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Climate Characteristics of Chongqing, China in the Mid-13th Century and the Changes in World Situation

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In the mid-13th century, the Mongol Empire rapidly rose to power, conquering vast territories stretching from East Asia in the east to Eastern Europe in the west. Its powerful military conquered over 40 countries across Eurasia. However, when the Mongol army attacked the cities of Chongqing and Diaoyucheng in southwestern China, they laid siege to them for a prolonged period, but were unable to capture them. Even the fourth Mongol emperor, Mongke, was killed at Diaoyucheng, causing the Mongol army to stall on the European front and halting its conquests in Eurasia. World historians have dubbed Diaoyucheng in Chongqing "the place where God broke his whip". From 1243 to 1279, Chongqing held out for 35 years, and Diaoyucheng for 36 years, respectively, against the Mongol army. How did Chongqing and Diaoyucheng hold out despite such long sieges? Recent archaeological discoveries at these two sites have provided scientific evidence: The remains of various small tropical and subtropical mammals have been unearthed at Chongqing and Diaoyucheng. These regionally unique tropical and subtropical animals reflect the subtropical humid climate of the region at the time. This climatic environment provided abundant rainfall and lush vegetation, providing ample water for daily life within the city. Subsistence farming, gathering, livestock breeding, and hunting provided the city with necessities. Despite decades of siege, the city maintained a water and food supply, which effectively supported its defenses. Both Chongqing and Diaoyu Fortress have been found to contain the small subtropical mammal *Suncus etruscus* and the species *Anourosorex squamipes*, native to Southeast Asia and Southwestern China. Furthermore, the tropical chiropteran *Rhinolophus stheno* and the tropical mollusc *Pseudodon chaperi* have been found in Chongqing. The discovery of these unique tropical and subtropical animals provides crucial scientific evidence for the long-term survival of Chongqing and Diaoyu Fortresses, which benefited from their climatic environment.

Keywords: 13th century, Chongqing area, climate characteristics, Mongol-Song War, world situation

Introduction

In the 13th century AD, the Mongols created a vast Mongol Empire that spanned the Eurasian continent (May, 2011). At its peak, its territory extended from East Asia to Central Asia, West Asia, Eastern Europe,

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and other vast areas. It destroyed more than 40 countries and established the largest empire in world history. The rise of the Mongol Empire marked the beginning of globalisation in culture, medicine, industry, science, and technology (Allsen, 2001). The Mongol Empire was of great significance to the Eurasian continent in the 13th century in terms of cultural and economic integration. However, the cruelty of the wars waged by the Mongols against other ethnic groups also became a shadow in the memory of people in many regions in history. In world history, this period is called the "Mongol Whirlwind", "God's Whip", "Yellow Peril", and other titles (May, 2011). In 1236 AD, the Mongols entered the Sichuan Basin for the first time, capturing Chengdu City and marking the beginning of their war to conquer the Sichuan Basin, located in the upper reaches of the Yangtze River. In 1243 AD, the Mongol army launched another offensive, conquering Chongqing City and the surrounding areas in the eastern part of the Sichuan Basin that had not yet been occupied. In 1258, the Mongol Emperor Mongke personally led the main force to attack Chongqing City, the command centre of the Southern Song Dynasty in the upper reaches of the Yangtze River, and Diaoyucheng, a military fortress near Chongqing City. On July 21, 1959, while commanding a battle at Diaoyucheng, Emperor Mongke was hit by a stone fired by a Southern Song soldier and died. After the news of his death spread to the battlefields in Europe and North Africa, the Mongol Empire halted its offensive against Western Europe, North Africa, and other regions, thereby ending the expansion of the Mongol Empire in Eurasia and even North Africa. Therefore, Chongqing Diaoyucheng was referred to as "the place where God broke his whip" by historians (May, 2011). Chongqing City and Diaoyucheng became the main battlefields for directly resisting the Mongol army from 1243 until Chongqing City was occupied due to betrayal by a rebel general in 1278; in 1279, Diaoyucheng surrendered under the condition of a promise of protection after the Southern Song Emperor committed suicide and the Southern Song Dynasty ceased to exist. From 1243 to 1279, Chongqing City held out for 35 years, and Diaoyucheng for 36 years (even during this period, the Mongol emperor himself was killed in battle at Diaoyucheng). How did Chongqing and Diaoyucheng survive the siege for decades and become pivotal locations that changed world affairs? Recent archaeological excavations at Chongqing and Diaoyucheng have unearthed previously unnoticed materials. Scientific analysis and comprehensive examination of these newly unearthed materials provide new insights into the story of the Mongol defeat in Chongqing: The unique climate of the Chongqing region played a crucial role in the Mongol defeat. Chongqing's unique climate, geographical environment, and subsistence economy were key factors in supporting its status as a pivotal location that transformed world affairs in the 13th century.

