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The Evolution of the Plow in Pre-Qin China

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Abstract: The pre-Qin period represents a significant phase in the development of China's bronze civilization; bronze ware serves both as a symbol of Chinese civilization and as one of the factors that gave rise to this symbolism. Currently, most bronze artifacts unearthed in China consist primarily of ritual vessels and weapons, while agricultural tools represented by the bronze plow are exceedingly rare; nonetheless, the practical and ritual significance inherent in these bronze agricultural tools invites deep reflection. This paper aims to explore the historical evolutionary trajectory by examining the morphological evolution of the bronze plow.

Keywords: Stone plow; Bronze plow; Bronze artifacts; Ritual vessels

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1. Introduction

Among excavated bronzes, ritual vessels predominate, while bronze plows also deserve discussion. Current scholarship has three main views: Guo Moruo and some contemporaries regard them as purely ritual implements [1]; Wang Wenyao identifies the Eastern-Zhou bronze plow excavated at Qishan, Shaanxi, as a functional agricultural tool [2]; Wang Shuigen argues the Shang-dynasty bronze plow from the Dayangzhou tomb in Xingan, Jiangxi, had both utilitarian and ritual purposes [3].

Plows developed through multiple phases in ancient Chinese agrarian societies. In China, plows can be traced back to the Shang dynasty, when the character for "plow" already appeared in oracle-bone inscriptions [4]. There is still academic debate over their origin: one hypothesis proposes West Asian influence, as plow-based agriculture existed in Mesopotamia and Egypt as early as 3500 BCE; the other argues for indigenous Chinese evolution from primitive lei-si digging implements [5].

2. The development of plows in Ancient China

Iron plows came into use from the late Western Zhou through the Spring and Autumn periods, paving the way for ox-drawn plowing. The Western Han straight-shaft plow has a structure of a plowshare and a wooden

beam. In regions without draft oxen, human-powered foot-operated plows (chan) were widely used. This implement is recorded in Zhou Qufei's Song-dynasty work Lingwai Daida, and comparable manual plowing techniques still exist in present-day Yunnan's Naxi communities [6]. Warring States socioeconomic expansion was closely tied to the spread of iron plows and ox-plowing, so further research is needed on the earlier evolution of stone and bronze plows and the social impact of these productive technologies.

Curved-shaft plows developed in the Sui-Tang dynasties, with additional components including moldboards, plow pointers, and cutting blades. According to Lu Guimeng's *Leisi Jing*, the Tang curved-shaft plow had eleven parts, allowing adjustable tillage depth [7]. With a total length of 2.3 zhang, it generally required two oxen for traction. A full-scale reconstruction of this plow is collected by the National Museum of China, and its working principle is comparable to modern motor-driven disc harrows. Compared with the earlier straight-shaft plow, the Tang curved-shaft design enabled more flexible adjustment of tillage depth; its improved moldboard reduces traction resistance, inverts furrow slices, and suppresses weed growth.

The developmental sequence of plows after the Warring States period is relatively well-documented, while early evolutionary paths and the question of indigenous origin remain unclear, which can be clarified by focusing on practical function and historical-archaeological logic.

3. The rise of agriculture and the origins of tillage implements

The transition from mobile hunting-gathering to sedentary farming was driven by the rise of agriculture. Food surpluses secured stable subsistence for early populations, and agricultural progress depended heavily on cultivation implements for soil breaking and sowing. After observing natural crop reproduction, early farmers found higher yields when seeds were buried under soil, starting with hand-dug sowing. As large-scale cultivation became necessary, wooden sticks replaced manual digging, and hole-digging, seed placement, and soil covering gradually became a core cultivation technique in China's early agricultural societies.

Archaeological sites across China preserve evidence of early crop domestication. In southern China, 12,000- to 10,000-year-old cultivated rice remains were found at the Xianrendong-Diaotonghuan site (Jiangxi), the Yuchanyan site (Hunan), and the Shangshan site (Zhejiang). In northern China, 10,000- to 8,000-year-old broom corn and foxtail millet remains were unearthed at Donghulin (Beijing) and Xinglongwa (Inner Mongolia). These records support the hypothesis of independent agricultural origins in China. Through sustained labor, early communities created native tillage tools called Lei and Si.

4. Lei and Si: The forerunners of the plow

Lei and Si were two distinct tillage implements. Lei, derived from digging sticks, resembled a wooden fork with a hand-crank at the upper end and a pointed tip for breaking clods. Si functioned like a spade, with a long handle and a broad blade for turning over soil. Later versions added a solid blade to the tip of lei to improve durability and efficiency, and added a transverse crossbar for foot-powered thrusting. The main body of lei was usually wooden; most surviving si blades are stone, and evidence for other raw materials remains inconclusive.

Lei-si relies entirely on human muscle power. Some scholars hypothesize ancient farmers attached auxiliary pulling ropes to its handle; this practice appears in recent ethnographic records but lacks direct archaeological confirmation. Since plows evolved from lei-si and operate via continuous traction, it can

be inferred that early lei-si sometimes used rope-assisted pulling. Traction-aided tillage with lei-si uses intermittent strokes. Higher agricultural output required a continuously operating plow-style implement, which needed simultaneous improvements to tool geometry and raw materials. Repeated continuous soil breaking produces high mechanical stress, and wooden lei-si often fractures in heavy clay soils, creating demand for dedicated plowshares.

