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The Worm and the Clock: On the Genesis of a Global Time Regime

Johan Goudsblom *

Abstract: *»Der Wurm und die Uhr: Über die Entstehung eines globalen Zeitregimes«*. The spread of a unitary time grid over the whole world is a remarkable aspect of globalisation. Time is not a natural given; as suggested by Norbert Elias, it is a means, devised by humans, for comparing processes of various speed and duration. As such, it is function of "timing" – an activity which is inherently place-bound. Four phases can be distinguished in the development leading up to universal global timing. In Phase 1 there are no instruments for dividing the day into clearcut intervals such as hours. Phase 2 brings various instruments such as sundials and waterclocks with which the day is divided into 24 hours of unequal length. In Phase 3 the mechanical clock makes standardisation of the hour possible. In Phase 4 the world is divided into 24 time zones, with a synchronised schedule of hours, minutes and seconds spread globally as an invisible net.

Keywords: Concept of time, development of timing, time regime, globalisation, standardisation.

1. Introduction

Time is money. Haste is debt.
J.A. Emmens

One of the most remarkable aspects of globalisation is the spread of a uniform system of time measurement around the world. Nowadays, anyone with an accurate watch can tell to the second what the time is for nearly any location worldwide. If we know, for example, that it is forty-three minutes after twelve o'clock in Amsterdam, we can say with absolute certainty that it is forty-three

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minutes past the hour in Tokyo or Rio de Janeiro – while also knowing that in Bombay it is thirteen minutes past the hour, since the time difference in India is thirty instead of sixty minutes.

This all refers to the division of time for a single day. With regard to years, months, or weeks, there is less uniformity. Variations occur when certain religions or nations use specific calendars with particular arrangements of months and weeks. However, the number of such cases is small. By far, the most commonly used calendar is the Christian calendar. It is used in China as well as in some Islamic countries. In Japan, two calendars are officially recognised: the Christian and the imperial, though in daily practice, people primarily hold to the Christian calendar.

Usually, the world-wide system of time measurement is left out of the current literature on globalisation – most likely because it seems to cause relatively few problems. This last point, however, can also be an incentive to examine such a notion somewhat further. This is particularly so given that the very procedure of time measurement is essentially locally bound. How can it be, then, that a single uniform system of time measurement has emerged for the entire world?

2. The Concept of Time

In daily life, we rarely stop and wonder about the concept of time and, if we do so, we usually tend to perceive time as a "natural, ahistorical, and unproblematic" given (Rotenberg 1992, 2). Upon closer examination, however, such characterisations are rash. Many discussions of the nature of time begin wisely with the words of St. Augustine who, commenting on the meaning of the concept of time in his *Confessions,* remarked: "Provided that no one asks me, I know. If I want to explain to an inquirer, I do not know" (Augustine 1991, xi, xiv, 17).

The concept of time can be defined in a number of ways. One way is to look at it as being inexorably bound to individual experience, whether that be as a purely subjective inner sensation or as a general category of perception in the sense of Kant. On the other hand, there is the view that time is a natural process which carries on independently from human life; even if there were no humans present to experience or observe time, time would still march on. That is, the earth keeps turning and the "fourth dimension" continues to exist, regardless of any individual person.

The gap between these two views appears unbridgeable. Perhaps, however, we can bring them closer together if we take a third, more sociological approach. We may then regard time as a socio-cultural construction which aids people in their efforts to collectively orient themselves in the world and to co-ordinate their actions.[1] This view represents the position taken by Norbert Elias (1992).

"Timing," according to his theory, is a mental activity based on the ability to compare processes of varying type, varying duration, and varying speed by measuring them against standardised processes of collectively calibrated duration and speed. Thus, processes which take place inside the human body (such as blood circulation or reading one's pulse), social processes (such as a game or a meeting), and processes in the outside world that carry on completely independently of people (such as the revolution of the moon) can be seen and understood as belonging to the same "dimension."

For us today, it has become nearly impossible to describe the experience of time without referring to the institutionalised forms of measurement – the instruments, the techniques, and the terms – which have been developed in human society to provide a common denominator to all those manifold processes. The same institutionalised forms also provide the basis for all scientific knowledge about time as a process of nature.

