Chapter 1

Historical Overview: The Relationship Between Climate Crises, Anxiety, and Violent Reactions

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ABOUT THIS CHAPTER

This chapter will try to introduce—with the tools of history, archaeology, climatology, paleoclimatology, religious studies, and anthropology—a vast psychiatric review of the problem of ecoanxiety, one of the main byproducts of the impact of climate crises on mental health. In a complex system such as the human one, culture, society, mental health, and meteorological mechanisms are intertwined. It is not at all my intention to suppose a mechanistic cause-and-effect relationship of climate on culture and mental health. Instead, in my opinion, anthropology and the study of human cultures are entangled with the nonhuman. The distinction between human and nonhuman is, in fact, strongly influenced by culture; different cultures place these borders in different positions, or make them absolutely permeable or unrecognizable according to Western criteria, or entirely break them down. Human and nonhuman, mental health and climate, and society and meteorology are, therefore, strongly interrelated. At different times, spirits of nature or of the air or of the rain, anthropomorphic divinities, a monotheistic God as master of the sky and the Earth—or the radiative balance linked to the concentrations of greenhouse

gases—have acted on the complex climate system and on the complex culture systems, the latter intertwined with the first if only for reasons of subsistence. In moments of climate change, these forces have generated anxieties, expressed differently depending on the culture of reference, but essentially they are of an ecological nature. Today, the methods for treating these anxieties are not the task of the sacred but first and foremost of those who cultivate mental health.

CLIMATE CHANGE AND *HOMO SAPIENS*

Climate crises are much older than human history (Zalasiewicz & Williams, 2012; Williams et al., 2015). The most notable climatic variations that the Earth has experienced in the hundreds of millions of years that it has hosted life have caused, alone or with other concomitant causes, important and often destructive changes in the biosphere, including the so-called "great mass extinctions." Most scholars recognize five mass extinctions (plus other minor ones); now, the sixth, of anthropogenic origin, is underway. The previous mass extinctions have had various natural origins, both geological and astronomical, and have generally led to violent climatic variations; it was these that produced the extinction of living beings. Some causes were sudden and global, such as the impact of the asteroid that marked the end of the Secondary Age (or Mesozoic Era) of dinosaurs or large volcanic eruptions and explosions.[1] The climate also varies due to other slower-acting causes, such as the variation in solar radiation—which shows a very slow, progressive increase—and secular oscillations that are not yet well understood, as well as the Milankovitch cycles, or the effects on the climate of long-term variations in the Earth's orbital eccentricity and inclination. Another cause may even be the very arrangement of the continents. Variations in ocean currents, such as El Niño[2] and La Niña in the Pacific and the Gulf Stream in the Atlantic, also have a significant effect on the climate. The chain of causes and effects that each of these phenomena can trigger is complex and made up of positive feedbacks, which amplify and accelerate climate change, and negative ones, which slow it down, tending to maintain the previous equilibrium.

There are various methods of different origins to scientifically study the climatic history of our planet, which we will not dwell on. The study of written sources must be added, where available, to the experimental, "scientific" evaluations. All these methods, with varying degrees of reliability, allow the science of paleoclimatology to reconstruct with fair approximation the climate of the Earth in the past, though debates on this subject are not lacking. For example, some climatic situations should be considered local variations and not an indication of a global climatic situation. From this point of view, the current anthropogenic global warming enters the "restricted club" of climatic variations that affect the entire planet, such as glaciations and the devastating impact of the asteroid that exterminated the dinosaurs.

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[1] Strictly speaking, we can distinguish between extreme climate events (ECE) on a large but local scale (e.g., continental), and planetary-scale extreme events (PEE) or "catastrophes," responsible, among other things, for mass extinctions (van de Pol et al., 2017).

[2] Also known as ENSO: El Niño–Southern Oscillation.

Climate changes have probably been crucial in the adaptive evolution of our species (Schaebitz et al., 2021), in a biological but also cultural sense. But it is easy to understand that the impact of climate change has often been destabilizing—if not destructive—for various societies, at least at a local level. With all that could ensue, the climate crisis immediately caused a crisis in the system of production of means of subsistence, even in systems capable of organizing accumulation and shared redistribution of resources to cope with periods of shortage or famine. Born perhaps precisely to be able to manage the impact of these crises, societies could still collapse in the face of particularly intense crises, especially those extending in time beyond a single year or a little more. Climate change can also lead to a much longer period of instability followed by a new equilibrium (unfavorable for human needs) capable of lasting decades, centuries, or millennia. The crisis in or collapse of society obviously has had an impact on the mental health of the people who constitute that society. Just by being economic and food-related, the crisis becomes cultural in those societies where the order of seasons is linked to the order of the cosmos and is guaranteed by invisible powers who are considered to be the true owners of food sources, through which the sacred operates. This is particularly evident in societies that have become sedentary after the transition from a hunting and gathering economy to a mixed hunting/horticulture one, and finally to an agricultural and sedentary one. For nomadic and seminomadic hunting and gathering cultures, non-settlement could be useful in the case of a local climate crisis, allowing them to move to more favorable areas; on the contrary, the improvement of climatic conditions in certain areas (such as postglacial Europe) has certainly generated population migrations to the less inhabited areas. Climate change probably also caused our ancestors to leave Africa due to the stress they experienced, which translated into a push to move. Subsequent history has shown that excessively sedentary lifestyles, linked to isolation, represent a potential risk given the reduced adaptability of these types of societies. Collapse is more likely in rigid, hierarchical, and centralized societies that are isolated and with logistical difficulties related to movement, while nomadic populations have often been able to escape the consequences of climatic events by migrating.

Since about 2.6 million years ago, the Earth has been going through an ice age, interrupted by warm interglacial periods usually lasting about 10,000 years, including the one we are currently experiencing. As we will see, humans altered this dynamic equilibrium. During the glacial phases, sea ice, tundra, and glaciers advanced toward the temperate zones; sea levels dropped; deserts expanded in some areas due to less evaporation; and a cycle of partial desertification of Africa would have begun. During the last glaciation, the climate was, on average, 6 °C colder, a large difference considering current conditions (Tierney et al., 2020); this shows how a 4 °C warming could have a violent impact on the world. In the Americas, the Great Lakes were the southern boundary of the Arctic ice mass. Demonstrating the strong, stressful impact of climate crises, there is evidence of how catastrophic and global climate changes produced strong population decreases among our ancestors, endangering the very survival of humankind. By analyzing genetic sequences, we can estimate the size of the hominid population in even very ancient times, which allows us to identify these "bottlenecks." The oldest hypothesized extinction affected our distant ancestors between 930,000 and 813,000 years ago (Hu et al., 2023), with a 98% reduction

in population and an impact that would have lasted about 117,000 years. Presumably, current humanity descended from just under 1,300 survivors. The reason for the extinction is believed to be climatic, probably linked to the glaciation of that period, in which the great decrease in temperature was associated with severe droughts. Within the past few decades, evidence has emerged of a similar extinction due to the eruption of the Toba volcano in Sumatra, Indonesia, which occurred between 70,000 and 75,000 years ago. The explosion would have had a strong climatic effect, with the volcanic dust blocking sunlight and leading to planetary cooling for about 10 years. At that time, the last glaciation was already underway, so the further decrease in the global average temperature—of at least 3–5 °C—would have had a serious impact on *H. sapiens*; it is possible that only 1,000–10,000 individuals would have survived (Ambrose, 1998). It is also likely that the crisis would have extended to the entire global ecosystem, with a reduction in genetic variation also found in other mammalian species. According to other recent studies (Kappelman et al., 2024), the Toba catastrophe did not cause a generalized extinction but only that of groups in less favorable geographical positions or those less able to adapt and less willing to move to look for new sources of food and otherwise cope with the new conditions induced by the volcanic explosion. Any genetic bottleneck would once again demonstrate how greater adaptive flexibility is the best way to deal with climate changes. Similarly, a first wave of *sapiens* population in Europe sustained a large population reduction around 40,000 years ago but not a total extinction as was previously supposed (Bennet et al., 2023). These still-debated catastrophic events would explain, at least in part, the low genetic variation in our species. Humanity has already survived climatic apocalypses.

A Cultural Discourse on Peoples, Catastrophes, and Fears

The climate of planet Earth has a history of slow changes and rapid catastrophes that have impacted biology and human societies and acted as long-term drivers or as agents of apocalyptic transformations. Let's suspend the historical discussion for the moment to introduce the theme of cultural and psychological responses to climate crises.

This response was first and foremost mythopoeic—for concerned peoples, climatic catastrophes have been a mythological subject and a self-centered interpretation. It is no coincidence that, in Western culture, with its Judeo-Christian and Hellenistic-Roman roots, the mythical referent of cataclysms that strike humanity can be linked to extreme climatic transformations. Take, for example, the universal flood, an archetype of a catastrophe found in Greece with Deucalion and Pyrrha, in the Jewish world with Noah, and in Mesopotamia with Ziusudra (also known as Utnapishtim), as well as in many other cultures, including the least technologically advanced, such as that of the Andaman Islands. Multiple examples exist of floods considered "universal" or catastrophic and "local," leading to the disappearance of cities, islands, and perhaps even continents. Among the "local" cases, we have the Ys and Lyonesse myths of Celtic origin, which were widespread throughout the Middle Ages and similar to the very famous Greek myth of Atlantis, purportedly submerged into the ocean, as narrated in Plato's *Timaeus*. But among the Greeks, there was also another archetype of

catastrophe: the terrible and burning drought caused by the excessive approach of the chariot of the Sun, poorly guided by the inexperienced Phaeton, as told by a great Roman poet.

(Ovid, *Metamorphoses*, 2013)

> "(…) Then Libya
> Became a desert where wild flames ate the dew,
> Even the rain that swept across her grasses;
> Nymphs wept their losses of bright lakes and fountains
> Into disheveled hair …"
>
> *(Ovid, 2009)*

The myth of destruction brought by fire was also present in the Ragnarök of the Norse cultures; one of the architects of destruction, Surtr, would have come from the south, bringing fire:

> The sea will lash against the land because the Miðgarð Serpent is writhing in giant fury trying to come ashore… In this din the sky will be rent asunder and the sons of Muspell ride forth from it. Surt will ride first and with him fire blazing both before and behind.
>
> *(Sturluson, 1965)*

In a characteristic juxtaposition, Surtr is cited together with the great Serpent of the ocean that, with its fury, causes marine floods. Similar content can also be found in the distant Mesoamerican cultures: the Maya and the Mexica knew different cosmogonies that ended with various apocalypses. Among the Maya, the "second humanity" was annihilated with a flood; among the Mexica, there were five "eras," each with a sun, and the second was destroyed by hurricanes, the third by a rain of fire, and the fourth by a flood. The fifth is the one we live in, unless, as some claim, it ended with the landing of Cortés—that is, by the destructive hand of the modern human. Even non-eschatological cultures such as those in Central Africa conceive the cosmic catastrophe in climatic terms, placing it not as a final apocalypse but as an initial crisis to which one must react by starting a new cycle. A Yoruba myth (therefore, Nigerian, but whose tragedy of slavery spread to Latin America and the Caribbean) says that when, in the beginning, the Earth was inhabited only by the gods, the *orishas*, there was a period of drought so severe that it put their very lives at risk. Obatala, demiurge and god of purity, undertook the difficult journey to go to the supreme celestial god Olofin to ask for help; the problem was that Olofin, being a typical *deus otiosus* (Doniger & Eliade, 1999), was now old, tired, and sick, but the orishas asked the dying father Younger god to abdicate and give the orishas the power to enable the world to live.

