2 The Environment of Central China

Introduction

The environment of Central China sets the physical stage for various social and cultural topographies that comprise the ancient landscape. As explained earlier, Central China refers to the Upper and Middle reaches of the Yangzi River (103°–116°E longitude and 27°–33°N latitude) and encompasses parts of the modern provinces of Sichuan, Hubei, Hunan, Guizhou, and Chongqing Municipality (see Figure 2.1). Altitudes in this region range from less than 50 meters above sea level (masl) in the plains of the Middle Yangzi to peaks of more than 3,000 masl west and northwest of the Chengdu Plain and at Shennong peak in the Wu Mountains north of the Three Gorges.

Central China is dominated by a main artery – the Yangzi River – and its tributaries. The Yangzi is known in Chinese as *Changjiang*, or "Long River," a name that speaks to its tremendous length (approximately 6,380 km from its source in the Himalayas to its mouth near Shanghai). The Yangzi's separate sections each has its own local designation. "Yangzi" once only referred to the last approximately 300 km near the river mouth, but nineteenth-century Western experience with exclusively this region extended "Yangzi" to the entire river in modern parlance, and we will use it this way throughout this book. Over its length, the Yangzi and its tributaries drain an area of nearly 1,127,000 km^2, currently populated by more than 350 million people (Shaw 2004; Van Slyke 1988).

The present course of the Yangzi emerged owing to the collision of the Indian-Australian plate into the Asian plate starting about 45 million years ago (mya). This impact resulted in the rise of the Himalayas and the Tibetan-Qinghai Plateau and the creation of deep folds that serve as conduits for several major rivers that drain this highland area toward the Indian Ocean and South China Sea. In this mountainous area of the Upper Yangzi (known locally as the Jinsha River – "River of Golden Sands"), the river parallels several other major watercourses of Southeast Asia: the Salween, the Mekong, the Brahmaputra, the Red, and the

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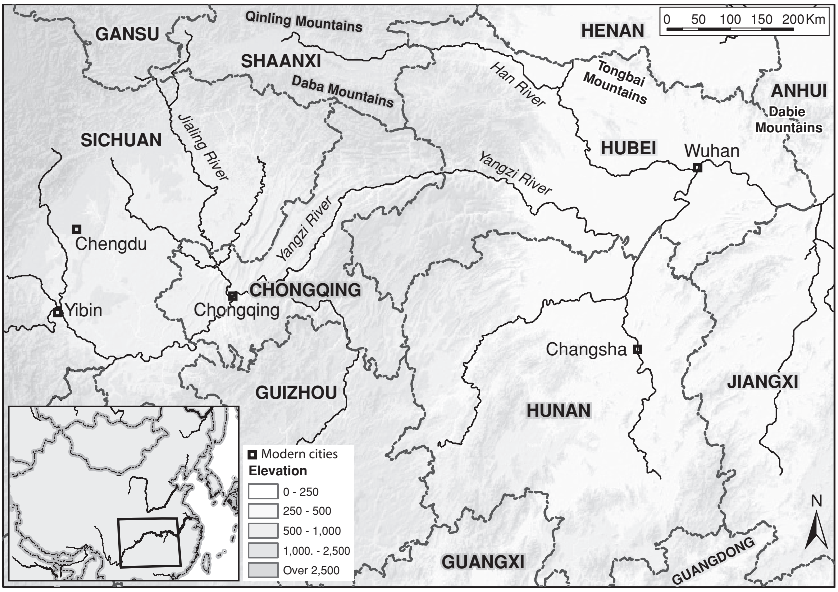

Figure 2.1. Map of Central China showing modern provincial boundaries, physical topography, and principal rivers.

Irrawaddy (Figure 2.2). Whereas these other rivers all continue unabated southward, the Yangzi turns sharply northward at Shigu owing to a large clump of carboniferous limestone called Yunling ("Cloud Mountain"), a course change that led Simon Winchester (1996: 354) to call Yunling "the axial point of China's very being." At this point of redirection, the river has already traversed more than half of its total length and 90 percent of its total elevation, yet it is here, as the river enters the Sichuan Basin and forges its way eastward, that the Yangzi takes on its central role in the populous areas of Central China.

The Yangzi is an important conduit along this east–west axis, giving the river a central role in transportation and interregional communication in prehistoric and early historic periods. Simultaneously, however, the river is often seen as a barrier separating northern and southern parts of China. The first bridge across the Lower Yangzi was built only in 1968, and areas south of the river were linguistically, culturally, and politically distinct from the central states and imperial capitals of northern China. It is also true that communities on the northern banks of the main course of the Yangzi, and along tributaries that fed the river from the north, were in many respects distinctly "southern." This is particularly true of communities in the Sichuan Basin and the middle reaches of the Yangzi

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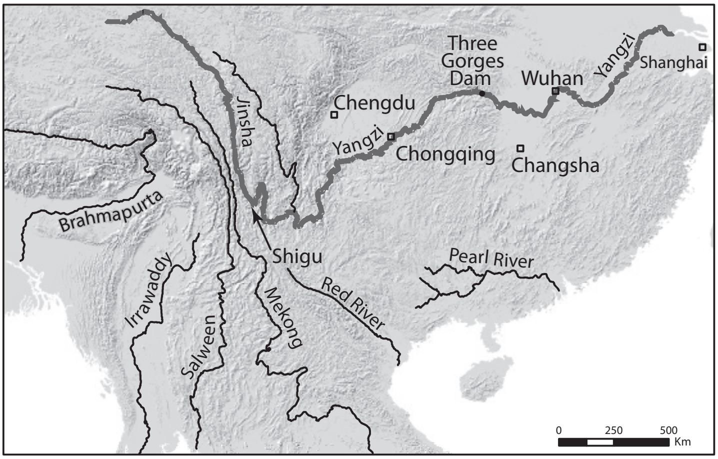

Figure 2.2. Rivers of Southeast Asia.

Valley. In fact, the cultural dividing line between the north and south is more appropriately the Huai River valley in Henan, Anhui, and Zhejiang provinces north of the Lower Yangzi. North of the Middle Yangzi, the Dabie and Tongbai ranges of southern Henan divide north from south by separating the Central Plains of the Yellow and Huai River systems from the Han River valley. The Qinling mountain range south of the Wei River acts as divider farther to the west. The Yangzi, in this sense, is not so much a dividing line between north and south as a central artery at the heart of southern China.

The Yangzi River valley, from the point where it enters into the Sichuan Basin near modern Yibin to its delta in the flat plains around Shanghai, traverses a diverse, low-elevation area for the second half of its march to the sea. In the first approximately 500 km, its elevation drops from approximately 500 masl at Yibin to approximately 250 masl near Chongqing City. There it is joined by another major tributary, the Jialing River, and over the next 1,700 km, it drops an average of merely 15 cm/km.

