Late Pleistocene Human Migrations in China

by Youping Wang

Many archaeological and paleoanthropological discoveries have been made in China over the last 2 decades. Among these findings, I particularly note the recently excavated Late Pleistocene sites in the loess plateau in northern China and others found in a number of river basins in southern China. They all provide significant new information concerning Late Pleistocene human migrations across this vast region. A result of these excavations is the confirmation that flake- and pebble-tool industries dominated the region before the late marine isotope stage (MIS) 3. Small-flake-tool assemblages emerged suddenly during the late MIS 3 in South China. Blade industry first arrived in northwest China at the end of MIS 3, and microblade assemblages appeared in the loess plateau and the surrounding areas at a later stage. In this paper I briefly introduce the progress in Chinese Paleolithic archaeology and discusses Late Pleistocene human migrations and related issues.

For decades, Pleistocene China has been regarded as a vast and relatively isolated land at the eastern part of the Eurasian continent. Regardless of the geopolitical border, the natural boundaries are set by the Qinghai-Tibet Plateau, the northern and western deserts, and the subtropical lands in the south that stretch into Southeast Asia. Since the 1920s, thousands of Paleolithic localities have been found in this vast region, but only a few are known to Western scholars. Many sites remain unpublished or have been reported in regional journals and have material stored in local museums and work stations. Paleolithic research increased dramatically during the last 2 decades, leading to the discovery of numerous Late Pleistocene sites found across the loess plateau in northern China and at several river basins in South China. The new localities currently provide important new information concerning Late Pleistocene cultural changes and human dispersals. Below I review the new developments of Chinese Paleolithic archaeology and discuss the evidence for Late Pleistocene human migrations and related issues.

The Archaeological Record of the Early and Middle Pleistocene

The Earliest Occupations in China

In the early twentieth century researchers working around the area of the Nihewan village, located in a basin of northwest Hebei Province, recognized several Pleistocene sequences and other prehistoric occurrences. Based on surveys and excavations, the ongoing investigations in Nihewan identified an important core area for early hominin sites. The excavations at Majuangou, Xiaochangliang, Donggutuo, Banshan, Feiliang, and Cenjiawan yielded artifacts and animal bones attributed to the activities of such early hominins. Majuangou is identified as the earliest hominin occupation in China, dated to ca. 1.66 mya (Bar-Yosef and Wang 2012; Dennell 2013; Wei 1997; Wu, Wu, and Zhang 1989; Xie 2006, 2008; Zhu et al. 2004). Other sites are also dated to the time period between 1.6 and 1.0 mya. These early occupations are located along paleolakeshores and wetlands that supplied sources of vegetal and animal food as well as drinking water. Studies of knapped lithics found together with animal bones indicate that Early Pleistocene hominins obtained their food by hunting and scavenging (Y. P. Wang 2005). In addition, the basic operational sequence for manufacturing flakes with sharp edges is not much different from the industry revealed at the earliest site of western Asia, namely, Dmanisi in the Republic of Georgia (Ferring et al. 2011).

One of the most important findings from this period is the hominin skull from Gongwangling, Lantian County (Shaanxi Province). The initial paleomagnetic dating placed the fossil in the period between 1.1 and 1.15 mya, but more recent research suggested an earlier date of 1.63 mya (Zhu et al. 2014). The associated faunal remains indicate warm and wet climatic conditions similar to those of southern China today (Y. P. Wang 2005; Wu, Wu, and Zhang 1989).

The aforementioned archaeological records indicate similarities in the biological and cultural evolution of early hominins during the late Pliocene and the earliest Lower Pleistocene between China and western Asia. The common core chopper or core and flake industries reflect the earliest dispersals of hominins from Africa into Eurasia. Geography, climate, vegetal association, and the local fauna in East Asia did not present major obstacles to the migrating and colonizing groups. The region north of the Qinghai-Tibet Plateau was covered by spo-

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radic dunes instead of the large sandy desert of today (Cui et al. 1996; Shi et al. 1996). In addition, paleolakes and wetlands were widely present across the vast land in northern China, providing favorable conditions for early hominin survival (Dennell 2009; Y. P. Wang 2005).

Hominin Adaptation during the Middle Pleistocene

The Middle Pleistocene period was a time for flourishing hominin evolution and cultural development in China. Numerous fossils of *Homo erectus* with associated lithics and animal bones have been discovered across China. The records present a variable occupation pattern: caves are commonly occupied in the north, while in the south open-air sites on lakeshores or riverbanks are more common.