Connecting myth and history, there is a hypothesis that the presence of flood myths in very different and distant cultures could be a cultural memory of the end of the glaciation (or the more rapid end of the Younger Dryas), during which the sea level rose by tens of meters, not slowly and steadily, but catastrophically, "in leaps" (Stanford et al., 2011). Since it was a period of warming after cold and dry periods, it is possible that an increase in precipitation perceived as disastrous took place. Another possible event that would have influenced the cultural memory of the flood (though the thesis is controversial) could have occurred about 7,600 years ago when the Dardanelles opened and the Mediterranean Sea colossally flooded the Black Sea—which, at that time, was only a lake, and whose northern half was a fertile plain inhabited by flourishing and rich Neolithic communities, early builders

of large urban centers (Ryan et al., 1997). We also know that droughts have always been a mortal danger for humankind. Just as rains of fire can be representations of devastating explosive eruptions, drought and flood, present in the myths of creation and destruction of many cultures, are cultural mythologems with possible roots in reality—perhaps memories of authentic catastrophes. For this reason, they are still at the root of deep anxieties today.

Humanity must now cope with a potential mix of flood and drought—these two mythological, archetypal, and traumatic catastrophes. Progressive global warming of an anthropogenic nature, induced by activities that release various greenhouse gases (starting from CO_2) into the atmosphere, represents a climate crisis that can cause, in addition to increased temperatures, the following: excessive and violent precipitation that is excessively concentrated in specific areas and in short periods of time; drying up and desertification; and, at the same time, a catastrophic increase in sea levels due to the possible collapse of the great Arctic and Antarctic ice caps.

If the semantics of our psyche are informed by cultural materials, then those of our anxieties can connect to those contained in mythology and religion. Ours is an age of anxieties, and they are all the more pervasive because they are based on rational concerns and, therefore, not treatable through rationalization. I am referring to climate anxieties, which—per the apocalyptic myths across religious history but also per prehistory itself—have an ancient origin and a long persistence. I refer to climate anxieties, as well as anxieties generated by crises of climatic origin.

Moreover, the fact that climate uncertainty and the potential disasters it generates have always and practically everywhere been a source of anxiety for humanity is demonstrated by the innumerable cases in which personalities believed to be able to influence weather conditions have held exceptional roles in their societies—roles that made them powerful protagonists but which also exposed them to violent behavior. The origin of this is complex, but it can at least, in part, be related to climate anxiety.

The classic (and sometimes contested) text *The Golden Bough* by James Frazer (1915) / Public Domain alone reports dozens of examples. Frazer explains that

> Hence in savage communities the rain-maker is a very important character; and often a special class of magicians exists for the purpose of regulating the heavenly water-supply. (ivi)
>
> Evidently, this power is a response to anxiety about the possibility of inclement weather. Countless rituals appear as responses to these climatic anxieties, which become anxieties for survival (Frazer, 1915 / Public Domain):
>
> When the Chams of Cochinchina are sowing their dry rice fields and desire that no shower should fall, they eat their rice dry in order to prevent rain from spoiling the crop. (ivi)
>
> …in many villages of Provence the priest is still reputed to possess the faculty of averting storms… when a change of pastors takes place, the parishioners are eager to learn whether the new incumbent has the power (pouder)... At the first sign of a heavy storm they put him to the proof by inviting him to exorcise the threatening clouds; and if the result answers his hopes, the new shepherd is assured of the sympathy and respect of his flock. (ivi)
>
> To put an end to drought and bring down rain, women and girls of the village of Ploska are wont to go naked by night to the boundaries of the village and there pour water on the ground. In

> Halmahera …a wizard makes rain by dipping a branch of a particular kind of tree in water and then scattering the moisture from the dripping bough over the ground. In New Britain the rain-maker wraps some leaves of a red and green striped creeper in a banana-leaf, moistens the bundle with water, and buries it in the ground; then he imitates with his mouth the plashing of rain. (ivi)
>
> In spring-time the Natchez … used to club together to purchase favorable weather for their crops from the wizards. If rain was needed, the wizards fasted and danced with pipes full of water in their mouths…But if fine weather was wanted, he mounted the roof of his hut, and with extended arms, blowing with all his might, he beckoned to the clouds to pass by. (ivi)
> In time of severe drought the Dieri of Central Australia, loudly lamenting the impoverished state of the country and their own half-starved condition, call upon the spirits of their remote predecessors. (ivi)

This Ethiopian example is particularly significant:

> The people of Egghiou … used to engage in bloody conflicts with each other, village against village, for a week together every January for the purpose of procuring rain. Some years ago the emperor Menelik forbade the custom. However, the following year the rain was deficient, and the popular outcry so great that the emperor yielded to it, and allowed the murderous fights to be resumed, but for two days a year only. (ivi)

This testimony also shows how climate anxiety can affect the behavior of "climate"-related sacred workers:

> So among the Toradjas the rain-doctor, whose special business it is to drive away rain, takes care not to touch water before, during, or after the discharge of his professional duties. He does not bathe, he eats with unwashed hands, he drinks nothing but palm wine, and if he has to cross a stream he is careful not to step into the water. (ivi)

Climate anxiety could lead one to direct anxious concern against sacred beings who failed to fulfill their duties:

> In a Japanese village, when the guardian divinity had long been deaf to the peasants' prayers for rain, they at last threw down his image and, with curses loud and long, hurled it head foremost into a stinking rice-field. "There," they said, "you may stay yourself for a while, to see how you will feel after a few days' scorching in this broiling sun that is burning the life from our cracking fields." In the like circumstances the Feloupes of Senegambia cast down their fetishes and drag them about the fields, cursing them till rain falls… (ivi)
> …the mandarins of Canton prayed to the god Lung-wong to stop the incessant downpour of rain; and when he turned a deaf ear to their petitions they put him in a lock-up for five days. This had a healthy effect. The rain ceased and the god was restored to liberty … in time of drought, the same deity had been chained and exposed to the sun for days in the courtyard of his temple in order that he might feel for himself the urgent need of rain. (ivi)

In Italy, there were similar examples in the past:

> By the end of April 1893 there was great distress in Sicily for lack of water. The drought had lasted six months…. Food was becoming scarce. The people were in great alarm. All the most approved methods of procuring rain had been tried without effect … At Nicosia the inhabitants, bare-headed and bare-foot, carried the crucifixes through all the wards of the town and scourged each other with iron whips. It was all in vain … At last the peasants began to lose patience. Most of the saints were banished. At Palermo they dumped St. Joseph in a garden

> to see the state of things for himself, and they swore to leave him there in the sun until rain fell. Other saints were turned, like naughty children, with their faces to the wall. Others again, stripped of their beautiful robes, were exiled far from their parishes, threatened, grossly insulted, ducked in horse-ponds … At Licata the patron saint, St. Angelo, fared even worse, for he was left without any garments at all; he was reviled, he was put in irons, he was threatened with drowning or hanging. "Rain or the rope!" roared the angry people at him, as they shook their fists in his face. (ivi)

Anxiety, frustration, and anger in the face of the absence of supernatural help end up overwhelming Christian respect for saints or, if you like, the fear of the taboo of mistreating a sacred being. The example is from the nineteenth century, but in Italy, there remain both processions organized by the official Church to ask for rain and called "rogations" and rarefied traces of a "punitive" attitude toward certain country saints who fail to comply. Elsewhere, the persistence is more evident (Shaffer, 2017). The ancient Mayan ceremonies, the rituals of sowing and invoking rain, would be in strong historical continuity with the current rites linked to uncertain weather conditions performed today in Guatemala, Belize, and eastern Mexico (Jobbová et al., 2018). In Burundi, the "abavurati," or "Rain Bringers" described by Ntahokaja (1978) officially resurfaced in 2022, during a drought, when the President demanded that on one Sunday, in all Christian churches across the nation, prayers be said for rain and to avert famine (Gugg, 2022).

Returning to the Story of a Humanity Immersed in (and Conditioned by) the Climate

The impact of the end of the last glaciation on *H. sapiens* was probably enormous and coincides with the beginning of the Holocene, which is the most recent warm interglacial period. The end of the last glaciation meant the beginning of a difficult, oscillating, and not yet fully clarified path toward "higher civilization," starting with the slow transition from hunting and gathering to agriculture. The warming was not linear; following a dynamic that could theoretically also occur in the current climate crisis, it was interrupted between 12,800 and 11,500 years ago by a partial cooling called Younger Dryas, which lasted about a thousand years and had an effect on nascent higher cultures—notably, the progressive affirmation of sedentary agriculture and urban civilization. For example, in the Middle East in this period, the nascent culture of the Natufian villages disappeared (Behringer, 2016). The end of the Dryas also coincides with the period of construction of the monuments of Göbekli Tepe, which began around 9700 BC.

The impact of human activity on Planet Earth, which evoked the use of the term Anthropocene (Crutzen, 2002), is placed by some at the beginning of the so-called "Neolithic revolution" with the birth of agriculture, the very first land reclamation, and then the first cities; it is a concept attributed to V. Gordon Childe (Childe, 1930) but which was recently called into question by various scholars (Graeber & Wengrow, 2021). The transition would have lasted several millennia, with "oscillating" phases between the two modalities, which would have coexisted for a long time (Graeber & Wengrow, 2021). The slow transition to agriculture would have probably occurred independently in at least

five areas of the world (the Fertile Crescent, India, China, Mexico, and Peru). There is no doubt, however, that this transition, and then its diffusion, coincided with a period of mild and relatively stable climate. For years, there has been a scientific debate about the existence of a warm climatic optimum of the Holocene between 10,000 and 5,000 years ago, followed by a slight cooling, whereas the latest data indicate a constant increase in temperatures throughout the Holocene, which would be associated with a slight increase in greenhouse gases; at least from a certain point onward, these events could be associated with the first anthropogenic impact of the spread of agriculture (with the related cutting or burning of forests to obtain free land). Of great interest is the culture that developed in today's Sahara, which has left beautiful petroglyphs in the Algerian Tassili and in other mountainous areas now in the middle of the desert (Tibesti, Hoggar). The Sahara has a 41,000-year cycle between desert and savanna (White & Mattingly, 2006), caused by the variation of the Earth's inclination between 22° and 24.5°. At the end of the last ice age, the Tassili area was a humid savanna full of life, depicted in images probably dating back to the centuries before 4500 BC. The warming and drying had a heavy impact, as demonstrated by how the petroglyphs became more and more rudimentary. Finally, part of those people migrated, both south and north and, supposedly, east toward Egypt, whose flourishing began a few centuries later. The ancestors of the Tuareg people remained in the area (Soukopova, 2011). We can imagine how these peoples, fleeing the drought, joyfully arrived in the fertile and humid valley of the great Nile River, where they mingled with the inhabitants already present. The impact of this arid phase is recognizable as far as the Far East; studies carried out in Laos have discovered traces of an alteration of the monsoon cycle that generated problems and famines (Griffiths et al., 2020).

The birth of Sumer follows the end of the glaciation, with the melting of the Caucasus glaciers and the formation of the fertile alluvial plain of Mesopotamia. Subsequently, the impact of the arid phase of the Sahara may have caused problems with food supplies, which, for millennia, had been minimally impacted by agriculture and horticulture, in parallel with the permanence of hunting, gathering, and breeding (Graeber & Wengrow, 2021). This would have pushed populations to concentrate in alluvial valleys rich in water and to move to a regime based on large-scale agriculture, with reclamation works and irrigation techniques developed by populations organized in gradually growing urban nuclei; the necessary work was provided in exchange for the food already accumulated, in a regime of sharing and redistribution. A new humid period may have favored this transition by creating a lagoon environment rich in food resources on the coastline, but causing elsewhere and later a progressive salinization of the soils. Agriculture developed independently in various areas of the world during this period. The city-states of Sumer developed around 3500 BC, and, shortly after, the first kingdoms of predynastic Egypt flourished. A similar process occurred in the Indus Valley, China, Mexico, and Peru.