When compared to the Yellow River valley in northern China and its tributaries, the Yangzi Valley is distinct in many ways. From early periods, for example, subsistence in the Yellow River valley was generally dominated by millet agriculture, whereas Yangzi Basin communities relied more heavily on rice (Zhao Z. 2005). Similarly, animal exploitation in these macroregions also varied substantially during the Neolithic period. Yellow River valley communities adopted domesticated animals relatively quickly, whereas those living in the middle and lower reaches of

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the Yangzi River valley remained strongly reliant on fishing and hunting throughout the Neolithic and into the Bronze Age (Yuan et al. 2008).

Differences also exist within the river systems, of course, and different sections of the Yangzi are in many ways very distinct from one another. The uppermost parts of the Yangzi before the turn at Shigu, for example, cut through precipitous high-altitude terrain with diverse flora and fauna. This environment is extremely different from the very flat alluvial section of the Yangzi closest to the Pacific Ocean. In this chapter, we focus on three sections of the Yangzi drainage that compose Central China – the Sichuan Basin on the west, the Middle Yangzi on the east, and the Three Gorges region in between. Here we focus on physical geography and climate. We will see that the population centers that become the focus of discussion in Part II are located in relatively low-lying fertile areas near rivers – potentially advantageous locations for agriculture and transportation. A third element of the environment, the distribution of natural resources and their exploitation in the past, will be a topic of discussion in Chapter 7.

Physical Geography

Sichuan

The modern province of Sichuan comprises two main physiographic zones (Figure 2.3). Western Sichuan includes rugged mountains averaging 3,500 masl and comprises the eastern parts of the approximately 2.5 million km^2 Tibetan-Qinghai Plateau. Most of this region was a separate province called Xikang from 1939 to 1955. Eastern Sichuan is a mostly hilly basin between 250 and 750 masl covering approximately 260,000 km^2, or about 54 percent of the total area of the province. We will focus on the Sichuan Basin and immediately adjacent areas, leaving a discussion of the archaeology of highland Sichuan to another time and place.

The Sichuan Basin was formed as a by-product of the Himalayan uplift described earlier. When the Indian and Asian plates collided, causing the Indo-Sinian Orogeny (the mountain-forming process caused by tectonic uplift and folding), the Tethys Sea covered most of Southeast Asia as far north as Sichuan. As the surrounding land transformed, this sea was cut off and became landlocked by about 60 million years ago.

This inland sea evaporated during the Middle Pliocene (ca. 3.4–1.6 mya), leaving the Sichuan Basin separated from surrounding regions by mountain ranges on all sides. To the west, the Himalayan Plateau rises sharply. North of the basin, the Qinling and subsidiary ranges rise to

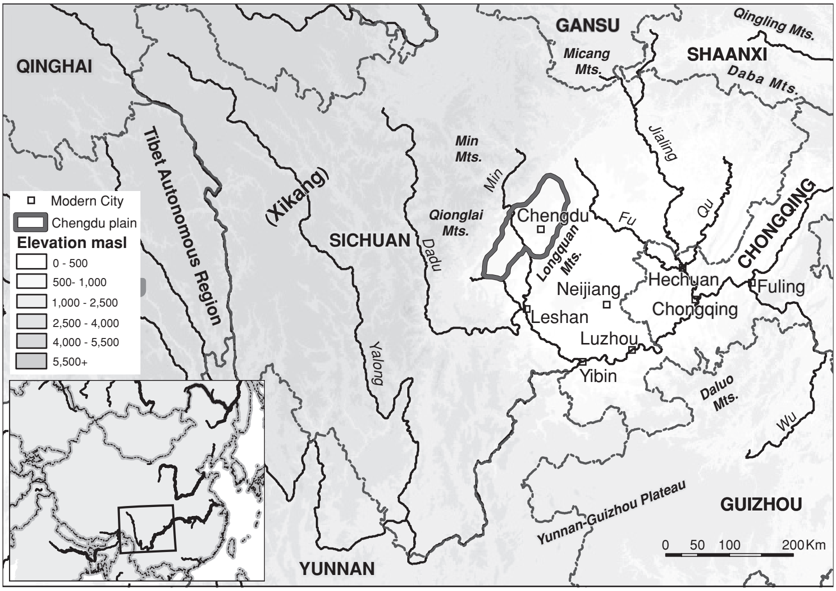

Figure 2.3. Physical topography of the Sichuan region showing major rivers, important cities and county seats, provincial boundaries, and the Chengdu Plain. Western Sichuan, including the former province of Xikang, is shown in the high elevations on the western side of the map.

heights between 2,000 and 3,000 masl, separating the Sichuan lowlands from the Wei River valley. In the east, a southeastern extension of the Qinling range called the Daba Mountains divides Sichuan from the Han River valley of the Middle Yangzi region. This extends southward into the Wu Mountains. By 1.16–0.75 mya, the Three Gorges of the Yangzi River cut through this range, which peaks between 2,000 and 3,000 masl in the north and around 1,000 masl toward the south (Li J. et al. 2001; Xiang et al. 2007). South and southeast of the Sichuan Basin, the Yunnan-Guizhou Plateau rises to heights of between 1,000 and 2,000 masl. The majority of land in these hilly areas on all sides of the basin was steep and cut by swift mountain streams, altogether not conducive for settlement by early agricultural communities. The basin thus defined can be subdivided into three subzones: the Chengdu Plain in the northwest, the central hills and Jialing River corridor in the middle, and a series of parallel ridges and valleys in the east.

The Chengdu Plain is the only area of extensive flat land in the Sichuan basin and, with an area of about 8,000 km^2, is the largest plain in southern China (Figure 2.4). The plain is the result of eight alluvial fans that

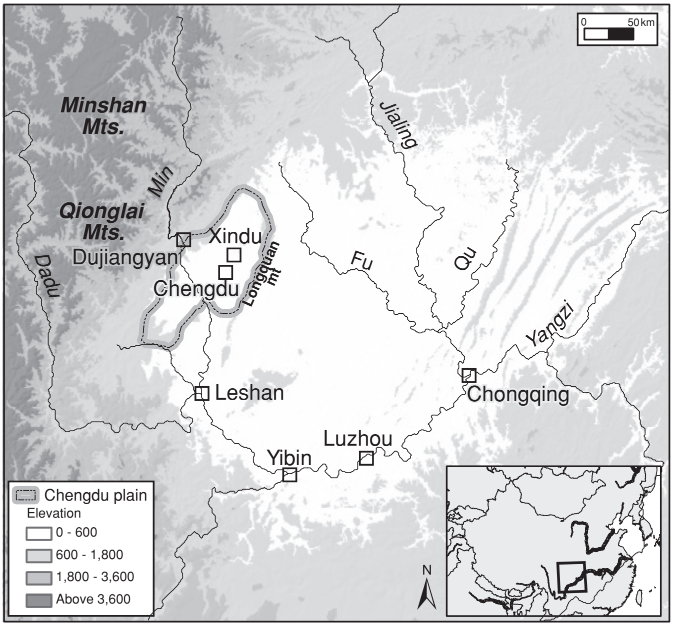

Figure 2.4. Map of the Sichuan Basin and the Chengdu Plain showing rivers, cities, and county seats mentioned in the text.

incline from northwest to southeast at a four percent grade, forming a dendritic drainage pattern across the plain (Sichuan 1996a: 381). These fans are formed by rivers that crash out of the Min and Qionglai mountain highlands to the north and west of the plain. These rivers also produced a foundation nearly 300 m thick of sand and gravel across the plain during the Quaternary era. The largest of the local rivers is the Min River, which meets the plain at Dujiangyan (Box 2.1).