However plausible this sociological vision of time may be, it is certainly not self-evident, nor generally accepted. To illustrate this point I quote from Jeremy Campbell who, in a book on the very subject of time, simply considers time as a phenomenon which exists on its own and, as such, seems to require no further elucidation:

> In the simplest sense, time is important for most living species. As time goes on, the environment changes in a periodic fashion, and the changes have meaning for the organism. An animal's whole way of life, indeed its life history as an individual, may be designed to take advantage of changes that are beneficial and to avoid changes that are harmful. Day alternates with night, and the environment of day is very different from the environment of night. In temperate zones the seasons follow their annual cycle, from warm to cold and back to warm again, as predictably as a clock. A simple type of animal, lacking any biological means of opposing these changes, would have to adjust its way of life accordingly. Time would be a dictator, a tyrant. The animal would be cold when the weather is cold, and warm [...] when the weather is warm. An earthworm's temperature is the same as that of the soil in which it moves, and a fish is neither warmer nor cooler than the sea in which it swims. Such "cold-blooded" animals, which are not necessarily cold but take on the temperature of their surroundings, are at the mercy of the clock and the calendar. Only if the physical environment were to remain the same 24 hours a day, 12 months a year, would such an animal's behaviour be unaffected by time. (Campbell 1986, 43)

This is a fluently written passage, the tenor of which – at first glance – cannot be disputed. The facts to which it refers are irrefutable. There is, however, something profoundly wrong in the way these facts are rendered. To

[1] Good overviews of sociological theories about time can be found in Adam 1990, Notwotny 1994, and Schmied 1985.

maintain that an earthworm is tyrannised by time displays a fundamental misunderstanding of the meaning of the concept of time.

The earthworm is indeed extremely susceptible to the natural conditions in which it finds itself. The "internal rhythms" of the organism adjust automatically to the "external rhythms" of its environment; changes in the outside temperature bring about changes in the inside temperature of its body. This in no way means, however, that the earthworm is obeying a clock or calendar. On the contrary, the earthworm has absolutely no contact with anything remotely resembling a clock or calendar. The only way for the earthworm to be "at the mercy of the clock" would be if it were transferred into a laboratory where humans could raise or lower the temperature by a few degrees according to a fixed time schedule. Then, and only then, would the worm live under a time regime.

What a Dutch proverb has to say about sociability applies also to the earthworm: it does not know time. Worms can only respond directly to what is happening around them. Only humans are aware of time. To help them get a firmer grip on the manifold processes involving and surrounding them, humans have developed the means for comparing the duration and speed of all these processes to each other.

This, in brief, is the sociological view of time developed by Norbert Elias. One can only speak of time if – in addition to individual experiences and observations, as well as processes of nature which take place independently of people – the third level is also taken into account: the level on which people "use a socially standardised sequence in order to compare sequences that are not directly comparable" (Elias 1992, 2). The category of "time" results from the social activity of "timing."

3. The Development of Timing

Roughly four phases can be distinguished in the development of timing that have led to current practice. I will first give a short characterisation of each and will then elaborate on them successively. To distinguish each phase, I will refer to the particular instruments developed for marking the consecutive segments of the most elementary unit of time, the day. In *phase one*, there were no such instruments and, as a result, it was not possible to divide the day into clear-cut intervals. *Phase two* is marked by the development of different types of instruments such as the sundial, the water clock, and the hourglass, with which people could measure time in the localities in which they happened to find themselves. During this phase, a system of dividing the day into twenty-four hours emerged; it remained, however, that not only did the hours vary in length from place to place, but, in most places, the length of the hours would also change considerably from day to day in the course of the year. *Phase three* is distinguished by the development of mechanical clocks which, with fixed hours of equal length, made standardised time measurement possible; matching the clocks to each other also became possible, at least at a local level. *Phase four* represents the emergence of new techniques ranging from faster means of transport and telecommunication to the implementation of a global system of standard time, thereby creating the conditions to synchronise time measurement to the tiniest fraction of a second anywhere in the world.

Obviously, the enumeration of phases does not say anything about the actual chronological order in any specific case. The transition from phase one to phase two, for instance, could have occurred in different societies at very different moments. Moreover, one or two phases can be skipped. This has been the case during the twentieth century, as societies which previously had no time-measuring instruments were at once exposed to the generally applied grid of globally standardised time.

Furthermore, the implementation of a later phase of timing in any particular society does not mean that traces of earlier phases are automatically and totally erased. Even in societies with a social rhythm which is strongly regulated by the clock, there are still many opportunities for people to withdraw from the time regime. The margins for doing so, however, are limited and one can only "forget time" temporarily. From its first day, a baby born in the contemporary Netherlands will grow up in a social world drenched in time consciousness. Rhythms of sleeping and eating are immediately fitted into a schedule of hours (cf. Gleichmann 1983). While the degree to which people are subjected to the regime of the clock varies around the world-both within and between societies, the regime as such has penetrated everywhere.