Zhoukoudian Locality 1 is, to a large extent, the best example of human adaptation during this time period. Locality 1 was a cave site preserving very thick deposits, with thousands of lithics and a large number of animal bones. Most notable is the location where six *H. erectus* craniums (commonly known as Peking Man) were unearthed. Important but controversial was the evidence indicating the use of fire at the site (Zhang 1987). The initial dating by uranium series, thermoluminesence, electron spin resonance (ESR), and paleomagnetism indicated that the lower unit dated to around 500 ka and the upper unit to 230 ka. The occupation of *H. erectus* at the site may have continued for more than 200,000 years (Wu, Wu, and Zhang 1989). A more recent dating attempt suggested an even earlier start of the occupation at Locality 1 from 700 ka onward (Shen et al. 2009). Several layers contained rich cultural remains, while others yielded only very few lithics or hominin remains. This may indicate changes in the intensity of occupation of the cave. The hominins of Zhoukoudian Locality 1 exploited locally available raw materials such as quartz cobbles from the nearby river and the surrounding hills. The lithic assemblage includes large heavy tools such as choppers and small-flake tools including scrapers and points. The larger choppers seem to have played an important role in the early phases of the occupation, but lighter tools became more common in the upper, younger layers of the site (Pei and Zhang 1985).

Important evidence of human adaptation during the late Middle Pleistocene comes from Jinniushan cave at Dashiqiao city (Liaoning Province). The site is located on the plain of the Liao River, and the excavations retrieved abundant lithics, animal bones, hearths, and a human burial (Lu et al. 2011). Ashes of variable thickness dispersed throughout the cave document the use of fire in this northern cold region at about 250 ka (Chen et al. 2004). Several of the fireplaces appear to have been encircled with rocks. Intentionally broken long bones and burnt bone fragments indicate exploitation by hominins. The small scrapers and the large quantity of animal bones, in particular the processed ones, indicate a great degree of human reliance on meat resources (Norton and Gao 2008*a*; Zhang 1996). The lithic industry of Jinniushan resembles that of Zhoukoudian Locality 1 by its medium- and small-size scrapers of quartz and the use of bipolar technique. The archaeological record from both Zhoukoudian and Jinniushan is a clear demonstration of the success of the subsistence and adaptation strategy of humans living in higher-latitude areas with cold temperatures and steppe vegetation.

In southwest China, Guanyindong Cave, in the area of Yunnan-Guizhou Plateau, is located in a well-developed karst landscape. Uranium-series dating of the residual sequence ranges from the late Middle to the Late Pleistocene (Wu, Wu, and Zhang 1989). The lithic assemblage is dominated by medium- and small-size scrapers, which are considered very effective for the acquisition and consumption of meat. Stone tools were made on siliceous rocks with the adoption of direct percussion by hard hammer (Li and Wen 1986). A large number of percussion-marked bones also reflect the importance of animal resources. Similar lithic technology can be observed in other caves in the southwest—for example, at Panxian Dadong—and is considered by many a regional adaptation trait of early humans (Karkanas et al. 2008).

From the southern part of northern China to the valleys in the southeast, many open-air localities or clusters of sites were discovered. The sites spread along the rivers, mainly along the upper-middle part of the Han River and the middle-lower area of the Yangzi River as well as the Baise Basin in the very south of China. These sites exhibit a highly distinct lithic industry compared with those of the regions mentioned above. Stone artifacts are made of cobbles, and the tool kit is characterized by large, heavy choppers and points but very few small tools. This type of lithic assemblage appears to fit the wood and bamboo resource exploitation and processing and could be perceived as an adaptive strategy for living in an environment with rich vegetation (Wang 1998; Y. P. Wang 2005).

One of the significant findings from this period is the human fossils and cultural remains from Quyuanhekou site, Yun County, Hubei Province, on the terrace of the Han River. The site yielded two relatively well-preserved skulls and some stone artifacts. The lithic assemblage includes scrapers made of quartzite as well as choppers and large points made of quartz or sandstone cobbles. A large group of animal fossils are identified as fauna typical of subtropical South China (Li et al. 1998).

Another concentration of sites is located along the Yangzi River, where many localities in the middle-lower Li River valley were surveyed and excavated. The sites are deposited in red sediment and are widely spread on the different level terraces in this region. Huzhaoshan, Hunan Province, is a typical example of this period, located on the fourth terrace of the Li River. It was excavated in 1988 and yielded several stone artifacts. The lithic assemblage can be assigned to the traditional cobble-tool industry, with large points made from long, loaf-shaped cobbles (Wang 1997). Besides Huzhaoshan, several other locations with similar lithic technology were recovered from the third and second terraces.

In the region of the Shuiyang River, a tributary of the larger Yangzi River, several sites have been discovered. Chenshan, for example, a site formed in the red soil under the lower part of the "Xia Shu" loess, yielded more than 1,500 lithic pieces. Based on the local geological sequence, the site is considered to have been occupied since the late Early Pleistocene until the end of the Middle Pleistocene, from around 900 ka to 150 ka. The cobble-tool industry had been present at the site throughout this long period. Lithics do not show changes in terms of technological organization. Locally available cobbles of quartzite and sandstone were exploited as raw materials. Cobble blanks were simply knapped into choppers and large points. Small-size flake tools were used in low frequency (Fang et al. 1992).

