The Punctuated Evolution of Civilisations

The Punctuated Evolution of Civilisations:

How Climate Pulsations Shaped History

By

Tingguang Ma

Cambridge Scholars Publishing

The Punctuated Evolution of Civilisations:
How Climate Pulsations Shaped History

By Tingguang Ma

This book first published 2023

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN (10): 1-5275-1001-8
ISBN (13): 978-1-5275-1001-2

TABLE OF CONTENTS

LIST OF FIGURES

FOREWORD

As a fire protection engineer, my initial purpose for this project was to find the climate pattern behind waves of community fires. However, the relationship between climate and fire cannot be fully established, and the general pattern behind climate change cannot be found. So I jump into the field of climatology to find the patterns of climate pulsation and their impacts on our society. Fortunately, we can find repeatable societal events bearing the impact of climate pulsations. The more subjective decisions involved in a response, the more predictability it will demonstrate in its repeated occurrence. Rather than developing in one direction, the world developed intermittently and in different directions. So this book works on the thread of "climate-response-society", with a detailed discussion on various repeatable responses from different civilizations. All these patterns would be valid if modulated by the same mechanism, the rule of climate pulsations first proposed in this book. With this rule, the world is developed in a semi-deterministic way.

The book is organized into four parts.

The first part has three chapters dealing with basic concepts of climate and civilization. Here the climate is defined as something of a warming or cooling pattern, with a binary approach without diving into detailed physics. Civilization is defined as the means of production or survival constrained by geographical and climatic (or environmental) conditions. One decision may be subjective and random, while repeated decisions are deterministic under cyclic and objective challenges. By checking the cyclic environmental challenges and the repeatable subjective choices, we can understand the role of climate pulsation on society.

The second part has three chapters dealing with three "barbarian" civilizations. They are barbarian only in the records by sedentary people against being looted. These civilizations are bounded by their environmental conditions. Short of either solar input or rainfall, these civilizations cannot stay autarky and have a strong motivation for external plundering and conquering, leaving the impression of being "barbarian". They are less resilient against climate pulsations and played the major role of driving the civilizations forward through lootings and wars.

The third part has three chapters dealing with three "civilized" civilizations. They are civilized simply because they can keep a good record of the past, with progressive social organizations and better utilization of technologies. By checking their punctuated evolutions in history, we can understand the role of climate pulsations in creating the pulsative demand for new technologies. There is no good or lousy civilization, only a climatic window for the fittest civilization to grow. Climate pulsations drive the process of going "civilized".

The fourth and final part has three chapters, each dealing with one of Sima Qian's celestial cycles, other than the 30-year fundamental cycle. As a historian familiar with climate-dependent horticultural practices, Sima Qian had better insights into the role of climate pulsations on society. He proposed four cycles from his insights on history, including the 30-year technical cycle, the 100-year political cycle, the 500-year civilization cycle, and the 1,500-year climate cycle. All the cycles decode the misunderstandings behind major topics, such as the rise and fall of civilizations, the Great Divergence, revolutions in agriculture and technology, the mythical demise of Chinese naval adventures, etc. They are all shaped by one common variable, climate pulsation.

In summary, this book is devoted to two Huntingtons. Ellsworth Huntington's theory of climate pulsations is tailored to explain Samuel Huntington's thesis on the clash of civilizations. Repeatable societal responses demonstrate a decision pattern behind similar environmental

challenges, which opens a window for understanding concepts in diverse fields in human geography, including economic crises, population crises, the origin of communism/insurance, the creative destruction theory, etc. This climate determinism adds to Jered Diamond's geographical and human error determinisms. The traditional Chinese philosophy's three factors (Heaven/climate, Earth/geography, and People/culture) form a new environmental determinism. Civilizations and cultures were driven forward through these pulsative responses to climate pulsations. Overall, it provides an Occam's razor against the complex relationship between climate and society. It confirms the traditional Chinese philosophy that history is composed of repeatable events. Whether you can benefit from historical lessons depends on recognizing the repeatable challenges through the rule of climate pulsations. "Histories make men wise" only if you can appreciate similar wise decisions in previous cycles. Given China and Europe's different climatic and geographical conditions, the Great Divergence is deterministic and predictable. This traditional Chinese wisdom still applies today if you recognize and understand the role of climate pulsations in creating repeatable challenges in diverse societies. Theoretically, everyone can predict the climatic scene of a specific event via its occurrence in timing. It dramatically expands our view of history and society. I hope you can enjoy the fun of reinterpreting civilizations and cultures through the eyes of climate pulsations.