The time grid is not limited to days and hours, but extends to longer periods such as weeks, months, years, centuries, and aeons. Calendars and eras, marking longer periods of time, will also be referred to below. I will focus, however, upon the development of hours as the unit of time measurement during the day and on the subsequent division of hours into smaller units.[2]

4. Phase One: No Time Measurement and No Hours

Phase one represents the period extending the furthest back in human history, and I will deal with it only shortly here. In the absence of instruments for measuring time, people had to rely on signals derived directly from natural processes. Human beings find themselves continuously confronted with such "natural signals," originating both outside and inside their own

[2] In the interest of space, I am leaving out the development of the week. See Zerubavel 1985.

bodies. Any decision to act depends on their interpretation of those signals. Thus, people may decide to go to sleep because they either feel tired or because it is getting dark outside; in either case, the decision is based upon a signal from a natural process and not upon a specially designed instrument.

A third type of indication that the moment has come for a particular activity is given by the rhythm of social life. In the account of his research of the Nuer People in East Africa in 1930 and subsequent years, the anthropologist E.E. Evans-Pritchard has provided a graphic description of how the Nuer spent their days according to a common rhythm which was primarily determined by the sequence of events associated with tending to the cattle:

> The daily timepiece is the cattle clock, the round of pastoral tasks, and the time of day and the passage of time through a day are to a Nuer primarily the succession of these tasks and their relations to one another. The better demarcated points are taking of the cattle from byre to kraal, milking, driving of the adult herd to pasture, milking of the goats and sheep, driving of the flocks and calves to pasture, cleaning of byre and kraal, bringing home of the flocks and calves, the return of the adult herd, the evening milking, and the enclosure of the beasts in the byres. Nuer generally use such points of activity, rather than concrete points in the movement of the sun across the heavens, to co-ordinate events. Thus a man says, "I shall return at milking," "I shall start off when the calves come home," and so forth. (Evans-Pritchard 1940, 100-101)

The Nuer people did not use any special instruments to measure "time," nor did the concept of time exist in their language. The only specific units of time known to them were the day, determined by the cycle of lightness to darkness; the month, determined by the circulation of the moon; and the year. The ever-returning annual succession of wet and dry seasons had a profound effect upon their lives, and they indicated the seasons with words principally referring to the pertinent seasonal activities. They had no need for either clock or calendar, and when Evans-Pritchard refers to the cattle as their clock, it is clearly metaphorical.

5. Phase Two: Variable Time Measurements, Unequal Hours

Clearly, in phase two, people did not cease to rely on natural signals. Rather, in addition to the previous methods, special artefacts were designed for the purpose of timing. It has been suggested that megalithic constructions such as Stonehenge might have filled this function (Aveni 1990, 74-80). Only from later periods, however, are instruments found which were clearly intended to indicate time as a primary function. The most well-known of these are the sundial, which registered the movement of the sun by capturing the shadows it created; the water clock; and the hourglass, which made use ofa mechanical process.

Townspeople are to have used sundials primarily as a clock: the location of the shadow indicated how much of the day had passed. However, because the position of the sun changes from day to day in most places on earth, people were also able to tell how far advanced the year was from the length of the shadow, and how far away they were from the shortest or longest days of the year. In this way, the sundial also served as a calendar.

While this second function of the sundial was slightly more complicated, it was probably more useful to agricultural societies. For farmers, the division of the day was hardly a problem. Whether it was the season for sowing or harvesting, once they began their work they had little need of instruments to tell them the time; the division of the day was based on the regularly recurring activities of working, eating, and resting. The position of the sun and their own sense of hunger or fatigue were enough for them to assess how far the day had progressed.

Of much greater interest to the farmers was the question regarding the best time of year for sowing or harvesting – a question which was often turned into a matter for experts in establishing the calendar. Their opinion could also be crucial for other important decisions, such as when to carry out a military campaign. In many early agrarian societies, a class of priests arose who took on this special responsibility of determining when the day had come for particular collective activities; the close relationship which resulted between religion and the calendar still persists almost everywhere.[3]

In cities, where there was no longer one tacitly accepted common rhythm ruling daily life, the need emerged to have, in addition to a calendar, a more sharply defined division of the day. Sundials fulfilled this need by making it possible to observe distinct parts of the day on a two-dimensional surface. It is quite likely that the invention of the sundial was a necessary condition for the invention of the hour: one-twelfth of the distance covered by the shadow of a sundial in the course of a day. The figure twelve corresponded to the favoured duodecimal counting system of the Babylonians, who are known as the first to have implemented this method of timing. By adding twelve additional unobserved nighttime hours to the number of measured daytime hours, they established the twenty-four-hour time framework for one solar day.

