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MOLLUSCAN REMAINS FROM THE LIANGZHU ARCHAEOLOGICAL SITES OF ZHEJIANG PROVINCE, CHINA

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ABSTRACT

Many molluscan remains were collected from the Liangzhu Archaeological Sites, Hangzhou, Zhejiang, China, dating from 3,300 B.C. to 2,000 B.C. They occurred in the middle part of the Bianjiashan Site of the late Liangzhu culture. This is the first report on mollusks from the Liangzhu culture. Two viviparid gastropods *Bellamya quadrata* and *Bellamya* cf. *purificata,* six unionid bivalves *Unio douglasiae, Acuticosta chinensis, Arconaia lanceolata, Cuneopsis pisciculus, Lanceolaria* sp. indet. and *Lamprotula leai,* and one corbiculid bivalve *Corbicula fluminea* were recognized. The collected molluscan remains are characterised by abundant *Bellamya quadrata* and *Corbicula fluminea.* The generic composition is similar to the molluscan remains from the Holocene Luotuodun and Xixi historical sites of Yixing City, Jiangsu Province. These molluscan remains of the Liangzhu do not include marine elements, suggesting regression and cooler conditions after the Holocene warm event in which the palaeo-shoreline was near Hangzhou City.

Key words: Bianjiashan Site, China, Fresh-water Mollusca, Liangzhu Archaeological Sites, Neolithic, Zhejiang

野田芳和・赵　晔・金　幸生・李　怡紅（2007）中国浙江省良渚遺跡から出土した軟体動物遺体．福井県立恐竜博物館紀要 6 ：45 – 55.

中国浙江省杭州市北西部に位置する良渚遺跡群（紀元前3,300～2,000年），その卞家山遺跡から多くの貝類遺体を採集した．良渚遺跡からはこれまで貝類遺体の報告はなく，今回が初めてのものとなる．卞家山遺跡の中部には上下二条の大型灰溝Ｇ1およびＧ2が発見されており，貝類遺体は下位のＧ2北斜面の石舗装の埠頭周辺で発見された大量の生活ごみの中から産出した．タニシ類２種，イシガイ類６種およびシジミ類１種が同定された．群集としては，豊富に産出する*Bellamya quadrata* と *Corbicula fluminea* で特徴づけられる．属構成は江蘇省の骆驼墩および西渓遺跡からの群集に似ている．また本群集中に海生の要素がまったく含まれていないことから，縄文海進に相当する温暖期に杭州市付近まで海岸線があったことと合わせ，それ以降の海退と寒冷化を反映しているものと思われる．

INTRODUCTION

The Liangzhu Archaeological Sites are situated in the Yuhang division of Hangzhou City, Zhejiang Province, eastern China, and are one of the Late Neolithic relic sites, dating from 3,300 B. C. to 2,000 B.C. (Cultural Relics and Archaeology Institute of Zhejiang Province, 2005) (Fig. 1). The Sites cover an area of about 34 square kilometers, include more than 130 localities such as the Fanshan Cemeteries, the Yaoshan Altars, and the Mojiaoshan earth mound, “the Oriental Earth Pyramid”, and are the first discovered and named locality of the Liangzhu culture (Fig. 2). The Liangzhu Sites are the largest and widest representing the dawn of Chinese culture, and are one of the most important archaeological Neolithic sites of China. Dense villages, cemeteries, altars, and so on have been discovered. A great deal of beautiful jade is the most characteristic aspect of

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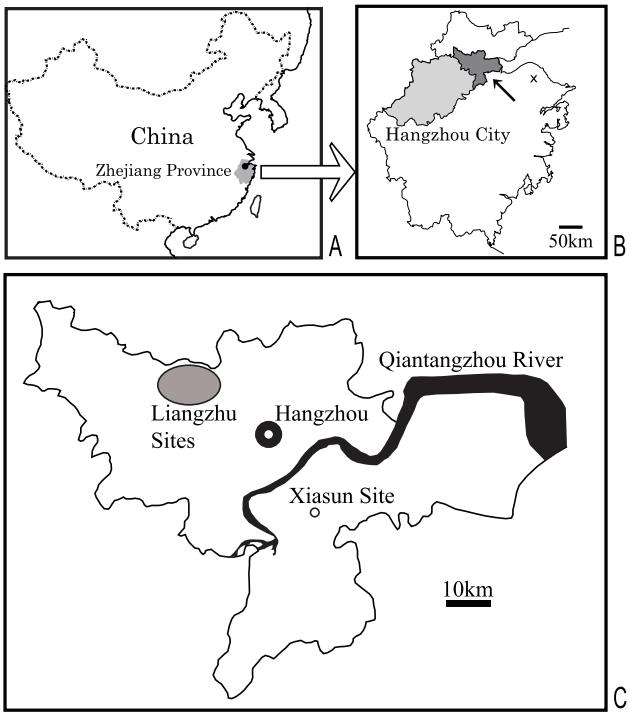

FIGURE 1. **A**, Locality map of Zhejiang Province; **B**, Locality map of Hangzhou City. An arrow shows the dark area enlarged in **C**. The cross mark shows the locality of the Hemudu Site; **C**, Locality map of the Liangzhu Sites and the Xiasun Site.

the excavated articles.

