

Thoughts about the Thermal Environment and the Development of Human Civilisation

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Abstract: Thermal conditions are the most challenging factors in studying human biometeorology, indoor and outdoor design, and adaptation to climate change. The thermal environment is always present and shapes everyday life, behaviours, and the natural and artificial environment. In this paper, we analyse some thoughts that link thermal perception to the roots of human civilisation. Following the narrative thread of mythology and the history of religions, there are direct and indirect references to the thermal environment everywhere. The thermal environment may be a part of the core of human culture.

Keywords: thermal perception; civilisation; climate behaviour; human biometeorology; thermal comfort; bioclimatology



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1. A Short Introduction about the Impact of Climate and Weather on Human Life

The atmospheric environment has been of concern to human life since the beginning of civilisation. This is because it is a part of the environment that affects civilisation directly, indirectly, and constantly since it exists wherever humankind exists [1,2]. From primitive human creations to the most complex expressions of art, the atmospheric environment seems to play a significant role. Before humans developed the sciences, they interpreted the elements and phenomena of the atmosphere as an expression of desire, the disposition of the gods, or other supernatural forces [3,4]. The thunderbolt was the symbol of Zeus; with it, he punished. Neptune created storms when he was angry. The clouds opened for God's angel to appear or for the voice of God to be heard. The flood comes to destroy the old world, and, in its place, a new one is created. The dust devil is some deity who looks like the lamp genie and can achieve supernatural things. The atmosphere and its various phenomena appear very often in poetry, literature, and music [5–8]. It is also one of the main factors that determined the way in which houses were built and the layout of cities [9–13].

If we look more systematically at the effects of atmospheric conditions on human civilisation's development, we can see that they are present everywhere. Obviously, the local climate has considerably influenced the location and development of organised settlements (villages to cities) [14–16]. Moreover, Hippocrates recommended that weather and climate be considered in developing settlements [17]. In essence, we have the appearance of the first settlements where the climate was favourable at the time when humankind left nomadic life to become farmers and herdsmen. The atmospheric environment was one of the primary shapers of the possible choices for a group of people to settle in a specific place. It affected the availability of critical resources such as water and food, as well as the residents' safety. As humans developed their technical/technological civilisation, they could protect or even utilise the atmospheric environment to benefit their better living.

Humans' technical means and developments have allowed for the expansion of possible dwelling places and accommodations in less hospitable climatic environments. The climate and its changes may have affected even the organisation's parts and subsystems. Climate has influenced many aspects of human civilisation; humans not only observe (now measure and record) weather and climate but also feel them. In fact, humankind's unconscious and most conscious decisions are not linked to their knowledge of climate and weather but are related to what the human body feels about atmospheric conditions. This is why humans have sensory organs in their body that allow them to perceive the atmospheric situation. This sense of the atmospheric environment and its changes enables the human body to react and adapt to survive while maintaining good functioning [18–21]. Therefore, the perception and sense of the thermal environment are of primary importance since it affects the core of human existence.

Despite the obvious importance of the thermal environment in the quality of human life, the concept of the sense of hot/cold began to be studied in the late 19th and early 20th centuries [22,23]. Furthermore, after World War II, efforts to analyse human physiology related to the human sense of the thermal environment became more intensive [18,24]. The findings of relevant studies showed that more and more human activities were directly and indirectly affected by the thermal environment and thermal sensation, such as work performance, entertainment, psychology, and human health in general [21–23,25,26]. The importance of the thermal environment soon led to the creation of biometeorological indices to quantify thermal conditions and the corresponding response of the human body to them [9,18,27,28]. Over time, these indices became more complex and accurate, while the spread of personal computers (PCs) made it possible to develop complex human energy balance models [19,29–32]. Today, with the help of the prevailing indices, human biometeorology can be applied in the design of outdoor or indoor spaces and in the assessment of the thermal load on humans during their stay in various configurations and situations [33–36].

While discoveries and developments in human biometeorology offer more accurate estimates of the interaction of humans with their thermal environment, the scientific debate about how deep the thermal sense lies in the origins of human civilisation has not yet begun. This paper aims to analyse in a narrative how strongly the evolution of human civilisation is linked to the perception of the human thermal sense. Since the factors that are connected to so-called human civilisation are numerous, we selected some of the most prevalent.