Dividing up the solar day (also referred to simply as "day," creating some confusion) into twenty-four hours was an important step in the standardisation of timing. This standardisation, however, remained at a very local level: the sun always appeared earlier above Babylon than above the

[3] For more reading about the method of timing by priests and the power they derived from it, see Goudsblom, Jones and Mennell 1996.

more westerly situated Damascus; determining the time differential in hours between the two cities was practically impossible.

An additional complication arose out of the north-south differential. During summer days, the sun stayed longer above Damascus than it did above the more southern Jerusalem. As a result, the hours were longer in the summer in Damascus, with the reverse being true in the winter. The further the distance from the equator, the greater the differences. In the Netherlands, at a northern latitude of fifty-two degrees, the sun stays twice as long above the horizon during the summer as it does during the winter. Therefore, in the Middle Ages, when the Babylonian system ofmeasuring hours was still in use in the Netherlands, an hour in the daytime in June was twice as long as an hour at night.

In response to the drawbacks of hours of varying lengths associated with the sundial, first the water clock and later the hourglass could offer a remedy. These instruments operated independently of sunlight – allowing their use during the night as well as during cloudy skies – and always measured, at least in principle, the same span of time. There were also some practical disadvantages, however. Water clocks and hourglasses were only capable of measuring limited spans of time; and the time span varied from device to device. Moreover, both types of instruments were strongly affected by the weather: during a frost, the water clocks would freeze, and humidity would cause the hourglasses to clog up.

When sundials were put to use in the third century BC in the city of Rome, satirists cursed the tyranny to which people were now subjected. Mealtime, they complained, was no longer to be determined by one’s stomach, but by the sundial. Still, the discrepancies between all the various sundials and water clocks were very large in comparison to the strict standards of our modern time regime. In the first century AD, Seneca lamented that people were more likely to reach consensus about problems of philosophy than about the time of day (Boorstin 1991, 50).

Until early modern times, people had to put up, just like Seneca, with all sorts of time measurers which, each in their own: way, divided the day into hours of varying lengths. In his book about feudal society in Europe, Marc Bloch described the situation as follows:

> These men, subjected both externally and internally to so many ungovernable forces, lived in a world in which the passage of time escaped their grasp all the more because they were so ill-equipped to measure it. Water-clocks, which were costly and cumbersome, were very rare. Hourglasses were little used. The inadequacy of sundials, especially under skies quickly clouded over, was notorious. [...] Reckoning ordinarily – after the example of Antiquity – twelve hours of day and twelve of night, whatever the season, people of the highest education became used to seeing each of these fractions, taken one by one, grow and diminish incessantly, according to the annual revolution of the sun. This was to continue till the

> moment when – towards the beginning of the fourteenth century – counter-poise clocks brought with them at last, not only the mechanisation of the instrument, but so to speak, of time itself. (Bloch 1961-62, 73-74)

Bloch did not even mention the problems with the calendar in this passage. The yearly course of the earth around the sun amounts to 365.2242 days and cannot possibly be expressed in an exact round number. The movement of the moon around the earth – measured by the amount of time between two successive new moons (the so-called synodical month) – lasts 29.5306 days, merely adding to the confusion. Egyptian astronomers in antiquity attempted to make years, months, and days correspond better to each other by rendering the passage of months independent from the position of the moon, and by periodically adding an extra day to the year. During the time of the Roman Empire, Julius Caesar used this information and experience to implement a calendar made up of months of unequal lengths as well as a leap year every four years.

The Julian calendar was, in turn, taken up by Christian Europe. However, it continued to display certain shortcomings which eventually led to a discrepancy of more than ten days between the official calendar time and the time according to the position of the sun. In response to this, Pope Gregorius XIII introduced some further refinements to the calendar in 1582 which, by making the leap year system slightly more complicated, improved the synchronisation. The Gregorian reforms were first accepted by the Roman Catholic countries, and later by the Protestant countries of Europe as well; with a few minor adjustments, the same system is still used today. On the other hand, the history of China – with more than fifty reforms made to the calendar by imperial decree over twenty centuries – shows far less continuity in this respect (Macey 1994, 73).

With the emergence of the diverse devices for timing, a general concept of time also developed, suggesting a synthesis of the various forms of measuring and experiencing time. The words of St. Augustine cited above illustrate the puzzlement aroused by reflecting upon the elusive yet inescapable character of "time."