Molluscan remains from the Neolithic sites in Zhejiang Province are only reported from the Hemudu Site, Yuyao City (Wei et al., 1990: Zhejiang Provincial Institute of Cultural Relics and Archaeology, 2003) and the Xiasun Site in Hangzhou of the Kuahuqiao Culture (Zhejiang Provincial Institute of Cultural Relics and Archaeology and Xiaoshan Museum, 2004). In the Hemudu, invertebrate remains are quite abundant, although most of the shells are dissolved and only two species of viviparid gastropod *Bellamya quadrata* and unionid bivalve *Anodonta* sp. were described. In the Xiasun, five species are described: *Ostrea rivularis, Ostrea gigas* (=*Crassostrea gigas*), *Ostrea glomerata* (=*Saccostrea glomerata*), *Sinonovacula constricta* and *Claucomya chinensis* (misspelled for *Glaucomya chinensis* = *Glauconome chinensis*). They all lived in brackish to marine waters in coastal waters (intertidal) or around estuaries.

The Liangzhu Sites have been excavated for more than 60 years, nevertheless, no molluscan remains have been reported. In 2005, we collected abundant molluscan remains from the Bianjiashan Site, one of the Liangzhu Sites. In this article, we study these molluscan remains, which provides a way to distinguish the lives of the Liangzhu people. This is the first report on molluscan remains from the Liangzhu.

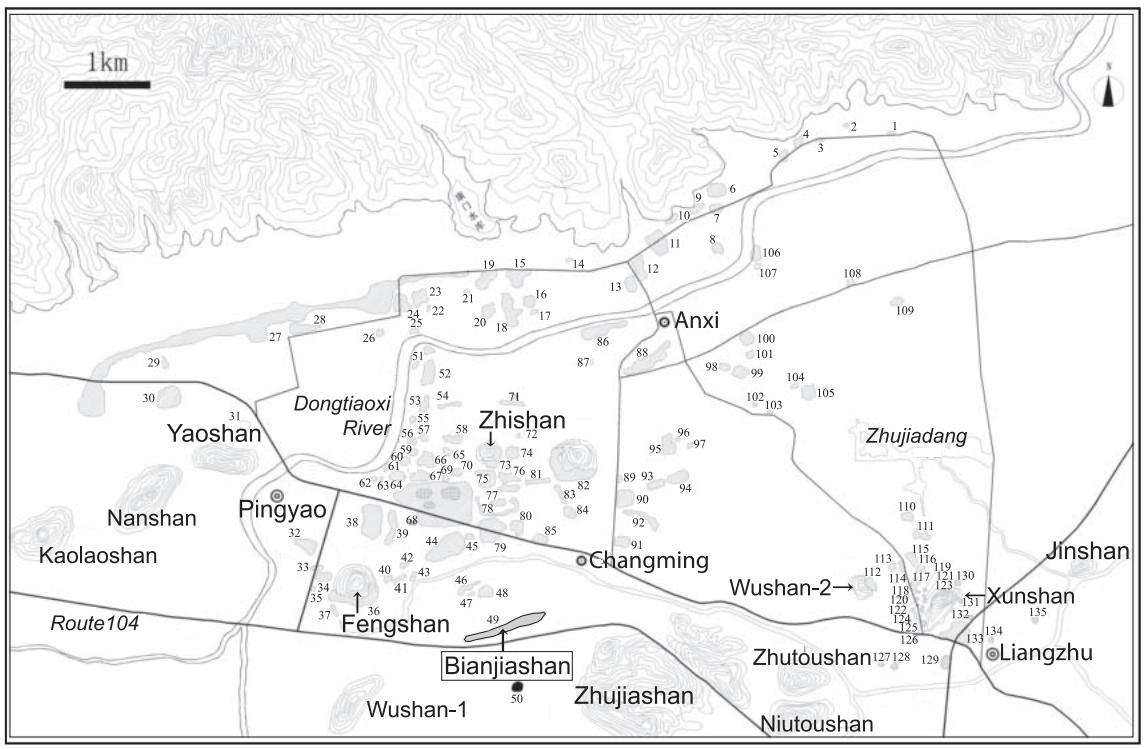

FIGURE 2. Distribution of the relic sites of the Liangzhu Archaeological Sites. Site number 49 is the Bianjiashan Site. Towns: Anxi, 安溪；Changming, 长命；Liangzhu, 良渚；Pingyao, 瓶窑. River: Dongtiaoxi, 东苕溪. Mountains: Bianjiashan, 卞家山；Fengshan, 凤山；Jinshan, 近山；Kaolaoshan, 栲栳山；Nanshan, 南山；Niutoushan, 牛头山；Wushan-1, 乌山；Wushan-2, 巫山；Xunshan, 荀山；Yaoshan, 窑山；Zhishan, 雉山；Zhujiashan, 朱家山；Zhutoushan, 猪头山. Lake: Zhujiadang, 朱家荡.

