Journal of World Prehistory, Vol. 11, No. 2, 1997

Current Issues in Chinese Neolithic Archaeology

Anne P. Underhill[1]

Every year archaeologists in China discover numerous rich sites demonstrating significant regional variability in Neolithic cultures, primarily from about 6500 B.C. to 1900 B.C. This paper discusses a topic not covered in detail in current or forthcoming publications, the origins and development of agricultural systems. Recent fieldwork in both northern and southern China suggests that initial steps toward settled agricultural villages began circa 11,000 B.P. I review evidence for the cultivation of millet, rice, and other plants as well as animal husbandry in different regions of China. There are several later Neolithic sites in northern China with evidence for rice cultivation. I suggest how future research projects can investigate regional variation and change over time in subsistence and settlement during the Neolithic Period.

KEY WORDS: China; Neolithic; food production; agricultural origins.

INTRODUCTION

Every year archaeologists in China discover scores of Neolithic sites, primarily from about 6500 to 1900 B.C. They publish their reports and articles in a variety of national as well as local journals. The goal of this article is to make the Neolithic Period of China more accessible to others by focusing on issues not discussed in detail in current or forthcoming publications. I include relevant information on Taiwan and Hong Kong. Given the immensity of new material on the Neolithic Period each year, I have chosen to discuss one topic in depth, the origins and development of agricultural systems. This topic has received considerable attention from ar-

[1]Department of Anthropology, Yale University, 51 Hillhouse Avenue, New Haven, Connecticut 06520.

Table I. Romanization of Chinese Terms for Sites and Cultures Discussed in the Text

Pinyin	Wade-Giles (Chang, 1986)
Northeast China	
Xinglongwa	Hsing-lung-wa
Xinle	Hsin-lo
Hongshan	Hung-shan
Western Yellow River valley	
Majiayao	Ma-chia-yao
Banshan	Pan-shan
Machang	Ma-ch'ang
Linjia	Lin-chia
Liuwan	Liu-wan
Qijia	Ch'i-chia
Central Yellow River valley	
West (eastern Gansu, Shaanxi, Shanxi provinces)	
Xiachuan	Hsia-ch'uan
Laoguantai	Lao-kuan-t'ai
Dadiwan	Ta-ti-wan
Baijia	Pai-chia
Yangshao	Yang-shao
Banpo	Pan-p'o
Jiangzhai	Chiang-chai
Beishouling	Pei-shou-ling
Yuanjunmiao	Yuan-chun-miao
Taosi	T'ao-ssu
East (Henan, Hebei)	
Peiligang	P'ei-li-kang
Cishan	Tz'u-shan
Dahecun	Ta-ho-ts'un
Xiawanggang	Hsia-wang-kang
Longshan	Lung-shan
Jiangou	Chien-kou
Erlitou	Erh-li-t'ou
Shang	Shang
Zhou	Chou
Eastern Yellow River valley	
Beixin	Pei-hsin
Dawenkou	Ta-wen-k'ou
Wangyin	Wang-yin
Middle Reaches of the Yangzi River valley	
Daxi	Ta-hsi
Qujialing	Ch'u-chia-ling
Lower Reaches of the Yangzi River valley	
Xianrendong	Hsien-jen-tung
Hemudu	Ho-mu-tu
Majiabang	Ma-chia-pang
Songze	Sung-tse
Liangzhu	Liang-chu

Table I (continued)

Southeast China, Taiwan	
Changbin	Ch'ang-pin
Zengpiyan	Tseng-p'i-yen
Baozitou	Pao-tzu-t'ou
Dapenkeng	Ta-p'en-k'eng
Fengbitou	Feng-pi-t'ou
Zhishanyan	Chih-shan-yen
Kending	Ken-ting
Tanshishan	T'an-shih-shan
Shixia	Shih-hsia

chaeologists outside China. Important new discoveries in both north and south China are providing more information about early agricultural systems. I discuss regional variation and change over time in plant cultivation and animal husbandry.

Following conventions in both Chinese and English publications, I refer to different phases of the Neolithic by approximate years B.C. The estimates for phases are based on calibrated radiocarbon dates whenever possible. Major journals regularly publish radiocarbon dates, and the Institute of Archaeology (1991) in Beijing provides an extremely useful, regularly updated volume of calibrated radiocarbon dates for Neolithic and later sites in each province, stating the lab, context, sample, and half-life (using 5730 and 5568). Publications in English about archaeology in China use either the pinyin or the Wade–Giles system to romanize Chinese characters. The former system is used in the People's Republic of China, and the latter, in Taiwan. I use pinyin in this paper, with the exception of surnames of authors from Taiwan and Hong Kong. Since the spelling of terms is a constant source of confusion for people who are not familiar with Chinese, I provide a conversion table for archaeological cultures and sites mentioned in the text (Table I). The current edition of *The Archaeology of Ancient China* (Chang, 1986) uses Wade–Giles, but recent publications tend to use pinyin. Readers may not realize that different authors using different spellings are discussing the same sites or cultures. Some publications erroneously refer to Chinese sites or cultures by using a mixture of the two systems.

By the term "Neolithic," archaeologists in China refer to settlements from the Holocene with the presence of one or more key traits such as pottery, ground stone tools, sedentism, cultivation, and animal husbandry. As discussed below, however, there is evidence that these traits did not develop at the same time. The subsequent period, the Bronze Age, is characterized by fully developed bronze production and early states. The earliest Bronze Age cultures are in the Yellow River (*Huang He*) valley:

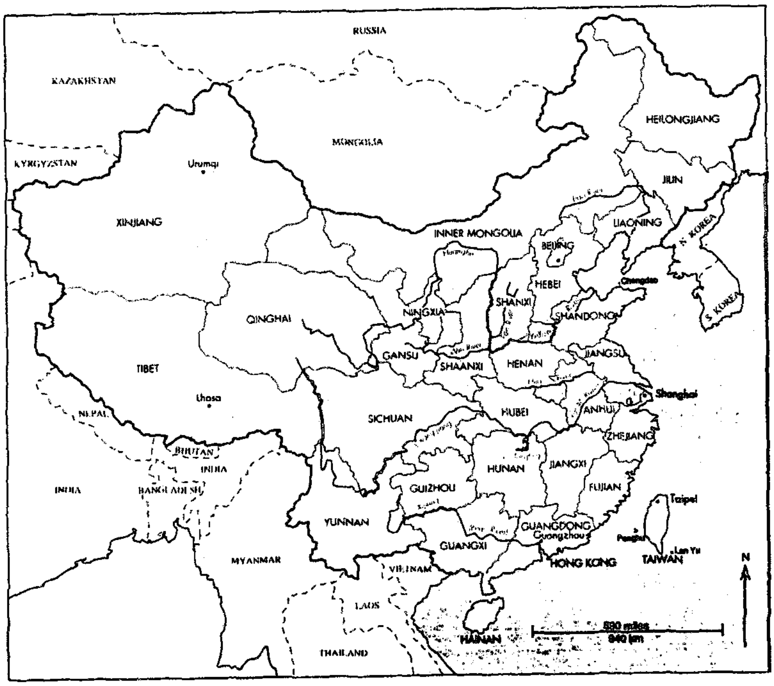

Fig. 1. Modern provinces and major cities in China.

Erlitou, Shang (ca. 1700–1100 B.C.) and Western Zhou (ca. 1100–770 B.C.). Many scholars link at least the earliest phases of the Erlitou Culture (ca. 2100–1700 B.C.) in western Henan and southern Shanxi provinces (Fig. 1), with the legendary Xia Dynasty (Chang, 1983a, 1986). The Shang Dynasty is the first known period with a fully developed writing system. Research on the development of complex societies during the Neolithic Period in China has included the Yellow River valley (Liu, 1996; Underhill, 1994, 1996) and other areas such as the northeast (Nelson, 1996). Research on Neolithic and Bronze Age cultures in western China is increasing (see Chen and Hiebert, 1995).

This paper does not attempt to supercede the comprehensive surveys of Chinese archaeology that have been published in English, most notably *The Archaeology of Ancient China* by K. C. Chang (1986). A new (fifth) edition is currently in progress (Chang and Murowchick, personal communication, 1996). The impressive contribution of this book has been to present large amounts of data on Chinese archaeology and to offer a synthesis of regional variability, cultural change, and scholarship in China. There are a number of other important publications in English covering the Neolithic

Period and Early Bronze Age by archaeologists, historians, and art historians, including Chang (1983b), Keightley (1983), and Wu (1995). For a useful compilation of abstracts of translated articles directly from Chinese archaeology journals during the period 1972–1981, see Dien *et al.* (1985). Also, von Falkenhausen (1992) provides a detailed survey of archaeology journals published in the People's Republic of China.

There are additional, recent surveys of Chinese archaeology that include the Neolithic Period. Nelson (1995) provides a detailed review of archaeology in one area, northeast China, with translations of articles by Chinese scholars on the Neolithic Period and Bronze Age. Murowchick (1994) offers an effective introduction to the landscape, people, history, and archaeology of China. Barnes (1993) addresses the rise of civilization in China, Korea, and Japan, stressing interregional interaction and common patterns of development. A recently published collection of papers in both Chinese and English (Yeung and Li, 1995) also is a significant contribution, because it treats the archaeology of southern China and southeast Asia as one regional unit. Similarly, Higham (1996) considers data from the Neolithic Period of China relevant to an understanding of the Bronze Age in Southeast Asia.

I synthesize current data on the origins and development of agricultural systems on a regional basis. Patterns of regional variation on a large scale are emerging. Most publications discuss agricultural systems in China from a broad, historical perspective. Archaeologists are using an increasing number of techniques such as isotopic analysis (Cai and Qiu, 1984), flotation (First Henan Archaeological Team, 1994), and phytolith analysis (Z. Wang, 1995). However, few projects involve the systematic collection, analysis, and interpretation of agricultural data to investigate change over time in diet or subsistence practices on a regional basis. I discuss important issues that should be addressed in future studies.

THE ORIGINS AND DEVELOPMENT OF AGRICULTURAL SYSTEMS

Introduction

Archaeological evidence for early cultivation comes principally from two areas: the Yellow River valley (Middle and Lower Reaches) of northern China and the Yangzi River valley (Middle and Lower Reaches) of central China (Fig. 2). Animal husbandry began early in each area. More research on subsistence in western China may reveal other areas with evidence for cultivation and husbandry at an early date. First, I consider modern envi-

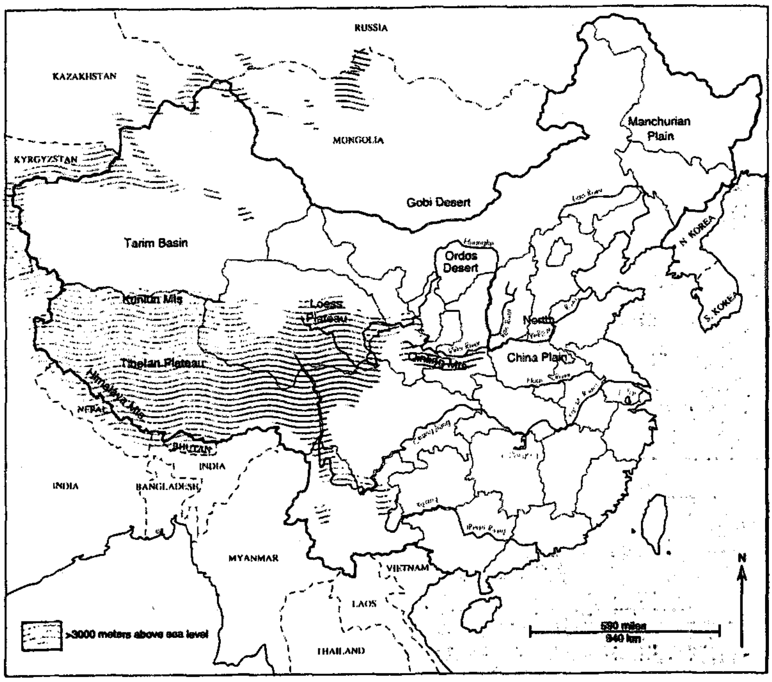

Fig. 2. Major physiographic features in China.

ronmental variation and data on paleoenvironment. Next, I discuss the origins and development of agricultural systems in northern China, beginning with the early Holocene. I focus on millet in the Yellow River valley and northeast China. I also review recent data on rice cultivation in the Yellow River valley. Then I discuss evidence for rice agriculture in the Yangzi River valley and south China, including Taiwan. There are debates about distribution areas of the wild progenitors of millet and rice as well as early agricultural techniques. I also consider intensification of agriculture during the later Neolithic Period, a process that may have been spurred by social factors.

Archaeologists in China have focused on the origins and development of rice agriculture, motivated by discovery of abundant rice remains at several sites in the Yangzi River valley. Also, many scholars consider rice as one of the key traits of early Chinese civilization (Mou and Wu, 1993). Botanists have long realized the great variety of plants native to China that could have been exploited as early as the Neolithic Period (Chang, 1970; Li, 1983; Harlan, 1995). In the future, scholars also should examine the origins and development of other domesticated plants. Millet and rice may not be the earliest plants cultivated in China. Other economically important plants that have not been investigated thoroughly include the soybean and taro.

Current models for the origins of plant domestication in China can be classified into two groups: those which involve stress on local resources, and those which involve resource abundance. Most models are of the first type. MacNeish (1992) outlines a trajectory of change that he believes occurred in several areas of the world. He proposes that early agriculture developed in areas with marked seasonal variation, including periods with limited plant and animal resources. People were compelled to develop new methods to acquire more dependable supplies of food, such as increased use of storage, exploitation of greater varieties of foods such as seeds, and eventually, cultivation. He includes both the Yellow and the Yangzi River valleys. W. Yan (1991, 1992) outlines a similar model for millet and rice in both areas. Chang (1989) also implies that people were compelled to obtain plant foods more efficiently over time. He suggests, like Watson and Kennedy (1991), that it was women who first cultivated plants, near residential areas (Chang 1989, p. 410).

In contrast, Smith (1995, pp. 136–137), proposes that millet was first domesticated in China among hunter-gatherers who lived in a rich environment with an abundance of wild plants. These "affluent foragers," already living in sedentary villages and exploiting wild plants, wanted to increase the reliability of important food plants. Similarly, Chang (1981) proposes after Sauer (1969) that hunter-gatherers living in rich natural environments of south China could afford the time and effort to experiment with plants such as taro or rice. Current data are not sufficient to support either type of model. However, recent discoveries of early Holocene sites are providing more information on the sequence in which key traits of the Neolithic Period developed, such as ground stone tools, pottery, sedentism, and domestication.

No doubt the increasing quantities of data on the early Holocene will inspire scholars to consider other models about the transition to agriculture. There is increasing interest among archaeologists in China about ecological models for the adoption of agriculture developed in other countries (see Chen, 1994). Scholars also should consider social factors in the origins of agriculture, such as increased demand for food production in conjunction with increasing inequality (Price, 1995). At this stage, it would be most productive to identify key variables for individual regions within China. Causal factors (cultural and environmental) for the origins of agriculture may vary significantly by area (McCorriston and Hole, 1991).

Environmental Variation

The generally accepted dividing line between north and south China is the Qinling (or Qin) Mountains (Fig. 2). There are significant differences between these areas in terms of vegetation, topography, and climate. I refer to four subareas of northern China: the western Yellow River valley (Middle Reaches), central Yellow River valley (Middle Reaches), eastern Yellow River valley (Lower Reaches), and northeast China. I refer to three subareas in southern China: Middle Reaches of the Yangzi River (Changjiang or Yangtze), Lower Reaches of the Yangzi, and south China (including Hong Kong and Taiwan). These subareas are not ideal, but they follow convention in the archaeological literature. There is relatively little published information on subsistence for Neolithic cultures in western China.

The Middle and Lower Reaches of the Yellow River are characterized by deciduous broadleaf forests, fertile loess soil (yellowish silt), and a temperate climate. There are several distinct environmental zones, such as the Loess Plateau (Gansu, Shaanxi, Shanxi provinces) and the North China Plain (eastern Shaanxi, southern Shanxi, southern Hebei, Henan, western Shandong). The Loess Plateau has relatively high elevations and deep deposits of loess. The geographic area I label "Western Yellow River valley" includes eastern Qinghai and western Gansu. Extensive archaeological fieldwork in the Central Yellow River valley makes it possible to discuss two subareas: (1) eastern Gansu, Shaanxi, and southern Shanxi and (2) Henan and southern Hebei. The geographic area I label "Eastern Yellow River valley" includes Shandong, northernmost Jiangsu, and Anhui provinces. Some archaeologists refer to the area including Shandong, northern Jiangsu, northern Anhui, and easternmost Henan as the Haidai area. The Huai River lies at the southern end of the North China Plain. Central and eastern Shandong are mountainous (Ren *et al.*, 1985; Tuan, 1970; Liu, 1988).

Modern northeast China (Manchuria) contains several environmental zones, from south to north: deciduous forests, steppe, mixed conifer–hardwood forests, and boreal forests (Liu, 1988; Ren *et al.*, 1985). There is a long, harsh winter, and the growing season is relatively short. The area I label "Northeast China" includes Liaoning, eastern Inner Mongolia, Jilin, and Heilongjiang provinces. Archaeological research has focused on Liaoning and eastern Inner Mongolia.

The Yangzi River valley is also enormous and contains several smaller environmental zones. The area is characterized by mixed deciduous-broadleaved evergreen forests to the north and subtropical broadleaved evergreen forests to the south, substantial rainfall, and a warmer climate.

Bamboo forests are common, and there are many freshwater lakes such as lakes Dongting and Tai (Ren *et al.*, 1985; Liu, 1988). Archaeologists have focused on the geographic areas I call the "Middle Reaches" (southern Hubei, northern Hunan, northern Jiangxi) and the "Lower Reaches" (southern Anhui, southern Jiangsu, northern Zhejiang).

South China is also environmentally diverse. Most research on the Neolithic Period has taken place in Guangxi, Guangdong, Fujian, Hong Kong, and Taiwan. The area is characterized by subtropical broadleaved evergreen forests, karst (limestone) topography, and a subtropical or tropical climate with much rainfall, including typhoons. There are laterite soils, and there is a year-round growing season. The extreme southern part of mainland China and Taiwan has tropical monsoonal rainforests.

Paleoenvironment

It is clear that humans have drastically altered the landscape in China during the historic era, especially by extensive deforestation. The nature of the environment during the Neolithic Period continues to be debated, particularly for northern China, as well as the extent of environmental change caused by anthropogenic and natural factors. There are important implications for explaining how and why the process of domestication began. The geographic distribution of the wild progenitors of millet and rice, incentives for beginning cultivation, and early agricultural techniques are not known. It is critical to obtain more paleoenvironmental data for the early Holocene, when the initial steps toward domestication probably began (Crawford, 1992, pp. 10–11).

Faunal and floral remains provide evidence for a warmer climate with more abundant vegetation for at least some phases within the early Bronze Age and Neolithic Period in northern China. Faunal remains and oracle bone records from the late Shang capital of Anyang in northern Henan indicate the presence of animals that favor a warmer, moister environment with abundant vegetation such as tiger, bamboo rat, water deer, water buffalo, and elaphure (Chang, 1980, pp. 136–145). Even if some of these animals were imported as tribute, there are other indications of a warm, moist climate. The oracle bone records state that there were two crops a year in the area, both rice and millet (Chang, 1980, p. 141).

Faunal remains, raw materials used to make artifacts, and botanical remains from northern Neolithic sites also indicate a warmer climate. Yangshao Culture sites (ca. 5100–2800 B.C.) such as Banpo in southern Shaanxi have yielded bones of water deer and bamboo rat. Some burials from the Dawenkou Culture in Shandong (ca. 4300–2600 B.C.) contain artifacts made from elephant ivory and the Yangzi alligator, *Alligator sinensus* (Shandong Office for the Protection of Cultural Relics and the Jinan City Museum, 1974). These could represent locally exploited fauna. Significantly, there are several Neolithic sites in northern China that have yielded domesticated rice as well as bones of water buffalo, and wild rice has been reported for the area (discussed below). These data suggest that environmental differences between the Yellow and the Yangzi river valleys were not great during at least parts of the Neolithic Period.

Palynological studies are increasing and provide valuable data on changes in vegetation during the Holocene. They clearly indicate a forested environment with a warm climate for the mid-Holocene in northern China (Pearson, 1974; Li, 1983; Chang, 1986, pp. 76–79). The presence of *Artemisia* does not always indicate an arid environment such as a steppe (contrary to Ho, 1969, 1977, 1984). Several more recent pollen cores in northern China also indicate a warmer and moister climate with abundant vegetation, as early as the Peiligang Culture, about 6300–5100 B.C. (Liu, 1988; Zhang *et al.*, 1994). Pollen studies for the Yangzi River valley suggest little change from current conditions since the Pengtoushan Culture, about 6500–5000 B.C. (Liu *et al.*, 1992; Hunan Province Pollen Lab, 1990; Zhao and Wu, 1984).