The Middle Pleistocene archaeological record of China and East Asia is dominated by core and flake industries, or Mode 1 technology, revolving around the production of cores and flakes or cobble tools. Based on up-to-date observations and analysis, the handaxes reported from East Asia so far are different from those of the West in terms of absolute numbers, frequency in the assemblages, and technological system of production (Norton et al. 2006; Wang et al. 2014). Some scholars have argued that new discoveries of handaxes in East Asia indicate the dispersal of populations bearing the Acheulean technological concept (Hou et al. 2000; Huang 1987; Li, Li, and Kuman 2014; Li et al. 2014; Lu et al. 2011; S. J. Wang 2005; Wang et al. 2012; Xie and Boden 2007). However, it is clear that the issues of how handaxe technology appeared in China and its role in early human evolution and adaptation in East Asia require further investigation.

The Transition to the Early Late Pleistocene

The cultural evolution in China is best recorded during the period marking the end of the Middle Pleistocene through the early Late Pleistocene, to about 50–40 ka. Notably, the number of sites increases, and their geographical distribution extends significantly. The regional differences seen previously in the lithic industries continue to be present. In northern China, a typical example comes from the open-air site of Xujiayao, Shanxi Province, which was dated by uranium series to 125–100 ka. The cultural remains are dominated by tens of thousands of stone artifacts. The raw material includes quartz, chert, volcanic rock, and quartzite, all of which can be obtained locally. Direct percussion is the major knapping method, whereas bipolar technology is used only occasionally. The tool assemblage is composed of small-flake tools such as scrapers, points, awls, and burins. The scraper category accounts for more than 50% of all tools. Importantly, spheroid is a characteristic tool type, and over a thousand such tools have been discovered at the site. The lithic assemblage indicates persistence in the traditional small-flake industry. However, a transformation in lithic production is evidenced by the presence of prismatic cores and elegant round scrapers, which are commonly regarded as a signature of the Upper Paleolithic (Gao and Norton 2002; Jia et al. 1979; Norton et al. 2009).

In the southern part of northern China, the tool industry is based on large cobbles. At Dingcun, for example, large points and choppers played a major role in the tool kit. However, in many other sites in this region, for example at Dali, heavy-duty large tools were replaced with medium- and small-size scrapers and points (Y. P. Wang 2005).

In southern China, the lithic industry does not exhibit noticeable differences from the earlier period. Persistence in the traditional cobble-tool industry is indicated both in raw material acquisition and tool production. The systematic excavation of the Jigongshan site, Hubei Province, revealed in its lower layer an activity surface covering about 500 m^2 that yielded several thousand lithic pieces and cobbles. The site is interpreted as a base camp where stone knapping occurred on a regular basis. Supporting evidence is offered by the presence of piled cobbles and a large concentration of lithic tools and other artifacts (Liu and Wang 2002).

At the same time, the Mousterian culture appeared in western Eurasia and replaced most of the Acheulean tradition with the adoption of the Levallois technique. Although the influence of Levallois techniques reached Xinjiang and Inner Mongolia—that is, the boundary between central and northeast Asia—during the late marine isotope stage (MIS) 3 period, foragers in East Asia continued to produce tools on flakes and cobbles using simple core and flake technology (Gao 2013; Gao and Norton 2002). This cultural division may be attributed to the lack of interaction between populations caused by the Qinghai-Tibet Plateau, a significant physical barrier (Wang 2003).

The Late Late Pleistocene

North China

Until very recently the emergence of modern humans in East Asia was considered a local evolutionary process taking place at around 50–40 kyr BP (Liu, Wu, and Xing 2016). This hypothesis derived from the study of human fossils. On the other hand, various archaeological assemblages indicate the presence of novel technological features and new behavioral traits usually associated with modern humans (Norton and Jin 2009). Below, I present the innovations and changes in human adaptations observed in the Chinese archaeological record of the period.

Some of the most abundant evidence comes from Upper Cave, Zhoukoudian (Norton and Gao 2008*b*). Three well-preserved skulls surrounded with decorations and ochre were discovered at the site, suggesting an intentional burial. Only a few stone artifacts were found, knapped by direct hard-hammer percussion and bipolar techniques. The tool assemblage is composed of scrapers and choppers, produced in a simple and crude manner. Bone and antler artifacts are also present, most notably an eyed bone needle and a polished antler with a broken tip. In addition, various types of body ornamentation were discovered, including beads (perforated pebbles, shells, animal teeth, fish bones) and an incised bone shaft. Some ornaments are covered with ochre. In other areas of the world—for example, in Western Europe and East Asia—the production of similar organic objects and ornaments has been suggested to serve as an important mark of modern behavior (Mellars 2006; Norton and Jin 2009; Pei 1990; Qu et al. 2013).