2. The Thread of Thermal Perception in Human History and Civilisation

Thermal sensation, thermal perception, thermal stress, and all expressions of the human biometeorological environment are present at every moment of the day [37]. This is the reason why its effect on health, psychology, and even human behaviour is not easily perceived.

More specifically, weather and climate have played a decisive role in many human activities throughout history. A significant number of studies have shown the influence of weather and climate on the evolution of human history. Atmospheric conditions can be traced in art, music, painting, and literature [8,38–41]. The atmospheric conditions also determined, to a significant extent, the location of settlements, the development of productive activities, and the possibility of trade and communication [36,42–48]. There are many recorded cases where climate determined the development, evolution, or even the end of a civilisation (Incans, Minoans, etc.) [49–54]. Meteorological conditions have even played a decisive role in world history in judging battles or war developments [49,55–59].

Biometeorological conditions, i.e., meteorological conditions on a shorter timescale that have influenced biological organisms in shaping our culture over time, seem to have played a significant role. To understand the influence of biometeorological conditions and thermal sensation on the various areas of human life, it is worth analysing the temporal evolution of the relevant individual influences from the present to the past. It is more accurate to say that human health and behaviour are influenced by the human heat balance and thermal sensation. In general, people need and prefer conditions of 20–23 °C to

feel good and have thermal equilibrium. This temperature range ensures good body function and health promotion and ensures high work productivity. The distance from the thermal equilibrium state negatively affects human health in a proportional but not linear relationship. The health burden from thermal stress (either due to cold or warm conditions) increases morbidity and mortality. The magnitude and rate of increase are obviously related to the prevailing biometeorological conditions and to each individual's characteristics and biological conditions [35,60–66].

Despite the apparent importance of the human thermal sense and perception, only a few decades ago, the attempt to quantify thermal comfort and human perception of their thermal environment began. According to Gagge et al. [22], since 160 AD, the importance of the sense of hot and cold has been understood. In the same work, the authors stated that *“comfort is a recognisable state of feeling, but possesses no identifiable sense organ like the basic five senses”*. Today, measurements and human biometeorological models are used in urban planning, outdoor space design, and parks and other recreational areas such as stadiums and sports facilities [27,31,32,60]. Biometeorological observations are also applied to design residential interiors, offices, and workplaces [35,60,67]. The information on thermal comfort/feeling and heat stress is valuable and concerns humans directly and indirectly. The direct effect relates to how people feel and how this impacts their psychology, productivity, and health. Therefore, by creating satisfactory biometeorological conditions in open or closed spaces, the individual's health, productivity, and psychology are improved [42,48,68,69]. In the era of climate change, the effect of heat, especially heat waves in the human health context and the increase in mortality and morbidity are mainly focused on developing strategies for protecting human health [66,70]. The indirect effect of biometeorological conditions is extremely important to humans and relates to energy consumption to achieve satisfactory thermal comfort conditions. Given that thermal comfort is a human need, large sums are spent on heating and cooling to create satisfactory conditions [71–73].

There are frequent reports from studies of the effect of weather on humans in the short and long term. It has been found that weather can affect human health, behaviour, and choices. However, the human body reacts to the thermal environment and adapts to maintain health and functionality. However, the human organism and its reactions differ according to age, gender, health status, and physical condition, which are parameters taken into account in modern biometeorological indicators such as PET, mPET, and UTCI [30–32,35,74–82]. It is, therefore, simplistic to consider that weather affects human health and behaviour.

2.1. Buildings and Built Environment

Our houses are built with biometeorological principles, whether consciously or empirically. From the beginning, humans sought a place to live to protect themselves from adverse weather conditions and wild animals that threatened them. In essence, they looked for a place that offered containment and protection, as well as more satisfactory atmospheric conditions than those found in the countryside. The first shelters were usually caves and recesses in rocks and were often sheltered near or in trees. They lit a fire at night to temper the cold conditions and to keep unwanted animals away. Later, humans were able to make makeshift shelters from animal skins and furs, which they erected in the areas they hunted and dismantled to take with them to the next hunting ground [83–85]. When people abandoned the nomadic life and became farmers and herders, they began to build more complex structures of a permanent character. Obviously, the materials they used were readily available, such as stone, mud, bricks, and wood. The first purpose that the buildings had to perform was protection from the weather and enemies (animals and people). As technology developed, people could use more natural materials, create artificial materials, and transport raw materials over greater distances.

