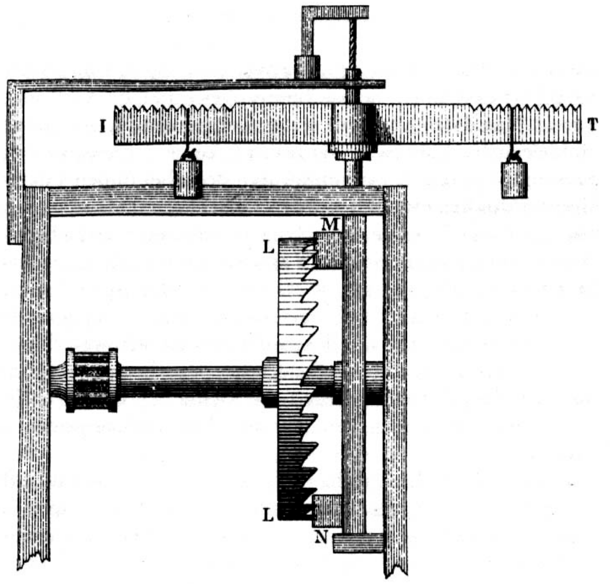
[4]Mumford, pp. 13-14.

[5]See: Douwe Draaisma, Het verborgen raderwerk - Over tijd, machines en bewustzijn, Baarn, Ambo, 1990.

event could be expressed. Where chronometers relied on natural processes, uniform repetition in natural processes was the key to the problem. The earth revolving evenly around its own axis provided such a means. It could be observed in the passage of celestial bodies across a fixed position in the sky. (Every 23 hours, 56 minutes and 4 seconds). Each repetition, or a sub-division of it, provides an 'atomic' unit in terms of which the duration of any event can be expressed. In our case it is the vibration of the Caesium 133 atom which provides a faiurly accurate measure for the second[6]. In any case this measure relies on agreement not on an absolute and independent standard of time. Thus time may be considered a cultural construction, a convention.

Every mechanism that provides even and repetitious movement can be used as a clock. This even motion can be achieved by using a uniform energy to propel the mechanism. Where there is an uneven source of energy (as in most mechanisms), the propulsion has to be *made*



1. Het oudste type echappement of gang: de 'verge and foliot'.

evenly. This function is performed by the escapement.

Draaisma: "The oldest type of escapement, the 'verge and foliot' (*figure*), consists of a pivot, or axis, to which two spoons (M and N) are attached at an angle of 90 degrees to each other. A tooth of the crown-wheel L pushes one of the spoons away each time, causing the other spoon to block the opposite tooth. The foliot (i - T) sways back and forth and keeps the pivot turning. Hanging the weights nearer to the centre of the foliot causes the clock to run faster. By letting the energy 'escape' tooth by tooth an even motion is created (thus: *escapement*)."

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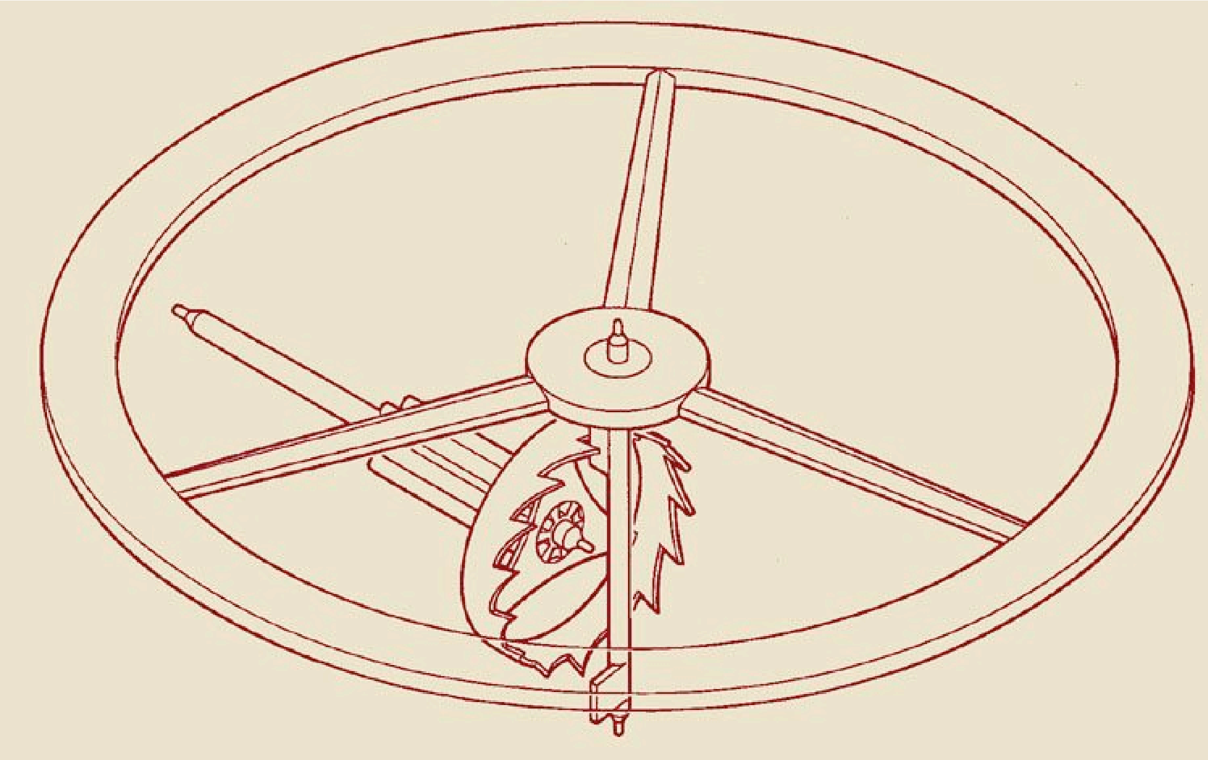
[6] The caesium atom's natural frequency was formally recognized as the new international unit of time in 1967: the second was defined as exactly 9,192,631,770 oscillations or cycles of the caesium atom's resonant frequency, replacing the old second that was defined in terms of the Earth's motions. The second quickly became the physical quantity most accurately measured by scientists. As of January, 2002, NIST's latest primary caesium standard was capable of keeping time to about 30 billionths of a second per year. [www.corneal.co.uk/Hist-of-Timekpng.htm]