A similar cultural complex is attested at Xianrendong Cave, Liaoning Province, in northeast China. The cave yielded stone artifacts, bone objects, ornaments, human-modified (percussed) bone fragments, and ashes. Compared with Zhoukoudian Upper Cave, the lithics are more numerous but follow the same basic knapping technology. The artifacts are made of quartz pebbles. The tool kit is diversified and includes scrapers, points, awls, burins, choppers, and spheroids. Of all, scrapers are found in the highest frequency. The osseous industry includes one harpoon, one projectile point, and a couple of well-shaped needles. The body ornaments include perforated teeth and shell beads (Zhang et al. 1985).

This technocultural complex is widely spread in the caves and open-air sites of the northeast, for example, in Sifang Cave, Tashuihe, and Xiaonanhai. They are estimated to date to the early phases of the Upper Paleolithic and display a new subsistence pattern in this region (An 1965; Chen 1989; Y. P. Wang 2005).

In the northwest, a series of open-air sites, dated around the Last Glacial Maximum (LGM), are spread throughout the region, but the main concentration appears post-LGM. The landscape is covered with grassland or desert/grassland with limited plants. Hunting is viewed as an important method for food acquisition, and some lakeshore sites of this region are identified as base camps of hunter-gatherers. For example, Salawusu (Inner Mongolia) is a cluster of localities that yielded small-size stone tools made on the pebbles of siliceous rock. The tools are intensively and well retouched into various types, including side scrapers, end scrapers, points, burins, and awls. Scrapers dominate the tool assemblage, but end scrapers are the most standardized type. Knapping is practiced with simple core and flake technology as it was in earlier periods. Evidence for specialized hunting has been recovered from Salawusu (Huang 1989; Y. P. Wang 2005). For example, in the Fanjiagou locality alone, 300 horns of antelopes were uncovered.

The site of Shiyu in the same region provides further evidence of specialized hunting. The site yielded rich faunal remains including over 200 individuals of wild horses and wild donkeys. The lithic industry is similar to that of Salawusu. Raw material was directly knapped with hard hammer. Irregular flakes with triangular- and trapezoid-shaped ones were also produced. It has been suggested that the lithic industry and the subsistence patterns of the human foragers at the site indicate persistence in traditional technologies along with the emergence of new behaviors; the latter is best reflected in the discovery of a body ornament in the form of a pendant (Jia et al. 1972).

Technological and behavioral transformations become evident in the Yellow River basin around 30,000 years ago. These are best reflected in the cluster of the Shuidonggou (SDG) sites 1–12 (Li 2013; Pei et al. 2012). In SDG Locality 1, the earliest layers contain assemblages composed of Levallois and blade techniques (Boëda et al. 2011), whereas the upper layers are dominated by the core and flake industry that is common in North China. A somewhat similar situation was recorded in SDG Locality 2, where in two of the earliest layers—dating to 34.4 to 32.6 kyr cal BP—the lithic industry is dominated by cores and flake production, and yet rare blades and blade cores are also present. Ostrich eggshell beads appear in the later deposits dating to 31.3–29.9 kyr cal BP (Li et al. 2013). In SDG Locality 7, dated by optically stimulated luminescence (OSL) between 30,000 and 22,000 years ago, the basic industry is represented by cores and flakes, although it was subjected to fluvial disturbance.

In all SDG localities, good-quality raw materials, including dolomite and chert, were exploited. The tool assemblages are made up of end scrapers, notches, points, and various type of scrapers. Given the absence of such a technocultural complex from the previous period, it is commonly accepted that material culture from the earliest layers in SDG Localities 1 and 2 were produced either by migrating populations or as a result of cultural exchange between immigrants and local people (Bae and Bae 2012; Gao et al. 2002). In regions to the northwest, such as Mongolia, lithic assemblages were dominated by the Levallois technique. Within China the effect of these techniques has been noted only occasionally (Li et al. 2013). The persistence of the core and flake industry means that the local tradition and possibly the indigenous population eventually dominated.

During the LGM, microblade technology appeared in the north and northwest and broadly spread throughout the north of China, surviving there until the end of the Pleistocene. The earliest microblade evidence was found at the sites of Xiachuan, Dingcun, and Shizitan in Shanxi Province (Qu et al. 2013). Two types of microblade cores were present. One is labeled as "boat-shaped," the other as prismatic; in addition, other types, such as wedge-shaped cores, were present. Bladelets removed from these cores were sometimes retouched. The tool kits also include end scrapers, occasionally backed knives, burins, and small bifacial foliates (Y. P. Wang 2005).