6. Phase Three: Standardised Time Measurement and Equal Hours

Just as the sundial created the technical conditions necessary for dividing the day into twenty-four hours (albeit variable), so did the invention of the mechanical clock enable people to standardise the hours into time units of equal length everywhere. This invention took place in Western Europe around 1300. In the beginning, the "hour-clocks," driven and regulated by weights and counterweights, did just that: they indicated the hours or, in a few cases, also the quarters of the hour. The large mechanical clocks of the Middle Ages were unfit for measuring shorter spans of time, which continued to be gauged by sundials and hourglasses. Yet, from the very beginning, the clocks had one great advantage because, in principle, they could function continuously without interruption, day and night the whole year through. Provided that the weights were monitored and the mechanism was adjusted as necessary, the clock rang out the hours with a set regularity.

Jacques LeGoff described how, as early as the fourteenth century, the standardised hour of the city hall and stock exchange towers in the cities of Western Europe overtook the more variable time units into which the church divided the day according to the moments of prayer. Everywhere, churches were forced to capitulate and adjust to the division of the day as determined by the mechanical clock. Before long, the hours also rang from the church towers, as well as from the city halls and market halls (LeGoff 1977, 46-65).[4]

A new time regime began with the implementation of mechanical clock time – one that was tighter and stricter, more secularised and more rationalised. If the residents of old Rome were already complaining about the tyranny of the sundial, the mechanical clock in medieval cities made the division of the day even more rigid. The implementation of standardised hours created the conditions for the type of labour relations which Karl Marx later typified as being specific to capitalism: relations in which the owners of the means of production employed others to carry out the actual labour, who were then paid not according to their performance, but according to the number of hours they had worked as wage-earners. Piece-wages became hourly wages, and time became money.

In Chapter 8 of the first volume of *Capital*, Marx described the struggle carried on since the fourteenth century between capitalists and workers over the length of the workday (Marx 1971). In doing so, however, he passed over the preceding conflict: before the struggle over the number of hours in a working day was the conflict about the length of the hours. Initially, workers were in favour of mechanical clock time because they saw it as their only protection against manipulation of the church hours carried out by the owners to their own advantage. Soon enough, however, the owners figured out ways to profit from standardised hours for workers. As such, both parties resigned themselves to the standardisation of hours, and replaced the struggle over the length of the hour with the struggle over the number of working hours (cf. LeGoff 1977, 66-79; see also Thompson 1967).

By Marx's time, the system of dividing the day into standardised hours and minutes was beyond dispute. Marx's own theory of capitalism was entirely predicated upon the existence of the "hour" as an inflexible unit of account. Indeed, we could hardly imagine a form of capitalism without the clock and

[4] Dohrn-van Rossum (1996, 140-150) modifies LeGoff's view by indicating that the municipal governments attached their own level of prestige to the public clocks.

calendar. The control and payment of workers, as well as the transactions between entrepreneurs, are based upon a generally accepted form of time measurement.

7. Phase Four: Synchronising the Hours

What had not yet taken place in the time of Marx was the synchronisation of the hours. Indeed, by the middle ofthe nineteenth century, the clock time of Europe – with a standardised division of the day into twenty-four hours, and each hour having the same length of sixty minutes – had been implemented in many parts of the world. Numerous clocks of good quality, off by just a few seconds per day, could be found. In most places, clocks were collectively set based on one common time. The common time, however, differed from place to place.

For a long time, this difference did not cause difficulties. What did it matter that the clocks in Amsterdam ran a minute or so ahead of those in Haarlem? Not until the development of rapid transport and means of communication did this lack in synchronisation actually become a problem. At the same time, though, that the modern transport and communications systems highlighted the difficulties resulting from a lack in synchronisation, they also facilitated the solution. The more people travelled, the more opportunity they had to compare the local times; along with this, the telegraph made almost simultaneous comparison of times between even larger distances possible.

Wherever there were train stations and telegraph offices, clocks were coordinated at a national level. England led the way, as it did in so many respects, and other countries followed. Everywhere, protests were heard from local notables who felt that a piece of local identity would be lost with local time. Modernisation, however, was not to be stopped; the mosaics of local times made room for the unified grid of a single national time. Just as the time of the stock exchange had triumphed over the time of the church, now the triumph came for the time of the station.