The case of Egypt, an environment in a delicate balance, is also interesting in terms of the relationship between climate crises and the impact on the local biosphere. Archaeological evidence and historical records, dating back to 3000 BC or earlier, show the presence of many mammal species, most of which (29 out of 37) disappeared from Ancient Egypt following a series of profound climate changes (Yeakel et al., 2014). The extinctions

were probably caused by the drier climate and the increase in human population, with significance similar to today. The ecosystem of the region became less stable. These crises affected society; often, extinctions occurred simultaneously with social upheavals. The first case was the collapse of the Old Kingdom (in about 2150 BC), which sources indicate was linked to a drought that blocked the flooding of the Nile, causing famine and poverty and, in turn, social revolts that destroyed the rigidly hierarchical state of the early dynasties. A pattern that is observed by independent research across different historical periods and cultural contexts is as follows: a climatic crisis causes famines, which generate riots and violent mass reactions, or which weaken the population, sometimes causing epidemics or preventing a valid reaction against external invasions (in Egypt, this was the case of the collapse of the Middle Kingdom), often triggered by the same initial climate crisis. All of these events can ultimately generate a social and political collapse. The various factors (riots, epidemics, and invasions), precisely because they can be traced back to the same primary climatic cause, present together (Weiss, 1997).

In Mesopotamia, the same drought around 2150 BC—combined with terrible winter dust storms (recalled as dramatic by the sources)—caused the collapse of the Akkadian Empire (Behringer, 2016), which had been (from the twenty-fourth century BC) the first united empire in Mesopotamia and had prospered with the development of irrigation and an ambitious policy of conquest. But its settlements seem to have been suddenly abandoned, and various areas seem to have remained uninhabited for about 300 years. Recent research has found evidence of severe and sudden droughts and prolonged winter seasons with frequent dust storms (shamal). These would have caused serious agricultural problems, which would have led to social instability and famine associated with the collapse of the empire (Watanabe et al., 2019)—a climate mechanism that is reminiscent of the Dust Bowl in Oklahoma of the past century.

In India, the Harappan civilization collapsed a few centuries later, around 1700 BC, supposedly due to a period of drought. The invasion of the Aryans occurred about 200 years later; they encountered little resistance and were able to push farther and farther south (Behringer, 2016). Other recent research attributes the Harappan crisis to a cooling that altered the thermal balance, increasing the winter monsoons and gradually destabilizing the summer ones (Giosan et al., 2018). The inhabitants of the large cities of the Indus mostly migrated to hilly areas with a more stable climate. Migration is, in fact, a typical solution to a climate crisis, not only for nomads. The duration of the migration is uncertain, but, in the end, the urban civilization of the Indus had practically disappeared, meaning that the Aryans would have found almost no opposition.

Another major crisis was that of the Cretan and Mediterranean civilizations in the middle of the second millennium BC, perhaps linked to the explosion of the Thera volcano, dating back with radiocarbon to around 1600 BC or shortly after (but with much uncertainty). It has been assumed that the eruption caused significant climatic changes throughout the Eastern Mediterranean and much of the Northern Hemisphere (LaMoreaux, 1995); this assessment has subsequently been both contested (Pyle, 1997) and confirmed (McCoy & Dunn, 2002). Evidence of the impact of a related tsunami has been found—for example, on the Anatolian coast (with at least four different waves). Dendrochronological studies date the event to 1628 BC (Baillie & Munro, 1988; Grudd et al., 2000), but uncertainties remain. Traces of the

explosion's effect have supposedly been found in the *Bamboo Annals*, Chinese documents dating back to the collapse of the Xia dynasty in China (Behringer, 2016); the documents, dating to approximately 1618 BC, describe a "yellow mist, a dim sun, later three suns, ice in July, famine and the drying up of all five grains" (Legge, 1865).

Meanwhile, Egypt's Middle Kingdom, in crisis due to a severe famine followed by revolts, collapsed under an invasion from Asia of the Hyksos nomads around the middle of the seventeenth century. A connection with the volcanic explosion is possible, but the difficulties associated with dating have generated a long-standing controversy (Eastwood et al., 2002).

A few centuries later, in the thirteenth century BC, a series of violent invasions devastated the Eastern Mediterranean, putting an end to the Bronze Age. The Hittite empire collapsed, the flourishing commercial port of Ugarit was destroyed, and Egypt, although invaded, managed to resist with great difficulty. Documents tell us that the "Sea Peoples" (known as mercenaries) set out on large fleets, invading the East from the West, in what appears to be a mass, armed migration. As in other cases, the migration was probably triggered by climatic factors; dendrochronology has shown traces of a severe drought in a very large area—for example, in Anatolia (Manning et al., 2023)—but almost certainly extended to the entire Mediterranean. This weakened the empires of the Near East and, at the same time, induced the Sea Peoples to invade them in search of new lands; it is possible that even the Sea Peoples themselves were pushed to carry out their armed migrations as a result of the same climate crisis in the Western Mediterranean. It must be ruled out that the invasion was triggered by the possession of technologies superior to those of the great and civilized Hittite and Egyptian empires, with the sole exception of naval ones. The origin of the invaders is uncertain; among them, the presence of the Achaeans is certain, as they could have acted alone in the region of Ilium/Wilusa and been subordinated to the others in the attack on Egypt (there are traces of this in the myth of the true Helen found by Menelaus in Egypt). Wall iconography, documents, and some archaeological findings allow us to suppose a probable Italic origin of almost all the other peoples of the sea. In Egypt, Ramses IX stopped the invasion, stationing many prisoners in the land of Canaan, which, from the name of one of those peoples (the Filistin or Philistines), was later also called Palestine. In this vast epochal upheaval, even the small kingdoms of continental Achaean Greece went into crisis (as mythology recalls, from the *Odyssey* to the *Oresteia*), perhaps also due to revolts caused by food scarcity (and while the warriors had left for the East). The climate crisis would then have generated a convulsive instability from which, after the "Dark Ages," Greek culture and Phoenician culture would have arisen. If the identification between Habiru and Jews is well-founded, in this period, together with Philistine Palestine, the Jewish presence in Canaan would have been born. The Jews would have migrated back to Asia, abandoning an unstable and war-torn Egypt.

According to some studies, there are signs of other droughts in the following two centuries (between 1100 BC and 900 BC) in a vast area from the Mediterranean to India. In this period or shortly before, the desertification of the Thar would have occurred, following the drying up of the course of the Ghaggar River, identifiable with the legendary Sarasvati, later called "disappeared river" (or, in the mystical interpretation, "invisible river"). Part of the population would have moved toward the Ganges. The dating is uncertain and the early

stages of the event could correlate with the previous end of the Indus civilization (Poonia & Rao, 2018).

From approximately 900 BC to 400/300 BC—i.e., in the final part of the so-called Greek Dark Ages and then in what Westerners call Classical Greece—the European climate cooled slightly, a phase characterized by bad weather, floods, and two strong advances of mountain glaciers (Göschenen phase I). At that time, the level of the Mediterranean Sea was probably about a meter lower than today, so the remains of infrastructure such as ports or fish farms are submerged; precipitation caused a supply of sediment from rivers that extended the coasts, tending to silt up some ancient ports. In Italy, forest cover increased. There was a migration of Celts to Northern Italy in the fifth and sixth centuries BC (Pfister et al., 2021), which overlapped with the remains of previous similar migrations, followed by further movements toward the Balkans and Anatolia until the third century.

From 300 BC to about 400 AD, the climate in the Mediterranean had a phase of slow warming that is defined as the "Roman Climatic Optimum" (Bianchi & McCave, 1999) and that seems to have caused a population increase in Italy and the Mediterranean regions. Roman sources report that, from the late Republic onward, Rome began to suffer from the summer heat; wealthy Romans began to build rich and comfortable villas on the stretch of sea from Rome to Naples. Tiberius eventually settled in Capri, but almost all the Julio-Claudians spent most of the year on the coast between Rome and Naples.

Temperatures became milder and, on average, precipitation decreased; according to the Latin scholar Columella, a famous agronomist of antiquity (second century BC), crops were undergoing this change, and regions that had previously been too cold for olive groves and vineyards now allowed these crops. A shift toward the north of the lines beyond which olive trees and vines did not grow was therefore observed, and authors such as Theophrastus (third century BC) and the encyclopedic Pliny the Elder (before 73 AD) noted the same phenomenon with the beech trees that had once extended up to the latitude of Rome and, with the passing of the years, had gradually moved toward northern Italy (Teofrasto, 1901/ Public Domain; Plinio il Vecchio, 1997). But Columella also reported complaints about the sterility of the fields and the variability of the climate that, in some regions, had become unfavorable to agriculture, with a probable reference to excessive warming and drying in previously very fertile and highly populated areas such as Mediterranean Spain, where he was born, and Southern Italy (Magna Graecia), where he died (Columella et al. 1977). Overall, warming generated population growth and, above all, favored the stable colonization of northern territories by the Romans, starting with northern Italy, and then moving on to Gaul, Britain up to Scotland, the Danubian area, Dacia, and Crimea. The cultivation of the vine, characteristic of the areas of legionary settlement, extended northward into areas where it had not previously been present: Gaul, the Danube up to Moldavia, the Rhineland, and Britain itself. Overall, the Roman Empire's expansion seems to have been favored by this moderately warm and humid phase in much of the Mediterranean, centered on the end of the first century BC—that is, the reign of Augustus. In this period, in fact, the Romans invaded Germany rather easily in a few years, only to lose it with the rebellion of their ally Arminius; a few years later, a progressive occupation of Britain began, which, in 50 years,

led to the almost total conquest of Great Britain. Before Rome, the warm and humid climate would also have favored Greece and the Hellenistic world, as well as Carthage. In fact, North Africa was not as arid as it is today; a dry phase began after the fourth century AD. In the Optimum period, there is evidence of many oases that favored the kingdom of the Garamantes in the Libyan Fezzan and of caravan routes that linked the coast to Chad and the Niger River, taken under Roman control between the reigns of Augustus and Domitian with military expeditions. From 300 AD, attacks by Berber nomads increased as the interior became more arid; the Romans progressively reduced their presence on the coast, abandoning areas such as the Moroccan Rif despite having just defeated the Berbers there, and in the abandoned areas, fragile local Berber-Roman kingdoms arose. The end of this warm and mild Optimum may have been a major cause of the final collapse of the Western Roman Empire, triggering an agricultural crisis and, consequently, a political, civil, and military fragility that prevented the management of great migrations, which began again at the end of the second century (Büntgen et al., 2011; Harper, 2017).

In Northern Europe between the fourth and fifth centuries AD, a cooling began, with environmental disturbances and frost that made agriculture difficult. Invading peoples began to press inward, first to be welcomed into the Roman Empire as allies (a common practice for centuries, but in a controlled way), then to ask for lands in exchange for the alliance, and finally to build their kingdoms within the empire.

There are many hypotheses on the causes of the empire" s collapse, starting from Christian reflection or Gibbon's anti-Christian thesis (scaled down by the evidence that Byzantium, more Christianized than the West, did not fall) up to today. Harper's (2017) study sees climate change as the real cause, putting food production in jeopardy and inducing pandemics facilitated by famines. The Roman Empire grew until 150 AD, thanks to a warm and humid climate that allowed a "virtuous" economic cycle. Crops and cultivation areas grew, the population was numerous, and new lands were colonized (around 120 AD in Dacia, the population of colonists was so rapid that it induced Hadrian not to abandon the province even though it was very exposed). Just after the beginning (around 150 AD) of a "transitional" climatic phase characterized by periods of cold, drought, drying up, and interruptions in the flooding of the Nile, an explosion of epidemics and a new invasion south of the Danube occurred, extending until about 450 AD. Christians and pagans, both seeing mystical causes in catastrophes, accused each other of being guilty of the disasters produced by weather systems in the Atlantic, by El Niño, by monsoons, and by solar activity (Harper, 2017). Let's go into more detail.