Major examples of microblade technology are concentrated in the Nihewan Basin, for example, at the sites of Hutouliang, Youfang, and Jijitan. Hutouliang was discovered in the 1960s, and the sequence contained a large number of lithics, especially microblades and wedge-shaped microblade cores. The site was dated to about 15,000 years ago by ^{14}C and OSL methodologies. End scrapers dominate the tool assemblage, but scrapers, notches, points, and burins are also present. Tools are elegantly retouched. Abundant ornaments including perforated shells, pebbles, ostrich eggshells, and bird bones are present in the assemblage. Fireplaces were discovered at all sites, often with bone fragments scattered around them. Many sites in the Nihewan Basin display similar technological traditions and material culture (Wang 2000; Y. P. Wang 2005). I should note that the wedge-shaped core technology is very different from the former boat-shaped or prismatic core technology and is closely related to the microblade technology of northeast Asia and North

America. This is the industry of (one of) the migrating waves of humans arriving first in the Japanese archipelago and later in North America (Bae 2010; Ono 2004).

Central China

During the last 2 decades, many new Paleolithic sites have been excavated in Central China, including Zhijidong (Wang 2008*b*), Zhaozhuang (Zhang et al. 2011), Laonainaimiao (Peking University, School of Archaeology and Museology of Peking University, Institute of Archaeology of Zhengzhou 2012), Xishi (Wang et al. 2011), and Lijiagou (Peking University, School of Archaeology and Museology of Peking University, Institute of Archaeology of Zhengzhou 2011). These sites are located in the region of Zhengzhou, the capital of Henan Province, immediately south of the Yellow River. The region, traditionally referred to as a part of the "Central Plains of China," is situated on an assumed main crossroad of early human migrations between the East and the West as well as between North and South China (fig. 1). Except for Zhijidong Cave, these localities are open-air sites embedded in the loess, forming the well-known loess plateau of northern China.

Zhijidong Cave is located in the hilly region within the Mount Song range. The sedimentary sequence is over 20 m thick. The recently excavated area near the cave entrance is divided into nine layers. The lower unit (layers 8 and 9) yielded cobble tools (Wang 2008*a*) and is characterized by a higher frequency of heavy-duty tools such as choppers. Large pieces of quartzite and sandstone from locally available cobbles were primarily used, while quartz and chert are rare. On the other hand, layer 7 in the upper unit is characterized by flake tools. This layer was dated to ca. 40,000–50,000 years ago by ^{14}C and OSL. The lithics are mainly made of quartz and chert, and only a few quartzite and sandstone cobbles were used. It is worth noting that chert and quartz were exploited and transported from places between 5 and 30 km away from the site. Cores are directly knapped and