Around the end of the eighteenth century in England, a standard national time was slowly emerging, mainly as part of the attempt to increase the efficiency of stagecoaches and postal services. The rapid emergence of the railways after 1830 gave extra impulse to this development, and helped to relieve the chaos of uncoordinated service times and timetables, which often caused many inconveniences and also increased the likelihood of collision (Zerubavel 1982, 9). Almost as a matter of course, the establishment of one national standard time was based on the time in London. Not only was it the capital city, but it was also the terminal point of many railway lines, as well as the seat of the astronomical observatory at Greenwich, specialised in the practice of timing ever since its establishment in 1675.

As already said, the British example was followed by other countries, despite some protests. Within a few generations, standard time was realised everywhere. In connection with the theme of globalisation, it is worth noting that international time co-ordination has almost immediately followed national co-ordination, and in some respects, has even preceded it.

8. The Emergence of a Global Time Grid

The question of when and where the system of a single standard time for the whole world took its shape can be answered with great precision: it was in October 1884 at the International Meridian Conference in Washington, DC. Representatives from twenty-five countries decided then and there that the world would be divided into twenty-four time zones, each with an east-west span of approximately fifteen degrees. The prime meridian would run through the observatory in Greenwich.

These decisions, taken in the form of resolutions with varying majorities, did not come out of the blue. Fierce discussions took place at the conference, not about the desirability for a standard time as such, but about the proper location of the prime meridian. At an early stage in the debate, the majority of those present were already in favour of Greenwich; the representatives from France, however, found it difficult to join with this position. They argued that, first of all, it was not yet the appropriate moment to discuss the location of the meridian because the principles of the system of standard time had not been sufficiently addressed. Secondly, they found that if a decision must be made, then a "neutral" location should be given preference to the capital city of the already powerful England. Once the French realised that they were not going to acquire a majority in favour of their position, however, they supported a suggestion from Spain: in return for a prime meridian running through Greenwich, the British would agree to change over to the metric system. In response, the British spokesman stated that no matter how much he might welcome the idea, he could not promise that he would be able to persuade the people of Britain to adopt it. In the end, twenty-two votes were cast in favour of Greenwich; France and Brazil refrained from voting; San Domingo voted against the resolution (Howse 1980, 138-151).

England, therefore, gloriously carried the day over France, but it could not attribute its victory to the power of the British Empire alone. Rather, the decisive factor in the arguments was based on international navigation and the fact that for over a century sailors had been using Greenwich time as the standard time – a standard of particular relevance for determining the east-west position of ships. As early as 1880, two-thirds of all merchant sailors in the world were already orienting themselves according to Greenwich time.

The dispute took place exclusively between the European powers of England and France. The United States did little to draw attention to themselves and solidly took the side of England. This does not mean, however, that they played a minor role. Not only were they the initiator and host to the conference, but they had already set an example in the previous year by introducing a domestic system of time zones based on the Greenwich meridian (Howse 1980, 124).

In retrospect, this was the pivotal moment: the decision made in 1883 by the major railway companies in the United States to divide the country into four time zones. This set a precedent which apparently worked. The precedent as such, of course, was firmly grounded in its own history: firstly, the emergence of a national network of railways with all the co-ordination problems it entailed; secondly, the long-established practice found in all localities along every railroad of measuring local time in standardised hours and minutes; and thirdly, the availability of the system of degrees of longitude used by sea navigators with Greenwich as the point of orientation.

The railways, not the government, implemented a single national standard time in the United States. It was no different in other countries. The railways took the lead and the national legislatures followed. In the Netherlands in 1858, for instance, the director of the Rhine Railway declared Amsterdam time as the national railway time, and this was gradually accepted by other cities as the official time. In 1892, the directors of the railways – under pressure from their German colleagues – changed over to Greenwich time, and the post and telegraph followed. Not until 1909 was a single standard time established by law for the whole country; this, however, was not Greenwich time, but Amsterdam time, which ran ahead of Greenwich time by nineteen minutes and thirty-two seconds. To make international co-ordination a little easier, on July 1, 1937, the time difference was set at an even twenty minutes. On May 16, 1940, the German occupying forces imposed Middle European time on the Netherlands, making it the last country in Western Europe to join the system of time differentials based on the full hour (Knippenberg and De Pater 1988, 80-82).

Each land in Western Europe developed toward the standard system according to its own course and pace. Nearly everywhere, voices of resistance were raised to condemn the unconditional approval of "English" Greenwich time (cf. Kern 1983, 13-14). At the same time, however, people in the second half of the nineteenth century were well accustomed to the pattern of standardised hours and minutes, as it was already widely used at a local level. Because of this, the step from local, to national, and then to international standard time did not turn out to be very difficult.