(...) "Earlier attempts to create an even supply of energy made use of restraining mechanisms such as friction. The foliot on the contrary stops the movement for a short moment entirely, to then let it reach momentum again. The genius of this construction is that while the pivot continues to move because the crown-wheel is pushing it, the crown-wheel is halted for a moment each time because of the motion of the pivot. The escapement regulates the flow of energy in the clock by appropriating part of it for itself. Weights and springs control their own energy through the escapement."[7]

It is unknown who invented the escapement, or even where it was invented, although England seems most likely. The mechanism had no predecessor in any machine or invention. It suddenly appeared, and with it the mechanical clock. Draaisma calls it an invention *ex nihilo*, one of the greatest enigmas of the history of technology. As pointed at earlier by Mumford the mechanical clock spread through the monasteries, at the end of the thirteenth century. Documents of that time about mechanical clocks can be traced in various English monasteries: Exeter (1284), St.Paul, London (1286), Merton College, Oxford (1288), Norwich (1290), Ely Abbey (1291) and Canterbury (1292).[8]

During the 14th century the mechanical clock spread through the cities. The newly acquired autonomy of the city-states and their civil governments made it possible to raise taxes and thus finance their public clockworks. The clock spread across the cities as swiftly as it had across the monasteries: Milan (1335), Padua (1344), Genua (1353), Brussels (1362), Augsburg (1364). In the Netherlands the first public clockworks appeared only little later: Utrecht (1369), Maastricht (before 1373), and around 1400 most major cities all owned their own public clockwork.

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[7] Draaisma, ‘90, pp. 23-24

[8] Draaisma, ‘90, p. 25.

Public astronomical clock of the old twonhall of Prague

One possible factor that could explain this swift dissemination of the clock across Europe could be the mobility of the professional clock-makers, who travelled from city to city to offer their services. But more important still according to Draaisma was the adoption of *even hours* (1345), one of the most important reforms in the history of time-regulation. Traditionally the day had been divided into twelve even segments. The duration of these hours varied from season to season, and progressively from the south to the north. Whereas the sun-dial could take account of this uneven duration, the mechanical clock, as mentioned earlier could only measure hours of even duration. The adoption of even hours went hand in hand with the proliferation of the mechanical clock. Day and night would from now on consists of twelve even hours.

Draaisma holds that it is difficult to say whether the adoption of even hours was a prerequisite for the proliferation of the mechanical clock, or rather that it was the invention that lead to the adoption of a different time-regulation. He feels that the measurement of time was more probably adapted to the possibilities of the machine. In Japan, for instance, even hours were only adopted until 1872, a few years after the introduction of the first mechanical clocks in the country. It illustrates, he says, the precedence of technology over tradition.[9]

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[9]Draaisma, ‘90, pp.30-31.