Downstream from Dujiangyan, the northernmost branches of the Min River fan flow east-southeast toward the county seat of Xindu and become contributory streams that feed into the Tuo River. The Tuo is fed by other streams flowing into the northern part of the Chengdu Plain and flows east, across the ridge of hills that forms the eastern edge of the Chengdu Plain, known as the Longquan Mountains, and then south-southeast past Neijiang to the Yangzi River, which it joins at Luzhou. It drains the hilly region east of the Chengdu Plain and west of the Jialing River drainage. The remainder of the Min River fan streams and their tributaries rejoin the main course of the Min at the southern end of the Chengdu Plain. There, at the town of Leshan, the Min is joined by the

Box 2.1. Dujiangyan

Dujiangyan is well known for a weir constructed in the middle third century B.C. by Li Bing (3rd c. B.C.), who became the Qin Dynasty governor of Shu Prefecture in 256 B.C. This complex water diversion system diverts a portion of the excess water flow and sediment load of the Min River during high-volume periods into a separate channel for irrigation. The system has effectively controlled flooding and sediment problems for more than 2,200 years (Peng B. 2006; Sichuan et al. 1986; Sun J. 2006; Sun and Deng 2006; Zou Y. 2005) and became a United Nations Educational, Scientific, and Cultural Organization World Heritage Site in 2000.

The degree to which this system dramatically changed the nature of the Chengdu Plain landscape during the Qin is not yet clear. Settlements are known to have existed across the plain from as early as the third millennium B.C. (Wang Y. 2003; Wang and Jiang 2000; Wang and Sun 1999; see Chapter 4), so there were communities in the region before the weir was constructed. Furthermore, earlier water diversion systems are known that predate the Dujiangyan weir (e.g., at Fangchijie in modern Chengdu; Chengdu and Chengdu 2003; Wang Y. 1991b). Recent research, however, suggests that early settlements were sparser toward the northern and western parts of the plain (Chengdu 2010). It is possible, therefore, that before this water control was introduced, the area closest to Dujiangyan was precarious owing to flooding and sedimentation problems.

Dadu River and continues flowing southward until it joins the Yangzi at Yibin.

The Chengdu Plain has been a primary focus of archaeological research in Sichuan and consequently serves to structure discussions of Neolithic and Bronze Age societies in the region. The finds at Sanxingdui in particular (discussed in Chapter 4) have been identified as evidence for a polity centered in the Chengdu region, and subsequent phases document a continuous sequence of complex societies in the area into the historical Shu period (before 316 B.C.). Relative to other parts of the Sichuan Basin, the Chengdu Plain is the best understood and will be one geographical focus in subsequent chapters.

Farther east, the central part of the Sichuan Basin is the hilly area dominated by the Jialing River and its tributaries (see Figure 2.3). The Jialing River runs 1,119 km from its source in southern Gansu through

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Shaanxi and Sichuan provinces to Chongqing City, where it meets the Yangzi. Its major tributaries are the Fu River on the west and the Qu River on the east, both of which join the Jialing at Hechuan. The central hills of the Jialing drainage range between 250 and 600 masl and cover about 105,000 km^2. These hills are composed of horizontal strata of Jurassic and Cretaceous sandstone and shale and have steep sides and thin soil deposits.

The Jialing River will eventually prove to be a critical area for understanding macroregional relationships among communities in early periods. Historical documents identify this as the center of the Ba polity during the last third of the first millennium B.C. (Sage 1992). Unfortunately, little field research has been conducted in this region to date, and, therefore, the role of the Jialing watershed in interregional interaction is still not well understood. Future research will likely fill this lacuna.

The easternmost portion of the basin comprises a series of parallel ridges and valleys that trend northeast at about 30°. The elevation of these ridges decreases from approximately 1,000 masl in the west to approximately 700 masl in the east. These ridges, like the central hills, are made of sandstone and shale, but their strata protrude at angles owing to the aforementioned tectonic movements. The ridges form a series of barriers to communication between the Sichuan Basin proper and the northeastern-trending section of the Yangzi on the eastern edge of the basin. The ridges closest to the Yangzi converge on the river, eventually meeting near Fengjie, where the first of the Three Gorges discussed later is located.

Archaeologically, this region is bifurcated between the ridges west of the Yangzi, where little research has been conducted, and the land closest to the Yangzi River, where the Three Gorges dam project described in Chapter 3 has directed significant resources during the last decade. Owing to the cultural and historiographical connections between these sites and those in the Gorges, our discussion of this region in other chapters is included in the sections that focus on the Three Gorges.

In addition to these three main subareas of the Sichuan Basin, the Wu River valley southeast of the basin proper is a fourth major region of the physical topography of Sichuan. The Wu River flows 1,100 km northward through steep gorges in the Dalou Mountains of the Yunnan-Guizhou Plateau, until it joins the Yangzi from the south at Fuling in Chongqing Municipality. Together with the Min, Tuo, and Jialing rivers, the Wu completes the set of four rivers to which "Sichuan" ("four river districts") is often said to refer.

The name "Sichuan" dates to the Song Dynasty (A.D. 960–1279) and in fact references four districts along rivers in the eastern part of the modern province (Ren and Ren 2002: 29–31). One, the Yi District (i.e., Yizhou), included the Chengdu Plain and surrounding areas and is associated with the Min River. A second, the Zi District (Zizhou), contained the central part of the basin, including the Tuo River drainage and the Middle Jialing, Fu, and Qu river valleys. The Upper Jialing River drainage as well as the surrounding mountains comprised the Li District (Lizhou). Finally, the Kui District (Kuizhou) consisted of the Wu River valley and the section of the Yangzi River upriver from the Three Gorges. During the Yuan Dynasty (A.D. 1271–1368), "Sichuan" first became the name for a province-level administrative entity.

The Wu River valley has also had limited archaeological attention, but elaborate tombs at Xiaotianxi, discussed in Chapter 9, have provided important information on Late Bronze Age communities in the upper reaches of the Three Gorges area. The Xiaotianxi tombs also relate to the nature of the Ba people and their social structure during this period.

In summary, the physical geography of the Sichuan Basin can be subdivided into four general zones: the Chengdu Plain, the Jialing River and its tributaries, the parallel ridges of eastern Sichuan, and the Wu River valley. Of these, the Chengdu Plain has received the most archaeological attention, while the other areas are poorly understood. Each zone presents rather different topographical conditions and slight variations in climate regimes. As a whole, the geological history of the basin has set it physiographically apart from regions to the east and north, a situation that has fostered the rather independent cultural developments that have occurred in this part of Central China.

