Studien / Studies

Original paper UDC: 115:6(045)
doi: 10.21464/sp39106
Received: 5 February 2024

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Chronogenetic Institutions as Categorical Nuclei of Temporal Ideas

Abstract

This paper explores the genesis of the concept of time, analysing how the initial methods, techniques and institutions employed by early human groups to measure environmental changes became increasingly aligned with human activities, thereby forming the basis of our modern understanding of time. Adopting a discontinuous materialist perspective, this work posits that complex ideas like time often have simple technological origins. We introduce the term chronogenetic institutions *to describe the early mechanisms used by human groups for measuring world transformations before having a clear concept of time. These chronogenetic institutions are grouped according to the cyclical phenomena they represent, primarily natural occurrences such as the movement of celestial bodies, changing weather patterns, and seasonal variations in flora and fauna. This study challenges the view that temporal concepts were purely theoretical at their inception, highlighting that they initially emerged and spread through institutional practices in social contexts. It promotes a refined understanding of time's complexity, advocating for a transition from a singular "Nature Time" to a conception of multiple temporalities, constructed both socially and technologically. Furthermore, it advocates for an objective and pluralistic examination of early human groups' initial attempts to synchronise their activities with the changing and unpredictable world around them.*

Keywords

time, temporalities, natural time, chronogenetic institutions, discontinuous materialism, anthropological space, referential

Introduction

Opinions on the origins of temporal concepts are notably diverse. Time can be seen as a natural or physical reality or depicted as temporality within social or cultural contexts. The vast number of scientists, philosophers, artists, writers, and politicians who have analysed time and temporal phenomena is too substantial to summarize succinctly, making time a fundamental topic in the history of science and philosophy. This paper will explore the issue concerning the origins of time, not as a concept, but as a phenomenon – or more precisely, as a group of phenomena – of reality, distinguishable by early human groups.

Spanish philosopher Gustavo Bueno (1972, 2014) claims that even the most abstract ideas come about from the practical experience of humans dealing with their environment. Drawing inspiration from such a contention, we will direct our attention to specific instances, phenomena, techniques, terms, or institutions that played a significant role in formulating fundamental theories or conceptions about the cyclical and rhythmic appearance and transformation of certain phenomena in reality. Our central thesis is that these processes constitute the nuclei of what would eventually be recognized as 'time.' In relation to these central time-related phenomena, we will employ the category of *chronogenetic institutions*.

Philosophical discussions about time often exhibit a dualistic nature, characterized by contrasting perspectives such as relationism versus absolutism or eternalism versus presentism (Emery *et al*., 2020). Such dichotomies, including "nature versus society", "object versus subject", and "matter versus mind", are pervasive in social and human sciences. Within the domain of time, this dualism takes shape as "physical and experienced time" (Elias, 1993: 85). This temporal dualism encapsulates an extensive range of characterizations and theories linked to the phenomenon of time, which are tied to numerous disciplines within the sciences and philosophy, aligning with one extreme or seeking an intermediate stance.

In the first sense, one can discuss thermodynamic, atomic, astronomical, geological, and biological time, among others. In the second sense, we encounter social, psychological, cultural, and symbolic time. Each discipline has evolved its categories, concepts, and time-related ideas.

Some perspectives have perceived time as temporality, with physical time seen as merely one approach to the temporal – specifically temporality as established by physicists. These perspectives argue that time transcends individuals as it originates in society or culture and is socially apprehended through institutional transmission. Despite these disparities, numerous theories converge on theses indicating some transcendental aspects associated with time. Isaac Newton argues that time is an absolute objective fact of the physical world although in the *Scholium of the Principia* he famously moves on to identify absolute space and time with God's eternity and omnipresence. Kant's idealist position attaches the nature of time to the transcendental structure of the experiencing ego. In both cases, despite attributing different natures to it times remains beyond the concrete operational experience of human communities dealing with their environments.

Taking a step back from this debate, it is crucial to acknowledge that unraveling the essence of time is unattainable without first looking to its beginnings. In other words, we must examine the earliest approaches or attempts to measure or calculate the changes or transformations of the phenomena that surrounded humans if we want to deeply understand what was later called 'Time'. From this perspective, regardless of our position on the nature of time, it is commonly assumed that the concept of time is an inherent aspect of human cognition, dating back to the earliest stages of human history. However, archaeological and anthropological evidence does not provide definitive support for this assertion. There is no compelling reason to suggest that the concept of time has always been present, even in its most fundamental form.

Conversely, the alternative hypothesis, which posits that at some point in human history, humans did not possess or perceive a need for the concept of time, requires the conjecture of a mechanism that served the role now occupied by this concept. The challenge then becomes identifying whether this mechanism or mechanisms shaped subsequent temporal perceptions. This is a pivotal matter, as it might offer a gateway to demystifying the concept of time. Such exploration also enables us to discern the "contaminations" embedded within the concept of time, which are elusive through purely theoretical contemplation. For instance, viewing time as a figment of imagination or human psychology, fails to account for its physical, chemical, biological, social, and cultural dimensions. An alternative perspective is that if time is rooted in institutional phenomena that amalgamate these facets, then it offers a more comprehensive understanding of the myriad ideas linked to it.

Drawing inspiration from the notion of *anthropotechnics* developed by philosopher Peter Sloterdijk (2006, 2013), in a totally different context, we use the term *chronogenetic* to denote institutionalized devices that shape repeatable patterns of time where operations can be carried out within the social sphere. It is a common misconception that social times are purely subjective or psychological phenomena. In fact, social times direct the operations of subjects in ways that are as inter-subjective as they are predictable. This is because the inherent purposefulness of social actors' plans is to make sense. In this context, while we acknowledge the socio-technical origin of human time, we also recognise the integration of natural elements, both physical and biological. These elements were often used as reference points in early techniques. These initial methods, referred to as *chronogenetic institutions*, were instrumental in forming the basis of our modern understanding of time. Our hypothesis posits that every historical institution or idea originates from modest, tangible, ideographic, and material roots. With regard to time, the working theory is that the evolution of temporal concepts is grounded in technological institutions. Historically, these institutions have played a pivotal role in denoting, measuring, marking, and effectuating changes in worldly phenomena. In addition, this paper employs the *discontinuous materialism* (DM) framework (Bueno, 1972; Pérez-Jara, 2022) to propose an alternative analysis that diverges from the previously discussed dichotomies. Instead of viewing these polarities as dichotomous positions, the paper posits that they can be reconciled as "conjugate concepts". Furthermore, the paper elucidates the interconnections between physical versus cultural time and social versus subjective time in the evolution of time.

Theoretical Structure of the Paper

Although some accounts of time are reductive, focusing exclusively on physical or astrophysical terms, this paper begins by emphasising the plurality of temporal categories across a range of scientific, technological, and technical disciplines. These include relativistic physics, thermodynamics, classical chemistry, radiochemistry, molecular biology, evolutionary biology, evo-devo, geology and geomorphology, and palaeontology. In alignment with a pluralistic perspective on the interrelationships between these diverse scientific domains (Alvargonzález, 2024; Harman & Pérez-Jara, 2022; Hull & Dupre, 1994), we propose that the overarching concept of time cannot be fully captured by any single perspective, as though there were a singular scientific scale that could explain or even deduce all temporal phenomena.

Despite the undeniable intuitive appeal of epistemic and metaphysical monism[1], and its long history in philosophy of science since the days of the Vienna Circle, one of the key insights from scientific practice is that there is no single, comprehensive explanatory framework. We therefore put forward the notion that time should be conceived of as a complex and multifaceted reality, comprising a number of intertwined and partially discontinuous layers. This is not to claim that these layers are all of equal metaphysical import. On the contrary, multiple asymmetries exist between, for example, physical and geological or evolutionary scales of analysis in that the degree to which they depend on one another does not always need to be reciprocal. However, reducing all concepts of time to the physical level of analysis is an ill-conceived general theoretical project (Cartwright, 1994).