Climate Crisis and "Barbarian" Invasions

A recent multidisciplinary study (Drake, 2017) supported the idea that climate changes in the past affected migratory phenomena that upset the geopolitical balances of the time.

The study identified the North Atlantic Oscillation (NAO; an atmospheric circulation phenomenon located in the North Atlantic Ocean) as a driving factor behind Eurasian migratory movements. The NAO generates strong disturbances in the North Atlantic, in correlation with the Arctic Oscillation. The study correlated the variations of the NAO with climate changes in recent history, noting that its variations were contemporaneous with extreme weather phenomena, which occurred between the first century BC and the

fifth century AD in Europe north of Rome. Cooling and drought pushed native populations to migrate, invading other territories. Significant examples are the invasions of the Cymbers and Teutons from 113 to 101 BC; the Quadi and Marcomanni tribes from 164 to 180 AD; the Goths in 376 AD; and the Goths, Huns, and Slavs from 500 to 600 AD. A climatic cooling appears certain after 200 AD, up to a small glaciation in the fifth century AD. The study examines four events of Germanic migration into territories of the Roman state.

The first great migration was that of the Cymbers and Teutons peoples from Denmark, who advanced first into Gaul and then toward northern Italy, defeating the Romans in 112 BC, 109 BC, and 105 BC. The Roman general Gaius Marius reorganized the army, extending military service to the propertyless plebeians and increasing the power of military commanders; with this new popular army, Marius heavily defeated the Cymbers and Teutons in 101 BC. But within a few years, the military commanders, now in charge of armies more devoted to themselves than to the state, fought over power until the final victory of Octavian and the birth of the empire.

This migration is less famous than the later ones because the Roman state was able to contain it, even if, to do so, it had to change its nature; these changes were enormously successful, leading to a century of continuous conquests, but they worsened social instability and amplified social clashes that had begun a few years earlier. This moment seems very significant to us because, as we will see, it was associated with apocalyptic anxiety and religious crises that had violent outcomes. It is an excellent introduction to the historical development of crises of "mass anxiety" with often violent outcomes, which have probably also occurred in more recent times and may provide a clue about potential ecological anxiety in the future.

After about two centuries of relative stability, several Germanic tribes, including the Marcomanni and the Quadi, violently attacked the Danube border. The tribes penetrated south, as far as Aquileia, in Italy, on the northern coast of the Adriatic Sea. Emperor Marcus Aurelius repelled the invaders and invaded their territories in retaliation, but his son Commodus accepted a peace deal that restored the status quo. Rome, weakened by a violent pandemic, was not able to "punish" the invaders by annexing their territory, as it had previously done. The era saw the spread of new religious anxieties and a widespread cultural crisis and pessimism, as well as a significant expansion of Christianity. A few years later, in 230 AD, there was a very serious crisis, with a violent offensive by the new Persian Empire, a series of winter raids by the Franks across the frozen Rhine, and general disorganization within the empire, which temporarily ended 40 years later with the Illyrian emperors and Diocletian. Shortly after, Constantine legalized the Christian religion.

In 376 AD, the Goths settled in a kingdom between Romania and Ukraine but, fleeing the migration of the Huns, asked permission to be welcomed by Rome. The Romans' inability to manage and feed the refugees led to their revolt. The Eastern Emperor Valens tried to stop them, but at Adrianople, the Romans were heavily defeated.

When peace seemed to have been restored, the West Germans moved and invaded Roman territory at the end of 406 AD after crossing the Rhine, starting the final phase of the "barbarian" invasions that would lead to the definitive fall of the Western Empire. The Rhine was frozen, a fact considered unusual by the sources of the time. For the first time,

it was not possible to force the enemies to return to Germany or to settle as "foederati," military allies paid with tribute and/or with the right to inhabit Roman lands, as the Goths had also agreed to. Other Germanic tribes invaded the Roman Empire, and, a few years later, the Huns themselves did the same (Bardi, 2017; Behringer, 2016). Attila, king of the Huns, was stopped, but by then, the Western Empire was coming to an end, devastated by invasions and weakened by climate change.

The theory that these geopolitical changes were influenced by climate changes was proposed as early as the eighteenth century, but there was no clear connection between climate and individual migrations. Regarding the various migrations of the fifth and sixth centuries AD, various findings confirm that, in those periods, there were extreme weather phenomena, with very cold areas and other areas that became more arid. Palynological data indicate that, throughout Europe, there was an advancement of forests and a reduction in cereal crops caused by the cold. The migrations of this period occurred simultaneously with the small glaciation called LALIA (Late Antique Little Ice Age), which forced the peoples of the north and east to migrate west and south to survive. There is, therefore, considerable confidence that the NAO was a climatic driver of historical migrations in Europe for about seven centuries.

The fall of the empire was at the beginning of a cold period, characterized by several years without a hot summer season and coinciding with the NAO oscillation with maximum volcanic activity and a probable minimum of solar activity. For example, reports exist of a very bad climate situation in the Justinian era. According to McCormick, 536 AD marked the beginning of one of the worst climate crises in history in Europe and beyond (Gibbons, 2018). That year, according to multiple sources, a mysterious haze shrouded the Sun in the skies of Europe, the Middle East, and parts of Asia for about 18 months. The Byzantine historian Procopius of Caesarea reported a reduction in the Sun's light and heat comparable to that of an eclipse. Temperatures would have dropped by 1.5–2.5 °C, causing the coldest decade in the past 2,300 years. The consequences were global, including drought, famine, and snow in midsummer in China. In 541 AD, an epidemic broke out in Egypt, the "plague of Justinian," which killed perhaps a third of the inhabitants of the Eastern Roman Empire. The ice cores of Monte Rosa in the Alps offer an explanation, revealing evidence of an intense volcanic eruption in Iceland in early 536 AD (followed by others in 540 AD and 547 AD). It is estimated that, because of the ash, a quarter of the planet experienced a severe reduction in sunlight for a year and a half. The subsequent series of famines and plagues were probably decisive in stopping Justinian's attempt to restore the Roman Empire to its original borders. The next signs of warming appeared a century later. Shortly after, in the seventh century, the Arab peoples conquered Persia and part of the Byzantine Empire, founding an empire centered in the arid areas between Syria and Mesopotamia. In the same century, a further period of European migration involved the Slavic tribes, who moved both into the areas previously populated by Germanic populations and into the eastern Balkans, while other migrations occurred in the south of Great Britain due to the invasion of the Angles and the Saxons.

Climatic causes and effects can, therefore, be multiple. If the NAO is positive, it causes more humid conditions in central Europe and drier conditions in the Mediterranean, and

the opposite when the NAO is negative. Climatological analyses show that there were simultaneous NAO oscillations and historical migrations in European antiquity, with minimums around 150 BC, 190 AD, 375 AD, and between 500 and 600 AD.

In each period in which the NAO increased (from 0 to 1), significant migrations occurred. These climatological assessments are in agreement with ancient sources. The chroniclers of the time noted the severe drought conditions that pushed the tribes to migrate beyond the Roman borders.

Although these drivers are important, the outcomes also depended on the social solidity of the countries that opposed them, as demonstrated by the contrasting stories of the Cymbers and the Franks. Between these extremes, for centuries, other tribes migrated in more manageable conditions and were welcomed and peacefully integrated, as was the case with the faithful Ubii tribe in the Rhineland.

Climate change is only a contributing factor to migration. If the countries targeted by migration react decisively and consistently, the social impact is mitigated. In the absence of cohesion, even peaceful migration (Goths) can stress the connective tissue of society, leading not to integration but to cultural opposition. However, in many cases, even societies capable of a strong and resilient response have shown substantial signs of cultural stress in conjunction with climate crises due to both their direct impact (famine and plagues) and indirect impact (migration and invasions) (Drake, 2017).

Climate Crises: Historical Sources of Anxiety, Fear, and Violence

The great crises that endanger our civilization and our life have always generated fears and apocalyptic anxieties, and have often been translated into millenarianisms or messianisms, per premodern cultural mechanisms. Therefore, crises have always destabilized human societies—both the simplest and the most organized, acting directly or indirectly. Some societies have been able to react by transforming themselves, especially in response to relatively brief crises or after long phases of instability. Others have collapsed. The crisis we are currently experiencing is particularly dangerous because it is progressing relatively fast and, above all, it is global. We will now discuss, with examples, how societies threatened by climate crises have reacted—in particular, how they have faced a threat capable of endangering their survival. The reactions of these groups and their selected solutions are certainly of interest and have left their mark on history.

By triggering anxiety and fear, climate crises are capable of generating cultural crises and episodes of mass cultural violence. An example of institutional violence was the Trial of the Vestal Virgins in Republican Rome in the first century BC, which shocked Roman society at the time. In 114 BC, the Roman Republic was in a difficult situation: Anxiety had exploded due to the migration of the Germanic Cymbers and Teutons peoples from the north, caused by a climate crisis; Rome also had endured bad harvests. A violent response to growing societal anxiety was triggered by a "bad omen": Lightning struck and killed Helvia, a young virgin woman, in anomalous circumstances, which was interpreted as particularly ominous. All meteorological and climatic events outside the norm—but

especially lightning—were regarded as fundamental divinatory elements for the Etruscans and Romans. Like many ancient cultures, the Romans tended to attribute crises to mystical causes that had disturbed the cosmic order. A typical method to reduce anxieties generated by cosmic crises was to search for "contaminating" impieties committed by priests—in particular, by the Vestal Virgins. In this context, three priestesses, Aemilia, Licinia, and Marcia, were accused of *incestum*, or the loss of virginity. The accusation came from a slave disappointed by the failure to be freed. The alleged accomplices of the Vestals belonged to an emerging social class: the knights. The accusation caused a scandal; anxiety over the difficult situation was compounded by a political will to discredit the equestrian order. The pontifex maximus Caecilius Metellus Dalmaticus tried to tamper with the demand for severe punishments. Forced to hold a trial against the three in December 114 BC, he condemned Aemilia to death, but managed to acquit the others.

But, in Rome, anxiety was growing. In the first clash against the Cymbers, the consul was heavily defeated. The following year, the pontiff was temporarily deprived of his powers, with the aim of invalidating the outcome of the first trial; a second trial was called under the leadership of the ex-consul Lucius Cassius Longinus Ravilla, who was notorious for his severity. All three vestals were condemned to a cruel death: being buried alive. Their alleged lovers were flogged to death. But the violence continued and became similar to a witch hunt. Ravilla accused and condemned many other people in the context of the affair. The Romans carried out numerous purification rites in their "contaminated" City, including a human sacrifice for the third and last time in its history, the other two being in the hard crisis of Hannibal's invasion. A pair of Gauls and a pair of Greeks, symbols of otherness and of the enemy, were buried alive. The archaic nature of this sacrifice is revealed by the choice of Greeks and Gauls as "others," dating the choice to engage in sacrifice and the nature of the sacrifice chosen before the beginning of the disputes with the Carthaginians. Such sacrifices were already perceived as barbaric by the Romans, who abolished them in 97 BC; the historians Livy and Plutarch were ashamed of them and tried to pass them off as rites of non-Roman origin. The trial was a sensational event and remained in the Roman imagination for a long time because of inhumane cruelty of this harsh religious rigor. Fifty years after the executions, Lucius Cassius Longinus, brother of Caesar's assassin Cassius and relative of Ravilla, minted coins in memory of the trial.