Special Archaeological Materials From the Mongol-Song War Period Unearthed in Chongqing City and Diaoyucheng

The ruins of the Southern Song Dynasty government office in Chongqing are located in the centre of Chongqing, at the confluence of the Yangtze and Jialing Rivers (with coordinates 29º33'13''N, 106º34'46''E). Diaoyucheng is located northwest of Chongqing, at the confluence of the Jialing, Qu, and Fu Rivers (with coordinates 29º59'30''N, 106º17'32''E). It is approximately 55 kilometers away from Chongqing (Figure 1).

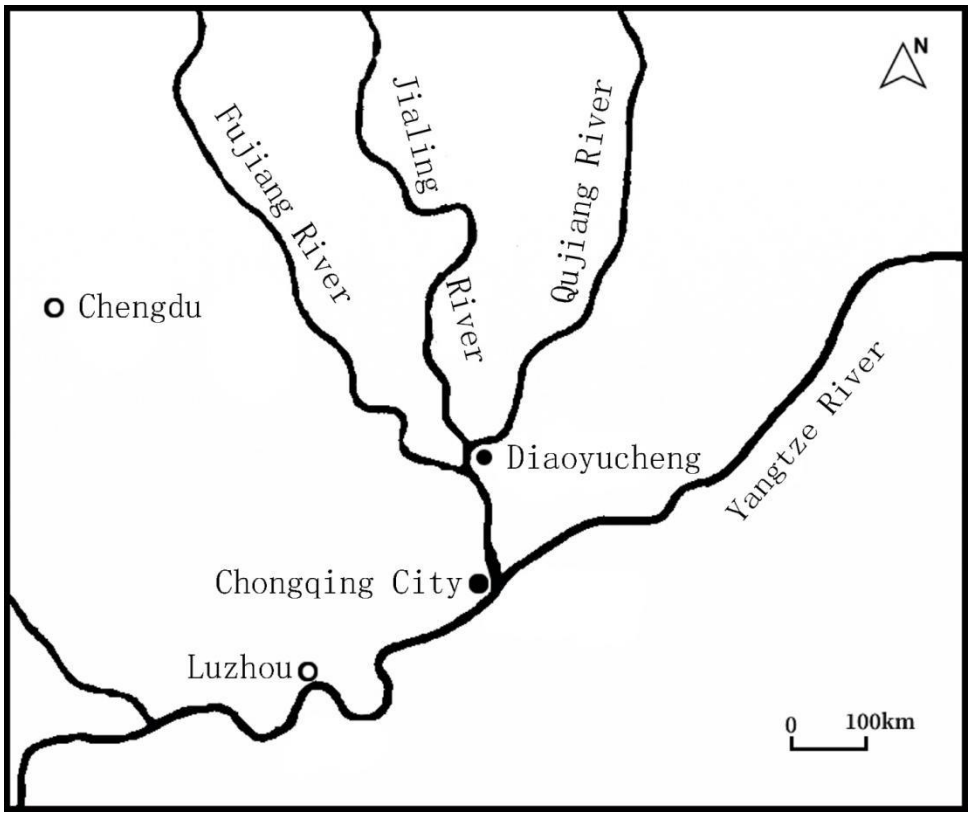

Figure 1. Location map of Chongqing City and Diaoyucheng.