Nowadays, the idea that one is submitting to British hegemony by accepting the Greenwich meridian as the prime meridian rarely comes up, at least not in Europe. Outside of Europe, occasional protests continue to be heard. In

1979, the Ayatollah Khomeini called it an unacceptable thought, even a nightmare, that he had to be subjected to the clock time of Europe (Zerubavel 1982, 19).

Indeed, the division of the world into time zones is oriented around Europe. It is probable, though, that the twenty-four-hour system originated in the Middle East – out of Khomeini's neighbouring country, Iraq. Within Europe, the final word on standard time is no longer determined in Greenwich; since 1913, that has been taking place in Paris, in the Bureau International de l'Heure. The French institute does not play a significant role in the daily practice of timing around the world, however. The time grid functions autonomously, without regular guidance from Greenwich, Paris, or any other centre.[5] The Eurocentric character is most evident in regard to the date line: this is the invisible line which runs along the one hundred and eightieth longitude, as far away from London as possible – and, because of which, the Fiji Islands are always one day behind neighbouring Samoa.

9. The Contemporary Time Regime

It is conceivable that at some point in time, a tyrant of a military-agrarian empire could have attempted to set the time according to his own will, and all his subjects would have been forced to conform the division of their days to match his. It still happens that people make other people wait – sometimes for hours. The length of the hour, as well as the beginning of the hour, though, are indisputable. More than anything nowadays, time itself is the tyrant; nobody anymore has the illusion that they can set it their own way.

Uniform clock time is linked to some longer-term divisions of time. One of these, the combination ofthe Christian era and the Gregorian calendar, has become the standard for most parts ofthe world. The fit between the days, weeks, months, and years is irreparably awkward; still, wherever the system is used, it provides people with a convenient way of reaching agreement about the time of day, date, and year.

In one way or another, the naming of the globally accepted system of time continues to reflect its origins. The names of days and months, in many languages, are directly reminiscent of Roman gods and emperors, and the most prominent calendar is "Christian." Attempts have been made to obscure the Christian origins by replacing the words "before Christ" with the initials BCE (Before Common Era). This substitute, however, does not do very much

[5] Officially, Greenwich Mean Time (GMT) has been replaced by the Co-ordinated Universal Time as the international standard time, determined in the Bureau International de l'Heure in Paris, and indicated by the initials UTC. The differences among GMT and UTC are very small. The same goes for the third world standard time, International Atomic Time (TAI), which is also determined in Paris. For further detais, see Howse 1980, 173-190, and Macey 1994, 156-159.

in removing the original orientation toward the Christian tradition. The same goes for the prevailing geological time scale. Major eras continue to be named after the European areas and regions where their traces were first discovered and described: Jura, Devon, Maastricht, and so forth.

The development of many new techniques has made it possible to spread the uniform time grid further and to expand it extremely far into the past of historical, archaeological, geological, and astronomical time. Historians can go back five thousand years, to the earliest written sources; archaeologists, several hundreds of thousands of years to the oldest remains of human culture; geologists, more than five billion years to the creation of the earth; astronomers, somewhere along the lines of fifteen billion years to the Big Bang. Any type of past that we can possibly conceive of is caught up into the same net of time, and accessible to "absolute dating." All processes which have ever taken place can be expressed in terms of the same convertible units oftime.

At the same time, this time grid can be broken down into the smallest units imaginable. The standard for contemporary chronometers is set by the cesium atom clock, measuring to the 9,192,631,770 fraction of a second (Macey 1994, 158).

The accuracy of such clocks is so great that they can determine the most minute deviations in the rotation of the earth on its axis. The clocks themselves are said to have a deviation of no more than one second in 350,000 years.

The time grid in its entirety is uniform and anonymous, and applicable to the past, the present, and the future. Any and every moment can be assigned to its place in the system of years, days, hours, minutes, and seconds. In offices and factories, in observatories and laboratories, at the stock exchange and in markets, in international treaties, and for athletic competitions – people unquestioningly avail themselves of one and the same time scale. All measured times are internationally comparable and all are subjected to the ever-increasing precision of chronometers; without this, no athletic world records would be possible. Moreover, the time grid is also strictly synchronised so that it is possible to determine exactly whether a transaction in Tokyo took place a second earlier or later than a similar transaction in New York.

