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Control strategies and polity competition in the lower Yi-Luo Valley, North China

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Abstract

The development of control strategies is a key to understand the evolution of complex societies. The nodes of control are central places comprise public facilities and monumental structures and are often inhabited by large non-food producing population. The ability to levy labor and food surplus from the countryside are essential challenges to the social elite in the building and maintenance of central places. By strategically locating the regional and local control nodes, a web is formed to regulate the political economy of the polity. The Yi-Luo Valley in North China is a circumscribed region that documents in archaeology a long sequence of the development of social complexity. The settlement pattern suggests that the placement of control nodes facilitated the effective extraction of resources from the hinterlands. In addition, the formation of two large primary centers, Erlitou and Yanshi, in the mid-second millennium B.C. indicates the competition between regional polities.

In the study of the evolution of social complexity, chiefdom, and state represent two distinct political forms with fundamental difference in the structure of control. Chiefly regulators are generalized controlling devices that all the decision-making are vested on a few agencies, usually a few individuals. Because the information any individual agent can process at any particular time is finite, the organizational structure of chiefly polities limits its own growth. The state develops specialized regulators so that there is a clear division of labor and a hierarchy of decision-making. This new control structure is capable of making various decisions in different places at different time, thus it could support continuous growth of stately polities. The difference in regulating processes among chiefdom and state gives rise to the difference in scale of integration and is viewed as the threshold in the evolution of complex societies. This development is analogous to punctuated equilibrium in biological evolution that the chiefdom may remain relatively stable in its political structure for a long period of time. Once generalized regulating processes transforms into specialized regulating processes, however, a series of critical changes would have followed in a short period of time.

One of the essential ways to monitor the control structure of a polity is to study the nodes of control. These nodes are the seats of the rulers and therefore consist administrative facilities. They are also the locales for public gatherings, so public features and monuments are built. A chiefly establishment should have a hierarchy of two to three levels of control, while a stately polity should have a hierarchy of at least three levels of control. These nodes of control or central places usually comprise large non-food producing populations that include the social elite and the specialized craftsmen patronized by the elite. Complex societies, therefore, must fulfill two crucial tasks: to mobilize a large number of laborers to construct the public facilities and monuments, and to extract food surplus to sustain the urban

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population. Given that in preindustrial societies agricultural surplus is small, and the transportation of bulky staple is expensive, a vast hinterland, a large farming force, and an efficient extracting system are needed to support central places. A study of the settlement pattern of complex societies not only can throw light on their organizational principles, it can also monitor the controlling processes.

The Yi-Luo Valley in the middle reaches of the Yellow River is a geographic region that provides exceptionally rich natural resources for the rise of urban centers. On the one hand, the river valley is surrounded by natural barriers, which circumscribes a well-defined geographic region. On the other hand, the rich alluvial soil is fertile for farming. During the second millennium BC, the Yi-Luo Valley witnessed the emergence of central places, which included two exceptionally large urban centers, Erlitou and Yanshi Shangcheng (literally, the walled settlement of the Shang period at Yanshi; hereon, Yanshi). Archaeological investigation of the Yi-Luo Valley illustrates the pathways of the rise and development of the controlling and mobilization strategies of complex societies in northern China.

Information approach to social complexity

In recent years, social evolution has received harsh criticisms in the field of anthropology. A number of scholars (e.g., Crumley, 1987, 1995; Ehrenreich et al., 1995; Mann, 1986; Patterson and Gailey, 1987; Yoffee, 1993) contended that it was untenable to view chiefdom and state as uniform and static social types, and to view social evolution as a ladder of continuous advancement from one stage to the other. Marcus and Feinman (1998) pointed out that these criticisms were based on problematic assumptions. Evolutionary anthropologists had long recognized the heterogeneity within the social categories of chiefdom and state, and a set of necessary conditions had to be met for a chiefdom to evolve into a state (e.g., Carneiro, 1970, 1991; Drennan, 1987, 1991; Earle, 1991; Erickson, 1973, 1975; Feinman and Neitzel, 1984; Ferguson, 1991; Flannery, 1995; Johnson and Earle, 1987; Marcus, 1989, 1992; Marcus and Flannery, 1996; McGuire, 1983; Spencer, 1990, 1993; Trigger, 1993). I agree with Marcus and Feinman that the terms "chiefdom" and "state" are useful in providing shorthand references to widely-agree-upon categories of societies, each characterized by an interrelated set of social and political institutions (Marcus and Flannery, 1996, p. 236). The debate described above sharpens the perception of social evolution and is instrumental for archaeologists engaged in the study of past complex societies. However, it is still unclear how to operationalize the notions of chiefdom and state in the study of archaeology.

The difficulty of distinguishing chiefdoms and states in archaeology is attributable to the fact that they share many characteristics. Earle (1978, 1997) pointed out that the fundamental dynamics in chiefdoms are essentially the same as those of the state. Both chiefdom and state are regional systems integrating several local groups within a single polity (Carneiro, 1981). Both of them involve centralized decision-making processes and social stratification such that access to political offices is differential. Also the chiefdom and the state are funded by a political economy wherein surplus is extracted as tribute or tax from local communities. In a comprehensive treatment of different forms of human societies, Johnson and Earle summarized that a major difference between chiefdom and state is their scale of integration. Chiefdoms are polities of several hundred people to one of 100,000 (Johnson and Earle, 1987, p. 227); wherein states could integrate populations numbering in the hundreds of thousands or millions (Johnson and Earle, 1987, p. 247). Yet, it is erroneous to view the state as a larger version of chiefdom. A fundamental question is why some states could be small, even smaller than a large chiefdom, while no chiefdom could be large enough to integrate a population of millions.

Chiefdoms and states are political organizations, therefore, their fundamental difference can only be sought in the political field. The political offices of chiefdoms are highly generalized such that the volume of information that they can process simultaneously is very limited. In contrast, political offices of the state are internally specialized such that the volume of information they can process is potentially infinite (Johnson and Earle, 1987; Marcus and Feinman, 1998; Wright, 1977). This structural difference in administrative organization between chiefdoms and states gives rise to differences in control strategy, regulatory pattern, hierarchical structure, and oscillation of hierarchical pattern in time. Being able to establish hierarchically specialized regulators is a threshold in the evolution of complex societies. It not only explains why the state is a much bigger polity, it also explains why most chiefdoms never evolved into states.

To be more specific, the regulators of chiefdoms are highly generalized agencies with regard to the activities that they regulate, and are non-differentiated internally (Wright, 1984). As generalized and non-differentiated regulators, the overall control of activities is vested in one single apparatus. A chiefly office may lead in affairs of politics, religions, and economics (Earle, 1997, p. 14). This apparatus thus has to process all the information at the same time. The volume of information a regulator can process at any particular time is finite. In addition, decisions have to be communicated directly from the central regulator to every individual within the chiefdom. A common strategy of communication from the chief to the commoners is to use public ritual

as the medium of communication (Johnson, 1982). Commoners get the message through observation of the ritual performance. This kind of control, by nature, is not strong and has a size limit. Since the ruling of a chiefdom necessitates face-to-face communication between the chief and the commoners, mostly through ritual, the territory that a chief can effectively controls is limited to a day's travel from the chief's residence (Spencer, 1998).

When a chiefdom starts to grow through subjugating its bordering population, it soon reaches its capacity limit of information processing and the quality of decisions decline rapidly. The communication of the decision from the regulator to the public becomes increasingly difficult as well. This communication breakdown might trigger fissioning of the polity along lineage lines of the ruling house, with the senior line of a lower-ranked lineage becoming a separate chiefdom in competition with the original lineage line (Johnson and Earle, 1987, p. 227). The alternate strategy would be that the paramount chief actively adjusts the local unit territories by bestowing land to his sons or close kinsmen and making them subordinate chiefs. The sub-chiefs are to a great extent copies or structural equivalents of the paramount chief in that they are generalized and undifferentiated regulators as well. Each of the chiefly and sub-chiefly entities occupies a territory approximating the one-day travel limit to meet the face-to-face communication requirement.

The authority of the paramount chief over the subchiefs is charismatic rather than institutional. As time goes by, especially upon the death of the old paramount chief, the new paramount and the subchiefs would have equal claims to legitimacy that would intensify competition. Therefore, chiefly societies are inherently unstable and often go through two cycles, a cycle of development and collapse, and a cycle of two- (simple chiefdom) to three-tiered (complex chiefdom) hierarchies of control (Wright, 1977). It has been observed in archaeology that pre-state societies with two to three levels of control hierarchies have persisted for centuries, with intense competition and frequent replacement of centers, but with little or no increase in sociopolitical complexity (Wright, 1986).

In contrast to chiefdoms, regulators of the state are specialized with regard to the local activities that they regulate, and they are internally specialized (Johnson, 1973; Wright, 1977). The most important feature of this new control apparatus is the capability of division into separate activities that can be performed in different places at different times. It is also capable of expansion and building of a multi-leveled hierarchy of control. Flannery (1972) has furnished several models of the operation of control hierarchies. The general feature is that the lower-order regulators feed information to the higher-order regulators in summary form. The higher-order regulators make decisions based on the summary information supplied by several lower-order regulators. Decisions made would channel down the regulatory hierarchy and eventually reach every individual of the polity. Unlike the paramount chief, the head of a state can delegate the power of decision-making with minimal fear that subordinate elements in the hierarchy will engage in effective independent action because a lower-order agency has less access to information (Johnson, 1982; Wright, 1977). This structure of specialized and hierarchically organized agencies of control has the potential to facilitate the processing of infinite amount of information and to effectively communicate the decisions made, which no chiefdom can match. The emergence of the state, correlated with the emergence of three to four levels of control hierarchies, was often coupled with rapid population nucleation, most often at the expense of defeated or subjugated neighbors (Wright, 1986).

The above discussion on the fundamental distinction between chiefdom and state is built on a theoretical study of hierarchy formation and communication stress (Johnson, 1978, 1982; Reynolds, 1984). This notion can adequately monitor the central question of political evolution; that is, structural change of the ruling apparatus. Every regulating agency is seen to be limited in its capacity to process information. Generalized and internally undifferentiated regulators of the chiefdom cannot overcome this communication bottleneck. Therefore, the chiefdom is limited in its development and expansion when the structural threshold has reached. Once the structurally limited regulating apparatus is replaced with a specialized and internally differentiated bureaucratic hierarchy, more information can be handled by adding new levels to the existing administrative hierarchy. This is the so-called "qualitative change" in social evolution of Carneiro (1987) and dialectic philosophy. This is also the moment when a chiefdom evolves into a state. After a political entity evolves into a state, it has the potential of continuously expanding into sizes several hundred times larger than its predecessor. Sometimes we refer to this super-large state as an empire. However, the structure of the ruling apparatus of an empire is no different from that of a state. We see the hierarchically organized structure of information processing regulators of an archaic state is no different from that of a modern state, regardless of the technological difference in information transmission. The above discussion explains why not all the chiefdoms evolved into states. In spite of other conditions, like population density, surplus food resources, that must be met, a chiefdom, or to be more precise, the elite individuals of a chiefdom, had to be innovative in control strategy in order to set this transformation in motion.

The processes of the evolution of complex societies, that is the evolution from chiefdom to state, is analogous to the notion of punctuated equilibrium in biological evolution. The key for this evolution is the control strategy. When the information bottleneck is reached, chiefdom cannot expand its scope of control because of the structural constraint. Therefore, there is a limit for the scale of integration for pre-state political formations. Chiefdoms might continue to exist for centuries or the intense competition among themselves might break down the system and the society returns to a simpler level of organization centered at the village communities. Once the problem of control strategy has been resolved, there is no structural limit for growth. By definition, this is a new type of political formation called the state. The earliest states might be very similar to the chiefdoms in many areas, but the rapid development that followed would clearly distinct them from the chiefdoms.