Some pollen studies indicate fluctuating climates and increasing aridity during the later Holocene. There is evidence for increasing aridity in the Beijing area and the Liaodong peninsula (Liu, 1988, p. 15). Cao (1994) finds evidence for increasing aridity beginning circa 3000 B.C. in northern Henan. In contrast, phytolith samples from a Longshan site and nearby lake in southeast Henan indicate a warm and wet climate (Jiang and Piperno, 1994). More systematic studies are needed to clarify the nature of environmental variation among regions and climatic change.

The Early Holocene in Northern China

Research on terminal Pleistocene and early Holocene sites is increasing and will provide more information on the economic, social, and technological changes that led to the development of sedentary, agricultural villages. Sites north of the Yellow River in the provinces of Hebei and Inner Mongolia in particular have yielded early pottery, domesticated animals, and hints of plant use.

The open-air site of Nanzhuangtou, located in a limestone area of Hebei (Xushui County), is currently the earliest site regarded as "Neolithic" in northern China (Ren, 1995; Jin and Xu, 1992; Baoding District *et al.*, 1992) (Fig. 3). In the lowest cultural layers (layers six and five), archae-

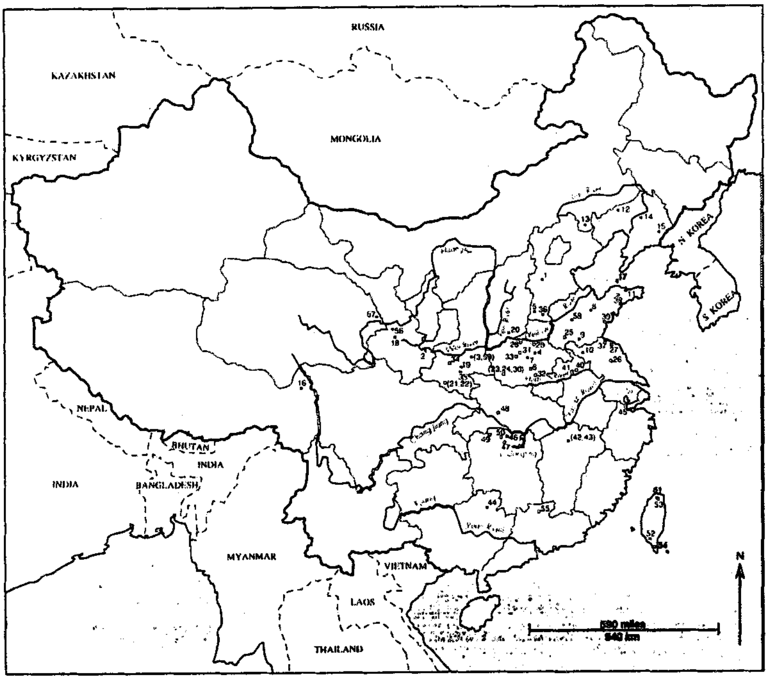

Fig. 3. Important Neolithic sites in China discussed in the text; open squares indicate sites with remains of rice. (1) Nanzhuangtou, (2) Dadiwan, (3) Baijia, (4) Peiligang, (5) Cishan, (6) Jiahu, (7) Shuiquan, (8) Houli, (9) Beixin, (10) Dadunzi, (11) Baishicun, (12) Chahai, (13) Xinglongwa, (14) Xinle, (15) Houwa, (16) Karou, (17) Beizhuang, (18) Linjia, (19) Banpo, (20) Xiyin, (21) Lijiacun, (22) Hejiawan, (23) Xiaji, (24) Xiawanggang, (25) Wangyin, (26) Honglongzhuang, (27) Erjiancun, (28) Xigaoya, (29) Dahecun, (30) Huanglianshu, (31) Yanzhai, (32) Yangzhuang, (33) Lilou, (34) Anban, (35) Keshengzhuang, (36) Jiangou, (37) Yancangcheng, (38) Yangjiajuan, (39) Yaowangcheng, (40) Haochengzhen, (41) Yuchisi, (42) Xianrendong, (43) Wangdong, (44) Zengpiyan, (45) Hemudu, (46) Pengtoushan, (47) Hujiawuchang, (48) Chengbeixi, (49) Chengtoushan, (50) Zaoshi, (51) Dapenkeng, (52) Fengbitou, (53) Zhishanyan, (54) Kending, (55) Shixia, (56) Qinweijia, (57) Liuwan, (58) Dawenkou, and (59) Kangjia.

ologists found pottery sherds (coarse paste, red or gray in color) from thick-walled jars, fragments of grinding stones (*mo pan*) made of quartz, pestles (*mo bang*) made of diorite, and bones of possibly domesticated dog and pig. Pollen samples indicate a climate that was "relatively warm and moist but inclined towards dry and cool." Pollen grains of plants such as bean and green bristlegrass (*Setaria viridis*), the probable wild ancestor of millet, suggest to scholars that the site may represent a stage of incipient cultivation (Jin and Xu, 1992, p. 1019).

The site may represent a cultural phase circa 12,000–10,700 B.P. (Ren, 1995, p. 37). Seven uncalibrated radiocarbon dates have been reported for layers 5 and 6. Scholars accept the oldest date for layer 6: 10,815 B.P. ± 140 years [BK87088, half-life 5730 (Baoding District *et al.*, 1992, p. 968)]. Calibration of this date (if possible) could indicate that people first used the site circa 12,000 B.C. Some publications present the radiocarbon date without explaining the significance of the lack of calibration (Jin and Xu, 1992, p. 1018; Li *et al.*, 1996, p. 467). Clearly, archaeologists need to find supporting evidence from other sites for the presence of pottery, plant use, and domesticated animals as early as 12,000 B.C.

Reports on the site do not describe the morphological features of the dog and pig bones suggesting domestication. However, the conclusion that the dog was domesticated seems reliable. Skeletons of domesticated dog (*Canis familiaris*) are very distinct from their wild ancestor (*Canis lupus*), a small species of wolf known from the Pleistocene period in China (Olsen and Olsen, 1977; Olsen, 1985). Archaeologists should investigate whether these animals were used as an aid in hunting or as a food source. The latter could be identified by features such as butchering marks (Olsen, 1985, p. 53). Given the wide distribution of the wolf in the northern hemisphere in prehistory, people probably domesticated the dog in more than one area (Ho, 1977, p. 466). At present the site of Nanzhuangtou has the earliest evidence for domesticated animals in China (Jin and Xu, 1992, p. 1019). It is not possible to evaluate the interpretation about pig domestication, since there is no information on how the bones at the site differ from those of wild pigs. Scholars in China concur that the chicken bones at the site probably do not represent domestication (Ren, 1995, p. 41).

The initial appearance of grinding stones may represent increasing reliance on wild plants in the diet. Grinding stones were first used by preceramic populations during the late Pleistocene in China. A few grinding stones, made of quartz or quartzite as at Nanzhuangtou, were recovered from the late Pleistocene site of Xiachuan in southern Shanxi (Jia and Huang, 1985, p. 217). Radiocarbon dates give a range of about 22,000–20,000 B.P. (Jia and Huang, 1985, p. 217). There are possible pestles as well (Jia and Huang, 1985, p. 217; Tang and Gai, 1986, p. 353). Grinding stones probably served a variety of purposes in addition to processing plants, such as making bone tools (Tang and Gai, 1986, p. 353). Toth *et al.* (1992) observed farmers in New Guinea using circular grinding stones with shallow depressions for edge grinding stone tools. Therefore, grinding stones alone may not indicate increased reliance on plant foods. It is critical to obtain direct evidence for increased reliance on plants in the diet by flotation or other techniques. Also, microscopic analysis could determine the function of grinding stones at these early sites.

Important research on the transition between the late Pleistocene and early Holocene in northern China has been carried out in the Alashan area of westernmost Inner Mongolia (Bettinger, 1994). This project systematically examines change over time in subsistence and settlement in relation to environmental change for the critical transitional period. Pollen data indicate a relatively warm climate, but the extent of aridity in the late Pleistocene of northern China is not known (Bettinger *et al.*, 1994, p. 76). A later study by an international research team in the vicinity of the Helan Mountains of Ningxia and Inner Mongolia suggests the transitional period was characterized by numerous climatic fluctuations that had a significant impact on the availability of water sources (Madsen *et al.*, 1996, pp. 220–222). The availability of water in turn affected site location. The appearance of microblades at sites in these northern areas could signal increased use of plants, either wild or cultivated (Bettinger *et al.*, 1994; Madsen *et al.*, 1996). People in these areas may have invented pottery during the early Holocene. Some researchers place the presence of pottery circa 11,000 B.P. in Inner Mongolia, but there are no radiocarbon dates for the ceramic assemblages (see Bettinger *et al.*, 1994, p. 79).

There are other potentially early sites in northern China that may eventually provide more information on the origins of agriculture. Sites in eastern Inner Mongolia (Tongliao or Jirem County) and northern Shanxi (Huairen County) seem to have Neolithic artifacts, but no direct evidence for cultivation (Xu, 1994, p. 32). In addition, sites described as Mesolithic (no pottery, terminal Pleistocene or early Holocene) such as Shizitan in southern Shanxi (Jixian County) have been found in northern China (Linfen Cultural Bureau, 1989; W. Yan, 1992, p. 115).

Nanzhuangtou and the sites in Inner Mongolia raise the possibility that hunter-gatherer populations in China invented pottery as early as in Japan. The first pottery vessels from the Jomon Period of Japan, regarded as the earliest in the world, are dated to about 12,500 B.P. (Esaka, 1986, p. 226; Pearson, 1992). Like the early Jomon pottery, the sherds from Nanzhuangtou are not cordmarked, and at least some represent jars. Most sherds have a plain surface, and vessel walls are thick. The sherds have a soft, porous paste. Scholars have identified inclusions of hornblende and vermiculite. The vessels were modeled by hand, and the firing temperature was low (Li *et al.*, 1995, 1996).

The excavators of Nanzhuangtou suggest that the first pottery was invented to cook cereals (Jin and Xu, 1992, p. 1020). However, people may have needed durable containers such as pottery jars to cook a variety of foods if a broad spectrum economy developed during the early Holocene, as in other areas of the world. The role of pottery vessels in facilitating processing and storage of wild or cultivated plants needs to be investigated (Crown and Wills, 1995). In Japan, people may have needed more durable containers to cook shellfish as well as plants (Ikawa-Smith, 1976). Future work at early Holocene sites in China will contribute to a growing body of data on the origins of pottery around the world (Brown, 1989; Barnett and Hoopes, 1995). Causal factors for the invention of pottery in China could differ from other areas (Chen, 1994). The particular adaptive advantages of clay containers have to be explained for each environmental zone. For example, it is likely that wooden containers and gourds were used during the early Holocene in several areas of China. Presumably clay containers allowed greater versatility of size and shape and, consequently, function. Bettinger *et al.* (1994, pp. 94–95) propose that the invention of pottery in western Inner Mongolia was linked to increasing reliance on local food resources, especially plants, causing an increase in sedentism. Also, scarce firewood in the area may have motivated people to develop containers that could cook a variety of foods more efficiently (presumably if other fuel sources for firing the pottery were available). Pottery may have been independently invented in more than one area of China, due to different causal factors.

It is possible that domestication of animals such as the dog and the invention of pottery took place in northern China before cultivation of plants began. As discussed below, this sequence of development may characterize southern China as well. China may be different than other areas of the world such as parts of the Near East, where cultivation seems to have preceded the invention of pottery (Bar-Yosef and Belfer-Cohen, 1991). This will continue to be a challenge to resolve, due to the difficulties in identifying cultivation of genetically wild plants (land clearance, planting, weeding, etc.) versus domestication (morphological changes in species) in many areas (Harris, 1989; Bryd, 1994; Fedick, 1995). Xu (1994), however, believes that pottery vessels and ground stone tools developed in China after cultivation began, since people needed more reliable containers for cooking plant foods and adequate cultivation tools.

Another important issue is the emergence of ground stone tools, also considered a key trait of the Neolithic Period. People probably began to edge-grind stone tools such as flaked axes (giving them a polished appearance) in order to produce a stronger working edge. As Toth *et al.* (1992) observed in New Guinea, these tools are easily resharpened and effectively cut down trees in order to clear fields for agriculture. It is difficult to trace the development of ground stone tools at Neolithic sites, because many reports do not clearly describe variation in the amount and placement of grinding and polishing (edge, surfaces, etc.). Ground stone axes are not known in northern China until the Laoguantai and Peiligang Cultures, as discussed below. However, it appears that the grinding stones (*mo pan*) at Nanzhuangtou indicate partial grinding during manufacture (Jin and Xu, 1992, pp. 1019; Baoding District *et al.*, 1992, p. 970). The initial appearance of relatively heavy grinding stones at late Pleistocene sites may indicate an increase in sedentism. It would be worthwhile to look for indicators of increasing sedentism that archaeologists have used in other areas. At Jomon sites in Japan, increasing labor investment in shelters, storage pits, and artifacts indicates increasing sedentism (Watanabe, 1986). Also, the relationship between sedentism and the origins of cultivation should be assessed on a regional basis. Sedentism does not necessarily indicate the development of cultivation (Arnold 1993, pp. 78–79).

Another possible indicator of increasing sedentism noted by researchers working in the Near East that is particularly appropriate for China is the presence of ritual expressions of territoriality and ancestral ties to land (Bar-Yosef and Belfer-Cohen, 1991). Formal burial areas, exhibiting great concern in preparing the deceased for an afterlife, are a defining characteristic of Neolithic China. An increase in the number of formal burials and in the overall labor expended on treatment of the dead should indicate a growing sense of territoriality and sedentism. The earliest mortuary ritual in China is evident from the Upper Cave deposits at the site of Zhoukoudian near Beijing, dated circa 20,000–12,000 B.P. (Jia and Huang, 1985, pp. 212, 221; Chang, 1986, pp. 60, 63). A few human skulls and postcranial remains were found on a layer of hematite powder. Some ornaments nearby showed staining from hematite. By the time of the earliest known agricultural villages in northern China, circa 6300–5000 B.C. (the Laoguantai and Peiligang Cultures), there are formal pit burials with grave goods.

Agricultural Systems in Northern China

Cultures circa 6300–5000 B.C. in the Central Yellow River Valley

For many years archaeologists have recognized two varieties of millet in northern sites, foxtail millet (*Setaria italica*, or *su*, the more common variety) and broomcorn millet (*Panicum miliaceum*, or *shu*). The wild ancestor of foxtail millet probably is green bristlegrass (*Setaria viridis*, or *gouweicao*) (Smith, 1995, p. 136; W. Yan, 1992; An, 1988a; T. T. Chang, 1983, p. 68). Apparently, green bristlegrass still grows in semi-arid, upland regions of north and southwest China as well as in India, Africa, and Europe (Smith, 1995, p. 136; T. T. Chang, 1983, p. 68). The wild ancestor of broomcorn millet is unclear. It may be represented by a wild broomcorn millet still growing in northern China (W. Yan, 1992, p. 115).

Future research needs to clarify the distribution area of wild millet in China. Studies of possible processing methods and the food value of wild

Table II. Presence of Cultivated Millet and Other Possible Dry-Land Crops Among Cultures of Northern China (Data from Ren, 1995; Nelson, 1995; Yan, 1992; An, 1988; Chang, 1986) (Dates Are Approximate)

Northeast China	Western Yellow River Valley	Central Yellow River Valley: West	Central Yellow River Valley: East	Eastern Yellow River Valley
Late Neolithic; none, cultivation inferred	**Qijia,** 2100–1900 B.C.; foxtail millet, hemp	**Longshan,** 2800–1900 B.C.; millet—foxtail, broomcorn	**Longshan,** 2800–1900 B.C.; foxtail millet	**Longshan,** 2600–1900 B.C.; foxtail millet
	Machang, 2300–2100 B.C.; foxtail millet			
	Banshan, 2800–2300 B.C.; broomcorn	**Longshan**	**Longshan**	**Longshan**
	Majiayao, 3400–2800 B.C., millet—foxtail, broomcorn; hemp seeds	**Late Yangshao,** 3500–2800 B.C.; millet—foxtail, broomcorn?	**Late Yangshao,** 3500–3800 B.C.; millet—foxtail, broomcorn?; sorghum?	**Dawenkou,** 4300–2600 B.C.; millet—foxtail, broomcorn
Hongshan, 4500–3200 B.C.; foxtail millet	**Yangshao,** 5000–3400 B.C.; unknown	**Early Yangshao,** 5100–3500 B.C.; millet—foxtail, broomcorn; hemp? mustard seed?	**Early Yangshao,** 5100–3500 B.C.; foxtail millet	**Beixin,** 5500–4300 B.C.; foxtail millet
Lower Xinle, 5500–4800 B.C.; broomcorn millet	**Early Neolithic;** unknown	**Laoguantai,** 6000–5000 B.C.; broomcorn millet, rape seed	**Peiligang,** 6300–5100 B.C.; millet—foxtail, broomcorn	**Houli,** 6200–5500 B.C.; none, cultivation inferred
Earlier Cultures 6200–5300 B.C.; none, cultivation inferred				

millet also are needed, through experiments, observation of people who currently exploit it (if any), and examination of historical records. Wild millet may have been present in several areas of northern China. It appears that green bristlegrass has been discovered only at the site of Nanzhuangtou. Flotation or pollen analysis should help clarify where people in northern China exploited green bristlegrass during the early Holocene.

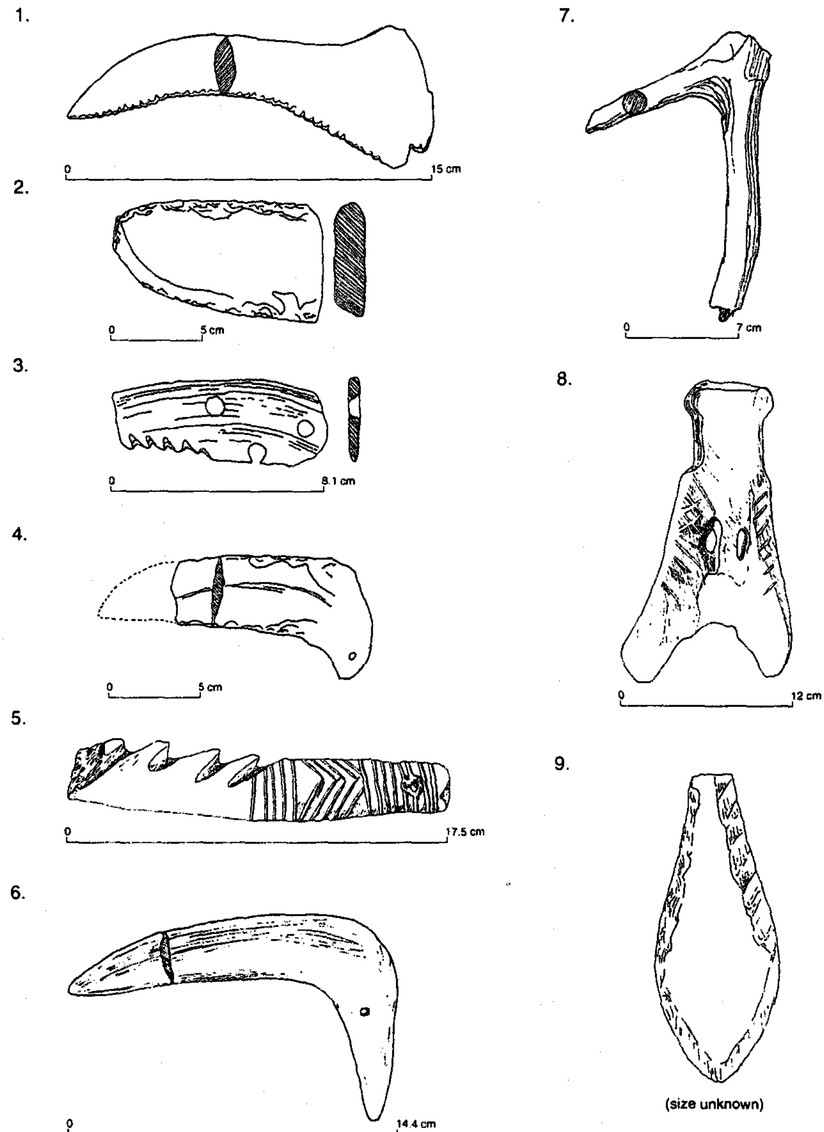

Fig. 4. Agricultural tools from Neolithic sites: (1) stone sickle from Peiligang, Henan, Peiligang Culture; (2) stone sickle from Lilou, Henan, Longshan Culture; (3) shell sickle from Baijia, Shaanxi, Laoguantai Culture; (4) shell sickle from Beixin, Shandong, Beixin Culture; (5) bone sickle from Hemudu, Zhejiang, Hemudu Culture; (6) bone sickle from Dawenkou, Shandong; Dawenkou Culture; (7) bone hoe from Zhishanyan, Taiwan; Zhishanyan Culture; (8) bone spade from Hemudu, Zhejiang; (9) stone spade from Hulijingzi, Inner Mongolia, Hongshan Culture.