The tendency to revive violent sacrificial acts, previously set aside by a progressive softening of customs, during serious crises can also be found among the Phoenicians. Within their culture, there is evidence that Moloch—the sacrifice of the firstborn, which was eliminated over the centuries even by conservative religious communities such as Carthage—was reinstated by cities under siege as a desperate attempt to implore salvation from the gods. Since, in ancient times, conquering a city often meant either massacring its inhabitants or enslaving them, a siege by the Greeks or the Romans represented an apocalyptic crisis for the Carthaginians.

The same mechanism was at work in the sacrificial rite of the "scapegoat"—in Greece, *pharmakos*. At set intervals, but also during climatic crises such as drought, Ancient Greeks chose one or two people, often with physical deformities, and conducted a ritual similar to a festival; the victims were then chased out of the town or city, or even killed. The victims

were assigned all the negativity and tasked with freeing the city from it in order to bring about good weather, good harvests, and public health.

The fall of the Western Roman Empire was a very complex phenomenon, attributable to various causes, including the progressive hardening of the social and bureaucratic structure of the State. The climate crisis in Europe, however, lasted until about the ninth century. The movement of peoples continued until the invasions of the Saxons in Britain, the Lombards in Italy, the Avars in Hungary, the Slavs in Greece, the Vikings and the Varangians, and the Hungarians in 900 AD.

Starting from 800 AD, especially shortly before 1000 AD, a new warm period began in Europe and North America (Jones & Mann, 2004). Western Europe benefited from this change, with a civil and cultural recovery that later historians would call the "renaissance of the year 1000." The invasions ended shortly after 900 AD. International trade resumed, and the population surplus pushed for expansions (crusades) both toward the Holy Land and toward Eastern Europe. The return of the vine to England (as far south as Scotland) is a good indication of this warming (Jones, 2004). There is evidence of the invasion of African locusts far north, as far as Austria and even Scandinavia.

The collapse of the refined Maya Mesoamerican civilization, rapid and not without evidence of exogenous reasons (invasions), has long been a mystery. It is now assumed that, before 900 AD, the Maya civilization grappled with an agricultural crisis caused by a series of severe droughts (Gill et al., 2007; Douglas et al., 2016), with a reduction of the water table and erosion of arable land, which, in the Yucatán Peninsula, is particularly fragile (Diamond, 2005). The regions inhabited by the Maya of the Classic Period were at risk of rapid degradation of arable land if it were excessively exploited, especially if there was a concomitant period of drought that affected the water table; moreover, the Maya used burnt lime to construct their colossal temples, using as fuel the trees of the forests (the same ones that, after their collapse, covered the empty cities). The collapse of the civilization was followed by a severe cultural regression, supposedly accompanied by violent revolts. The Mayan elites were composed of nobles but, above all, of priest-scientists, who were authors of extraordinary mathematical works, capable of using zero (discovered independently by Indian mathematicians), and authors of complicated calendars that extended into the past for very long periods of time; their attention to time was obsessive, to the point that the days themselves were transformed into divinities. For the Maya, drought depended on the astronomical movements of stars and planets. Evidently, the anxiety born from drought led the people to consider nobles and priests guilty, as they were incapable of acting to bring back the rain. This would explain the presence of unfinished buildings at different times and in different areas; the explosions of violence led to the sudden abandonment of the cities. Several cities survived in areas with greater water availability, as some of the Maya moved north and into more wooded areas (Kennett et al., 2022). The Maya, however, never again reached the high scientific level of the Classic Period, and their culture became increasingly violent; their religious rituals became increasingly bloody and began to be characterized by human sacrifices, similar to those, later, of the Mexica. If, during a certain dry period, an astronomical event occurred—such as the rising of Venus—a sacrifice was offered to avoid drought. This can be interpreted as a violent response to

climate anxiety. We can hypothesize that the growing climate anxiety eventually led to a "crisis of confidence" directed toward the elite, who were considered to be the custodians of (sacred) science; this may have culminated in a final explosion of punitive violence and subsequent development of religious phenomena based on blood sacrifice, which, in Mesoamerica, always functioned to preserve the cosmos in response to strong apocalyptic anxieties (i.e., the blood of the sacrificed must give energy to the sun and the gods so that the cosmos does not end). As we have seen in other cultures, violence became a way to focus and unload unmanageable anxiety on specific victims.

Even in this context, climate is not the only cause of the collapse of a civilization, as cultural and social evolution is complex and not so deterministic; rather, climate is a triggering cause that generates crises and anxieties that cultures have particular difficulty in dealing with. Here, a strongly hierarchical and rigid system, in a relatively fragile ecological context, has not been able to be culturally resilient and manage climate anxiety.

Among the major historical attractions of the United States are the Pueblos spread across New Mexico, Arizona, and Colorado, cities built by the Anasazi people ("the ancients") starting from around the ninth century and flourishing especially in the eleventh century—therefore, in the Medieval Warm Period. The pueblos were largely abandoned between the twelfth and thirteenth centuries. This abandonment had dramatic characteristics: As if to sanction the irrevocability of their choice, the Anasazi burned the *kivas*, circular rooms with a probable sacred function. Evidently, the Anasazi were certain that they would not return. The causes of this collapse were almost certainly climatic. Dendrochronology has, in fact, found evidence of a drying-up that progressed with three long droughts: 1125–1180 AD, 1270–1274 AD, and 1275–1289 AD, all in the Medieval Warm Period. The first marked the end of the Anasazi's peak and the others the abandonment of the pueblos, causing famines that forced the survivors to migrate southward to the Rio Grande area. There is evidence of a progressive deforestation of the area, connected to increasingly greater imports of wood from other, less arid areas. Evidence has also been found that, in the final stages of this period of severe famine, there were explosions of violence that reached the point of cannibalism (Diamond, 2005; Meloni, 2009; Weiss, 2017). In essence, it is possible to assume a multipolar relationship between climate crisis, climate anxiety, and explosion of violence, then connected to food scarcity. Even larger than the Pueblos were the Cahokia Mounds in Illinois, which perhaps reached 40,000 inhabitants, but were abandoned between 1250 and 1400 AD—that is, shortly after the Anasazi crisis. Here, too, one could assume there was a climatic contributory cause linked to the Medieval Warm Period—or to the sudden cooling that marked its end.

A Little Climate Crisis: The Little Ice Age

At the end of the Medieval Warm Period, the weather suddenly went through phases of worsening, with a decrease in temperature and, above all, almost continuous precipitation. One cause could have been the eruption of the Mount Tarawera volcano in New Zealand around the year 1315 AD, which would have caused the lowering of temperatures across the entire planet. Between 1310 and 1330 AD (Hodgson & Nairn, 2005), Northern Europe

experienced some of the worst and longest periods of bad weather in the Middle Ages, characterized by harsh, rainy winters and cold summers. With this climate change, medieval governments demonstrated a growing inability to manage crises and secure food supplies.

The causes of the LIA and its temperature oscillations are unknown. The presence of one or more periods of reduced solar activity, also called grand minima, is recognizable from the study of isotopes and other methods. The beginning of the cooling coincided with the solar minimum, called the Wolf minimum (1300–1320 AD), followed by the Spörer minimum (1420–1540 AD) (Jiang & Xu, 1986). Typically, a characteristic of minima is fewer sunspots. In the West, spots were discovered by Galileo, but, a few years later, in the mid-seventeenth century, they disappeared, causing quite an impression; this was the Maunder minimum (1645–1715 AD ca.), followed by the shorter Dalton minimum (1790–1830 AD ca.). Evidence of strong volcanism has also been found between 1250 and 1500 AD (the beginning of the cold period) and between 1550 and 1700 AD—that is, at the time of lowest temperature (Hammer et al., 1981).

Between 1309 and 1311 AD, due to repeated adverse weather events, there was a serious shortage in cereal production in Northern Italy, so much so that, according to medieval sources, people were seen dying of hunger in the streets. Between 1312 and 1315 AD, several droughts followed by violent storms threatened crops in other parts of Northern Italy. But the worst was yet to come. In the spring of 1315 AD, anomalous, continuous, heavy rain began to fall across Europe. Throughout the spring and summer, rain continued to fall and temperatures remained low. It was called the "year without sun," and it caused the Great Famine. Grain failed to ripen. In England, food doubled in price within a few months. Salt, used to preserve meat, became difficult to obtain by evaporation in the humid climate; the price increased from 30 to 40 shillings. In Lorraine, flour prices tripled, leaving the common people unable to buy bread. Emergency grain stores were reserved for lords and nobles. All of these problems struck a Europe that was much more populous than in previous centuries, thanks to growth in the Medieval Warm Period, which left little margin for difficult harvests. People's options were reduced to gathering wild edible roots, plants, herbs, nuts, and berries in the forests. Many documented cases show the extent of the famine. For example, when Edward II of England stopped at St. Albans in August 1315, no bread was found for him and his entourage. In the spring of 1316, the rain continued to fall on an increasingly distressed European population. Chroniclers of the time reported many cases of cannibalism.

The rain continued into the first half of 1317, and the famine reached its peak. Finally, during the summer, the weather returned to normal; however, the population had been weakened by lung and other diseases, and most of the seed reserves had been eaten, so it was not until about 1,325 that food supplies returned to relatively normal conditions and the population began to increase again. It is estimated that between 10% and 25% of the European population died. For many, the Great Famine was worse than the subsequent Black Death of 1347, which raged in one area for only a few months, whereas the Great Famine persisted for years, generating widespread despair and violence, including phenomena such as cannibalism and infanticide. Apocalyptic anxieties began to spread, growing with the arrival of the terrible epidemic of bubonic plague, which reduced the

population by about a third. The plague was probably so devastating because it struck a population already weakened by malnutrition; the same was true for subsequent epidemics, which showed particular recrudescence during periods of adverse climate and poor harvests, such as the decades between 1570 and 1630 AD. The European population had become dependent on cereals during the Medieval Warm Period, which had enabled cultivation up to the far north; thus, the climatic cooling—with unseasonal snowfall, violent storms, and recurrent floods—caused a sharp decrease in crops, triggering famines and thereby worsening health and epidemics (Fagan, 2000; Grove, 2004).

An example of millenarian phenomena linked to the anxieties generated by crises, including those of climatic origin, is the Flagellant movement, which beat themselves as a form of petitioning for the pardon of their sins in the face of a supposedly imminent Apocalypse. They originated at least in the thirteenth century but increased greatly during the difficult following century. The first Flagellants, known at the time of the Black Death, appeared in Styria, Austria, in September 1348; subsequent Easter (springtime) processions were accompanied by violent storms that ruined the grape and cereal harvest and which, shortly after, were considered premonitory of death and destruction. Anxiety about an imminent apocalypse, coupled with the anxiety generated by the death present everywhere and the fear of the approaching severe judgment of God, made the movement grow, especially in cities. Typically, the Flagellants wandered in areas not yet affected by contagion to implore God to spare them from death and to postpone the end of the world, together with the local population. Hundreds of Flagellants walked the streets—poorly dressed, chanting, and complaining—the personification of mass anxiety reaching the point of self-harm. They were characterized by apocalyptic anxieties and by ecstatic states, probably caused by the pain and wounds produced by the plagues or psychotic behavior.

Even after the end of the famine, the climate continued to cool: Toward the middle of the century, the Little Ice Age (LIA) began, which, according to many scholars, lasted until the first part of the nineteenth century (Behringer, 2016). Once again, a good indicator of the change is the range of the vine, which became extinct in England shortly after 1440 AD. The geographical extent of this cooling is the subject of a rather lively debate among scholars, but much evidence suggests that there were periods in which the area involved was more limited, as well as other periods in which it could have extended to much of Asia and North America, which is confirmed by some sources. It was probably not a planetary phenomenon like the ice age or the anthropogenic warming of today.