Special Animal Remains Unearthed in Chongqing

During the Chongqing City Reconstruction Project in 2009, bricks with inscriptions dating back to the late Southern Song Dynasty (AD 1245) were discovered at the ruins of a Southern Song Dynasty government office in Chongqing. This period coincided with the period when the Mongolian army occupied Chengdu, Sichuan Province, and marched towards Chongqing City to launch a major war. From 2010 to 2013, archaeological excavations were carried out continuously for three years at the ruins of the Southern Song Dynasty government office in Chongqing (the highest administrative headquarters of the Mongol-Song War in the upper reaches of the Yangtze River). Over 20,000 cultural relics of various types, including metal objects, ceramics, and bone products, from the Mongol-Song War period were unearthed (the discovery was rated as one of the top 10 archaeological discoveries in China in 2012) (Wu, Ma, & Yuan, 2016).

Discovery of the tropical endemic Chiroptera *Rhinolophus stheno*. Two left mandibles belonging to *Rhinolophus stheno* were unearthed from the site of the Southern Song Dynasty government office in Chongqing, and they were numbered YSH43:X20 (Figure 2.1) and YSH43:X21. This is a regional species that now lives in Southeast Asia. Its distribution area includes tropical rainforest climate zones and tropical monsoon climate zones, such as Malaysia, Thailand, Laos, Vietnam, Sumatra, and Java Island (Figure 2) (Csorba, Ujhelyi, & Thomas, 2003). These two specimens belong to the order Chiroptera, specifically the tropical suborder. We identified and reported them in 2017, proposing that the natural environment between the low-altitude area of the Three Gorges Gorge of the Yangtze River and Chongqing City in China during the Southern Song Dynasty was similar to the tropical monsoon climate zone (Wu, Ma, & Zhou, 2017).

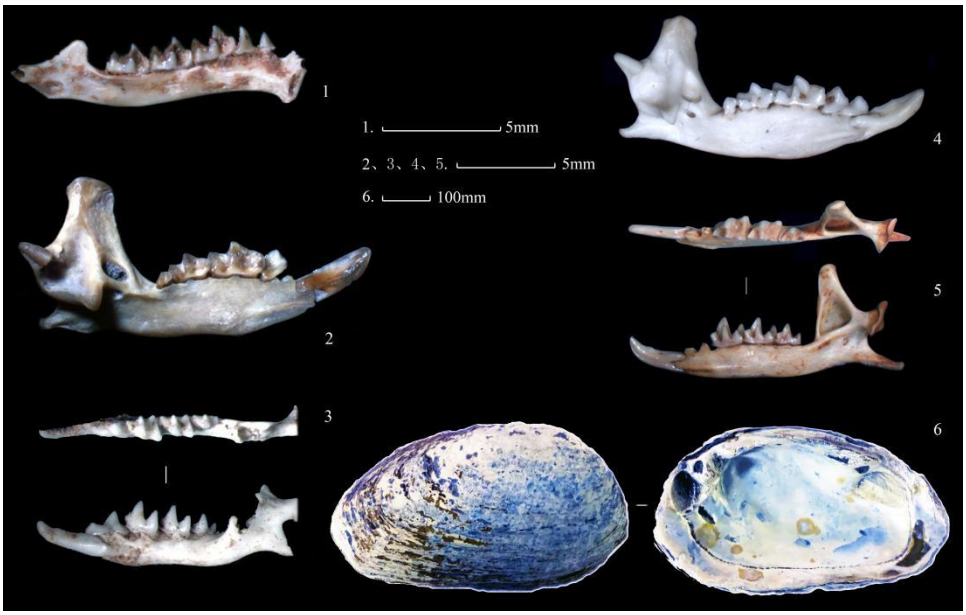

Figure 2. Tropical and subtropical animal remains from the Mongol-Song War period in Chongqing.