The advantage of the information approach is its inclusiveness. It is not in disagreement with any of the traditional notions of complex societies. For instance, the information definition of the state subsumes the classical definitions based on coercive force, social stratification, trade, warfare, craft specialization, environmental stress, technology, and so forth. I maintain that in order to gain a holistic understanding of the processes of social evolution as a human cultural phenomenon, all these variables should be investigated independently. Each of the pristine states of the world might have a particular permutation of the variables and a difference in the strength of the variables during its formative phase. Nevertheless, they all have to face the same structural problem in information processing, and they seem to have solved the problem with the same strategy of building hierarchical decision-making apparatuses. This might represent a universal evolutionary pathway of human social organization. By taking such an approach, we gain insights into both the general and the particular evolution of human societies.

The information approach is also not in conflict with some current notions in the study of the rise of social complexities, for instance, human agency. The notion of human agency is instrumental for the understanding of the dynamics of human societies. One of the recent criticisms against social evolution is that processualists had overlooked the role of human agency in social change (Brumfiel, 1992, 1994; Pauketat, 2001). Systems theorists like Flannery (1999) had tried to incorporating human agency in a processual model. He maintained that universal processes and human agency are complementary forces, neither of which provides an adequate explanation on its own (also see Marcus and Flannery, 1996; Fash, 2002). This is a bold and perspective stride that elucidates the proper relationship between culture change and the individual. A balanced perspective on processes and agency can only raise our understanding of the dynamics of culture change to a new holistic level. The information approach necessitates innovative human agents on administrative strategy. When the conditions are ripe for the evolution of chiefdom to state, it needs a final push from aggressive human agents (Spencer, 1993). The fact that only a tiny fraction of chiefdoms ever gave rise to states demonstrates the importance of individual actors.

The time depth of archaeology enables us to monitor the evolution of societies from simple to complex. This development is by no means a smooth progression, but is rather full of zigzagging and backtracking. Unlike biological evolution, complex social systems might collapse and be replaced by simple social systems (devolution). Nevertheless, social evolution is the consequence of the adaptive success of our own kind. As the pressure on the existing socio-political system continues to mount, it becomes more likely that a new system would evolve to regulate the relationship between people. The sources of pressure are not a major concern in the information approach; they could be internal or external, and more likely, a combination of both. Also, the development is not an inevitable one. Higher pressure gave more opportunities for aggressive individuals to gain power over other people. The particular event itself is a stochastic occurrence wherein the precise reasons are now unknown. For instance, the critical factor might have been a particular leader who, by virtue of unusual charisma and political skill, was able to outmaneuver rivals in neighboring regions (Flannery, 1999; Steponaitis, 1991, p. 227). However, we can monitor the result of the event through the study of hierarchy of decision-making. Viewed from the perspective of the organization of information processing, chiefdom, and state are distinctive from each other. This structural difference is a pivot in the evolution of social organization.

Lastly, the information definition of complex societies can be operationalized into parameters observable in archaeology. The centralized decision-making mechanism of complex societies give rise to political central places, and the specialized regulation of the state give rise to more complex hierarchy of central places. Archaeologists have been using the existence and organization of central places to gauge social complexity, in spite of the fact that there exists considerable variation among complex societies of similar scale and level of complexity with regard to the regional population density, and the extent of concentration of regional population into a central place (Drennan, 1987). In the following, we are going to investigate the organization of central places and their geographic relationship to other sites so as to monitor the processes of social complexities in the Yi-Luo Valley of North China.

State societies in the Yi-Luo Valley

In recent years, a few systematic regional studies in North China became available. They provide important information for the study of the rise of social complexities. Nevertheless, their patterns either suggest that pre-state political formations were maintained for hundreds of years with no increase in sociopolitical complexity until the latter historical period (Shelach, 1998, 1999) or show evidences of sudden collapse of complex sociopolitical forms (Underhill, 1998). To date, the Yi-Luo Valley is the only regional study in North China that shows clear signals of the emergence of state societies no latter than the second quarter of the 2nd millennium BC.

Two classes of archaeological information are available for the study of social complexities in the Yi-Luo Valley. Large-scale excavations at Erlitou and Yanshi, two regional political centers in the valley, provide critical data for the assessment of the internal structures of the control centers. Their sequences of development chronicle the competition between polities during the formative period of early Chinese states. In addition, a full-coverage survey of the lower Yi-Luo Valley documents the development of settlement pattern from the early Neolithic to the Iron Age. It shows an increase in complexity corresponding to the rise of major political centers in the region.

Erlitou was discovered in 1959 in a survey expedition aimed at finding the ruins of the Xia Dynasty (Xu, 1959), the first of the two dozens dynasties in Chinese history. The site is rich and expansive that it occupies about 400 ha of area (Kaogu Yanjiusuo, 1999, p. 6). Subsurface probing and excavation indicate that palatial complexes first appeared in the 18th Century BC. In addition, bronze wine vessels and jade artifacts, symbols that were used in royal ceremonial rituals during the Shang and Zhou times, were also yielded from the site, indicating its prominent status (Kaogu Yanjiusuo, 1999, p. 151–156).

Yanshi was discovered in a salvage operation in 1983 (Luoyang Han Wei Gucheng Gongzuodui, 1984). It is located in the outskirts of the county seat of Yanshi, less than 10 km northeast of Erlitou. The site is a large fortified walled settlement enclosing an area of about 200 hectares. Inside the walls, a palatial complex comprised about nine large structures were revealed through archaeological coring and excavation (Wang, 1997; Henan Dier Gongzuodui, 1984, 1988, 1999a).

Two large-scale regional centers located side-by-side fueled a debate on their relationship for two decades (see Lee, 2002 for a summary). Nevertheless, the combined results of the stratigraphic observations, ceramic seriation, and wiggle matched radiocarbon dates become abundantly clear that they represent a chronological sequence of the fall of Erlitou then followed by the rise of Yanshi (see below). This pattern also meshes with the written documentation of the hegemonic competition between the Xia and the Shang Dynasties, with Erlitou represents the Xia and Yanshi represents the Shang. Yet, this part of Chinese history is being regarded as the legendary period. The textual records are at best sketchy and historical facts often intertwine with myths and legends. With the increasingly rich archaeological information, we can gain understanding on the processes of the competition between early state polities in China.

The Yi-Luo Valley is particularly important in the political history of China because for thirteen times, different locales in the valley had been selected to be the state capitals. Ruins of perimeter walls of some of these historical state capitals have been located and identified (Fig. 1). The ancient emperors chose the valley to locate their imperial seats for a number of reasons. The region is physically circumscribed that it is enclosed by high mountain ranges and the Yellow River, making it militarily defendable. Communication with the outside world, however, can be easily made through the several mountain passes and the navigable water-courses. The surrounding highlands are rich in natural resources, such as timber, kaolin, and coal deposits, etc., which facilitated the development of local industries. These advantages would not be realized if the farming productivity of the valley itself was insufficient to support a large urban population associated with the state bureaucracy. The valley is of considerable size that it runs about 80 km from east to west, and is about 20 km wide from north to south. The center of the valley is a vast alluvial plain periodically rejuvenated by flooding. The present day annual precipitation is about 650 mm with a modest variability of 25–30% (Shuilibu Huanghe Shuili Weiyuanhui, 1989, p. 148–150). The high productivity attributable to these favorable environmental characteristics was one of the major concerns to the ancient emperors when selecting the locations of their seats.

The economic importance of Yi-Luo Valley in the process of imperial seat selection is most dramatic during the Tang Dynasty (AD 618–907). When the Tang first came to power, it selected Chang'an, about 350 km west of the Yi-Luo, to be its state capital for military, political, and international trade reasons. However, the emperor soon found that the agriculture of the Chang'an hinterlands was inadequate to sustain the ballooning central bureaucracy. In between 657 and 736, the Tang emperors were forced to move the imperial offices to Luoyang—located in the eastern part of the Yi-Luo Valley—for about half of the time (Quan, 1944, p. 15–31). All of the moves occurred in late winter and early spring, when the agricultural storage started to dwindle. It was only after the improvement of canal transportation, enabling steady shipment of food surplus from the Yangtze Valley to Chang'an, the Tang stopped this biennial ritual of capital relocating. Nevertheless, the fact that it chose Luoyang, rather than any other locations, to be its secondary capital during these eight decades of difficulties speaks in volume the economic importance of the Yi-Luo Valley.

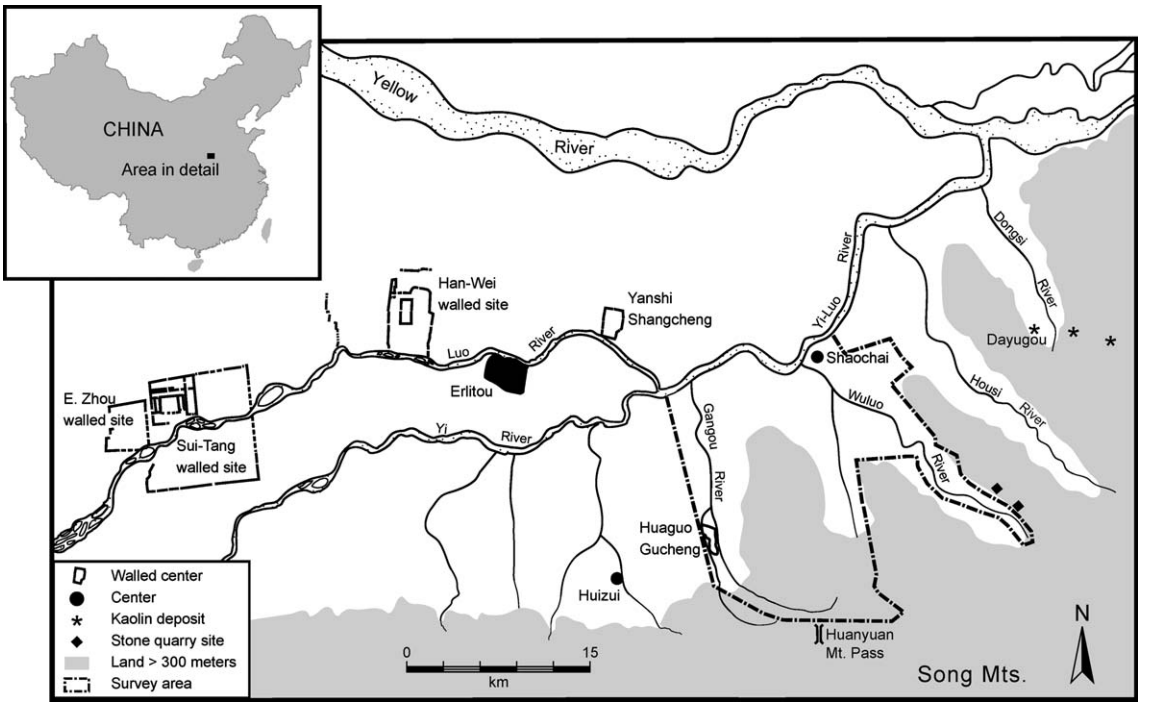

Fig. 1. The Yi-Luo Valley.

The Lower Yi-Luo Valley Survey Project,[1] launched in 1998, was based on the above understanding of the archaeology and history of the region. Its primary goal is to recover high quality settlement information critical for the study of the rise of social complexity. A total of about 300 km of area have been systematically surveyed for archaeological sites. The full-coverage survey provides the diachronic settlement pattern of a time span of about 8000 years. Evidently, settlement hierarchy started to emerge in the valley in the 4th millennium BC. By the 2nd millennium BC, a highly complex settlement pattern consistent with state societies appeared. This pattern synchronized with the rise of Erlitou and Yanshi as regional political centers. Apparently, people took advantage of the rich resources of the Yi-Luo Valley and developed one of the first, if not the first, state polities in China in slightly less than 4000 years ago.