The development of technological civilisation gradually led to the differentiation of the construction of houses built by people from region to region, according to criteria which,

among other things, had to do with maintaining thermal comfort inside the houses [86,87]. Keeping indoor conditions at tolerable levels for humans helped maintain a better state of health when medicine was less developed. One with a better dwelling in terms of indoor thermal conditions was likely to have better health. In temperate climates such as the Mediterranean, the main concern during cold periods of the year was to have adequate light, heating, and heat retention. In contrast, during the warmer periods of the year, the concern was protection from the sun and air renewal to maintain cool conditions. For these reasons, these climates had relatively large windows of appropriate orientation and shape, and the buildings were lightweight constructions. In warmer climates, the main focus was on shading during most of the day since exposure to the sun created conditions far from thermal comfort. These buildings often had high walls designed to provide shading and vertical air movement so that warm air would rise high and exit the building and be replaced by cooler air from lower levels. On the contrary, in areas of the world with a cold climate, buildings were built with thick walls (made of stone or other materials) with small and few openings. Often buildings were sunk into the ground or rock to reduce heat loss, and there are cases where earth covered low-rise buildings up to the roof. These structures aimed to keep heat inside and provide the best possible insulation from the outside environment. In all cases, the buildings were built to provide thermal conditions as close to thermal comfort as possible for as long as possible [83,84,86–92]. That is, the structure and form of the buildings were determined by the need to maintain a satisfactory thermal sense of their inhabitants. It should be noted that long-term acclimatisation of their inhabitants took place along with the adaptation of buildings to local thermal conditions. It would be difficult for a resident of a hot desert to live in a traditional Icelandic house and vice versa.

Thermal perception is very individual, and people sometimes prefer cool or warm conditions according to their state of health, psychology, previous physical activity, gender, acclimatisation, clothing, and medal condition [18,32,64,93–97]. Apart from the indoor built environment, humankind's thermal perception also influenced the outdoor environment and the layout of their settlements. When the citizens walk in cities under intense sunshine, they follow the route with the most shade. Many modern studies have shown that shading is the key factor in improving the thermal sensation of humans in warm environments with high sunshine duration [90,98–101]. The need for shading, which determines human thermal comfort, is one of the main factors that shaped traditional architecture and open space configurations, such as that of the Aegean islands in Greece or the regions of North Africa. The main characteristics of these configurations are the narrow streets and high walls surrounding the buildings and the courtyards [102–106].

Conversely, in areas with less sunshine, where the presence of solar radiation is desirable, traditional or even modern urban planning includes a wider street width and a generally shallower urban canyon [107–111]. Modern and mainly traditional human settlements have generally adapted to the needs for a thermal environment as close to optimal as possible. Therefore, both the indoor built environment and the outdoor environment, two essential elements of human culture, have been and still are influenced by humankind's need for thermal balance.

2.2. Energy Requirements

From the very beginning of their existence, humans sought a way to heat the space they lived in and keep aggressive animals away. The first solution to these two issues was the discovery of fire. This was the beginning of humankind's systematic energy consumption (other than food). Technological development has led to the rapid demand for energy to feed transportation, industry, production processes, lighting, heating and cooling water, and indoor spaces. However, most of the energy consumed by households today is spent on heating, which is directly linked to thermal sensation [71,112–115]. In fact, the amounts spent on heating and cooling indoors are directly related to how the inhabitants feel about their thermal environment at any given time. That is, it does not depend on the area's

climate but on what the inhabitants feel at any given time. The distribution of energy resources today shapes the global geopolitical arena, triggers wars, and largely determines nations' economies. The need for energy leads to new technological discoveries while simultaneously intensifying the phenomenon of climate change (through the release of greenhouse gases) [72,113,116]. Another critical factor of human civilisation, over time, is dependent on humankind's perception of their thermal environment.