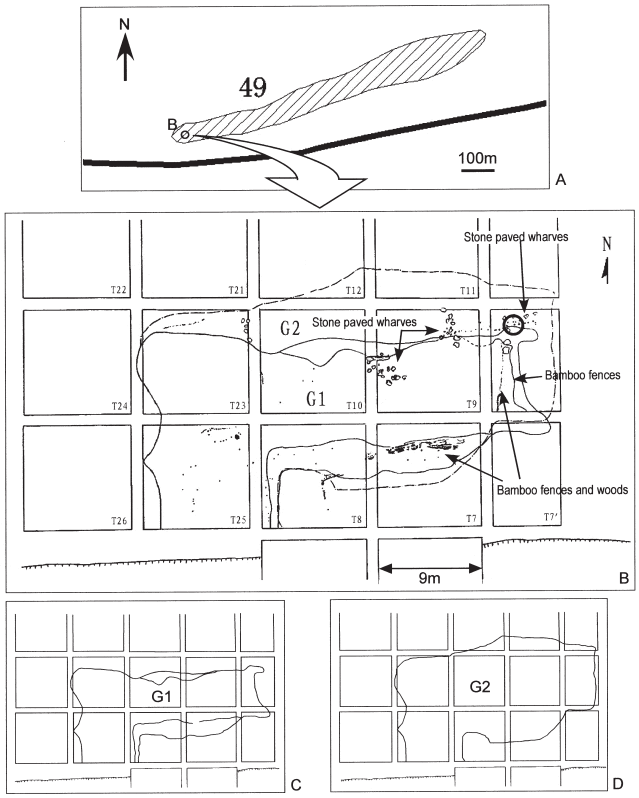

FIGURE 3. Locality of the molluscan remains in the Bianjiashan Site. **A**, The Bianjiashan Site. A small circle (B) indicates the locality of B; **B**, A detailed sketch map of the ash drains G1 and G2, including the molluscan locality indicated by a circle. Solid lines show G1 and broken lines show G2; **C**, G1 extracted from B; **D**, G2 extracted from B.

FIGURE 4. Photograph of the locality of the molluscan remains. An arrow shows the collected point, the circle on B of Figure 3.

FIGURE 5. Photographs of the occurrence of molluscan remains. **A**, General view; **B**, abundant *Corbicula*; **C**, common *Unio*; **D**, abundant *Bellamya.*

OUTLINE OF LOCALITY

The Bianjiashan Site is located at the southeast of Pingyao town in the Yuhang division of Hangzhou City, neighboring the national road 104 to the south, and northwardly about 1.5 km distant from the center of the Mojiaoshan Site (Fig. 2). The main part of the site is an east-to-west elongated mound, about 1 km in length, 30 to 50 meters in width and 1 to 2 meters in height from the surface of the rice fields. It is said that before 1949 there were cultural remains such as jade which were stolen after 1949. In 2002, a tentative excavation was made in a factory west of the site and potsherds and wood posts were discovered. At the same time the distribution of the site was surveyed and confirmed. In 2003 to 2005, there were three excavations, a total area of 2,600 square meters was dug to outcrops, and the following was discovered: the northern part of the excavated area is a large cemetery of the middle to late Liangzhu culture; the middle part provides two large ash-drains of the late Liangzhu; the southern part is river wharfs of the late Liangzhu; the site was enlarged and developed from the north area to the south; and the period of the site was rather long.

The two large ash-drains, G1 and G2 (Fig. 3), of the middle part are piled up vertically, settled from east to west and curved with a nearly right angle to the south, and they enter into the water area. G1 is more than 10 meters in width and was provided with bamboo fences and wood posts. G2 underlies G1, occupies a wider area, and was also provided with bamboo fences and wood posts. The bamboo fences of G2, standing along the southern side, are preserved in rather good condition and their stitches are systematic and luxurious. The northern slopes of the two ash-drains, respectively, were provided with useful stone-paved wharfs. Around the wharf of G2, a great deal of trash was deposited, such as tools from the Liangzhu people's lives as well as shells, conchs, fish bones and other items discarded after eating.

The Bianjiashan Site, provided with water facilities and ash-drains, is characteristic in the Liangzhu Sites. The excavation of the Bianjiashan Site provided us rather abundant materials to recognize the level of social development of the late Liangzhu culture, and it is significant for studying social features, natural environments, the village situation and the future of the Liangzhu culture. In particular, the trash of the ash-drains offers the best material to study the lives of people in those days.

MATERIALS

The molluscan remains were collected from muddy to fine sandy sediments along the wharf of G2 of the middle part of the Bianjiashan Site (figs. 3, 4 and 5), and occurred together with wooden and ceramic fragments of cultural remains. They are abundant viviparid gastropods and corbiculid bivalves, and common unionid bivalves. We examined the following species:

Bellamya quadrata (Benson, 1842)	very abundant
Bellamya cf. *purificata* (Heude, 1890)	common
Unio douglasiae (Griffith and Pidgeon, 1834)	common
Acuticosta chinensis (Lea, 1868)	rare
Arconaia lanceolata (Lea, 1856)	rare
Cuneopsis pisciculus (Heude, 1875)	rare
Lanceolaria sp. indet.	rare
Lamprotula leai (Gray *in* Griffith and Pidgeon, 1834)	rare
Corbicula fluminea (Müller, 1774)	abundant

All specimens are deposited in the Zhejiang Museum of Natural History (collection numbers: ZMNH M10101 to M 10109).

DISCUSSION

All these species are living species in China. Among them, *Corbicula fluminea* has the widest distribution all over continental China, Korea, Japan, Taiwan and countries of Southeast Asia (Liu et al., 1979; Wang, 1988). *Bellamya quadrata* and *Unio douglasiae* are also distributed widely in China as well as Korea and Japan. All species are commonly distributed in the Anhui, Jiangsu, Zhejiang, Jiangxi, Hubei and Hunan provinces.

The generic composition of the studied materials is similar to the molluscan remains from the Holocene Luotuodun and Xixi historical sites of Yixing City, Jiangsu Province (Huang, et al., 2005). Huang et al. (2005) divided them into three assemblages, i.e. *Unio-Cuneopsis, Arconaia-Lamprotula* and *Corbicula-Bellamya* assemblages. The molluscan assemblage of the Bianjiashan (Liangzhu) is not natural because the shells and conchs were selected for eating by the Liangzhu people. The specific composition is different between the Bianjiashan and the others. For example, *Corbicula fluminea* obtained from the Bianjiashan is not included in the Luotuodun and Xixi. The difference might be assigned to the age of the Liangzhu which is about two thousands years younger.