From the point of view of cultural and artistic testimonies, a fresco such as the *Triumph of Death* in the Pisa cemetery in Italy could be representative of a historical situation dominated by anxiety, after the previous, very different eras of the troubadours and the *dolce stil novo*, attentive to the beauties of life and courtly love. The fresco had already been painted in 1338 AD (Behringer, 2016); therefore, it precedes the Great Plague and probably dates after the Great Famine.

Among the effects of the cooling was a particularly destructive storm, called the first "Grote Mandrenke" (in Low Saxon, the "great drowner of men"), which hit the coastlines on the North Sea between January 15 and 16, 1362 AD, destroying more than 60 villages in Denmark (including the city of Rungholt) and killing between 11,000 and 25,000 people

(Lamb & Frydendahl, 1991). The myths of Ys and Lyonesse became real; in times of climate crisis, a colossal storm can destroy an entire city. The destruction was such that the exact location of the remains of Rungholt was only found centuries later.

From the fourteenth century onward, peasant revolts due to food shortages spread to various parts of Europe. The French Jacquerie, a spontaneous and disorganized revolt, exploded after 1358 AD and was harshly repressed. Shortly before, revolts had exploded in the Netherlands, and, after 1370 AD, riots occurred in Italy, directly or indirectly related to instability caused by famine. In 1415 AD, at Agincourt, the heavy cavalry of the French aristocracy, invincible until a century before, became bogged down in rain and mud, evidently because they were more suited to weather conditions that no longer existed; they were massacred by the English light infantry, on "the day of Saints Crispin and Crispinian," as Shakespeare recalls.

Interestingly, at the same time in China, a climatic crisis characterized by flooding of the Yellow River caused a disastrous famine that sparked a series of peasant revolts, which succeeded in driving the Mongols of the Yuan dynasty out of the country after a century. In their place, in 1368 AD, the peasant Zhu Yuanzhang became the leader of the revolts, founding the Ming dynasty (Behringer, 2016).

Back in Europe, the widespread discontent remained endemic and then climaxed, immediately after the Reformation, in the Peasants' War in Southern Germany, which later contributed to the religious wars. This instability may have been due to the decrease in temperatures and the resulting food shortages that extended throughout this period, which saw a progressive increase in the price of cereals, despite the collapse of the population after the Black Death.

At least from 1570 onward, a new intense cooling began, with consequent crop crises and decreased cereal supply. Exhumed bodies from this period show evidence of malnutrition (Behringer, 2016).

The LIA cooling started earlier in the northern regions—for example, in Iceland. Navigation became more difficult because of icebergs. In Scandinavia, many farms in the interior regions were abandoned (Behringer, 2016). One effect of the LIA was the extinction of the small Viking colony in Greenland, which had survived for four centuries during the Medieval Warm Period. In the latter part of the first millennium, the Viking population increased and new colonies were founded toward the south but also toward the north, where evidently the ice had retreated. Iceland was colonized and its population grew rapidly, followed by Greenland. Around 980 AD, the Icelandic Vikings discovered the island and settled on the southwest coast. Later, the Vikings also landed in Newfoundland in North America, and then explored lands farther south that they called Markland, Helluland, and Vinland, founding small settlements that were later abandoned. The name Greenland ("green land") is attributed to Erik the Red and is a promotional name—like "Iceland"—that reflected different conditions, such as practicing agriculture and livestock farming (e.g., it was possible to dig graves where the ground later became too hard due to the permafrost). The colony reached 2,500 inhabitants, then began to decline; the western settlement was abandoned around 1360 AD, and the final disappearance was around 1480 AD. Climate warming today has been causing more and more of these settlements to

reemerge. An important factor in their decline was isolation due to increasing difficulty in maintaining maritime connections. With an ever-decreasing supply capacity, cut off from communications and trade, and unable to build constructive relationships with the Inuit, the colonies failed to adapt. It seems that, similar to today's world, they did not understand the need to change their lifestyle, possibly imitating that of the natives, since the lack of fodder was killing their livestock. Although the Vikings began to hunt seals, they did so too sporadically, and they should have switched to a regime based exclusively on hunting and fishing like the Inuit. Until the end, they persisted in a European lifestyle—for example, continuing to use fabric clothes instead of converting to fur. The Greenlanders are an excellent example of how rigidity can lead to the collapse of a society in the face of changed living conditions (Bardi, 2017; Diamond, 2005)—a lesson that resonates today. However, cultural and technological factors, as well as access to resources, are crucial in these cases (Bardi, 2017; Behringer, 2016; Diamond, 2005). The trend of Greenland temperatures from 500 to 1990 AD, reconstructed through analysis of ice samples, is consistent with what can be reconstructed from historical sources and archaeology. The Inuit population also seems to have followed the climate oscillations, with expansion in warm periods and extinction in cold ones (e.g., the first Saqqaq culture disappeared in 800 BC).

Witch Hunts: A Possible Expiatory Mechanism for Climate Anxiety

During the LIA, further cooling from 1570 AD onward led to severe crop failure and grain supply difficulties, as confirmed by various evidence. Some historical data suggest an increase in violence linked to the climatic crisis of the LIA—and to the anxieties produced by the worsening of the crisis. In general, during the LIA, there was an increase not only in death sentences and torture but also in religious violence (Behringer, 2016). In particular, it has been suggested that the progressive intensification of witch hunts during the sixteenth and seventeenth centuries was due to the worsening of climatic conditions. Obviously, in this context, too, climate is not the sole cause, but rather a possible contributor to a complex cultural and historical phenomenon. The increase in violence may have been an intense cultural response to the strong anxieties produced by social and economic stress caused in the long term by famines and in the short term by sudden, catastrophic climatic events. This is a distinction we will explore in more detail.

Generally, before the thirteenth century, people tended to consider stories about witches, night flights, and magical gatherings as little more than fantasies, possibly suggested by the devil, but not corresponding to facts (Flint, 1991). Therefore, suspected witches were punished with penances—sometimes extremely harsh, but not cruel punishments such as imprisonment or execution—because there was considered to be no authentic relationship with the devil. This was a balanced interpretation and attentiveness to facts, given that, in most cases, witchcraft stories were related to trance and dreamlike states. The cultural mindset progressively darkened, especially when witchcraft began to be associated with apostasy (pagan cults) and heresy, and specifically after the beginning of the LIA. In Dante's time, witch trials had just begun. In Tuscany, the first case was in 1250 AD, and in Florence, in 1298 AD. The population in the Middle Ages,

therefore, generally believed in the existence of witches (as did the Greeks, Romans, Jews, Mesopotamians, Africans, and many other peoples), but without the frighteningly violent repressions that occurred in the sixteenth and seventeenth centuries. Persecutions arose, if anything, when evidence of relics of pagan cults or heresies was found.

The publication of the main treatise about witchcraft, the *Malleus Maleficarum*, dates back to the end of the fifteenth century. But many doubts about witchcraft remained. Between 1520 and 1560 AD, convictions decreased. The period of the worst mass persecution began after 1560 AD, in remarkable agreement with the intensifying climatic cooling in Europe, which was very evident from 1570 AD. The perception of witchcraft had changed, and there were real campaigns of search and mass execution, concentrated in bursts of violence and in certain regions more than in others. In Trier and its surroundings, the trials were concentrated between 1581 and 1593 AD, with 368 victims; the witches were considered responsible for the drought. The peak of the witch hunt was around 1600 AD. During a new cooling phase, from 1620 AD, the first doubts about the reality of witchcraft (or rethinks) began in Spain, and a new wave of violence occurred in France and the Rhineland. In the following years in the Rhineland, thousands of people were burned alive. In England, the worst period was between 1643 and 1647 AD, when the official inquisitor of the parliament, Matthew Hopkins, traveled across the country terrorizing, torturing, and condemning hundreds of victims to death. "In total, during his period of activity, Hopkins sent to their deaths more people than all the other witch hunters in England in the previous 160 years of history," wrote Notenstein (1911). In Europe, the phenomenon finally began to decline only in 1660 AD and onward. There are some commendable examples where persecution began to decline earlier for cultural reasons, including, paradoxically, in Inquisition-era Spain: the Spanish inquisitors, with a university-level education, were more cultured and began to doubt the correctness of the sentences they had already inflicted, and the anxieties and violence in Spain began to be directed more toward the "false converts" (Jews or Muslims or even natives in Spanish colonies). It should be noted that Spain, a Mediterranean country, could have been less violently involved in the climate crisis, and the persecutions were mainly in the mountainous and colder Basque Country. In reality, however, there were strong criticisms expressed by contemporaries everywhere against the irrational hunting and violence.

The association between witches and worsening climate was quite common at the time; witches were considered responsible for bad weather, drought, any extreme or adverse weather condition, and famine (all of which were actually caused by these climatic crises). They were also held responsible for the infertility of the land (and of animals and of humans), epidemics, and disease cases. In short, witches (and, more generally, sorcerers, but, in this period, women were the focus) were popularly considered the cause of any unnatural and harmful condition. The chronicles of the time depict this deleterious dynamic, which unfortunately extended to the clergy, especially those most in contact with people, and to the provincial magistrates, who had the final say in punishments, including those in religious trials. The charge could be cast on people of any social class, but the rich had a greater chance of escaping alive. The vast majority of victims were women from peasant villages around the cities rather than from the cities themselves.

Dozens of similar testimonies exist: A climatic crisis hit a certain area or a city—for example, a disastrous storm that caused damage, floods, deaths, and the ruin of crops—and triggered the search for a scapegoat upon which to unload anxieties, not only related to the ruin that had occurred but also as an attempt to eliminate future threats. The anxiety then transformed into an explosion of homicidal violence, legal or not, against the chosen victim (Girard, 1982). This victimization showed strong class and gender patterns, with women becoming the perfect scapegoat—in particular, women of humble origins who were in possession of traditional knowledge linked to medicinal plants and obstetrics ("low magic") and, more broadly, life and nature and, therefore, the climate. It was precisely nature that seemed to be attacking humanity during these climate crises. Finally, after having claimed thousands of victims, the paroxysm of violence calmed down at the end of the period of crisis, bad weather, and scarcity (Behringer, 2016; Golden, 2007). These explosions of violence were neither constant nor homogeneous. Their geographical distribution is indicative: They were particularly violent in regions with cold climates (England, Scotland, and Denmark) or with a continental climate (southern Germany, the Rhineland, Austria, Switzerland, eastern and northern France, and later Hungary) but also in regions crossed by political and religious tensions and by the fault lines between Catholicism and Reformation. Often, the accusations came from peasants, but they were almost always supported by the propaganda of the local authorities—primarily, the ecclesiastical ones, but also the state ones and especially the judicial ones. After the food crises and famines around 1560 AD, the peasants wanted to "eradicate the evil at the root" by killing the witches, with chiliastic expectations: They believed that once the cause was eliminated, the crops and the grape harvests would be excellent again, and that children and animals would no longer die of hunger and cold.

In the late seventeenth century, witch hunts began to expand into Eastern Europe. The cooling that had begun about 120 years earlier persisted, and so did, above all, the Maunder solar minimum that had begun a few decades earlier. In Europe, between 1693 and 1694 AD, a gigantic famine due to worsening climate caused over a million deaths and was followed by a terribly cold winter in 1709 AD (Le Roy Ladurie, 2006). However, the explosion of violence against witches had already been culturally defused; in peripheral areas, the mechanisms of anxiety–response and violence–rational awareness arrived late. The North American case of the Salem witch trials, which shocked Massachusetts in 1692 and 1693 AD, can be considered one of the final acts of this long horror. The origin of the British colony's anxiety was the strange behavior of two very young girls, amplified in a context of social and religious tensions as well as generalized scarcity. There were 20 victims out of at least 200 convictions, including an elderly woman, a respected member of the religious community, who was condemned just because she courageously stated that she did not believe in witchcraft. In Salem, the presence of an anxious mechanism that expanded out of control was particularly evident; Salem was culturally isolated and deeply affected by Puritan fundamentalism but slowly opened up at the first signs of the Enlightenment sensitivity of the eighteenth century, as well as due to the decisive intervention of religious authorities. In the following years, the victims' reputations were generally rehabilitated to the point where compensation was provided to the families.