There is a gap of about 3000 to 4000 years before there is direct archaeological evidence for domesticated millet in northern China (Table II). It has been known for quite some time that the earliest sites with millet, circa 6000 B.C., are located in the Central Yellow River valley: the Laoguantai Culture to the west (Gansu, eastern Shaanxi provinces; ca. 6000–5000 B.C.) and the Peiligang Culture to the east (Henan and southern Hebei; ca. 6300–5100 B.C.). There are many debates about the classification of these early Neolithic cultures. Some archaeologists also identify a Dadiwan Culture and a Lijiacun Culture in addition to Laoguantai (sometimes called the Baijia Culture). Similarly, some archaeologists refer to a separate Cishan Culture in southern Hebei rather than a single Peiligang Culture (Shi, 1992; see also Fang, 1994). There are several radiocarbon dates for these cultures.

For several sites, the varieties of millet have not been identified. However, it appears that broomcorn millet is more common in western areas of the Central Yellow River valley, and foxtail millet in eastern areas. Only broomcorn millet has been recovered at Laoguantai Culture sites such as Dadiwan (Qinan County, Gansu). This variety of millet may be better adapted to drier and cooler, upland areas. Foxtail millet may have originated from eastern areas of the Yellow River valley (W. Yan, 1992, p. 117). Both broomcorn and foxtail millet have been discovered at sites from the Peiligang Culture such as Peiligang (Xinzheng County, Henan; First Henan Team, 1984; W. Yan, 1992; Ren, 1995).

The extensive archaeological remains at these sites clearly represent substantial settlements and fully developed agricultural systems, although hunting and gathering probably continued to provide some basic resources. The earliest cultural layers have several houses, storage pits, kilns, and formal burial areas. The large quantity of millet represented at the site of Cishan (Peiligang Culture, Wuan County, southern Hebei) especially indicates great reliance on domesticated cereals (CPAM, Hebei Province, 1981; Chang, 1986; Pearson and Underhill, 1987; Shi, 1992; W. Yan, 1992).

The report for Baijia (Lintong County, Shaanxi) is the most detailed for a site from the Laoguantai Culture (Institute of Archaeology, 1994). Among the Early Period cultural remains are river (freshwater) mussel shell tools with serrated edges, identified as sickles for harvesting grain (*lian*; Fig. 4). Another distinctive feature of the Baijia site is the earliest painted pottery in China (Institute of Archaeology, 1994, p. 115). There are red designs such as wavy lines on the interior of wide mouthed bowls. Rape seeds *Brassica* (*you cai*), were discovered at the site of Dadiwan. People probably ate the green leaves of the plant (Ren, 1995, p. 41). Common forms of pottery vessels at Laoguantai sites include bowls and deep jars with impressed surface decoration, often with three small legs.

More than 70 sites from the Peiligang Culture have been discovered, primarily in central Henan (National Bureau, 1991, pp. 29–31). Burials at the site of Jiahu (Wuyang County) contain especially intriguing artifacts (Henan Province, 1989). Archaeologists found a bone flute, apparently the earliest known musical instrument in China, as well as turtle shells with incised symbols and small turquoise ornaments. Pits at the site of Shuiquan (Jiaxian County, Henan) containing peaches and Chinese dates suggest a variety of plant foods in the diet (First Henan Team, 1995). Hackberry seeds and walnuts also were found at Cishan (CPAM, Hebei Province, 1981). The stone tools with serrated edges found at Peiligang Culture sites probably were sickles (Fig. 4). These tools appear to represent the earliest stone sickles in China (An, 1989, p. 648).

Domesticated animals reported for Laoguantai Culture sites are dog, pig, chicken, sheep, and water buffalo (Ren, 1995, p. 41; Zhou, 1994, Table III). Scholars are confident about the evidence for dog and pig domestication. It is likely that there was a wide distribution area for wild pigs (*Sus scrofa*) in ancient China. People could have domesticated pigs in more than one region (Ho, 1977, p. 464). One probable cause of the controversies in interpreting pig bones at early Neolithic sites in China is that differences in morphology between wild and domesticated pigs are subtle and not always clear (Olsen and Olsen, 1980). Bones of chicken, probably domesticated, were found at the site of Baijia (Zhou, 1994). The conclusion that sheep were domesticated in northern China at this time is controversial. The wild ancestor of sheep (*Ovis*) probably had a wide distribution in the Old World during prehistory, allowing domestication to take place in several areas (Ho, 1977, p. 465). However, this may have been a late development. An (1989, p. 648) concludes that there is no evidence for the domestication of sheep until the Longshan Period.

Bones of water buffalo (*Bubalus*) are reported for Baijia, but it is not clear whether they came from the early layers at the site. Archaeologists have found bones of wild water buffalo at more than one late Pleistocene site in China (Zhou, 1994, p. 125). It is possible that water buffalo were domesticated in more than one area of China during the Neolithic Period. As discussed below, bones of domesticated water buffalo (*shui niu*) were found at later Neolithic sites in northern China as well as southern China. More reports need to describe explicitly the features of bones that distinguish domesticated water buffalo from wild water buffalo.

Remains of domesticated dog, pig, sheep, cattle, and chicken have been reported for sites from the Peiligang Culture (Ren, 1995, p. 41). Detailed morphological features of dog bone distinguishing it from the wolf are presented in publications, as well as detailed descriptions of the domesticated pig and chicken bones (Zhou, 1981; CPAM, Hebei Province, 1981). There are clay models of pigs at several sites, providing further support for the interpretation of domestication (Ren, 1995, p. 41). At the site of Peiligang, the interpretation of sheep domestication is strengthened by the recovery of clay models of animals interpreted as sheep (Ren, 1995, p. 42). Bones of cattle (*huang niu*) have been recovered from sites such as Peiligang and Cishan.

Cishan has the earliest undisputed domesticated chicken (*Gallus gallus*) in China (West and Zhou, 1988; Ren, 1995, p. 41). West and Zhou (1988) propose that the wild ancestor is the red junglefowl, native to extreme southern China. Also, when people brought domesticated chicken from the south to the north, they had to provide shelter for the animals to help them survive a harsh winter climate. However, if the earlier Holocene in northern China was warmer than today, the distribution of wild junglefowl may have been more widespread than they assume (see also Ho, 1977, p. 460).

The Eastern Yellow River Valley, Circa 6200–5000 B.C.

A new, early Neolithic culture, called Houli (ca. 6200–5500 B.C.), has been identified in Shandong province. Relatively extensive information is available for the Houli site (Linzi, north-central Shandong), discovered during construction of the new highway from Qingdao to Jinan. There are six radiocarbon dates for the culture (Ren, 1995, p. 38). Archaeologists infer an agricultural economy due to the presence of houses, burials, a kiln, possible plant processing tools such as grinding stones, stone rollers, and sickles, and numerous pottery vessels from the lowest cultural layer at Houli (Jinan-Qingdao Team, 1992, 1994). Remains of millet or other plants have not been reported for any site. Since millet has been identified at sites from the later Beixin Culture in Shandong, millet probably was cultivated at Houli Culture sites. Pottery from the lowest cultural layer at the Houli site is mainly red in surface color, with a coarse texture (shell and mica inclusions). It appears that the firing temperature was low. The most common form of vessel is a deep, round-bottomed jar, and there are edge-ground and completely ground stone tools. A recently published report for the Houli Culture site of Xiaojingshan (Zhangqiu County) describes house foundations (mostly semisubterranean), storage pits, a variety of artifacts, and bones from domesticated dog and pig (Shandong Province, Institute of Archaeology, and Zhangqiu City Museum, 1996).

Archaeologists are reevaluating relative dating based on ceramics from Houli and Beixin sites (Wang, 1993). They conclude that some artifacts from surveys and excavated sites in three counties (Zhangqiu, Changqing, Zouping) previously identified as Beixin should be classified as sites from the earlier Houli Culture instead (Wang *et al.*, 1994). Thus, sites from the Houli Culture are distributed in north–central to northwestern Shandong.

Archaeologists also are reconsidering the diagnostic stylistic characteristics of artifacts from the Beixin Culture, circa 5500–4300 B.C. The culture was first identified from excavations at the Beixin site in south–central Shandong (Shandong Team, 1984). There are seven radiocarbon dates from Beixin. The culture has been recognized almost everywhere in Shandong province as well as northern Jiangsu. Sites with recently recognized Beixin components in northern Jiangsu include Dadunzi (Peixian County) and Erjiancun (Lianyungang city); those in central Shandong include Wangyin (Yanzhou County) and Dawenkou [Taian County (Wu, 1986, 1989)]. Recently discovered sites with a Beixin component include Yuancheng [there is a Houli component as well; Zouping County, central Shandong (Shandong University, 1989; Shandong Province, 1992)], Dongjiabai [Wenshang County, southwestern Shandong (Shandong Team, 1993)], and Baishicun [near Yantai city, northeast Shandong (Yantai City, 1992)]. There are Beixin sites near Jinan city too (Liu *et al.*, 1994).

There is little direct evidence for domesticated millet at Beixin sites. An agricultural economy is likely, given the evidence for substantial settlements such as houses, kilns, burials, and a wide range of artifacts, including probable farming tools. Two pottery bowls (one shallow bowl, called a *bo,* and one deeper bowl, called a *wan*) from the Beixin site have impressions of chaff from grain identified as foxtail millet (Shandong Team, 1984, p. 182). Potters may have hand-built vessels on a layer of millet chaff in order to prevent wet clay from sticking to the ground surface (Ren, 1995, p. 39). Carbonized foxtail millet also is reported for the newly identified Beixin component at the Dadunzi site (Ren, 1995, p. 39). Possible agricultural tools at the Beixin site include shell sickles, similar to those from the Central Yellow River valley (Fig. 4). The site of Baishicun has fish bones and stone netweights, indicating the importance of fishing to the economy as well as agriculture.

Five kinds of domesticated animals have been reported for Beixin sites: pig (Dongjiabai, Yancheng, Beixin, Erjiancun, Dadunzi), dog (lower layer at Dadunzi), chicken (Beixin), cattle (Beixin, Erjiacun), and water buffalo (Dadunzi; Ren, 1995). One possibility is that the water buffalo was only semidomesticated during this period (Ren, 1995, p. 42). Water buffalo also have been identifed at sites from the later Dawenkou and Yangshao cultures in the Middle and Lower Reaches of the Yellow River valley. The identification of domesticated rice at several sites in northern China during the past few years makes the presence of water buffalo more plausible. Given the evidence for a warmer and wetter climate discussed above, both domesticated rice and water buffalo could have tolerated some areas of the Yellow River valley.

Northeast China, Circa 6200–4800 B.C.

There are roughly contemporary cultures in Northeast China, circa 6200–4800 B.C., primarily in the Manchurian Plain and the Liaodong Peninsula. Similarities with early cultures of neighboring Korea indicate that both areas should be considered in investigations of the origins and development of agricultural systems (Nelson, 1990; Choe, 1990). The earliest site is Chahai (Fuxin County), in western Liaoning (Nelson, 1990, 1991; Fang, 1991; Guo, 1995). There are no remains of plants, with the exception of walnut shells. However, archaeologists infer that some cultivation took place due to the size of the settlement and the presence of possible plant processing tools. Eleven square houses have been discovered as well as stone tools interepreted as hoes (Guo, 1995, p. 47). The seventh excavation at the site recovered rich remains from more than one cultural layer, most notably, a long pile of stones interpreted as the earliest, and largest, image of a dragon in China. Archaeologists also found several more houses, burials, pig bone, jade ornaments, and a potsherd with what is reported as an incised image of a dragon. An unusually large sample of the settlement has been excavated (Zhongguo Wenwu Bao, 1995). It is evident that the rich ceremonial life of Northeast China began before the Hongshan Period, well-known for its large stone structures used for rituals, jade objects, and clay figures depicting females (Guo, 1995; Nelson, 1990). The jade ornaments from Chahai are the earliest made from true jade or nephrite in China (Wen and Jing, 1992, p. 258).

Archaeologists debate the cultural classification of early sites in Northeast China as well. Several cultures prior to the Hongshan Culture (ca. 4500–3200 B.C.) have been identified in this large area (Guo, 1995; Ye, 1992; Nelson, 1990; Xu, 1989). The Xinglongwa Culture, located mainly in eastern Inner Mongolia, dates to about 6200–5300 B.C. [there are 12 radiocarbon dates (Ren, 1994, 1995)]. Bones of domesticated pig and chestnuts have been found (Guo, 1995, p. 49). There is no direct evidence for plant cultivation. At the site of Xinglongwa (near Chifeng city) there are semisubterranean square houses, stone tools interpreted as hoes, burials, and jade ornaments (Guo, 1995, p. 49; Zhongguo Wenwu Bao, 1993). The Xinle Culture, circa 5500–4800 B.C., is represented at sites in central Liaoning. Carbonized broomcorn millet has been recovered from a house in the lower level at the Xinle site (near Shenyang city). Archaeologists also found domesticated pig, green onion, carbonized acorns, hazelnuts, and Chinese hawthorn (Ren, 1995, pp. 40–41; Xinle Museum, 1990, p. 979). Remains of wild animals and fish at many sites, in addition to bone and stone tools, indicate the continued importance of hunting and fishing. No doubt some areas relied exclusively on fishing, hunting, and gathering, especially farther north beyond the Liao River basin, during both the early and the late Neolithic periods (Liu, 1995).

Remains from the lower cultural layer of a site near the border of North Korea called Houwa (Donggou County), somewhat later than the Xinle culture to the west, suggest a similar economy (Xu, 1995; Xu *et al.*, 1989). One striking characteristic of the Houwa site is the large number of steatite and clay figurines shaped like the heads of animals, humans, or both. There are few objects with human features from any area during the Neolithic Period, and these figurines appear to be the earliest. Xu (1995, pp. 82–85) suggests that the figurines with nonhuman features represent the supernatural, while the others represent people living in the settlement. Other scholars suggest that the figurines were used by shamans in rituals (Song, 1989; Tong, 1996).

Later Neolithic Cultures in Northern China

Millet was cultivated throughout northern China during the later Neolithic Period, circa 5000–1900 B.C. (Table II). Foxtail millet is present in several geographic areas, and by about 3000–2000 B.C. it is present in eastern Tibet at the Karou site (Tibet Autonomous Region, 1985). Foxtail millet is the most common variety at northern sites. It seems well adapted to arid climates (An, 1989, pp. 645). During the late Neolithic Period, people may have focused on this variety in areas where the climate was becoming increasingly arid. Broomcorn millet is rare in the east; the only known occurrence in the Eastern Yellow River valley is at the site of Beizhuang on Changdao, an island off northeast Shandong facing the Liaodong peninsula (W. Yan, 1992). Future fieldwork should clarify the geographic distribution of each variety of cultivated millet during the Neolithic Period.

Agricultural systems may have become more diversified in some regions during the later Neolithic Period. Systematic recovery of floral remains by flotation could determine the role of other cultivated plants such as hemp, *Cannabis sativa.* This plant probably was first domesticated during the earlier Neolithic Period. People in more than one region of northern China could have used the fruit for food or oil and the coarse fiber from the stems for clothing or mats (Crawford, 1992, p. 27). The Majiayao site of Linjia (Dongxiang County, Gansu) yielded some carbonized hemp seeds in addition to broomcorn millet (Teacher's College, 1984). The base of a pottery bowl at the Yangshao site of Banpo (Xian, Shaanxi) shows traces of a woven fabric, possibly hemp (Banpo Museum, 1982). At Banpo, archaeologists also found seeds of Chinese cabbage or leaf mustard in a pottery jar. Another potential crop that needs to be investigated further is wheat. Wheat has been recovered from sites of the Early Bronze Age, Siba Culture (after ca. 1900 B.C.), in Gansu province (An, 1991). There is debate whether wheat was independently domesticated in China or whether it was introduced through contacts with people to the west (Xu, 1994). It is not clear when wheat was first cultivated in China. Wheat has been reported for one Longshan site in Shandong, Xiwusi (Yanzhou County; State Bureau, 1990).

Scholars continue to debate the techniques used in dry-land agricultural systems of northern China. Some argue that fertile, loess soils allowed short fallow systems during the Yangshao Period (Ho, 1969, 1977, 1984). However, swidden agriculture (slash and burn) is likely, at least for relatively early Neolithic cultures such as Yangshao, given the evidence for a forested environment and the quantity of probable woodworking tools such as adzes and axes at sites (Chang, 1986). Ethnographic data counter the common assumption that frequent relocation of settlements due to soil depletion characterizes a swidden regime. In some areas, swidden systems allow long-term settlements, and people often move for social or ideological reasons instead (Carneiro, 1960; Conklin, 1975). Swidden fields for millet agriculture among contemporary aboriginal peoples in Taiwan may be used for up to 20 years (Fogg, 1983, p. 100). Thus, sites such as Banpo may have been occupied continuously for many years. Key variables that must be understood for Neolithic sites include soil conditions in each region, climate, vegetation, and chronology. Reports describe the phases of occupation at settlements as spanning a few hundred years. Within each phase of occupation, there probably was rebuilding to repair or expand houses (Underhill, 1994).

More research is needed on the role of different kinds of pottery vessels and tools in processing and cooking foods. Yang (1994) provides an innovative study of methods to prepare foods from the Banpo Culture, including the role of specific forms of pottery vessels. Systematic examination of vessels for function (soot, residues, etc.) would be useful in addition to experiments with replicated vessels. The decline in long, rectangular grinding stones and rollers after the Peiligang Period (An, 1989, p. 648) could indicate that people were using a wider variety of materials such as wood for processing plant foods. People continued to use shell, bone, and stone for agricultural tools during the later Neolithic Period of northern China (Fig. 4). Probably some tools identified as knives in reports also functioned as sickles. Use-wear analysis and experiments should be employed to iden-

Table III. Remains of Domesticated Animals from Neolithic Cultures in China (Data from Ren, 1995; Nelson, 1995; Yan, 1992; Ye, 1992; West and Zhou, 1988; Chang, 1986; Olsen 1985; Ho, 1977) (Dates Are Approximate)

Culture	Dog	Pig	Chicken	Water Buffalo	Cattle	Sheep	Goat
Western Yellow River valley							
Qijia, 2100–1900 B.C.	X	X			X	X	X
Banshan, Machang, 2800–2100 B.C.							
Majiayao, 3400–2800 B.C.		X	X			X	
Yangshao, 5000–3400 B.C.							
Central Yellow River valley							
Longshan, 2800–1900 B.C.	X	X	X	X	X	X	X
Yangshao, 5100–2800 B.C.	X	X	X	X	X		X?
Peiligang, 6300–5100 B.C.	X	X	X		X	X	
Laoguantai, 6000–5000 B.C.	X	X	X	X?		X?	
Eastern Yellow River valley							
Longshan, 2600–1900 B.C.	X	X	X		X	X	
Dawenkou, 4300–2600 B.C.	X	X	X	X	X		
Beixin, 5500–4300 B.C.	X	X	X	X?	X		
Houli, 6200–5500 B.C.							
Northeast							
Late Neolithic							
Hongshan, 4500–3200 B.C.	X	X			X?	X	
Earlier cultures		X					
Middle Yangzi							
Longshan, 2500–1900 B.C.	X	X	X				
Qujialing, 3000–2500 B.C.	X	X	X				
Daxi, 4500–3000 B.C.	X	X	X		X?	X?	
Zaoshi, 5500–4500 B.C.		X		X	X		
Pengtoushan, 7000–5500 B.C.				X			
Lower Yangzi							
Late Neolithic							
Liangzhu, 3300–2200 B.C.	X	X		X		X?	
Songze, 3700–3300 B.C.		X					
Majiabang, 4500–3700 B.C.	X	X		X			
Hemudu, 5000–4500 B.C.	X	X		X			
Southeast							
Late Neolithic, 2500–1000 B.C.	X	X					
Dapenkeng and other early cultures, 5000–2500 B.C.							

tify agricultural tools. Form is not a sufficient criterion to identify tools such as hoes and to infer the presence of agriculture.

Remains of domesticated dog, pig, and chicken have been found at later Neolithic sites in most areas of northern China, especially the pig (Table III). It also is possible that people raised silkworms during the Late Yangshao or Early Longshan period. Part of a silk cocoon is reported for the site of Xiyin [Xiaxian County, southern Shanxi (Chang, 1986, p. 113; Li, 1983, pp. 36–37)]. Other reported domesticated animals are cattle, water buffalo, goat, sheep, and the horse.

Cattle bones have been found at later Neolithic sites in most areas of northern China. There is an increase in the occurrence of water buffalo in the Central and Eastern Yellow River valley. This is similar to the pattern for rice, as discussed below. When more reports include faunal remains and specify the variety of bovines present, the quantity may increase. Remains of water buffalo are reported for the Yangshao site of Xiawanggang in southwest Henan (Xichuan County), the Dawenkou layer at Wangyin (Yanzhou, southwest Shandong), and two Longshan sites: Jiangou in southern Hebei (Handan) and Keshengzhuang in Changan, central Shaanxi (Ren, 1995, p. 42). Water buffalo could have been used to prepare paddy fields by trampling soil (puddling or compacting wet soil) or for pulling plows (Ho, 1977, p. 448). Archaeologists could look for the material indicator of the role of water buffalo in rice cultivation that was developed in Thailand, traces of stress on the third phalanx resulting from plowing (Higham *et al.*, 1981; Higham and Kijngam, 1979).

