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Identification and Analysis of Objective Time in Historical Monument Conservation and Restoration Scientific Studies

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ABSTRACT

In this article, time is recognized as a fundamental factor in the scientific and theoretical discussions of conservation and restoration. Based on theories presented from ancient to contemporary times, time is a phenomenon with scientific and philosophical dimensions that must be analyzed from various aspects for its understanding and identification. Thus, in this research, time is identified through a qualitative approach with phenomenological strategy, and while introducing its various dimensions, the objective or tangible aspect of this phenomenon in scientific studies of conservation and restoration is elaborated. Accordingly, time, in its scientific and objective dimension, manifests itself through continuity and interdependence with change and transformation, alongside the processes of deterioration of monuments and the studies of time measurement in human awareness. Therefore, time measurement experiments and determining the historical period of a monument, as well as the scientific analysis of deterioration processes to understand the altered layers of the surface in various things, represent the scientific efforts in conservation and restoration to identify the objective phenomenon of time in monument and preserve them.

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Introduction

Time and the way of human understanding of it is one of the fundamental scientific and philosophical issues, which theories have been presented over the centuries. At the beginning of the 20th century, Einstein's theory of relativity brought modern man to change his attitude about the world, and the progressive minds of the world, who had a great desire to discover the secrets hidden in nature, welcomed the writings of this great scientist. This important theory removed time and space from being absolute, unlike the previous concepts, and defined and determined the concept of event. According to this theory, four-dimensionality is necessary to know the world. Determining a position in addition to the Cartesian coordinates actually requires four measurements, and these measurements do not establish the position of the object in the place, but rather an event in the place, thus the concept of the event or The event replaced material objects and space-time replaced space and time, which means that encountering material objects is actually encountering events, not just a mass made of matter; If, according to the previous theories, it was possible to imagine a number of objects in a single moment and ignore it because the time was the same for all of them, now we have to face the objects -or in more correct terms- events; Time also identified and comprehensively analyzed the object. Therefore, the world that this theory introduces to us is the world of events, a place inside which matter is moving at a certain time, and objects are actually events that happened at their own time. Matter, space, time and motion are the building materials of the universe.

Time is the foundation of the existential nature of material. The theory tells us that time is not a different matter. All objects are, in fact, time events or events in their space-time. Space-time forms the place of the actual texture of events or objects (Russell, 1961: 104-233).

Based on this, by reflecting on the fundamental concept of events in this theory, all sciences that deal with the study of various works and objects, including artworks from different historical periods to contemporary ones, are not only faced with mere masses made of various materials but are scientifically engaged with an event that has a real and thoughtful relationship with time. The question is, what is the nature of time that is measured in these studies, and how is it identified? This article analyzes this question using a phenomenological approach. In the study of various works, a comprehensive understanding of time reveals the very essence of artistic works, highlighting the importance of recognizing time in the study of these works. Time is a phenomenon with its own specific aspects, and this article focuses solely on its objective facet.

Time is the foundation of the existential nature of matter. This theory tells us that time is not a separate and distinct subject from matter, and that all objects are, in fact, temporal events or occurrences in their own right, forming the actual context of these events (objects) (Russell, 1961: 104-233). Accordingly, by reflecting on the fundamental concept of events in this theory,

all sciences that engage with the study of various works and objects, including artworks from different historical periods to contemporary ones, are not only confronted with mere masses made of various materials but also with events that have a real and thoughtful relationship with time. The question arises: what is the nature of time that is measured in these studies, and how is it identified? This article analyzes this question using a phenomenological strategy. In the study of various works, a comprehensive understanding of time reveals the very essence of artistic works, highlighting the importance of recognizing time in these studies. Time is a phenomenon with its own specific aspects, and this article focuses solely on its objective facet.

Research Background

Humans perceive the passage of time through changes in their surrounding environment; however, their understanding of time differs from their understanding of space. Considering the dimension of time, objects are essentially events, and human temporal perception is dependent on the understanding of these events. Humans have the mental ability to perceive the sequence of events as before and after, thus grasping the passage of time (Horel, 1998: 156-171). Accordingly, time is recognized in the form of events. Additionally, our knowledge of the past is not based solely on the mind but rather involves the use of historical-cultural evidence and remnants left by predecessors. Thus, one can gain insights about the past in the present without being in that time (Campbell, 1997: 105-118), because humans possess special cognitive mechanisms that enable them to understand time. This understanding manifests as mental simulations of the future and representations of the past through memory and recollection, particularly in the study and recognition of historical and cultural monuments. The perception of the passage of time relates to changes in surrounding objects, and the way humans experience time is tied to their understanding and analysis of the concept of events. Exploring this topic, especially regarding human cultural monuments across different historical periods, can be a subject of reflection (Le Poidevin, 2015: 1-9).