The adoption of even hours meant more for the citizen of the 14th and 15th century then the mere change of a convention. It meant that the sun was no longer the principal means of orientation in the day, but rather a mechanical device. It also prompted a greater need for accessible clocks. In the 15th century the mechanisms of the clockwork were miniaturised and the spring device was adopted to drive the mechanism (instead of weights). The clock could thus enter the private home. A new market was provided for clocks, at first by court and nobility, later also by wealthy citizens.

Clocks and Navigation

Draaisma calls it ironical that it was the need for an improved spatial orientation that prompted the development of more precise mechanical clocks.[10] For seafaring countries like Spain, Great Britain and the Netherlands navigation on sea was a major problem. Although many trade routes along the coasts of Europe and Africa were well-documented, navigation across the seas and the oceans was a hazardous affair.

Satisfactory methods to determine the degree of latitude (*breedtegraad*) at sea, by taking the height of the sun or the polar star above the horizon, had been available for a long time, but a good method for determining the degree of longitude (*lengtegraad*) remained difficult until the end of the 18th century. Many ships, cargos and lives were lost as a result of this deficiency, making a method for determining the longitude at sea a commercially interesting challenge.

One proposal was to use mechanical clocks to determine the longitude at sea. The idea was simple; by measuring the difference between the moment when the sun reached its highest point in the sky (noon local time) and the time in the harbour were the ship had left, the longitude could be determined. Knowing that the earth revolved around its axis in 24 hours, each hour of time-difference meant a distance of 15 degrees longitude (360 degrees in all, divided by 24 hours). What was needed was a clock precise enough to enable reliable calculations, and robust enough not to be influenced by the movements of a ship in a harsh sea. And this clock indeed had to be uncommonly precise, since one degree of longitude on the equator equals 69 miles.

In 1714 the British government established the *Board of Longitude* and offered an award of 10.000 pound (at that time an astronomical figure) "*for such Person or Persons as shall discover the Longitude at Sea*". It had to be precise within one degree. If the method would be precise within a range of half a degree, the sum was even doubled. The prize spurred the imagination and a great number of entries. Eventually it was awarded to John Harrison, who developed five clocks for it during his lifetime. The last of these (completed in 1760) was a miniaturised version, based on a portable watch he had developed alongside the other clocks, measuring no more than 15 centimetres across. Harrison spent his entire life on the project, but was given the prize only in 1773, after an intervention of king George III, three years before he died.

By the end of the 18th century other manufacturers began to produce mechanical clocks in greater numbers, which were increasingly precise and miniaturised. The navy was the principal customer for these clocks, using them not only for navigation, but also to synchronise and co-ordinate the actions of their fleets at sea. Clocks became a part of the weaponry.

On land the need for more precise clocks was at first less urgent. But with the ongoing industrial revolution in the course of the 19th century, the clock was to become an important device for the co-ordination of social activities and public services. During the 15th century the first forms of mass-production came into being, mainly textiles, that relied on this improved co-ordination of activity. It furthermore shifted the attention in the reward for labour from goods or money in return for a finished product to the length of a working day and the time invested in the production of a given product.

The mechanical clock exerted an increasing grip on daily life. It became a pre-requisite for

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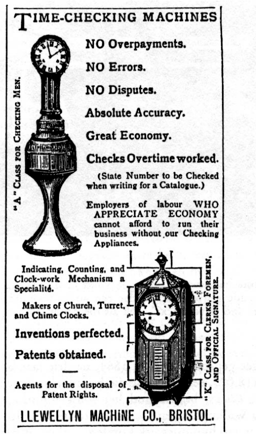
[10] Draaisma, ‘90, p.48.