Figure Labels: 1. Left mandible of *Rhinolophus stheno* from the Southern Song Dynasty government office site in Chongqing (YSH43:X20); 2. Left mandible of *Anourosorex squamipes* from the Southern Song Dynasty government office site in Chongqing (YSX:1); 3. Left mandible of *Suncus etruscus* from the Diaoyucheng site (YSH43:X66); 4. Right mandible of *Anourosorex squamipes* from the Diaoyucheng site (D2019F15:G01); 5. Left mandible of *Suncus etruscus* from the Diaoyucheng site (D2019F15:G02); 6. *Pseudodon chaperi* from the Southern Song Dynasty government office site in Chongqing (LGLH43R0015).

Discovery of the tropical-subtropical endemic insectivore *Anourosorex squamipes.* In 2015, it was reported that *Anourosorex squamipes* was discovered at the site of the Southern Song Dynasty government office in Chongqing (Wu, Yuan, & Drozdov, 2015). The specimen number (YSX:1) was a well-preserved left mandible (Figure 2.2). This was the first time Anourosorex squamipes specimens had been found in urban archaeology in China (Wu et al., 2015). The distribution range of *Anourosorex squamipes* mainly includes India, Thailand, Myanmar, Northern Vietnam, and Southwestern China (South Asia tropical to Southwestern China mid-subtropical). Its habitat climate is humid and hot, with high accumulated temperatures and precipitation, and sufficient water sources within its range (Motokawa & Lin, 2002).

Discovery of the South Asian tropical endemic insectivore *Suncus etruscus.* Recently, while analyzing and identifying the flotation remains from the Southern Song Dynasty government office site in Chongqing in 2012, we discovered a relatively well-preserved left mandibular specimen of *Suncus etruscus* (Figure 2.3), numbered YSH43:X66. The specimen has a 1.1.1.3 lower tooth type, a slightly concave bottom edge of the horizontal ramus, and a medium-sized mandibular foramen; the incisors extend smoothly forward, the tooth tips are slightly curved upward, and the incisal edges of the lower incisors have a precise serrated tip; there is no diastema behind the lower incisors. The crown of tooth m1 is the largest in the lower dentition; its lower trigone is long, and the lower heel is wider than the lower trigone. *Suncus etruscus* is a small insectivore that is now widely distributed in Asia, Africa, and Europe. However, the southern subtropics of the Eastern Hemisphere were its historical origin and distribution center (Dom ńguez Garc á, Laplana, & Sevilla, 2020). Its current distribution in China is also limited to the southwestern part of Yunnan Province, which has a southern subtropical forest

environment (Pan, Wang, & Yan, 2007). Therefore, the discovery of this species plays a vital role in discussing the paleoclimate of the Chongqing area at that time.

Discovery of the tropical mollusk *Pseudodon chaperi.* Recently, during the analysis and identification of animal remains at the Southern Song Dynasty government office site in Chongqing in 2012, we discovered five new specimens of *Pseudodon chaperi*. The specimen numbers are LGLH43R015 to LGLH43R020. *Pseudodon chaperi* is a medium-sized mollusc with an oval shell shape, a thin shell wall, a bulge in the middle of the shell surface, and no shell cavity. The shell features a thin, triangular pseudo-primary tooth and a prominent, long lateral tooth at the hinge of the shell's top. Specimen LGLH43R0015 is a relatively complete one (Figure 2.6), with a shell length of 66.43 mm and a shell height of 38.40 mm. This mollusc is currently known to be mainly distributed in Thailand, Malaysia, and the Xishuangbanna rainforest area in the tropical climate zone of Southwest China (Liu, Zhang, Wang, & Duan, 1992).

Special Animal Remains Unearthed From the Diaoyucheng Ruins

Diaoyucheng, located on the Jialing River, which is the most significant direct current in the upper Yangtze River, was constructed for the purpose of defending Chongqing. Between 2014 and 2022, eight years of archaeological excavations at the Diaoyucheng site yielded numerous relics from the Mongol-Song War period. In 2019, flotation analysis of sediments in the Fanjiayan excavation area at the Diaoyucheng site yielded a collection of animal bones, two of which are of significant significance for paleoclimate research.