Concerning the category of *chronogenetic institutions*, it will be used to denote the technical origins of temporal ideas implemented by human societies and groups, will be substantiated by historical-practical examples of temporalization, focusing on the temporal relationship of cyclical-progressive events framed within different axes of what the Spanish philosopher Gustavo Bueno Martínez (2005) termed as *anthropological space*. This category encompasses the spectrum of interactions between humans and diverse phenomena, categorizing these relations along three primary axes: circular (C), radial (R), and angular (A). These axes represent relations among humans (C), between humans and natural phenomena (R), and between humans and phenomena often linked to their own will, personality, and non-human powers, such as deified animals (A).[2] These latter relations eventually evolve into the concept of gods with the emergence of religions, as discussed by Bueno (2005) and García Sierra (2021).

In the following sections, we focus on the intricacies of social time as marked by an institutionalized cultural context in which one or more subjects deploy a system of purposeful operations concerning corporeal objects located in their perceptive space. Thus construed, one characteristic of social time is its teleological structure, as the operations of the subject present a directionality towards their aims. It should be noted that a key element of what purposiveness and teleology implies here is that, rather than a straight line ("the arrow of time" as this trope is usually employed in thermodynamics or paleontology), the structure of social time is better described by resorting to the metaphor of the spiral. This suggests that the future (the intended aims of the operations) needs to be somehow presupposed before the agent begins the operations themselves (the present). For this sort of retroactive causality to make sense, the subject needs to be able to construct a representation of the contents of the future to which their projects are expected to lead. This is regularly done by drawing on insights from past courses of similar operations, which are already known in hindsight (Bueno, 2014).

This understanding of the temporal dimension of human life is embedded within specific human operational contexts. As time progresses, categories emerge that denote mechanisms of calculation and measurement, inextricably linked to the subjects operating them. In this context, the different concepts, categories, and ideas related to the phenomena of time will be understood through their evolutionary dialectical relation with the material phenomena that comprise them, as well as their role in the processes of building factual and non-factual institutions that trace the cyclical transformation of reality.

The Nature as a Clock, Chronogenetic Institutions Linked to Physical and Biological References

During the initial stages of human development, natural phenomena played a crucial role in determining the timing and duration of events. This is particularly evident in pre-state societies, where time was perceived not as a steady flow marked by calendar years, but in a different manner. Instead, repetitive natural phenomena with cyclical courses of occurrences were used to mark time. Norbert Elias (1993) characterizes this phase as one where time is experienced not as a constant progression of years, but as a series of cyclical and natural occurrences. This understanding of time was eventually replaced by the modern concept of time as a linear and impersonal flow. In the analytical framework presented in this paper, it is posited that during this phase, cyclical phenomena were observed. These were primarily associated with anthropological space and related to physical and natural cyclical changes. Such processes served as benchmarks for initial efforts to temporalize human activities. In certain instances, possibly due to their effectiveness and to ensure their continuation, these processes were eventually imbued with proto-religious or sacred meanings to secure their persistence.

To cite a few examples of this type of temporalities, we could point the low and high tides, the frequency of the body's pulse, sunrise and sunset, climatic seasons, the migrations of certain animals, and many others. All these phenomena have been used both as instruments for coordinating human activities on a group or social domain and to predict phenomena related to the human-external world, with which humans also interacted. The cyclical patterns of these biophysical phenomena enabled the structured organization and planning of activities across a range of cycles, from short to very long. This cyclicity enabled the coordination of diverse social functions, which could be repetitive or otherwise, over periods ranging from a single day to several days or even longer durations. Essentially, these cyclical or progressive natural phenomena acted as temporal benchmarks, around which human activities were organized and structured.

The comprehension and use of these cyclical phenomena ultimately led to the creation of what we term as *chronogenetic institutions* in this paper. These institutions persist through various stages of human development, influencing all anthropological domains. In other words, they are evident in every aspect of human interaction: human-to-human, human-to-natural or physical phenomena, and human-to-perceived-as-sacred phenomena. In this context,

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We agree that monism both in metaphysics and epistemology has a history that long predates the Vienna Circle, but here we meant to restrict our attention to the longstanding influence of monism in philosophy of science to make the point that it is astray, and metaphysics and epistemic pluralism is a more plausible position, also when it comes to different scientific disciplines with regards to the concept of time.

Each axis (C, R, A) can be combined with another to form a two-dimensional figure – (CC), (CR), (CA – and all three can be combined to form a three-dimensional figure (CRA), encapsulating the relationships between humans, the natural world, and phenomena attributed to 'supernatural' or, at times, 'divine' entities.

a vast array of practical mechanisms aimed at the determination and rational organization of specific events over varying time spans can be observed. In pre-state societies, these mechanisms primarily revolved around the human-to-natural or physical phenomena within the anthropological space. For instance, among the ancient Greeks, such planning was conceptualized through the elapsed time, personified in the mythical figure of Chronos. This led to the development of *chronological measurements*, encompassing methods to determine various time frames like days, months, seasons, years, or even longer periods. Additionally, there emerged another type of mechanism, not for measuring extensive, repetitive, or cyclical periods, but rather for tracking singular or short to medium-term processes. The detailed tracking of these processes is crucial for various reasons. This concept of time is known as *duration*, and the corresponding mechanisms fall under the category of *chronographic measurements*.

As noted, the mechanisms in pre and proto-state societies for measuring both types of temporalities are innumerable and exhibit significant diversity. Many have evolved into historical institutions over time. Despite this diversity, it is still possible to categorize these institutions into distinct classifications. Guided by the insights of Martin P. Nilsson in his seminal work *Primitive Time-Reckoning* (1920), we categorize pre-state temporal institutions into two principal groups. The first group is centred on celestial phenomena – specifically the sun, moon, and stars – while the second group focuses on nature's phases, including climate fluctuations and the cycles of plant and animal life. Our contribution in this paper is to situate these institutions within what we term the *anthropological space* system of relations. This theoretical framework allows us to discern instances where a temporal institution may appear similar to a past counterpart (a chronogenetic one) in form but is materially distinct. We argue that such variations can be attributed to a shift from one relational order within the anthropological space to another. For example, circadian cycles, which we will examine in depth, have been utilized historically and continue to be used today, both chronologically and chronographically. However, in pre-state societies, these mechanisms were predominantly associated (emic) with the sacred and natural (biophysical) order of human relations. In contrast, in contemporary contexts, they align more closely with social (human-to-human) relational domains.

In alignment with this framework, this paper presents its classification system. While generally adhering to Nilsson's model, it integrates other classifications into various subgroups. Accordingly, the classifications for *chronogenetic institutions*, predicated on the reference points they utilize for timing the specific transformation processes they employ, could be founded on:

1) cycles of celestial bodies (rise and set of the sun and moon, movement of stars and constellations, comet sightings);
2) bio-atmospheric seasonal cycles (repeated cycles of phenomena of non-celestial enveloping nature);
3) mixed-type cycles (from the first and second category)

Chronogenetic institutions, based on these temporal patterns, manifested through diverse forms such as objects, processes, technologies, and techniques. These embodiments signalled transformations linked to natural, social, or sacred processes. Employed for timing phenomena, these institutions functioned either *chronologically* or *chronographically*. However, due to their temporal span, certain chronogenetic institutions were more frequently used for chronological purposes, while others were predominantly utilized in a chronographic manner. This distinction highlights the diverse applications and relevance of these institutions in different contexts.

For example, in the first timing category, which focuses on the cycles of celestial bodies and chronological time measurement, we find commonality due to the extended cycles of the elements used as cyclical relationship patterns. This category includes phenomena such as the seven-day moon phase cycle, the appearance of specific stars at particular cardinal points in the celestial vault, the cyclical movement or sighting of comets, and occurrences of significant stellar phenomena like massive meteorite falls. The perceived movement of entire constellations has been used to mark long-lasting temporal phenomena like eras, memorializing significant past events such as the death of an important tribal leader, meteorological catastrophes, or wars.

This short introduction paves the way for an in-depth examination of chronogenetic institutions, categorized by celestial, bio-atmospheric, and mixed cycles. Our forthcoming analysis will explore examples of these institutions in the two forms as they are presented according to archaeological and anthropological evidence.