PART 1:

CLIMATE

Ellsworth Huntington, a professor of geography at Yale University, first proposed the connection between climate and civilization. During his lifetime, academia welcomed radical concepts in Social Darwinism, with rapid advances in geographical theories, including environmental determinism. Huntington proposed his climate pulsation theory in his masterpiece, *Civilisation and Climate*[1]. However, he did not fully recognize the pattern of climate pulsations. Therefore, his idea was built upon a shaky foundation of climate change, ignored quickly along with other deterministic theories. Everyone knows the importance of external challenges to evolution from Darwin's Theory of Evolution, but how and when these challenges work is still uncertain. Temperature alone cannot determine civilization since we can find diverse societies from tropical areas to the Arctic Ocean. Precipitation alone cannot determine civilization since communities adopt a suitable culture to meet the challenge. Therefore, the study of climatology can provide some insights but cannot fully explain the rise and fall of civilizations.

Funded by the US-donated Boxer Indemnity Scholarship Program, Zhu Kezhen (aliasing Ko-chin Cho) enrolled first in the agriculture program at Purdue University but got a degree in Meteorology from Harvard University in 1918. He combined both experiences into a pioneering new field of phenology, where the flowering of plants or the migration of animals was

[1] Huntington, Ellsworth. 1915. *Civilization and Climate*. New Haven, CT: Yale University Press

treated as a natural response toward climate change. Since the ecological system responds to climate disturbances in a direct and intermediate way (with less resilience), he struggled with too much seemingly random climatic evidence and failed to propose a coherent theory with any definite cycles from his compilation.

Here, with the assumption of climate pulsations, we can find a new pool of climatic evidence from our society. Civilization is defined as a means of production with collective efforts for survival. Since society has more resilience against climate shocks, only major changes will arouse societal responses. Therefore, resilient societal responses demonstrate better periodicity than nature or climatology. That means we can find better repeatable time series in economic, political, technical and military reforms, to find the impact of climate pulsations. This thread of "climate-response-society" reasoning allows us to utilize better the historical record for understanding the role of climate change on society.

An empirical rule on climate change is proposed first (in Chapter 1), with many findings from phenology (in Chapter 2) to support this hypothesis. It establishes a framework of historical climate fluctuations, through which we can study the responsive patterns near climatic nodes by filtering out minor disturbances. The result is the geographical distribution of civilizations (in Chapter 3) and their unique responsive patterns (scattered through Chapters 4-9).

CHAPTER 1

CLIMATE PULSATIONS AND CLIMATE DISTURBANCES

A weather forecaster broadcasts the weather every day. He tells people about the temperature, sunshine, humidity, and the probability of precipitation in the next few days. The weather is a collection of parameters for a short period in a specific location and lacks accurate forecasts due to its volatility and variability. At the same time, the weather patterns in various locations may differ. It may be hot and sunny in one part of the world but cold and snowy in another. Due to the transient nature and the scale of atmospheric flow, it is difficult to make long-term forecasts. The world's best computers are busy calculating atmospheric flows for weather forecasts. In summary, the weather is a temporary set of localized parameters. Whether it represents the overall climate of the world is still debatable.

The term climate is derived from the ancient Greek word for "tilt". The different temperatures worldwide may be attributed to the earth's tilt angle or the direction solar rays hit different places. Therefore, the climate is the long-term and cumulative effect of weather, mainly constrained by geographical locations. It comprises a collection of average weather parameters in the region over the years and excludes variations (or fluctuations) in four seasons of a year. Although the weather may change within a few hours or days, climate change takes tens, hundreds, thousands, or even millions of years, making it more difficult to find patterns of climate change.

Weather is local and short-term, while climate is global and long-term. Weather is the story, while climate is the plot. However, there are some sharp changes between the weather and the climate, which are middle-term and society-moving. Professor Ellsworth Huntington labeled them climate pulsations to stress their pulsative nature and repeatability. For example, the floating ice around Iceland came along with the expansion of ice sheets in the Alps, both of which caused widespread famines in Europe, a frequent symptom in the so-called Little Ice Age. Around the same time, China suffered frequent coastal floods, and sea walls were built for defense. The symptoms of climatic pulsations go beyond the normal weather fluctuation but are still below a significant level of climate change. Therefore, climate pulsation refers to cyclic climatic changes, usually within a person's lifespan. It has direct consequences in natural science (ecological), social sciences (economical and financial), and political sciences (military and administrative), which drive civilization forward.