In this context, Matthew Davidson addresses the topic of time and four-dimensionality in artworks by discussing the concept of time within them. His key points revolve around the events concerning the temporal aspects of physical objects. The author explicitly states that no one can conduct a deep scientific examination and study of the materiality of objects without also investigating time because time is in direct relation with physical objects and is constantly connected to them (Davidson, 2004: 17-33). Therefore, in scientific studies of conservation and restoration, a comprehensive understanding of the time aspect of the artwork holds special significance, which this article analyzes focusing on its objective aspects.

Methodology

This research adopts a qualitative approach and an inductive reasoning framework, utilizing a phenomenological analysis strategy. It involves the coding and logical arrangement of qualitative data derived from scientific theories. Phenomenology gained recognition in the twentieth century through the works of Edmund Husserl in Germany, advocating for a return to the things themselves, and in France through Maurice Merleau-Ponty. Husserl presented phenomenology as a means to carry out clear and justifiable research stages (Primozic, 2009). Phenomenology represents a fundamental movement in the twentieth century and is recognized as the philosophy of that era. Its aim is to provide a clear perspective for understanding the meanings of research questions or to approach philosophical issues with a phenomenological lens (Glendinning, 2008). In essence, it serves as a subjective method to lend scientific legitimacy to philosophy (Wall, 2015: 14), and according to Heidegger, it defines how research should be conducted (Heidegger, 2016). However, the manner in which questions are posed in research centered on the phenomenon of time is itself a fundamental issue. Regarding time, it is essential to discern what question to ask and how to articulate it, followed by contemplating ways to answer it (Bardon, 2016: 9). When inquiring about time, one should focus on all dimensions of the issue and phenomenological reveal its manifestations in human consciousness (Heidegger, 2008: 61-62). The main inquiry of this article is analyzed based on prominent scientific theories. The concepts presented aim to address the objectives of the research in an inductive manner, delving into the meaning relevant to answering the fundamental questions of the study (Cresswell, 2005; Torrance, 2008).

The entirety of phenomenology, or its ultimate meaning, can be viewed as a quest to discover the implicit form of a concept, a determination, or a thought (Levinas, 2013: 119). According to Husserl, phenomenology examines the intertwined nature of consciousness and the phenomenon under study. The realm of phenomenology is limitless, making it impossible to confine it within a specific science. Thus, this article approaches time through a phenomenological lens, delving into its nature as something that is apparent and tangible, yet, in reality, is a concealed phenomenon requiring reflection for proper understanding. The discussion will detail the phenomenological recognition and its function as the fourth dimension of objects in the conservation and restoration of various types of monuments throughout different periods, emphasizing a process that directly engages with objects.

In proposing a phenomenological method, certain steps are taken that involve returning to the essence of the phenomenon to intuitively analyze it from various perspectives and modes of emergence. Observing how the phenomenon manifests in human consciousness is a stage in phenomenology that culminates in the awareness of the phenomenon, which is a key phase within Husserl's phenomenology (Spiegelberg and Schumann, 2013: 984). This article solely

focuses on one aspect of how time manifests in human consciousness within the context of conservation and restoration of monuments, emphasizing its objective dimension and highlighting its role as a fundamental aspect of the physical dimensions in this process.

Meaning and Concept of Time

The concept of time has been a subject of extensive study by thinkers for thousands of years. Plato was one of the first philosophers to address the issue of time in his dialogue "Timaeus." Within the framework of his theory of Forms, he considered time to be limited to the natural world and a moving image of eternity, which is continuously in motion according to numerical multiplicity. For him, time was related to ordinary physical movements, such as the movements of celestial bodies, which serve as suitable tools for humans to measure time (Weinert, 2013). However, the first philosopher to provide a comprehensive explanation of time was Aristotle, who dedicated parts of his book "Physics" to the subject. Like Plato, he associated time with number and movement, defining it as "the number of movement in respect of before and after" (Aristotle, 2014: 192).