1. Chronogenetic Institutions Based on the Cycles of Celestial Bodies

There exists a vast array of ethnographic materials pertaining to what we term as chronogenetic institutions based on the cycles of celestial bodies. This wealth of diversity enables us to further subdivide this group into three distinct subcategories, anchored in the material references employed for temporalization. Namely, these are chronogenetic institutions rooted in: a) lunar, b) solar, and c) astral cyclical changing phenomena. Moving forward, we will delve into each of these subcategories, beginning with lunar temporalizations, to unravel their distinct influences and roles in the historical and cultural fabric of human societies

1.1. Chronogenetic Institutions Based on Lunar Cycles

Chronogenetic institutions that utilize the moon's phases for timekeeping are among the earliest methods of time measurement (Nilsson, 1920). The moon's short cycles allowed nomadic groups to calculate periods sequentially, whereas the sun required longer observations. For instance, the Mapuche people of Araucanía employed a lunar chronology to structure their year. Their calendar consisted of 13 lunations. Their month was divided into three weeks, each consisting of ten days, spanning from one moon phase (*cüyen*) to the next. The year began on 24 June with the *wiñoy xipantu* (turning of the year). In terms of dividing the day, they lacked precise segments. Some Mapuche words associated with the measurement of time are – year: *chripantu*; eternal: *ñamnoval, moll nguen*; fleeting: *levmauve*; instant: *müchaique*; long time: *alüntu*, *alumna*; term (time, lapse): *chroquil* (Belloli, 2008). Similarly, the Ona people of Tierra del Fuego used the moon's phases for orientation, but they did not conceptualize time into units like weeks, months, or years; the moon's position at night indicated the approximate time. The seasons were also counted by the lunar way, with approximately six moons for each one, although they could observe some stars, such as the Betelgeuse (*Kwányip*), to determine when the length of the days would increase (Belloli, 2008).

Among Polynesians, in general, the way of counting time was by nights (*po*); tomorrow (*a-po-po*) literally meant "the night's night". Yesterday was *po-i-nehe-nei*, or "the night that is past". (Nilsson, 1920: 24). Something similar is true of the older Sandwich Islands and present-day New Zealand inhabitants, who used the moon's phases to count their days (Nilsson, 1920: 24). In ancient Assyria, the priests who observed the sky were required to inform the king "when a new moon had been seen", and among the peoples of Assyrian origin, the moon's phases were used to count their days (Elias, 1993: 53), and among the Aryan peoples of the Indus Valley, they counted in *nîçanîçam* ("night by night") the course of important events. Tacitus noted that the Germanic peoples "do not count by days, as we do, but by nights. And in this way, they make their contracts and assignations so that it seems that the night guides the *day*" (Tacitus, 2016: 10). Caesar notes that the custom also existed among the Celts, and in this sense, he points out:

> "The Gauls claim that they are all descended from one father, Dis,[3] and they say that this is the teaching of the druids. For this reason, they define the passage of time by nights rather than days: they observe birthdays and the start of months and years in this way, with day coming after night."[4] (De Bell. Gall. VI, 18 – Hirtius & Caesar, 2016)

In English, it survives even nowadays expressions such as *fortnight*, and among some Arab peoples, phrases such as "in three nights", "in seventy nights", "the first night of Ramadan", or "when two nights of Ramadan have passed" are used (Nilsson, 1920: 24). Even pivotal rituals like the resurrection of certain deities can be linked to lunar measurements. This is perhaps the case of the three days as the period of Christ's resurrection, whose origin could be in some Semitic traditions, where, as is well known, the "cult" of the moon is fundamental.[5] In this case, the Messiah is resurrected on the third day in a clear reference to the three days between the new moon and the first crescent. When the night remains moonless for seventy-two hours, foreshadowing his total disappearance, and yet he reappears on the third day.

In summary, lunar cycles are one of the first main ways of timekeeping, particularly among early nomads. Moon phases offered a chromogenic system that allowed movement and transit and settled in one particular place. Next, we will delve into chronogenetic institutions based on solar references.

1.2. Chronogenetic Institutions Based on Solar Cycles

Solar chronogenetic institutions primarily use the sun's path as their timing reference. Such institutions were common among groups that remained geographically stationary or spent considerable parts of the year in the same area, often due to hunting, gathering, or agricultural practices. Sedentary life allowed stable reference points for observing the sun's movements and noticing changes in its horizon position. In such cultures, the word for "sun" is typically synonymous with "day". Solar-based societies observe solstices when the sun behaves differently as key reference points and develop myths and institutions to explain these behaviours while seeking mechanisms for precise determination.

Consequently, various cultures have developed myths and institutions to explain these solar behaviours, simultaneously seeking precise determination mechanisms. Among the Aztecs, for example, it was believed that the rising sun (Huītzilōpōchtli) killed the moon (Coyolxāuhqui) and the stars daily. Something similar is observed among the Nile Valley cultures, for whom the sun god Ra emerged from the darkness every morning in his great boat, carrying light with him until sunset. For the Aztecs, the main festival of the year was held around the winter solstice, *Pānquetzaliztli,* where the sun was reborn with renewed strength to face its daily struggle. Among the Egyptians, there are multiple myths of cyclical rebirth, the most famous being that of the eternal battle between Ra and his court of gods against Apophis (or Ape), the primordial serpent, a representation of chaos, who day after day must be defeated so that creation may continue and Amon's ship may sail the sky bringing sun and light to the world (Mark, 2016). Both civilizations constructed artificial observatories and pyramids to calculate the synodic revolutions of the sun, moon, and stars. This represents an artificial evolution of the natural solar calculation mechanisms of antiquity, which involved mountains and other geographical features on the horizon to observe the sun's positional variations throughout the year. Evidence of this can be seen in the exact analogy between the Egyptian pyramids and Mount Benben, believed to be where the sun god Ra perched to create the creatures of the world (Wilkinson, 2021).

While the sun is often used in long-cycle chronological measurements, it is also central to shorter chronologies and specific timekeeping methods, especially in the tropics, where the length or position of shadows cast by natural or artificial features is observed (Nilsson, 1920). The Maasai, for example, describe the day's parts based on the sun's position. At 4 AM, It is "not yet early"; by 5 AM, "early", but not dawn. At 5:30 AM, they say "the-sun-is-still-far", and at dawn, "the-sun-is-perpendicular" or "rises". From 8 to 10 AM, It is "still-early"; by 11 AM, "the-sun-is-not-yet-perpendicular", becoming "the-sun-is-perpendicular" at noon. Afternoons, from 3 to 5 PM, are "the-shadow-is-rounded". They refer to 12 to 2 PM as "the-sun-is-rounded"; 2 to 4 PM as "the-afternoon-now"; and 4 to 6 PM as "sunset". At 5 PM, It is "the-sun-sets", and twilight is "the-dusk-follows-the-sun" (Merker, 1910: 157). Solar cycles have been pivotal in early chronogenetic institutions, particularly in agricultural or land-based societies, using the sun's path as a temporal reference. However, the sun was not the only celestial body used in ancient timekeeping, as other stars and star clusters were also crucial.

1.3. Chronogenetic Institutions Based on Astral Cycles

The Lapps, tending their reindeer during long winter nights, use stars to track weather patterns. Sarvon, a prominent star at the celestial vault's centre, signifies midnight and is known as the Lapps' night watch. Alongside Sarvon are three minor stars – "The Great Dog, the Old Man, and the Old Woman" – perceived to chase Sarvon. These stars rise when people sleep and set before dawn, moving obliquely in front of Sarvon. Some suggest Sarvon or Sarva is the Big Dipper, with the Old Man and Old Woman being the first pair of accompanying stars, and the Dog and the Moose the second pair. The reindeer

2
Pluto for the Romans.

3
"The passage of time", or "after night", suggests that the Galus were sprung from the god of the earth and darkness. They begin the reckoning of time with darkness, calling a period of time a number of nights, such as the English expression "a fortnight".