Climatic shock refers to the abnormal manifestation of short-term changes in weather, such as ocean currents (as tidal disasters), river floods, droughts, snowstorms, etc. The cold wave in southern China is a typical climatic shock. Sometimes, it happens near a climatic node, which arouses more societal responses. On the other hand, it may happen anytime, unpredictable and random (but frequently caused by a climatic disturbance, such as a volcano eruption or a sunspot-related event). These untimely climatic shocks prevent academia from proposing a clearly defined periodicity for climate pulsations.

In summary, we have three levels of climate change: climate shock, climate pulsation, and climate change, respectively, in different time scales. A climate shock stays for a year or two due to an untimely volcano outbreak. A climate pulsation may last for decades. It is repeatable with a fixed cycle and is the central theme of this book. Climate change spans roughly 1500 years, which will be briefly discussed in Chapter 12.

1.1. Climatic Evidence

Archaeologists, historians, and paleoclimatologists use various methods to study ancient climate change, including direct (instrumental and historical records) and indirect (deep-sea and lake cores, coral records, and tree rings/dendrochronology). [2] Here we follow Zhu Kezhen in using phenology as the primary climatic evidence. The elephant will migrate north or South, depending on the climatic background. The tropical fruits will be planted north and grow there whenever the climate permits. We will find many ecological events as natural responses to climate pulsations by checking these abnormal changes in phenology. They were not caused by the short-term weather (or climate shocks) or the long-term climate (or climate change) but by the middle-term climate pulsations. However, because of the pulsative nature of ecological and natural responses, they were still too many to generalize a simple trend since they had many disturbances embedded with less resilience than a society.

Most societies respond to climate pulsations similarly to plants or animals in the ecological system. The harvest in agriculture will spill over into other segments of society. We can find market expansion with money shortages in warming cycles and market contraction with inflating monetary policies in cooling cycles. Other major political or technical reforms are also responsive to the climate pattern. Therefore, we can identify better periodicity and repeatability for climate pulsations by checking these response patterns in societies.

In addition, society will take active measures to relieve the internal stress induced by climate pulsations. A successful taxation reform will collect more money without imposing too much of a burden on taxpayers. Successful political reforms in military organizations will reduce the total

[2] Fagan, B. 2008. *The Great Warming, Climate Change and the Rise and Fall of Civilizations*, Bloomsbury, New York, pp. 8-9

cost without sacrificing defensive capability. A unification war is necessary to remove confrontation and to save defensive costs. Primary societal responses frequently occur in a repeated way with climatic cycles embedded.

Here we are checking historical records for ecological, passive and active societal responses for clues of climate pulsation instead of using instrumental or indirect evidence accepted in climatology. The latter is tedious and incomplete, with a poor relationship to the evolving society. Using new evidence collected from human societies, we can better understand the climatic contribution to the evolution of societies and cultures. All climatic pieces of evidence are summarized in Figure 1.1 below.

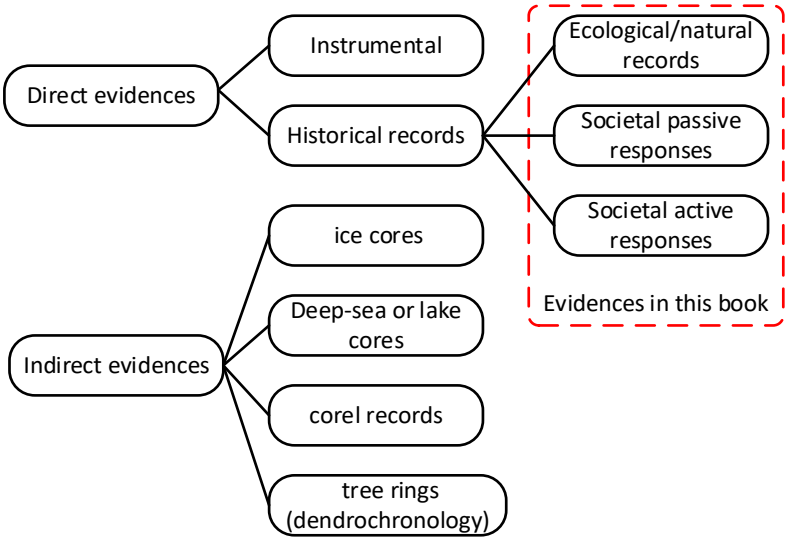

Figure 1.1. The framework of climatic evidence (in dashed lines) in this work.