Discovery of the South Asian tropical endemic insectivore *Suncus etruscus.* The identification results of the Diaoyucheng *Suncus etruscus* have been recently published. The specimen is a relatively complete left mandible, numbered D2019F15:G02 (Figure 2.5) (Chen & Wu, 2025). The appearance of this animal reflects that the Diaoyucheng site had the characteristics of a southern subtropical climate at that time.

Discovery of the tropical-subtropical endemic insectivore *Anourosorex squamipes.* During the study of the animals at the Diaoyucheng site, a well-preserved specimen of the right mandible of *Anourosorex squamipes* was also found, complete with a set of attached teeth (Figure 2.4). The specimen is numbered D2019F15:G01. The research results have been reported in a recent paper (Chen, 2007).

Chongqing's Geographical Location and Regional Climate Characteristics

Chongqing's Geographical Location and Topographical Characteristics

Chongqing is located in the southeastern part of the Sichuan Basin. Water from the Qinghai-Tibet Plateau and the entire upper Yangtze River basin in the Sichuan Basin must flow through Chongqing to the middle and lower reaches of the Yangtze River. Chongqing is only about 1,600 kilometres southwest of the Bay of Bengal in the Indian Ocean and only about 900 kilometres south of the Beibu Gulf in the Pacific Ocean (Chen, 2012). Most of the interior of the Sichuan Basin is between 350 and 450 meters above sea level. The basin features a flat terrain and a subtropical, humid climate, with the highest temperatures occurring in the southeastern part of the basin (Cheng, 2012). Chongqing is located on the southeast edge of the Sichuan Basin. Although it is separated from the Bay of Bengal in the Indian Ocean and the Beibu Gulf in the Pacific by the Yunnan-Guizhou Plateau, the terrain of the Yunnan-Guizhou Plateau is high in the northwest and low in the southeast. The eastern part of the Yunnan-Guizhou Plateau, along the line of Tongren County and Qiandongnan Miao and Dong Autonomous Prefecture, is mostly below 1,000 meters above sea level. There is a reasonably wide area below 600 meters above sea level (the lowest point is only 149 meters above sea level), and there are many river canyon

areas with an altitude of less than 350 meters and a nearly north-south distribution (such as the Wujiang River and the Qijiang River). In this area, Chongqing forms a river channel that connects the low-altitude regions to the south (Cheng, Zhou, Li, & Shen, 2019). Therefore, the low-altitude areas and river canyons in the eastern part of the Yunnan-Guizhou Plateau have formed a land-based animal and plant and air flow channel between Chongqing and Southeast Asia and the Beibu Gulf to the south (referred to as the "Chongqing Southern Channel" in this article). The "Southern Corridor of Chongqing" is closely linked to the distribution of mountain ranges in China. There are no peaks or mountain ranges that can serve as geographical barriers within the corridor. The corridor is surrounded by peaks on the west, north, and east sides, and there is a gap in the distribution of mountain ranges on the south side. The corridor forms a "bag-shaped" landform that extends from south to north into the hinterland of southwest China (Figure 3) (Wang, 2004). There is no doubt that the relatively close distance between Chongqing and the Bay of Bengal and the Gulf of Tonkin, as well as the special terrain of the "Southern Corridor of Chongqing", provides the basis for Chongqing to receive the warm and humid air currents from the south.