4
The crescent is one of the most important symbols of Islam.

herder uses these astral movements to gauge night progression and anticipate relief. The Pleiades (*Lovosj* or *suttjenes*) also indicate midnight, especially in clear weather. One legend narrates how this constellation guided a servant through the dark tundra on a cold winter night. In Lapp culture, young men jokingly tell women to "kiss the suttjenes young woman", to which the women retort, "go yourselves and kiss the suttjenes maidens" (Nilsson, 1920: 46). The same is true of the Sami people who, when grazing in dark weather (polar night) when the darkness lasts for more than 24 hours, use the moon for light and the stars to tell the time and direction. For them, the stars *gállá*, *bártnit*, and *čuoiggaheaddji* (chasing ski), all part of the Orion's Belt, align to form a constellation and appear in the night sky at specific times. In the *Guovdageaidnu* area, when *gállá* and *bártnit* appear in the south, it is approximately 7 PM (Bongo and Eira, 2023; Eira *et al*., 2023).

Among the astral measurements, it is also possible to find other cyclical phenomena. These events are less frequent than the rotation of stars and predicting them generally (though not always) required a higher level of development than what most pre-state societies experienced. This refers to solar and lunar eclipses, the appearance of itinerant or cyclical comets, or even meteor showers. In these cases, to be used as a temporal referential mechanism, the society in question required more elaborate data recording forms, such as hieroglyphic writing, to account for the relevant events of the state. In other words, this required a shift from a mythical to a more historical mode of thinking. In this context, "stars" (possibly comets or supernova explosions) foretelling the arrival of the Messiah or anointed kings are prominent in certain Hebrew traditions. "After Jesus had been born at Bethlehem, in Judaea, during the reign of King Herod, some wise men came to Jerusalem from the east. 'Where is the infant king of the Jews?' they asked. 'We saw his star as it rose [in the east] and have come to do him homage" (Matthew, 2:1–2). Or the well-known account of the sighting of a great meteorite by Aztec priests, "a spike of fire in the sky", as the first of the "dire tales of Montezuma" (León-Portilla, 2020: 36) that foretold the debacle of their civilisation.

To summarize, early human groups commonly based chronogenetic institutions on astral cycles, extending from simple star patterns to complex phenomena like eclipses and comets. This required the development of mythical thinking to weave these celestial events into communal chronologies, able to transcend from one generation to another. These celestial bodies were not the sole reference points; internal planetary phenomena and natural occurrences also played a crucial role in shaping these institutions. The upcoming section will analyse some of these Earth-based phenomena and their characteristics.

2. Chronogenetic Institutions Based on Seasonal Bio-Atmospheric Cycle

Together with celestial bodies, early human groups also used references related to their Earth-based world. Biological phenomena such as migratory patterns, botanical cycles, and atmospheric ones like climatic seasons helped develop initial timing mechanisms. We refer to these as chronogenetic institutions based on seasonal bio-atmospheric cycles. Among these institutions, we can identify two main types:

1) based on biological cycles;
2) based on atmospheric cycles.

The first type can be subdivided into three categories: a) zoological, b) botanical, and c) agricultural. The second type mainly includes meteorological changes, encompassing the classical division of climate seasons or variations in weather, which we will elaborate on in the following sections.

2.1. Chronogenetic Institutions Based on Zoological Cycles

Among the initial temporalizations of this category, namely zoological ones, the primary reference points include animal behaviours such as migrations, reproduction, and even human birth and death cycles. These types of referential are prevalent globally, particularly in areas where prolonged periods of sun or moon obscurity occur due to clouds, fog, monsoons, etc. These references become particularly crucial when the sun sets, as the inhabitants in these regions rely on them to estimate time and interpret process evolutions effectively.

For instance, zoological mechanisms serve as chronological markers, denoting specific times of the year and seasons linked to certain economic or productive activities. Take the Tunguses of northeastern China as an example: they marked the onset of summer with the spawning of grayling (*Thymallus*) and the commencement of winter when the first sizable squirrel was captured (Nilsson, 1920: 53). The Dyaks of south-eastern Borneo discern the rice planting season by the emergence of a fungus known as *kulat bantilong*, which proliferates at specific times annually. Similarly, the Paez Indians of Colombia use the term *enzte* to denote fishing, summer, and the year, as large-scale fishing predominantly occurs in a single season, typically in January or February. The Algonquians of Virginia track their winters (*cohonks*) by counting the migrations of wild geese, using the frequency of these migrations to determine the years since an event occurred (Nilsson, 1920: 53).

Likewise, in classical Greece, institutions recognized the significance of birds as time indicators. This is exemplified in Aristophanes' *The Birds*, where the chorus proclaims:

> "The finest things in human life all come from us, the birds. To start with, we announce the start of winter, spring, and autumn. Migrating off to Libyan shores, the crane cries, 'Sow your seed!', And to the merchant, 'Winter comes: hang up your rudder and sleep!' He tells Orestes, 'Weave a cloak!'-to keep him warm while mugging. Then later on the kite appears, to signal change of season: It is time to sell your heavy cloak and buy some summer clothes." (Aristophanes, 1998: 42)

Homer describes, "as the long, hoarse cries of cranes echo across the sky and vast formations escape winter's harsh storms, flying forcefully southward to the oceanic gulfs" (Homer, 1991, bk. III: 2–3). In a similar vein, the Eskimos traditionally marked births by the time of egg gathering or seal fishing.

However, among such references, longer cycles are often marked by unique phenomena like the spread of diseases caused by specific bacteria or viruses within populations. An example is the Batak of Sumatra, who believed that smallpox epidemics recurred every nine to twelve years. Consequently, they based their biographical chronologies on this pattern. As recounted by a traveller, when a chief was asked about the age of his house, he responded that "it has stood through two smallpox epidemics", thereby indicating it was just over 24 years old (Nilsson, 1920: 94).

In shorter chronological cycles, zoological time referential like those based on animal behaviours have proven useful. Among these, the rooster is perhaps the most renowned for its role in timekeeping. In certain cultures, the crowing of roosters signifies the end of the night. For instance, the Swahili and residents of the Dutch Indies could tell it was around 5 or 6 AM. on rainy days by the first crow of the rooster (Nilsson, 1920). Similarly, the Yoruba people have adopted this chronological approach. In their culture, it has become institutionalized, with the rooster serving as a revered animal that appeases deities governing specific rhythms. This is exemplified by Elegguá, the deity associated with opening and closing paths, to whom roosters are offered as sacrifices. Like Elegguá, the rooster's initial crowing symbolizes the dawn's beginning, and occasionally, its crowing also marks the sunset or day's end (Cabrera, 2009).

Chronogenetic institutions grounded in zoological cycles not only underscore the crucial role of animals in the temporalization of human societies. In regions where the sky was often obscured, making celestial bodies hard to observe, seasons and years were instead indicated by animal behaviours. These patterns of animal species became essential tools for timekeeping, enriching cultural traditions and institutional structures closely linked to these processes.

2.2. Chronogenetic Institutions Based on Botanical and Agro-Livestock Cycles

Botanical and agricultural cycles play a pivotal role in chronogenetic institutions, serving as key markers of time through the stages of crop growth, cultivation, and harvesting. For societies heavily dependent on agriculture or recollection of vegetables, nuts, and wild fruits; these institutions were crucial, offering vital timekeeping mechanisms to enhance farming efficiency and resource management. Chronogenetic institutions have utilized botanical and agricultural phenomena to demarcate short, medium, and long periods, employing their consistent occurrence to signify daily, monthly, or even annual cycles.