Sheep are reported for several sites in Northeast China and the Western Yellow River valley (W. Yan, 1992, p. 123). However, the identification of sheep bone in Yangshao sites is debatable (W. Yan, 1992, p. 123; Yang, 1994). Future research projects should investigate whether people raised cattle, sheep, or other animals for secondary products such as yogurt or wool during the later Neolithic Period. People may have been able to digest yogurt, even if they were lactose intolerant like much of the modern population. Archaeologists could apply expectations indicating exploitation of animals for secondary products based on particular age profiles that have been developed for European sites (Greenfield, 1991).

Domesticated goat are known only from later Neolithic sites in northern China (Ren, 1995; W. Yan, 1992, p. 123) (Table III). The date of the site in western Henan mentioned by Yan (1992) is not clear. The first clear case of goat is the Miaodigou II site (Early Longshan), circa 2800 B.C., in the loess highlands (Ho, 1977, p. 474). Goats are more prevalent in sites from the Qijia Culture in Gansu, circa 2000 B.C. If the wild ancestor of the goat, *Capra hircus*, was not native to China, the goat must have been introduced from culture areas farther west (Ho, 1977, pp. 466–477, 474).

There is abundant archaeological evidence indicating the importance of the horse (*Equus caballus*) to elites in the Central Yellow River valley during the Shang Dynasty (Chang, 1980). However, there is considerable disagreement about whether the horse was first domesticated in northern China during the Neolithic Period. The introduction of the horse probably represents contact between farmers and pastoralists from the north. The Asian wild horse (*Equus przewalskii*) was common on the Mongolian steppe until the mid-1800s (Olsen, 1984). Apparently, horse bone was found at Qijia sites in Gansu, circa 2100–1900 B.C. (Chang, 1986, p. 282). An (1988b, p. 757) states that the horse was first domesticated during the late Neolithic Period, but he later suggests (An, 1989, p. 648) that Neolithic people used wild rather than domesticated horses. Chang (1980, p. 143) concludes on the basis of statements in oracle bones that Shang elites imported horses (either tamed or domesticated) from northern areas. Future fieldwork needs to recover more evidence for the presence of the horse in different regions during the late Neolithic Period. It also should determine whether there is any evidence for an association between horses and elite activities (especially with chariots) such as hunting, military activities, or travel. As in other areas, initial use of the horse for transportation would have been revolutionary and a symbol of prestige (Anthony and Brown, 1991). Wear patterns on the teeth could indicate the use of bits for riding (Anthony and Brown, 1991). Archaeologists also should investigate whether horses were used for food (Olsen, 1984).

Rice in Northern China

Recent discoveries have indicated that rice (*Oryza sativa*) was grown in a number of areas in northern China during the Neolithic Period (Table IV). Most of the rice remains date to phases after 5000 B.C. Rice is most common in Longshan sites after circa 2800 B.C. The sites with rice are concentrated in the Central and Eastern Yellow River valley, especially near the Huai River (Fig. 3). It is likely that rice was introduced from areas to the south such as the Yangzi River valley. Bellwood (1995, p. 16) states that these new discoveries suggest there may be only one area in China where the initial domestication of plants took place. However, Nanzhuangtou and the other possible early sites suggest that dry-land crops such as millet were domesticated in northern China, while aquatic crops such as rice were domesticated in southern China.

Some scholars maintain that rice was grown in the Wei River valley of Shaanxi province (western Central Yellow River valley) before 5000 B.C., but the evidence is debatable. The most thorough discussion of the evi-

Table IV. Dated Sites in Northern China with Evidence (Macrobotanical Remains or Impressions in Pottery, Unless Noted Otherwise) for Cultivated Rice (Data from Wang, 1995; Wu, 1994; Zhang *et al.*, 1994; Jiang and Piperno, 1994; Yan, 1991, 1992)

Central Yellow River valley, west	Central Yellow River valley, east	Eastern Yellow River valley
Longshan Period, ca, 2800–1900 B.C.	Longhan Period, ca. 2800–1900 B.C.	Longshan Period, ca. 2600–1900 B.C.
• Anban site, Fufeng County, southwestern Shaanxi; Early Longshan Period	• Lilou site, Ruzhou city, central Henan; Late Longshan Period; *indica*, *japonica*, and wild rice • Yangzhuang site, Zhumadian city, southern Henan; rice phytoliths • Yanzhai site, Yuzhou city, central Henan; Mid-Late Longshan Period	• Yaowangcheng site, Rizhao, southeastern Shandong; Longshan Period; *japonica* rice • Yangjiajuan site, Qixia County, northeast Shandong; Early Longshan or Late Dawenkou Period? • Yancangcheng site, Ganyu County, northern Jiangsu; Early Longshan or Late Dawenkou Period? • Haochengzhen site, Guzhen County, northern Anhui • Yuchisi site, Mengcheng County, northern Anhui; Early Longshan or Late Dawenkou Period?; rice phytoliths
Yangshao Culture, ca. 5000–2800 B.C.	Yangshao Culture, ca. 5000–2800 B.C.	Dawenkou Culture, ca. 4300–2600 B.C.
• Hejiawan site, Xixiang County, southwestern Shaanxi • Lijiacun site, Xixiang County, southwestern Shaanxi; either Early Yangshao or late Laoguantai Culture	• Huanglianshu site, Xiachuan County, southwestern Henan; Late Yangshao or Qujialing Culture • Xigaoya site, Luoyang city, central Henan; Early or Late Yangshao Culture • Dahecun site, Zhengzhou city, central Henan; Early or Late Yangshao Culture • Xiaji site, Xiachuan County, southwestern Henan; Early Yangshao Culture, ca. 5000–3500 B.C. • Xiawanggang site, Xiachuan County, Early Yangshao Culture	• Wangyin site, Yanzhou County, southwest Shandong; Early Dawenkou Culture; rice pollen • Erjiancun site, Lianyungang city, northern Jiangsu; Early Dawenkou Culture or Late Beixin Culture • Honglongzhuang site, Gaogou County, central Jiangsu; Early Dawenkou or Late Beixin Culture
Laoguantai Culture, ca. 6000–5000 B.C.	Peiligang Culture, ca. 6300–5100 B.C.	Beixin Culture, ca. 5500–4300 B.C.
• Possible site above	• Jiahu site, Wuyang County, central Henan; *indica* and *japonica* rice	• Possible sites above

dence is provided by Wu *et al.* (1994), who state that there is only one possible site, Lijiacun, in southwestern Shaanxi (Xixiang County). The dating of the component with rice is not clear; it may belong to the Late Laoguantai or the Early Yangshao Culture (Wu, 1994; see also W. Yan, 1991, 1992). The site of Hejiawan in the same county apparently dates to the Yangshao Culture. There have been difficulties in reanalyzing materials collected up to 70 years ago, a significant problem faced by archaeologists in any area. The most recently collected material is the most reliable (Wu, 1994; see also Wu, 1996).

There is agreement that domesticated rice is present at the site of Jiahu from the Peiligang Culture. Jiahu, located in central Henan (33°N), is the earliest known site from northern China with rice (Ren, 1995, p. 40; Zhang *et al.*, 1994). Both varieties of rice known from Neolithic sites in southern China are represented. Husks of short-grained rice, *japonica* (*geng*), and long-grained rice, *indica* (*xian*), were recovered from red, burnt earth. Investigators used a scanning electron microscope to examine the remains as well as phytolith analysis. They conclude that the rice grains resemble modern paddy rice (Zhang, 1994; Ren, 1995).

There are several occurrences of rice in the Eastern Yellow River valley after 5000 B.C. in southern Shandong, northern Jiangsu, and northern Anhui (Table IV). Unfortunately, the dating of many of these sites is uncertain. Yangjiajuan (easternmost Shandong, Qixia County) may date to the Late Dawenkou (ca. 2800 B.C.) rather than the Longshan period (W. Yan, 1992; Zhang *et al.*, 1994). The rice pollen from Wangyin (Yanzhou County) probably dates to the Early Dawenkou rather than the Beixin period (Wu, 1994, p. 79). The rice husk from red burnt soil at Erjiancun (lower layer), is roughly contemporary or a little earlier than the lower layer at Wangyin (Wu, 1994, p. 79; Ren, 1995). Therefore, it could date to the Late Beixin or Early Dawenkou period. Artifacts from Yancangcheng (Ganyu County, northern Jiangsu) are similar to those from Erjiancun and could date to the Dawenkou or Early Longshan period (Wu, 1994, p. 79), although some scholars maintain the site dates to the later Longshan Period (Zhang et al., 1994). The site of Honglongzhuang (Gaoyou County, central Jiangsu) could date to the Beixin rather than the Early Dawenkou period (Zhang *et al.*, 1994). Rice phytoliths were identified from soil inside a *ding* tripod pottery vessel at Yuchisi (Mengcheng County) in northern Anhui (Z. Wang, 1995). It is not clear whether the vessel dates to the Late Dawenkou or Longshan period. Rice (*japonica*) also has been recovered by flotation at the Longshan site of Yaowangcheng, Rizhao County, southeastern Shandong (Zhongguo Wenwu Bao, 1994). Archaeologists propose that coastal areas of Shandong and other provinces played an important role in the transmission of rice to Japan during later periods (Nongye Kaogu, 1994, p. 75; Ren, 1995, p. 40).

Sites with rice in the Central Yellow River valley are more securely dated. Again, the sites are located in southerly areas. Rice has been found at Yangshao sites in western and central Henan (Wu, 1994; Zhang *et al.*, 1994; W. Yan, 1992). However, there are debates about cultural classification of sites in southwestern Henan, near Hubei province. It is not clear whether the site of Huanglianshu (Xichuan County), which also has remains of millet, should be classified as belonging to the Qujialing or Yangshao culture (Ren, 1995, p. 40; W. Yan, 1992).

Rice has been discovered at several sites from the Longshan Period in the Central Yellow River valley. The rice from Anban (Fufeng County, southwestern Shaanxi) has been examined by spodogram analysis (Wu, 1994, p. 79). The site of Yanzhai (Yuzhou County, central Henan) dates to the mid-late Longshan Period (Zhang *et al.*, 1994). The rice from Lilou (Ruzhou, central Henan), collected by flotation, is the largest and most completely analyzed sample from northern China (Zhang *et al.*, 1994; First Henan Team, 1994). There are grains of *japonica*, *indica*, and even wild rice (discussed below). The report includes photos of the carbonized rice, with data on the sizes of different kinds of grains. Two radiocarbon dates indicate that Lilou was occupied during the late Longshan Period, circa 2000 B.C. The recent data on domesticated rice in the Yellow River valley show that the rice phytoliths identified by Jiang and Piperno (1994) from the Longshan site of Yangzhuang and a nearby lake in southern Henan are not aberrant as the authors suggest. Systematic collection of botanical remains is necessary to clarify the process by which rice cultivation began in northern China. Wet rice cultivation may have been adopted in warmer areas with adequate water sources. The relative importance of rice versus millet in the diet must be examined on a regional basis and from a diachronic perspective.

Agricultural Systems in Southern China

Processes in the Domestication of Rice

Approximately 80% of the Neolithic sites in China with domesticated rice are located in the Yangzi River valley. Since the Yangzi River valley contains the greatest number of sites with rice as well as the earliest sites, it is probably the area where rice was first domesticated (W. Yan, 1991, p. 124; 1992, pp. 120–121; Tang *et al.*, 1994). Scholars acknowledge that rice could have been first domesticated in areas farther south or beyond the borders of China. W. Yan (1991, 1992) points out that a wide area encompassing the Middle and Lower Reaches of the Yangzi River valley and southernmost China should be investigated. However, he believes that the rich natural environment of south China would not have compelled people to change their methods of obtaining plant foods. Only people in a more temperate environment such as the Yangzi River valley would have had the incentive to attempt cultivation. He predicts that the area where the initial steps in domestication of rice took place during the Early Holocene is the lower Yangzi River valley, given the developed system of rice agriculture found at Hemudu in northern Zhejiang by 5000 B.C. As discussed below, his international team has found some evidence for this process further west in northern Jiangxi province. Others predict that the middle Yangzi River valley was more important (Xiang, 1995).

More information on the distribution of wild rice in prehistory is needed to understand the process by which domestication began. The ancestor of *Oryza sativa* is generally regarded as *Oryza rufipogon*. One problem confounding research is that weed races of wild rice may hybridize with domesticated rice. Thus, it is difficult to reconstruct the specific type of wild rice ancestral to domesticated rice. Also, the significance of the different kinds of wild rice known from the historic and modern periods in China is not clear (Crawford, 1992, pp. 24–25; Harlan, 1977, p. 370; Chang, 1989). At present, wild rice may be found in the Middle and Lower Reaches of the Yangzi River valley. A survey in 1984 reported a weed form of wild rice (*Oryza sativa* var. *spontanea*) growing in Hunan and Jiangxi provinces (Yan, 1991, p. 123). It appears that wild rice grew in the Lower Yangzi River valley in prehistory. Tang *et al.* (1994) conclude that some of the carbonized rice grains from the site of Hemudu in Zhejiang (discussed below) actually represent a form of wild rice. They compare quantitative data on the morphological characteristics of modern wild rice and domesticated rice from the Lake Tai area to excavated rice from Hemudu.

Recent fieldwork indicates that parts of northern China also had a suitable climate for wild rice in prehistory. The area of the Lilou site in central Henan, about 34°N, may represent the northern border of the distribution area for wild rice during the Neolithic Period (Tang *et al.*, 1994; W. Yan, 1992). It is also possible, however, that the wild rice from this site represents a weed race that is not ancestral to *Oryza sativa*. Oracle bone records from the late Shang Dynasty suggest that a form of wild rice grew near the capital of Anyang in northern Henan. Some scholars argue that the term *ni* in the oracle bones means wild rice, and thus, rice was a major crop during the Shang Dynasty (Chang, 1980, p. 149). However, this term occurs only once in the oracle bone records (Keightley, 1977, p. 56). It may indicate a weed race rather than a form of wild rice ancestral to modern paddy rice. Only systematic recovery of plant remains at Shang sites can determine whether wild rice grew in the area and whether cultivated rice played a major role in the diet.

Records for the later historic period in China indicate the presence of some kind of wild rice in both north and south China, including Taiwan (T. T. Chang, 1983, pp. 70–71). More information is needed on the dates when people observed the wild rice. Records indicate wild rice as far north as 38°N, in Hebei province (Ho, 1969, pp. 21–22, 1977, pp. 443–446; T. T. Chang, 1983, 1989). They also mention wild rice near the site of Erjiancun in northern Jiangsu, discussed previously. During the eighth through the eleventh centuries A.D., wild rice grew in the Huai River area (Zhang *et al.*, 1994). More research is needed to determine the evolutionary significance of each variant of wild rice from the prehistoric, historic, and modern periods.

It also is necessary to determine the sequence in which the two varieties of cultivated rice known from the Neolithic Period, *japonica* and *indica*, developed. These varieties are ideal types, because there is a range of variation in grain size (Crawford, 1992, p. 24). *Japonica* is adapted to a temperate climate and currently can grow only in the Yangzi River valley. *Indica* favors warmer climates such as south China but can also grow in the Yangzi region. W. Yan (1991, p. 125, 1992, p. 122) implies that the first rice domesticated in China should be *japonica*. Tang *et al.* (1994) propose that both varieties of rice developed from common wild rice and that both were early domesticates. They also suggest that *japonica* was the first variety domesticated in China and that the earliest sites should be near Lake Tai in the Lower Reaches of the Yangzi River valley.

The most common cropping system for rice in southern China during the Neolithic Period probably was a simple form of wetland cultivation. The earliest sites from the Yangzi River valley are located in marshy areas, and they have yielded several kinds of aquatic plants. It is likely that farmers throughout the Neolithic Period took advantage of the extensive, naturally flooded areas in river valleys (T. T. Chang, 1983; Harlan, 1977). Transplanting, the current, labor intensive method of rice farming in China, is a relatively recent development. Historical texts first mention transplanting during the Han Dynasty, 206 B.C.–A.D. 220 (Ho, 1969, p. 26, 1977, p. 448). Neolithic farmers probably broadcast seeds in low-lying, naturally flooded areas. It is likely that this was supplemented by the digging of ditches to facilitate water flow and drainage. This simple, but effective method of rice farming has been documented in floodplain areas of southeast Asia. There, farmers broadcast seeds over large areas where the seasonal overflow of rivers causes flooding (Piper, 1993). Recent ethnoarchaeological research in areas with wild rice suggests that this type of system characterizes early rice cultivation in Thailand (White, 1995).

Archaeologists also should investigate the possibility that dry-land rice cultivation developed at a relatively early date in upland areas of China and southeast Asia (Tang *et al.*, 1994; White, 1995). In mountainous central Taiwan, for example, aboriginal peoples grow millet using the swidden technique (Dewar, 1978; Fogg, 1983). Neolithic farmers in southern China may have used different techniques for different species of plants. On Orchid Island (Lan Yu, or Botel Tobago), off the southeast coast of Taiwan, the Yami use more than one cultivation technique (Dewar, 1978, pp. 225–226).

The Early Holocene in Southern China

Archaeologists have long noted the potential of early cave sites in southern China for providing information on the origins of agriculture. Limestone caves such as Xianrendong, northern Jiangxi (Wannian County), in the Middle Yangzi River valley and Zengpiyan, farther south at Guilin, Guangxi, have artifacts such as grinding stones that may indicate plant processing. Revised radiocarbon dates for the bulk of the excavated materials at these two sites indicate occupation circa 7800–6300 B.C. (Ren, 1995, p. 37; Yuan, 1993). The area also has some early open-air sites such as Baozitou (Nanning, Guangxi). It is likely that there was considerable regional variation in subsistence within southern China during the early Holocene. In some areas, people probably began to cultivate other plants besides rice, such as taro. Methods to recognize cultivation of root crops that have been used in other areas should be attempted in China, such as identification of starch residues on stone tools (Loy *et al.*, 1992) or organic residues in pottery (Hill and Evans, 1989). People in southern China also probably exploited a variety of wild plants during the Neolithic Period. A recent pollen analysis at Zengpiyan suggests use of fruit, starchy plants, and plants for fibers, especially during the later cultural periods (Yang, 1992; Ren, 1995, pp. 41–42).

An important reason archaeologists infer that cultivation began early at cave sites in southern China is the evidence for pig domestication at Zengpiyan. The relatively large quantity of pig bones (representing 67 pigs) and the young ages of pigs represented (1–2 years old) seem to indicate killing of animals raised by humans rather than an age profile for a population that died naturally (Ren, 1995, p. 41). Although hunters could have selected young, wild pigs (Smith, 1995, pp. 139–140), the canines seem to exhibit the size reduction resulting from artificial selection that is expected for domesticated pigs. Also, the age profile matches the expected pattern for domesticated pigs in other areas, since pigs tend to be exploited by humans exclusively for meat (Greenfield, 1991, pp. 178–179). However, evidence for domestication of pig at one site does not necessarily indicate that people also cultivated plants. Regional variation in the domestication of animals within southern China should be investigated. Chicken bones have been reported for the site of Xianrendong, but there is no convincing evidence for domestication (Ren, 1995, p. 41; W. Yan, 1992, p. 123). The cultural layer associated with the bones of water buffalo discovered at the site is not clear (Ren, 1995, p. 42).

Recent studies have begun to identify regional variation in subsistence and settlement in southern China during the early Neolithic Period. Dai (1989) identifies distinctly different patterns in terms of stone tool inventories between coastal sites (mainly shell middens) and inland sites (mostly caves) circa 10,000–8000 B.P. in five areas (Jiangxi, Guangxi, Guangdong, Fujian, and Taiwan). There is evidence for change over time in subsistence activities at the inland sites, in contrast to the coastal sites. The period circa 10,000–9000 B.P. at inland sites is represented by chipped stone tools and some perforated stone tools. For the period circa 9000–8000 B.P., polished stone tools increase (at least partial grinding on the tools; and completely polished tools appear), and pottery with coarse paste appears. Jiao (1994) focuses on identifying stages of cultural development in South China, beginning with the late Pleistocene in Guangdong and Guangxi provinces. He maintains that the final Pleistocene–early Holocene, circa 14,000–9000 B.P, is characterized by the development of edge ground stone tools, perforated, chipped stone tools, and shell and bone tools. He classifies sites from this stage as Mesolithic. Like Dai (1989), Jiao sees significant changes after circa 9000 B.P., when completely polished stone tools develop (or ground stone, on the basis of the published illustrations). Also during this phase, coarse tempered pottery appears, and shell and bone tools become more common. Jiao (1994) argues that this set of artifacts including ground stone tools and pottery indicates the emergence of cultivation and, therefore, the beginning of the Neolithic Period in South China.