2.3. Clothing

The clothes we wear are determined by the biometeorological conditions, i.e., the thermal sense of the human body. Humans originally created clothes to protect them from atmospheric conditions. From the earliest days of humankind's appearance as a hunter-gatherer, they moved from place to place and, as a result, had no permanent shelter. As a result, they were constantly exposed to the weather. They removed the skin from the animals they killed to feed themselves and used it as the first garment. This practice allowed humans to protect themselves from inclement weather and survive in areas where they could not otherwise. Clothing is an additional insulating layer that allows humans to explore more areas and exploit more environmental resources found in areas with unfriendly climatic conditions. [83,88,117]. After animal skin and fur, humans discovered or created other materials to make clothes, such as flax, wool, and cotton, which could form thinner layers of effective clothing when processed. The clothing available to humankind protected them not only from cold but also from intense sunlight and high temperatures. As long as humans could have effective clothing to regulate their thermal sense, they could explore and inhabit more areas. This ability led to the colonisation of new areas, resulting in an increase in the world's population and the development of more civilisations. The need for thermoregulation and protection from extreme co-conditions led to the creation of a means that at first was through survival but later became much more. Today, clothing is one of the basic elements that make up any culture and can also symbolise power, social class, or status [18,118–122]. However, whatever the clothing we wear daily, it is definitely and primarily a means of regulating our thermal sensation. Thus, the need to regulate humankind's thermal environment initially created and subsequently led to the evolution of a wide variety of clothing that is ultimately an important part of the tradition and culture of people.

2.4. Language

The languages spoken by humans and their sounds are influenced by many non-linguistic factors, which are environmental and topographical [123,124]. It has been found that, in dry and cold environments, people develop and speak languages with fewer vowels as a result of the effect of atmospheric conditions on the vocal cords and larynx. Conversely, in areas of increased humidity and heat, the languages spoken by people have more vowels. Scientists believe that in addition to the effect of thermogravimetric conditions on the physiology and function of the speech organs, it is also important to determine how far the sound can reach and be heard clearly. Therefore, in areas of relatively high temperature and humidity, which are often rich in vegetation, growing languages have more vowels and can be heard more clearly despite the presence of trees or water that absorb sound [123–128]. It remains to be examined the possibility that the existence of vowels is linked to humankind's thermal comfort since they lose heat through breathing and the opening of the mouth [18,129]. Therefore, thermal balance is regulated with the environment. This oral heat loss function can be a critical body heat reduction function for populations living in areas of high temperature and humidity. It should be kept in mind that high humidity reduces the effectiveness of the heat loss process through perspiration.

Conversely, in low-temperature and dry environments, a closed mouth (i.e., few vowels) may reduce heat loss from the mouth area. Lastly, it is possible that, in addition to how far the sound of the voice reaches, it is also possible that the maintenance of the human heat balance is essential. Reducing body heat in warm environments and retaining it in cold

ones is vital, especially in the past when humans did not have the insulated buildings and clothing available to them today. Hence, we can assume a possible connection between the thermal environment and the language sound, especially under extreme climatic conditions, since respiration is one of the most prominent thermoregulation functions. Humans may have altered their language sounds in their effort to maintain their thermal equilibrium with their environment. Thus, thermal perception can influence the language spoken by a people, which is a critical element of their culture.

2.5. From Social Life to Philosophy

Social life in the early stages of the development of civilisation was directly dependent on the thermal environment. The place where small or large groups of people met, exchanged opinions, and made decisions was the marketplace of each city, called Agora. This was basically an open-air place where trade took place while, at the same time, citizens met and learned about news and problems. How often they could do this depended on the weather. How long they could stay in this marketplace depended on how comfortable they felt in this outdoor space. Later, when the system of government of democracy was devised, it was necessary for citizens to meet, consult on the issues of their concern, and finally vote to make decisions. For this to happen, all the citizens who had the right to vote had to gather in one place for several hours. Historically, the place where democracy emerged and developed in ancient Athens and the place of deliberation was the rock of the Pnyx next to the Acropolis (Figure 1). Athens, then as now, had good weather for much of the year, allowing citizens to stay outdoors. It seems that the biometeorological environment played a role in discovering democracy and its early operational stages.