All species of the Liangzhu live in freshwaters of river streams, lakes and ponds, except for *Corbicula fluminea* which also lives in brackish waters. That means the Liangzhu people gathered these conchs and mussels from the river, lake and/or ponds around their living areas. None of marine molluscan remains have been observed in the Liangzhu. Also in the Hemudu Site, about a thousand years earlier than the Liangzhu culture, only fresh water molluscan remains have been excavated, although only two species were recognized. On the other hand, at the Xiasun Site, about 1,000 years older than the Hemudu, the collected and reported molluscan remains are all brackish to marine-water species. During the time from the Xiasun, around 6,000 B.C., to the Hemudu, the paleotemperature is estimated to have been the warmest in the Holocene. The sea level was the highest around 4,000 B.C., the Hemudu age, and the paleo-shoreline is estimated to have invaded near Hangzhou (Wu, 1983, 1996), which correlates to the Jomon Transgression in Japan. According to Wu (1996), the warm and wet weather changed to cool conditions at the beginning of the Liangzhu culture. The fact that molluscan remains in this study do not include marine elements indicates that the weather was cooler and the seashore might have been farther away from inhabited places during the age of the middle part of the Liangzhu.

REMARKS ON IDENTIFIED SPECIES

Bellamya quadrata (Benson, 1842) (Gastropoda: Viviparidae) (Fig. 6, 1–4) ZMNH M10101

37 specimens were examined, and are identified to *B. quadrata* by their characteristics such as rather thick test, long and conic outline, high spire, not inflated body whorl, fine and obvious growth lines and spiral cords which are conspicuous on body whorl, and indistinct umbilicus (Liu et al., 1979). Almost all specimens have about five whorls; earlier whorls were dissolved. Each whorl has four spiral cords of which the lowest one is situated just above the suture and makes an angle between a side and base of the body whorl. Some specimens have spiral cords intercalated with narrower cords and/or are followed by a cord above the uppermost ones; some have faint cords. Seven spiral cords are recognizable on a body whorl of several specimens and eight on one specimen (No. 30). A small specimen (No. 11) has a larger spiral angle than the others, but it is considered to be at a young stage of the species.

The next species, *B.* cf. *purificata,* is distinguished from this species by more inflated whorls and less distinct spiral cords than the former.

Dimensions are shown in Table 1.

Bellamya cf. *purificata* (Heude, 1890) (Gastropoda: Viviparidae) (Fig. 6, 5–7) ZMNH M10102

Seven specimens among a lot of *Bellamya* specimens are distinguishable from the others in their more swollen body whorl and more faintly observed spiral cords. They have four spiral cords which are not so strong and are invisible in some specimens. They are closely comparable to *Bellamya purificata,* but their spiral cords are inconspicuous on some specimens although typical *B. purificata* always possess three or four spiral cords on the body whorl and the penultimate whorl (Liu et al., 1979). *Bellamya aeruginosa* (Reeve) is also similar to the studied specimens in its shell outline but it has three spiral cords on the body whorl, of which the lowermost