When they were not interpreted as the effect of witchcraft, extreme weather phenomena such as hailstorms, storms, floods, droughts, and others related to famine and plague were considered divine punishments. A new economy of sins was born that did not always seek scapegoats, as with witches, but that was managed by religious hierarchies with the aim of control over the behavior of the faithful (Behringer, 2016). Even in art and literature, this period saw an ever-increasing interest in prodigies of all kinds, as well as in every malformation or human and animal deformation. There was also a strong increase in millenarian movements, especially in the evangelical sphere. In the Catholic sphere, however, there was a proliferation of miracles, especially Marian ones, which often involved exponents of the so-called subaltern peasant world (in the Gramscian sense). These peasants, shepherds, and fishermen witnessed miraculous healings, apparitions of the Virgin Mary, and ancient (or presumed such) miraculous sacred images; in these discoveries, animals (usually cattle) are sometimes protagonists. These miracles were valorized and used by the Counter-Reformation, which showed an openness toward the prodigious, a far cry from the previous Thomistic mentality that tended toward the rational.

The response to anxiety and the interpretation of the climate crisis could vary depending on cultural contexts. For example, in the difficult climatic moment of the sixth century, a response of this type was not triggered, even if the climatic anxieties of the time were also managed by the mediators of the sacred—for instance, interpreted as signs of divine wrath from which to protect oneself by means of rituals, masses, and displays of miraculous icons. The response against witchcraft could also be "magical," as in the Italian case of the *benandanti*, people who, in an oneiric, altered state of consciousness, thought they were magically fighting against evil sorcerers to protect the harvest (Ginzburg, 1966). Judged by ecclesiastical powers as the very witches they thought they were fighting (per the new mentality that considered these magical actions "real"), the *benandanti* were persecuted by the Inquisition between 1575 and 1675 AD. A culturally analogous phenomenon was that of the Slavic *krsnik* and the Hungarian *táltos*, figures associated with the shamanic paradigm; these beings endeavored to fight night battles against a host of their negative equivalents who aimed to destroy the harvests by unleashing storms (Meens, 2012).

In the years of the LIA, especially from the beginning of the sixteenth century, desperation and suicidal acts became much more widespread than before, despite the churches' continuing to forbid them. These traits became more represented in art, with melancholia becoming fashionable; for example, the famous eponymous engraving by Dürer is from 1514 AD. The phenomenon became more pronounced during the Elizabethan period; in fact, we speak of the Elizabethan malady (Babb, 1951), born from the cultural climate of the Reformation and Counter-Reformation. A characteristic figure of this particular psychological profile was Rudolf II of Habsburg, a melancholic, eccentric, esoteric emperor locked away in Prague Castle and who is portrayed as the autumn god *Vertumnus* by Arcimboldo. The wonderful paintings by Bruegel and other Northern European artists from the mid-sixteenth century consistently show snowy winter landscapes, frozen lakes, and rivers full of people walking or skating on them. In England, Germany, and the Netherlands during this period, rivers, lakes, and stretches of sea began to freeze almost constantly in the winter, certainly more than before and obviously more than today.

Shortly after 1570 AD, Lake Constance froze completely, something that had not happened for centuries. The recent novel by the Italian writer Paolo Di Paolo, *Romanzo senza umani*[3] (Di Paolo, 2023), is inspired by the study of that event and, drawing inspiration from various historical figures (Midelfort, 1994), describes a feudal lord affected by a typical form of mental disorder widespread in that period. The novel's protagonist is, in fact, a historian for whom these ancient events become a metaphor for his own anxieties and relationship issues.

Despite these crises, Western Europe overall showed a certain capacity to adapt to the LIA that had destroyed its colonies in Greenland. During this long period, a season of geographical and colonial explorations began, which solved many problems of scarcity of resources, also due to the climate crisis, and bypassed the hostile Ottoman Empire that risked blocking the trade routes to the East. Colonialism also began, and, according to some scholars, the tremendous reduction of the Native American populations due to diseases caused a climate cooling (due to the advance of forests in previously cultivated lands) that can be considered the beginning of the Anthropocene (Lewis & Maslin, 2018).

Modern science was also born in this period. The explosions of irrational violence against scapegoats, aimed at eliminating the traces of peasant magical culture (and which can also be interpreted as a response to the climate crisis), were overcome by the Enlightenment (Behringer, 2016).

In China, once again, sources report the fall of a dynasty due, in whole or in part, to revolts caused by famines related to a climate crisis. The Ming, who had taken power under similar circumstances, also lost it for this reason. The continuous, cyclical repetition of this phenomenon in Chinese history deserves a cultural explanation. In Chinese Confucian culture, society must follow a pyramidal and paternalistic order, which is not immutable in its succession. Heaven can withdraw its support from an incapable or unworthy emperor. Therefore, climatic disasters and the resulting famines were often interpreted as signs of Heaven's changed attitude. In a cultural system characterized by a rational order that recognized itself in the cosmos and replicated itself in society, catastrophes generated strong anxiety; the order of the cosmos (created by the first semidivine emperors who reclaimed the Earth by overcoming a state of watery chaos similar to a flood) needed to be restored by violently overthrowing the old, decadent dynasty that was hated by Heaven. Changes in the cosmos had to be reflected in a change in the political sphere. The upheaval made it possible to resolve the anxious state caused by the uncertainty of a cosmos in crisis and return to a "stable" state. From 1601 AD onward, Chinese chronicles record a series of environmental disasters, with frosts in regions with a mild climate and a dry climate that led to the collapse of Chinese agriculture. These caused a peasant revolt, which greatly weakened the Ming dynasty. Unlike two hundred years earlier, the rebels did not win; however, to regain their reputations, the Ming launched an ill-advised invasion of Manchuria that ended in disaster and the subsequent Manchu invasion of China (Behringer, 2016). Meanwhile, similar crises devastated Indonesia and other areas of Asia.

[3] The title of the novel in English is *Novel Without Humans*.

Toward Global Warming

In the early eighteenth century, sunspots slowly reappeared, and, around 1715 AD, the Maunder minimum finally ended. But solar activity returned to the secular average level only around 1740 AD. It is not easy to evaluate thermal inertia or the delay with which the Earth's climate responded to variations in solar radiation or the concentration of greenhouse gases, which had already begun to increase again for a few decades; this was because, in much of the Americas, the plantation economy had taken hold with the consequent cutting of forests, which had gained space at the beginning of the seventeenth century. The LIA was finally over, but throughout the eighteenth century, there was a very slow warming, with setbacks. In contrast, the response to the emission of dust into the atmosphere due to an eruption is very fast: the dust spreads over weeks or months and reduces the insolation on the ground, causing rapid cooling that can last for months or years.

According to one hypothesis, there may be a relationship between climate and the French Revolution. In Iceland between 1783 and 1784 AD, the Laki volcano erupted. The eruption was serious, generating a thick, toxic cloud of ash that arrived in England in the summer of 1783 AD, killing tens of thousands of people and causing an anomalously hot summer followed by years of harsh winters and cold, wet summers. The winter of 1784 to 1785 AD was one of the coldest of the century, with global temperatures dropping by one degree. In 1785 AD, drought and disease decimated French livestock. In July 1788 AD, a gigantic hailstorm devastated the regions around Paris. Requests for help to the government increased; anxious and desperate requests from the provinces went to Versailles in the *cahiers de doléances*. Louis XVI then convened the Estates General, but, due to bad weather, the Third Estate had to meet in a closed room, and the Tennis Court Oath was born. December 1788 AD was one of the coldest of the millennium, and, in March 1789 AD, it snowed for days in Rome. The famines of the following years greatly increased discontent against an already weak sovereign. The eruption of Laki, therefore, played a role in starting the crisis of the old system of the *ancien régime*. July 14, 1789 AD, the day of the storming of the Bastille, was also the day that cereal prices peaked (Behringer, 2016).

Added to this were two weak solar cycles between 1800 and 1820 AD; Napoleon could have been a victim of this in Russia in 1812 AD. Furthermore, another volcanic event occurred, this time on a global scale. On April 5, 1815 AD, the Tambora volcano in Indonesia erupted, spewing a thick cloud of ash into the air that expanded throughout the atmosphere and soon crossed the borders of Indonesia (Schurer et al., 2019). Sunlight was attenuated by dust in the atmosphere, so temperatures plummeted. Accordingly, 1816 AD is remembered as a "year without a summer." The ecological, economic, and social repercussions were many, including famine in North America, floods of the Rhine and other rivers in Germany, riots due to the lack of grain in Great Britain and France (all harshly repressed), and the declaration of a national emergency in Switzerland, in which the continental climate worsened the situation. A cholera epidemic that started in the Ganges area of India, where it was endemic, spread to Bengal, invaded Afghanistan, reached the Caspian area and the Black Sea, and then reached the West for the first time, where it continued for many years.

The consequences of Tambora also affected art. The splendid red sunsets painted by Turner during this period do nothing but realistically reproduce the effect of the reddening of the light due to the dust, which absorbed short wavelengths. But there is another important artistic creation that seemed to give "body" to the anxieties generated by this year of anomalous climate: *Frankenstein*, by the great Mary Wollstonecraft, a feminist intellectual who was extremely advanced for her time.

The Romantic sensibility was born, and among its protagonists was a group of English artists and intellectuals who that year went on a summer vacation to Lake Geneva, located between France and Switzerland. The group consisted of Lord George Byron, the poet Percy Shelley, the writer Mary Wollstonecraft and her sister, and Dr. John Polidori. The rain confined them to a villa, and, to overcome the boredom and anxiety generated by this "monstrous" season, they invented a literary competition with the theme of the Gothic novel. Polidori wrote *The Vampyre*, an interesting prototype, and Wollstonecraft generated the extraordinary myth of the "Frankenstein's monster." Product of the climate crisis, the novel's main theme appears prophetic: What limits must humanity place on themselves in their technological pursuits in Nature and life? The continuous storms probably inspired the famous scene in the novel in which the lightning infuses life into the creature. The climate also may have influenced the conclusion of the novel, a dramatic confrontation between a scientist and a creature on the freezing Arctic ice. And can't the current global warming crisis be interpreted, today, as a "Monster" created by human arrogance that turns against us, its creators? A possible dialogue between our climate anxieties and the anxieties of Wollstonecraft, who has written other directly apocalyptic texts, seems not without sense.

Humanity's Hot Summer: Climate Crisis from Anthropogenic Global Warming

From about 1850 AD, a period of warming was evident, probably of anthropogenic origin and spurred by the Industrial Revolution. Solar radiation in the decades around 1850 AD was high, but, around 1900 AD, it decreased. However, global warming did not stop, as one would expect if the only driver were solar activity; even if the increase was not yet very steep, it was significant that it was in contrast. In this phase, practically all of North America and Europe witnessed a progressive industrialization, with increasing consumption of coal, followed by oil.