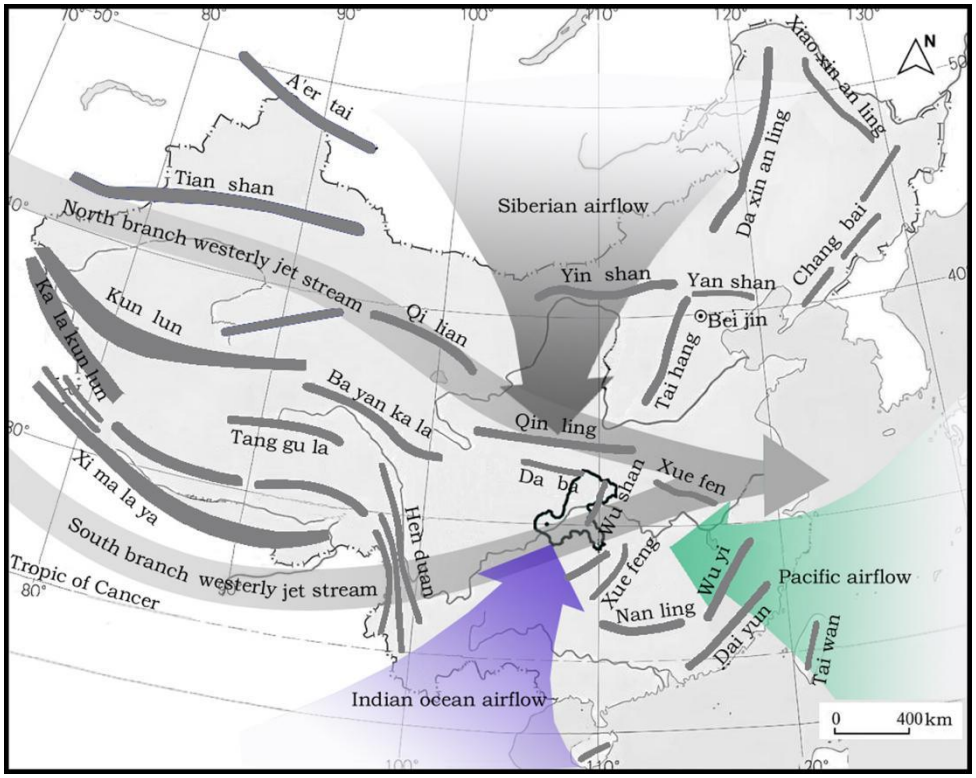

Figure 3. Chongqing's geographical location and regional climate map.

Climate Characteristics of Chongqing

Research on the paleoclimate of China during the Pleistocene found that warm and humid air currents from the Bay of Bengal in the Indian Ocean had a long-term impact on southwest China, including Chongqing (Shi, 1998). In paleontological studies of Chongqing and southwest China, it was also discovered early on that the mammalian fossil species in the region were related to tropical areas, such as Southeast Asia and India (Von Koenigswald, 1939). The paleontological community believes that the paleofauna of Southeast Asia, including Indonesia and Java, migrated from southern China, and that there was close communication between the

paleofauna of Northern India and Southwest China (Von Koenigswald, 1939). In recent years, numerous tropical animals have been discovered in Chongqing, underscoring the close relationship between Chongqing and the tropical climate zones of South Asia and Southeast Asia. For example, at the Yanjinggou fossil site in Wanxian County, Chongqing, a tropical animal, Hapalomys delacouri, which now lives in Southeast Asia, was unearthed (Zheng, 1993). At the Wazhuozui site in Zhongxian County, Chongqing, Nesolagus sinensis, which is now restricted to the tropical climate zone of Southeast Asia, was unearthed (Wu & Wang, 2018). At the Longgupo site in Wushan County, Chongqing, and the Meiziwan Cave in Wulong District, multiple batches of giant ape fossils have been discovered (Hu et al., 2024). This big ape is a large species found only in India, Southeast Asia, and Southwestern China (Welker et al., 2019).

In the study of China's modern weather system, it is known that the winter air masses and air fronts in January are controlled by the continental cold air masses (the southern branch of the westerly jet stream and the northern branch of the westerly jet stream) on the south and north sides of the Qinghai-Tibet Plateau and the polar cold air masses from Siberia (Figure 3) (Liu, 1998). These two land-based cold air masses cover almost 80% of China's land area (the Yangtze River Basin and its north). Chongqing, located in the southwest, can receive two warm high-pressure air currents originating from the Indian Peninsula in South Asia and the Indochina Peninsula in Southeast Asia. The influence of this warm high-pressure air front originating from the southwest can extend along the "Chongqing Southern Channel" to affect Chongqing and its surrounding areas (Liu, 1998). In the distribution of summer air masses and air fronts in July in China, the middle and lower reaches of the Yangtze River and the lower reaches of the Yellow River are mainly affected by the tropical marine air masses from the eastern Pacific Ocean, while the north and northwest regions are primarily affected by the northwest monsoon of the polar continental air mass; however, in the southwest region (including Chongqing), it is mainly affected by the equatorial marine air mass from the Indian Ocean (Figure 3) (Liu, 1998). Therefore, the distribution of winter monsoon or summer monsoon airflow in mainland China, Chongqing, is affected by the warm and humid air flow from the southwest Indian Ocean. This weather and airflow characteristic results in a high annual accumulated temperature and significant annual rainfall in Chongqing, with the rainfall mainly coming from the water vapor transported by the Indian Ocean monsoon airflow (Chen & Huang, 2007). Chongqing's air flow characteristics, related to Southeast Asia and the Indian Ocean, result in its plant and animal environment, as well as animal populations, being closely tied to Southeast Asia and the Indian Peninsula (Zhang, 1987).