Another positive trend in research is the comparison of early sites in South China with those from southeast Asia. Jiao (1994) notes similarities in stone tools from Guangdong and Guangxi with roughly contemporary sites in Vietnam. Similarities in subsistence practices, tool function, and settlement patterns among rockshelters should be examined in more detail. Comparisons to Hoabinhian [ca. 11,000–4500 B.P. (Higham, 1989, p. 35)] sites in adjoining Vietnam would be especially useful. Similar changes in material culture and economy probably took place in both areas. In Vietnam, rockshelters were occupied from about 12,000 B.P. There is evidence during later phases for the development of edge grinding, resulting in partially polished stone tools such as hafted axes for forest clearance. Pollen analysis also indicates that several species of wild plants were available (Higham, 1989, pp. 39–43). It is possible that hunter-gatherer populations in some areas of Vietnam and South China began cultivating plants before they developed pottery, like the Near East. There may have been a wider range of alternative materials for cooking than in northern China, especially different kinds of wood such as bamboo. Even in the present century, people in southwest China have used bamboo sections for cooking (Eberhard, 1968, pp. 100–101).

Archaeologists have begun to identify similarities in dating, material culture, and economy between inland sites in southern China and sites in the highlands of northern Thailand such as Spirit Cave (Ren, 1995; Chang, 1986). Spirit Cave was occupied intermittently from circa 12,000–7500 B.P. (Higham, 1989, p. 50). The extensive macrobotanical analyses for the site clearly indicate the use of a range of wild plants (Gorman, 1971; Higham, 1989, pp. 45–53). There is no direct evidence, but scholars suggest that the earliest cultivated plants were leguminous plants or nut producing trees (Higham, 1989, pp. 53–54), a pattern that could characterize southern China as well. Another nearby site, Banyan Cave, demonstrates that hunting and gathering continued in some upland areas of Thailand during the later prehistoric period (Higham, 1989, pp. 54–57). Although it was occupied from circa 5500–1100 B.P., it contains artifacts similar to those at older sites in the area (including pottery and hafted and polished adzes) and husks of wild rice. The emergence of pottery in northern Thailand probably signifies an increase in sedentism rather than plant cultivation (Higham, 1989, p. 60). Banyan Cave shows that some sites in southern China with pottery and polished stone tools may not indicate plant cultivation and may represent continuation of a hunting and gathering economy over time. It is clear that the developmental sequence for the complex of traits regarded as "Neolithic" should be investigated on a regional basis in China.

There has been little investigation of the early Holocene period in some parts of South China, such as Taiwan. One possibility is that indigenous populations on Taiwan began to cultivate root crops or other plants. However, there is no evidence for cultivation during the early Holocene, and the preceramic cultures of Taiwan are not understood. The preceramic period is known primarily from one cave site, Changbin. Archaeologists suggest that the Changbin Culture extends back to about 15,000 B.P., and they characterize it as either Paleolithic or Mesolithic. Chopping tools and flakes are characteristic artifacts. Scholars also link the few human skeletal remains recovered from late Pleistocene deposits on Taiwan to the Changbin Culture. A similar economy may have continued for several thousand years, since some radiocarbon dates for the Changbin site are about 4000–3000 B.C. (Sung, 1989,

Table V. Summary of Data on Subsistence from Test Excavations at Wangdong (Wang Dong) and Xianrendong (Xian Ren Dong) Cave Sites in Northern Jiangxi Province (Compiled from MacNeish and Libby, 1995; MacNeish, 1997)

Period	Plant remains	Tools
Neolithic 4 (Wan-nian Phase), ca. 7700–6000 B.P.; no C14 dates; similar ceramics at Hemudu in Zhejiang	Rice phytoliths at Xianrendong; inferred rice cultivation	Ground stone tools, perforated stone disks, pecked stone adzes
Neolithic 3 (Jiangxi Phase), ca. 9550–7700 B.P.; one C14 date; similar ceramics at Pengtoushan in Hunan	Many domesticated and some wild rice phytoliths at Wangdong, inferred rice cultivation; isotopic analysis of human skull fragments suggests paddy rice agriculture	Possible stone hoes at both sites, perforated stone disk weights, chipped stone adzes, many large, shell harvesting tools
Neolithic 2 (Wang Phase), ca. 11,200–9550 B.P.; one C14 date; first cordmarked pottery	Wild rice phytoliths; pollen and phytoliths of *Oryza sativa*, domesticated rice; possible rice cultivation	Stone adzes and hoes, possibly for tilling; possible stone weights for digging sticks as for planting rice
Neolithic 1 (Xian Ren Phase), ca. 14,000–11,200 B.P.; three C14 dates; earliest pottery (traces of wiping with a toothed implement)	Wild rice phytoliths; plant use	Mollusk-shell tools for harvesting
Dayuan (Epi-Paleolithic Phase), ca. 17,000–14,000 B.P.; two C14 dates	Wild rice phytoliths; isotopic analysis of one human skull suggests rice consumption (wild)	Fewer microlithic tools, more chopping tools, many bone tools, more mollusk-shell harvesting tools
Yangtze (Late Paleolithic Phase), ca. 42,000–17,000 B.P.; 12 stratified zones; three C14 dates from middle and upper zones	A few possible phytoliths of wild rice	Several forms of chipped stone tools, chopping tools, microblades, and possible mollusk-shell harvesting tools

p. 101; Pearson 1989, pp. 116–117). Continued fieldwork on the late Pleistocene in Fujian province should eventually provide data on the movement of people into Taiwan via the Dongshan Land Bridge (Olsen and Miller-Antonio, 1992, p. 152) as well as early subsistence practices.

Recent test excavations by the international team of Richard MacNeish and Yan Wenming (Beijing University) at the cave sites of Xianrendong and Wangdong (the focus) in Wannian County, northern Jiangxi, are extremely significant, because they indicate four phases of occupation in southern China even earlier than 9000 B.P. (MacNeish and Libby, 1995; MacNeish, 1997). I summarize the published results of these test excavations in order to put them in a regional context (Table V). The team of MacNeish and Yan identifies six major phases: Yangtze (Late Paleolithic; ca. 42,000–17,000 B.P.), Dayuan (Epi-Paleolithic, ca. 17,000–14,000 B.P.), Neolithic 1 (ca. 14,000–11,200 B.P.), Neolithic 2 (ca. 11,200–9550 B.P.), Neolithic 3 (ca. 9550–7700 B.P.), and Neolithic 4 [ca. 7700–6000 B.P. (Zhao *et al.* 1995; MacNeish, 1997)]. Apparently, there are other early sites in the Middle and Lower Reaches of the Yangzi River valley as well, but no published descriptions are available. For example, W. Yan (1992, p.121) mentions a cave called Shenxian in central Jiangsu (presumably in Lianshui County) with a sherd dated about 11,000 B.P.

The previously excavated materials from the lower level at Xianrendong and materials from related sites seem similar to the late Neolithic 2 and the early Neolithic 3 phases MacNeish and Yan identify. The pottery from Neolithic 3 is said to be similar to that from the earliest site with clear evidence of agriculture in the Yangzi River valley, Pengtoushan, discussed below. The research team infers that rice cultivation is present during the Neolithic 3 phase, based on the presence of stone tools interpreted as hoes as well as phytoliths from mainly domesticated rice (MacNeish, 1995, p. 88; 1997). By Neolithic 4, groundstone tools and pottery similar to that at the site of Hemudu appear.

The preliminary results from the Sino-American collaborative project are significant, because they suggest that cultivation began even earlier than scholars had expected—during the Neolithic 2 phase, circa 11,200–9550 B.P. (MacNeish, 1995, 1997; Zhao *et al.*, 1995). The most compelling evidence for the Neolithic 2 phase is the phytoliths of domesticated rice, found in both caves. There also is an increase in the quantity of tools possibly used for cultivation by Neolithic 2. The team plans several studies of tool function, such as experimental replications and use-wear analysis, to refine their interpretations. No doubt there are plans to conduct more isotopic analyses of human bone (when available) for data on rice consumption. Initial efforts at flotation indicated poor preservation of macrobotanical remains at the site (Zhao, 1995; 1996).

A recent study of samples of domesticated rice dated by radiocarbon from more than 100 sites (incorporating unpublished data) in the Yangzi River valley, conducted by Syuichi Toyama, an archaeologist in Japan, suggests a similar time frame for the origins of agriculture. Summarizing the results of this study, Normile (1997) states that most of the oldest sites with domesticated rice have a median age of 11,500 B.P. and are located in Hubei and Hunan provinces. Apparently, this date is based on results of the MacNeish and Yan project. Also, the earliest sites are located not in Hubei province, but in Jiangxi and Hunan provinces (MacNeish, personal communication, 1997). Detailed results of the study are not available. Other scholars have done innovative research on the origins of rice domestication. Zhao (1996) presents a thorough evaluation of early sites in the Yangzi River valley with remains of rice, a model for the origins of rice agriculture stressing ecological factors, and a systematic analysis of rice phytoliths from several sites.

The team of MacNeish and Yan found no evidence for pig domestication at either Wangdong or Xianrendong. Statistical data for the pig molars at Wangdong are within the size range of wild pigs (Redding, 1995, p. 56). It appears that pigs were domesticated in some areas of southern China after the invention of pottery and perhaps also after cultivation had begun. The wild pig probably was distributed over a wide area in prehistory (W. Yan 1992, p. 122). Also in contrast to Zengpiyan, chicken bones from the upper levels at Xianrendong seem to indicate domestication (Redding, 1995, p. 58).

The test excavations by MacNeish and Yan indicate the emergence of pottery in southern China at a much earlier date than previously known, circa 14,000–11,200 B.P., during the Neolithic 1 phase. Judging from the radiocarbon dates this pottery is at least as old as the pottery from Nanzhuangtou in northern China and possibly as old as the earliest pottery in Japan (or even older). A priority of research should be to date other potentially early sites with pottery in the area.

The earliest pottery from southern China was found at Xianrendong. Like the early pottery from other areas, it is not cordmarked. The exterior portion of most sherds shows traces of wiping with a toothed implement, perhaps of wood (Hill, personal communication, 1997). Many sherds have crushed quartzite in the paste (Hill, 1995, pp. 35–36). Cordmarked pottery does not appear until the Neolithic 2 phase, circa 11,200–9550 B.P. One possible sequence of development for some regions in northern and southern China is that increased exploitation of local, wild resources, especially plants, led to an increase in sedentism and the invention of pottery by about 12,000 B.P. People may have desired more kinds and quantities of containers for cooking, storing, and serving the increasing varieties of food. Later, plant cultivation began, and eventually people relied more heavily on cultivated plants. Finally, new kinds of stone tools for more efficient farming were invented.

Archaeologists working in southern China also should look for evidence of increasing sedentism such as the emergence of formal burials. Burials at the site of Zengpiyan in northern Guangxi are estimated at circa 7800–6300 B.C. If they date closer to 7800 B.C., they are the earliest in southern China. These burials seem similar to those from the late Pleistocene deposits at Zhoukoudian in northern China (Upper Cave; ca. 20,000–12,000 B.P.), with respect to the kind of ritual that is represented and the extent of care in treatment of the dead by the living kin. Some of the 18 flexed burials from Zengpiyan have red ocher on them, and there are no associated artifacts (Chang 1986, p. 102; Guangxi Team, 1976). The dates of the secondary burials at Pengtoushan, discussed below, are not clear; they could range from circa 6900–6300 B.C. During the later Neolithic Period in several areas of both northern and southern China, the living began to provide their deceased kin with formal pit graves and a variety of objects such as tools, pots, and ornaments. This significant change in treatment of the dead most likely symbolizes stronger beliefs about territoriality, ties to the land, and the importance of ancestors.

Neolithic Sites in Southern China, circa 7000–4500 B.C.

The earliest site with clear evidence for domesticated rice is Pengtoushan, in the Middle Reaches of the Yangzi River valley (Table VI). This site is located in Lixian County, Hunan, on Lake Dongting. Survey has indicated several other potentially early sites in the area (Hunan Province, 1989). Archaeologists infer from several conventional radiocarbon and AMS

Table VI. Cultures in Southern China with Macrobotanical Evidence for Cultivation of Wet Rice and Other Crops (Data from Wang, 1995; Tang *et al.*, 1994; Yan, 1991, 1992; An, 1988)

South China (southeast mainland, Taiwan	Lower Yangzi River Valley	Middle Yangzi River Valley
Late Neolithic cultures, ca. 2500–1000 B.C.; both *indica* and *japonica* rice; first documented rice on Taiwan	Late Neolithic; rice, unknown varieties	Longshan Period, ca, 2500–1900 B.C.; several sites with rice, *japonica* identified at some
Shixia Culture in Guangdong, ca. 3000–2400 B.C.; *indica* and *japonica* rice	Liangzhu Culture, ca. 3300–2200 B.C.; *indica* and *japonica* rice	Qujialing Culture, ca. 3000–2500 B.C.; rice at several sites, only *japonica* identified
	Songze (ca. 3700–3300 B.C.) and Majiabang (ca. 4500–3700 B.C.) cultures; *indica* and *japonica* rice	Daxi Culture, ca. 4500–3000 B.C.; both varieties of rice
Dapenkeng Culture, ca. 5000–2500 B.C.; no evidence but possible cultivation of root crops and other crops such as rice	Hemudu Culture, ca. 5000–4500 B.C.; both *indica* (more common) and *japonica* rice, wild rice, soybean	Zaoshi Culture, ca. 5500–4500 B.C.; rice at several sites, *japonica* identified at some
		Pengtoushan Culture, ca. 7000–5500 B.C.; unknown varieties of rice

dates that the Pengtoushan site was occupied circa 6900–6300 B.C. They estimate that the Pengtoushan Culture spans the period circa 7000–5500 B.C. Thus, this culture is somewhat earlier than the Peiligang Culture of the Yellow River valley (Ren, 1995, p. 37; W. Yan, 1991, 1992; Chen and Hedges, 1994).

At Pengtoushan, carbonized rice husks and grains similar to modern rice were found in red burnt earth and in pottery sherds [especially from jars, possibly representing tempering material (Hunan Province, 1990; Yan, 1990, 1991; Ren, 1995)]. Like sites in the north such as Peiligang and Cishan, Pengtoushan represents fully sedentary, village life. Two houses (one larger one at surface level; one semisubterranean) and 18 burials were excavated. Most of these are secondary burials, which are older than the few primary burials at the site. Common pottery forms are bag-shaped jars and basins with round bases. Much of the pottery is cordmarked. Flint tools are more abundant than ground stone tools. Pollen analysis indicates a somewhat warmer climate at the time of occupation (Hunan Pollen Lab, 1990). Test excavations at the nearby site of Lijiagang also recovered domesticated rice (Ren, 1995, p. 40). The variety of rice present at these sites is not known. Some archaeologists believe that the bones of water buffalo found at Pengtoushan indicate domestication (Ren, 1995, p. 42). Recent discoveries are providing more data on the Pengtoushan Culture. The site of Bashidang (Lixian County, Hunan) from the late Pengtoushan Culture has a circular ditch interpreted as a moat, as well as a surrounding wall likely built during a later phase (Hunan Province, 1996).

Archaeologists currently are revising the classification and dating of cultures in the Middle Yangzi River valley prior to the Daxi Culture, circa 4500–3000 B.C., in Hunan and Hubei provinces (Lin and Hu, 1993; He, 1995). The culture after Pengtoushan in Hunan near Lake Dongting is generally referred to as Zaoshi. At the site of Hujiawuchang (Linli County) and other sites, rice grains and husks inside sherds were recovered (Hunan Province, 1993; Ren, 1995, p. 40). Bones of domesticated pig and water buffalo also were discovered. Some scholars refer to sites in western Hubei province, circa 6500–5000 B.C., as belonging to the Chengbeixi Culture (Lin and Li, 1988; He, 1995; Ren, 1995; Hunan Museum, 1986; W. Yan, 1992). Others refer to a separate, local Zaoshi Culture in Hubei. To simplify matters, I refer to all early cultures in the Middle Yangzi valley as Pengtoushan (ca. 7000–5500 B.C.) and all later cultures as Zaoshi (ca. 5500–4500 B.C.). At the Chengbeixi site (Yidu County), a husk of *japonica* rice was found in a sherd. Water buffalo bones have been found at several sites, and bones of cattle (*huang niu*) at the Zaoshi site [Shimen County (Ren, 1995, pp. 40, 42)].

The Hemudu Culture of the lower Yangzi River valley existed circa 5000–4500 B.C. (Zhao and Wu, 1987; W. Yan, 1992; Liu and Yao, 1993). The Hemudu site (Yuyao, northeast Zhejiang) is well known for its extensive preservation of organic materials, including massive quantities of domesticated rice (Zhejiang Province, 1978; Hemudu Team, 1980; Liu, 1985). Both the *japonica* and the *indica* varieties have been identified, in addition to wild rice, as discussed above (Tang *et al.*, 1994). Most archaeologists refer to the first two cultural layers at this waterlogged site as belonging to the Hemudu Culture and the two upper cultural layers to the Majiabang or Songze Cultures. Other sites from the Hemudu Culture such as Luojiajiao also have yielded both varieties of domesticated rice. The importance of the Hemudu site to archaeology in China is reflected by the construction of a new museum and research center in Yuyao city (Li, 1993). The Hemudu Culture is regarded as playing a significant role in the origins, development, and diffusion of rice agriculture to other areas in China and Japan (Chen and Huang, 1994).

The excellent preservation of organic materials at Hemudu provides an unusually complete picture of a Neolithic agricultural settlement. It is clear that people relied on a great variety of plants and animals adapted to an aquatic environment, both domesticated and wild. Other possible early domesticates include water caltrop, lotus root, and gourd. Bones of domesticated dog and water buffalo were found at the site. A pottery model and engraved design on a pot indicate domesticated pig as well. Liu and Yao (1993) argue that some clay models represent sheep and oxen, but there are other possible interpretations for the identity of these animals. Archaeologists infer knowledge of silk production from designs on an ivory "cap" for a tool, interpreted as silkworms with a woven pattern, and the recovery of mulberry pollen (Liu and Yao, 1993). The wooden, pile dwellings exhibiting a sophisticated mortise and tenon joining technique and a wooden well (the earliest known in China) point to a substantial settlement. The lacquer objects (wooden, covered with resin from the lacquer tree) are the earliest known in China. Among the extensive wooden artifacts were the earliest known oar for a boat, recovered from the lowest layer (Liu and Yao, 1993). Other significant artifacts from the lowest layer (four) include a bone whistle (similar to the flute at Jiahu in the north) and painted pottery, apparently the earliest in southern China. Layer three yielded a small pottery head, reminiscent of the figures from Houwa in Northeast China and interpreted as having features of both humans and monkeys (Liu and Yao, 1993).

The wooden and bone agricultural tools preserved at Hemudu have generated much discussion, especially the spades from scapulae of water buffalo and other large animals (Fig. 4). They could have been used for a variety of tasks, such as digging drainage ditches for rice fields. The translations of Chinese terms for tool forms can cause confusion. Scholars such as Song (1979) refer to the spades as *si*. This term has been translated as "plow share" for stone tools from the Hongshan Culture in Northeast China (Guo, 1995; see also Nelson, 1990, p. 246). However, some publications refer to similar forms of tools from Hongshan sites such as Hulingzhi (eastern Inner Mongolia) as spades (Institute of Archaeology, 1993, p. 111). More studies of tool function involving criteria such as use wear in addition to morphology are needed for sites in southern China.

Comparisons of the varieties of agricultural tools between geographic areas must consider differential preservation. Some scholars conclude that there were fewer kinds of agricultural tools in southern China compared to the north, where greater quantities of stone sickles and stone knives that could have been used for harvesting have been found (Liu, 1994). However, people in the Yangzi River valley and South China may have used organic materials more often than stone for agricultural tools. Tools of bone, wood, and bamboo may not be preserved in sites (Bellwood, 1995, p. 16). A bone sickle was found at the unusually well-preserved site of Hemudu (Liu and Yao, 1993, p. 55) (Fig. 4). Also, aboriginal peoples of Taiwan have been observed using bamboo knives for harvesting cereals (Fogg, 1983, p. 103). Future work will need to determine whether the relative lack of emphasis on stone as a material for tools during the Pleistocene in southern China (Pope, 1989) also characterizes the Neolithic Period. There are some stone artifacts from the Yangzi River valley (Xiang, 1991) which could have been used in agricultural activities.

Later Neolithic Cultures of Southern China

An agricultural economy based on rice continued during the later Neolithic Period in both the Middle and the Lower Reaches of the Yangzi River valley (Table VI). Both varieties of rice, *japonica* and *indica*, have been found. Large quantities of rice (both varieties) were recovered from Daxi Culture deposits at the site of Chengtoushan in Lixian County, Hunan (W. Wang, 1995). A recent report presents the results of a detailed statistical analysis of variation in morphology of carbonized rice grains from this period. It also identifies phytoliths of domesticated rice from the Daxi Culture and the following Qujialing Culture (Gu, 1996). The same suite of domesticated animals continued during the later Neolithic in southern China as well: water buffalo, chicken, pig, and dog (Table III). When animal bones are systematically recovered at more sites, the cases of domesticated water buffalo should increase.