For instance, the Bigambul tribe in south-eastern Australia discerns seasons through the flowering of specific trees, such as the Yerra tree's September bloom indicating *yerrabinda*. This practice is mirrored by the Kiowa Indians, whose sun dance coincides with the whitening of the cotton plant. Similarly, in the Society Islands, the timing of annual festivals aligns with the flowering of reeds (Nilsson, 1920: 52). Further south, the Tupis of Brazil use the term *akayú* (also *cajú* or *cayú*) for both the cashew nut, which flowers, and fruits annually, and the season. The cashew's kidney-shaped stone, essential for food and fermented drinks, also plays a role in tracking age; every year, a bone is set aside to count a person's years, intertwining botanical cycles with human life (Rochefort *et al*., 1666: 33). Temporal rhythms extending over decades are also marked by botanical cycles. Roy A. Rappaport (1984) observed that the Tsembaga Maring in New Guinea use the growth of the rumbim tree as a symbol of peace time, before their Kaiko festival. This practice helps maintain ecological balance and regulates tribal conflicts. Hostilities are resumed when the rumbim tree reaches a certain height, marking the end of a peace period that typically lasts 8 to 12 years (Harris, 1989).

Similar to botanical references, agricultural seasons also function as timing mechanisms. The Maya civilization in Mesoamerica developed an intricate calendar system based on agricultural cycles. This system, known as the

Haab', comprised 18 months of 20 days each, plus an additional five-day period called the Wayeb'. This 365-day calendar was essential for scheduling agricultural activities such as planting, cultivation, and harvesting (Sharer and Traxler, 2005). Many indigenous communities have created chronogenetic institutions based on agricultural cycles. For example, the Hopi people in the American Southwest use an extensive agricultural calendar that guides the timing of planting, cultivating, and harvesting essential crops such as corn, beans, and squash. This calendar is informed by observations of celestial movements, seasonal changes, and the development stages of the crops (Patterson-Rudolph, 1997).

In the Indian Archipelago, where rice cultivation is fundamental to many communities' diets, the seasonal cycle is intimately tied to the stages of rice growth. People commonly reference past events in terms of the rice lifecycle, such as during flowering or harvesting periods. For example, the Bahau, a Dyak tribe in Borneo, divide the year into eight periods, each linked to different rice cultivation tasks like clearing weeds, cutting trees, burning wood, planting, weeding, and various stages of harvest, which culminates in celebrating the new rice year. Similarly, the Javanese peasant calendar, also used in Bali and Java, divides a 360-day year into 12 periods, each corresponding to specific agricultural activities. These range from the preparation for rice planting, including the felling of trees and burning of dry grass, to the sowing, growth, and eventual harvesting of rice, aligning with seasonal changes like the rutting season of animals, flooding of rivers, and the onset of cold weather.[6]

In some cultures, agricultural chronology adopts a dual system, centred around the cultivation and harvest of key crops. The Bontoc Igorot in the Philippines' mountains divided the year around rice growing and harvesting (*cha-kon*) and the remainder of the year (*ka-sip*) (Nilsson, 1920: 58). The Thonga of South Africa have a vague concept of the year, starting it with ploughing and the harvesting of early fruits. Among some Dahomey tribes, 'year' is linked to the cycle of planting, eating, replanting, and harvesting maize (Foà, 1895: 120) with the year ending after the harvest.[7]

Beyond domesticated plants, temporal measurements also encompass the cycles of domesticated animals integrated into agricultural activities. A notable example is the Javanese method of marking daily hours based on the routines of rural animals, like the times for sending buffaloes to pastures or bringing them back (Nilsson, 1920: 38). Such practices are not unique to Java, the Hottentots, for instance, gauge biological age through the calving and lambing cycles of their cattle. Similarly, some Arab communities historically used the fertile cycles of female camels to define time periods. They determined the appropriate time for mating a camel based on its age, marked by the number of *rhabīʿ*,[8] a term denoting *spring* or *autumn* and often associated with the

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Those periods were: *koso* of 41 days; *karo* of 23 days; *katigo* of 24 days; *kapat* of 24 (25) days; *kalimo* of 26 (27) days; *kanam* of 41 (43) days; *kapitu* of 41 (43) days; *kawolu* of 26 (in leap year, 27) days; *kasongo* of 25 days; *kasapuluh* of 25 (24) days; *dasto* of 23 days; and *sodo* of 41 days (Nilsson, 1920: 69–70).

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Similarly, in early 20th-century rural Cuba, the year was split into the sugarcane harvest period (December to April/May) and the 'dead time' post-harvest, when sugarcane-related activities ceased (Ortiz, 2002).

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According to François de Blois: "The common noun rabīʿ means 'spring' in modern

rainy season (Bin Jamil, 2021). This usage, as François de Blois (2020) notes, links temporal measurement more to seasons and weather patterns than to direct agricultural activities. These examples set the stage for exploring bio-atmospheric temporalisations, another dimension of timekeeping in various cultures, which we'll delve into next.

2.3. Chronogenetic Institutions Based on Meteorological or Atmospheric Cycles

Chronogenetic institutions, utilizing meteorological and atmospheric cycles like tidal movements and seasonal patterns, significantly influence societies. Tidal cycles, with their twice-daily ebb and flow, provide a natural measure of time, each cycle lasting about 12 hours and 25 minutes (Nilsson, 1920: 43). For longer periods, indicators like ice thickness signify seasonal transitions (Mirsky, 1937). In Iceland, such principles organize agricultural and livestock activities, with seasons defined by tidal changes. Key periods include Lamb-weaning (Pen-tide) in May, Parting-tide for moving sheep to hills, and Market-tide for annual purchases. Hay-time spans July and August, and Folding tide (Rettir) in September marks gathering sheep from hills for sorting. Egg-tide indicates the wild birds and eider-ducks season, while fishermen recognize different fishing seasons like Ver-tid, with specific spring, autumn, and winter fishing months (Vigfússon and Powell, 1883: 431).

Beyond tides, other atmospheric phenomena like winds also mark time in various locations. For instance, the Marshall Islands have calm months and squall months, while the Fanti of the Gold Coast divided their year into nine parts, starting with the harmattan wind in January and ending with tornadoes in December (Nilsson, 1920: 66). In monsoon regions like Sumatra, seasons are named after the wind's direction. The Taluk season, from April to mid-June, features the south monsoon, and other seasons correspond to east, west, and north monsoons. In New Britain (Bismarck Archipelago), between the major southeast and northwest monsoon seasons, each lasting five months, are two one-month intermediate seasons of variable winds and calm. In Songa (Solomon Islands), seasons are defined by wind direction: west wind (*nanano*), north wind (*tovarauru*), south wind (*rari*), and east wind (*sassa nanamo*), followed by calm (*mbule*) and another cycle of *tovaruru* and *sassa nanamo*. In Lambutjo, Papua New Guinea, winds are classified by their cardinal origins, influencing activities and perceived qualities. For instance, the south wind signifies a good almond ripening time. The ancient inhabitants of the Mediterranean, including the Hellenes, had a complex system for classifying seasonal winds, vital for their naval activities (Braudel, 2020; Gosch and Stearns, 2007), where operations and timing were closely linked. For the Yoruba, thunder signals a shift in cycles, prompting fishermen and hunters to switch to farming, a practice echoed in some Pacific islands where the first lightning marks yam planting (Nilsson, 1920: 85). Thunder typically indicates a dual seasonal system, often tied to monsoon variations, as seen in Bali, where the year splits into two six-month periods based on monsoon arrival.

In tropical and subtropical regions, a natural division exists between dry and rainy seasons. For example, in the Orinoco region, both summer and winter are dry, with the rest of the year being rainy. This distinction is embedded in local languages: in Maipuri, the dry season is *camoti* (sun's brightness), and the rainy season is *canepó*. In Tamanaco, *canepó* means rain or rainy season, and summer is *vannu* (crickets) (Tavera-Acosta, 1907). The Bakairi of Brazil have semesters for these seasons (rain and dry), while the Karaya count years from one river flood to the next, living on sandy banks during the dry season and upper banks during the rainy season (Krause, 1911).

