Early Neolithic Hemodu Culture along the Hangzhou Estuary and the Origin of Domestic Paddy Rice in China

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THE SWEDISH GEOLOGIST J. G. Anderson was the first person to recognize and excavate an important Neolithic village in China in 1921. The Yangshao (仰韶) culture and its successor, the Lung-shan (龍山) culture—both based on hoe agriculture and distributed mainly in North China—have consequently become quite well known in the archaeological world. One typical Yang-shao cultural site, the Pan-po (半坡) Museum near Xian, has on record that the appearance of dry farming (chiefly millet growing) dates back to 6000 B.P.

In recent years, thousands of Neolithic cultural sites have been excavated over most of China (Xia 1977). Numerous Neolithic cultural sites in North China, such as Da-di-wan (大地灣) in eastern Kansu Province, Pei-li-gan (裴李崗) in western Henan Province, and Ci-shan (磁山) in southern Hebei Province, have on record that the appearance of dry farming dates back to 7000–8000 B.P., while several Neolithic cultural sites along the Hangzhou Estuary (Fig. 1) such as He-mo-du (河姆渡) on the southern bank and Luo-jia-jiao (羅家角) in the southeastern Yangtze Delta have recorded that the origin of domesticated paddy rice in South China is as early as 7000 B.P. The latter are certainly among the earliest sites anywhere for growing paddy rice.

FEATURES OF THE HEMODU CULTURAL REMAINS

The Hemodu cultural site is located on the coastal plain along the Hangzhou Estuary's southern bank, about 25 km northwest of Ningbo (Zhejiang Museum, 1978). It has an excavated area of about 40,000 m^2 and an elevation of 3–4 m above sea level. Extensive lignite deposits lie underneath the surrounding paddy-rice fields, revealing an ancient lagoon and marsh environment. Significant cultural remains

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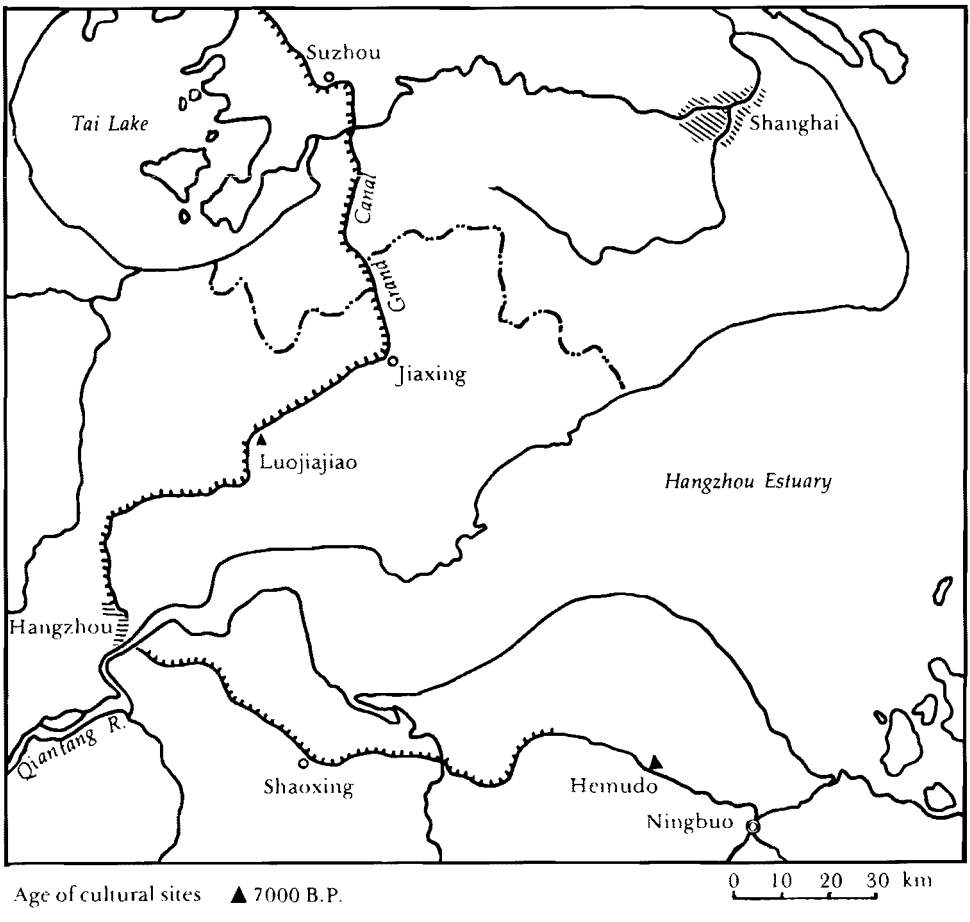

Fig. 1 Neolithic sites along the Hangzhou Estuary.

include large quantities of pile dwelling, domesticated rice, bone spade, pig, buffalo, and dog, as well as more than 50 kinds of wild animals and many kinds of tropical and subtropical hydrophytes (such as *Murraya paniculata* L., *Lygodium microstachyum*, and *L. salicifolium*).