Middle Yangzi

The eastern part of Central China consists of the Middle Reaches of the Yangzi River between the Three Gorges and Poyang Lake (Figure 2.5). The Middle Yangzi is a tectonic subsidence zone with a series of alluvial and lacustrine plains formed since the Cretaceous period by two great rivers, the Yangzi and the Han, and two large lakes: Dongting and Poyang (and their tributaries). These lakes were probably formed relatively recently through river-flow processes (Fang 1991). To the north, the Tongbai and Dabie ranges, with elevations between 500 and 1,000 masl, separate this region from the Central Plains of northern China. North of the Tongbai, rivers run into the Yellow and Huai River drainage systems, while south of these mountains, water flows into the Han River and, eventually, into the Yangzi. The southern end of the Dabie Mountains north of the Yangzi and the Mufu Mountains south of the Yangzi define the eastern edge of Central China, just upriver from the plains surrounding Poyang Lake. The highlands and lowlands of the modern province of Hunan comprise the southern extent of the Middle Yangzi region discussed here. The western limit of the Middle Yangzi is defined in the north by the Daba and Wu mountains, through which the Three Gorges are cut, and farther south by the northeastern end of the Yunnan-Guizhou Plateau. The Middle Yangzi thus defined can be divided into three subareas: the Nanyang Basin, the Jianghan Plain, and the Dongting Lake Plain (cf. Li F. 2006: 319).

The Nanyang Basin lies between 80 and 140 masl and includes a collection of tributaries that feed into the Tangbai River and then into the Han River at Xiangfan. The basin is circumscribed by highlands on three sides. To the west are the Daba Mountains, to the north is the eastern end of the Qinling range, and, to the east, the Tongbai Mountains separate the basin from the Huai River drainage. To the south and southeast, the Nanyang Basin is connected to the Jianghan region through two relatively low areas: the Han River valley on the west and the Yun River corridor on the east. These are separated by the Dahong Mountains, a highland area covering 330 km^2 and reaching peaks higher than 1,500 masl.

Although the Neolithic cultures of the Nanyang Basin are related to northern China cultural sequences, this region is important to the political topography of Central China discussed in Chapter 4. It was probably the original political core of the Chu state that came to dominate the Middle Yangzi during the first millennium B.C. As Chu expanded, its main thrust brought it south along the Han River into the Jiangling area in the western part of the Jianghan Plain.

The Jianghan Plain is a large, densely populated lowland area coincident with the northern parts of the great Yunmeng Marsh and surrounding lowlands. Most of the plain lies below 50 masl, and its peripheral areas range between 50 and 200 masl (Hubei 1997: 274). The plain is characterized by a low, flat topography with occasional hills interspersed among plains of fluvial sediments that have settled within former basins. Within this plain, the Yunmeng Marsh extended from Jiangling in the west 170 km to Wuhan in the east (Tan 1982: 29–30), covering a total area of approximately 8,000 km^2. It probably reached its maximum size around the beginning of the second millennium B.C. (Yang et al. 1998) and remained a large swampland through the Han Dynasty (206 B.C.–A.D. 220). Most of this marshland is now low agricultural land drained by an eastward flowing section of the Han River, but, during the period discussed in this book, much of this area would have been swampy and inhospitable, with tributaries flowing south into the marsh and frequent floods (Tong 2000; Yin et al. 2007; Zhu C. et al. 1997). The draining of this marsh occurred during the medieval era and has been accelerated by

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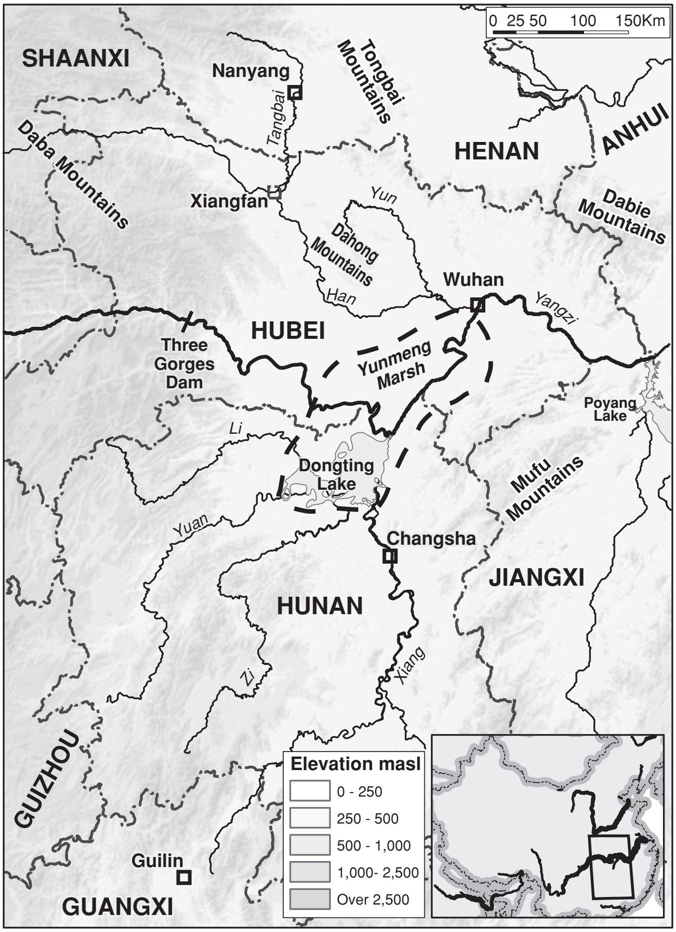

Figure 2.5. Map of the Middle Yangzi showing important rivers, mountains, and cities mentioned in the text. Elevation shading is the same as in Figure 2.1.

the reclaiming of wetlands for agricultural purposes during the twentieth century.

Despite the wetlands across large parts of the Jianghan Plain, during prehistory and the early historic periods discussed in this book, certain parts of this area were central nodes in the political, cultural, economic, and ideological topographies that characterize the Middle Yangzi region. Sites associated with the Early Neolithic cultures of the Middle Yangzi can be found in the western part of the Jianghan Plain from the earliest

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periods. During the second millennium B.C., discoveries in the eastern parts of the plain indicate that communities with strong ties to the Shang state of the Central Plains were established near Wuhan and connected to northern polities along the Yun River valley (see discussion of Panlongcheng in Chapter 4). By the first millennium, the western parts of the plain were central to Chu populations, who established large walled communities and huge burial grounds with hundreds of mounded tombs just northwest of the Yunmeng Marsh areas.

Dongting Lake lies south of the Jianghan Plain, fed by four rivers and their tributaries. From west to east, these rivers are the Li, the Yuan, the Zi, and the Xiang. The Xiang is the largest and flows 856 km, mostly northward, from its source in Guangxi near Guilin. During the Han period, when the Yunmeng Marsh was a large wetland, Dongting Lake was much smaller than the 4,300 km^2 that it covered in recent times, and it may have been formed only as recently as 2,500 years ago (Fang 1991: 528) or slightly earlier (Hunan 1987: 560). Subsequently, Dongting became the major flood basin for the Middle Yangzi and the largest freshwater lake in China. Recent land reclamation has shrunk its modern size to approximately 2,800 km^2 during the dry season, but it grows to many times this size during floods.