Why go into society for climate evidence? The evidence from plants or animals is too rich and confusing to condense into any useful pattern. Unlike plants or animals, human communities are more resilient against climate

shocks. Therefore, human societies are more subjective and resilient, responsive to major challenges only, ignoring or tolerating minor ones. If the climate repeats itself, we will find that the responsive solution also occurs repeatedly. So, we can find many periodical and repeatable events in history. For example, tropical fruits are most efficient and profitable in utilizing solar energy. Therefore, they are transplanted into the northern territory whenever the climate permits. By checking the timings of these subjective decisions behind their transplantation, we can better understand the climate pattern in the background. Here three general principles help us recognize the repeated pattern behind societal responses.

Spatially, since all climatic shocks come from the Arctic Ocean, the longer the distance to the source, the less climatic shocks occur. Therefore, the periodicity of climate pulsation in the Southern Hemisphere is more significant since minor disturbances to the climate are filtered out or damped by the long distance between the two. For example, in December 2013, a little blizzard swept across the Middle East. On the 12th day, it snowed in Israel, Iran, Palestine, and Lebanon, while the news reported, "Egypt saw the first snow in Cairo for the first time in 112 years." The southern Hemisphere must wait 120 years for a climatic shock to strike like this. The scarcity of environmental challenges is the primary cause behind the slow development in Africa or the Southern Hemisphere.

Temporally, if a societal response occurred earlier in history, its periodicity was more significant. That means ancient observers had a better relationship with Heaven (climate), therefore being more familiar with climate cycles. In addition, societal memory served as a temporal filter, with minor responses or insignificant evidence dropped from historical records. Moreover, the earlier climate (at the beginning of civilization, somewhat 3000 years ago) was generally warmer than today, with thick forests everywhere, which means a higher resilience wherein fewer climatic shocks occurred. Therefore, periodicity was more significant in the past than today. Ancient means of production (horticulture) depended more on weather

forecasts than the current means of production (agriculture), so ancient practitioners were more sensitive to climate patterns than modern researchers. For these reasons, ancient people were more aware of the climate cycle than today. Modern-day people have grown distant from their earlier close relationship with Heaven.

Socially, suppose a social response is distant from nature or less dependent on ecology; it has a better chance of demonstrating the periodicity of climate pulsations since human society has served as a massive buffer in filtering out minor disturbances, only responding to the most crucial ones. We can observe that many economic, legal or religious reforms occurred cyclically because they are subjective and do not need to respond to climate change directly. For example, wine consumption is a social behavior distant from natural impact, so we can find frequent and periodic reforms in its sales in history (see section 8.1.2).

Regardless of climate patterns, the environment was always the target/victim under the constant drive for a better society. For example, the cooling climate pattern is conducive to large-scale "reclamation of forests (deforestation)" since the cooling climate will suppress mosquito-related plagues, paving the way for deforestation. On the other hand, a warming phase will induce droughts and a rise in population, inviting large-scale "reclamation of lakes for farmlands". Both patterns work alternatively. As a result, the environment is changed. The agricultural means of production spread to South China, along with the retreat of elephants to the South.[3] The colonization of the South is accomplished by converting the horticultural practice into an agricultural means of production.

Compared with the traditional approach to climate studies, we are not looking at the instrumental records or the indirect records/proxy data, which are too tedious and too professional for the general audience. Instead, we

[3] Elvin, M. 2006. *The Retreat of the Elephants: An Environmental History of China*, Yale University Press

discuss three types of climatic responses, ecological (natural) responses, passive societal and active societal responses, to find the universal impact of climate pulsations. Generally, it isn't easy to relate societal responses to climate evidence. However, an empirical rule is generalized and introduced below, which provides a framework for climate pulsations. Without knowing the exact cause of climate pulsations, we can still predict the behavior of societal responses by this rule, which comes next.