Figure 1. Pericles speech on Pnyx rock hill. Painting of Philipp Foltz. Wall painting in Maimileaneum Palace of Munich. From Wikimedia commons: https://commons.wikimedia.org/wiki/File:Discurso_funebre_pericles.PNG (accessed on 10 October 2022).

Therefore, the possibility of gathering citizens and their communication, i.e., the exchange of views and recreation, was linked in those years to the time they could be in the marketplace and chat. In addition to the apparent relationship that the system of government of the ancient Greek democracy, which was based on the possibility of all citizens voting for decision making, we find another decisive relationship between the bioclimate and the development of civilisation, which is the ancient philosophical

schools. These were where all citizens who were interested in and conversed about matters relating to life and philosophy gathered. This was under the supervision and teaching of a philosophical teacher. Most of these schools were nothing more than groups of people gathering in open spaces, often under trees, to protect themselves from the Greek sun and think and discuss philosophy [130,131].

Plato's famous academy was a garden where all the students gathered, and, in this beautiful and comfortable environment, they developed their philosophical thoughts [132]. Moreover, Aristotle's philosophy school was called Peripatetic (walking) because the master and the students walked in the open space (gardens, market etc.) and discussed their preferred topics [133–135]. The prerequisite for these important schools of thought to function was the concentration of people in a pleasant environment of comfort. Furthermore, this comfort was predominantly thermal comfort and, in some cases, aesthetic comfort.

2.6. Mythology and Religions

Human civilisation is interwoven with great and important narratives. These came from mythology and religion. Both include, among other things, rules of life and teachings that help society function better. The mythology and sacred texts of religions include moral rules and lead to thoughts on how humans should function and coexist. The relevant texts that have survived are ancient and, despite the changes they may have undergone, provide information about the way of life and perceptions of people in the early stages of developed civilisation. Some references and descriptions show the importance of the thermal sense in shaping these texts and descriptions.

2.6.1. Ancient Greek and Roman Mythology and Tradition

Starting from Greek Mythology, the Elysian Fields (Figure 2) were part of the underworld. In this place, the souls of heroes and the virtuous found their final resting place. It is of great importance that this was the last residence, the place that would be the permanent home and where the soul would remain forever. These are described as meadows of flowers and trees where eternal spring prevailed. Under the shade of Myrtle (a Mediterranean plant), the virtuous and the heroes rode horseback and other athletic sports while playing music and other games. In the *Odyssey*, Homer says “Σοὶ δ’ οὐ θέσφατόν ἐστι, διοτρεφέες ὦ Μενέλαε, Ἄργει ἐν ἵπποβότῳ θανέειν καὶ πότμον ἐπισπεῖν, ἀλλὰ σ’ ἐς Ἥλυσιον πεδῖον καὶ πείρατα γαίης ἀθάνατοι πέμψουσιν, ὅθι ξανθὸς Ῥαδάμανθς, τῇ περ ῥήϊστη βιοτῇ πέλει ἀνθρώποισιν οὐ νικητός, οὐτ’ ἄρ’ χειμῶν πολὺς οὔτε ποτ’ ὄμβρος, ἀλλ’ αἰεὶ ζεφύροιο λγὺ πνέοντος ἀήτας Ὠκεανὸς ἀνίσχιν ἀναψύχειν ἀνθρώπους, οὐνεκ’ ἔχεις Ἑλένην καὶ σφιν γαμβρὸς Διὸς ἐσσι”, which means “as for you, divine Menelaus, it is not fated for you to close your eyes to Argos that feeds horses, and there find the fate of Death. To the ends of the earth, the gods will refer thee to the Elysian Fields, where the blond Rhodamante, where life blessed, graced, is coming of men. Snow does not fall, nor heavy winters, with showers unceasingly the ocean lifts the clear breaths of the zephyr and gives dew to men; you have Helen as your wife, you are the god of Dias-gamma, brother” [136,137]. We see that the Paradise of ancient Greek civilisation is a place that looks like a region without cold but with coolness and without extreme weather. Since ancient times, Greece's region has had a warm climate with high sunshine duration [138–141]. Therefore, the inhabitants of this area did not want constant and prolonged exposure to heat and sun and would not want to be exposed to cold because they were not used to it. The Elysian Fields, the paradise of the ancient Greeks, the place where the virtuous and heroes would forever remain, is a place that ensures permanent thermal comfort. This is a place that will be thermally pleasant. Tartarus, which represents Hell according to Greek mythology (or ancient Greek religion), i.e., the place of eternal punishment, is described in detail by Virgil in the *Aeneid*. There he says that there is a river of fire called “Pyriphlegethon” and describes the area as a harvest that burns while wild winds stir up the flames. Tartarus is described as being in the depths of the Earth in caves. It was so deep that if one cast a bronze anvil, it would take 9 days and 9 nights to reach Tartarus [142,143]. That is, darkness and unbearable heat prevailed.