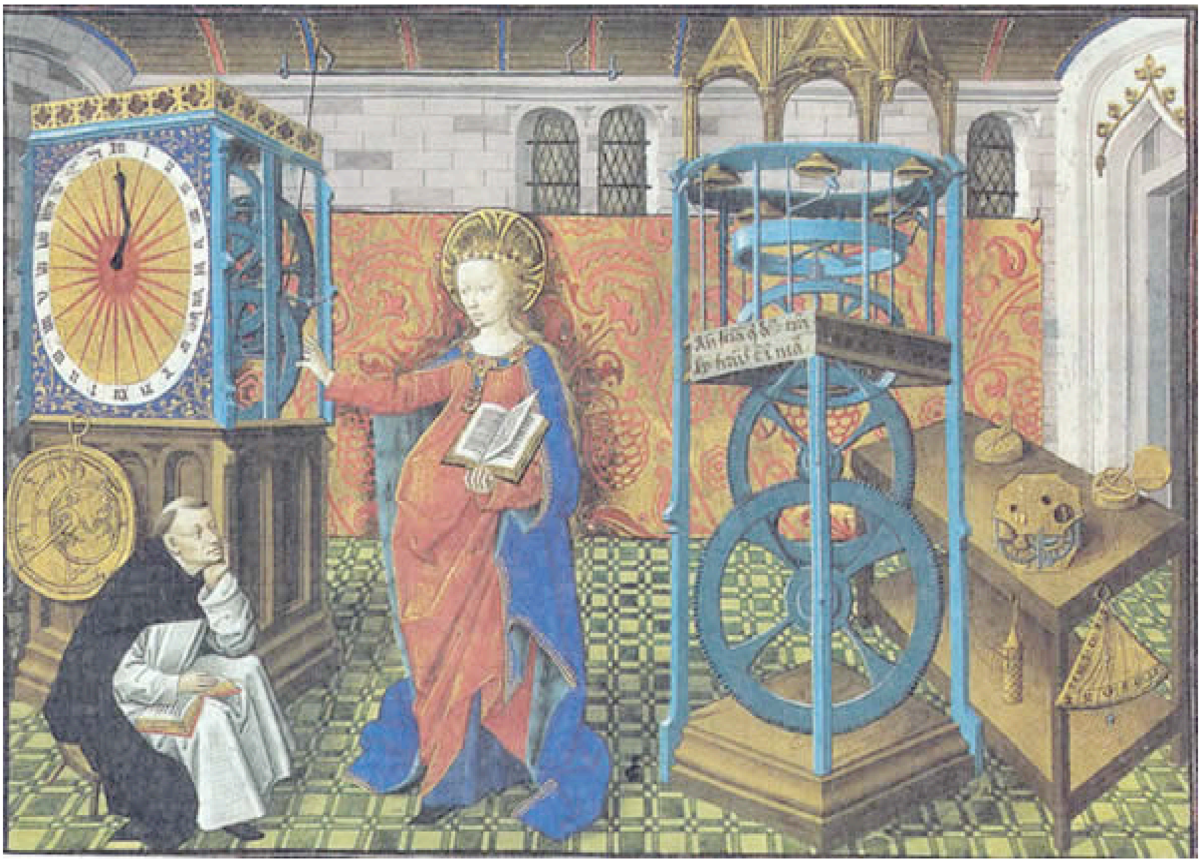
the division of tasks over various parts of the society. The complex interrelations of the modern industrial society could only emerge because more sophisticated means of co-ordination and *control* were available. The industrial societies could only function by virtue of this co-ordination mechanism that relied on the uniform mechanisation of time. Thus the clock made itself increasingly invaluable for the modern fabric of society. The tragic aspect of this domination of machine over man (and nature) prompted the anti-utopian futuristic literature of the 19th century (especially Samuel Butler). In the second half of the 19th century it materialised in the form of yet another clock, a time-checking machine; the time-clock.

The Metaphorical Clock

Already from the 14th century onwards the clock is given a metaphorical significance in literary and philosophical writings and artistic representations. The escapement for instance became a symbol for reason and restraint. "Where desires and passions stirred human behaviour, reason has to control and direct this energy, alike an escapement."[11] Even in the 17th century Comenius still represented the will as the crown-wheel, the desires as weights, and reason as escapement.

Within the iconography of time and death there is however a significant difference between the symbolical meaning of the mechanical clock and the hour-glass. Where the hour-glass was usually associated with the finiteness of life, the passing of time and the inevitability of death, the mechanical clock was a symbol for eternity, for the timeless order behind the temporary appearance of things.

[11] Draaisma, '90, p.36.



14th Century illustration representing Heinrich Suso's Horologium Sapientiae (Wisdom's Watch upon the Hour)

Also for the civil-state the clock was a useful metaphor. Draaisma: "The mechanical clock was the embodiment of what was missing in the natural state, or in real life: in contrast with the disruption by epidemics and bad harvests stands the regularity of the clock-work, against the chaos of wars the order of the harmonious machine, against the caprice of natural disasters the predictability of determinism. For the constitution of the state in which people could live safely and comfortably, and to which the measurement of time belongs as self-evidently as architecture and literature, Hobbes uses in his *Leviathan* the image of a clock. Comparable to the conception of the human body as an automaton ('A machine that moves itself by springs and wheels, like a clock'), with the heart as a spring, the nerves as snares and the joints as wheels, so the state too is a delicate arrangement of parts that drive and restrain each other, a controlled balance of forces."[12]

Standard Time

Through various technical innovations the clockwork had by the 18th century become increasingly reliable and precise. Through miniaturisation and mass-production it had also become transportable and accessible for individuals. The portable watch became a status-symbol for the wealthy citizen. This prompted the need for a general time-standard to which the clocks could be adjusted. A common method was to fire a gun once a day,
when the sun had reached its highest point (at noon). There are two obvious problems. One is that with the change of seasons the sun does not always reach its highest point at the same moment in the day. The other is more banal: *No sun, no gun*. Furthermore this system

[12]Draaisma, '90, pp. 41-42.

could only provide a local time-standard.
Many cities therefore developed a system of *average time*, taking the average moment throughout the year when the sun reached its highest point in the sky as a reference. After the adoption of even hours in the 14th century the system of average time was the next step towards a clock-oriented time. This system, however, still had the disadvantage of being only a local standard of time.