Discussion

The climate environment is closely related to the rise and fall of ancient history; for example, drought events led to the decline of the Mayan civilization (Haug et al., 2003). China also has many historical climate change research results, such as the overall analysis of China's climate characteristics from 210 BC to 1910 AD based on historical materials, dividing China into three warm periods (210 BC to 180 AD, the Han Warm Period; 541 AD to 810 AD, the Sui and Tang Warm Period; 931 AD to 1320 AD, the Song and Yuan Warm Period) and three cold periods (181 AD to 540 AD, the Wei, Jin, Southern and Northern Dynasties Cold Period; 811 AD to 930 AD, the Late Tang Cold Period; 1321 AD to 1910 AD, the Ming and Qing Cold Period) (Yin, Su, & Fang, 2016), etc. However, due to the vast territory, diverse terrain, and the one-sidedness of different research materials, there are still many unclear areas in the coupling between climate, environment, and historical events and social development drivers in other parts of the world, as well as in China.

In the 13th century, the Mongols demonstrated their formidable strength in their conquests of Eurasia. The Mongol army had its own combat advantages: Traditional fortifications, such as city walls, castles, and any other defensive facilities, were not considered barriers by the Mongols. They had accumulated rich combat experience in their long-term mobile life and military campaigns, and were quick to act and powerful in combat (Sinor, 1981). The 13th-century Persian historian Djuveni, ‘Ala u ‘d-Din ‘Ata—Malik, believed that the organisation and combat capability of the Mongol army were the strongest in history since God created man, and it was unimaginable what kind of army in the world could resist the attack of the Mongol army (Boyle, 1958). So, what was the reason that led to the defeat of the Mongol army in Chongqing and Diaoyucheng? Chongqing held out for 35 years without being conquered by the Mongol army, and Diaoyucheng held out for 36 years without being conquered by the Mongol army. The reason why these two cities could hold out for so long, as revealed by recent archaeological discoveries, was related to the special climatic conditions and geographical environment of Chongqing.