Humans perceive the world around them through their senses. They see colors, hear sounds, and feel softness and roughness. However, a concept like time cannot typically be perceived through the five senses. The perception of time requires something beyond the ordinary sensory abilities of humans, and it seems strange to say that the passage of time can be seen or heard. Nevertheless, the passage of time is recognized through changes in human thought patterns. Time is identified through indirect perception of changes in other things around us (Le Poidevin, 2015).

The human capability to comprehend the issue of time manifests in various ways; "the past, present, future, change, transformation, and the concept of events are different forms that the problem of time appears in human awareness" (Smart, 1968: 17). In general, the theories proposed by various thinkers regarding time can be categorized into three main groups: idealism, realism, and relativism. This article focuses on realism and examines the objective (or external) aspect of time.

Bertrand Russell considers the continuous perception of movement and change, which leads to awareness of time based on momentary understanding, as real. He claims that humans genuinely understand change in the exact sense of the word. Edmund Husserl views the act of awareness in human experience as continuous. Humans become consciously aware of time through their ability to perceive change and transformation in a real and direct manner. Accordingly, realists regard time as an objective, real entity and a container for events. They hold the opposing view to idealist thought, believing that change and movement occur in reality independently of human perception and outside of mental interpretations, and that time passes irrespective of human

existence. Humans experience changes directly and objectively; therefore, they can have a realistic perspective on time (Bardon, 2016: 14).

Each of the theories presented by various thinkers contains important and noteworthy points regarding time. However, the common essence of different perspectives on time is that what is referred to as time pertains to the measure of change and transformation that occurs due to movement. The universe is in a state of transformation and change because of motion, and time is considered the measure of this movement and change (Russell, 2015).

Consequently, when dealing with objects in the field of conservation and restoration, the material used in the work is continuously linked with time. The artwork is inherently temporal because it possesses a material structure, and within this material, there is an organized and ongoing movement at the atomic level. From the perspective of realistic theories that regard time as an objective phenomenon, time is related to movement.

By considering time objectively, based on the inherent temporality of the material of the work, specific changes in the material can be taken as criteria. By measuring these changes over a determined duration with the help of accurate instruments and various experimental methods, the precise age of the artworks can be estimated. This plays a significant role in determining the period of the work in the technical studies of conservation and restoration (Liritzis et al., 2013).

The time often examined and measured in archaeological studies is objective or external, which is measurable and identified through timing methods. Depending on the type of material of the artwork, various methods for measuring the age of the piece exist. For instance, thermoluminescence dating is often used for mineral materials, carbon-14 dating for organic materials, and dendrochronology for determining the age of wooden monuments. Overall, any method based on studies of changes in the material of the artworks falls under the category of methods for revealing the objective time of these works.

In each of these methods, the foundation relies on the precise analysis of a change. Every change is dependent on movement, even the smallest movement at the molecular scale within the material, which leads to a change in the artwork material. Since time is a measure of movement, it can serve as a basis for measuring the age of the artwork. As the composition of a work changes over time, its age can be determined precisely or relatively, depending on the selected methods (Caple, 2006: 69).

Objectivity and Time

The concept of time, arising from the phenomenon of movement, is objective and represents the primary understanding of time that aligns with the structures of classical mechanics and quantum mechanics. The passage of time is characterized by the occurrence of events in an unpredictable and creative manner within an irreversible historical context; time has a unique

historicity and irreversibility. The universe is in a state of change, and time stems from these changes and organized movements. Plato and Aristotle are prominent supporters of this idea, and many scientists have followed their views from their time to the present day.

In this perspective, "time is a kind of number, the number of changes in terms of before and after." From Aristotle's viewpoint, time is a measurable unit and is used to describe changes. When considering time as dependent on movement and change, change is a real phenomenon that can be measured in time units (Weinert, 2013).

In other words, according to Aristotle's view, "time cannot exist without change; time is a kind of number," and this number represents continuous movements. This dependency is profound (Franz, 1974: 19). The dependency of time on movement relates to the laws of physics, and in any subject where movement and change are discussed, time is also a consideration. This time also has a spatial meaning because movement and change occur in anything that is tangible and measurable. From macroscopic measurements in nature to movement and change within substances at the microscopic, atomic, and molecular scales, Galileo, in his work, discussed the relationship between time and movement. This relationship is essentially the measurement of movement with time; time, according to Newton, measures uniform rectilinear motion, which covers equal distances in equal times.