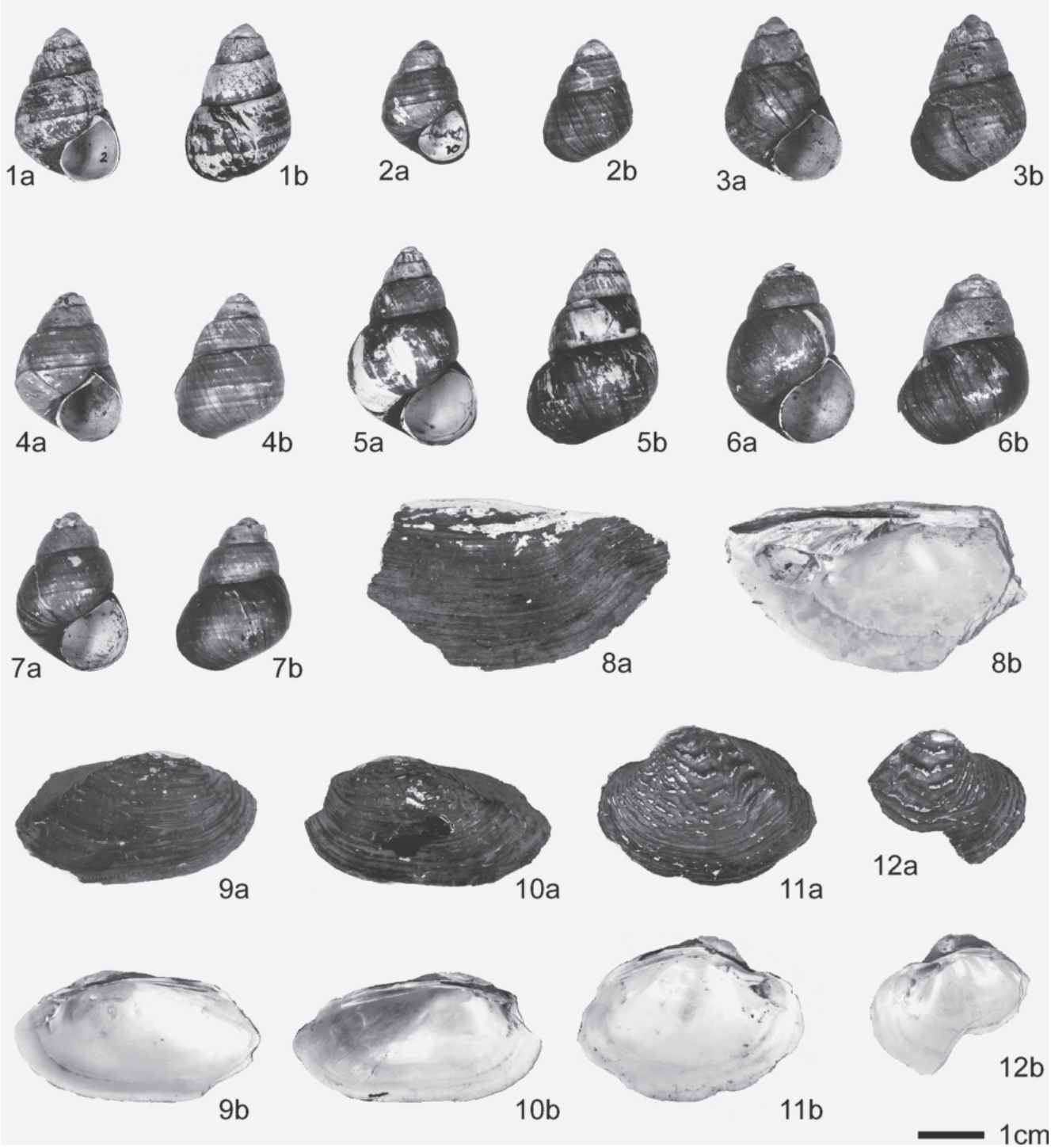

FIGURE 6. **1–4**, *Bellamya quadrata* (Benson), **a**: apertural view, **b**: dorsal view, **1a–b**: ZMNH M10101-2; **2a–b**: ZMNH M10101-9; **3a–b**: ZMNH M 10101-17; **4a–b**: ZMNH M10101-30. **5–7**, *Bellamya* cf. *purificata* (Heude), **a**: apertural view, **b**: dorsal view, **5a–b**: ZMNH M10102-1; **6a–b**: ZMNH M 10102-3; **7a–b**: ZMNH M10102. **8a–b**, *Arconaia lanceolata* (Lea), ZMNH M-10105, right valve, **a**: external view, **b**: inner view. **9–10**, *Unio douglasiae* (Griffith and Pidgeon), **a**: external view, **b**: inner view, **9a–b**: ZMNH M10103-1, right valve; **10a–b**: ZMNH M10103-2, left valve. **11–12**, *Acuticosta chinensis* (Lea), **a**: external view, **b**: inner view, **11a–b**: ZMNH M10104-1, left valve; **12a–b**: ZMNH M10104-2, right valve.

TABLE 1. Measured dimensions of *Bellamya quadrata* (ZMNH M10101) (in mm).

Specimen No.	Shell height	Shell width	Height of aperture	Remarks
1	21.9	14.8	11.0	
2	23.7	15.4	11.4	Fig. 6. 1a–b
3	20.8	15.2	10.4	
4	24.5	16.6	12.2	
5	22.3	14.5	11.2	
6	18.7	13.5	9.4	
7	22.4	15.0	11.5	
8	24.0	16.5	11.8	
9	18.6	13.2	9.7	Fig. 6. 2a–b
10	22.0	15.0	10.5	
11	13.4	10.7	7.5	
12	25.3	17.5	12.1	
13	24.0	17.2	11.7	
14	20.8	14.2	10.9	
15	20.0	13.3	10.2	
16	22.1	15.2	11.3	
17	25.5	17.0	11.6	Fig. 6, 3a–b
18	27.3	18.1	12.0	
19	23.0	16.2	11.5	
20	22.0	14.6	10.4	
21	22.2	15.7	10.6	
22	26.0	16.6	11.8	
23	21.6	14.3	10.4	
24	19.4	13.0	10.2	
25	22.3	14.7	10.4	
26	21.0	15.2	10.4	
27	22.7	16.4	11.6	
28	22.6	15.2	10.3	
29	22.1	14.8	10.5	
30	22.5	16.3	11.6	Fig. 6. 4a–b
31	20.4	13.8	9.8	
32	17.2	13.2	10.6	
33	19.0	13.2	10.4	
34	19.8	13.8	10.0	
35	22.3	15.2	9.7	
36	22.7	15.6	10.5	
37	22.0	15.4	11.0	

is the strongest (Liu et al., 1979).

Recently, Wu et al. (2000) studied shell and radular morphology of three species of *Bellamya, quadrata, purificata* and *aeruginosa,* and concluded that *B. purificata* is considered to be synonymous with *B. quadrata.* But in the present study, we distinguish between them using the characters described by Liu et al. (1979).

Dimensions are shown in Table 2.

TABLE 2. Measured dimensions of *Bellamya* cf. *purificata* (ZMNH M10102) (in mm).

Specimen No.	Shell height	Shell width	Height of aperture	Remarks
1	30.2	18.9	13.1	Fig. 6. 5a–b
2	26.2	18.7	13.0	
3	17.7	19.5	13.6	Fig. 6. 6a–b
4	24.2	16.5	12.3	Fig. 6. 7a–b
5	20.8	14.0	9.6	
6	15.7	11.4	7.7	
7	22.0	16.1	12.0	

TABLE 3. Measured dimensions of *Unio douglasiae* (ZMNH M10103) (in mm).