In extreme polar regions, outside these hemispheres, the division is into summer periods with some vegetation, and winters characterized by abundant snow and ice, as exemplified by the Labrador Eskimo year. The Comanche counted using cold and warm seasons. Something similar is true among the Hopi of Arizona, for whom the year had two divisions which may be called named and unnamed periods of the months: the first is the cold period, the second is the warm period (Nilsson, 1920: 56). It is almost the rule among all people living in a climate that has a winter with snow and ice. The Ostiaks also counted the years using winters, and the same happened with the Eskimos of Greenland and the Bering Strait. Moreover, the North American Indians, e.g., the Kiowa, Pawnee and Omaha, also used this method. In all these cases, the calculation methodology commonly used was not the season itself, "cold weather", but specific phenomena that distinguish it, such as snow and ice. This is the case with the tribes of the interior Northwest, the Hupa and Dakota, whom to say that a human was so many 'snows' old or that so many 'snow-seasons'[9] have passed since an occurrence (Mallery, 1886; Vigfússon and Powell, 1883; Weeks, 2003).

However, the division of seasons extends beyond the common dual and tetra-seasonal systems (spring, summer, autumn, winter) to include ternary, octagonal, and even more complex systems. For example, Burma recognized three seasons – cold, hot, and rainy (Nilsson, 1920: 64). The Siciatl of British Columbia also had a tripartite system, comprising spring, summer, and winter. Neighbouring Thompson Indians and the Shuswap in British Columbia identified five seasons. Their winter spanned from the first enduring snowfall to its disappearance in valleys (2nd to 4th months). Spring was marked by the melting snow and frequent Chinook winds (5th and 6th months), leading into summer (7th to 9th months), followed by autumn or Indian summer (10th and 11th months), with the year ending as autumn concludes (Carlson and Bona, 1995).

The Lapps have names for the four ordinary seasons, but their language also contains compounds such as "spring-winter", i.e. late winter, a compound also known in Swedish (*vår-vinter*) (Nilsson, 1920: 61). Something similar happens with the Sámi in Finland that even today call *Giđđadálvi* to the spring-winter, *Giđđageassi* to the Spring-Summer, *Čakčageassi* the "autumn-summer" and *Čakčadálvi* to the "autumn-winter" (Eira et al., 2023). The Västerbotten Lapps divide the year into *sjeunjestie*, the dark period, and *tjuoikestie*, the light period. They also have four seasons: *dalvie*, winter, from the freezing of the lakes to the melting of the snow; *geira*, spring, the time of the melting of the snow and the spring floods; *gese*, summer, from the time when the land becomes visible to the fading of the grass; *tjatj*, autumn, from

Arabic, but the classical lexica are unanimous in stating that it is also (or even primarily) used for 'autumn' and is synonymous with xarīf. The verb rabaʿa is supposed to mean 'it rained' and there is a likelihood that rabīʿ actually means 'rainy season', which of course can be at different times in different regions." (de Blois, 2020: 194)

8 Institutions designed to temporalise with seasons even reach the present day. In many Latin Americancountries, expression *quince primaveras* denotes the time when girls turn fifteen. In English, the expression *summer eighteen* used to be used for a similar purpose.

this time until the lakes begin to freeze again. The Lapps also speak of *talve-qvoutel*, mid-winter, *kese-qvoutel*, mid-summer, and *tjaktje-kese*, late summer (Collinder, 1949; Gjessing, 2021).

Other cultures have also used intercalated seasonal systems. Among the Spanish, for example, apart from the four known seasons, an intermediate one is included, "el veranillo de San Martín", in mid-November, when temperatures rise in the middle of autumn (RAE-ASALE, 2021). In Cuba, there are three recognised seasons (spring, summer and a short winter). Even so, there are cycles marked by meteorological phenomena, which include certain socio-economic activities. This is the case of the well-known "Lenten winds" (February, March or April) (Rubiera, 2021) or the "hurricane season" (beginning of June – end of October) (Roura Pérez *et al*., 2019). For example, in some Slavic countries, Russia and Ukraine, *rasputitsa* is the "mud season". This word refers to the period between the end of winter and the beginning of spring when the snow melts (Olsen *et al*., 2020) obstructing traffic through them.

These temporalisations are often highly important and are frequently combined with subsistence activities. In this sense, several authors (Harvey, 1994) agree that the major seasons are mostly taken from the variable phases of the climate. However, in more than a few cases, it is necessary to establish subdivisions relating to the natural phenomena accompanying them. Because of their fluctuating duration and limited number, the climatic phases do not allow a more significant number of minor seasons to be distinguished and named. This shorter duration includes the phases of plant and animal life, can be used as equivalents and are much better suited for this purpose, especially when regular occupations such as gathering, hunting or agriculture are added.

For the Hidatsa Indians, the 'season of heat' coincides with the 'season of strawberries', both referred to as *kadu* (Nilsson, 1920: 50). Similarly, the Yoruba people associate crop seasonality with climate, where *odun*[10] signifies both the year and the month of October, marking the transition from the rainy to the dry season. This period is celebrated with festivals and is a time for listening to "the secrets of the cold and dry wind, of the half-naked tree" (Brew aka, 2015) It is a busy time for farmers, involving clearing farms for second harvest crops and fishing. The dry season *erun* is split into two two-month periods, involving harvesting and preparation for the next season's crops (Bartle, 1978). The wet season also has two parts, with a short dry season in between (Dennett, 2018). The Akan Asante, predominantly farmers, begin their planting season in March to anticipate the April rains, a period known as Oforisuo or Ofresuo, meaning "to call for rain" (Adjaye, 1994: 63).

In summary, temporalizations based on seasonal bio-atmospheric meteorological cycles, particularly significant in pre-state societies, are widespread. Their impact has been so profound that traces of them can still be found today. In Spanish-speaking and Spanish-influenced countries, for example, there is a meaning of the word "weather" that refers not to the course of phenomena but precisely to the climate. In Cuba and some areas of Florida in the USA, for example, the section of the news programmes dedicated to the weather report is called "*parte del tiempo"* (weather report). In the same way, an old traditional Cuban Trova song titled "Saludo Compay" has verses where time (*tiempo*) and weather (*clima*) are interchanged.

3. Chronogenetic Institutions Based on Mixed Cycles

While unique temporalizations exist as previously described, and have been analysed for heuristic purposes, most anthropological evidence suggests a predominance of mixed-type temporalizations. Like meteorological systems, temporal orientation systems often blend various elements. Human groups frequently utilize chronological and chronometric institutions that combine reference points from similar or different categories. This employment is due to two fundamental factors: institutions' coexistence and the logical need to temporise phenomena if the commonly used referential fails or manifests differently.

Certain cultures utilize celestial calendars, such as lunar-solar types, exemplified in Classical China, or solar-astral and even sun-moon-astral types. For instance, the Chinese agricultural calendar, known as the "Huangdi Calendar", operated on a 60-year cycle. Each year was identified by one of the twelve Chinese zodiac animals and one of the five elements (wood, fire, earth, metal, water). It was segmented into 24 solar terms, each linked to distinct agricultural processes like sowing, harvesting, and storage of crops (Needham *et al*., 1980).

The Egyptians, pre-conquest Mesoamerican civilizations like the Maya and Aztec, and Imperial Persia employed similar mechanisms, suggesting the existence of comparable chronogenetic institutions. These cultures combined solar and lunar measurements in their calendars without abandoning the use of stars to denote dates and events of extended duration. James Fraser, in *The Golden Bough* highlights an intriguing aspect of Spartan culture, suggesting that their eight-year regal tenure might have stemmed from early Greek astronomical considerations. The concept of an octennial cycle, representing the shortest period for the sun and moon to realign after overlapping, served as the foundation for a calendar that harmonized lunar and solar times to some extent (Fraser 2009: 222).

Likewise, other societies have merged seasonal bio-atmospheric temporalities into diverse composite systems. This was the case of the ancient inhabitants of northern Skåne (southern Sweden), who used a chronogenetic institutions based on botanical and agricultural elements. For them, barley was only sown when the hawthorn blossomed. Similarly, to know their date of birth, they were guided by the rye or potato harvests or by the time when the cattle were first put out to pasture, which coincided with the spring (Nilsson, 1920: 51). The inhabitants of Bohuslän (western Sweden) also used botanical methods, but this time in combination with zoological ones. For them, planting time was near when the swallow had arrived, and the juniper was in flower. Similarly, the ancient Egyptians who depended on the Nile's annual flood cycle to structure their agricultural calendar, categorizing the year into three seasons: inundation, growing, and harvest. The Nile's flooding marked the start of the agricultural year, signalling the onset of the inundation season (Wilkinson, 2021).