7. Het middagkanon te Parijs. Prent van Gustave Doré.

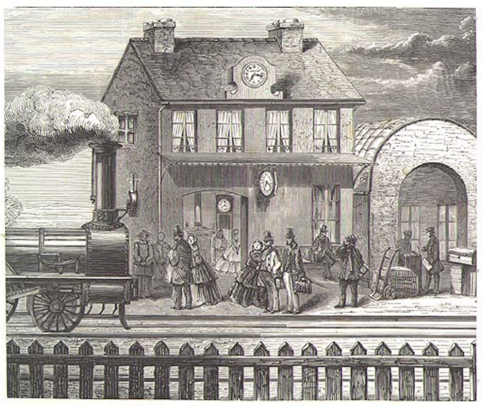
Draaisma provides three prerequisites for the introduction of a general standard of time. (1) It has to be *produced*, (2) it has to be *distributed*, and (3) there have to be *clients* for it. All three requirements were met only by the middle of the 19th century.[13]

In England the standard-time was 'produced' by the observatory of Greenwich, a time-standard we still know today as Greenwich Mean-Time. However, already within England there could be considerable time-differences because of the differences in longitude of the various cities (between London and Plymouth, for instance already some 15 minutes). The need for a general time-standard arose when activities had to be co-ordinated closely between various places, or nation-wide.

[13]Draaisma, ‘90, p.59

8. Ruth Belville neemt te Greenwich de ware tijd in ontvangst en zal deze met haar *Mister Arnold* uitventen te Londen. (Uit: Howse, 1980)

In England it was the mail transport system (with mail coaches) which necessitated this closer co-ordination. During the last quarter of the 18th century the British mail services developed an increasingly dense network of mail-transportation. A general standard of time for the entire country became necessary to make exchanges between the various coaches possible and more efficient. The second category of clients for this standard-time were the watch makers, who needed to synchronise their watches. Thirdly the development of a railway system was an important factor in establishing a general standard of time.



The standard-time was at first distributed through visual and auditory signs. The Big Ben in London, installed in 1859 is a good example. It struck its clock every hour on the first second in Greenwich Mean-time. The map of London was charted with concentric circles indicating the time-delay of the travelling sound. So the clocks could be adjusted quite accurately throughout the city.

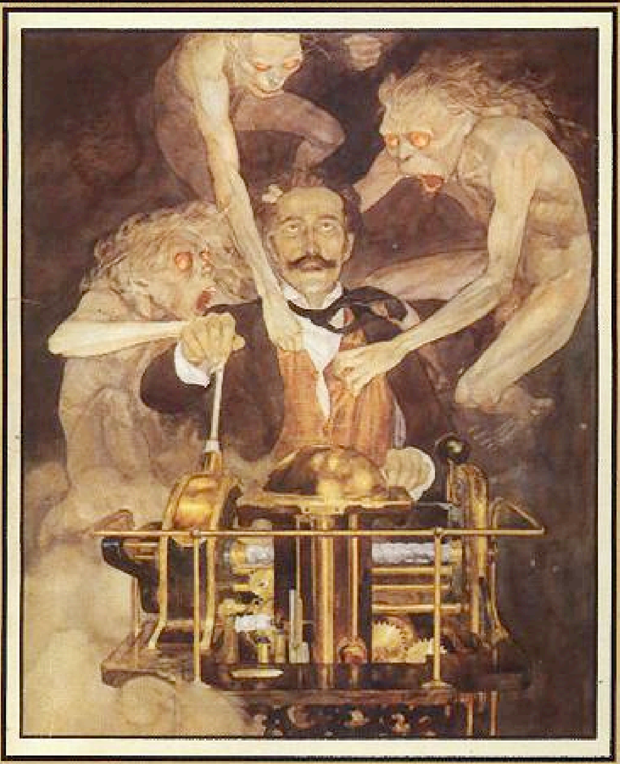
The greatest improvement for the distribution of standard-time was provided by the telegraph-service. In the Netherlands, where the adoption of a general standard of time followed along similar lines as in England, a time signal was sent out by telegraph from the observatory of Leiden from 1859 onwards. Draaisma points to the fact that from the moment when Amsterdam watch-makers were granted permission to receive the time-signal at the telegraph office, the precision of their time-measurement increased by a factor of 1500 within a few years: Their time signal was precise by halve a minute in 1856, by 1 second in 1858, and by 1/50th of a second from 1859 onwards.