Specimen No.	Length	Height	Thickness	Remarks
1	26.5	19.7	6.9	Right valve. Fig. 6. 9a–b
2	37.7	20.0	7.2	Left valve. Fig. 6. 10a–b
3	(27.4)	16.0	5.5	Left valve, posterodorsal broken
4	(21.1)	19.0	5.3	Right valve, anterior and posterior broken
5	(31.7)	19.0	6.9	Right valve, posterior broken
6	(30.9)	19.6	7.4	Left valve, both ends broken
7	(30.5)	21.5	8.4	Left valve, anterior broken

TABLE 4. Measured dimensions of *Acuticosta chinensis* (ZMNH M10104) (in mm).

Specimen No.	Length	Height	Thickness	Remarks
1	33.6	24.7	8.8	Left valve. Fig. 6. 11a–b
2	(24.5)	(20.2)	8.4	Right valve, posterodorsal broken. Fig.6. 12a–b

Unio douglasiae (Griffith and Pidgeon, 1834) (Bivalvia: Unionidae) (Fig. 6, 9–10) ZMNH M10103

Seven specimens of which five are fragmental were examined. Their thin but rather solid test, shell outline, hinge plate and muscle scars are identical with the species.

This species resembles *Unio douglasiae nipponensis* Martens from Japan, but is different from the latter by its broader posterodorsal part of the shell. *Unio douglasiae biwae* Kobelt from Lake Biwa, Japan, is also similar to the present species in shell outline, but is distinguished by its thick and triangular posterior cardinal tooth of right valve, whereas the latter has thin bladelike cardinals.

Dimensions are shown in Table 3.

Acuticosta chinensis (Lea, 1868) (Bivalvia: Unionidae) (Fig. 6, 11–12) ZMNH M10104

Only two specimens of left and right valves were obtained and examined. The posteroventral part of the right valve is broken away. The posterior slope is distinct, separated from the main disc by the posterior ridge. The hinge plate is provided with two cardinals and two posterior lamellar teeth on the left valve, and one cardinal and a posterior lamellar on the right valve; the ventral cardinal on the left valve was mostly broken out to know details. The shell surface is ornamented by concentric growth lines and rugose lines of sculpture. The rugose lines, about 13 in number, are regularly separated, almost concentric but turning dorsally and ventrally, and crossing the concentric growth lines. Anterior and posterior adductor muscle scars are distinct and subrounded in shape. Pallial lines are impressed and entire.

The radial ornamentations which characterize living *Acuticosta chinensis* could not be observed because the periostracum was not preserved on the examined specimens. The cardinal and posterior teeth are identified to the species. The rugose sculpture on the surface of shells is observed faintly in some living specimens and clearly in others.

Acuticosta ovata (Simpson) resembles the species in shell outline, but is different in its triangular cardinal of right valve, more remarkably developed posterodorsal ridge, and the shell surface without rugose sculptures.

Dimensions are shown in Table 4.

Arconaia lanceolata (Lea, 1856) (Bivalvia: Unionidae) (Fig. 6, 8 a–b) ZMNH M10105

Only one fragmental specimen of the right valve was collected. The thick test, preserved ligamental character and