The rise of Erlitou

Erlitou, like most archaeological sites in this part of the world, is completely buried under contemporary farming fields, leaving no trace on the surface except scatters of pottery sherds. The site, covering an area of about 400 ha, is occupied by multiple cultural components of the Yangshao, Miaodigou II, Erlitou (sub-divided into phase I to IV based on ceramic style), Erligang (sub-divided into the upper and lower phases), and Han (Kaogu Yanjiusuo, 1999, p. 1). Forty-five years of extensive archaeological work at Erlitou adds up to a total of more than 20,000 m^2 excavated area, only a meager half percent of the total occupation area. Nevertheless, the excavation concentrated on the public structures of the site, opening a window for the study of the administrative mechanism of the polity.

During the ceramic phase of Erlitou III of the first half of the 16th century BC, Erlitou unambiguously rose to become a major administrative center of a complex society. Two large rammed earth compounds were found in this phase. The first compound, referred to as Palace I in the report, occupied 9600 m^2, approximating the size of two football fields (Erlitou Gongzuodui, 1974; Kaogu Yanjiusuo, 1999, p. 138–151; Luoyang Fajuedui, 1965). The whole compound was built on a rammed earth terrace (Fig. 2). The main feature was a rectangular hall (30 m × 11 m) set on a 36 m × 25 m rammed earth platform and facing a large open courtyard. The whole compound was then enclosed by walls with roofed corridors on both the inside and the outside. The main gate was located on the south, and two smaller

[1] The Lower Yi-Luo Valley Survey is a collaborative project among the Chinese Institute of Archaeology, La Trobe University of Australia, and Harvard University.

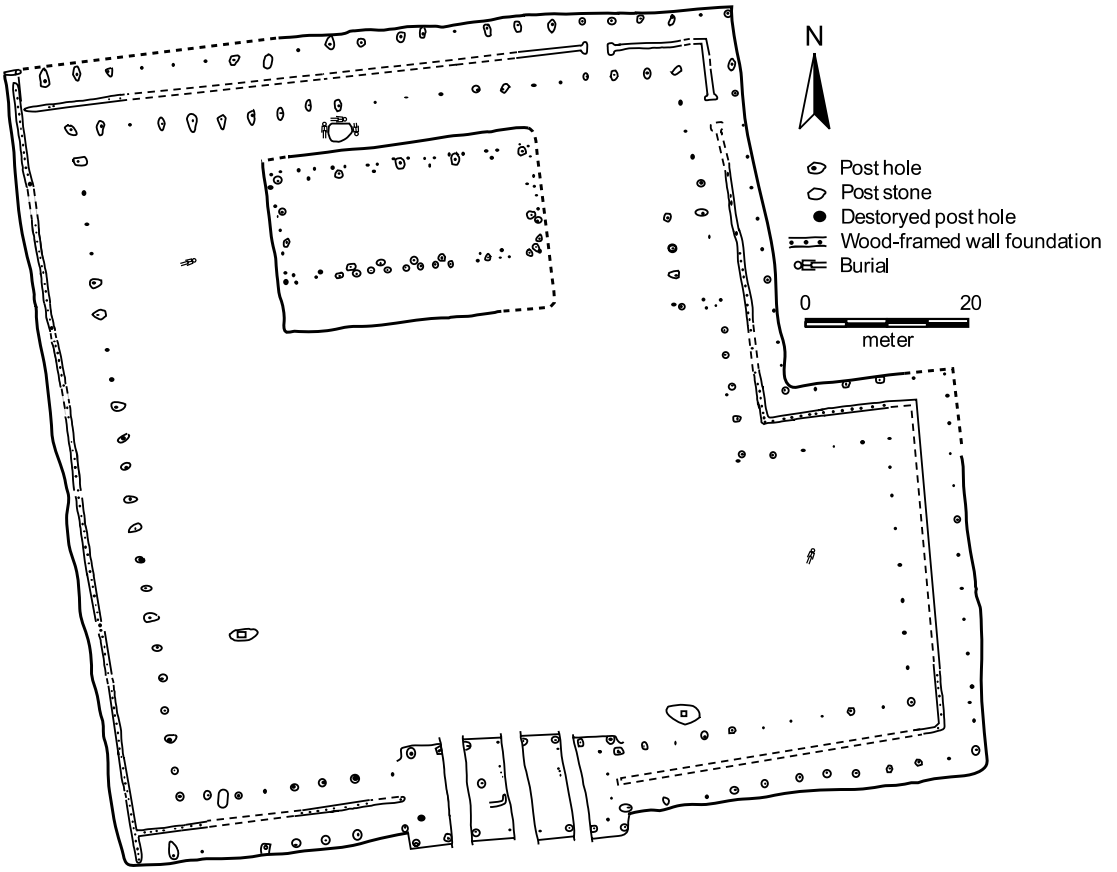

Fig. 2. Plan of Palace I at Erlitou (redrawn after Kaogu Yanjiusuo, 1999: Figure 84).

gates were opened in the northeast corner. Archaeologists cut a 70 m long and 2 m wide trench through the center of the compound to reveal its construction sequence. A foundation pit was first dug. The part where the hall stand was the deepest part of the foundation of at least 3.1 m deep and it gradually shallow out to 2 to 1 m on the periphery. The foundation was then filled with earth and rammed. The ramming started with the hall platform. The 4.5–9 cm layers of earth fill were repeatedly pounded by round-headed tools made of wood or stone until compact and firm. Other than layers of earth fill, three layers of pebbles were laid. The courtyard was rammed after the hall platform was finished. The hall platform was 10–20 cm higher than that of the courtyard terrace, while the courtyard itself was a platform of about 80 cm above the ground surface. It was also apparent that underground pottery sewage pipes were laid during the construction. The whole compound seemed to have completed at one time. Five possible sacrificial burial pits cut into the rammed platforms. Each of the burials yielded one human skeleton that showed evidence of having been constrained by ropes or limbs severed.

The second compound, referred to as Palace II in the report, was located about 150 m northeast of Palace I (Erlitoudui, 1983a,b; Kaogu Yanjiusuo, 1999, p. 151–159). The plan of the second compound was similar to that of the first compound (Fig. 3). A three-roomed main hall was built on a rammed earth platform, facing a rectangular courtyard terrace that was enclosed by walls with roofed corridors. A major difference between them was the size that Palace II covered an area of 4200 m^2, slightly less than half the size of Palace I. Another difference was that Palace II had a room on each side of the main gate; the rooms were probably used as guardhouses or messenger rooms. The two compounds were contemporaneous for a considerable time during Erlitou III, then the main hall of Palace I appeared to have been destroyed by fire. Palace II, however, continued to be used during Erlitou IV.

The large open courtyards and the raised hall platforms of these two earthen features suggest function of public observance. In addition, the walls not only delimited the dimensions of the compounds, they also indicate differential access to the ceremonies performed inside. The walls provided screens for the activities

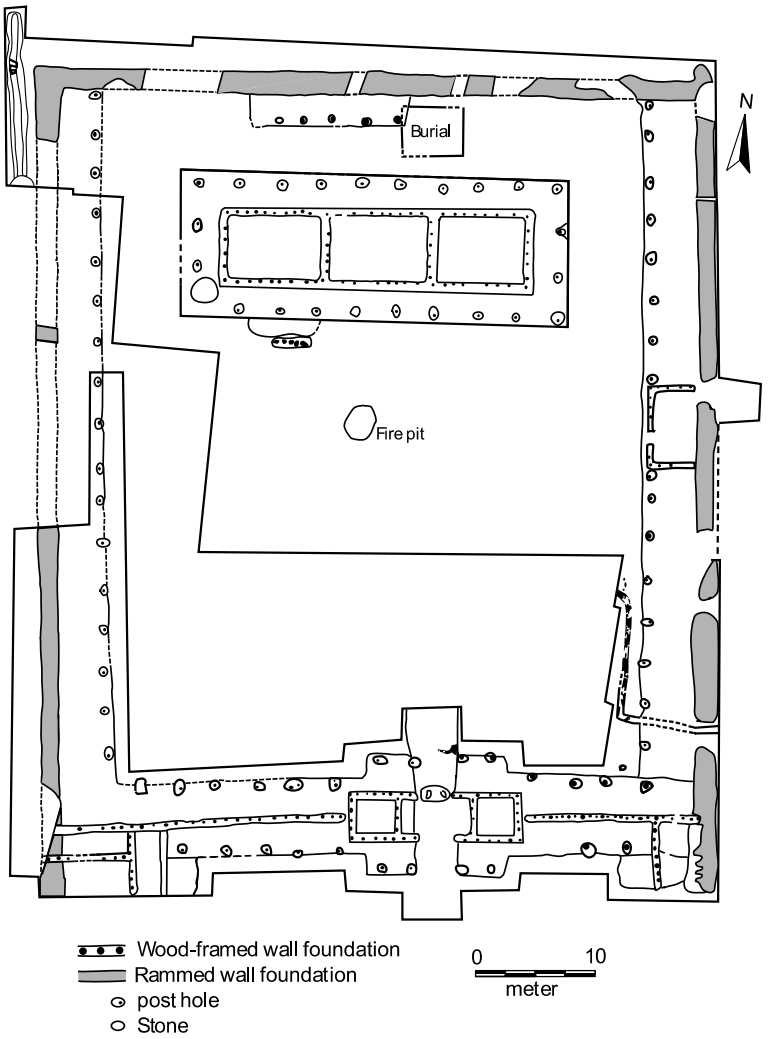

Fig. 3. Plan of Palace II at Erlitou (redrawn after Kaogu Yanjiusuo, 1999: Figure 93).

inside. Most likely, only privileged individuals were allowed to enter into the courtyards. The open space in front of the main halls of Palace Palace II and I measured up to 5000 and 1500 m^2, respectively. They had the capacities of entertaining several thousands spectators at any one time (Thorp, 1991). Yet, several thousands probably were only a fraction of the population of a polity that controlled the entire Yi-Luo Valley (see below). Based on the discussion of the communication strategies of complex societies, these two compounds could not be effectively used for public rituals common in chiefly societies, wherein rituals were observed by the general populace. Differential access to ritual is one of the characteristics of the state.

The building of these two public structures necessitated the mobilization and organization of large labor forces, thus pointing to the large population incorporated in the political system of Erlitou society. Public structures of this magnitude probably first appeared in the ceramic phase of Erlitou II, as early as the 18th century BC. At least one large rammed earth feature, Palace III, dated to this phase was found to be overlaid by Palace II (Erlitoudui, 1983a,b; Kaogu Yanjiusuo, 1999, p. 158; Erlitou Gongzuodui, 2003). It is likely that during the Erlitou II phase, Erlitou had already claimed the status of a major administrative center.

If large rammed earth features are indications of the political status of a site, Erlitou's paramount position is obvious. The rammed earth technique was in use in preference to brick and stone for major constructions throughout the Chinese Bronze Age and early historical period in the Yellow Valley (Bagley, 1999). The technique was laborious but the finished products were durable; many have been preserved until their revelation by

modern archaeological works. Rammed earth features are not something that we can find in every site. During the Erlitou phase, Erlitou is the only known site in the Yi-Luo Valley that yielded rammed earth features. Regardless of the excavation and systematic subsurface probing in Shaochai, a contemporary site of about 60 ha (see below), a recognized secondary center, no remains of rammed earth were detected. But in Erlitou, in addition to the palaces, more than 30 substantial rammed features were revealed through subsurface probing in the center of the site, that is, in the general vicinity of the palaces. These large rammed features spanned from phase II to phase IV of the Erlitou occupation (Kaogu Yanjiusuo, 1999, p. 138). Furthermore, excavation revealed several smaller rammed features scattered around the site (Erlitou Gongzuodui, 1975, 1984b, 1986; Erlitoudui, 1985). For instance, in an area several hundred meters northeast of the two palaces, Area III according to the grid system of the site, several rammed earth structures were found. The largest rammed foundation is comparable to the size of the main hall foundations of Palace I and II. It measured at least 28.5 m × 8 m, with a three-roomed wood-framed structure that measured 28.5 m × 6 m standing on top of it (Erlitou Gongzuodui, 1984b). Other rammed features are smaller, such as IIIF1 is 8.5 m × 4 m, IIIF3 is 19 m × 4.5 m (Kaogu Yanjiusuo, 1999, p. 162). These features could be structures of different functions or the residences of people of different statuses.