Underneath the tilth strata (40–50 cm thick) and the underlying alluvial deposits (0–100 cm thick), four cultural strata appear downward successively:

1. First cultural strata: about 5100–5600 B.P.; sticky cinnamon-yellowish silt, 70–105 cm thick; greyish pottery and numerous stone utensils unearthed;

2. Second cultural strata: about 5600–5900 B.P.; sticky green-yellowish silt, 20–35 cm thick; pile dwelling, well, stone utensils and reddish pottery unearthed, but with no elephant or rhinoceros remains;

3. Third cultural strata: about 5900–6600 B.P.; loose greyish sandy soil, 60–110 cm thick; large quantities of pile dwelling, bone spade, wood spade, domesticated rice, domesticated animals (dog, pig, buffalo), wild animals (elephant, rhinoceros, David's deer), as well as greyish pottery, ivory, and lacquer works unearthed;

4. Fourth cultural strata: about 6600–7000 B.P.; soft darkish silt, 100–165 cm

thick; large quantities of domesticated rice, bone spade, pile dwelling, black pottery, wood paddle, wild animals (Asian elephant, Java and Sumatra rhinoceros, David's deer, Chinese alligator, sea turtle, land turtle), and domesticated animals (pig, dog, buffalo) unearthed.

The Luajiajiao cultural site is located on southeastern Yangtze Delta and on the eastern bank of the Grand Canal, about 50 km northeast of Hangzhou. Four cultural strata have also been identified. Large quantities of pile dwelling, domesticated rice, bone spade, pig, dog, and buffalo, as well as more than 20 kinds of wild animals have been unearthed in its third and fourth cultural strata. According to ^{14}C dating, the age of its fourth cultural strata is ca 7040 (± 150) B.P. [lab and half life used not reported, *editor*].

There are four more Neolithic cultural sites along the Hangzhou Estuary similar to the Hemodu or the Luojiajiao. All other cultural sites in the region have only the upper one, two, or three cultural strata.

HOLOCENE PALAEOGEOGRAPHY ALONG THE HANGZHOU ESTUARY AS CONSTRUCTED ON THE BASIS OF HEMODU CULTURAL REMAINS

Based on Neolithic cultural remains as shown on Fig. 1, the Holocene palaeogeography along the Hangzhou Estuary can be briefly constructed as follows (Wu 1983).

1. Formation and evolution of the alluvial-lacustrine-marine plain along the Hangzhou Estuary. During the Würm glaciation, the coastline of the Yangtze Delta area moved eastward up to the margin of the continental shelf of the East China Sea. The Yangtze Delta area was then characterized by broad valleys interspersed with low hills, with well-developed terrestrial deposition. The area was partially submerged during the postglaciation marine transgression. In the eastern suburb of Hangzhou and several other coastal sites, oyster-shell beds about 5–30 m beneath the ground surface have been discovered. Since 7000 B.P., coastal shallow water has been gradually silted up. Holocene palaeogeography of the area thus can be divided into two phases, coastal-shallow and sea-coastal, the second coastal phase being the geographic background of the Hemodu culture. The Hemodu cultural site is thus built on coastal marshes and lagoons, while the Luojiajiao cultural site is a little more elevated, built on alluvial deposits.

Since 7000 B.P., the area has been characterized by numerous lakes and a very high ground water table. However, the dimension of water surface fluctuates considerably. Three periods have been distinctly marked with smaller water areas: 6700–6000 B.P., 5500–5000 B.P., and 4300–4000 B.P. The Hangzhou Estuary and the famous Qiantang Bore were formed about 6000 B.P., resulting in severe erosion on the river channel as well as heavy deposition along river banks.

2. Changes in Holocene climate and biogeography: Based chiefly on pollen analysis in the eastern Yangtze Delta as well as from evidence of Hemodu cultural remains, five climatic-biological periods are identified in the Holocene (Fig. 2):

a. From 12,000–9500 B.P., climate was temperate and moist, with mixed needle- and broad-leaved forest dominant, the main vegetation type being the Castanea–Quercus–Pinus–Chenopodiaceae association.

b. From 9500–7500 B.P., climate was a little drier and warmer, with mixed

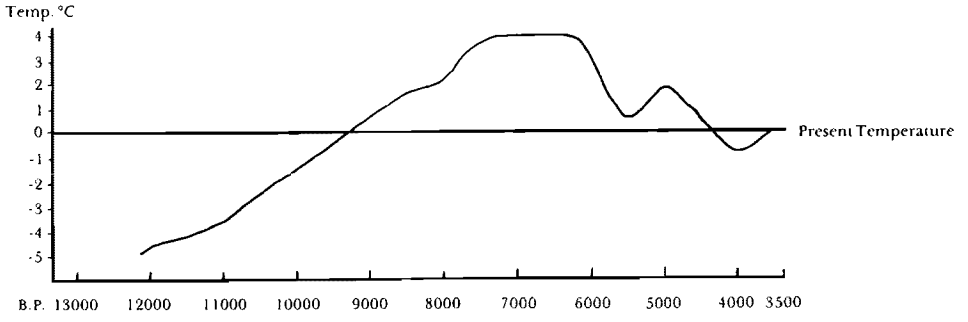

Fig. 2 Temperature variation in Holocene along the Hangzhou Estuary.