Liangzhu Culture sites in the Lower Yangzi River valley have yielded the earliest undisputed evidence for sericulture and silk reeling in the form of thread, ribbon, and fabric (W. Yan, 1992, p. 123). Archaeologists debate whether there were later Neolithic cultures after Liangzhu or whether the Liangzhu Culture lasted until the onset of the Bronze Age (see Fung, 1994, p. 53; An, 1994, p. 83; Sun, 1993).

It appears that rice agriculture and domestication of animals diffused to South China by about 3000 B.C. Both varieties of rice are present at Shixia Culture sites in Guangdong, circa 3000–2400 B.C. (W. Yan, 1992). Domesticated pig and dog are reported for the Tanshishan Culture of Fujian, circa 2200–1500 B.C. (X. Yan, 1992).

Current data suggest that cultivation began in Taiwan at a relatively late date in comparison to other parts of southern China. Several valuable, systematic studies of paleoecology, subsistence, and settlement have been conducted in Taiwan (Chang *et al.*, 1969; Chang, 1977; Dewar, 1978; Tsang, 1992). The earliest Neolithic Culture known on Taiwan is called the Dapenkeng Culture, circa 5000–2500 B.C. Most scholars accept the antiquity of this culture, although recently, Tsang (1992, pp. 266–277) argues that the culture begins at least 1000 years later. Sites with Dapenkeng components are located in northern, west-central, and southern Taiwan and the Penghu (Pescadores) Islands. Key sites are Dapenkeng (northern Taiwan) and Fengbitou (southeast Taiwan) (Chang *et al.*, 1969). Dai (1989) uses the term "Dapenkeng" to refer to a later Neolithic culture in both southeast China and Taiwan. Distinctive artifacts for the sites on Taiwan include gritty, cordmarked pottery, stone netweights, polished (ground) stone tools such as adzes, and stone bark beaters for extracting fiber (Chang *et al.*, 1969; Chang, 1981, 1986; Sung, 1989; Pearson, 1989, p. 119; K. Li, 1989, pp. 149–150). Similarities in artifact styles suggest that people migrated from the southeast coast of mainland China to Taiwan (Sung, 1989, p. 71). There is no archaeological evidence for cultivation, but cultivation of root crops, rice, or other plants is likely.

The Dapenkeng Culture of Taiwan and related cultures of southeast China are significant in debates about origins of the Austronesian language family (Chang, 1994, 1989; Blust, 1995). Current and historic populations of Austronesian speakers are distributed across a vast area, from tropical Asia to the Pacific islands. Historically, the aboriginal peoples of Taiwan spoke languages that belong to the Austronesian language family. Linguistic reconstructions of the origin and development of Austronesian have important implications for subsistence. Many scholars maintain that the area in or near Taiwan had proto-Austronesian speakers during the earlier Neolithic Period (Bellwood, 1985; Tsang, 1992; Blust, 1995). Further, the proto-Austronesian speakers migrated from south coastal China (primarily Fujian and Guangdong; perhaps as far north as the Hemudu cultural area in the Lower Yangzi River valley, although there is no linguistic evidence for Austronesian speakers there), continuing their subsistence practices in each area they moved through. Given the dates documenting early cereal agriculture on the mainland, they propose that rice and probably also millet cultivation were introduced to Taiwan circa 4000 B.C., during the Dapenkeng period.

Blust (1995) uses linguistic data to provide a detailed reconstruction of the subsistence economy of proto-Austronesian speakers, primarily on Taiwan. He concludes that there was a variety of cultivated plants: rice and millet, root crops such as taro, sugarcane, and tree crops such as banana and betel nut, as well as domesticated animals (dog, pig, and possibly chicken and water buffalo). More archaeological fieldwork is necessary to support this reconstruction. If skeletal remains from the Dapenkeng Culture were available, it should be possible to identify betel nut mastication. The betel nut, from the areca palm, provides caffeine and is somewhat addictive (Harlan, 1995, pp. 64–165). Currently, some people in Taiwan begin to chew betel nut at an early age, causing staining of the teeth. Late prehistoric skeletons at the Peinan site in southeastern Taiwan show evidence of this activity, including black staining on molars and attrition (Lien, 1989, p. 181). The linguistic data also suggest that Austronesian speakers wove cloth using fiber from hemp or banana plants (Blust, 1995). However, a stone bark cloth or tapa beater, a distinctive trait of cultures in the Pacific islands, was discovered at a Dapenkeng site (Chang, 1989).

There is no archaeological evidence for cultivation on Taiwan until the late Neolithic Period, after 2500 B.C. During this period, artifacts throughout Taiwan, especially pottery vessels, show even more stylistic similarities with cultures of the southeastern mainland (Huang, 1989). The term "Lungshanoid" emphasizes these shared characteristics. However, there is substantial regional variability within Taiwan itself (Chang 1989, pp. 94–95). It is likely that marine resources such as fish and shellfish continued to play an important role in the subsistence economies of both Taiwan and the mainland. The earliest evidence for rice on Taiwan comes from the Zhishanyan site. Three radiocarbon dates place the Zhishanyan Culture of northern Taiwan at about 2000–1000 B.C. Unusual preservation at the site allowed recovery of carbonized *japonica* rice, wooden objects, woven straw, and other materials. It is likely that rice was introduced by people from the mainland (You, 1986; Tsang, 1992, pp. 31–32). One proposed cultivating tool at Zhishanyan is a hook-shaped, deer horn "hoe" (You, 1986, p. 34) (Fig. 4). However, Liu and Yao (1993) conclude that a similar form of bone tool at Hemudu is either a handle for an ax or adze or a pick ax.

There are traces of rice at other late Neolithic sites on Taiwan after about 2000 B.C. The *indica* variety was discovered at Kending in southern Taiwan (T. T. Chang, 1989, p. 411; Tsang, 1992). Tsang (1992, p. 261) proposes that people from the island of Taiwan eventually moved to the

Penghu Islands and attempted wet rice agriculture there. He suggests that the *indica* rice on the Penghu Islands may be as early as 2600 B.C. (Tsang, 1992, p. 168), implying that the initial period of rice agriculture on Taiwan had to begin much earlier. The origins and development of millet agriculture on Taiwan, known in the historic period, are other unresolved issues.

The Social Implications of Agricultural Change in China

Current data suggest that there was diversification of subsistence practices during the later Neolithic Period in both northern and southern China. Farmers may have deliberately introduced new species of domesticated plants or animals to reduce risk (Morrison, 1994). An important, unresolved issue is the degree to which Neolithic economies in the Yellow and Huai River valleys depended on cultivated rice in comparison to millet. It also is unclear whether farmers grew more than one variety of millet or rice, whenever possible, to reduce risk. During the later Neolithic Period, secondary products probably became more important, such as wool from sheep in parts of northern China. Plants and animals such as hemp, silkworms, and the horse probably were raised for uses other than food.

Social and ideological functions of food became more important during the later Neolithic Period, especially with regard to mortuary ritual. Dog skeletons have been found in graves of the Dawenkou Culture (W. Yan, 1992, pp. 122–123) and could represent food consumed by mourners or offerings of food to the deceased. The practice of putting pig bones (mandibles, skulls, or complete skeletons) in graves began with the Laoguantai Culture in the western part of the Central Yellow River valley (Ren, 1995, p. 41). Eventually, it became widespread. Pig bone has been found in some Yangshao burials (Zhang, 1985). It is an especially distinctive characteristic of burials from the Dawenkou Culture of the Eastern Yellow River valley. These bones may represent feasting during funerals by mourners, offerings to the deceased, or both (Kim, 1994; Underhill, 1997a). The practice also is evident from the late Neolithic, Qijia Culture of the Western Yellow River valley. One Qijia grave at Qinweijia (Yongjing County, Gansu) contains bones of 68 pigs, the most in any Neolithic burial (W. Yan, 1992, p. 122). Aspiring elites may have used pigs as valued resources when they competed for status, as in other areas of the world (Kim, 1994; Blanton and Taylor, 1995). There is evidence for feasting and social display with a variety of domesticated animals during the Longshan Period at the site of Kangjia in Shaanxi (Liu, 1995, p. 24).

It is likely that food was an important component of mortuary ritual for most individuals during the Neolithic Period, since pottery vessels are the most common kind of offering in all culture areas. Examination of the contents of pottery jars in graves by flotation and other techniques should reveal that plant foods had an important role in mortuary ritual. Pottery jars in graves containing foxtail millet have been found at Banpo (Yangshao Culture; Banpo Museum, 1982) and at the late Neolithic site of Liuwan in Qinghai (W. Yan, 1992, p. 114). A secondary product from grain that probably also was important in mortuary ritual is alcohol (Underhill, 1997b). Archaeologists should examine skeletons for evidence of a relationship between rank and diet during the later Neolithic Period. Higher-ranking people should be taller in stature and have fewer caries, indicative of a diet richer in meat (Powell, 1988, p. 80).

Another important question for future research is how intensification of agricultural production took place during the later Neolithic Period. The large, walled sites from the Longshan Period (Underhill, 1994; Liu, 1996), for example, must have been associated with short fallow systems to obtain greater yields per unit of land, labor, or technology (Morrison, 1994, p. 115). Liu (1994) suggests that earlier Neolithic cultures, circa 5000 B.C., in both the Yellow and the Yangzi River valleys had swidden agriculture. Later, more permanent fields and hoe farming developed. However, there are no simple indicators for intensification such as the appearance of new forms of tools. The factors that need to be considered include type of crop, environment, cropping system, and social motivation (Morrison, 1994). Intensification of production should be examined on a regional basis in China.

Farmers may have focused on particular plants that provided relatively great yields. Tong (1994) argues that Neolithic farmers in northern China could obtain high yields from millet, facilitating the development of the earliest complex societies in this area, in comparison to farmers in the south growing rice. Bray (1978, p. 25) suggests instead that both broomcorn millet and rice could provide high yields. The agricultural techniques used to obtain high yields also need to be identified. Cattle and water buffalo may have been used as draft animals in conjunction with plows (Bray, 1978, pp. 25–26). In some regions, however, water buffalo may have been used only for tasks such as threshing rice (Piper, 1993). For wet rice, simple methods such as digging more ditches for greater control over water or greater use of fertilizers could help achieve higher yields. The proper amount of water is critical for rice to survive. People probably learned how to supplement insufficient water flow in dry seasons and create adequate drainage during flood seasons (Rigg, 1991, p. 222). In southern China, people may have deliberately integrated rice cultivation with other types of food procurement such as raising fish. The antiquity of aquaculture, or growing fish and other aquatic species in controlled environments (Jenkins, 1991, p. 218), is unknown. There would have been ecological advantages as well. Modern farmers find that fish help control the number of insects threatening the crop of wet rice (Jenkins, 1991, p. 218).

Current data suggest that technological change was not a significant factor in the development of complex societies, since agricultural tools are similar to those from the early Bronze Age, and extensive water control systems develop much later in time (Chang, 1983b; Ferrie, 1995). It is more likely that social and religious factors motivated people to intensify agricultural production and had a causal role in the development of complex societies.

CONCLUSIONS

The extensive fieldwork in both northern and southern China has generated important data on the origins and development of agricultural systems during the Neolithic Period. Sites from the early Holocene Period will continue to provide valuable comparative data on agricultural origins. It is likely that there were two centers of early cereal cultivation, millet in the north and rice in the south. It is possible that other plants such as taro and the soybean were early cultivars, perhaps even earlier than cereals. More research is needed to determine the regions within northern and southern China where the initial steps in plant domestication took place. Some previously unexpected areas such as northern Hebei and western Inner Mongolia have intriguing remains. It is possible that animals such as the pig were independently domesticated in more than one region. The dog and the pig may have been domesticated before plants (the dog at Nanzhuangtou in Hebei and the pig at Zengpiyan in Guangxi).

Models of the origins of agriculture should be developed for individual regions in China. Regional investigations of the origins of agriculture should consider the related processes of increasing sedentism and the invention of pottery. Archaeologists should look for indicators of increasing sedentism such as more permanent housing, nonportable artifacts, storage facilities, and more careful treatment of the dead. In some regions, the invention of pottery could be linked to increasing sedentism and increasing reliance on plants in the diet, either wild or cultivated. More research devoted to examining regional variation in subsistence practices is needed, investigating topics such as change in diet and intensification of production. Furthermore, more studies should link change in agricultural systems to social and ideological change as well as environmental change. Finer chronological control is needed, too, since most cultures from the Neolithic Period span several centuries.

Archaeologists are employing an increasing variety of methodological and theoretical approaches for investigating topics such as subsistence during the Neolithic Period of China. There has been great interest in employing new techniques for data collection and analysis. In my view, adoption of relatively simple techniques would be the most valuable. Widespread use of flotation and screening for systematic recovery of floral and faunal remains would revolutionize knowledge about the origins and development of agricultural systems. Finally, more information about the extraordinary Neolithic sites of China would be conveyed if a greater number of publications provided detailed information on research designs and procedures used to make interpretations.

ACKNOWLEDGMENTS

I thank Erika Evasdottir, Department of Anthropology, Harvard University, for preparing the first draft of Figs. 2 and 3 and Bryan Natinsky, School of Architecture, Yale University, for the amended version of Figs. 2 and 3 as well as Figs. 1 and 4. I did a comprehensive review of the recent literature on the Neolithic Period during my year at Harvard as a visiting scholar, from 1994 to 1995. I am grateful to several colleagues for stimulating discussions about Neolithic archaeology, insight, and advice: Professor K. C. Chang, Robert Murowchick, Liu Li, Wang Wenjian, Yangjin Pak, Cao Yin, Li Guo, Chen Xingcan, Michael Puett, Chris Fung, and Erika Evasdottir. I thank the American Council of Learned Societies and the Chiang Ching-Kuo Foundation for support during that year. I am also grateful to Gary Feinman, Cynthia McQueeny, and two anonymous reviewers for their valuable comments on a draft of this paper. Richard MacNeish, David Hill, and Zhao Zhijun provided extremely useful information about early sites in the Yangzi River valley. Discussions about agricultural systems with Harold Conklin and Dana Lepofsky were very helpful as well. Finally, I thank my colleagues in China for all they have taught me and for their extraordinary dedication. Any errors or omissions in this paper are my own responsibility.

REFERENCES

An, Z. (1988a). Zhongguo de Shiqian Nongye [Prehistoric agriculture in China]. *Kaogu Xuebao* 4(1988): 369–381.

An, Z. (1988b). Archaeological research on Neolithic China. *Current Anthropology* **29**(5): 753–759.

An, Z. (1989). Prehistoric agriculture in China. In Harris, D., and Hillman, G. (eds.), *Foraging and Farming. The Evolution of Plant Exploitation,* Unwin Hyman, Boston, pp. 643–649.

An, Z. (1991). Radiocarbon dates in Chinese archaeology. *World Archaeology* 23(2): 193–200.
An, Z. (1994). Tanshisi Duandai He Zhongguo Shiqian Kaoguxue [The division of history into periods by radiocarbon dating and Chinese prehistoric archaeology). *Wenwu* 3(1994): 83–87.
Anthony, D. W., and Brown, D. R. (1991). The origins of horseback riding. *Antiquity* 65: 22–38.
Arnold, J. E. (1993). Labor and the rise of complex hunter-gatherers. *Journal of Anthropological Archaeology* 12: 75–119.
Banpo Museum (1982). *Xian Banpo. Neolithic Site at Banpo Near Xian*, Wenwu Press, Beijing.
Baoding District Office for the Protection of Cultural Relics, Xushui County Office for the Protection of Cultural Relics, Beijing University, Department of Archaeology, and Hebei University, History Department (1992). Hebei Xushui Xian Nanzhuangtou Yizhi Shijue Jianbao [Short report on test excavations at the Nanzhuangtou site in Xushui County, Hebei]. *Kaogu* 11(1992): 961–986.
Barnes, G. L. (1993). *China, Korea, and Japan: The Rise of Civilization in East Asia*, Thames and Hudson, New York.
Barnett, W. K., and Hoopes, J.W. (1995). *The Emergence of Pottery. Technology and Innovation in Ancient Societies*, Smithsonian Institution Press, Washington, DC.
Bar-Yosef, O., and Belfer-Cohen, A. (1991). From sedentary hunter-gatherers to territorial farmers in the Levant. In Gregg, S. (ed.), *Between Bands and States*, Center for Archaeological Investigations, Occasional Paper No. 9, Southern Illinois University, Carbondale, pp. 181–202.
Bellwood, P. (1985). A hypothesis for Austronesian origins. *Asian Perspectives* 26(1): 107–117.
Bellwood, P. (1995). Early agriculture, language history and the archaeological record in China and Southeast Asia. In Yeung, C.-t., and Li, W.-l. B. (eds.), *Archaeology in Southeast Asia*, The University Museum and Art Gallery, University of Hong Kong, pp. 11–22.
Bettinger, R., Madsen, D., and Elston, R. (1994). Prehistoric settlement categories and settlement systems in the Alashan Desert of Inner Mongolia, PRC. *Journal of Anthropological Archaeology* 13: 74–101.
Blanton, R. E., and Taylor, J. (1995). Patterns of exchange and the social production of pigs in highland New Guinea: Their relevance to questions about the origins and evolution of agriculture. *Journal of Archaeological Research* 3(2): 113–145.
Blust, R. (1995). The prehistory of the Austronesian-speaking peoples: A view from language. *Journal of World Prehistory* 9(4): 453–510.
Bray, F. (1978). Swords into plowshares. A study of agricultural technology and society in early China. *Technology and Culture* 19: 1–31.
Brown, J. A. (1989). The beginnings of pottery as an economic process. In van der Leeuw, S. E., and Torrence, R. (eds.), *What's New? A Closer Look at the Process of Innovation*, Unwin Hyman, London, pp. 203–224.
Bryd, B. F. (1994). From early humans to farmers and herders—Recent progress on key transitions in Southwest Asia. *Journal of Archaeological Research* 2(3): 221–253.
Cai, L., and Qiu, S. (1984). Tanshisan Ceding he Gudai Shipu Yanjiu [Carbon-13 analysis and research on ancient diets]. *Kaogu* 10(1984): 949–955.
Cao, B. (1994). Henan Huixian Ji Qi Fujin Diqu Huanjing Kaogu Yanjiu [Research on environmental archaeology in the vicinity of Huixian County, Henan]. *Huaxia Kaogu* 3(1994): 61–67, 78.
Carneiro, R. L. (1960). Slash-and-burn agriculture: A closer look at its implications for settlement patterns. Bobbs-Merrill Reprint Series in the Social Sciences A-26, University of Pennsylvania, pp. 229–234.
Chang, K. C. (1970). The beginnings of agriculture in the Far East. *Antiquity* 44: 175–185.
Chang, K. C. (ed.) (1977). *Reports of the Archaeological Investigations in the Choshui-Tatu River Valleys of West-Central Taiwan*, Special Publications No. 70, Institute of History and Philology, Academia Sinica, Taipei.
Chang, K. C. (1980). *Shang Civilization*, Yale University Press, New Haven, CT.

Chang, K. C. (1981). The affluent foragers in the coastal areas of China: Extrapolation from evidence on the transition to agriculture. In Koyama, S., and Thomas, D. H. (ed.), *Affluent Foragers: Pacific Coasts East and West*, National Museum of Ethnology, Osaka, Japan.

Chang, K. C. (1983a). Sandai archaeology and the formation of states in ancient China: Processual aspects of the origins of Chinese civilization. In Keightley, D. (ed.), *Origins of Chinese Civilization*, University of California Press, Berkeley, pp. 495–521.

Chang, K. C. (1983b). *Art, Myth, and Ritual. The Path to Political Authority in Ancient China*, Harvard University Press, Cambridge, MA.

Chang, K. C. (1986). *The Archaeology of Ancient China*, 4th ed., Yale University Press, New Haven, CT.

Chang, K. C. (1994). Zhongguo Dongnan Haiyan Kaoguxue Nandao Yuzu Qiyuan Wenti [Archaeology of the southeast coast of China and questions on the origins of the Austronesian language family]. In Tang, C. (ed.), *Nan Zhongguo Ji Linjin Diqu Gu Wenhua Yanjiu*, Chinese University of Hong Kong, pp. 311–319.

Chang, K. C., Lin, C.-c. Stuiver, M, Tu, H.-y., Tsukada, M., Pearson, R., and Hsu, T.-m. (1969). *Fengpitou, Tapenkeng, and the Prehistory of Taiwan*, Yale University Publications in Anthropology No. 73, New Haven, CT.

Chang. T. T. (1983). The origins and early cultures of the cereal grains and food legumes. In Keightley, D. (ed.), *The Origins of Chinese Civilization*, University of California Press, Berkeley, pp. 65–94.

Chang, T. T. (1989). Domestication and spread of the cultivated rices. In Harris, D., and Hillman, G. (eds.), *Foraging and Farming. The Evolution of Plant Exploitation*, Unwin Hyman, London, pp. 408–417.

Chen, C. (1994). Shiqi Shidai Fenye Wenti [Issues regarding the division of periods within the Stone Age]. *Kaogu* 3(1994): 239–246.

Chen, K. T., and Hiebert, F. (1995). The late prehistory of Xinjiang in relation to its neighbors. *Journal of World Prehistory* **9**(2): 243–300.