Shortly afterwards the Greenwich time-standard was adopted as an international standard of time, following an agreement reached through a number of global conferences, called "World Conferences on Time". Thus the innovations in the mechanical clock and the need for a better synchronisation of social and economical activities, especially the demands of the industrial fabrication, supply and distribution of goods and services, had lead to a uniform standard of time. The clock became the regulator of societal life, a tyrant that abstracted the modern citizen from the natural flow of the physical world. The rhythm of the clock started to dominate social life, and the rhythms of the machines started to dominate the (industrial) societies as a whole.

Around the turn of the 18th to the 19th century the clock/machine metaphor for the universe, as well as human and animal life, began to change in character. Instead of a reliable, wondrous and almost divine mechanism, it became a symbol for the threat to human life, of domination, control and unguided destructive forces. It now reflected the horrors of an alienating machine driven and sub-human society, that destroyed the traditional fabric of society and brought terrible living conditions upon a large mass of underprivileged people. It may be no wonder that Marx choose the machine as a metaphor for this 19th century industrial society.

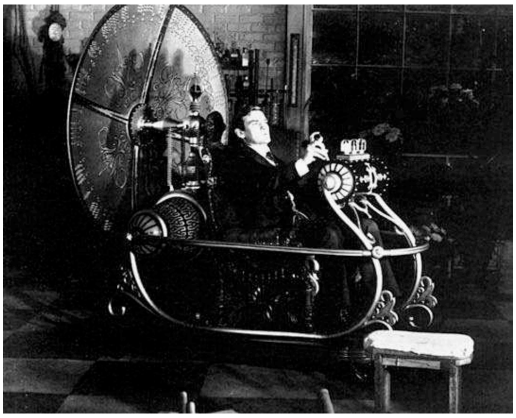
The sophistication of the means for measuring time may rightly be seen as an attempt to synchronise and control the flow of processes *in* time. This desire for control could be taken one step further: instead of controlling processes *in* time one should also be able to control *the flow of time itself*; to bring time to a halt and thus become immortal, and to be able to travel in time to past and present. Of course this control had to be exerted through machines. With a rise in interest in the concept of time in the natural sciences of the late 19th century (speculations about the fourth dimension), the prospect of travelling in time stirred the popular imagination. In 1895 H.G. Wells published the final version of his famous novel *The Time Machine*, which had appeared in earlier versions as *The Chronic Argonauts* in 1888 and 1894.

VISIONS OF UTOPIA – MEN, MAIDENS & MONSTERS
ARTWORK FOR BOOK & SCREEN



TOP Left: Especially memorable jacket-painting by ALAN LEE for the 1953 Edition by PAN BOOKS.
TOP Right: Italian Poster for the 1960 film-version is very similar, except that Morlock horrors have moved into the background to make way for love!
At LEFT: The Original USA Poster depicts the fantastic split-level world of AD 80,000 including the Sphinx, the Great Library and the Vents above the subterranean realm of the Morlocks.
ABOVE: A more cartoonish rendering for smaller format posters shows Rod Taylor parting a sea of Morlocks while Yvette Mimieux flashes her breasts, leg and tinited highlights all at once!

The time machine is, for want of an existing technology for travelling in time, first of all a mental image, an imaginary machine. It can be found purposeful, yet imaginary in many guises in the genre of science fiction, but it also appeared in an ironical form in the absurdistic fiction of Alfred Jarry. In an epilogue to the neo-scientific novel *Gestes et opinions du docteur Faustrol, pataphysicien*, Jarry describes a fantastic time-machine. The machine is fitted with gyroscopes and built inside an ebony bicycle-frame. The gyroscopes enable it to move very fast while remaining, like a top, in perfect immobility at a fixed position. The time-traveller operating the machine can travel independent of time, and sees how the surrounding space is transforming constantly. Like the ether which is penetrated by light waves without changing its structure, and which in turn can penetrate all substances, the time-traveller is able with the time machine to be penetrated by time and in turn to penetrate time and move independently to both past and present.[14]



The Long Now
www.longnow.org

"The Long Now Foundation was established in 01996* to develop the Clock and "Library" projects, as well as to become the seed of a very long term cultural institution. The Long Now Foundation hopes to provide counterpoint to todays "faster/cheaper" mind set and promote "slower/better" thinking. We hope to creatively foster responsibility in the framework of the next 10,000 years."