On the one hand, Paradise was sunny but cool, while the Hell of the ancient Greeks was dark and hot. That is, we see that the place where those who deserved punishment would spend eternity had characteristics that the people of the Mediterranean region wanted to avoid, the unbearable heat and darkness. If we compare Paradise (Champs Élysées) and Hell (Tartarus), we can see that one of their main differences is the thermal sensation there. It is also crucial that both places will be the eternal dwelling place, which means that those who go there will live forever in these environments and the conditions they form. The conditions formed in these environments (Champs Élysées and Tartarus) are the reward and punishment, respectively. The imprint of the thermal sense in shaping the associated narratives is clear.



Figure 2. The Elysium or Aeneas finding his father at the Elysian Fields, between 1597 and 1607, from the collection of the Museum of Fine Arts of Lyon in Lyon, France. It depicts a scene from Virgil's Aeneid where Aeneas meets his father, Anchises in Elysium. From Wikimedia commons https://commons.wikimedia.org/wiki/File:Enee_meeting_with_his_father_in_the_Elysium-Sebastien_Vrancx-MBA_Lyon_H1153-IMG_0415.jpg (accessed on 10 October 2022).

2.6.2. Ancient Egyptian Mythology and Tradition

In the region of Egypt and the surrounding areas, according to sources and analyses, high temperatures with extremely low rainfall have prevailed since the time of the Pharaohs. As a result, agriculture was based on the flooding of the Nile rather than on water from rainfall, which was insufficient [144–146]. According to the religion that prevailed in ancient Egypt, Hell (Duat) was a place with a vast element of fire, boiling water, and darkness. Like any place of punishment, it had demons that tormented those who reached it, but the environment was described as dark and extremely hot. In contrast, the Paradise of the ancient Egyptians (A'aru, Earu, or Iaru) was lush with meadows and plenty of water (Figure 3). In some depictions, it appears as a series of small islands occupied by reeds (rushes) [147,148]. As Brook–Hitching pinpointed [148], “*this was the Paradise of the ancient Egyptian afterlife for all virtuous Egyptians, its lush, watered, green fields the very antipode of daily Egyptian life*”; that is, Paradise had landscape characteristics that fostered humankind's thermal sense and were the pleasant opposite of the everyday life of the ancient Egyptian. The eternal reward of a more pleasant afterlife is an environment of thermal comfort that was neither given nor common for the Egyptians of that time.



Figure 3. Sennedjem and Ineferti in the Fields of Iaru. From: <https://www.metmuseum.org/art/collection/search/548354> (open access source) (accessed on 10 October 2022).