Timing at the end of the twentieth century has achieved an unprecedented degree of precision, orderliness, range, and relevance.[6] The degree of precision extends to the millionth of a second. Orderliness, however, continues to be hampered by the fact that a year is not a simple multiple of days – a fact which obstructs a neatly metric or duodecimal system of nicely rounded-off numbers. Here, we can clearly see that the human intellect is not

6 I have used these four concepts as ordering principles in Goudsblom 1977.

sovereign in marking time. On the one hand, the movements of the earth allow us to construct a very simple arithmetic relation between years and centuries. On the other hand, they make an equally simple division of the year into days and hours impossible. In this respect, nature sets limits to culture. Culture itself, moreover, exerts a robustness of its own in the survival of the Babylonian duodecimal system.

Even if a few knots in the net of time have thus far resisted a simple arithmetic solution, the range of the net has, in spite of these imperfections, expanded over the whole earth with seemingly no problems. It has at once become more intricate and more comprehensive. It extends from the furthest point imaginable in the past to the furthest point imaginable in the future. It also includes, in principle, mental processes – even though these may be experienced in a very different way.[7]

The compelling strength of the global time grid lies in its relevance – in the functions it has for all those who are involved in it and collectively maintain it. As its last step, the time grid forms a time regime which exists by virtue of the continuing pressures that people exert on each other and on themselves. People arrange their lives according to the clock because they know that others do also. In this way, as early as the seventeenth century in Europe, the penetration of the clock had taken on its own dynamic; in the words of the Italian historian Carlo Cipolla:

> [...] the machine which had been devised to satisfy particular human needs created new ones. Men began timing activities that, in the absence of clocks, they had never thought of timing. People became very conscious of time, and, in the long run, punctuality became at the very same time a need, a virtue, and an obsession. Thus a vicious circle was set into motion. As more and more people obtained clocks and watches, it became necessary for other people to possess similar contrivances, and the machine created the conditions for its own proliferation. (Cipolla 1967, 103)

Cipolla takes a negative view of the development. His statement expresses a widespread tendency to experience the time regime of clocks as a fatal fetishism: people have turned the clock into an idol which they are now forced to worship (cf. Young 1988, 227-228). It was in a similar vein that Evans-Pritchard (1940, 103) considered the Nuer People fortunate for not knowing time.

Time manifests itself as a tyrant wherever people compel themselves and others to obey it. The constraints they experience as time pressure are the workings of the time regime – the urgency they feel to be somewhere or to be done with something "on time." As Norbert Elias (1994, 457-8) noted in his study of the civilising process, the pace at which people live is a function of the amount ofsocial connections in which they are involved.

7 Adam (1990, 129) cites the description of a person's experience in the face of death. It was said that the experience "seemed to last for centuries," but in reality it took only "a few seconds."

This pace is now picking up impulses from all over the world. A century ago, the railway stations functioned as the principal nerve centres of the new national times which, in turn, quickly assumed an international dimension. Nowadays, there are numerous international organisations with national bases at airports, in embassies, at stock exchanges, and in offices, which together form just as many junctions in the network of global time. The network finds further support in a multitude of direct personal connections by way of radio and television, the telephone, and computers. Satellite and cable connections reduce the time needed to make contact to a minimum.

The result is an abundance of information circulating around the world at unprecedented speed. Almost inevitably, this tempo leads to a shortening of time perspectives: one has to be constantly informed about the latest developments and events, as well as be prepared to react to them promptly. The need to keep abreast is unrelenting.

The extent and the intensity of the interdependencies, at the same time, also foster a lengthening of time perspectives. The same combination of knowledge and skills which allows people to reach further and further into the past, also enables them to extend the time grid into the future. In economic forecasting, scenarios are usually made in terms of months or years; demographic predictions can be made in terms of generations; and ecological projections are, at times, already couched in terms of centuries. Experts active in computing the radioactivity of nuclear waste do not even shy away from estimates along the lines of half a million years.

These forecasters and experts all operate within a linear concept of time. Of course, the years which are their standard units refer to regularly repeating processes of a cyclical nature. They balance, however, those years against a linear time axis according to which no single moment can ever repeat itself. The art of timing continues to rest on the principle of repetition. All the technical devices which people have developed for measuring time either represent or reproduce regularly repeating processes, the speed and duration of which are known. Aided by these devices, physicists have designed an image of the universe as a clock, subjected to eternally unchanging laws of motion. Over the last two centuries, an awareness of the limitations of this image has grown, first in geology and biology, and later in astronomy and physics. In all these sciences, a “rediscovery of time” is taking place, resulting in a view of the entire universe within the framework of an all-encompassing singular evolution (Prigogine andStengers 1984, 26). It is, perhaps, not far-fetched to suppose that a link exists between this “temporisation” of the world image and the globalisation of the time regime.

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