Other than the rammed features described above, 23 houses were recovered from the cultural levels of Erlitou II to Erlitou IV. This is an extremely low number corresponding to the total excavated area. Nevertheless, they show a complex hierarchy in terms of size. In the top of the hierarchy, of course, were the palatial compounds that were either royal courts or residences of the royal families, or both. They were followed by the large houses built in the same manner as the great halls of the palatial compounds. Some were quite big, an example being III F8, which occupied 71.4 m^2. However, they were not enveloped by corridor-walls and courtyards like Palace I and II. These were possibly the residences of high elites. Then there were also houses smaller in size and not built on rammed foundations. For instance, feature III F2 comprised two chambers and occupied 39.8 m^2. The living floor was lined with a layer of dried straw and mud mix. This house could have been the residence of the low elites. Finally, there were the humble huts, occupying no more than a few square meters, of the commoners.

A symmetry of the house features is seen in the pattern of mortuary treatment. Unfortunately, only slightly more than 200 burials were ever reported from Erlitou, and many of the published material are sketchy, which hampers a systematic mortuary study. At any rate, if we can accept that the extant mortuary material at Erlitou to a certain extent represents a social cross-section of the Erlitou community, we have at our disposal some rich burials of paramount elites near the top of the social pyramid, some causally disposed skeletons of the base, and an array of burials of the nobility and commoners in between.

The most impressive burial at Erlitou is a tomb (VD2M1) located between the north wall and the main hall of Palace II (Fig. 3) (Erlitoudui, 1983a,b; Kaogu Yanjiusuo, 1999, p. 157). The structure of the tomb can be described as two nested pits. A larger pit, measuring 5.3 m × 4.3 m at the mouth, was first dug; then a smaller chamber about one meter deep for the coffin was excavated in the bottom of the larger pit. The maximum depth from the mouth to the bottom of the chamber was 6.1 m. The tomb filling had been rammed. Unfortunately, the tomb had been plundered and little was left besides traces of cinnabar, fragments of lacquer coffin, and the complete skeletons of a dog encased in a red lacquer box. Its sheer size, the largest tomb ever reported in Erlitou, and its location indicate that it must be the tomb of a very high elite. Recent excavation on the courtyard of Palace III reveals five graves richly furnished with cinnabar, bronze, jade, lacquer wares, turquoise, sea shells, white pottery, and glazed wares (Erlitou Gongzuodui, 2003). These must also be the burials of the highest elites.

By contrast, about forty human sacrifices and casual disposals of human skeletal elements were found in the site. The five burials within the rammed precinct of Palace I, as discussed above, were likely human sacrifices in relation to ritual. They were stripped of furnishings, having been tied up with ropes, and limbs were severed in one case. Other casual disposals were scattered all around the site (Erlitou Gongzuodui, 1975; Kaogu Yanjiusuo, 1999, p. 125, 245–249, 337–341; Luoyang Fajuedui, 1961, 1965). They were usually found in trash pits; sometimes several individuals were buried together, and buried along with masticated animal bone fragments. Postures of the skeletons suggest that they were being restrained by ropes and sometimes buried alive. Examples of mutilation were common wherein the heads or the limbs were missing. Isolated finds of human bone fragments in the cultural layers and ash pits were found everywhere. These kinds of human skeletal remains comprise at least 20% of the total burials yielded, which makes a fairly high percentage of the extant burial sample.

In between these two extremes, there was a continuum of burial treatments. A typical "rich" grave would have a secondary ledge, rammed grave fills, lacquer coffin, cinnabar lining, and a dozen or so bronze, jade, and pottery goods. A typical "poor" grave would have no or just a few pottery vessels (Erlitou Gongzuodui, 1975, 1976, 1984a, 1986, 1992; Erlitoudui, 1985, 1991; Yanshixian Wenhuaguan, 1978).

In spite of the constraint of paucity of burial information, the above summary of Erlitou's mortuary

program indicates a highly stratified community. Most intriguing is the fact that the burial data suggest institutionalized violence, which is one of the major strategies of control among archaic states. The Erlitou elites apparently ruled with an iron fist. Institutionalized violence is an indication of the use coercive force, one of the many traits of state societies. A well-known example in China is that at Anyang; the late Shang capital yielded systematically layout of sacrificial burials in the thousands in the royal cemetery (Chang, 1980, p. 119–124). The oracle bone inscriptions contemporary with the Anyany occupation also indicate the Shang used human sacrifices extensively (Shelach, 1996).

Erlitou started to flourish in the 18th century BC and continued to dominate the Yi-Luo Valley for three hundred years. It met its nemesis by the end of the 16th century BC that its paramount status in the region was abruptly replaced by Yanshi, which was located less than 10 km to its northeast.

The rise of Yanshi

The most intriguing characteristic of Yanshi is its nested plan (Fig. 4). The center of the site was a walled rectangular palatial precinct (Complex I), occupying an area of about 5 ha, located in the center of the southern half of the site (Luoyang Han Wei Gucheng Gongzuodui, 1984). This palatial precinct was encircled by the inner perimeter walls of 6–7 m wide, which delimited an area of about 80 ha (Du et al., 1999; Henan Dier Gongzuodui, 1999a). The inner enclosure was then nested by the outer perimeter walls of about 20 m wide (Henan Erdui, 1985; Luoyang Han Wei Gucheng Gongzuodui, 1984). The outer enclosure surrounded an area of 200 ha. Finally, the whole site was surrounded by a 10 m wide, 6 m deep moat. Two smaller complexes (Complexes II and III) were located to the northeast and southwest of the palatial complex. They were all enclosed by wood-framed earthen walls of about 2–3 m thick.

Complex I, the so-called palatial complex, had been intensively investigated (Henan Dier Gongzuodui, 1988; Henan Erdui, 1985). A cluster of at least nine large rammed earth terraces and two man-made ponds were found within the perimeter walls (Fig. 5). The size and plans of the nine buildings show considerable variability, indicating they might have been used for different functions. Here we take Palaces II and IV to illustrate their variability.

Palace IV (Fig. 6) was a closed compound primarily comprised a main hall, room blocks, and a courtyard (Henan Erdui, 1985). The whole compound, built on a rammed terrace, measured 51 m from east to west, and

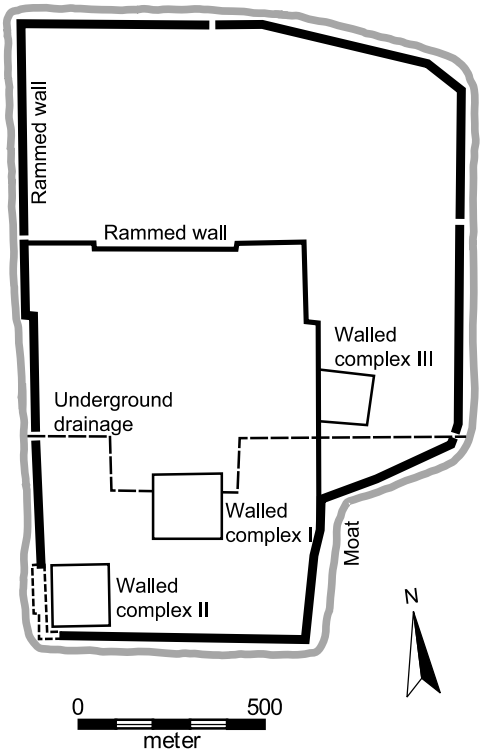

Fig. 4. Plan of the walled site at Yanshi (redrawn after Henan Dier Gongzuodui, 1999a: Figure 1).

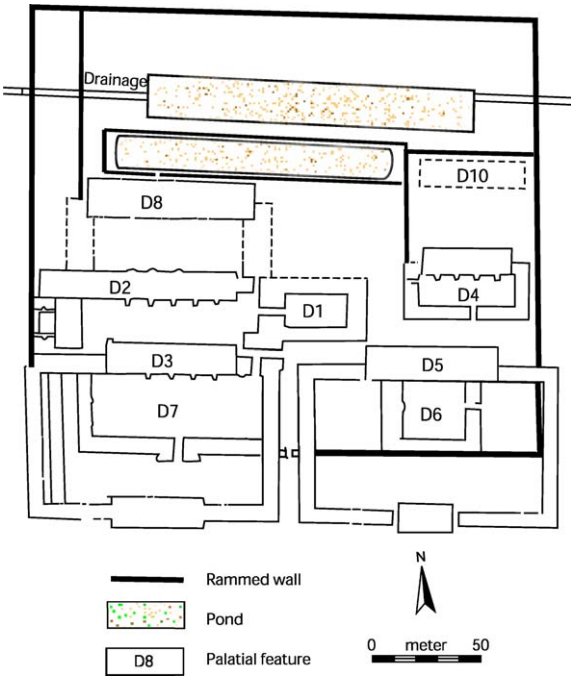

Fig. 5. Plan of Walled Complex I, Yanshi (redrawn after Yang, 2001: Figure 32).

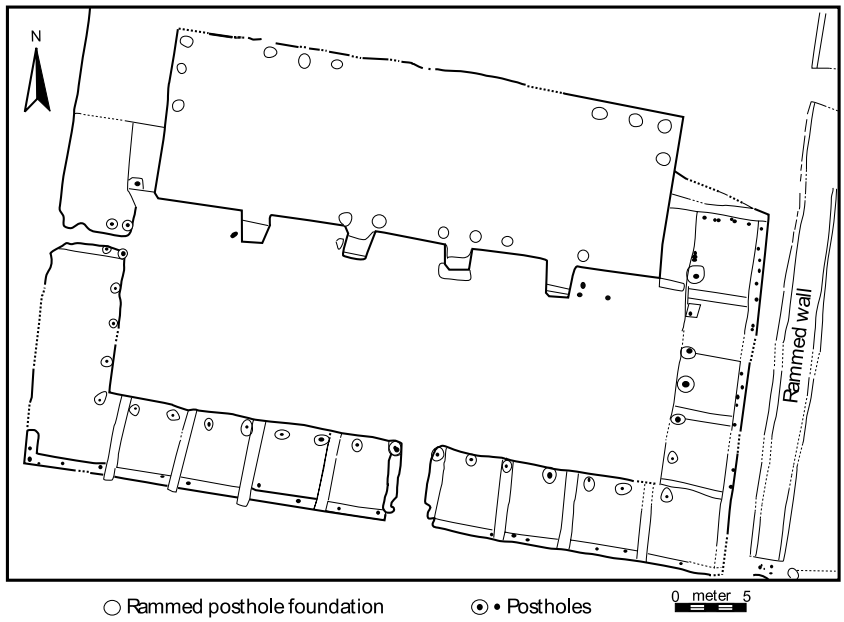

Fig. 6. Plan of Palace IV at Yanshi (redrawn after Henan Erdui, 1985: Figure 2).