Danny Hillis:

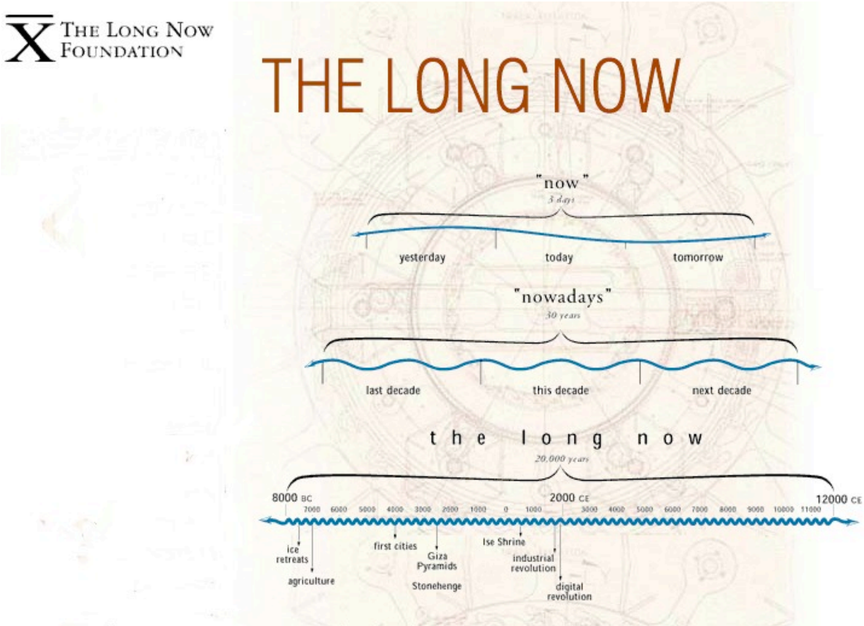
"Some people say that they feel the future is slipping away from them. To me, the future is a big tractor-trailer slamming on its brakes in front of me just as I pull into its slip stream. I am about to crash into it.

When I was a kid, three decades ago, the future was a long way off - so was the turn of the millennium. Dates like 1984 and 2001 were comfortably remote. But the funny thing is, that in all these years, the future that people think about has not moved past the millennium. It's as if the future has been shrinking one year, per year, for my entire life. 2005 is still too far away to plan for and 2030 is too far away to even think about. Why bother making plans when everything will change?

How we name our years is part of the problem. Those three zeros in the millennium form a convenient barrier, a reassuring boundary by which we can hold on to the present and isolate

[14] See: Alfred Jarry, *Gestes et opinions du docteur Faustroll pataphysicien*, comments from the Dutch translation: Perdu, Amsterdam, 1994, introduction by Pieter de Nijs, pp. 9-19.

ourselves from whatever comes next. Still, there is more to this shortening of the future than dates. It feels like something big is about to happen: graphs show us the yearly growth of populations, atmospheric concentrations of carbon dioxide, Net addresses, and Mbytes per dollar. They all soar up to form an asymptote just beyond the turn of the century: The Singularity. The end of everything we know. The beginning of something we may never understand.



I think of the oak beams in the ceiling of College Hall at New College, Oxford. Last century, when the beams needed replacing, carpenters used oak trees that had been planted in 1386 when the dining hall was first built. The 14th-century builder had planted the trees in anticipation of the time, hundreds of years in the future, when the beams would need replacing. Did the carpenters plant new trees to replace the beams again a few hundred years from now?

I want to build a clock that ticks once a year. The century hand advances once every one hundred years, and the cuckoo comes out on the millennium. I want the cuckoo to come out every millennium for the next 10,000 years. If I hurry I should finish the clock in time to see the cuckoo come out for the first time.