The earliest agricultural settlements in the Yangzi River valley are found in the Li River valley, where it drains into the Dongting Basin. Even earlier sites containing late Pleistocene ceramics are found in the upper reaches of tributaries to the Xiang River. The Dongting Lake and its tributaries, therefore, are important centers of cultural development in Central China. During later epochs, this region was marginalized in the political developments that connected the Middle Yangzi to northern China. Archaeological discoveries suggest that the fragmented topography of Hunan was paralleled by heterogeneous cultural and political topographies throughout the Bronze Age.

The three subregions of the Middle Yangzi River zone of Central China were affected by slightly different climatic regimes and more substantial differences in their hydrology and physiographic topographies as well as their proximity to other populated regions. Despite these differences, settlements across this region were fairly consistently located on secondary terraces above water courses and were frequently moved as new terraces were formed by river downcutting and lateral erosion processes (Zhu C. et al. 2007).

Three Gorges

Between the Sichuan Basin and the lowlands of the Middle Yangzi lie the Three Gorges. In our discussion, we divide the Three Gorges region

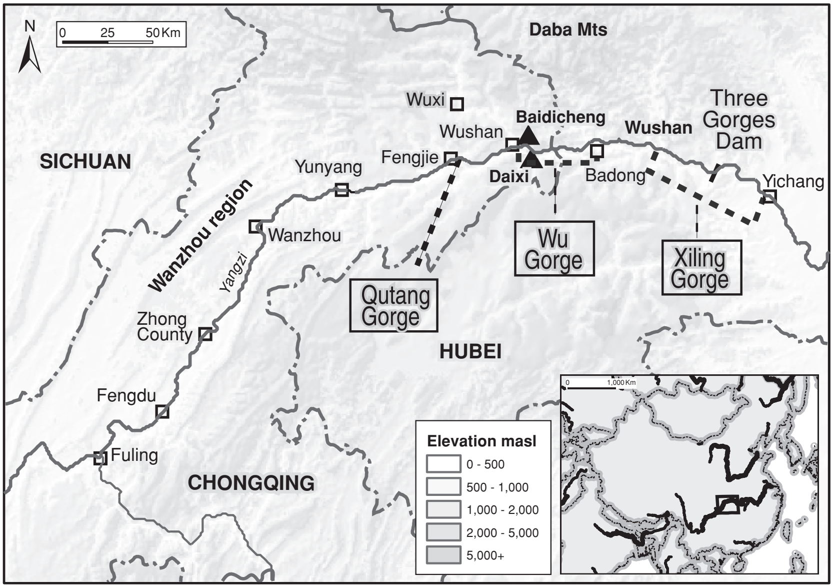

Figure 2.6. Map of the Three Gorges region showing the location of major county seats, the three individual gorges, the dam site, and sites mentioned in the chapter.

into two main sections: the Wanzhou region on the west and the Three Gorges proper on the east (Figure 2.6).

In the Wanzhou region, from Fuling to Wanzhou County (i.e., Wan County), the Yangzi River runs mostly northeastward between two of the northeastward-trending folds on the eastern end of the Sichuan Basin. At the seat of Wanzhou County, the orientation of these ridges turns eastward and the river follows suit, gradually being funneled into the Three Gorges proper at Fengjie. Most of this region on either side of the Yangzi is characterized by rolling hills that lie atop a stratum of precipitates called the Wanzhou Salt Bed (Wan Xian 1991: 52; see Figure 2.6). Along the banks of the Yangzi and its tributaries in this area, numerous archaeological sites have been identified during the last decade of research (see Chapter 6).

The Three Gorges proper comprise three successive narrow defiles of the Yangzi River course between Fengjie and Yichang: the Qutang, Wu, and Xiling gorges. These gorges are the result of downcutting by the Yangzi River through a series of ridges that were formed during the Yanshanian Orogeny (ca. 190–130 mya) – the same processes that created the parallel ridges in the eastern part of the Sichuan Basin.

The Qutang is the westernmost and shortest gorge at 8 km long. The surrounding peaks reach 1,000 masl and are part of the Qiyao ridge anticline, through which the Yangzi River has cut (Shaw 2004: 57). The most dramatic features here are the vertical cliffs of Mesozoic limestone and sandstone that form the Kuimen Gate at the entrance to the gorge (Figure 2.7). Most famous as the location of an Eastern Han Dynasty (A.D. 25–220) fortification named Baidicheng, which became an important setting in the Three Kingdoms period, the Kuimen Gate and associated rapids made this section of the Yangzi River particularly difficult to traverse in antiquity.

Just downstream from the Qutang Gorge, on the southern bank of the river, is the Neolithic site of Daixi, the type site for an important Middle Neolithic culture that was mainly distributed in the Middle Yangzi region (see Chapters 5 and 6). Farther along, the Daning River enters the Yangzi from the north and the Wu Gorge begins. This gorge stretches 45 km and is the part of the Yangzi that cuts through the anticline of the Wu Mountains proper.

From Badong, below the Wu Gorge, until the confluence of the Xiang Stream, the surrounding topography is less precipitous. The Yangzi then enters the Xiling Gorge, composed of a series of smaller, distinct gorges in succession. Many treacherous shoals in the river affected early traffic in this gorge, although most were removed in the twentieth century. In this area, the surrounding mountains are primarily limestone escarpments with many caves. Despite the apparent attractiveness of this environment, investigations of the caves by Nels C. Nelson in the 1920s demonstrated little evidence of early occupation (see Chapter 3). In fact, identified archaeological sites throughout the gorges are mostly open-air sites relatively close to riverbanks.

Subsequent to Nelson's initial work, archaeologists mostly ignored the Three Gorges, but recently the region has become an intense focus of interest owing to the construction of the Three Gorges Dam (see Chapter 3). There are Paleolithic and Early Neolithic remains in the region, the latter of which share some similarities with Neolithic cultures from the Middle Yangzi. Early Bronze Age remains, in contrast, share affinities with Sanxingdui materials from the Chengdu Plain, while later Bronze Age remains are fairly local and idiosyncratic in nature. The cultural developments in this region are discussed in detail in Chapter 6.

The precipitous gorges themselves, the narrow tributary valleys that feed into the gorges, and the long, parallel ridges that compose the easternmost section of the Sichuan Basin each constrain population movement through the area and affect the subsistence practices that characterized communities in the region in antiquity. Furthermore, the swift,

Figure 2.7. Kuimen Gate. (Photograph by Flad, March 2007.)

treacherous currents of the Yangzi River in this area also affected the ease of transportation and the suitability of the region to centralized political control. These environmental characteristics played an important role in structuring the relationships among communities within the Three Gorges and between these communities and other regions throughout antiquity.

Climate

Central China is characterized by a temperate subtropical climate regime that promotes broadleaf evergreen forests and a relatively diverse faunal biome. The region's climate is fundamentally affected by monsoons caused by the rise of the Tibetan Plateau during the Himalayan Orogeny beginning approximately 50 mya. Seasonal shifts in prevailing winds and climate patterns in East Asia were observable by approximately 10–8 mya (An Z. et al. 2001) and may have begun much earlier (Sun and Wang 2005). As the monsoon system intensified during the late Miocene, seasonality and summer precipitation across most of East Asia increased. These markedly seasonal monsoons occur when the heating of the Asian landmass relative to oceans causes pressure gradients that drive low-altitude airflow inland, producing summer rains across the southern part of the continent.