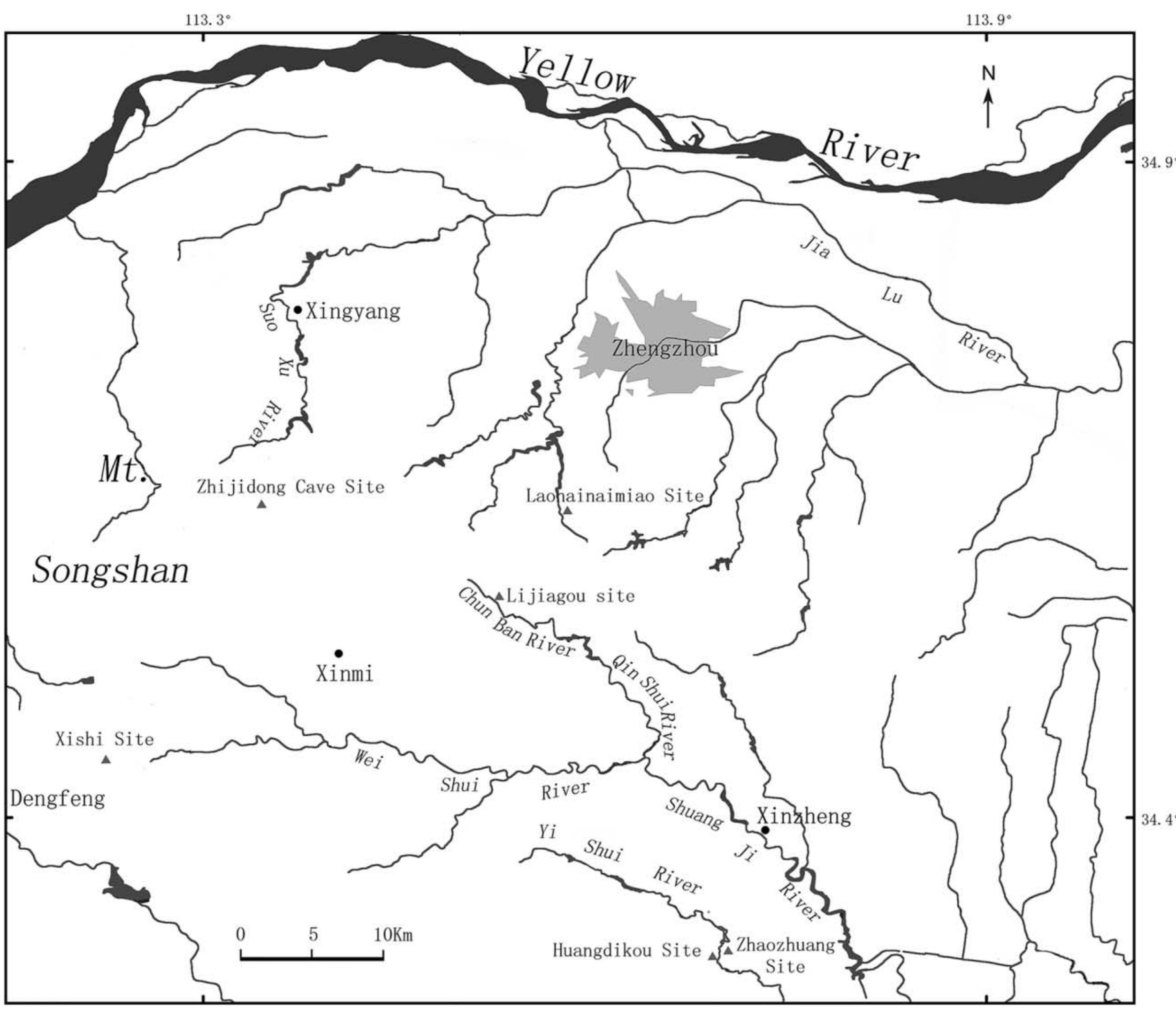

Figure 1. Geographic distribution of sites in Central China (triangles). A color version of this figure is available online.

are mostly of irregular shape. A few of them were produced by the bipolar technique. Several thousands of retouched pieces, classified as side scrapers, end scrapers, notches, awls, burins, and choppers were discovered.

Laonainaimiao is situated on the loess plateau along the banks of the Jialu River. The site has been excavated since 2011, and the exposed sequence contains 13 layers, demonstrating a consistent human occupation from 45,000 years ago based on ^{14}C and OSL readings. Layer 2 preserved a hearth rich in charcoal and ash and surrounded by animal-bone fragments and lithics. Layer 6 contained four fireplaces that formed a half-circular structure. The site has yielded a lithic assemblage of about 5,000 pieces characterized by the use of quartz sandstone and quartz. Quartz sandstone flakes are found in high frequency, but retouched pieces are less common. Most cores are multiplatformed and knapped by simple techniques without any indication of core preparation. The tool kit contains small-size side scrapers and points. In addition, over 10,000 fragments of animal remains were recovered, many of which are about 10 cm in length. The size and shape of the bones appear to be suitable for handheld use. Some fragments bear knapping scars and use wear. The primary identified faunal taxa include Equidae, Bovidae, and Cervidae. Several bones are human modified; carnivore and rodent gnawing marks are rarely seen. In addition to mammalian fauna, plenty of ostrich eggshells have been recovered from the site. Faunal analysis combined with the presence of over 20 hearths indicates that the site was a long-term base camp (Wang and Qu 2014).

Zhaozhuang is located on the third terrace of the east bank of the Yishui River. The stratigraphy is divided into seven layers, and the main body of the cultural unit is layer 7, which is composed of whitish-gray clay sand. It dates to about 35 kyr cal BP. The recovered lithics amount to over 5,000 pieces. Quartz and quartz sandstone were exploited for tool production, but quartz is the most dominant type. The quartz artifacts, the majority of which are smaller than 5 cm, include cores, flakes, chunks, and chips as well as scrapers, points, and choppers. Quartz sandstone artifacts are on average larger than 15 cm in length. Most quartzite material is knapped or broken into blocks, and only a few are retouched.

Next to the lithic workshop, a pile of stone blocks with an elephant skull on top was uncovered. The elephant skull, quartz sandstone, and quartz artifacts exhibit a south-north distribution. When it was recovered, the elephant skull was in a fragmented condition either as a result of postdepositional processes or by human activity. Most quartz sandstones underlie the skull, but some were also spread around it. Overall, it is possible that the stone pile was purposely erected to support the elephant skull. The large blocks of purple-red quartz sandstones were removed and carried to the site from the bedrock of Xing Mountain, about 5 km away. It is clear that the transport of these rocks was intended for the construction of the stone pile instead of producing stone artifacts.