2.6.3. Northern Europe Ancient Mythology and Traditions

According to the mythologies and religions of the ancient peoples of the European North in the areas where the Vikings had spread, Hell was called Hel, a term related to the English term Hell referred to as a cold realm of shadow, where even its inhabitants were shivering. Many references to Hell in northern cultures place it in the frozen north, where famine was frequent [148–150]. The people who lived in northern Europe, i.e., Scandinavia and Iceland, suffered from a lack of food and the weather conditions of the northern European climate, which is cold and lacks sunshine. In this case, the connection between the place of eternal punishment and the conditions that shape the thermal environment of humankind is clear. Again, the northern regions' climate elements that tormented them in their daily life are those mentioned in the sources describing their Hell. The Paradise of the northern peoples of that time was known as Valhalla, and, unlike what has been described so far in other cases, it was not an open space, but a huge building (hall) with hundreds of doors, and the roof was covered with hundreds of golden shields. This was where those who fell heroically in battle went. Those who got there would forever have plenty of good food and drink, and they could play sports or even fight (which was very popular at the time), and all wounds would be healed the next day [147,150,151]. Here, Paradise was a place without sun and shade, but it is a place protected from the weather. This difference is likely due to the nomadic life of the Vikings, who were constantly away from permanent homes as they travelled on their ships. Housing was lacking in their terrestrial life, as were the thermal conditions of a dwelling.

2.6.4. Islamic Religion and Tradition

The Arabian Peninsula, which is the region where the Islamic religion and tradition emerged and spread while experiencing a wide variety of climatic changes from the period of the emergence of this religion until today, has a dry and hot climate in a predominantly desert environment [152,153]. The inhabitants of this region of the planet were very often in extremely hot conditions (high temperature and low humidity and precipitation), regularly accompanied by high-intensity winds that even increased the loss of water (from the human body or from the environment). The Islamic tradition has its roots in the Arabian Peninsula, a region with a very hot and dry climate (desert). In this case, Hell, the place of eternal punishment, referred to as Jahannam or Gehenna, is a place with a fire that does not go out, and this is 69 times hotter than the fires of the Earth. The descriptions in many sacred

texts of Islam describe a place of martyrdom dominated by fire. In other references, the existence of a great monster is described, which torments and threatens sinners who reach there [147,148,154].

In contrast, Paradise, the place where those who have lived virtuously and morally end up, is described as a beautiful garden with plenty of water, grass, and many large trees with flowers and fruit. The descriptions say that this beautiful garden even had carpets on the ground, as well as fine food and drink. There was also a regular northerly and cool wind that carried aromas [148,154,155]. In this case, we see an environment that forms thermal conditions that were desired by the inhabitants of these areas but were not common and usual in the areas where they spent their terrestrial life.

2.6.5. Jewish and Christianic Religion and Tradition

The area of present-day Israel and the surrounding areas has been dry with relatively high temperatures since ancient times. More specifically, the climate was cooler than that of neighbouring Egypt but warmer than that of the Greek area, and it had more rainfall than the Egyptian area but less than the Greek area [156–159]. Consequently, the inhabitants of the areas of present-day Israel very often experienced conditions of intense heat stress due to high temperatures and increased sunshine. Thus, in the case of the Jewish religion, things are less clear since there are two instances that seem to describe Hell. The first is Sheol, which is a dark set of caves where dust prevails [148,160,161]. Dust is another element of everyday life that bothered the inhabitants of the areas where the Jewish religion appeared and spread. The Sanctuaries report that Sheol was inside the Earth at great depth. The second is Gehenna (or Gehinnom), which, according to some reports, is a valley south of Jerusalem called Topheth where the ancient Canaanites made sacrifices to the gods Moloch and Baal. In later accounts of traditions, Gehenna is the place of Judgement, where the perpetual fire burns, burning the corpses of men and animals. Archaeologically no such place has been found in the valley south of Jerusalem [148,162–164]. The Paradise in the Jewish tradition is called Gan Eden and consists of five chambers; the first one is made of cedar, and the ceiling is made of transparent crystal. This room is the dwelling place of those who were not Jews but became devoted to this religion and code of life. The next is made of cedar, and the ceiling is covered with vine silver, which is the dwelling place of penitents. The third chamber is made of gold and silver and is very large, containing the best of Earth and Paradise with the most wonderful aromas, spices, and smells, with the huge Tree of Life in the centre. Under the shade of the Tree of Life are Abraham, Isaac, Jacob, and other iconic figures of the religion. The fourth chamber is made of olive wood and is inhabited by those who suffered for the name of their religion. According to Cohn-Sherbok [163], olives typify bitterness in taste and brilliancy in light (olive oil), symbolising persecution and its reward. The fifth chamber is built of precious stones, gold, and silver, surrounded by myrrh and aloes. In front of the chamber runs the river Gihon, on whose banks are planted shrubs affording perfume and aromatic incense. There are couches of gold and silver and fine drapery. This chamber is inhabited by the Messiah ben David, Elijah, and the Messiah of Ephraim (Joseph). In the centre is a canopy made of the cedars of Lebanon, in the style of the tabernacle, with posts and vessels of silver, and a settee of Lebanon wood with pillars of silver and a seat of gold, with a purple covering [163,164]. In contrast to the religious and mythological descriptions, in the case of the references to the Jewish religion, Paradise has no significant references that refer directly to factors that directly or indirectly shape the thermal environment.