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Table 2.1. Temperature and precipitation averages in Central China

	Annual temp. (°C)	Jan. temp. (°C)	July temp. (°C)	Annual precip. (mm)
Sichuan Basin	16°–18°	5°–8°	26°–29°	900–1,300
Middle Yangzi	15°–17°	2°–6°	25°–30°	700–1,700
Three Gorges	15°–17°	~5°	27°–28°	1,000–1,200

Central China is mostly affected throughout the Holocene by the southeastern summer monsoonal weather patterns (i.e., the East Asian Monsoon) that flow from the Pacific across most of eastern China to approximately 40°N. In winter, the process is reversed as high pressure over Siberia is reinforced and cold, dry air from higher latitudes flows into China (An Z. et al. 2000; He et al. 2004). Precipitation is heavier toward the southeast of the region, where monsoon conditions are stronger, and lighter toward the north and west. Years of weaker summer monsoons mean more rain in the south and drought conditions in the north. Strong summer monsoons mean more rain in the north and less in the south. More than 60 percent of annual precipitation is concentrated in the summer months of June, July, and August.

Modern Climate Conditions

Although broadly part of the same climate zone, the different sections of Central China vary in their modern annual temperature and precipitation conditions. The Sichuan Basin, for example, has a warmer winter climate than the Middle and Lower Yangzi owing to the surrounding mountain ranges. Mean January temperatures are 5°–8°C and summer temperatures are hot, at approximately 26°–29°C (Table 2.1). Annual precipitation ranges from 1,500 to 1,800 mm in the surrounding mountains and from 900 to 1,300 mm in the basin (Zhao S. 1994: 234). The winters are particularly dry – only 10–30 mm of precipitation fall across the basin during January, compared to 150–200 mm during the month of July (Sichuan 1996b: 18–22). Relative humidity across the basin averages about 80 percent throughout the year, without much fluctuation (Sichuan 1996b: 42). The average number of hours and the strength of solar radiation are relatively low during winter (40–95 hours per month) and reach a peak in summer (August) around 150–200 hours (Sichuan 1996b: 37–39).

In the Chengdu Plain, precipitation averages are slightly higher than in other parts of the Sichuan Basin range at approximately 1,000–1,300 mm

(Liu Q. 1997; Zhong Xian 1994). On the western fringe of the plain, annual precipitation is even greater (as much as 1,700 mm) owing to the effects of the surrounding mountains (Sichuan 1996b: 19). Average temperatures in the plain are more or less the same as in the basin as a whole (ca. 16°–18°C), and seasonal patterns are similar as well, although summers are slightly cooler (Sichuan 1996b: 102). In the Jialing River drainage and into the parallel ridges of eastern Sichuan, temperature conditions match the Sichuan Basin average, although summer temperatures can get extremely hot, above 40°C. Precipitation averages are slightly lower than in the basin as a whole.

Average precipitation varies across the Middle Yangzi area, from around 700 mm per year in the north around the Nanyang Basin to more than 1,700 mm per year in the hills leading into the northeastern section of the Yunnan-Guizhou Plateau in the southwest and in the highlands of the Mufu Mountains in the southeast (Hubei 1997a; Hunan 1987). Across the Jianghan Plain, averages range between 1,000 and 1,300 mm, and averages in the Dongting Lake area and southward in its tributary valleys are between 1,300 and 1,400 mm. Farther north, in Shaanxi and Henan, most precipitation occurs in the late summer and autumn, and more than 70 percent falls between the months of March and August in the Middle Yangzi (Hubei 1997: 365). January temperatures range from 2.5°C in the Nanyang Basin to 6.0°C south of Dongting Lake, several degrees cooler than in the Sichuan Basin. The Jianghan Plain has the coldest winter temperatures, sometimes dipping down to −20°C. In the summertime, July temperatures are hot, with average highs between 25.5°C and 30°C. The annual average temperature in the lower elevations of the Middle Yangzi is 15°–17°C, with higher averages occurring farther south in Hunan. The difference between winter and summer in solar radiation is slightly greater here than in the Sichuan Basin due in part to the monsoonal climate (44–130 hours per month in winter and 190–280 hours per month in summer; Hubei 1997: 369).

In the Three Gorges, the climate patterns are affected by the surrounding topography. Monsoon systems from the southeast are disrupted by the highlands on the western side of the Middle Yangzi region. Annual temperatures average approximately 15°–17°C, and precipitation averages approximately 1,000–1,200 mm (Lan 2003: 3). On the eastern end of the Gorges, in the Badong region, average January temperatures within the gorges themselves are relatively warm (around 5.0°C) and rarely go below −10°C (Hubei 1997). Summer average temperatures are also warm, around 27°–28°C. The surrounding mountains, however, are several degrees cooler. To the north of the river, highlands are also drier, while to the south and southeast, the highlands are much wetter, with average precipitation greater than 2,000 mm per year in the southern reaches of the Wu Mountains and in the northeastern parts of the Yunnan-Guizhou Plateau. Farther upriver in the Wanzhou area, average temperatures are warmer at 18°–19°C, with January averages between 6° and 8°C and July averages between 27° and 29°C (Sichuan 1996b: 101). Annual solar radiation in this region is between that of the Sichuan Basin and the Middle Yangzi valley, reaching 230–250 hours during August (Sichuan 1996b: 37).

In sum, the climatic conditions of Central China are moderate, with winter temperatures typically above freezing and with hot, humid summers. Local conditions vary even within the subregions of Central China. The effects of the physical geography discussed earlier on weather patterns and monsoon strength cause much of this variation. The subtropical climate is conducive to the broadleaf evergreen canopy that covers this entire region and is mild enough to allow multiple agricultural seasons. It is worth noting that the completion of the Three Gorges Dam may induce dramatic climatic changes in this region. Already in 2003, after the reservoir level behind the new dam was raised to 147 masl, local weather patterns became quite unstable. It is very difficult to say whether this short-term fluctuation is related to the dam, but climatic conditions should be monitored closely over the next several decades to evaluate its effect.

Ancient Climate

Modern climatic conditions obviously do not represent average past temperature and precipitation amounts (Jarvis 1993; Keightley 1999a; Yi et al. 2003; Zhu K. 1972). Studies of Holocene paleoclimate in particular have documented several differences between earlier periods in the Holocene and the present day. These include a global period of optimal climatic conditions during which temperatures were warmer and rainfall was more abundant than now (Winkler and Wang 1993). In East Asia, another diachronic trend involves maximum monsoon strength in the early to middle Holocene, after which monsoons weakened (An Z. et al. 2000; He et al. 2004; Kutzbach 1981; Kutzbach and Gutter 1986; Wang Y. et al. 2005; Zhao Y. et al. 2007: 51). According to some research, optimal climatic conditions occurred between 6500 and 1000 B.C. (although paleoclimate reports typically use dates before present (bp or ka), here we use B.C. dates to retain consistency throughout the book), with a peak period approximately 4500 to 3500 B.C. (Shi et al. 1993, 1994; He et al. 2004:61), although this claim has been doubted by some (Chen F. et al. 2006). A period of climate stress identified as

Holocene event 3 has been dated to approximately 2000 B.C. across the northern hemisphere, and some scholars implicate this event in cultural collapses that occurred around this time (Wu and Liu 2004; see also An C. et al. 2006; Sun and Chen 1991; Tang et al. 1996; Tao et al. 2006). Holocene climate, therefore, has not been identical to modern conditions, nor has it been stable.