1.2. The Rule of Climate Pulsations

Before we dive into the sea of societal responses towards climate pulsations, we need to know which evidence is more important than others. Generally, the evidence reflecting the high environmental stress is more important, such as political reform or a religious movement. We can find more challenges near climatic nodes, which deserve special attention. An empirical rule is proposed for identifying these climatic nodes: **if a year in the Gregorian calendar is dividable by 60, it is a climatic node of global warming.** A warming climate pattern happened around this node, along with corresponding societal response patterns. **Otherwise, if this number is dividable by 30, it is a climatic node of global cooling.** A cooling climate pattern happened around this node. This is a binary treatment of climate patterns but good enough to predict the timings and patterns of climate pulsation in history. This book comprises various repeatable natural or societal events around these nodes since these nodes bear the highest environmental stress induced by climate pulsations. **Throughout this book, the square bracket [] is used to stress the climatic node, from which you can infer the climate pattern by a small estimation, while the curly bracket {} is used to emphasize the expected duration with complete climatic cycles (in years) embedded.** Both tricks help you recognize the climatic background for each event, thereby understanding the role of climate pulsation in driving civilization.

Note that a warming node may come with extreme events accompanied by environmental stress, such as flooding, droughts, cold waves, unexpected ecological responses, etc. Therefore, judging the climate pattern from the ecological reactions alone is difficult. Instead, we must combine all responses (natural and societal alike) to infer the climatic pattern behind each node. This is the primary difference from other studies, where climate evidence has little or superficial connections with societal responses. Unlike Brian Fagan, who relies heavily on ecological/instrumental records in historical interpretation,[4] societal responses are more valued here to infer the climate pattern, which is used in predicting other societal reactions. It is implicitly assumed that each subjective decision was made in the best interest of the community's survival. Therefore, response patterns are deterministic and repeatable in the same climate pattern.

With the environmental stress near a climatic node, social reforms were aroused to meet the challenge. However, not all events occurred near a climatic node with the highest environmental stress. Sometimes, they are sensitive to a switch in climate patterns or a disturbance. For example, the three slave wars (Servile Wars) in Rome Republic happened in 135-132 BCE, 104-100 BCE, and 73-71BCE, interspaced by roughly 30 years. We can find signs of a climate switch in Chinese records for these events. So they are still responsive to a specific change in environmental pressure. We can apply this rule for the following reasons:

1. It helps us identify the climate pattern behind a specific historical event. Historically, we have had many economic, political, and religious reforms. This rule gives us an explicit clue on the climatic background behind each reform.

[4] Fagan, B. M. 2005. *The long summer: how climate changed civilization*. Basic Books

2. A climate pattern usually prevails for a certain period. Therefore, we can infer the climate pattern through the other event during the same period. It provides a binary view of the climatic impact on society and helps us recognize the pattern behind repeated societal responses. Historic philosophy in China (in I-Ching, or Book of Changes) was built upon binary and repeatable worldviews. The rule of climate pulsations shows the root cause behind this philosophy and worldview in China.
3. It helps us to understand technology cycles, business cycles, political cycles, war cycles, dynastic cycles, etc. Any long-wave behavior in society has a climatic contribution embedded.

This rule has a long history in China. It first appeared 2200 years ago in a weather-forecasting book named *Book by Lou Jing,* circulated in Hunan Province. This book forecasted the local weather based on a periodicity of 60 years. After this, a dozen more farming manuals or booklets stressed the repeatable local weather, all based on this 60-year cycle. Since most Chinese calendars repeat themselves in 60-year cycles in providing the yearly cultivating scheme, repeatability or periodicity is the cornerstone of Chinese historical philosophy.

Why China? The first empirical rule on climatic evidence tells us that Europe is located too close while Africa is too distant from the Arctic Ocean. Too many or too few climatic shocks prevent a response pattern from being recognizable. China has a long history of the distant past, serving as ancient wisdom. Chinese society underwent frequent reforms, which bear the impact of climate pulsations. Therefore, this book utilizes the richness and uniqueness of Chinese records to infer the climate pattern under climate pulsations.

1.3. Climate Disturbances

Throughout this book, most societal responses aligned well with the empirical rule of climate pulsations. However, the evidence is too abstract, numerous and tedious to be listed here. Another monograph will be published recently for listing societal responses toward climate pulsations for 1020 years, from [720] to [1740]. In this monography, major reforms, arts and drawings, and technological breakthroughs aligned well with this rule of climate pulsations. They are intentionally omitted here for brevity and simplicity.

However, two uncontrollable factors come into play, making the climate cycles unrecognizable in the background. The first factor is the sunspot. Previous researchers have identified the Oort Minimum, Medieval Maximum, Wolf Minimum, Spörer Minimum, and Maunder Minimum for explaining historical climate fluctuations. They are all related to a specific climate pattern. Yoshimura even found a cycle of 55 years in sunspots for predicting solar activity without fully explaining any mechanism. The disturbance from sunspots is still beyond our knowledge.