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In Yoruba and Akan cultures, *odun* has religious meanings. For Yoruba, it is part of the *ifá* corpus, involving myths and divination using the *ifá* board. In Akan culture, *odun* signifies Tata Odun, a deified ancestral leader. This religious dimension of *odun* demonstrates how some chronogenetic institutions are imbued with sacredness, ensuring their persistence and significance within the community.

This is also true for the Ba-Ronga, residents of present-day Mozambique, where January marks the season of the first ripe corn ears. This date is also known for the precautions to be taken to keep the *nkapa* (*mu-mi*) birds away from the *sorgho fields*, hence a period at the beginning of this month was known as "the time when the birds are chased away", which coincides with "the time to be the regular sowing" (Junod, 1913: 23). On the islands of New Zealand, something similar occurred. Here, plants and birds appeared at regular times signalling among the Maori that the time to start farming was approaching. Specifically, two types of migratory cuckoos, *Cuculus piperatus* and *Cuculus nitens*, which appeared at Christmas on the coasts, marked the period of the first tuber harvest. The flowering of clematides (*Clematis albida*) in October reminded people to dig up the soil to plant again (Nilsson, 1920).

In several cultures, timekeeping systems intricately weave together elements from different categories such as celestial movements and seasonal changes. The Bangala of the Upper Congo exemplify this, utilizing lunar months (astral reference) in conjunction with the seasonal inflow or flood of rivers (meteorological reference) to measure longer cycles, adapting to their environment without a dry season. Similarly, the Samoans employ a combined solar and zoological system to divide their day. Their system includes: (a) 'first dawn' marked by cock crowing, (b) 'full dawn' at the call of the bird *iao*, (c) 'morning' as the time for feeding domestic pigeons around 9 am, (d) 'noon' described as 'the sun rising', (e) 'mid-fall' around 3 pm, and (f) 'sunset' and the onset of night, indicated by the cricket's cry, about 20 minutes after sunset. These methods demonstrate the rich diversity in chronographic measurements across different cultures (Nilsson, 1920: 37). Gonzalo Rodríguez García (2020) described this concept as a "cyclic vision of time and the universe", where opposing forces such as cold-heat and day-night revolve around an unchanging central axis, symbolizing the constant core.[11]

The Ammassalik Eskimos of Greenland, who traditionally lacked a distinct concept of time (Gagné, 1968), combined solar/lunar celestial mechanisms with zoological and botanical seasonal indicators to discern specific times of the year. They counted from the winter solstice five moons until the time when the nights became so bright that it was impossible to continue counting with the moon. Then they counted by the growing size of the eider duck's young and the ripening of the berries. Besides, they paid attention, along the coast, by the departure of the terns and the fatness of the seals. Moreover, when the reindeer shed the velvet of their antlers, they also knew it was time to move into winter homes (Nilsson, 1920: 54). For the Ammassalik these dates are distinguished from the "time of fasting", sometimes "time of hunger", which takes place especially in winter when seal meat is very scarce and life becomes mainly communal because of shortages (Mirsky, 1937).

The Pokot, sometimes known as Suk, who lived between eastern Uganda and north-western Kenya, also have combined measurement systems. In this case, fascinating sacred (religious) associated institutions allow them to establish the hours of the day by combining solar, astral and lunar temporalities. Here, the day and the seasons were determined by the positions and sometimes the moods of Asis (the Sun), the younger brother of Torôrut, the supreme deity of the Pokot. Torôrut was also the consort of Seta (the Pleiades), through whom certain seasons were also established, and the father of Arawa, the moon, his first-born son who reigned at night, just before Topogh, the star and his first daughter, announced the arrival of his elder brother. For the Pokot, the seasons were divided into dry and rainy seasons. In the former, a very angry Asis predominates; in the latter, *Ilat* (rain), son of the supreme lord Torôrut, reigns supreme (Beech, 1911).

The natives of New Britain (Bismarck Archipelago), like the Alu (Solomon Islands) inhabitants, also used botanical/astronomical measuring systems. The former determined the planting season from the budding of certain trees and the position of certain stars. The latter divided the year into two, based on the almond tree's flowering and the Pleiades' position in the firmament (Brown, 1910) The Pennsylvania Indians also used botany, but this time combined with zoology. When the white oak leaf, which comes out in spring, is as big as a mouse's ear and the whippoorwill bird (*Antrostomus vociferus*) had arrived and fluttered around them calling out its wekolis Indian name, as if to say "hacki heck" – "go and plant corn" – it is the time for planting (Nilsson, 1920: 52).

Finally, there are cases where the temporal combination is given using multiple combined references. This group can also include short cycle chronologies, such as times of day, and longer ones, which cover a whole year or part of it, e.g., a season. In Antananarivo, Madagascar, locals used a sophisticated system for short-cycle time measurement, blending lunar, solar, zoological, atmospheric, and agricultural references. This system, indicating average times, defined hours of the day through myriad natural signs. Midnight was marked as the middle of the night; 2 AM by the crowing of frogs; 3 AM by roosters' crowing; and 4 AM as a period where morning and night intertwined and the day progressed with events like the crowing of crows and the appearance of a luminous horizon at 5 AM, sunrise at 6 AM, and the drying of dew on leaves by 6.30 AM. Unique winter phenomena, like frost, were noted at 6.45 AM. The sun's position relative to specific landmarks, like being over the leash at 9 AM or aligning with the roof ridge at noon, provided clear time indications. Thus, the system is intricately woven with various elements of the natural world to measure time throughout the day (Nilsson, 1920: 39).

The ancient Nandi people of Kenya's Rift Valley Province had a rich system for measuring time, intricately weaving together cyclical references from celestial, zoological, meteorological, and atmospheric sources. Each hour of the day was defined by a specific natural or daily activity: at 2 AM, marked by elephants going to the waters (zoological); at 3 am, signified by the roar of waters (meteorological); at 4 AM, the brightening sky (solar); and continuing through the day with events like the opening of houses, the movement of oxen and sheep to grazing fields (agricultural), the rising and warming of the sun (atmospheric), and the activities of goats and cattle. The system even detailed evening and night hours, from the closing of cattle gates and the setting of the sun to the completion of evening meals and the sleeping patterns of the community, culminating in the midnight hour (Hollis, 1909: 96–97).

In the case of mixed systems for medium and long cycles, it is seen how for the Orinoco Indians certain signs indicated that a medium or long period of

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Notably, this pagan calendar deeply influenced Christian rituals. The summer solstice, the night of Saint John, is celebrated with dances, music, bonfires, and rituals, marking the "great Sun" and year's shortest night. Similarly, All Saints' Day and the Night of the Deceased echo the Celtic Samhain, honoring ancestors. This ancestral respect is also evident in Mexico's "Fiesta de las Calaveras de Ánimas", rooted in both Christian and pagan traditions shaped by solar calendars.

the year had elapsed. The rainy season was announced by the cry of the monkeys at midnight or the approach of day (*zoological*); the sudden flowering of certain trees (botanical); the swelling of the streams (atmospheric), the greening of the yams (agricultural) and, finally, the heliacal setting of the Pleiades (astral) (Nilsson, 1920: 52).

In summary, human societies have developed diverse systems of temporalization through complex combinations of chronogenetic institutions, incorporating celestial, meteorological, and biological elements. These systems play a crucial role in understanding and measuring the cyclical transformations of various phenomena across different cultures. These changes have been the primary source of reference for associating human processes with group and societal development.