5. The emergence of stone plowshares

In sustained plowing, plowshares endured far greater abrasive wear than traditional hoes, requiring higher material hardness and wear resistance. In performance, wood is outperformed by stone, and stone by metal. Against this background, the Liangzhu-culture stone plow emerged around 4,500 years ago. Most Liangzhu stone plowshares are flat and sheet-like, and composite perforated triangular specimens also exist. Pan Xin of Nanjing University conducted experimental-archaeological research on stone plow artifacts from the Taihu Lake basin and argues that the term “stone plowshare” better reflects their actual function [8].

Compared with wooden plowshares, stone plowshares had better wear resistance, but were much harder to manufacture. Most surviving examples are perforated flat slabs with a beveled cutting edge optimized for soil penetration. After the advent of metallurgy, casting allowed metals to be shaped into specialized tool forms, giving rise to metallic plowshares. Bronze, China’s dominant early alloy, was widely used for ritual vessels and weapons in the Shang-Zhou period, and was also cast into plowshares. Excavated bronze plowshares are still rare, with confirmed finds concentrated in Jiangxi, Shandong, Shaanxi, Zhejiang and Jiangsu. Representative examples are from the Shang-dynasty Dayangzhou tomb in Xingan.

6. Morphology and function of bronze plows

Shang-Zhou bronze plows were technologically more advanced than stone plows, with shapes that improved soil cutting, inversion, and overall cultivation efficiency. Excavated bronze plowshares can be divided into two morphological types.

Type I has an isosceles-triangular outline, with a raised median ridge on the leading edge and a triangular or semicircular socket for hafting. Its flat blade resembles stone plow prototypes; the socket ensures a firm connection to the plow beam, and some specimens have additional nail holes for fastening. Type II is triangular and nearly trapezoidal, shares the same socket design as Type I, and its adjusted rear contour helps loosen soil and prepare seedbeds.

Some excavated decorated bronze plows are classified purely as ritual objects by some researchers. However, bronze plows originated as practical agricultural tools. In the Zhou dynasty’s royal Jitian (Sacrificial Plowing) ceremony, the Son of Heaven tilled symbolically with exquisitely decorated bronze plows, through which these artifacts gained symbolic and ritual meaning without losing their core identity as plowshares. Because bronze was valuable, worn bronze plows were often melted down for recasting, and ordinary people would not bury such plows with the dead, explaining why few practical bronze plows have been excavated. Li Xueqin also emphasizes that bronze recycling was a widespread ancient practice [9].

7. Indigenous origins and the antiquity of ox-plowing

Debate continues over whether plowing technology originated indigenously in China. Xu Zhongshu proposed that plows did not exist before the adoption of iron tools, and ox-plowing spread to China from Egypt via Persia and India [5]. This diffusion hypothesis contradicts existing evidence: ox-assisted plowing was already used on the Chengdu Plain by the late Shang to early Zhou transition, while Bo communities in southern Sichuan and eastern Yunnan still lacked ox-plowing in the Ming dynasty, and people in Jiuzhen (modern northern Vietnam) only learned ox-plowing from Eastern Han official Ren Yan. This comparative evidence disproves the foreign origin theory.

Domestication of draft animals in China dates back to the Yangshao period, when cattle, horses, and pigs were already raised. Liangzhu culture has evidence of large-scale water buffalo husbandry in southern China, and 6,800-year-old water buffalo bones have been found at the Hemudu site. Cattle bone frequencies at the Taosi site (Xiangfen, Shanxi) remained stable across its early and late phases around 4,500–3,900 BP, showing cattle had been integrated into the subsistence economy. Age-at-death data from Taosi cattle teeth indicate many cattle were raised to mature age, matching their use as draft animals. Written sources including Shiji·Yin Benji and the Bamboo Annals record that Shang ancestor Wang Hai rode oxen and horses, indicating the Shang people had already mastered animal harnessing [10]. More than fifty Shang chariot-and-horse pits have been excavated at Yinxu (Anyang), with nearly twenty more found at other Shang sites [11]. Combined, archaeological and textual sources confirm cattle were used for productive labor in the Shang period.

8. Paleographic evidence for the character Li

Insights may be drawn from the paleography of the character li (“plow”). Modern li links to the ox radical, while the earliest graphic forms related to ox-drawn plowing remain under investigation. Early Chinese writing was pictographic, so semantic content can be reconstructed by studying archaic character shapes. A contested oracle-bone graph has multiple interpretations: Wang Guowei read it as wu, meaning a hybrid-ox variety [12]; Guo Moruo proposed it as the early prototype of li [1]; Dong Zuobin noted phonological interchange between graphs transcribed as li, rejecting the readings as wu (“mixed ox”) or wu (“not”) [4]. In July 1980, Shanghai Museum acquired 32 oracle-bone fragments. One fragment joins Jiaguwen Heji no. 23148 to reconstruct a complete ten-inscription sequence, which contains parallel terms you-niu (“reddish-brown ox”) and huang-niu (“yellow ox”). If the contested graph meant “hybrid ox”, the color modifiers you and huang would be semantically redundant. This paleographic evidence supports identifying the graph as early li (“plow”).

9. Conclusion

Claims that ox-plowing was absent in the Shang and only emerged in the Han dynasty misrepresent Pre-Qin agricultural development and underestimate Shang technological capacity. The Shang bronze plowshare from Dayangzhou confirms Shang animal-powered tillage, improved soil-breaking performance, and pushes the origin of plow cultivation back to the early Shang. The view that plowing spread from overseas to Sichuan before reaching the Central Plains contradicts existing material evidence. Possible connections with Eurasian steppe transmission require further research. In any case, plows first originated as production tools and

gained ceremonial functions later; they did not start as ritual artifacts and then adapt to farming.

Disclosure statement

The author declares no conflict of interest.

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