Xishi is located on the second terrace of the upper Weishui River and was excavated in 2010. Dating to ca. 25 kyr cal BP, it yielded 8,500 lithics with clear evidence of blade production. Blades were concentrated in an area of 6 × 4 m in the northeast part of the excavation. The lithic assemblage contains hammer stones, cores, flakes, blades, bladelets, retouched pieces, and chert nodules. The collection is dominated by incomplete flakes, chunks, and chips. Most blades and blade cores may have been carried away by foragers when they moved to other sites (Wang et al. 2011). Some cores and flakes can be refitted, shedding light on the blade-knapping process. The typological and technological attributes of the lithics as well as their spatial distribution document a clear operational sequence of blade production.

Thousands of flakes were recovered at Xishi, and the frequency of typical blades exceeds 20%. Flakes with rejuvenated platforms and what may be considered as "the first blade of blade-core knapping" characterize the assemblage. With regard to the cores, blade core and blade-core fragments are dominant. Retouched pieces are present but in low frequency. The tool kit is composed of end scrapers, side scrapers, burins, and points; end scrapers dominate the assemblage. The majority of the raw material is chert, which was easily obtained from the bedrock near the site.

South China

The Upper Paleolithic in the south developed along a different trajectory apparently due to the peculiarities of the natural environment. In the southwest, the number of sites increases remarkably, and the material culture diversifies with the addition of bone and antler objects in the assemblages. The lithic industry does not show major differences from that of the local tradition of simple core and flake production. The cave inhabitants in the area of Yunnan-Guizhou Plateau used small-flake technology to produce tools, and their tool kit is dominated by scrapers. On the other hand, foragers living nearby, in the Sichuan Basin, tended to directly knap and retouch large cobbles into choppers and scrapers (Wang 1998).

In the surrounding area of the Nanling Mountains, cobble-tool industry was produced in the early MIS 3. This lack of change in the production of lithic tools may be best explained as a human adaptive strategy to this favorable environment where food and wood or bamboo resources were plentiful. However, at Bailiandong Cave in Liuzhou (Guangxi Province), Xianrendong Cave (Jiangxi Province), as well as other caves and open-air sites, small-flake-tool assemblages emerged suddenly during the late MIS 3. The number of small-flake tools continues to increase until the beginning of MIS 2. The presence of small-flake-tool assemblages, with the same flaking technique and tool types as those found in North China, may indicate the southward arrival of new populations from the north of the country.

The small-flake-tool industries were replaced with cobble tools at the beginning of MIS 2. The new industry, dominated by choppers, is different from the earlier traditional local cobble-tool industry. For instance, disk-shaped choppers appear in the assemblages, whereas large points are not present anymore (Wang 1997).

Discussion

The Qinghai-Tibet Plateau

The Qinghai-Tibet Plateau and the large desert area to the north of this high-altitude region appear to be almost isolated from the Eurasian continent during the Pleistocene. The Qinghai-Tibet Plateau was not as high as it is at present during the early Pleistocene (Fang and Li 1998; Li 1988*a*, 1988*b*; Pan et al. 1998), and early migratory populations along both sides of the plateau would have been able to cross this natural boundary. However, the uplift in the succeeding period seems to have made human migrations more difficult. This is often pointed out by scholars to explain why East Asia exhibits unique lithic technology, material culture, and patterns of human adaptation (Gamble 1993; Lycett and Norton 2010; Wang 1995, 2001, 2003; Zhou et al. 1991).

The tempo and intensity of the Qinghai-Tibet Plateau uplift as well as its effect on human adaptation and migrations has attracted numerous discussions over the years. Some researchers suggested that the plateau raised and reached its present height ca. 7–8 mya (Harrison et al. 1992). Recent evidence shows that the desertification of Asian hinterland at least 22 mya could have been the result of this uplift (Guo et al. 2002). However, dramatic plateau uplift is also recognized to have occurred during the Pleistocene based on a series of recent multidisciplinary research efforts. These point to the fact that the plateau reached its present height after three tectonic events during the late Cenozoic; the Qinghai-Tibet tectonic event (3.4–1.7 mya), Kunlun-Huanghe (1.1–0.6 mya), and the Gonghe tectonic event (0.15 mya; Pan et al. 1998). The plateau thus separated China and East Asia from the western part of Eurasia into a relatively isolated geographic region during the Pleistocene. This uplift is also believed to have led to the development of the Asian Monsoon, causing global climate change (Fang and Li 1998).

Based on current evidence, the earliest human occupation in China and East Asia took place at least ca. 1.66 mya. The Lower Paleolithic industries in North China follow the flake-tool tradition and consist of scrapers, points, and other light-duty tools made on flake blanks. The flake-tool technology continued to exist with no obvious change from the Early to the Late Pleistocene in north and southwest China. In the meantime, several hundred localities with core-chopper industries were found recently along the river valleys of central and southern China. These consist of choppers, picks, and spheroids as well as other heavy-duty tools. The core-chopper industries continued to develop from the late Early Pleistocene to the early Late Pleistocene.