Time and movement are so deeply interconnected that it is not easy to determine which precedes the other. The dependency of time on movement also underscores its connection with the materiality of the universe, as movement always involves a mover and cannot be conceived without matter. Therefore, time is also related to matter (Madelin, 2016).

Movement is an inherent characteristic of a body and a result of matter itself. A body cannot exist without motion. Each body has both translational and rotational movements, as well as other types of motion. The observable and measurable movements are external, while the intrinsic movement of a body cannot be understood through mere observation and sensory experience. This intrinsic movement is essential to the body; if it lacks such movements, it cannot be considered as existing. The assertion that a body cannot exist without motion also clarifies the fact that movement does not happen without a mover (Ebrahimi-Dinani, 2013).

In other words, movement is intrinsic to the body, and the various states of the body correspond with different moments in time. Ibn Sina and Mulla Sadra believe that movement signifies a change occurring in an object, essentially something that has emerged which was not present before. These transformations occurring within an object are considered types of motion, suggesting that "an object appears to be at rest yet is in fact in motion" (Motahari, 1987: 26). The Quran also refers to movement, highlighting that even mountain, which appear solid and stationary, are in motion and flowing like clouds by God's creation (Quran, 384).

Time measures and counts the existence of objects due to its connective identity. Mulla Sadra introduced time as an analytical characteristic of objects, asserting that the essence of objects is contingent upon their temporally significant movement. Thus, he regards time as a dimension of matter, yet this dimension, unlike the other dimensions, is transient and gradual (Sadr al-Din Shirazi, 1998: 69, 71). Ibn Sina also considers time as a measure of movement, and he sees movement as dependent on the mover. He maintains that the inseparability of the mover from matter is evident, and when Ibn Sina characterizes time as a measure of movement, he emphasizes the realistic aspect of time (Ebrahimi-Dinani, 2013: 89).

The world is in a constant state of change and transformation due to movement, and time is regarded as the measure of this movement and change (Russell, 2015: 499). According to Heidegger, movement refers to the transformation or transition from one state to another, which is not necessarily spatial. This implies that during this transformation, it is not required to witness spatial change of the body (Heidegger, 2016: 302).

Consequently, the materials used in the artworks we encounter in conservation and restoration are continuously intertwined with time, and the artworks are intrinsically temporal due to their material structure, allowing for organized and continuous atomic movement. Time is inherently linked to movement. Based on the principles of the intrinsic temporality of the material of the artwork, specific changes in the material can be taken as criteria for estimating the precise age of monuments through instrumental methods and accurate measurement in various experiments. This plays a crucial role in determining the period of the work in technical studies of conservation and restoration.

This element is critical in the field of time measurement; in studies of dating, we face not only macroscopic scales but also microscopic scales, where changes within the body can be measured and analyzed temporally through precise instrumentation. Although the effects of these movements within the material may also manifest visibly to humans, such as the annual growth rings in cross-sections of tree trunks, each indicating the passage of a year due to changes in the material during different seasons of growth.

based on the science of chemistry-physics, it has been established that even in seemingly stationary objects, continuous movement and dynamism are occurring within the substance and atomic structure. Movement is specifically dependent on time, and the nature of time is movement. With the help of the perception of temporality, humans can understand the changes that have been created by movement and quantify them numerically. Every object is formed through movements, and these movements require the passage of time to take shape and be completed; in other words, the characteristic of movement is that it is time-consuming and requires the passage of time (Carli, 2017).

If change is not inherent in a being, it will necessarily require a cause, which creates a cycle of causation that is invalid. In fact, a thing requires a cause to exist, but in motion, "the motion is inherent to the thing and is related to its existence; thus, if a thing exists, it is in motion" (Ebrahimi-Dinani, 2013: 577). In this regard, a statement by Mulla Sadra is discussed, which states that time requires a motion to sustain it. Rest cannot be found except in time, and the sustainer of time is a cyclical motion; time, due to its connective identity, possesses quantitative movements, and the number, amount, and connective identity of time are the same. Especially cyclical movements, by which other movements are measured, but the cause of time itself is outside the chain of time and space (Sadr al-Din Shirazi, 1998).