Chongqing City is located on an island-like hill at the confluence of the Yangtze River and the Jialing River. The elevation difference between the city and the river surface is more than 80 meters (the river surface is about 160 meters above sea level, and the city is more than 240 meters above sea level). Diaoyucheng is located on a peninsula where the Jialing River, Qu River, and Fu River meet. The elevation difference between the city and the river surface is about 155 meters (Chen & Wu, 2025). These two island-like hill cities share common characteristics: large areas of native forests and ponds, a relatively rich variety of wild animals and livestock, and extensive arable land. Chongqing was rich in water resources at the time. In addition to water sources such as pools and ditches, there were also artificial waterscape gardens (Wu et al., 2017). Unearthed wild animals include Rattus flavipectus, *Anourosorex squamipes*, Crocidura attenuata, Rhinolophus rex, Pipistrellus pipistrellus, Mus musculus, Rattus norvegicus, Leopoldamys edwardsi, Petaurista caniceps, Cervus canadensis, Anser cygnoides, etc. Unearthed domestic animals include Equus caballus caballus, Capra hircus, Ovis aries, Bos taurus, Bubalus bubalis, Sus scrofa domestica, etc. (Wu et al., 2017; Wu et al., 2015). Diaoyucheng also had abundant water resources. In addition to ponds and wells, there were also small lakes for artificial fish farming. Wild animals unearthed included *Anourosorex squamipes*, *Suncus etruscus*, Eptesicus serotinus, and Pelodiscus sinensis, and domestic animals unearthed included Anser cygnoides domesticus and Gallus gallus domesticus (Chen & Wu, 2025). The presence of these domestic and wild animals suggests that the city’s ecology was sound, its food resources were sufficient, and its water resources were abundant. From the history of Chinese wars, when a city was besieged for a long time during the Cold War era, the reason for the city’s capture was often related to the lack of water and food within the city. For example, during the defence of Fengxiang City in the late Tang Dynasty, the city was besieged for more than a year, and the water and food supplies within the city were exhausted, leading to the defending soldiers killing each other and ultimately resulting in the city’s capture (Ouyang, 1974). In the defense of Yongxing City during the late Tang Dynasty, the city was besieged for more than a year, and the water and food supplies were cut off, resulting in the city’s defeat, with people resorting to cannibalism for survival (Xue et al., 1976). Even if a city is not besieged during a war, a natural disaster that causes a food shortage in the city will also impact the city’s safety. For example, during the Tang Dynasty, when the food supply in the capital, Chang’an, was insufficient, the emperor led officials and attendants to relocate from Chang’an to Luoyang 15 times. Chinese historiography referred to this as “moving the capital to get food” (Ding, 2021). And so on. During the Mongol-Song War, the Mongols besieged Chongqing City and Diaoyu City for 35 and 36 years, respectively. However, because there were water and food supplies in the city, they were able to hold on. Why did Chongqing City and Diaoyu City have water and food supplies for more than 30 years?

First of all, the area has a subtropical humid climate, which receives warm and moist air currents from the Indian Ocean. Recent archaeological discoveries at Chongqing and Diaoyucheng have revealed the presence of Suncus etruscus, an insectivore endemic to the subtropics, and Anourosorex squamipes, an insectivore endemic to the tropical and mid-subtropical regions. Chongqing also unearthed regionally unique animals, including the tropical chiropteran *Rhinolophus stheno* and the tropical mollusc *Pseudodon chaperi*. The presence of these diverse tropical and subtropical animals confirms the region's subtropical climate during the war. A subtropical climate is characterised by high rainfall and abundant water resources, multiple harvests of plants (a year-round growing season), and a high biomass capacity. This allows for the development of subsistence economies within the city walls (agriculture, livestock production, gathering wild plants, hunting birds, and small wild mammals), ensuring adequate water and basic food supplies. Consequently, despite being besieged for over 30 years, the populations of Chongqing and Diaoyucheng were able to survive with necessities.

Conclusion

The defense of Chongqing and Diaoyucheng resulted in the death of Mongol Emperor Mongke at Diaoyucheng (which became known as "the place where God broke his whip"). This halted the Mongol Third Western Expedition towards Europe and altered the Mongol occupation of Europe, Asia, and Africa. The reason Chongqing and Diaoyucheng remain legendary in world war history, representing pivotal locations that changed the course of world history, can be attributed to the region's abundant subtropical climate at the time, which provided sufficient water for daily life and production, rich flora and fauna, and strategic terrain and fortified strongholds. These two cities held out for 35 years and 36 years, respectively, despite being conquered. Recent archaeological excavations of various tropical and subtropical animals in the region have revealed that Chongqing and Diaoyucheng achieved remarkable feats of resistance.

The tropical or subtropical animals *Rhinolophus stheno* and *Anourosorex squamipes*, discovered in Chongqing City, and the subtropical animals Anourosorex squamipes and Suncus etruscus, discovered in Diaoyucheng, have been previously reported. However, the newly discovered tropical mollusk *Pseudodon chaperi* and subtropical animal *Suncus etruscus* at Chongqing City are reported for the first time. These essential landmark animals from Chongqing City and Diaoyucheng reflect the paleoclimatic context of the time, providing crucial data for analyzing the climatic characteristics of Chongqing City, the Diaoyucheng Defense War, and their relationship to world events.

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