needle- and broad-leaved forest still dominant, but with a larger proportion of grasses.

c. From 7500–6000 B.P., climate became subtropical and more humid, with mixed evergreen and deciduous forest dominant, the main vegetation being the Castanopsis–Quercus–Polypodiaceae association. Elephant, rhinoceros, alligator, and other tropical wild animals were widely distributed.

d. From 6000–4000 B.P., temperature became distinctly lower. In about 4000 B.P., temperature was lower than at 5000 B.P. by 2–3°C, and lower than present temperatures by about 1°C, resulting in the decrease of tropical components in the flora and the extinction of tropical wild animals in the fauna.

e. Since 4000–3500 B.P., the present climate and biological conditions have been established.

3. Changes of sea level since 7000 B.P. (Fig. 3): From 7000–4000 B.P., ancient sea level was somewhat lower than present sea level. Since 4000 B.P., sea level has fluctuated somewhat, yet with an amplitude of less than 1 m.

ORIGIN AND SPREAD OF PADDY RICE CULTIVATION IN CHINA

In both Hemodu and Luojiajiao cultural remains, large quantities of domesticated paddy rice have been discovered. This rice belongs to two subspecies: *Oryza sativa* L. subsp. *Hsien Ting*, and O. S. L. subsp. *Keng Ting*; both originated in China. The pollens discovered in these cultural remains are composed mostly of grasses, including rice (*Oryza sativa*), although so far we are unable to distinguish between wild and domesticated rice pollens. These cultural remains dated back as early as 7000 B.P., much earlier than all excavated rice remains in India, Thailand, or Indonesia (Glover 1979)[1]. There are also more than 30 Neolithic cultural sites south of the Yangtze River already discovered with paddy rice remains. The Hemodu culture site might be the earliest area in China in which rice was domesticated.

Again, in palaeogeographic as well as in geological and archaeological studies, the present is usually a key to the past. At present, paddy rice cultivation is distributed very widely south of the Qin-ling Mountains–Huai-he River line, accounting for 25.5 percent of total cropland areas in China; China has long since been the largest rice producer in the world (353.4 million tons in 1982). It seems reasonable to assume that the domestication of rice originated somewhere in South China, especially on China's subtropical and humid southeast coast.

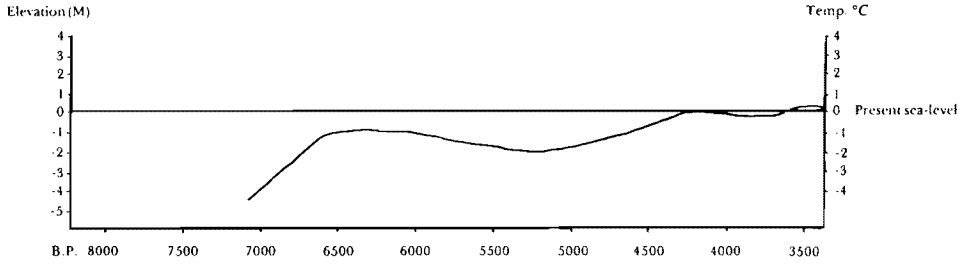

Fig. 3 Changes of sea level and its relationship with variation of temperature.

Consequently, the Hemodu cultural sites along the Hangzhou Estuary might be the center (or at least one of the centers) of domesticated rice in the world. From here, domesticated rice has been spread to all South China since 7000 B.P. Internationally, domesticated rice might have been introduced from China's southeast coast to Japan and Southeast Asia as well as to South Asia, and then to all other rice-growing areas in the world.

SOME PRELIMINARY CONCLUSIONS

1. According to recent archaeological excavations and ^{14}C-dating, the origin of China's farming might date as far back as 7000–8000 B.P. Since then, farming has been practiced uninterruptedly in China.

2. The origin of China's farming might be multicentered. At least the millet dry farming in North China and the paddy rice cultivation in South China are quite divergent from each other, and thus they cannot have originated in the same geographical region.

3. The Hemodu culture sites might be where paddy rice was first domesticated in China as well as in the world.

4. So far, we still do not know much about the origin and spread of farming in China. There exist many gaps and missing links. Further research in this area is needed.

NOTE

[1]According to Glover (1979), the earliest excavated domesticated rice remains in India date back 4300 B.P., while all excavated domesticated rice remains in Ban Chiang, Non Nok Tha, and Spirit Cave in Thailand as well as in Ulu Leang, Indonesia, date back less than 6000 years.

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