In fact, thinkers have related time to the amount of movement, and if there is a movement, its existence will be in time. According to Plato, who presented the first ideas about time, time is associated with ordinary physical events such as the movement of celestial bodies that have specific orbits for organized and infinite cyclical motion, and these regular movements are commonly suitable tools for measuring time, which humans use to measure a day (Weinert, 2013).

Movement is time-bound, and time is recognized through movement (Young, 2004). Movement is associated with change, and in the timing of works, changes in the material of the works are often tracked in the form of observable phenomena. Change over time is what makes it possible, and this is a sign of the existence of objective time. Movement, in another sense, makes time comprehensible in nature for humans. Movement causes change and our experience of sensing time. If a work is created, there is a time for its manifestation, and time has been spent on its creation and completion to come into existence from raw material.

In other words, it can be said: "The special characteristic of movement is that it is time-consuming and requires time for completion" (Carli, 2017: 45-63). As previously mentioned, timing methods based on the changes that occur in the substance due to movement at the molecular scale can measure and demonstrate time with their special tools, and the following will discuss the ways of manifesting objective time in works.

Time and Processes of Erosion

The world is in a constant state of change and transformation; for nature, change is a proven fact, and time arises from these transformations and their organized movements. In this perspective, time measures movement and represents its quantity. As previously mentioned, Aristotle is a prominent advocate of this thought. Change is a real phenomenon, and in this viewpoint, time is an objective phenomenon that can be measured in time units (Sadr al-Din Shirazi, 2013: 140; Bardon, 2016: 15-23). The concept of time that arises from the phenomenon of movement is the first concept of time, which is more related to scientific studies in the realm

of movement and belongs to the field of physics. The relationship between time and movement is essentially the measurement of movement by means of time (Heidegger, 2008: 77- 76). The passage of time, or the occurrence of events, is irreversible and unique. Change and transformation are significantly dependent on time. The spatial coordinates of objects are functions of the variable time. For every passing second (t), we can present three spatial measurements: (x, y, z). These coordinates can pertain to any point whose values are functions of time. Thus, whenever time changes by a very small amount, the values of the spatial coordinates also change (Ibid, 78). This change, in the form of movement, applies to all points of the object and occurs even in its seemingly stationary core. According to Mulla Sadra, the different states of an object correspond to different instances of time. He, as well as Avicenna, believe that the changes that occur in an object are of the nature of movement, and time is dependent on movement, and an object that appears to be at rest also inherently possesses movement. Movement has two dimensions: time and distance, and rest occurs in the dimension of time (Motahari, 1987: 26).

Mulla Sadra did not view movement and time solely as external to objects, but rather considered the essence of objects to be temporal. If this were not the case, it would not be possible to measure them with time or determine the age of an object—just as if objects lack length or weight, they cannot be measured with scales of length and weight. On the other hand, time is a measure of movement, so it is essential that the essence of objects possesses movement. This is why, over the passage of time, changes and transformations occur in an object, and these changes are not only superficial but also happen within the core of the object due to the existence of movement, transforming it. An object is inherently in motion and is temporal (Sadr al-Din Shirazi, 1998: 69-71).

According to various chemical-physical discussions, we know that within the substance of objects, there is a continuous movement of atoms around themselves and around the nucleus, occurring systematically and to scale in atomic and molecular orbitals. These movements are inherent to all states of matter, flowing within the material structure of the universe, and are a product of matter: “The origin of movement is the same as the origin of primordial matter.” A material body cannot exist without movement (Ebrahimi-Dinani, 2014: 342). The movement of molecules and the occurrence of various chemical reactions in response to environmental conditions predispose each object to change, transformation, and perishability. Thus, all objects, including human-made artistic works, are susceptible to wear and destruction, for “the eternal existence of an object is impossible” (Sadr al-Din Shirazi, 2013: 191). Despite knowing the perishability of works, conservation and restoration are undertaken due to their uniqueness and human dignity as material culture or time-bound substance, effectively preserving the past as a truth in the present.

To express it in the words of Henri Bergson, a contemporary philosopher, the material world exists as a moving continuum, where everything changes and leaves remnants behind. The ever-changing existence in the present represents the truth of the object (Fell, 2012: 34-40). Change is made possible by the passage of time and can create an objective understanding of the passage of time. The objective existence of time's passage means that infinite layers of “now” are generated sequentially (Kennedy, 2014: 61).