32 m from north to south. The main hall, 36.5 m × 11.8 m, was situated on a rectangular rammed terrace that showed numerous plow scars, indicating that the top of the feature had been stripped by local farmers. The remaining main hall terrace, nevertheless, was 25–40 cm above that of the courtyard. Its height necessitated the building of four ramps for access. The hall was flanked by room blocks on three sides. The east and south blocks were well preserved, and they showed 12 rooms. If the west block was symmetrical to the east block, there should be a total of 17 rooms. Two meters to the east of Palace IV was the perimeter wall of Compound I. A possible well was located about 3.5 m northeast of the main hall. The excavators took it down to 6 m and still did not reach the sterile sediment. Remains of stone lined drainage were found in several localities inside the complex, indicating a drainage system was laid. The plan and facilities of Palace IV indicates that it was very likely a residential compound of the high elites; perhaps it was the dwelling of a royal household. The small size (about 750 m^2) of the central courtyard constrained it to host large public functions. Daily use of water was supplied by the nearby well; while the drainage network facilitated the waste-water disposal.

The plan of Palace II (Fig. 7) was completely different from that of Palace IV. Palace II was a cluster of several features. The main structure, situated on the northern part of the compound, was a rammed terrace of about 75 m long and 16 m wide. Eight ramps located on the northern and the southern sides of the terrace were found. Three rows of small post-holes ran from east to west. The western half of Palace II was dominated by intensive layout of post-holes; some post-holes, especially the outermost rows, were reinforced with rammed earth walls. The posts were planted on an untreated (i.e., not rammed) surface, prompting Yang (2001, p. 51) to argue that they were remains of the pilings of stilt structures. Five independent but connected structures were accounted for. This cluster of above ground buildings was connected to a rammed platform located in the open area between the main halls of Palace II and Palace III. The exact functions of this cluster of structures are not known. Nevertheless, we are certain that they were not used as dwellings like Palace IV.

The 4 ha occupation of Complex II had also been intensively studied by subsurface probing and excavation (Henan Dier Gongzuodui, 1988, 1995; Henan Erdui, 1985). The complex was delimited by earthen walls 3 m thick. Inside the walls, close to 100 large rammed terraces were evenly arranged in six rows. In between rows laid a grid of shallow ditches, probably a drainage system for runoff. From the 15 excavated terraces, where five have been completely excavated, we can generalize that the terraces measured about 29 m × 8 m. The procedures of terrace building started with the excavation of a foundation slightly more then 1 m deep, then layers of 12–16 cm fills were rammed. The terraces were built up to at least 10 cm above the ground surface. Houses of the same dimensions were built and rebuilt three times on the terraces. Let us take the middle layer of F2004 as an example (Fig. 8). The front and back of the house were lined with post-holes, indicating the roofs extended out to form porches. The insides of the houses were evenly partitioned by wattle-and-daub walls into three

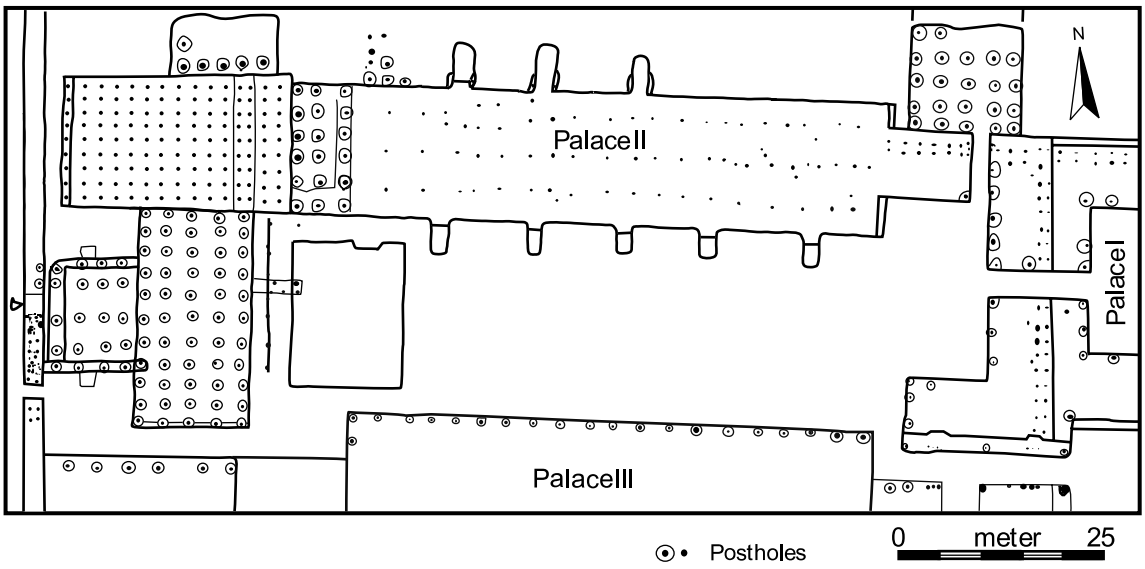

Fig. 7. Plan of Palace II at Yanshi (redrawn after Yang, 2001: Figure 33).

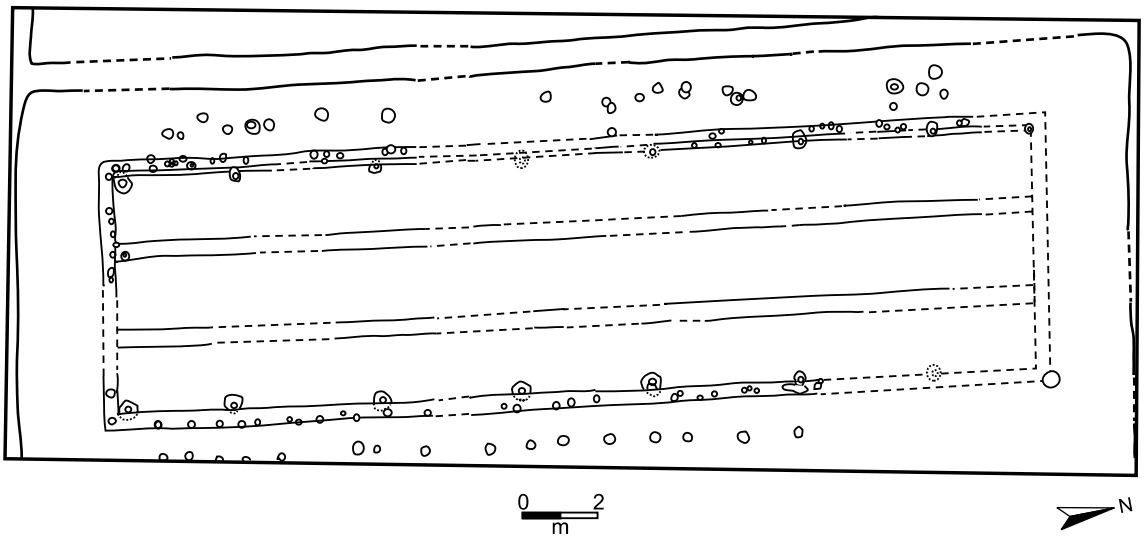

Fig. 8. Plan of feature F2004, Yanshi (redrawn after Henan Dier Gongzuodui, 1995: Figure 6).

parts. Interestingly, the occupation floor of the entire excavated area was stripped clean of domestic refuses and no evidence of fire use was found inside the house. These well-organized structures were very likely used as storehouses of the state.

The plan of Yanshi offers a glimpse of the power structure of the polity. The site was obviously carefully laid out. Since the inner enclosure was first built, the palatial complex was more or less situated on the southern half of the north–south axis. The plan of the storehouses was dramatically systematic. The storehouse complex was only about 100 m southwest of the palatial complex, indicating tight control by the high elites residing in the palatial complex. The settlement was divided into the upper town in the southern half of the site, where the monumental architectures, elite residences, and state treasury (storehouses) located, and the lower town in the northern half of the site, where the workshops, residences and burials of commoners were distributed (Henan Dier Gongzuodui, 1998; Wang, 1999). An intriguing characteristic of the layout is the innovative use of walls. Walls were constructed in Yanshi for defense; they were also used to symbolize differential access to power and resources. The inner and

particularly the outer walls no doubt functioned as defensive facilities; however, they also symbolized inside versus outside, and us against them. The complex of walls created boundaries for people of different statuses. The activities inside the walls were not only unobservable to the outsiders; they also delimited the source of power within the walls. Yanshi, therefore, represented a tightly controlled and hierarchically organized structure of power, a major characteristic of the state.

An intriguing question on the study of complex societies in the Yi-Luo Valley is the relationship between Erlitou and Yanshi, two political centers located practically next to each other. They are comparable in size and show internal complexity similar to the control centers of the state. The timing of the rise and fall of them as the regional centers is critical, which can be monitored through the study of the relative dates derived from stratigraphy and ceramic cross-dating, and the absolute dates derived from ^{14}C assays.

The ceramic seriation of Yanshi is partitioned into three phases and seven sub-phases by the site excavators (Henan Dier Gongzuodui, 1998, 1999b; Henan Erdui, 2000). In the following, I will use the short hand reference "Ii" to represent the early sub-phase of phase I, "Iii" to represent the late sub-phase of phase I, "IIi" to represent the early sub-phase of phase II, and so forth. It is apparent that the inner and the outer perimeter walls were built in different time periods (Du et al., 1999). The inner wall was completed no later than the early Iii phase. Later, the outer enclosure expanded on the existing walls of the inner enclosure, widening the existing south and west walls, and part of the east wall of the inner enclosure. During phase III, the north wall of the inner enclosure was almost flattened to the ground level (Henan Dier Gongzuodui, 1999a). Thus, the completion of the outer enclosure must have occurred at a time between phases II and III, most likely during the early IIi phase (Du et al., 1998; Du et al., 1999; Henan Dier Gongzuodui, 1998). On the other hand, the study of the complete and restored pottery vessels indicates that the Yanshi I assemblage is dominated by typical early Shang style vessels (also known as the Lower Erligang style) common in Zhengzhou, an extensive walled Shang site being generally regarded as the early capital of the Shang dynasty, and is substantially supplemented with diagnostic Erlitou IV vessels (Henan Erdui, 2000; Wang, 1999). Thus, the occupation of Yanshi I, was to a certain degree, contemporary with Erlitou IV. The radiocarbon dates are consistent with this contention.

Recent high precision radiocarbon dating and wiggle-matching calibration provide an intriguing picture of the succession of these two sites (Fig. 9; Lee, 2002, Qiu and Cai, 2002). Erlitou became a full-fledged regional center no latter than phase II, and continued to phase IV. The Erligang phase was the time period when Erlitou was no longer a regional center and had been reduced to the role of an ordinary village settlement. The downfall of Erlitou as the regional center of Yi-Luo Valley, at the end of Erlitou phase IV, can be firmly dated to no later than 1520 BC. We are highly confident that the inner walls of Yanshi was completed no later than 1485 BC, the end of Yanshi phase Iii. If the contention that the inner walls were completed during the early Iii phase holds, the inner enclosure at Yanshi could have been completed as early as 1530–1510 BC, which tightly meshes with the downfall of Erlitou. The stratigraphic, ceramic and radiocarbon studies all point to a successive sequence of the rise and fall of the two political centers in the Yi-Luo Valley. Only one regional center existed at any particularly time. This pattern is interpreted as the archaeological corollary of the Xia-Shang regime change depicted in the written documents.

Consumption centers and the countryside

The control centers of complex societies are consumption centers at the same time. Given the sizes of these centers, their maintenance and daily subsistence relied on the food surplus extracted from the immediate hinterlands.

We should not underestimate the importance of food surplus to the rise of social complexity. Grains are bulky and expensive to move on land over long distance. More than half a century ago, Childe (1974) was the first to point out that the effective extraction of food surplus from the hinterlands was crucial to the rise of urbanized societies. Following Childe, many studies in other parts of the world have demonstrated the importance of food surplus to emergent social complexity (e.g., D'Altroy and Earle, 1985; Earle and D'Altroy, 1982; Hassan, 1993; Stein, 1996; Stein and Wattenmaker, 1990; Wilkinson, 1993; Zeder, 1991). In China, the oracle bone inscriptions suggest that the Shang kings residing in Anyang (c. 1200–1050 BC) not only show great interest in the tribute extracted from the other parts of the kingdom, they were sensitive to the farming business and often gave specfic instructions to farmers working in the state capital (Chang, 1980, p. 220–240; Keightley, 2000, p. 55–61).