Comparative studies of Paleolithic industries between China and the western part of Eurasia indicate that connections between the East and the West existed probably before 1 mya as evidenced by the appearance of similar, simple lithic techniques and similar components of the lithic assemblages, sometimes referred to as “Mode 1 technology.” These sites offer evidence for the first human migrations from Africa to China and East Asia (Wang 2003).

Cultural and genetic bottlenecks between the two parts of the Old World must have occurred during the period from the late Early Pleistocene to the early Late Pleistocene. Mode 1 technology was quickly replaced by Acheulean industries (Mode 2) technology in the West, while the core-chopper and flake-tool industries continued to exist in the East for much longer. Such different technological trajectories persisted in the two sides of the Qinghai-Tibet Plateau until the early Late Pleistocene.

The Late Pleistocene Human Migration

With the onset of the early Late Pleistocene, Mousterian industries dominated many parts of western and central Eurasia while core-chopper and flake-tool traditions continued existing in China. The so-called Chinese Middle Paleolithic was, in fact, a continuation of the previous core-chopper and flake-tool traditions, different from the Mousterian industries in the West (Gao and Norton 2002). It seems, therefore, that two evolutionary paths succeeded the earliest Mode 1 technology: the Acheulean and Mousterian in the West, and core-chopper and flake-tool industries in the east of Eurasia.

It is also apparent that during the late phase of the Late Pleistocene, the simple core-flake technology still persisted in many regions of China. This cultural separation of China from the West comes to an end in this period evidenced by the emergence of blade and microblade industries in North China. The appearance of this new technology indicates a new cultural transformation that was either adopted by indigenous populations by means of cultural diffusion or was brought into this region as a result of demic diffusion, that is, with the arrival of new human migrants (Bae and Bae 2012).

It is often suggested that blade and microblade technology in East Asia was introduced by populations who entered northwest China and East Asia from Siberia (Bae 2010; Bar-Yosef 2015; Ono 2004; Qu et al. 2013). Given the barrier set by the Qinghai-Tibet Plateau and the vast desert of Central Asia, this means that the dispersal of modern humans must have taken place through the northern path, which was covered with grassland. However, deciphering migration routes and how the migrants succeeded in East Asia requires further evidence as well as consideration of the southern route for modern human dispersals, that is, the possibility of human movements south of the Himalayas.

In Central China, the paleoenvironmental record reveals a forest/steppe landscape between 50 and 40 kyr BP (Liu et al. 2008). The occupants at the lower and upper units of Zhijidong did not seem to witness an environmental change. Among the various markers of modern human behavior, the transportation of raw material over long distances, the high frequency of well-retouched tools, and the expansion of territory are clearly identified in Zhijidong's upper unit. These new elements of human behavior and adaptation at Zhijidong are very likely to have emerged as a result of the arrival of new human groups in the area (Wang 2008*b*).

The replacement of large cobble tools by small-flake tools is also commonly seen at other sites in the southern part of North China as well as in South China. The same reason that explains the emergence of small-flake-tool industries in the surrounding area of the Nanling Mountains during the late MIS 3—that is, the expansion of modern human groups from the north of the country southward—applies here as well. Hence, it appears that the transition from the Middle Paleolithic and the emergence of the Upper Paleolithic in China and East Asia differs from that in western Eurasia (Wang 2003); in the former case this involves the transition from cobble tools to flake technologies, while in western and central Eurasia the transition is typified by the change from Mousterian to blade-based technologies.

Conclusions

China is a vast land where early humans survived since the Early Pleistocene, and the abundance of material culture demonstrates a biological evolution sometimes considered separate from the rest of Eurasia. Recent research on the Qinghai-Tibet Plateau provides a geographic boundary one needs to consider when reconstructing possible hominin dispersal routes into and through China. New archaeological discoveries include many Late Pleistocene sites, from the loess plateau in North China to a number of river basins in South China, and provide detailed information about human dispersals in this region.

Small-flake-tool assemblages suddenly emerged in the surrounding area of the Nanling Mountains during the late MIS 3 period. This could be interpreted as evidence of a late Late Pleistocene human dispersal from North to South China. In addition, blade industries from Siberia or northwest Asia first arrived in the northwest of China during the late MIS 3 and then reached Central China about 25,000 years BP. Similarly, the wedge-shaped microblade core industries found in the Nihewan Basin may represent another migration wave from Siberia and northeast Asia to North China. Summing up, based on the current archaeological record, several hominin dispersal episodes, mainly occurring from north to south, affected China during the Late Pleistocene.

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