In fact, Holocene data suggest periodic shifts between wet and dry and warm and cool conditions (Chen F. et al. 2007; Wang Y. et al. 2005). These climatic cycles were connected to fluctuations in solar radiation, inland ice dynamics, and ocean and atmospheric circulation (Wünnemann et al. 2007). Although Holocene cycles have not been as dramatic in amplitude as those during the last full glacial period (between 24,000 and 14,500 years ago) or the Younger Dryas (around 12,700 to 11,600 years ago), the shifts have been frequent and regular, occurring at intervals of approximately 1,500 years (Madsen and Elston 2007: 71; Mayewski et al. 2004: 244). For periods of time, for example, weak summer monsoons led to arid intervals in northern parts of East Asia, including intense dry events around 5000–3000 B.C., 1000 B.C., and again around A.D. 1000 (Chen F. et al. 2007). These relate to worldwide periods of rapid climate change observed between approximately 3000 and 2000 B.C., 2200 and 1800 B.C., 1000 and 500 B.C., and A.D. 800 and 1000 (Mayewski et al. 2004: 246). Weak summer monsoons also mean potentially wetter periods in southern China. The Holocene event 3, mentioned earlier, seems to have been one such period when cooler temperatures and weak summer monsoons led to droughts in northern China and flooding in the south (Wu and Liu 2004).

Furthermore, not only was climate inconsistent through the Holocene, oscillations in the strength and impact of monsoons and climate trends also did not occur synchronously across East Asia (An Z. et al. 2000; Chen F. et al. 2006; He et al. 2004; Wu X. et al. 1994; Zhao Y. et al. 2007: 62). It is, therefore, problematic to take climate data from one subregion and apply them to another area. For example, the evidence used to support the claim for an early to middle Holocene climate optimum in East Asia has indicated that this optimum period occurred at different points in time across the region (An C. et al. 2006; An Z. et al. 2000; He et al. 2004; Wu X. et al. 1994) and may not even characterize the middle Holocene generally (Chen et al. 2006). Whereas precipitation in northern parts of China was at its maximum between 8000 and 5000 B.C., in the middle and lower reaches of the Yangzi River valley, this occurred between 5000 and 3000 B.C. (An Z. et al. 2000).

The exact character of paleoclimate in Central China is difficult to reconstruct. The general picture of macroenvironmental trends is based primarily on sources from other areas, with only scattered contributions from this region. The scattered data include several pollen studies from lake cores in the Middle Yangzi and lakes in the Yunnan-Guizhou Plateau south and southwest of the Sichuan Basin. In theory, faunal remains collected at archaeological sites also provide useful data for assessing climate in addition to monitoring the exploitation of natural resources and subsistence practices, but sensitive assessments of climate require a focus on microfauna, and no such research has been conducted in this part of China from late Holocene sites.

The data that do exist for Central China are not published thoroughly. Discussing this scattered information requires examining secondary literature that cites several unpublished studies (e.g., An Z. et al. 2000; He et al. 2004; Jarvis 1993; Sun and Chen 1991; Wu and Liu 2004). Closest to the Sichuan Basin are several studies that have been conducted in southwest China in the provinces of Yunnan, Guizhou, and Guangxi and in the highlands of Western Sichuan.

For example, two pollen cores from Shayema Lake in southwestern Sichuan provide one set of data from the region (see Figure 2.8; Jarvis 1993). These cores represent Holocene climatic conditions for the interface zone between the Sichuan Basin and the Himalayan Plateau. Here both the southeastern and southern Asian monsoons affected climate conditions over millennia. The pollen profiles from Shayema indicate that climate ameliorated between 7100 and 5800 B.C. as birch (*Betula*) and deciduous oaks decreased and pines (*Pinus*) and several deciduous broadleaf taxa increased (Jarvis 1993: 333). Evergreen oaks also became more common. Pollen from hemlock (*Tsuga*) became dominant thereafter, indicating a weaker summer monsoon system and increasingly seasonal rainfall with decreased differences in summer and winter temperatures until approximately 2000 B.C. At that point, climate stabilized for approximately 3,000 years. Some of these patterns are substantiated by additional pollen profiles and other climate proxy indicators for the region (see Jarvis 1993: 335–336), although the effect of the South Asian Monsoon is absent as one moves eastward.

Pollen profiles from Luoji Mountain near Xichang in Western Sichuan (Li X. 1986; Li and Liu 1988), for example, show fluctuating plant communities with a shift toward sclerophyllous broadleaf taxa with mesic conifers and mesic deciduous taxa during the period between approximately 6000 and 1000 B.C. (He et al. 2004: 54; Jarvis 1993; Wang J. et al. 1990). Slightly farther east, lake-level fluctuations measured at Caohai Lake in Weining, Guizhou, and other sites in Yunnan and Sichuan have contributed to a precipitation picture for the Yunnan-Guizhou Plateau. This picture indicates high water levels from 12,000 to 10,000 years ago,

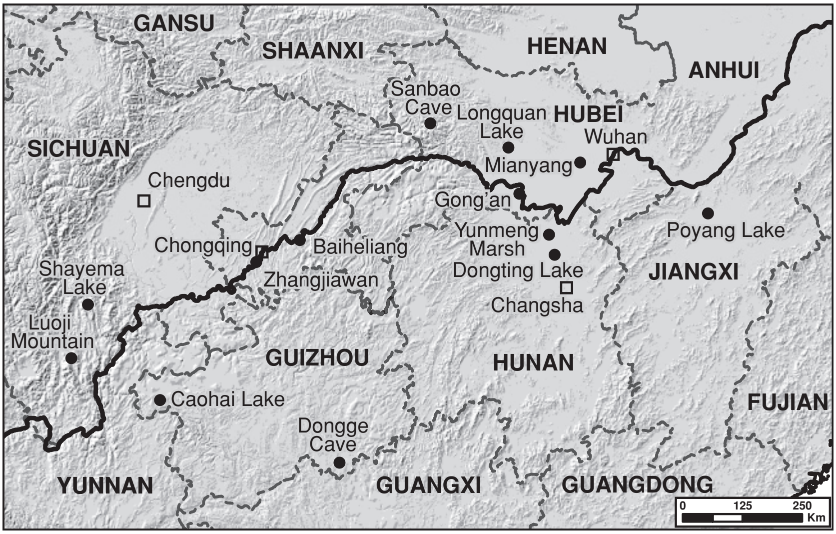

Figure 2.8. Location of paleoclimatic studies mentioned in the text.

followed by a gradual transition to intermediate levels for the rest of the Holocene, with the exception of some evidence for an increase between 4000 and 1000 B.C. (An Z. et al. 2000: 747; Lin and Zheng 1987). Farther south, near Libo, Guizhou (at Dongge cave), speleothem research on a 9,000-year sequence of stalagmite oxygen isotope ratios shows abrupt lowering of monsoon intensity around 2400 B.C. (Wang Y. et al. 2005). This coincides with other evidence of climate change around this time – the so-called Holocene event 3 mentioned earlier (Wu and Liu 2004).