How much food surplus was needed to sustain Erlitou and Yanshi is not clear. We are uncertain about their population sizes in spite of the extensive archaeological work of four and a half decades. Population estimation in archaeology is difficult in general because contemporaneousness is hard to establish. It is particularly difficult for Erlitou and Yanshi because the sites are totally buried and only tiny fractions of the occupations have been excavated, and also previous excavations concentrated on non-residential features, like the palatial clusters, the walls, the gates, the storehouses, etc. Only a very small number of residential houses have

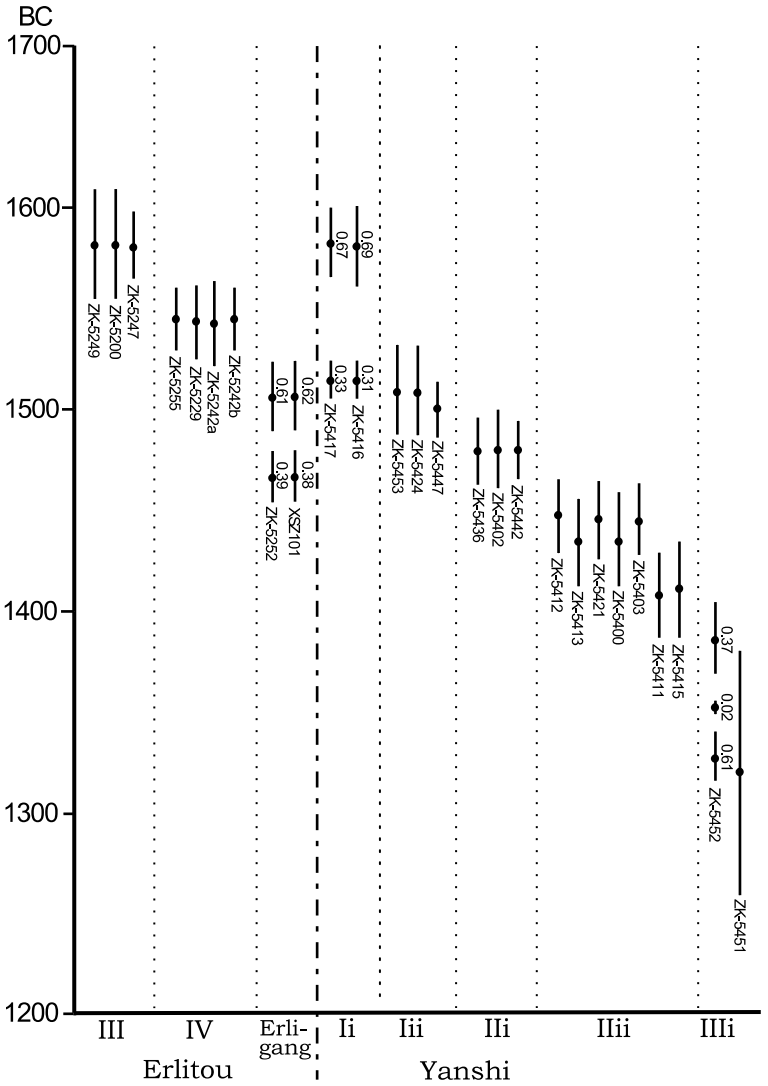

Fig. 9. Radiocarbon dates of Erlitou and Yanshi.

been excavated. Precise projections of Erlitou's and Yanshi's populations necessitate in depth understanding of plans of the entire sites and excavation of the residential sectors, particularly those of the commoners. An excavation in the north central part of Yanshi opening a small area of 4500 m^2 indicated that there existed a precinct of commoner residence (Wang, 1999). At this point, I would rather be conservative on the population estimate of the sites, and vaguely project that the inhabitants living in Erlitou and Yanshi must have been in the thousands.

Political centers like Erlitou and Yanshi must comprise significant populations of a range of nonfood-producing inhabitants of different roles and statuses. These centers were seats of the kings, accompanied by the royal families and vast households. These centers also housed large numbers of elites and nobilities who followed the court. The elites brought with them their own retinues and luxurious lifestyle, which necessitated the patronization of full-time craftsmen for the production of sumptuous goods. These centers were also the centers of the administrative hierarchy that ruled the kingdoms, so that hundreds of officials, along with their families, resided there. Control with coercive force was an essential facet of the centralization of power of early states; therefore, we anticipate a large number of part-time or professional troops should have been stationed in and around the capitals.

The archaeology at Erlitou and Yanshi provides considerable support for the above contentions. Hierarchies of house structures and burials, as discussed above, are evident in both sites. The variations in living

floors and burials are being interpreted as the existence of a social hierarchy.

The presence of full time and attached craftsmen is indicated by the jade and bronze artifacts found mostly in the mortuary context. Fragments of crucibles tinted with slag remains and pottery moulds were yielded from both sites, indicating that bronze casting was done in the sites. In addition, most of these findings were located in areas close to the palatial structures in Erlitou, suggesting an industry overseen by the elites.

Supporting the daily subsistence of large urban nonfood-producing populations with an agrarian economy depended on the surplus mobilized from the countryside, which was a major challenge to these archaic rulers. It is not my intention to argue that the entire populations living in Erlitou and Yanshi were nonfood-producing individuals. Indeed, a considerable number of farming, fishing and hunting tools were recovered from both sites. Given the labor force needed for the vast public work, daily maintenance of the political centers, services to the elites, the scale of craft production, etc., it would not have been possible for these two centers to be entirely self-sustaining. The storehouses in Yanshi suggest that there existed a sizable tribute economy regulated by the state. I would remind the readers that the size of Complex II alone was four hectares.

The crucial tribute extracted from the immediate hinterlands was staple food, primarily comprised millet and rice. Tribute to these early Chinese states centered in Erlitou and Yanshi would have included a large array of resources, such as minerals for the bronze industry, charcoal for casting, timber for building, exotic material like jade and turquoise for sumptuary paraphernalia, etc. Nevertheless, the effective extraction of staple food, particularly grain, was crucial for the continuous survival of the political centers, and the states themselves. The daily subsistence of any individual required regular amount of staple food so that a stable supply of no or little fluctuation was needed. The concentration of nonfood-producers in large urban centers created further problems. Transport of bulky staple like grains over long distances overland was not only slow, but was also prohibitively expensive. Therefore, the subsistence of the centers had to depend heavily on its immediate hinterlands. On the contrary, other low-bulk resources, such as minerals, could have depended on long distance acquisition strategies (see Brumfiel and Earle, 1987; Henrickson, 1994; Liu and Chen, 2001, 2002, 2003 for discussions of long distance acquisition strategies of complex societies). Unlike staple food, the need for minerals was comparatively small, and could tolerate a higher rate of fluctuation.

The agrarian economy of China during the second millennium BC remained in the Neolithic level. Although bronze technology had been invented, it was seldom used to cast farm tools. That is the reason why the late Kwang-Chih Chang argued that the formation of Chinese states was a political process, rather than resulting from technological development or commercial activities (Chang, 2000). The archaeology at Erlitou indicates that bronze, as an innovative technology, was cast into small utilitarian tools like knives, fishhooks, and spindle whorls; but the majority of the bronze was cast into ritual paraphernalia and weapons. Dependent on the Neolithic technology, the agrarian economy strictly limited the extent to which productivity might be increased; therefore, agricultural surplus was small and precarious. The maintenance of a large population in the centers required the labor of thousands of farm hands and the surplus production of a vast region. The performance of agriculture and the vagaries of the weather were critical to the survival of the centers and had grave political consequences.

What goods and services could the centers at Erlitou and Yanshi provided to the people living in the countryside? Theoretically, there was almost nothing substantial that could not be offered more cheaply by smaller centers at a more local level in the economic field. So, the question is why the Yi-Luo villagers did not vote with their feet? We can only find the answer in the political field. A plausible answer is that the central places provided concrete manifestations of the glory of the state (Morley, 1996, p. 5). This involved the grandiose building projects set in motion by the kings and imitated by the aristocracy. However, the use of walls among the grandest facilities at Erlitou and Yanshi to shield off the views of the outsiders argues against this proposition. In other words, the glory of the state could only be felt by the selected individuals who had access to the monumental structures, but could hardly be felt by the general populace. Social circumscription, I find, is the strongest proposition. By the beginning of the 2nd millennium BC, several complex societies emerged in the middle and lower reaches of the Yellow River (Liu, 1996). The high percentage of mutilated body parts found in Erlitou and the massive outer walls of Yanshi are indications of the institutionalization of violence and the intensification of conflict. Erlitou and Yanshi, therefore, provided the countryside with the services of a centralized administrative system and protection from invaders. The elites did not seem to hesitate to use force to coerce their subjects. The commoners had no choices but to become incorporated into the state systems surrounding the urban centers. These centers of population, therefore, invariably were also 'political' centers.

These political centers faced the same problems of feeding a large number of people, concentrated in one locality, under the condition of a pre-industrial economy. A critical question emerges: how did they effectively control the hinterlands and regulate the flow of resources from the villages to the centers? A study of the

settlement pattern can best elucidate the control strategies of the centers.

Settlement pattern and nodes of control

The Lower Yi-Luo Valley Survey provides high-quality information pertaining to the development of settlement pattern in the immediate hinterlands just east of Erlitou and Yanshi. Started in 1998, five seasons of fieldwork have covered the land between two major tributary systems of the Yi-Luo River, namely, the Wuluo River and the Gangou River (Fig. 1). To date, a total of about 300 km^2 of open field have been surveyed by archaeologists on foot, yielding slightly more than 200 archaeological sites of the Neolithic period and Bronze Age (see Chen et al., 2003; Liu et al., 2004 for discussion of field methods and results). It is beyond the scope of this paper to investigate this long sequence of processes of the emergence of complex societies in the Yi-Luo Valley. I am going to concentrate instead on a discussion of control strategies of complex societies during the ceramic phases of late Longshan (c. 2500–1800 BC), Erlitou (c. 1800–1520 BC), Lower Erligang (c. 1530–1420 BC),[2] and Upper Erligang (c. 1430—1320 BC).

The results of the survey are best represented by distribution maps of the sites. A few intriguing observations can be derived from eyeball examination of the distribution maps (Figs. 10, 12, 13, and 14). Sites were distributed along the banks of the Wuluo River and Gangou River, and basically no site was found in the land between the two tributaries. Settled along the river course was a common settlement strategy of early people in this part of China. The consensus is that a regular daily supply of water was one of the essential factors whereby early people selected sites to build year-round settlements. It was not until the end of the first millennium BC, during the era of the Han dynasty, that a sophisticated well digging technology freed people of this constraint of water availability when choosing sites to settle down. Our survey indicates that almost no settlement was found in the area between the two tributary systems during the pre-Han times. The majority of the population clustered along the river courses.

The distribution maps also indicate that the Caohe River, the small tributary located in between Wuluo and Gangou, was most likely not active during the study period. No site was found along the course of this river, except a few small sites were located on the foothills near its headwaters. The current course of Caohe is a dry gully in which no surface water had ever been seen during the several survey seasons. It is my contention that Caohe was the result of erosion from runoff during rain season. It was at best a seasonal river.

These two patterns combine to give rise to a third pattern such that the spatial relation of the sites is lineal. Communication between two sites would have followed the water courses and passed through the sites in between. Also there was an uninhabited area between the two tributary systems. This pattern had significant effect on the locations of the nodes of control of complex societies.