Movement in the form of change is typically seen as layers of erosion on the surface of an object. These layers often appear on the surface with a different appearance and color from the object itself, representing the passage of time and the accumulation of layers of the present, caused by the interaction of the material of the object with surrounding conditions. Because nothing in the world is destroyed by itself; rather, it deteriorates and perishes due to something other than itself (Ebrahimi-Dinani, 2014: 357).

In regard to historical and cultural monuments, various environmental conditions, especially the presence of moisture in burial environments or proximity to light and electromagnetic waves, air pollutants, and sometimes in urban environments, the presence of contaminants and dust particles significantly influence the initiation of chemical, photochemical, and biochemical reactions, causing changes in the material of the monument and its transformation. All these transformative chemical processes occur in the framework of movement in the molecular structure, so that as a result of these chemical interactions, sometimes the material over the years transforms into another substance. This change represents the passage of time and the age of the monument or, through a phenomenological perspective, appears as the manifestation of time in human awareness in the form of eroded layers. Consequently, the layers of wear on the monument must be protected as manifestations of time and the sequential “nows” of the past (Yousefnejad, 2021).

Change is a law of nature, and the efforts to protect, reduce it, and preserve the past exist in the present. In the current moment, change is inevitable; therefore, the goal of conservation and restoration, despite the knowledge that an object is inherently in constant transformation and, like everything else in the material world, is subject to decay, is to protect the essence of the monument. This is pursued because preservation cannot stop change and transformation in the monument; otherwise, it would merely subject the monument to endless cycles of extensive treatment, which could pose a threat to the monument's integrity (Edgren, 2016).

Thus, when confronting objects in the realm of conservation and restoration, the material used in the monument is continuously linked to time, and the monument is inherently temporal due to its material structure. Within this material, there is a structured and ongoing movement at the atomic level, and time, from the perspective of realist theories that regard it as objective, is intrinsically related to movement.

With an objective view of time based on the principles of the inherent temporality of the monument's material, specific changes in the material of the monument can be used as standards in evaluation methods in scientific conservation and restoration studies. By measuring this change over a defined period using instrumental methods and precise tools in various experiments, the age of the monuments can be accurately estimated. This plays a significant role in determining the time period of the monument in the context of technical studies in conservation and restoration (Liritzis et al., 2013). As the composition of a monument changes over time, its age can be calculated with precision or relatively, depending on the selected methods (Caple, 2006).

Radiocarbon Dating

During the 1940s to 1950s, the discovery of chronometry using carbon-14 made it possible to date remnants of living organisms. Carbon-14 is a radioactive isotope (heavy isotope) of the stable element carbon, which converts to nitrogen-14 through beta-minus decay. The production of carbon-14 occurs at altitudes of 6 to 15 kilometers in the Earth's atmosphere, where high-energy neutrons are generated by cosmic ray collisions with the Earth's atmosphere, which then collide with nitrogen atoms to create carbon-14.

Once formed, carbon-14 atoms quickly combine with oxygen, leading to the formation of carbon dioxide-14 (CO2-14), which is released into the atmosphere and enters the global carbon reservoir on Earth through three sources: interaction with surface ocean waters and transfer to deeper waters, incorporation into plants through photosynthesis, and ultimately entering the bodies of animals and humans through food chains. It has been shown that the production of carbon-14 in the atmosphere is in equilibrium with its radioactive decay. As a result, the total carbon-14 reservoir on Earth remains constant.

When a living organism dies, the atoms of its organic matter exit the natural nutrient cycle (including both nutrient intake and waste). Consequently, the carbon-14 stored in the dead organism is now separate from the total global radioactive isotope reserve, and over time, it undergoes decay with a half-life of approximately 5730 years, gradually decreasing in quantity. This change in the amount of carbon-14 present in historical monuments, compared to today's constant levels, indicates how long it has been since the organism in question died (Holdaway, 2014: 86-89).

Thermoluminescence Chronometry

The thermoluminescence method is used for dating ceramics, pottery, and bricks. Thermoluminescence has the capability to emit light when the sample is heated to specific temperatures. The thermoluminescent light emitted from pottery indicates the release of energy stored in the minerals present in the clay; this energy is transferred to the body from two sources:

Radioactive materials, found in the clay or its surrounding environment, such as uranium, thorium, potassium, or rubidium. Ordinary clay is a mixture of various minerals and organic materials and contains a certain number of radioactive materials relative to its constituent substances. These radioactive materials emit alpha, beta, and gamma rays with specific energies during their decay. The energy released from these radioactive materials is stored in solid crystals, such as quartz and feldspar, found in the clay.