The Christian religion appears after the Jewish religion in the same region, in the area of present-day Israel. The general climatic conditions of the region favoured heat stress from high temperatures and sunshine, and the inhabitants of the broader region suffered from it regularly as they were mainly farmers and herders. In the Christian tradition, according to Ekroth and Nilsson [142], *“the representation of Hell was somewhat fixed in the imaginary of the Christian population of the Roman Empire. Its principal characteristics are darkness, stench, heat, and torment”*. Moreover, the word “Hell” does not appear in the Greek New Testament;

instead, one of three words is used: the Greek words Tartarus or Hades or the Hebrew word Gehinnom. Therefore, what details of these places does the New Testament give us? Matthew 5:22 warns of the “danger of Hell fire” as punishment, an “everlasting fire” that should be avoided at all costs: “And if thine eye offend thee, pluck it out, and cast it from thee: it is better for thee to enter into life with one eye, rather than having two eyes to be cast into Hell fire” (Matthew 18:9). In the blessing chanted during the funeral, it is stated that “Κύριε, ἀνάπαυσον τὴν ψυχὴν τοῦ κεκοιμημένου δούλου σου (τοῦδε), ἐν τόπῳ φωτεινῷ, ἐν τόπῳ χλοερῷ, ἐν τόπῳ ἀναψύξεως, ἔνθα ἀπέδρα ὁδύνη, λύπη καὶ στεναγμός”, which means “the Lord gave rest to the soul of the servants in a place of light, a place of grass and a place of dew, where there is no pain, sorrow, and sighing”. It becomes clear that the place where we would like every soul to go to stay is the place that is cool, with vegetation and light. This is the place that seems to have those characteristics that provide an environment of thermal comfort according to the needs of the early Christian peoples in the eastern Mediterranean.

It seems that Hell is related to extreme climate conditions, and Paradise is related to preferable and pleasant conditions mainly expressed by the thermal environment. Therefore, we see that the eternal reward and the reason for living according to the rules of one’s religious tradition is an excellent thermal environment. In contrast, the eternal punishment for not obeying the rules is an unpleasant thermal environment. The above reveals its (thermal environment and perception) central position in the value system of the societies of ancient civilisations.

3. Concluding Remarks

From the analysis of the basic parameters of human life in the first centuries of organised societies, it appears that the biometeorological and bioclimatic conditions, as the thermal environment shaped them, played a decisive, direct, and indirect role. More specifically, the following can be posited:

- They largely determined the configuration of the outdoor and built spaces of humankind’s residential environment.
- They have influenced and continue to control much of the amount of energy consumed by humankind, thus significantly affecting the economic model of our civilisation in every era.
- They play an important role in the type of clothing since its inception as it is a fundamental tool for regulating the human body’s temperature.
- They play a vital role in shaping human language and its sound according to prevalent climatic conditions.
- They helped in the development of human socialisation and the development of democracy and philosophy.
- They are at the core of the narrative of many religious beliefs and traditions, symbolising eternal punishment through Hell and reward through Heaven.

All the above shows a connection and influence of the thermal environment ranging from daily life issues to the perception of the afterlife.

Ultimately, the thermal sensation created by the bioclimatic and biometeorological environment is an underground, large, and powerful current that played and still plays a decisive role in the evolution of human civilisation by influencing every aspect of it.

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