Now let us turn our attention to the settlement pattern of the Longshan phase. Social complexity had emerged during the late Longshan phase. The distribution map indicates the emergence of two larger than usual settlements (Fig. 10). Luokou, located in the middle reaches of the Wuluo Valley, occupied an area of 20 ha. Fuxi, located in the middle reaches of the Gangou Valley, occupied 13 ha of area. The other 40 sites averaged 1.7 ha of occupation, and none of them was larger than 7.5 ha (Fig. 11). These two settlements were then at least two times larger than the biggest site of the next level of hierarchy suggesting a two-tiered settlement hierarchy. This hierarchy is primarily based on settlement size, and not on evidence of decision-making. Archaeological sites on the Yi-Luo River are generally buried under the surface. Information yielded by surface reconnaissance is anticipated to be limited. Unless large-scale excavation is conducted on these sites, like what have been done on Erlitou and Yanshi, we will not be able to ascertain the existence of centralized decision-making mechanisms. Site size, therefore, is used here as a proxy. Since population nucleation is a general feature of the rise of social complexity, this strategy is justifiable.

The two centers, Luokou and Fuxi, were the centers of two independent political entities. They were comparable in size in that they did not exhibit a relationship of subordination and domination. They were strategically located in the middle reaches of the river valleys, ideal for the control of the hinterlands both upstream and downstream of the respective valleys. The maximum straight-line distance between the centers and the peripheral sites was about 13 km, well within the range of a one-day trip. In addition, no significantly large sites of the Longshan phase were found in the Yi-Luo Valley by other archaeologists. This negative evidence supports the idea that the Wuluo and Gangou Valleys were two independent entities. To conclude, the pattern of settlement during the Longshan phase is consistent with that of chiefdoms, particularly that of simple chiefdoms.

[2] The absolute dates of Lower Erligang culture are usually quoted to start at about 1600 BC. The dates given here are local dates of the Lower Erligang culture, which are based on the assumption that the event of the rise of Yanshi as the regional center represents the initial intrusion of Erligang Culture into the Yi-Luo Valley.

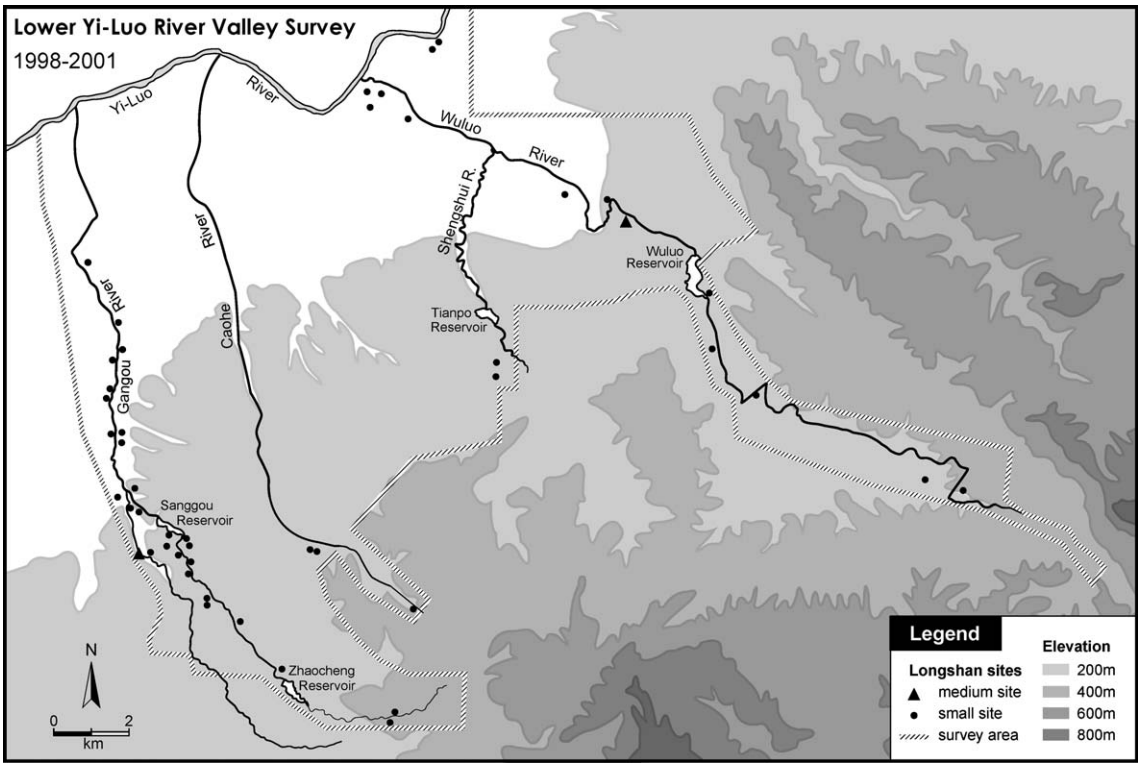

Fig. 10. Distribution of Longshan sites, lower Yi-Luo Valley.

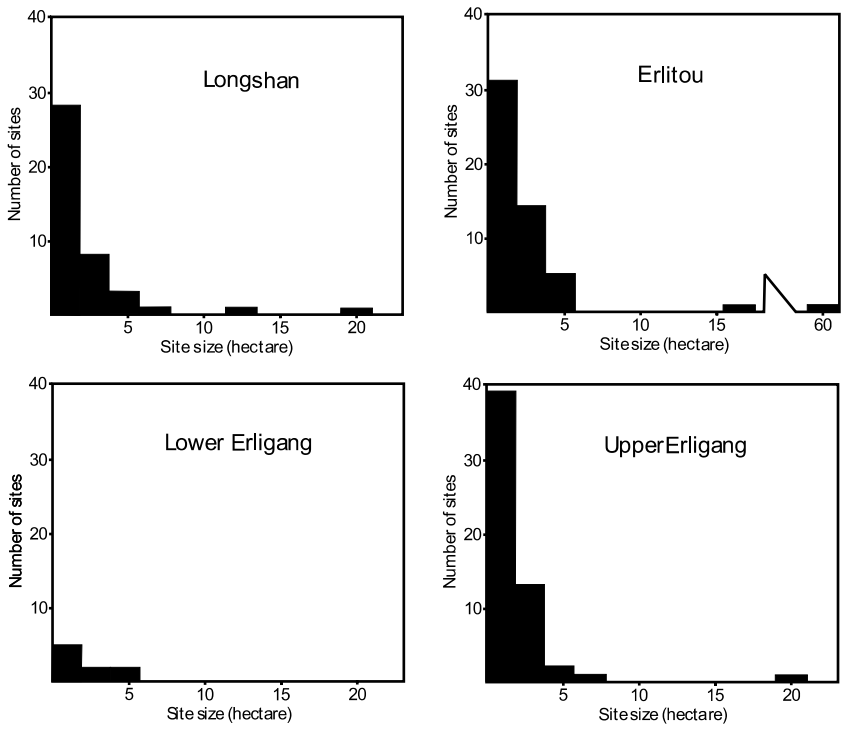

Fig. 11. Distribution of site size, lower Yi-Luo Valley.

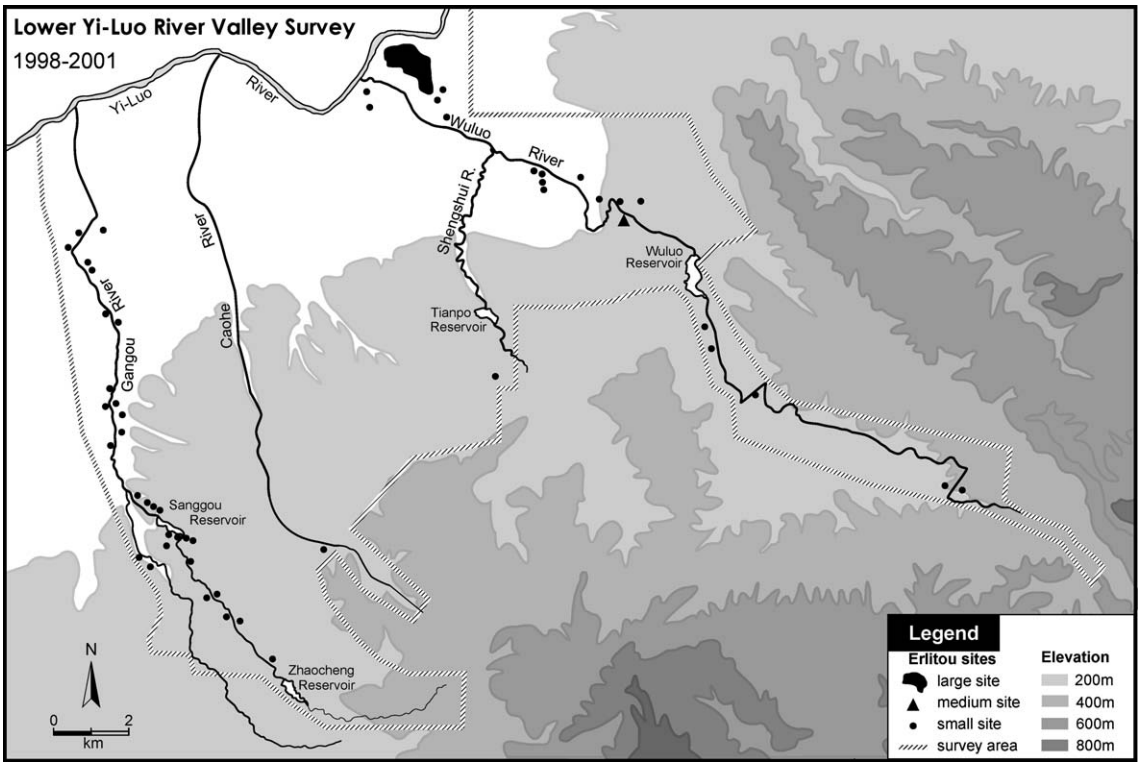

Fig. 12. Distribution of Erlitou sites, lower Yi-Luo Valley.

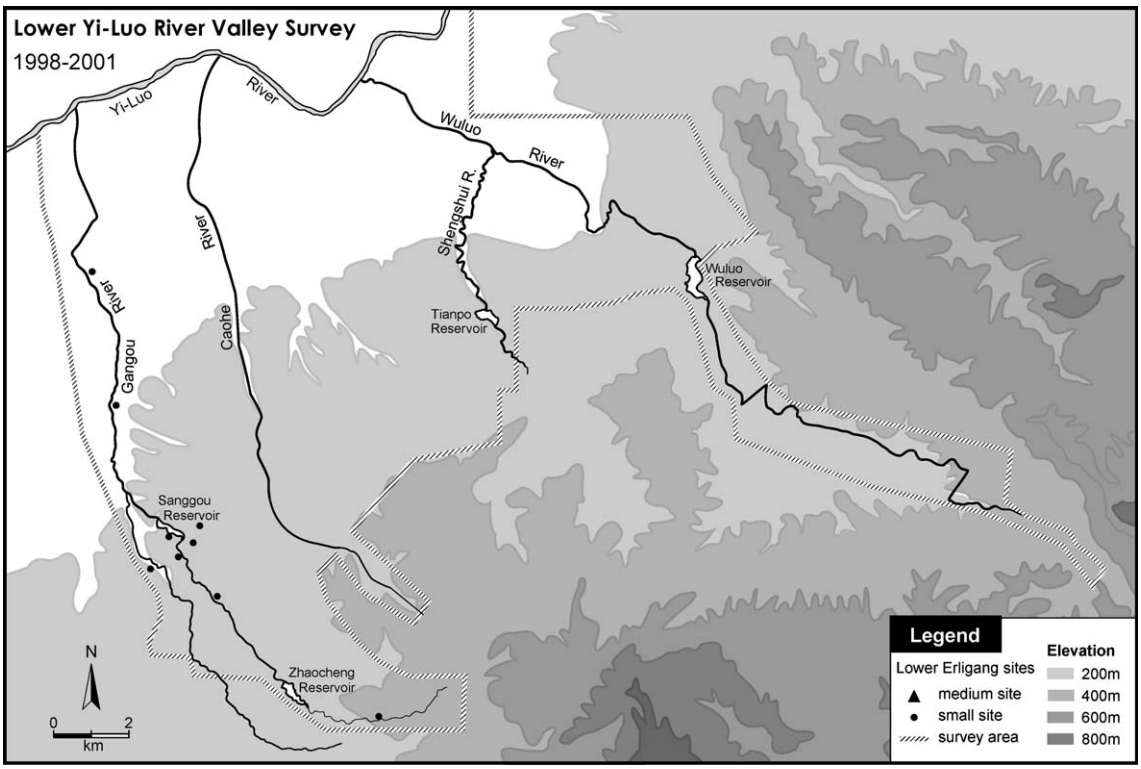

Fig. 13. Distribution of Lower Erligang sites, lower Yi-Luo Valley.