Another factor is the untimely eruption of volcanos. Benjamin Franklin first connected the eruption of volcano Laki in Iceland in 1783 with the freezing Winter in North America.[5] Several famous eruptions, such as the eruption of Tambora (1815) and Krakatau (1883), have their impact well documented and studied.[6] It is widely accepted that an eruption will impact the climate through the atmospheric dispersion of dust. The major eruption will disperse tens of millions of dust particles into the stratospheric air. Dust (including particles) in the upper atmosphere tends to scatter sunlight back

---

[5] Brown, N. 2001. *History and Climate Change, A Eurocentric perspective*, London and New York, pp. 60

[6] Kusky, T., 2007. *Volcanoes, Eruptions and Other Volcanic Hazards*. Facts On File, Inc.pp. 53~67

into space, lowering the amount of incoming solar energy.

In contrast, particles that only get injected into the lower atmosphere absorb sunlight and contribute to greenhouse warming. So not all eruptions contribute equally to the climate. In addition, once dust re-enters the troposphere, it is usually washed out by rain or snow within two weeks. So some eruptions had a pulsatory perturbation to the climate, frequently missing detection. If a volcano has consecutive or simultaneous eruptions within a short period, this may change the global temperature significantly. Note here the immediate impact means a delay of one to three years, and the long-term implications mean a delay of something for a decade or more. It was observed that a second dust peak might appear in the stratosphere 600 days after the eruption.[7]

The above facts leave the climatic impact of a volcano eruption uncertain since its location and scale may not be well documented and studied. Given the diversity among various volcanos, we need to check one volcano for its continuous record so that we may use this as a point of comparison. Mt. Vesuvius is a good candidate for its well-documented history. Due to its easy accessibility to communities and long historical record, Mt. Vesuvius is one of the most studied volcanos in history. The discovery and excavation of Pompeii and Herculaneum added to its fame, and various Earth Science theories were tested on its records. Scandone et al.[8] provide a thorough review of eruptions in history. We will use this record against the rule of climate pulsation for its impact on society.

The eruption of 79 is unique since it does not fit into a climatic node. However, it had a precursor to an earthquake in 62 or 63, consistent with

---

[7] Brown, N. 2001. *History and Climate Change, A Eurocentric perspective*, London and New York, pp. 61.

[8] Scandone R, Giacomelli L, Gasparini P. 1993. *Mount Vesuvius: 2000 years of volcanological observations*. Journal of Volcanology & Geothermal Research, 58(1–4):5-25.

the rule of climate pulsations. This quake happened before a famous urban conflagration, the Great Nero's Fire of 64. Another blaze followed this eruption in Rome in 80,[9] the second in its destruction only to the Great Fire of Nero in 64. This fire raged for three days and nights, burned a large section of the Campus Martius, and, moving thence in a southeasterly direction, devastated the Capitoline hill. Many public and private buildings were swept away along its paths.

Interestingly, this conflagration had an echo in China. A local magistrate, Lian Fan, lifted a curfew law in Chengdu and replaced it with a policy of storing public water for firefighting, which locals welcomed.[10] The motivation behind this action was not explicitly stated in the record. A cooling climate invites more fires, which leads to a curfew law. The curfew law restrained residents from working at night, driving more illegal activities, and inviting more disasters. This curfew was abolished twice in China (a second time in 1292) and once in the UK around 1100, all responding to the climate pattern of global cooling.

The next eruption in 203 directly affected the firefighting force in Rome. Around this time, no significant fire was recorded, but the enrolment in the Corps of Vigiles suddenly doubled in 205 [210],[11] from 560 to 1120. Little was recorded for this sudden increase. However, since the dropping ambient temperature invites more community fires, it can be considered a societal response to this cooling trend. The change in Vigile enrolment was infrequent in history (with another one in 27 [30]) since Rome had a critical popular opinion on public expenditures.[12] At about the same time in China,

---

[9] Canter, H. V. 1932. *Conflagrations in Ancient Rome*. Classical Journal, 27(4):270-288.

[10] Hou Han Shu, vol. 31.

[11] Rainbird, J. S. 1986. *The Fire Stations of Imperial Rome. Papers of the British School at Rome*, 54(3):147-169.

[12] Green-Hughes, E. 1979. *A history of firefighting*, Moorland Publishing