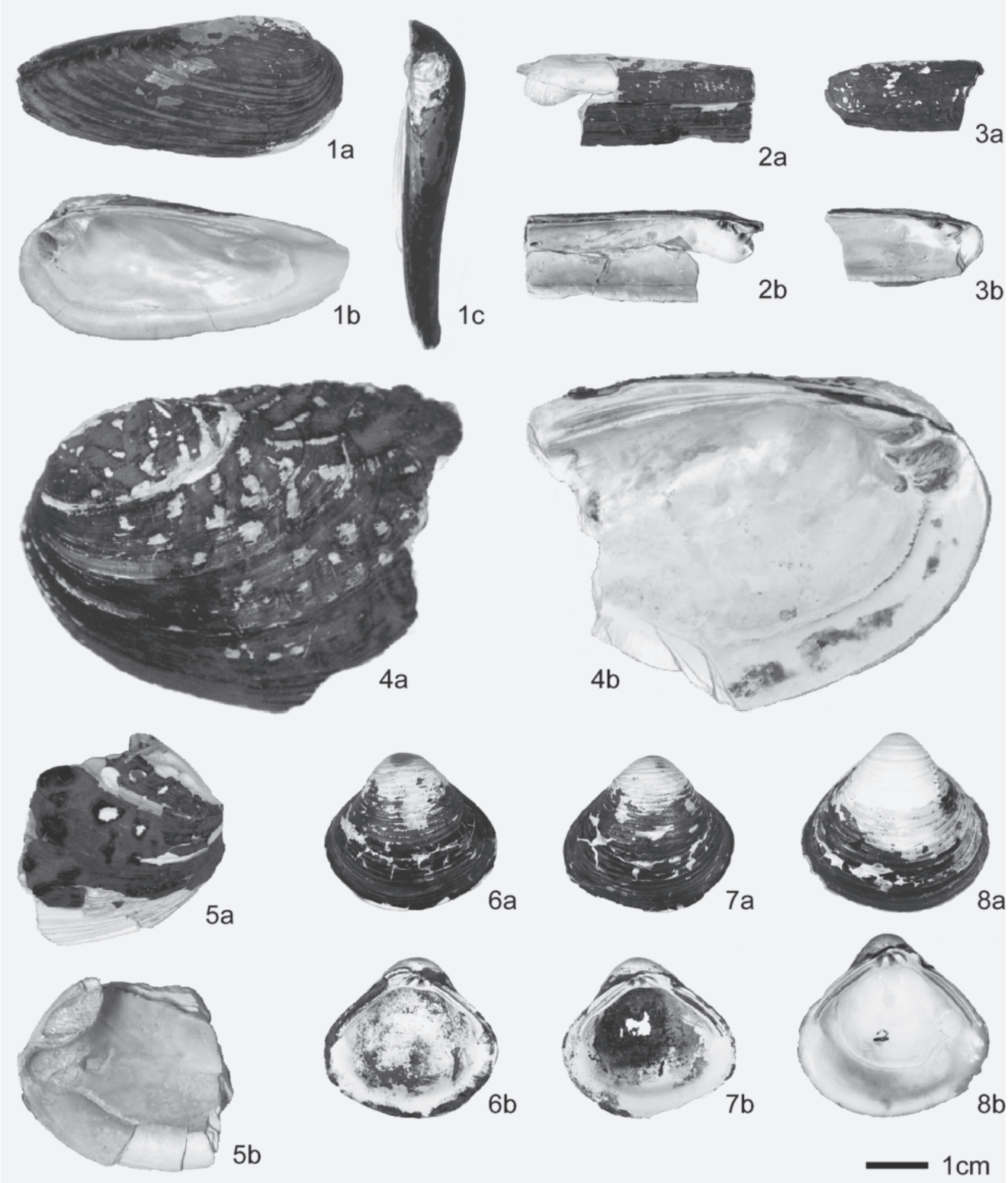

FIGURE 7. **1a–c**, *Cuneopsis pisciculus* (Heude), ZMNH M10106, right valve, **a**: external view, **b**: inner view, c: dorsal view. **2–3**, *Lanceolaria* sp. indet., **a**: external view, **b**: inner view, **2a–b**: ZMNH M10107-1, left valve; **3a–b**: ZMNH M10107-2, right valve. **4–5**, *Lamprotula leai* (Gray in Griffith et Pidgeon), **a**: external view, **b**: inner view, **4a–b**: ZMNH M10108-1, left valve; **5a–b**: ZMNH M10108-2, right valve. **6–8**, *Corbicula fluminea* (Müller), **a**: external view, **b**: inner view, **6–7**: ZMNH M10109-1, **6a–b**: right valve; **7a–b**: left valve; **8a–b**: ZMNH M10109-2, right valve.

TABLE 5. Measured dimensions of *Arconaia lanceolata* (ZMNH M10105) (in mm).

Length	Height	Thickness	Remarks
(45.4)	26.6	8.6	Right valve, posterior broken

TABLE 6. Measured dimensions of *Cuneopsis pisciculus* (ZMNH M10106) (in mm).

Length	Height	Thickness	Remarks
53.5	23.4	9.0	Right valve

TABLE 7. Measured dimensions of *Lanceolaria* sp.(ZMNH M10107) (in mm).

Specimen No.	Length	Height	Thickness	Remarks
1	(39.0)	15.2	4.4	Left valve, anterior and posterior broken. Fig. 7. 2a–b
2	(25.7)	8.1	4.5	Left valve, anterior part preserved. Fig. 7. 3a–b

TABLE 8. Measured dimensions of *Lamprotula leai* (ZMNH M10108) (in mm).

Specimen No.	Length	Height	Thickness	Remarks
1	(72.6)	54.7	15.0	Left valve, anterior part preserved. Fig. 7. 4a–b
2	(34.3)	(35.2)	>8.3	Right valve, anterodorsal part preserved. Fig, 7. 5a–b

TABLE 9. Measured dimensions of *Corbicula fluminea* (ZMNH M10109) (in mm).

Specimen No.	Length	Height	Thickness	Remarks
1	27.9	26.0	18.0.	Left valve. Fig. 7. 6a–b
	28.0	26.0		Right valve. Fig. 7. 7a–b
2	30.7	29.6	9.0	Right valve. Fig. 7. 8a–b
3	27.0	24.9	8.3	Right valve
4	28.9	26.5	8.9	Left valve
5	30.3	28.6	19.2	Left valve
	30.9	28.6		Right valve
6	26.2	27.4	8.6	Left valve
7	27.9	26.5	8.8	Left valve
8	26.2	25.7	8.6	Right valve
9	25.8	25.0	8.7	Right valve
10	22.3	20.9	7.1	Right valve
11	19.3	17.9	6.6	Right valve

an adductor muscle scar are identical with the species as well as the distinguishable undulated shell shape.

Dimensions are shown in Table 5.

Cuneopsis pisciculus (Heude, 1875) (Bivalvia: Unionidae) (Fig. 7, 1a–c) ZMNH M10106

Only one right valve was obtained and examined. This species is distinguished by its posterior part turning to the right. The cardinal tooth of the right valve is rather high, triangular in shape, and provided with a radial groove, which is also characteristic of the species.

Dimensions are shown in Table 6.

Lanceolaria sp. indet. (Bivalvia: Unionidae) (Fig. 7, 2–3) ZMNH M10107

Only two specimens were examined. They are fragmental, but their preserved anterior parts with hinge plates are identical with the genus. Specific position is not determined although their shell outline is suggestive of *Lanceolaria grayana* (Lea).

Dimensions are shown in Table 7.

Lamprotula leai (Gray in Griffith et Pidgeon, 1834) (Bivalvia: Unionidae) (Fig. 7, 4–5) ZMNH M10108

Two specimens were examined. The anterior half of the left valve and the anteroventral part of the right valve are

preserved. They have a thick test. The left valve provided a large, long and projecting posterior cardinal tooth, deep and arched socket between the cardinals, two parallel lateral teeth, and a large and trapezoidal adductor muscle scar. The right valve has a huge, projecting cardinal and a deep, subrounded anterior adductor scar. The characters and many nodes on the shell surface are identical with the species.