Chen, T., and Hedges, R .E. M. (1994). Pengtoushan Deng Yizhi Taopian He Woguo Zui Zao Shuidao Cun de Jiasu qi Zhipu 14C Cenian [AMS dates for the earliest paddy rice in our country from sherds at Pengtoushan and other sites]. *Wenwu* 3(1994): 88–94.

Chen, X. and Huang, M. (1994). Zhongguo Hemudu Wenhua Guoji Xueshu Taolunhui Zongshu [Summary of the International Symposium on the Hemudu Culture of China]. *Wenwu* 10(1994): 84–86.

Choe, C. P. (1990). Origins of agriculture in Korea. *Korea Journal* **30**(11): 4–14.

Conklin, H. (1975). *Hanunoo Agriculture. A Report on an Integral System of Shifting Cultivation in the Philippines*, Food and Agriculture Organization of the United Nations, Rome, 1957. (Reprinted by Elliot's Books, Northford, CT.)

CPAM, Hebei Province and the Handan Bureau for the Protection of Cultural Relics (1981). Hebei Wuan Cishan Yizhi [The site of Cishan at Wuan, Hebei]. *Kaogu Xuebao* 3(1981): 303–338.

Crawford, G. (1992). Prehistoric plant domestication in East Asia. In Cowan, C. W., and Watson, P. J. (eds.), *The Origins of Agriculture. An International Perspective*, Smithsonian Institution Press, Washington, DC, pp. 7–38.

Crown, P., and Wills, W. (1995). The origins of Southwestern ceramic containers: Women's time allocation and economic intensification. *Journal of Anthropological Research* **51**: 173–186.

Dai, G. (1989). Huanan Diqu Xinshiqi Shidai Zaoqi Wenhua de Leixing Yu Fenqi [Classification and Definition of Stages of Development of Early Neolithic Cultures in South China]. *Kaogu Xuebao* 3(1989): 263–274.

Dewar, R. (1978). Ecological context and the prehistory of the West Central Taiwan coast. *Asian Perspectives* **21**(2): 207–241.

Dien, A., Riegel, J., and Price, N. (eds.) (1985). *Chinese Archaeological Abstracts, 2. Prehistoric to Western Zhou*. Monumental Archaeologica 9, Institute of Archaeology, University of California, Los Angeles.

Eberhard, W. (1968). *The Local Cultures of South and East China*. (transl. Eberhard, A.), E. J. Brill, Leiden.

Esaka, T. (1986). The origins and characteristics of Jomon ceramic culture: A brief introduction. In Pearson, R. J. (ed.), *Windows on the Japanese Past: Studies in Archaeology and Prehistory*, Center for Japanese Studies, University of Michigan, Ann Arbor, pp. 223–228.

Fang, D. (1991). Fuxin Chahai Yizhi de Fajue Yu Chubu Fenxi [A preliminary analysis of remains from excavations of the Chahai site at Fuxin]. *Liaohai Wenwu Xuekan* 1(1991): 27–34.

Fang, Y. (1994). Guanyu Huanghe Zhongyou Xin shiqi Shidai ZaoZhongqi Kaoguxue Wenhua de Xiangguan Wenti [Regarding the classification of archaeological cultures from the Early and Middle Neolithic Period in the Middle Reaches of the Yellow River]. *Zhongyuan Wenwu* 2(1994): 31–40, 80.

Fedick, S. L. (1995). Indigenous agriculture in the Americas. *Journal of Archaeological Research* 3(4): 257–303.

Ferrie, H. (1995). A conversation with K. C. Chang. *Current Anthropology* 36(2): 307–325.

First Henan Archaeological Team, IA, CASS (1984). 1979 Nian Peiligang Yizhi Fajue Baogao [Report for the excavation of the Peiligang site in 1979]. *Kaogu Xuebao* 1(1984): 23–52.

First Henan Archaeological Team, IA, CASS (1994). Henan Ruzhou Lilou Yizhi de Fajue [Excavation of the Lilou Site at Ruzhou, Henan]. *Kaogu Xuebao* 1(1994): 63–97.

First Henan Archaeological Team, IA, CASS (1995). Henan Jiaxian Shuiquan Peiligang Wenhua Yizhi [The Peiligang culture site of Shuiquan at Jiaxian, Henan]. *Kaogu Xuebao* 1(1995): 39–77.

Fogg, W. H. (1983). Swidden cultivation of foxtail millet by Taiwan aborigines: A cultural analogue of the domestication of Setaria italica in China. In Keightley, D. (ed.), *The Origins of Chinese Civilization*, University of California Press, Berkeley, pp. 95–115.

Fung, C. (1994). The beginnings of settled life. In Murowchick, R. (ed.), *Cradles of Civilization. China, Ancient Culture, Modern Land*, University of Oklahoma Press, Norman, pp. 51–59.

Gorman, C. (1971). The Hoabinhian and after: Subsistence patterns in Southeast Asia during the Late Pleistocene and Early Recent periods. *World Archaeology* 2(3): 300–320.

Greenfield, H. J. (1991). Fauna from the Late Neolithic of the central Balkans: Issues in subsistence and land use. *Journal of Field Archaeology* 18: 161–186.

Gu, H. (1996). Hunan Lixian Chengtoushan Yizhi Chutu de Xinshiqi Shidai Shui Dao Ji Qi Leixing [Varieties of paddy rice unearthed from the Neolithic site of Chengtoushan in Lixian, Hunan]. *Kaogu* 8(1996): 753–761.

Guangxi Cultural Work Team and Guilin City (1976). Guangxi Guilin Zengpiyan Dongxue Yizhi de Shijue [Test excavations at the cave site of Zengpiyan at Guilin, Guangxi]. *Kaogu* 3(1976): 175–179, 160.

Guo, D.-s. (1995). Hongshan and related cultures. In Nelson, S. M. (ed.), *The Archaeology of Northeast China*, Routledge Press, New York, pp. 21–64.

Harlan, J. (1977). The origins of cereal agriculture in the Old World. In Reed, C. (ed.), *The Origins of Agriculture*, Mouton, The Hague, pp. 357–383.

Harlan, J. (1995). *The Living Fields. Our Agricultural Heritage*, Cambridge University Press, New York.

Harris, D. R. (1989). An evolutionary continuum of people-plant interaction. In Harris, D., and Hillman, G. (eds.), *Foraging and Farming. The Evolution of Plant Exploitation*, Unwin Hyman, Boston, pp. 11–41.

He, J. (1995). Hunan Zaoqi Xinshiqi Shidai Wenhua Yicun [Early Neolithic Cultural Relics in Hunan]. In Yeung, C.-t., and Li, W.-l. B. (eds.), *Archaeology in Southeast Asia*, University Museum and Art Gallery, The University of Hong Kong, pp. 71–78.

Hemudu Archaeological Team (1980). Zhejiang Hemudu Yizhi Di Er Qi Fajue de Zhuyao Shouhuo [Important results from the second excavation at the Hemudu site in Zhejiang]. *Wenwu* 5(1980): 1–15.

Henan Province, Institute of Cultural Relics (1989). Henan Wuyang Jiahu Xinshiqi Shidai Yizhi Di Er Zhi Liu Ci Fajue Jian Bao [Preliminary report for the second through the sixth excavations at the Neolithic site of Jiahu in Wuyang, Henan]. *Wenwu* 1(1989): 1–17.

Higham, C. (1989). *The Archaeology of Mainland Southeast Asia*, Cambridge University Press, New York.

Higham, C. (1996). *The Bronze Age of Southeast Asia*, Cambridge University Press, New York.
Higham, C. and Kijngam, A. (1979). Ban Chiang and Northeast Thailand; The palaeoenvironment and economy. *Journal of Archaeological Science* **6**: 211–233.
Higham, C., Kijngam, A., Manly, B. F. J., and Moore, S. J. E. (1981). The bovid third phalanx and prehistoric plowing. *Journal of Archaeological Science* **8**: 353–365.
Hill, D. V. (1995). Ceramic analysis. In MacNeish, R. S. and Libby, J. (ed.), *Origins of Rice Agriculture. The Preliminary Report of the Sino-American Jiangxi (PRC) Project. SAJOR.* Publications in Anthropology No. 13, El Paso Centennial Museum. University of Texas at El Paso, pp. 35–45.
Hill, H. E., and Evans, J. (1989). Crops of the Pacific: New evidence from the chemical analysis of organic residues in pottery. In Harris, D., and Hillman, G. (eds.), *Foraging and Farming. The Evolution of Plant Exploitation*, Unwin Hyman, Boston, pp. 418–425.
Ho, P.-t. (1969). The loess and the origin of Chinese agriculture. *The American Historical Review* **75**(1): 1–36.
Ho, P.-t. (1977). The indigenous origins of Chinese agriculture. In Reed, C. (ed.), *The Origins of Agriculture*, Mouton, The Hague, pp. 413–484.
Ho, P.-t. (1984). The paleoenvironment of North China—A review article. *Journal of Asian Studies* **43**(4): 723–733.
Huang, S.-C. (1989). A discussion of relationships between the prehistoric cultures of Southeast China and Taiwan. In Chang, K. C., Li, K. C., Wolf, A., and Yin, A. (eds.), *Anthropological Studies in the Taiwan Area: Accomplishments and Prospects*, Department of Anthropology, National Taiwan University, Taipei, Taiwan, pp. 59–86.
Hunan Province Institute of Archaeology (1993). Hunan Linli Xian Hujiawuchang Xinshiqi Shidai Yizhi [The Neolithic site of Hujiawuchang in Linli County, Hunan]. *Kaogu Xuebao* **2**: 171–206.
Hunan Province Institute of Archaeology (1996). Hunan Lixian Mengxi Bashidang Xinshiqi Shidai Zaoqi Yizhi Fajue Jianbao [Preliminary report on excavations at the early Neolithic site of Bashidang at Mengxi, Lixian, Hunan]. *Wenwu* **12**(1996): 26–39.
Hunan Province Institute of Archaeology and Lixian Bureau for the Management of Cultural Relics (1990). Hunan Lixian Pengtoushan Xinshiqi Shidai Zaoqi Yizhi Fajue Jianbao [Short report on the excavations at the early Neolithic site of Pengtoushan, Lixian, Hunan]. *Wenwu* **8**(1990): 17–29.
Hunan Province Institute of Archaeology and Lixian Museum (1989). Hunan Sheng Lixian Xinshiqi Shidai Zaoqi Yizhi Diaocha Jianbao [Short report on a survey of early Neolithic sites in Lixian, Hunan]. *Kaogu* **10**(1989): 865–875.
Hunan Province Institute of Archaeology, Pollen Laboratory (1990). Hunan Lixian Pengtoushan Yizhi Baofen Fenxi Yu Gu Huanjing Tantao [Inquiry of the ancient environment from pollen analysis at the Pengtoushan site in Lixian, Hunan]. *Wenwu* **8**(1990): 30–32,69.
Hunan Provincial Museum (1986). Hunan Shimen Zaoshi Xiaceng Xinshiqi Yicun [The Neolithic site from the lower layer at Zaoshi, Shimen, Hunan]. *Kaogu* **1**(1986): 1–11.
Ikawa-Smith, F. (1976). On ceramic technology in East Asia. *Current Anthropology* **17**(3): 513–515.
Institute of Archaeology, CASS (1991). *Zhongguo Kaoguxue Zhong Tanshisi Niandai Shuju Ji. 1965–1991* [A Compilation of Radiocarbon Dates in Chinese Archaeology], Wenwu Press, Beijing.
Institute of Archaeology, CASS (1993). *Kaogu Jinghua* [The Cream of Archaeology]. Kexue Press, Beijing.
Institute of Archaeology, CASS (1994). *Lintong Baijiacun* [The Baijia Site at Lintong]. Ba Shu Press, Chengdu, Sichuan.
Jenkins, A. (1991). Feeding one-fifth of the world. In Tarrant, J. (ed.), *Farming and Food*, Oxford University Press, New York, pp. 212–221.
Jia, L., and Huang, W. (1985). The Late Paleolithic of China. In Wu, R., and Olsen, J. (ed.), *Palaeoanthropology and Palaeolithic Archaeology in the People's Republic of China*, Academic Press, New York, pp. 211–223.
Jiang, Q., and Piperno, D. (1994). Phytolith analysis of an archaeological site (Longshan Period) in Zhumadian City, Henan Province, China: Paleoenvironmental and cultural implications. *Geoarchaeology* **9**(5): 409–417.

Jiang, Q. and Wang, X. (1994). Kaoguxue de Yi Men Xin Jishu: Zhiwu Guishi Fenxi [A new technique in archaeology: Phytolith analysis]. *Kaogu Yu Wenwu* 4(1994): 94–98.

Jiao, T. (1994). Gengxinshi Mo Zhi Quanxinshi Chu Lingnan Diqu de Shiqian Wenhua [Prehistoric cultures of the Lingnan area from the Late Pleistocene to the beginning of the Holocene]. *Kaogu Xuebao* 1(1994): 1–24.

Jin, J., and Xu, H. (1992). Qianyi Xushui Nanzhuangtou Xinshiqi Shidai Zaoqi Yicun [Opinions about the early Neolithic site of Nanzhuangtou at Xushui]. *Kaogu* 11(1992): 1018–1022.

Jinan-Qingdao Highway Archaeological Team (1992). Shandong Linzi Houli Yizhi Di Yi, Er Ci Fajue Jianbao [Short report on the first and second excavations at the Houli site, Linzi Shandong]. *Kaogu* 11(1992): 987–996.

Jinan-Qingdao Highway Archaeological Team (1994). Shandong Linzi Houli Yizhi Di San, Si Ci Fajue Jianbao [Short report on the third and fourth excavations at the site of Houli at Linzi, Shandong]. *Kaogu* 2(1994): 97–112.

Keightley, D. (1977). The cradle of the East: Supplementary comments. *Early China* 3: 55–61.

Keightley, D. (ed.). (1983). *The Origins of Chinese Civilization*, University of California Press, Berkeley.

Kim, S.-O. (1994). Burials, pigs, and political prestige in Neolithic China. *Current Anthropology* 35(2): 119–141.

Li, H.-l. (1983). The domestication of plants in China: Ecogeographical considerations. In Keightley, D. (ed.), *The Origins of Chinese Civilization*, University of California Press, Berkeley, pp. 21–63.

Li, J. Zhang, Z., Deng, Z., and Liang, B. (1995). Study on Neolithic early pottery of China—Concurrent discussions on its origin. In Guo, J. (ed.), *Science and Technology of Ancient Ceramics 3. Proceedings of the International Syposium (ISAC '95)*, Shanghai Research Society of Science and Technology of Ancient Ceramics, pp. 1–7.

Li, J., Zhang, Z., Deng, Z., and Liang, B. (1996). Xinshiqi Shidai Zaoqi Taoqi de Yanjiu [Research on Early Neolithic pottery]. *Kaogu* 5(1996): 467–475.

Li, K. C. (1989). Taiwan as an archaeological laboratory. In Chang, K. C., Li, K. C., Wolf, A., and Yin, A. (eds.), *Anthropological Studies in the Taiwan Area: Accomplishments and Prospects*, Department of Anthropology, National Taiwan University, Taipei, Taiwan, pp. 143–158.

Lien, C.-M. (1989). The interrelationship of Taiwan's prehistoric archaeology and ethnology. In Chang, K. C., Li, K. C., Wolf, A. P., and Yin, A. C. (eds.), *Anthropological Studies of the Taiwan Area: Accomplishments and Prospects*, Department of Anthropology, National Taiwan University, Taipei, Taiwan, pp. 173–192.

Lin, C., and Hu, H. (1993). Chengbeixi, Pengtoushan Wenhua he Zhongguo Zaoqi Dao Zuo Nongye [The Chengbeixi and Pengtoushan cultures and early paddy rice agriculture in China]. *Nongye Kaogu* 1(1993): 116–122.

Lin, C., and Li, Z. (1988). Chengbeixi Yizhi Fucha Ji [Report on another investigation of the Chengbeixi site]. *Jianghan Kaogu* 4(1988): 7–14.

Linfen Cultural Bureau, Shanxi Province (1989). Shanxi Jixian Shizitan Zhongshiqi Wenhua Yizhi [The Mesolithic site of Shizitan at Jixian, Shanxi]. *Kaogu Xuebao* 3(1989): 305–323.

Liu, B., Sun, L., and Ning, Y. (1994). Shandong Jinan Shi Faxian-Pi Xinshiqi Shidi Zaoqi Yizhi [Early Neolithic sites in the area of Jinan City, Shandong). *Kaogu* 11(1994): 961–964.

Liu, F. (1994). Cong Minzuxue Youguan Ziliao Kan Zhongguo Zaoqi Xinshiqi Shidai Yizhi de Jingji Wenhua Leixing [Economic and cultural types of Early Neolithic cultures in China considering ethnographic data]. *Huaxia Kaogu* 2(1994): 50–60.

Liu, J. (1985). Some observations on the archaeological site of Hemudu, Zhejiang Province, China. *Indo-Pacific Prehistory Association* 6: 40–45.

Liu, J., and Yao, Z. (1993). *Zhongguo Hemudu Wenhua* [The Hemudu Culture of China]. Zhejiang Renmin Press.

Liu, K.-b. (1988). Quaternary history of the temperate forests of China. *Quaternary Science Reviews* 7: 1–20.

Liu, K.-b., Sun, S., and Jiang, X. (1992). Environmental change in the Yangtze River delta since 12,000 years B.P. *Quaternary Research* **38**: 32–45.
Liu, L. (1995). Subsistence and beyond in the Kangjia Village, Longshan culture. *Early China News* **8**: 23–24.
Liu, L. (1996). Settlement patterns, chiefdom variability, and the development of early states in North China. *Journal of Anthropological Archaeology* **15**: 237–288.
Liu, Z.-h. (1995). Recent Neolithic discoveries in Jilin Province. In Nelson, S. M. (ed.), *The Archaeology of Northeast China*, Routledge Press, New York, pp. 89–117.
Loy, T. H., Spriggs, M., and Wickler, S. (1992). Direct evidence for human use of plants 28,000 years ago: Starch residues on stone artifacts from the northern Solomon Islands. *Antiquity* **66**: 898–912.
MacNeish, R. S. (1992). *The Origins of Agriculture and Settled Life*, University of Oklahoma Press, Norman.
MacNeish, R. S. (1995). Summary of SAJOR initial endeavors. In MacNeish, R. S., and Libby, J. (eds.), *Origins of Rice Agriculture. The Preliminary Report of the Sino-American Jiangxi (PRC) Project. SAJOR*, Publications in Anthropology No. 13, El Paso Centennial Museum, University of Texas at El Paso, pp. 87–94.
MacNeish, R.S. (1997). The origins of rice agriculture in light of a Paleolithic-Neolithic sequence in South China. In Murowchick, R., von Falkenhausen, L., Tsang, C., and Yates, R. (eds.), *Festschrift in Honor of Kwang-chih Chang*, Academia Sinica, Taipei, Taiwan, and Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge, MA (in press).
MacNeish, R. S., and Libby, J. (eds.). (1995). *Origins of Rice Agriculture. The Preliminary Report of the Sino-American Jiangxi (PRC) Project. SAJOR*, Publications in Anthropology No. 13, El Paso Centennial Museum, University of Texas at El Paso.
Madsen, D., Elston, R., Bettinger, R., Xu, C., and Zhong, K. (1996). Settlement patterns reflected in assemblages from the Pleistocene/Holocene transition of North Central China. *Journal of Archaeological Science* **23**: 217–231.
McCorriston, J., and Hole, F. (1991). The ecology of seasonal stress and the origins of agriculture in the Near East. *American Anthropologist* **93**(1): 46–69.
Morrison, K. (1994). The intensification of production: Archaeological approaches. *Journal of Archaeological Method and Theory* **1**(2): 111–159.
Mou, Y., and Wu, R. (1993). Shui Dao, Cansi, he Yuqi—Zhonghua Wenming Qiyuan de Ruogan Wenti [paddy rice, silk, and Jade—Some questions on the origins of Chinese civilization]. *Kaogu* **6**(1993): 543–553.
Murowchick, R. (ed.). (1994). *Cradles of Civilization. China. Ancient Culture, Modern Land*, University of Oklahoma Press, Norman.
National Bureau of Cultural Relics Editorial Board (1991). *Zhongguo Wenwu Diqu Ji. Henan Fence* [A Compilation of Cultural Areas in China. Henan], Zhongguo Ditu Press.
Nelson, S. M. (1990). The Neolithic of northeastern China and Korea. *Antiquity* **64**: 234–248.
Nelson, S. M. (1991). Evidence for early agriculture in Korea. In Bellwood, P. (ed.), *Indo-Pacific Prehistory 1990, Papers from the 14th IPPA Congress, Yogyakarta*, Bulletin of the Indo-Pacific Prehistory Association, No. 10, Canberra, Australia, pp. 102–108.
Nelson, S. M. (ed.). (1995). *The Archaeology of Northeast China*, Routledge Press, New York.
Nelson, S. M. (1996). Ideology and the formation of an early state in Northeast China. In Claessen, H. J., and Oosten, J. G. (eds.), *Ideology and the Early State*, E. J. Brill, The Hague, pp. 153–169.
Nongye Kaogu (1994). Shandong Rizhao Shi Faxian Longshan Wenhua de Tanhua Daoli [Discovery of carbonized rice grains from the Longshan Culture in Rizhao, Shandong]. *Nongye Kaogu* **1**(1994): 75.
Normille, D. (1997). Yangtze seen as earliest rice site. *Science* **275**: 309.
Olsen, J. W. (1985). Prehistoric dogs in mainland East Asia. In Olsen, S. J. (ed.), *Origins of the Domestic Dog. The Fossil Record*, University of Arizona Press, Tucson, pp. 47–70.
Olsen, J. W., and Miller-Antonio, S. (1992). The Paleolithic in southern China. *Asian Perspectives* **31**(2): 129–160.
Olsen, S. J. (1984). The early domestication of the horse in North China. *Archaeology* **37**(1): 62–64.