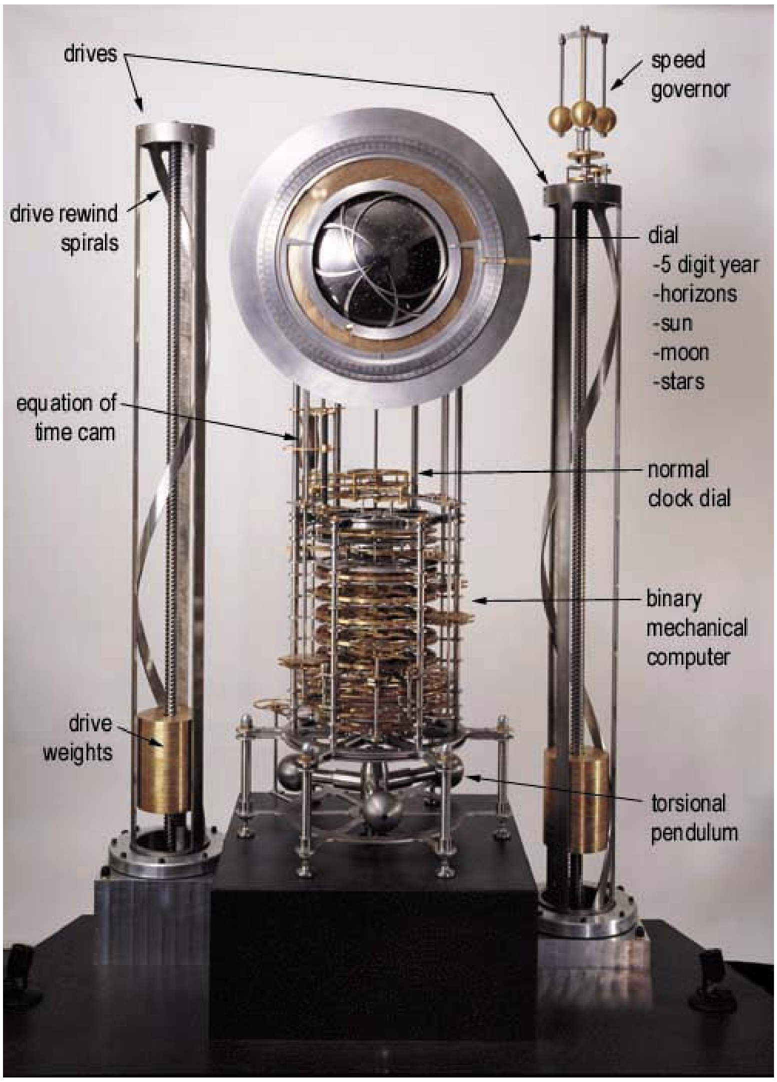
When I tell my friends about the millennium clock, either they get it or they don't. Most of them assume I'm not serious, or if I am, I must be having a midlife crisis. (That's nice, Danny, but why can't you just write a computer program to do the same thing? Or, Maybe you should start another company instead.) My friends who get it all have ideas that focus on a particular aspect of the clock. My engineering friends worry about the power source: solar, water, nuclear, geothermal, diffusion, or tidal? My entrepreneurial friends muse about how to make it financially self-sustaining. My writer friend, Stewart Brand, starts thinking about the organization that will take care of the clock. It's a Rorschach test - of time. Peter Gabriel, the musician, thinks the clock should be alive, like a garden, counting the seasons with short-lived flowers, counting the years with sequoias and bristlecone pines. Artist Brian Eno felt it should have a name, so he gave it one: The Clock of the Long Now.

Ten thousand years - the life span I hope for the clock - is about as long as the history of human technology. We have fragments of pots that old. Geologically, it's a blink of an eye. When you start thinking about building something that lasts that long, the real problem is not decay and corrosion, or even the power source. The real problem is people. If something becomes unimportant to people, it gets scrapped for parts; if it becomes important, it turns into a symbol and must eventually be destroyed. The only way to survive over the long run is to be made of materials large and worthless, like Stonehenge and the Pyramids, or to become lost. The Dead Sea Scrolls managed to survive by remaining lost for a couple millennia. Now that they've been located and preserved in a museum, they're probably doomed. I give them two centuries - tops.

The fate of really old things leads me to think that the clock should be copied and hidden. The idea of hiding the clock to preserve it has a natural corollary, but it takes Teller, the professional magician, to suggest it without shame: "The important thing is to make a very convincing documentary about building the clock and hiding it. Don't actually build one. That would spoil the myth if it was ever found." In a way, Teller is right.

The only clocks that have ever really survived over the long run (like the water clock of Su Sung, or the giant hourglass of Uqbar) have survived in books, drawings, and stories.

In the universe, pure information lives the longest. Bits last. Just before Jonas Salk died, I was lucky enough to sit next to him at a dinner. I didn't know him well, but in past conversations he had always encouraged my more mystical lines of thought. I was sure he would like the millennium clock.



I was disappointed by his response: "Think about what problem you are trying to solve. What question are you really trying to ask?"

I had never thought of the clock as a question. It was more of an answer, although I wasn't sure to what. I talked more, about the shrinking future, about the oak trees. "Oh, I see," Salk said. "You want to preserve something of yourself, just as I am preserving something of myself by having this conversation with you." I remembered this a few weeks later, when he died. "Be sure you think carefully about exactly what you want to preserve," he said.

OK, Jonas, OK, people of the future, here is a part of me that I want to preserve, and maybe the clock is my way of explaining it to you: I cannot imagine the future, but I care about it. I know I am a part of a story that starts long before I can remember and continues long beyond when anyone will remember me. I sense that I am alive at a time of important change, and I feel a responsibility to make sure that the change comes out well. I plant my acorns knowing that I will never live to harvest the oaks."

I have hope for the future.

-Danny Hillis

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