The preceding data all come from the Yunnan-Guizhou Plateau. The Sichuan Basin has been researched even more sporadically. Examples of recent Quaternary climate research in the basin are limited to a study of pollen profiles from a step terrace along the Jialing River and vague discussions of climate change based on pollen analyzed from Zhangjiawan (Luo L. 1989; Sun and Chen 1991; Zhu and Yu 2003: 203–205).

In the Middle Yangzi, data are slightly more abundant for the Holocene. They suggest that, during the Holocene optimum (probably between 5000 and 3000 B.C. for the region), temperatures averaged about 2°C warmer than present (Shi et al. 1993). Among these data are high-resolution oxygen isotope data from Sanbao Cave, on Shennong peak in Hubei, and pollen profiles from Longquan Lake in the Jianghan region and Dajiu Lake on Shennong peak (Liu G. 1988; Zhou M. 1985, as cited in Sun and Chen 1991). The stalagmite data from Sanbao Cave show maximum humidity during the period between 7500 and 4500 B.C., with a gradual decrease in monsoon intensity over the course of the subsequent six millennia (Dong et al. 2010). The reported pollen data demonstrate an increase in the total pollen sedimentation rate around 8000 B.C., which probably reflects the beginning of the climatic optimum (Li W. et al. 1992; Sun and Chen 1991, citing Liu G. 1988 and Zhou M. 1985). Subsequently, an increase is seen in warm-adapted broadleaf elements such as a genus of walnut (*Cyclocarya*), *Lithocarpus* beeches, oaks (*Quercus*), and wingnuts (*Pterocarya*) and conifers, including spruces (*Picea*), firs (*Abies*), and hemlocks. Together, these pollen indicate a decrease in Jianghan region seasonality. Diversity increased after 3000 B.C., and herbaceous pollen increased, perhaps indicating cooler and/or drier conditions (Sun and Chen 1991: 540).

Other pollen evidence adds to this picture. Four cores from Gong'an in Hubei record several cold intervals, including one at 2500 to 2300 B.C., which marks either the coldest period during the Holocene or a climatic jolt at the end of the climatic optimum in this area (Tang et al. 1996; Wu and Liu 2004). Additional cores have been collected from Poyang Lake (Editorial 1987: 63–69), Dongting Lake (Zhang X. 1991; Zhang X. et al. 1994), the Yunmeng Marsh (Tan 1980), and Mianyang (Yang X. et al. 1998; Wu and Liu 2004), contributing further supporting evidence (all cited in An Z. et al. 2000).

Associated studies of lake levels in the region suggest that precipitation was relatively high between 6000 and 5000 B.C. From 2600 to 500 B.C., data from the Jianghan Plain indicate a relatively wet period (Xie et al. 2005). Flooding in this region, once again tied to the Holocene event 3, was severe in this period (Wu and Liu 2004; Zhu C. et al. 1997, 2007). Some have suggested that this flooding was due to strengthening of the monsoon (Zhu C. et al. 1997), but others disagree and connect increased southern precipitation to weaker monsoon systems (Wu and Liu 2004: 162). Lake levels remained intermediate, however, until lower evaporation rates between 1000 B.C. and the present led to high levels again in this period.

Evidence for flooding is found in both the Middle Yangzi and the Three Gorges, and pollen evidence from Dajiu Lake in the Three Gorges also supports the general trends observed in the Middle Yangzi region. Other direct paleoclimate evidence from the Gorges is limited to faunal and macrobotanical data from archaeological sites. The presence of elephant and rhino remains between 2000 and 1000 B.C., for example, suggests a warmer climate regime in this period (Lan 2003; Flad 2005). Otherwise, reliable climate data are limited to much later periods and to historical sources. Included among these are 103 inscriptions at Baiheliang ("White Crane Ridge") in Fuling, Chongqing, which date to at least as early

Figure 2.9. Photograph of the inscribed Baiheliang rock outcrop in Fuling, Chongqing. (Photograph by Lothar von Falkenhausen, March 15, 1999. Used with permission.)

as A.D. 763 and concern Yangzi River water levels (Chongqing 1983a; Figure 2.9).

The impact of local Holocene-era climate changes on cultural evolution in Central China is very difficult to evaluate on the basis of current evidence. Certainly climatic conditions defined an important component of the natural environment within which human communities were established and changed, and radical fluctuations in climate could impact subsistence strategies and social institutions in extreme cases. In general, however, Holocene climate fluctuations were relatively subtle, and their impact was mitigated by the entrenched dialectic between social practices and institutions.

Summary

Together, the information presented in this chapter outlines two important aspects of the environment of the Three Gorges: the physical topography and the regional climate conditions. This discussion sets the physical stage for the archaeological data that compose most of the rest of the book.

The areas of the Sichuan Basin and the Middle Yangzi that became the population and political centers of Central China are in low, fertile locations accessible from multiple directions and proximate to variable terrain. In the Sichuan Basin, such an area is the Chengdu Plain, initially inhospitable owing to a propensity for flooding but that became a political center during the second and first millennia B.C. (see Chapter 4). This region was rich in animal and plant resources and proximate to multiple navigable rivers, which would have facilitated access to the nearby mountainous regions and interaction with communities farther afield. Although the Middle Yangzi situation is more complicated, nevertheless, the areas where we see most substantial political centralization are similarly low lying, near watercourses that allow access to resources and influences from various directions (see Chapter 5). In both the Dongting Lake region and the Chengdu Plain, this pattern was undoubtedly complicated by frequent flooding, but one consequence of this seems to have been investment in earthworks and other forms of hydrological engineering, potentially a stimulus for corporate institutions.

In contrast, the Three Gorges physical topography was restricted and encouraged interactions primarily in two directions – upriver and downriver along the Yangzi. Although the highlands of the Three Gorges contained small communities throughout prehistory, very little is known about this region archaeologically, and those settlements that did exist were not strongly integrated into regional networks. Sites along the Yangzi and on tributaries near the confluence with the great river were, in contrast, more closely tied to political and cultural centers elsewhere.

By presenting these aspects of landscape first, we do not intend to suggest that the environment predetermined the course of history. Instead, we believe that it framed the way that people lived and the ways in which people from different regions could interact. As we see in Part II, these factors do seem to have played a role in the isolation of the Three Gorges and the ways in which this region was connected to more distant places throughout history. First, however, we turn to another critical factor that structures our understanding of Central China – the topography of scholarly work on the region.