Olsen, S. J., and Olsen, J. W. (1977). The Chinese wolf, ancestor of New World dogs. *Science* **197**: 533–535.
Olsen, S. J., and Olsen, J. W. (1980). Zhongguo Zhulei de Xunyang [Suid domestication in China], *Vertebrata Palasiatica* **18**(2): 169–175 (translated by Kazue Pearson).
Pearson, R. (1974). Pollen counts in North China. *Antiquity* **48**: 226–228.
Pearson, R. (1989). Taiwan and its place in East Asia prehistory. In Chang, K. C., Li, K. C., Wolf, A., and Yin, A. (eds.), *Anthropological Studies in the Taiwan Area: Accomplishments and Prospects*, Department of Anthropology, National Taiwan University, Taipei, Taiwan, pp. 111–142.
Pearson, R. (1992). *Ancient Japan*, Arthur M. Sackler Gallery, Smithsonian Institution, Washington, DC, and the Agency for Cultural Affairs, Government of Japan, Tokyo.
Pearson, R., and Underhill, A. (1987). The Chinese Neolithic: Recent trends in research. *American Anthropologist* **89**(4): 807–822.
Piper, J. M. (1993). *Rice in South-East Asia. Cultures and Landscapes*, Oxford University Press, New York.
Pope, G. G. (1989). Bamboo and human evolution. *Natural History* **October**: 49–56.
Powell, M. L. (1988). *Status and Health in Prehistory. A Case Study of the Moundville Chiefdom*, Smithsonian Institution Press, Washington, DC.
Price, T. D. (1995). Social inequality at the origins of agriculture. In Price, T. D., and Feinman, G. M. (eds), *Foundations of Social Inequality*, Plenum Press, New York, pp. 129–151.
Redding, R. W. (1995). Preliminary report on faunal remains recovered from the 1993 excavations. In MacNeish, R. S., and Libby, J. (eds.). *Origins of Rice Agriculture. Preliminary Report of the Sino-American Jiangxi (PRC) Project. SAJOR*, Publications in Anthropology No. 13, El Paso Centennial Museum, University of Texas at El Paso, pp. 53–68.
Ren, M., Yang, R., and Bao, H. (1985). *An Outline of China's Physical Geography*, Foreign Languages Press, Beijing.
Ren, S. (1994). Xinglongwa Wenhua de Faxian Ji Qi Yiyi [The discovery and significance of the Xinglongwa Culture]. *Kaogu* **8**(1994): 710–718.
Ren, S. (1995). Gongyuan Qian Wuqian Nian Qian Zhongguo Xinshiqi Wenhua de Jixiang Zhuyao Chengjiu [Important results regarding Neolithic cultures in China Earlier than 5000 B.C.]. *Kaogu* **1**(1995): 37–49.
Rigg, J. (1991). Diversity in the tropics. In Tarrant, J. (ed.), *Farming and Food*, Oxford University Press, New York, pp. 222–229.
Sauer, C. (1969). *Agricultural Origins and Dispersals*, 2nd Ed., MIT Press, Cambridge.
Shandong Archaeological Team, IA, CASS (1993). Shandong Wenshang Xian Dongjiabaicun Xinshiqi Shidai Yizhi Fajue Jianbao [Short report on the excavation of the Neolithic site of Dongjiabai in Wenshang County, Shandong]. *Kaogu* **6**(1993): 481–487.
Shandong Archaeological Team, IA, CASS, and the Tengxian Museum (1984). Shandong Tengxian Beixin Yizhi Fajue Baogao [Report on the excavation of the Beixin site at Tengxian, Shandqng]. *Kaogu Xuebao* **2**(1984): 159–191.
Shandong Office for the Protection of Cultural Relics and Jinan City Museum (1974). *Dawenkou. Xinshiqi Shidai Muzang Fajue Baogao* [Report on the Excavation of the Neolithic Cemetery at Dawenkou]. Wenwu Press, Beijing.
Shandong Province, Institute of Archaeology (1992). Shandong ZoupingYuancheng Xinanzhuang Yizhi Kantan, Shijue Jianbao [Short report on test excavations at the sites of Yuancheng and Xinanzhuang at Zouping, Shandong]. *Kaogu Yu Wenwu* **2**(1992): 1–12.
Shandong Province, Institute of Archaeology, and Zhangqiu City Museum (1996). Shandong Zhangqiu Shi Xiaojingshan Yizhi Diaocha, Fajue Baogao [Report on the survey and excavation of the Xiaojingshan site at Zhangqiu City, Shandong]. *Huaxia Kaogu* **2**(1996): 1–28.
Shandong University, History Department (1989). Shandong Zouping Xian Yuancheng Zaoqi Xinshiqi Wenhua Yizhi Diaocha [Survey of the Early Neolithic site of Yuancheng at Zouping County, Shandong]. *Kaogu* **6**(1989): 489–496, 562.
Shanxi Province, Linfen Administrative Office (1989). Shanxi Jixian Shizitan Zhongshiqi Wenhua Yizhi [The Mesolithic cultural site of Shizitan in Jixian, Shanxi]. *Kaogu Xuebao* **3**(1989): 305–323.

Shi (Shih), X. (1992). The discovery of the Pre-Yangshao culture and its significance. In Aikens, C.M., and Rhee, Song Nai (eds.), *Pacific Northeast Asia in Prehistory. Hunter-Fisher-Gatherers, Farmers, and Sociopolitical Elites*, Washington University Press, Pullman, pp. 125–132.

Smith, B. D. (1995). *The Emergence of Agriculture*, Scientific American Library, New York.

Song, Z. (1979). Hemudu Yizhi Chutu Gu Si de Yanjiu [Research on bone spades unearthed at the Hemudu site]. *Kaogu* **2**(1979): 155–160.

Song, Z. (1989). Houwa Yizhi Diaosu Pin Zhong de Wushu Yuyi [The implications of the sculptures from the Houwa site with regard to Shamanism). *Wenwu* **12**(1989): 23–28.

State Bureau of Cultural Relics (1990). *Yanzhou Xiwusi*, Wenwu Press, Beijing.

Sun, Z. (1993). The Liangzhu Culture: Its discovery and its jades. *Early China* **18**: 1–40.

Sung, W.-H. (1989). Unity and diversity in prehistoric Taiwan: A cultural perspective. In Chang, K. C., Li, K. C., Wolf, A., and Yin, A. (eds.). *Anthropological Studies of the Taiwan Area: Accomplishments and Prospects*, Department of Anthropology, National Taiwan University, Taipei, Taiwan, pp. 99–110.

Tang, C., and Gai, P. (1986). Upper Paleolithic cultural traditions in North China. In Wendorf, F. and Close, A. E. (eds.), *Advances in World Archaeology, Vol. 5*, Academic Press, New York, pp. 339-364.

Tang, S., Min, S., and Zuo, T. (1994). Zhongguo Geng Dao Qiyuan de Tanlun [An exploration of the origins of paddy rice (Japonica) in China]. *Nongye Kaogu* **1**(1994): 59–67.

Teacher's College of Northwest China, Institute for Plant Research and the Gansu Provincial Museum (1984). Gansu Dongxiang Linjia Majiayao Wenhua Yizhi Chutu de Ji Yu Dama [Hemp and Millet from the Majiayao Culture Site of Linjia at Dongxiang, Gansu]. *Kaogu* 7(1984): 654–655, 663.

Tibet Autonomous Region, CPAM, and Sichuan University, Department of History (1985). *Maodou (Qamdo) Karuo* [The Site of Karuo at Maodou], Wenwu Press, Beijing.

Tong, E. (1994). Northern China and southern China: Two different trajectories of social development toward civilization. Paper presented at the International Conference of the Combination of Chinese Archaeology and History, Taipei, Taiwan, Jan. 4–8.

Tong, E. (1996). Magician, magic, shamanism and related problems in ancient China. Ms. on file, Department of Art, Wesleyan University, Middletown, CT.

Tong, E., Leng, J., and Wangdui, S. (1982). Unraveling Tibetan prehistory at Karuo. *Archaeology* 35(5): 62-63, 81.

Toth, N., Clark, D., and Ligabue, G. (1992). The last stone ax makers. *Scientific American* **267**: 88–93.

Tsang, C.-h. (1992). *Archaeology of the P'eng-hu Islands*, Institute of History and Philology, Academic Sinica, Special Publications, No. 95, Taipei, Taiwan.

Tuan, Y.-f. (1970). *The World's Landscapes. 1. China*, Longman Group, London.

Underhill, A. P. (1994). Variation in settlements during the Longshan period of northern China. *Asian Perspectives* **33**(2): 197–228.

Underhill, A. P. (1996). Craft production and social evolution during the Longshan period of northern China. In Wailes, B. (ed.), *Craft Specialization and Social Evolution: In Memory of V. Gordon Childe*, University Museum Monographs, Symposium Series, University of Pennsylvania, Philadelphia, pp. 133–150.

Underhill, A. P. (1997a). An analysis of mortuary ritual at the Dawenkou Site, Shandong, China. In Murowchick, R., von Falkenhausen, L., Tsang, C., and Yates, R. (eds.), *Festschrisft in Honor of Kwang-chih Chang*, Academia Sinica, Taipei, Taiwan, and the Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge, MA (in press).

Underhill, A. P. (1997b). Archaeological and textual evidence for the production and use of alcohol in ancient China. In Moskowitz, M. (ed.), *Fermented and Distilled: The Material Culture of Alcoholic Beverages*, 1996 Yale-Smithsonian Seminar Proceedings (in press).

von Falkenhausen, L. (1992). Serials on Chinese archaeology published in the People's Republic of China: A bibliographical survey. *Early China* **17**:247–295.

Wang, W. (1995). The Chengtoushan Project in Hunan, China. *Early China News* **8**: 23.

Wang, Y. (1993). Guanyu Houli Wenhua de Puxi Wenti [The Houli culture and questions of cultural classification]. In Jilin University, Department of Archaeology (ed), *Jingguo Ji* [Collection of Green Fruits], Zhishi Press, pp. 15–28.

Wang, Y., Wang, S., and Li Z. (1994). Haidai Diqu Shiqian Kaogu de Xin Keti- Shilun Houli Wenhua [New issues in prehistoric archaeology of the haidai area—an initial discussion of the Houli culture]. *Kaogu* 3(1994): 247–255.

Wang, Z. (1995). Zhiwu Guisuanti Fenxi Zai Anhui Mengcheng Yuchisi Yizhi Zhong de Yingyong [Use of phytolith analysis at the site of Yuchisi at Mengcheng, Anhui]. *Kaogu* 1(1995): 88–90.

Watanabe, H. (1986). Community habitation and food gathering in prehistoric Japan: An ethnographic interpretation of the archaeological evidence. In Pearson, R. (ed.), *Windows on the Japanese Past: Studies in Archaeology and Prehistory*, Center for Japanese Studies, University of Michigan, Ann Arbor, pp. 229–254.

Watson, P. J. , and Kennedy, M. C. (1991). The development of horticulture in the eastern woodlands of North America: women's role. In Gero, J., and Conkey, M. (eds.), *Engendering Archaeology*, Basil Blackwell, Oxford, pp. 255–275.

Wen, G., and Jing, Z. (1992). Chinese Neolithic jade: A preliminary geoarchaeological study. *Geoarchaeology* 7(3): 251–275.

West, B., and Zhou B.-X. (1988). Did chickens go north? New evidence for domestication. *Journal of Archaeological Science* 15: 515–533.

White, J. C. (1995). Modeling the development of early rice agriculture: ethnoecological perspectives from Northeast Thailand. *Asian Perspectives* 34(1): 37–68.

Wu, H. (1995). *Monumentality in Early Chinese Art and Architecture*, Stanford University Press, Stanford, CA.

Wu, R. (1986). Shilun Beixin Wenhua [An initial discussion on the Beixin Culture]. In *Shandong Shiqian Wenhua Lunwen Ji*, Ji Lu Press, Jinan, pp. 196–210.

Wu, R. (1989). Beixin Wenhua de Jige Wenti [Some questions about the Beixin culture]. In *Qingzhu Su Bingqi Kaogu Wushiwu Nian Lunwen Ji*, Wenwu Press, Beijing, pp. 155–164.

Wu, Y. (1994). Huanghe Liu Yu Xinshiqi Shidai de Daozuo Nongye [Neolithic paddy rice agriculture in the Yellow River Valley]. *Nongye Kaogu* 1(1994): 78–84.

Wu, Y. (1996). Prehistoric rice agriculture in the Yellow River Valley. In Glover, I., and Bellwood, P. (eds.), *Indo-Pacific Prehistory: The Chiang Mai Papers, Vol. 2*, Bulletin of the Indo-Pacific Prehistory Association 15, pp. 223–224.

Xiang, A. (1991). Lun Changjiang Zhongyou Xinshiqi Shidai Zaoqi Yicun de Nongye [A discussion of agriculture at early Neolithic sites in the Middle Reaches of the Yangzi River valley]. *Nongye Kaogu* 1(1991): 121–135.

Xiang, A. (1995). Zhongguo Dao Zuo Qiyuan Wenti Zhi JianTao [A critical review of the origins of rice cultivation in China]. *Dongnan Wenha* (1995): 44–58.

Xinle Museum and CPAM of Shenyang (1990). Liaoning Shenyang Xinle Yizhi Qiangjiu Qingli Fajue Jianbao [Short report on the salvage excavation at the Xinle site in Shenyang, Liaoning]. *Kaogu* 11(1990): 969–980.

Xu, W. (1994). Guanyu Nongye Qiyuan de Ruogan Wenti Tanlun [An exploratory discussion about certain questions on the origins of agriculture]. *Nongye Kaogu* 1(1994): 31–35.

Xu, Y. (1989). Dongbei Diqu Xinshiqi Shidai Wenhua Gaishu [Review of Neolithic cultures in Northeast China]. *Liaohai Wenwu Xuekan* 7(1989): 56–87.

Xu, Y.-I. (1995). The Houwa Site and related issues. In Nelson, S. M. (ed.), *The Archaeology of Northeast China*, Routledge Press, New York, pp. 65–88.

Xu, Y., Fu, R., and Wang, C. (1989). Liaoning Donggou Xian Houwa Yizhi Fajue Gaiyao [Outline of the excavation of the Houwa site in Donggou County, Liaoning]. *Wenwu* 1 (1989): 1–22.

Yan, W. (1990). Zhongguo Shiqian Daozuo Nongye Yicun de Xin Faxian [New discoveries of paddy rice agriculture in prehistoric China]. *Jianghan Kaogu* 3(1990): 27–32.

Yan, W. (1991). China's earliest rice agriculture remains. In Bellwood, P. (ed.), *Indo-Pacific Prehistory 1990, Vol. 1, Papers from the 14th IPPA Congress*, Bulletin of the Indo-Pacific Prehistory Association, No. 10, Yogyakarta, Canberra, Australia, pp. 118–126.

Yan, W. (1992). Origins of agriculture and animal husbandry in China. In Aikens, C. M., and Rhee, Song N. (eds.), *Pacific Northeast Asia in Prehistory. Hunter-Fisher-Gatherers, Farmers, and Sociopolitical Elites*, Washington State University Press, Pullman, pp. 113–123.

Yan, X. (1992). Cong Dongwu Kaoguxue Tan Tanshishan Wenhua de Youguan Wenti [A discussion of questions about the Tanshishan Culture from zooarchaeology]. *Kaogu Yu Wenwu* 1(1992): 102–109.

Yang, J. (1992). Jianlun Zengpiyan Yizhi Zhiwu Qun Ji Qi Xiangguan Wenti [A discussion of some questions on the plants from the Zengpiyan site]. *Kaogu* 1(1992): 90–93.

Yang, Y. (1994). Banpo Wenhua Xianmin Zhi Yinshi Kaogu [The archaeology of eating and drinking in the Banpo Culture]. *Kaogu Yu Wenwu* 3(1994): 63–72.

Yantai City Bureau for the Protection of Cultural Relics (1992). Shandong Yantai Baishicun Xinshiqi Shidai Yizhi Fajue Jianbao [Short report on the excavation of the Baishicun Neolithic site at Yantai, Shandong]. *Kaogu* 7(1992): 577–588.

Ye, W. (1992). Neolithic tradition in Northeast China. In Aikens, C. M., and Rhee, Song N. (eds.), *Pacific Northeast Asia in Prehistory. Hunter-Fisher-Gatherers, Farmers, and Sociopolitical Elites*, Washington State University Press, Pullman, pp. 139–156.

Yeung, C.-t., and Li, W.-l. B. (eds.) (1995). *Archaeology in Southeast Asia*, University Museum and Art Gallery and University of Hong Kong, Hong Kong.

You, X. (1986). Jieshao Taiwan Xin Faxian de Zhishanyan Wenhua [An introduction of the newly discovered Zhishanyan Culture of Taiwan]. *Wenwu* 2(1986): 31–36, 43.

Yuan, S. (1993). Huanan Zaoqi Xinshiqi 14C Niandai Shuju Yinqi de Kunhuo Yu Zhenshi Niandai [Puzzling radiocarbon dates from early Neolithic sites in South China and the actual dates]. *Kaogu* 4(1993): 367–375.

Zhang, J., Kong, Z., Liu, Z. (1994). Wuyang Shiqian Daozuo Yicun Yu Huang Huai Diqu Shiqian Nongye [Paddy rice at a prehistoric site in Wuyang and prehistoric agriculture in the Huang and Huai River areas]. *Nongye Kaogu* 1(1994): 68–77.

Zhang, Z. (1985). The social structure reflected in the Yuanjunmiao cemetery. *Journal of Anthropological Archaeology* 4: 19–33.

Zhao, S., and Wu, W.-t. (1987). Early Neolithic Hemodu (Hemudu) Culture along the Hangzhou estuary and the origin of domestic paddy rice in China. *Asian Perspectives* 27(1): 29–34.

Zhao, Z. (1995). Searching for the origin of rice (Oryza Sativa Poaceae): A Sino-American archaeological project in China. *Early China News* 8: 22.

Zhao, Z. (1996). *Rice Domestication in the Middle Yangtze Region, China: An Application of Phytolith Analysis*, Ph.D. dissertation, University of Missouri—Columbia, Columbia.

Zhao, Z., Pearsall, D., and Jiang, Q. (1995). Analysis of phytoliths from Xian Ren Dong and Wang Dong. In MacNeish, R. S., and Libby, J. (eds.), *Origins of Rice Agriculture. The Preliminary Report of the Sino-American Jiangxi (PRC) Project. SAJOR*, Publications in Anthropology No. 13, El Paso Centennial Museum. University of Texas at El Paso, pp. 47–52.

Zhejiang Province Committee for the Protection of Cultural Relics and the Zhejiang Provincial Museum (1978). Hemudu Yizhi Di Yi Qi Fajue Baogao [Report on the first excavation at the Hemudu Site]. *Kaogu Xuebao* 1(1978): 39–107.

Zhongguo Wenwu Bao (Newspaper on Cultural Relics) (1993). Xinglongwa Juluo Yizhi Fajue Zai Huo Shuoguo [Great achievements from further excavations on the settlement at Xinglongwa). *Zhongguo Wenwu Bao* Dec. 26.

Zhongguo Wenwu Bao (1994). Yaowangcheng Yizhi Di Er Ci Fajue You Zhongyao Faxian [Important discoveries from the second season of excavations at Yaowangcheng]. *Zhongguo Wenwu Bao* Jan. 23.

Zhongguo Wenwu Bao (1995). Chahai Yizhi Fajue Zai Huo Zhongda Chengguo [Important results from further excavations at the Chahai Site]. *Zhongguo Wenwu Bao*, Mar. 19.

Zhou, B. (1981). Hebei Wuan Cishan Yizhi de Dongwu Guhai [Animal bones from the Cishan site at Wuan, Hebei]. *Kaogu Xuebao* 3(1981): 339–347.

Zhou, B. (1994). Baijiacun Yizhi Dongwu Yigu Jianding Baogao [Report on identification of animal bones at the Baijiacun site]. In *Lintong Baijiacun*, Institute of Archaeology, CASS, Ba Shu Press, Chengdu, pp. 123–126.