Conclusion

In this article, we have explored phenomena that precede the concept of time. Our thesis led us to examine material phenomena in the natural world surrounding humans and distinctly social phenomena. Through their dynamic interrelationships, these phenomena have constituted the fundamental elements that, as they further developed throughout evolution, eventually transformed into what we know today as the idea of time. Through this exploration, we have sought to provide new insights into the complex field of temporalities. Our discussion has focused on the concept of 'chronogenetic institutions,' which we propose as a theoretical tool to help explain and categorize some empirical realities that form the basis of temporal concepts as they have evolved in different human societies over generations.

Drawing from the theoretical underpinnings of Gustavo Bueno and David Alvargonzález, our analysis has revealed that "social" time emerges from the techniques, technologies, and institutions employed by early humans to measure the cyclical flow of events. This perspective aligns with Norbert Elias' (1993) conception of time as a socially constructed entity. We have shown that throughout history, human societies have developed various institutions, symbols, and rituals to comprehend and interpret transformative phenomena, thereby creating a cyclical continuum characterized by distinctions of "before" and "after". The notion of "chronogenetic institutions" serves as a pivotal framework for categorizing these mechanisms of recording, measuring, and correlating, which continue to be integral in managing these transformations even in modern times.

Within our proposed theoretical framework, we have introduced a novel classification system for chronogenetic institutions, rooted in the cyclical referential phenomena they utilize. These institutions, closely linked to human activities and primarily associated with natural phenomena, have been crucial in shaping our early understanding of certain phenomena, aiding early humans in starting to build the foundation for what would later become an initial idea of "Time". We contend that this interpretation of the origins of the idea of time connects nicely with the more general thesis that maps the genesis of even the most abstract ideas in the practical operational experiences of humans.

Our investigation highlights that far from coming from the *objective reality of nat*ure or from the structure of the subject as realism or idealism would have it, temporal concepts evolve and are transmitted institutionally through the operational activities of individuals and groups within their societal contexts. This perspective challenges the traditional view of an absolute or singular "nature" or "social" Time. Instead, it advocates for recognizing multiple constructed mechanisms used to measure the ever-changing world. These mechanisms employ a variety of techniques, technologies, and institutions, and are grounded in diverse physical, biological, chemical, social, and cultural phenomena. By recognizing the existence of multiple chronogenetic institutions, we open avenues for further research and a deeper understanding of temporal phenomena. The classification categories we propose in this study aim to facilitate such research, providing a solid framework for comprehending what we believe to be the source of time as idea.

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Duzan Dussier Avila Castellanos, Íñigo Ongay de Felipe

Kronogenetske institucije kao kategoričke jezgre vremenskih ideja

Sažetak

Ovaj rad istražuje genezu koncepta vremena, analizirajući kako su početne metode, tehnike i institucije koje su koristile rane ljudske skupine za mjerenje promjena okoliša postale sve više usklađene s ljudskim aktivnostima, čineći tako temelj našeg modernog razumijevanja vremena. Prihvaćajući diskontinuiranu materijalističku perspektivu, ovaj rad predlaže da složene ideje poput vremena često imaju svoje korijene u jednostavnom tehnološkom podrijetlu. Uvodimo pojam kronogenetske institucije *da bismo opisali rane mehanizme koje su ljudske skupine koristile za mjerenje transformacija svijeta prije nego što su imale jasan koncept vremena. Kronogenetske institucije grupirane su prema cikličkim pojavama koje predstavljaju, prvenstveno prirodne pojave kao što su kretanje nebeskih tijela, promjenjivi vremenski obrasci i sezonske varijacije u flori i fauni. Ova studija izaziva gledište da su koncepcije vremena bile čisto teorijske u svojim začecima, ističući da su se u početku pojavile i proširile kroz institucionalne prakse u društvenim kontekstima. Promiče oplemenjeno razumijevanje složenosti vremena, zalažući se za prijelaz s jedinstvenog »vremena prirode« na koncepciju višestrukih temporalnosti, konstruiranih i društveno i tehnološki. Nadalje, zalaže se za objektivno i pluralističko ispitivanje početnih pokušaja ranih ljudskih skupina da sinkroniziraju svoje aktivnosti s promjenjivim i nepredvidivim svijetom oko sebe.*

Ključne riječi

vrijeme, temporalnosti, prirodno vrijeme, kronogenetske institucije, diskontinuirani materijalizam, antropološki prostor, referencijal

Duzan Dussier Avila Castellanos, Íñigo Ongay de Felipe

Chronogenetische Institutionen als kategorische Kerne zeitlicher Ideen

Zusammenfassung

In diesem Artikel wird die Genese des Konzepts der Zeit erforscht, indem analysiert wird, wie die initialen Methoden, Techniken und Institutionen, die von frühen Menschengruppen zur Messung von Umweltveränderungen eingesetzt wurden, sich immer stärker an den menschlichen Aktivitäten ausrichteten und hierdurch die Grundlage unseres modernen Zeitverständnisses bildeten. Eine diskontinuierliche materialistische Perspektive annehmend, postuliert diese Arbeit, dass komplexe Ideen wie die Zeit oftmals einen einfachen technologischen Ursprung besitzen. Wir führen den Begriff chronogenetische Institutionen *ein, um die frühen Mechanismen zu schildern, die von menschlichen Gruppen zur Messung von Welttransformationen verwendet wurden, bevor sie ein klares Konzept von Zeit hatten. Diese chronogenetischen Institutionen werden entsprechend den zyklischen Phänomenen gruppiert, die sie repräsentieren, wobei es sich vornehmlich um natürliche Vorkommnisse wie die Bewegung von Himmelskörpern, veränderliche Wettermuster und jahreszeitliche Schwankungen in Flora und Fauna handelt. Diese Studie stellt die Ansicht infrage, dass zeitliche Konzepte bei ihrer Grundlegung rein theoretischer Natur waren, und pointiert, dass sie zunächst durch institutionelle Praktiken in sozialen Kontexten in Erscheinung traten und sich verbreiteten. Sie fördert ein raffiniertes Verständnis der Komplexität der Zeit und plädiert für den Übergang von einer einzelnen „Naturzeit" zu einer Konzeption mehrfacher Zeitlichkeiten, die sowohl sozial als auch technologisch konstruiert sind. Überdies befürwortet sie eine objektive und pluralistische Untersuchung der anfänglichen Versuche früher Menschengruppen, ihre Aktivitäten mit der sich verändernden und unvorhersehbaren Welt um sie herum zu synchronisieren.*

Schlüsselwörter

Zeit, Zeitlichkeiten, Naturzeit, chronogenetische Institutionen, diskontinuierlicher Materialismus, anthropologischer Raum, Referenzial

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Institutions chronogénétiques comme noyaux catégoriques des idées temporelles

Résumé

Cet article explore la genèse du concept de temps, en analysant comment les premières méthodes, techniques et institutions, utilisées par les groupes humains primitifs pour mesurer les changements environnementaux se sont progressivement alignées aux activités humaines, jetant ainsi les bases de notre compréhension moderne du temps. En adoptant une perspective matérialiste discontinue, ce travail postule que des idées complexes comme le temps ont souvent des origines technologiques simples. Nous introduisons le terme d'institutions chronogénétiques *pour décrire les mécanismes précoces utilisés par les groupes humains pour mesurer les transformations du monde avant d'avoir une conception claire du temps. Ces institutions chronogénétiques sont regroupées selon les phénomènes cycliques qu'elles représentent, principalement des occurrences naturelles telles que le mouvement des corps célestes, les variations météorologiques, et les changements saisonniers de la flore et de la faune. Cette étude remet en question l'idée selon laquelle les concepts temporels étaient purement théoriques à leur origine, soulignant qu'ils ont d'abord émergé et se sont répandus à travers des pratiques institutionnelles dans des contextes sociaux. Elle promeut une compréhension affinée de la complexité du temps, plaidant pour une transition d'un «Temps de la Nature» singulier vers une conception de temporalités multiples, construites à la fois socialement et technologiquement. Elle défend, en outre, un examen objectif et pluraliste des premières tentatives des groupes humains pour synchroniser leurs activités avec un monde changeant et imprévisible.*

Mots-clés

temps, temporalité, temps naturel, institutions chronogénétiques, matérialisme discontinu, espace anthropologique, référentiel