Dimensions are shown in Table 8.

Corbicula fluminea (Müller, 1774) (Bivalvia: Corbiculidae) (Fig. 7, 6–8) ZMNH M10109

11 specimens were examined. The almost regular triangular shell shape, subequilateral shell, and rough and concentric growth lines are identical with the species. *Corbicula largillierti* (Philippi) has a transversely longer shell. *Corbicula nitens* (Philippi) has a less produced beak. Japanese species of *Corbicula japonica* Prime and *C. leana* Prime are similar to the present species, but the latter is distinguishable from the others by having more regularly arranged concentric lines of growth.

Dimensions are shown in Table 9.

CONCLUSION

A great deal of molluscan remains was obtained from the middle part of the Bianjiashan Site in the Liangzhu Archaeological Sites, and nine molluscan species were identified.

The molluscan assemblage is dominated by *Bellamya quadrata* and *Corbicula fluminea.*

The fact that the molluscan assemblage of this study does not include marine elements suggests regression and cooler conditions after the Holocene warm event.

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CORRELATION TABLE OF ENGLISH TO CHINESE

Anhui	安徽	Bianjiashan	卞家山	Hangzhou	杭州
Hemudu	河姆渡	Hubei	湖北	Hunan	湖南
Jiangsu	江苏	Jiangxi	江西	Kuahuqiao	跨湖桥
Mojiaoshan	莫角山	Liangzhu	良渚	Luotuodun	骆驼墩
Pingyao	瓶窑	Xiasun	下孙	Xixi	西溪
Yixing	宜兴	Yuhang	余杭	Yuyao	余姚
Zhejiang	浙江				

REFERENCES

Benson, W. H. 1842. Mollusca; pp. 486–490 *in* T. Cantor (ed.), General Features of Chusan with Remarks on the Flora and Fauna of that Island. Annals and Magazine of Natural History 9. (*non vidi*)

Cultural Relics and Archaeology Institute of Zhejiang Province. 2005. Liangzhu Sites Group. Reports of the Group Sites at Liangzhu, Volume III. Cultural Relics Publishing House, Beijing, 493 pp.**

Griffith, E., and E. Pidgeon. 1834. The Mollusca and Radiata. Cuvier's Animal Kingdom 12: 1-601. (*non vidi*)

Heude, P. M. 1890. Notes sur les molluses terrestres (et d'eau douce) de la valee de fleuve Bleu. Part 3. Memoires de la histoire naturelle de la Empire Chinoise 1, pt. 4: 125–188. (*non vidi*)

Heude, R. P. 1875–1885. Conchyliologie fluviatile de la province de Nanking (et la Chine Centrale). Librairie F. Savy, Paris. (*non vidi*)

Huang, B., X. Zhu, H. Cai, L. Lin and M. Tian. 2005. Holocene molluscs in Luotuodun and Xixi of Yixing City, Jiangsu Province. Marine Sciences 29 (8): 84–94.**

Lea, I. 1856. Description of a new species of *Triquetra,* Klein (*Hyria,* Lamarck). Proceedings of the Academy of Natural Sciences of Philadelphia 8(2): 79.

Lea, I. 1868. Descriptions of four new species of Exotic UNIONIDÆ. Proceedings of the Academy of Natural Sciences of Philadelphia 20: 150.

Liu, Y., W. Zhang, Y. Wang and E. Wang. 1979. Economic Fauna of China (Freshwater Mollusks). Science Press, Beijing, 134 pp.*

Müller, O. F. von. 1774. Vermivm terrestrium et fluviatilium, seu animalium infusoriorum, helminthicorum, et testaceorum, non marinorum, succincta historia. Volumen alterum. Heineck and Faber, Havniæ and Lipsiæ, 36pp. + 214 pp. (*non vidi*)

Wang, R. (ed.). 1988. Coloured Illustrations of Aquatic Mollusks in China. Zhejiang Publishing House of Science and Technology, Hangzhou, 255 pp.**

Wei, F., W. Wu, M. Zhang and D. Han. 1990. The Fauna from the Neolithic Site at Hemudu, Zhejiang. Oceanpress, Beijing, 125 pp.†

Wu. W. 1983. Holocene palaeogeography along the Hangzhou Bay as constructed on the basis of Neolithic cultural remains. Acta Geographica Sinica 38 (2): 113–127.**

Wu, W. 1996. Geographical environment in the Liangzhu culture time-Hangjiahu area-. Nicchu-Bunka-Kenkyu 11: 6–12.††

Wu, X., S. Ou'yang, Y. Liang, H. Wang and Y. Yu. 2000. Comparative studies on shell and radular morphology of Bellamya (Gastropoda; Viviparidae). Journal of Nanchang University (Natural Science) 24 (1): 1–5.**

Zhejiang Provincial Institute of Cultural Relics and Archaeology. 2003. Hemudu. A Neolithic Site and its Archaeological Excavations. Cultural Relics Publishing House, Beijing, 513 pp.***

Zhejiang Provincial Institute of Cultural Relics and Archaeology and Xiaoshan Museum. 2004. Kua Hu Qiao. Archaeological Report of Puyang River Valley 1. Cultural Relics Publishing House, Beijing, 379 pp.***

* : in Chinese

** : in Chinese with English abstract

***: in Chinese with English and Japanese abstracts

† : in Chinese with English summary

†† : in Japanese (original title translated)