Cosmic rays. The majority of these rays consist of high-energy protons with deep penetration capabilities. The energy from the ionizing rays present in the clay and cosmic rays has been stored since the minerals were formed. This energy can remain in the material for up to approximately 10 million years. However, when the material is heated, this energy is released all at once. During the firing of pottery in a kiln, all of this energy is released; it can be said that the thermoluminescence clock for baked objects resets to zero. After the pottery cools, the process of storing energy from ionizing rays begins anew, and the thermoluminescence clock starts functioning again.

The amount of energy stored in the pottery is proportional to the time elapsed since its firing in the kiln, which is the fundamental principle of thermoluminescence dating. If the sample is subsequently heated in the laboratory, the amount of energy stored can be measured over time, and by estimating the amount of energy transferred to the material annually, the age can be determined (Bahr al-Olumi, 2012). In this method, as previously mentioned, the basis for measuring time is related to the movement of electrons due to the absorption of energy and their transition to a higher energy level, followed by a return due to the emission of energy to a lower energy level. The elevation of an electron to a higher energy level occurs due to the heating in the laboratory, and the measurement of the emitted rays is used for dating purposes.

Dendrochronology

Dendrochronology is used to determine the age of wooden artifacts. In this method, the age is determined based on the annual growth rings in trees. Therefore, in dendrochronology, the relationship between time and the movement and change in matter is utilized, where the change occurs due to the growth process and the formation of annual rings in the tree, serving as an objective phenomenon for measuring time. The growth and formation of secondary wood are marked by the formation of rings that are distinct from previous rings each year. By examining the growth pattern and thickness of each ring, one can infer the climatic conditions and the suitability or unsuitability of the environment for plant nutrition, and additionally, by counting the number of secondary rings, the absolute age of the tree can be determined.

Thus, standard conditions have been established for the annual growth and development of each type of tree in past years. By placing the growth conditions of each type of tree into a

standardized table presented diagrammatically, one can find the lifespan of the tree and consequently its absolute age. This method can determine ages of up to six thousand years. By using the growth rings of specific species as a model and determining their age by counting the growth rings, one can compare unknown samples of wood from historical monuments to ascertain the age of the monument (Holdaway, 2014: 91).

Conclusion

Time is a phenomenon with various aspects that, for its understanding as the principle of the existence of objects, is examined based on the implementation of phenomenological strategies regarding its emergence and manifestation in human consciousness for identification in scientific studies of conservation and restoration. Its objective nature is analyzed in monuments. Time, in its objective aspect, is defined and measured by movement and change, and in this aspect, it is a measure of movement. Thus, there is a profound and meaningful connection between movement in various dimensions of matter and the phenomenon of time. Movement within matter, through various interactions, causes changes and transformations, which serve as the basis for determining the age of different monuments and can be assessed and measured through various dating methods.

Common instrumental methods for determining the age of monuments are based on measuring the changes that occur within their material structure and analyzing them, effectively assessing and manifesting objective time within them. This is because objective time, due to its close relationship with movement, change, and transformation, is dependent on the material of the monument and can be determined and measured through specific scientific methods.

The changes and transformations occurring in monuments are due to various reactions within their material structure. During these reactions, movement occurs at the molecular scale, resulting in the manifestation of layers formed from the products of these reactions on the surface of the monuments. In fact, the processes of erosion of monuments indicate changes within the material of the monument, and the changes in matter themselves reflect the molecular movements and exchanges occurring within the objects. Therefore, studying and identifying the processes of erosion of monuments and scientifically analyzing them to determine the altered layers indicate the time elapsed on the monument. Since time is the principle of the existence of the monument, preserving and maintaining these layers under stabilized conditions is essential for the conservation of the monument's existence. Studies identifying the processes of erosion and determining the altered layers can also identify potential damages, and since not every change is damage, these studies are of great importance in the preservation and maintenance of monuments.

Author Contributions

All authors contributed equally to the conceptualization of the article and writing of the original and subsequent drafts.

Data Availability Statement

Not applicable

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Ethical considerations

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Conflict of interest

The authors declare no conflict of interest.

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