The nineteenth century provides an example of anxieties triggered by a climate crisis in an arid and fragile area, which was suffering the effects of the burgeoning warm period. In Brazil, the town of Canudos was located in the alto sertão (desert) of the Brazilian state of Bahia; it is known for the ruthless repression to which it was subjected, which made it a symbol of struggle and resistance (Vargas Llosa, 1981). It was a complex era of Brazilian history, with the transition to the republic managed essentially by former slaveholders; since 1888 AD, slavery had been officially abolished, but many former slaves found themselves adrift without any compensation and excluded from access to land. The Brazilian *Nordeste* was also in a serious economic and social crisis, with unproductive large estates, extreme drought, and high unemployment. Thousands of people wandered,

hungry, in search of state help or divine help. Armed gangs of *cangaceiros* attacked *fazendas* and demanded social justice in their own way. Many former slaves and other desperate people united around the belief in a miraculous salvation from the scourges of the climate and economic and social exclusion; they gathered around Antônio Conselheiro, a pilgrim who had founded a community in the interior of the state of Bahia, in a small village called Canudos, where everyone could have land and work. Canudos was born from the desperation of the *sertaneos* in a territory affected by drought and desertification; it is a prototype of a response of millenarian anxiety to a climate crisis. Antônio Conselheiro's commune was exterminated by the army of the republic, which called itself secular and progressive; the resulting 20,000 deaths represented an internal colonialism that destroyed a social and shared reality because it referred to other values than those with which the former slaveholders had cloaked the new republic—which, in reality, was characterized by extreme classism.

In the twentieth century, scientists discovered that an increase in CO_2 from fossil fuels causes an increase in the Earth's temperature. Svante Arrhenius, Nobel Prize winner for chemistry, intuited this (Arrhenius 1896) . His publication was not met with great renown, but, in the scientific environment, this awareness is increasing.

In the 1930s, an example of anxieties triggered by a climate crisis comes from the United States (McLeman et al., 2014)a crisis that has been beautifully described by art, both cultured and popular:

> To the red country and part of the gray country of Oklahoma, the last rains came gently, and they did not cut the scarred earth. The plows crossed and recrossed the rivulet marks. The last rains lifted the corn quickly and scattered weed colonies and grass along the sides of the roads so that the gray country and the dark red country began to disappear under a green cover. In the last part of May the sky grew pale and the clouds that had hung in high puffs for so long in the spring were dissipated. The sun flared down on the growing corn day after day until a line of brown spread along the edge of each green bayonet. The clouds appeared, and went away, and in a while they didn't try any more. The weeds grew darker green to protect themselves, and they did not spread any more. The surface of the earth crusted, a thin hard crust, and as the sky became pale, so the earth became pale, pink in the red country and white in the gray country.
>
> *(Steinbeck, 1939)*

The Grapes of Wrath, a masterpiece by John Steinbeck—which inspired a film by John Ford in 1940—describes the desperate migration of the Oklahoma "Okies" who were affected by the Dust Bowl, a serious climate crisis characterized by violent dust and sand storms.

Popular novelists like Joe R. Lansdale are also able to provide a dramatic representation of the deep anxiety that the catastrophe generated; some died from silicosis from dust, and some chose not to escape but, rather, suicide:

> The wind could blow down a full-grown man, but it was the dust that was the worst. If the dust was red, I could figure it was out of Oklahoma, where we were…Mama always claimed you could see the face of the devil in them sandstorms, you looked hard enough. I don't know about that, it being the devil and all…It might as well have been the devil, though. In a way, it had blown Mama and Daddy away, 'cause one night, all the dust in her lungs—the dirty pneumonia, the

> doctor had called it—finally clogged up good and she couldn't breathe and there wasn't a what we could do about it. Before morning she was dead… When I went to look for Daddy, I found him out in the barn. He'd hung himself from a rafter with a plowline from the old mule harness.
>
> *(Lansdale, 2011)*

The Dust Bowl greatly damaged the ecology and agriculture of the American and Canadian semiarid prairies during the 1930s. The causes (Schubert et al., 2004; Seager et al., 2008) were a combination of natural factors (severe drought) and human-made factors: a failure to apply dryland farming methods to prevent wind erosion—most notably, the destruction of the natural topsoil by settlers in the region. There were three waves of drought—in 1934, 1936, and 1939 to 1940—but some regions experienced dry conditions for around eight years. An unusually wet period in the Great Plains mistakenly led the original settlers to Oklahoma, spurred by the Homestead Act of 1862; the federal government aimed to improve the settlements, with the unfortunate motto "rain follows the plow."

With insufficient understanding of the ecology of the plains, farmers conducted extensive deep plowing of the Great Plains' virgin topsoil during the previous decade; this displaced the native, deep-rooted grasses that normally trapped soil and moisture even during periods of drought and high winds. The rapid mechanization of farm equipment and widespread use of the combine harvester contributed to farmers' decisions to convert arid grassland to cultivated cropland. During the drought of the 1930s, the unanchored soil turned to dust, which prevailing winds blew away in huge clouds that sometimes blackened the sky. After fairly favorable climatic conditions in the 1920s, with good rainfall and relatively moderate winters that permitted increased settlement and cultivation in the Great Plains, the region entered an unusually dry era in the summer of 1930. When severe drought struck the Great Plains region in the 1930s, it resulted in erosion and loss of topsoil. The drought dried the topsoil, and, over time, it became friable, reduced to a powdery consistency in some places. Without indigenous grasses in place, the plains' high winds picked up the topsoil and created massive dust storms. The persistent dry weather caused crops to fail, leaving the plowed fields exposed to wind erosion. The Great Plains' fine soil eroded easily and was carried east by strong continental winds.

The drought and erosion of the Dust Bowl affected 100 million acres (400,000 km^2) in Texas and Oklahoma, as well as adjacent sections of New Mexico, Colorado, and Kansas. The Dust Bowl forced tens of thousands of poverty-stricken families, who were unable to pay mortgages or grow crops, to abandon their farms, and losses reached the modern-day equivalent of $550 million. The banks also engaged in land-grabbing activity. Many of the affected families migrated to California and other states, only to find that the Great Depression had rendered economic conditions there little better than those they had left. The causal mechanism for the droughts can be linked to ocean temperature anomalies. Specifically, Atlantic Ocean surface temperatures appear to have had an indirect effect on the general atmospheric circulation, while Pacific Ocean surface temperatures seem to have had the most direct influence. By 1935, many families had been forced to leave their farms and travel to other areas seeking work because of the drought, which had already lasted four years. The abandonment of homesteads and financial ruin resulting from catastrophic topsoil loss led to widespread hunger and poverty.

The anxieties of these people—who looked with increasing desperation at the sky, waiting for the next disastrous storm, who were forced to leave lands made unrecognizable by the climate crisis and to leave without clear prospects—have been beautifully described in the aforementioned novels and are palpable in period photos. That time, it was the Americans who migrated; ultimately, they received benefits from the Keynesian social policy of Roosevelt's New Deal.

In the early decades of the nineteenth century, deforestation, which had seen a pause in the West with the beginning of the Middle Ages and then resumed with colonialism in the Americas, increased consistently; in this period, terrestrial ecosystems were converted from predominantly wild to predominantly anthropogenic, exceeding the 50% threshold at the beginning of the twentieth century (Ellis et al., 2010). The human population grew ever more rapidly, with a progressive increase in life expectancy and well-being (first in the West and then, in the twentieth century, gradually across other areas of the world). Economic systems based on fossil fuels improved the production of goods, and consumption began to grow in a vertiginous global way.

Have Glaciations and the Holocene Ended?

The economy of the various industrial revolutions of the nineteenth and twentieth centuries has moved from having only coal as an energy source to having coal and oil and then coal–oil–gas, with a progressive reduction in the role of coal and the participation of nuclear fission, which does not generate CO_2 but waste and end-of-life plants to be decontaminated. Nuclear plants at the end of their operational life must be shut down and then decontaminated due to the presence of radioactive materials. In the post-Second World War period, mass anxieties also involved a possible nuclear war (and the related, destructive nuclear winter). A different sensitivity appeared from the assessments of the Club of Rome, which warned of the dangers of development and the progressive destruction of the ecosystem. Later, some scientific circles warned of a possible future climate crisis but feared a new glaciation. This idea was not unfounded; for over a million years, the Earth has been going through glacial and (like the one we live in, the Holocene) interglacial phases. But human action has overturned the nature of this crisis.

In fact, the rapid expansion of the use of fossil fuels—first coal and then oil (now gas)—has slowly begun to increase the atmospheric concentration of CO_2. Apparently, over the past 10 million years, CO_2 has decreased from a value of 380 ppm to a value of about 280 ppm; at this point in the Pleistocene—about 1,200,000 years ago—the first glaciation (called Günz or Nebraskan) would have started, during which CO_2 fell below 190 ppm. CO_2 would have subsequently oscillated between about 200 ppm (in glacial periods) and about 280 ppm in interglacial periods like ours (Ruddiman & Raymo, 2003).

The connection between temperature and CO_2 seems broadly evident, and ecoanxiety is entirely well-founded. Over the past 1,000 years, levels would have varied little (estimates vary, perhaps between 300 ppm in the Medieval Warm Period to 260 ppm during the LIA). At the beginning of the twentieth century, with the beginning of mass "Fordist" industrialization, the concentration of CO_2 had reached about 300 ppm—therefore, above the possible "glacial threshold." In 2024, it reached 424 ppm. This value is similar to that of

14 million years ago but reached in a mere 140 years. Two further accelerations, after the Industrial Revolution, Fordism, and the post-World War period, were very violent: one after 1980, when China began to industrialize by burning coal, and the other at an even faster pace after 2000, with its entry into the World Trade Organization. In the context of "globalization," China overtook India and the rest of the Eastern world, including the former Soviet states, which had already begun their industrial growth before 1980, but at a slower pace.

According to some authors, these accelerations could have a particularly significant consequence: the defusing, or at least the postponement, of glaciations (Ganopolski et al., 2016). This is not good news; rather, it is proof of how strong anthropogenic global warming's impact on Earth is.

The climate crisis is inevitable, no longer as a cooling but as a warming; it is of a new nature and difficult to predict. In the case of glaciation, science would have provided precise recommendations, based on the past, about what was happening and, therefore, what to do. Now, instead, we navigate unexplored seas guided by models whose results are frightening. An increase of 4 °C in a few decades could be catastrophic.

Moreover, this scenario makes the notion of the Anthropocene decisive. If the Pleistocene can be considered the era in which the glacial oscillations began, and even more so if the Holocene is the last interglacial period, the exit of Earth's climate system from this cycle indicates passage to a new era: the Anthropocene. Geologists must identify the cultural criterion in which to place the "crossing point," called by geologists the "golden nail," in the sediments that tell the story of the climate. To us, the most scientifically solid hypothesis seems to be the trace of radioactive material produced by the first atomic explosion in Alamogordo in 1945.

CONCLUSION

Our era, characterized by a total global hegemony of neoliberal capitalism in which every consideration is subordinate to profit, has evident, systemic problems of economic inequality (growing since about 1980) and equity. These problems are highlighted by the distribution of CO_2 emissions (Raupach et al., 2007). The poorest countries, with a total population of about 800 million people, have contributed less than 1% of cumulative emissions, but they will pay the highest price in terms of devastation, famine, and climate migrations.

Humanity's trajectory, from our long hunter-gatherer past to the twenty-first century, is proving to be a journey fueled by an ever-increasing exploitation of the Earth's resources. For centuries, we have severely reduced biodiversity, and we are increasingly less capable of counteracting this reduction (Butchart et al., 2010). We have transformed the planetary environment in a way that makes it increasingly favorable to our expansion and development but that has become increasingly more distant from a harmonious balance (characteristic, for example, of many native cultures) with the Earth's systems and with the nonhuman biome that surrounds us. Now, we are extracting from the Earth the resources to fuel not only our lives but also our consumerism, at a rate and scale that are altering the planetary system and its climate and dramatically reducing its capacity to support life—first nonhuman life, and then our own (Scheffer et al., 2001). This exploitation generates very strong anxious responses. It has done so in the past, it is already doing so, and it will do so increasingly in the future.

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