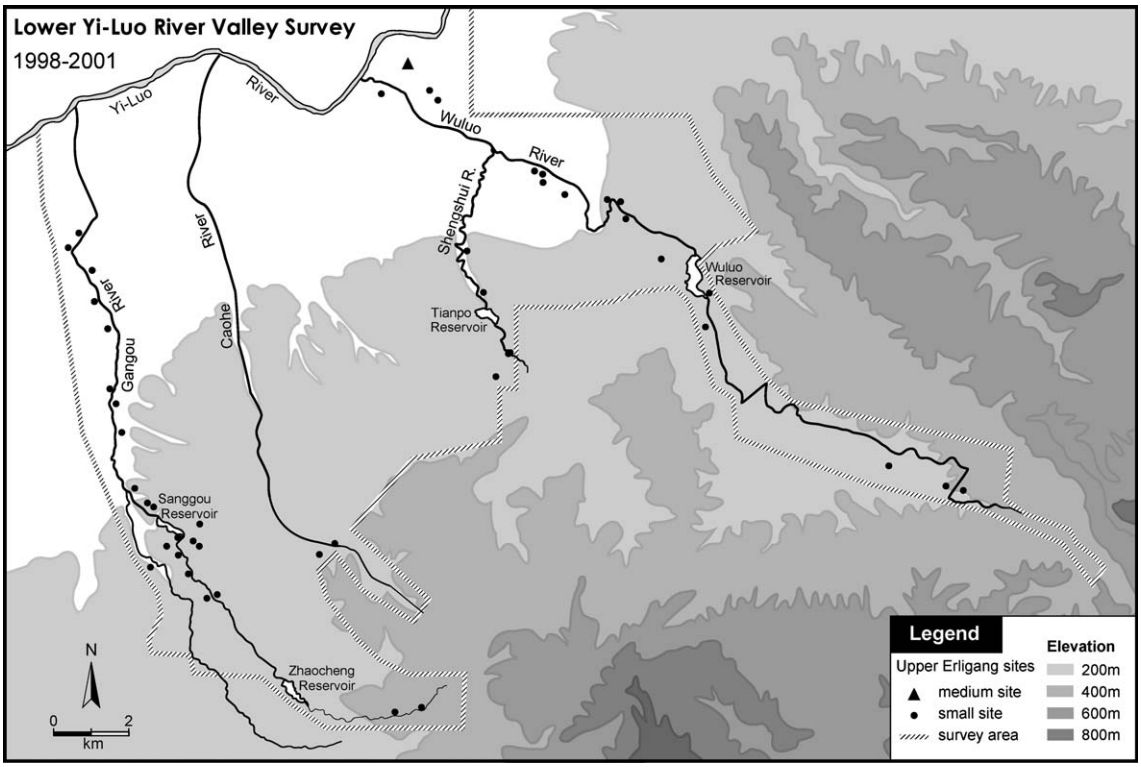

Fig. 14. Distribution of Upper Erligang sites, lower Yi-Luo Valley.

In contrast to that of the Longshan phase, the settlement pattern of the Erlitou phase was much more complex. This was the time when the Erlitou site rose to its prominence and dominated the Yi-Luo region. The overall settlement pattern in the lower Yi-Luo Valley showed a clear hierarchy that is typical of the state. Erlitou itself, with an occupation of 400 ha, was the primary center of the region. A secondary center of 60 ha, Shaochai, was situated on the strategic location of the confluence of Wuluo and Yi-Luo rivers (Fig. 12). A tertiary center of 18 ha, Luokou, was found to be located on the middle reaches of the Wuluo River. The village and hamlet level sites, with a mean size of 2 ha and no larger than 6 ha, were distributed along the banks of Wuluo, as well as Gangou (Fig. 11). A four-tiered settlement hierarchy had emerged.

The most striking feature of the Erlitou distribution map is that the settlement pattern of the Wuluo Valley showed obvious multi-tiered hierarchy, while all the sites distributed along the Gangou River were invariably small hamlets or villages in which no center of any size was found. Two possible interpretations can be offered to explain this difference. The first interpretation lies on the feasibility of direct control from Erlitou. The straight-line distance from Erlitou to the mouth of Gangou is about 12 km, while that from Erlitou to the mouth of Wuluo is more than double, about 25 km. Suppose one walks 4 km/h, which is a good estimate of normal walking speed, a round-trip journey between Erlitou and the river mouths of Gangou and Wuluo would have required about 6 and $12\frac{1}{2}$ h, respectively. When the factor of exhaustion is taken into account, the Erlitou-Wuluo trip probably takes longer than the projected time. In addition, when one moves up the courses of the rivers, the Wuluo Valley becomes hilly, presenting a more challenging terrain. Our previous discussion on chiefly ruling limits the territory to a one-day travel from the chief's residence because face-to-face communication was needed between the chief and the commoners. This communication limit applies to the state in a different way. When the distance was short, the elites of the primary center could effectively control the villagers and regulate the flow of resources. However, when the hinterland exceeds the threshold of a one-day trip, it would be necessary to establish secondary centers to regulate the flow of tribute.

A competing interpretation is that the tribute from the Gangou Valley was regulated by secondary centers located outside of the Gangou Valley. A likely candidate that has been studied archaeologically is Huizui, located about 7 km to the west of the Gangou Valley (Fig. 1). Huizui is found to be a multi-component site occupying about 14 ha of area (Henan Yidui, 2003; Wenwu Gongzuodui and Hennansheng Wenhuaju, 1961). The

Erlitou deposit of Huizui is extremely rich. Nevertheless, scores of blanks and flakes and refuses from lime making were yielded from the site indicating that it was more likely an economic center, rather than an administrative center. There are other likely secondary centers located to the northwest of Gangou that could have controlled the valley. But a control node outside of the Gangou system to regulate the political economy of Gangou would contradict the proposition that the spatial relationship between sites is lineal. At any rate, how the settlement pattern of the Gangou Valley integrated into the greater Erlitou political economy system is a question that needs to be addressed in future archaeological work. These two models seem to be equally possible based on the current data.

There are some indications that the settlement hierarchy of the Erlitou phase was coupled with a decision hierarchy. The political status of Erlitou as the primary center is obvious, as indicated by its numerous large-scale public structures. The status of Shaochai as the secondary center, however, is not exactly clear. Two seasons of excavation in 1960 and 1963 at Shaochai have not yielded sufficient evidence to support the claim that it was a secondary political center in the Yi-Luo Valley (Henansheng Wenwu Yanjiusuo, 1993). No rammed earth feature was found despite systematic subsurface probing. The four house features revealed were small. Among the six burials recovered, M5 was the most outstanding as it yielded five pottery vessels, which included a couple of drinking vessels *gu* and *jue*, and one white pitcher. White ware was very rare during the Erlitou phase. Its paste is made of a special clay, kaolin, which is found locally in the upper reaches of the Dongsi River (Fig. 1), a small tributary northeast of Wuluo. This finding indicates the presence of lower elite at Shaochai. No excavation has ever been conducted on the Luokou site, the tertiary center of the region. Consequently, we do not have much knowledge of this site.

When comparing the settlement pattern of the Erlitou phase with that of the Longshan phase, it is obvious that the secondary and tertiary centers were located on strategic locations to regulate the tribute economy of the Erlitou domain. As discussed above, the distance between Erlitou and the Wuluo Valley was critical as it became necessary to establish local centers to control the flow of resources. Shaochai, located on the confluence of two rivers, was the ideal location for control. The resources flowing down the Wuluo River were collected at this node before being pushed up to the regional center. In addition, being located on the bank of Yi-Luo, Shaochai could also regulate the flow of tribute along the Yi-Luo River. The length of the entire course of the Wuluo River was more than 20 km. The location of the tertiary center, Luokou, was slightly less than half way up the river from Shaochai. It was then a good location for an additional administrative node to regulate the tribute economy of the valley.

The Erlitou settlement pattern also points to the possibility of transportation of tribute on the river. The modern lower Yi-Luo River is wide and slow flowing. It was a busy waterway during the historical period, especially when Luoyang assumed the political and economic centers of China. Movement of staple goods on water is the most inexpensive and effective means of transportation. Although no prehistoric navigation remains have ever been found in the archaeology of Yi-Luo Valley, we should not discount the likelihood of the use of water courses for tribute transportation.

Resources extracted from the hinterlands of the Wuluo and Gangou Valleys probably included staple food, timber and fuel. Grain food was probably the most important resource extracted from these two river valleys. Remains of millet and rice were identified from the refuse collected from several sites in the Yi-Luo Valley (Chen et al., 2003). The grandiose public architectures of the regional centers used large amounts of timber to build. Historically, the upland regions of the Wuluo and Gangou were covered with woodland and forest, making them good lumbering fields for timber and firewood. In addition, kaolin deposits were found locally in Dayugou on the upper reaches of Dongsi River. Perhaps it was the source material of the rare white pottery of Erlitou.

The settlement pattern of the Lower Erligang phase is unexpectedly intriguing. Only nine small sites averaging 2.85 ha were found, and they all located in the Gangou Valley and no sites were found in the Wuluo Valley. Before interpreting this observed pattern, I must iterate that it is based on the settlement information of two tributary systems of the Yi-Luo River. Any proposition must be tested by settlement data of a wider area of the Yi-Luo Valley. In the following, I am going to propose two competing interpretations.

A straight-forward interpretation is that during the time when the political system centered at Erlitou collapsed, and Yanshi assumed the position of regional political center, the Yi-Luo Valley witnessed a significant depopulation, and the Wuluo Valley was completely deserted. Given the context of regime change, it might mean genocide or considerable population relocation coerced by the new regime. This interpretation is based on the implicit assumption that the ceramic dates are accurate representations of the absolute dates. That is to say, by 1520 BC, when Yanshi was firmly established as the regional center, it brought along with it a new style of ceramics that were made and used in the entire Yi-Luo Valley. A corollary of this proposition is that with an apparent shrink of the population in the valley, the maintenance of Yanshi had to extract more surplus per head from the remaining people.

The alternative interpretation is that the Lower Erligang settlement pattern is the archaeological expressions of domination and resistance. It challenges the assumption that the ceramic chronology neatly corresponds to the absolute chronology region-wide. In other words, some people in the Yi-Luo Valley still made and used the old Erlitou style ceramics after the rise of Yanshi. The Gangou Valley, being closer to Yanshi, was under the tight control of the new regime, and made the transition from Erlitou ceramics to Erligang ceramics on a faster rate. In contrast, the Wuluo Valley, being farther from Yanshi, maintained the old Erlitou ceramic style as a means of resistance to the Yanshi domination. This model can be used as working hypothesis for future archaeological work in the valley. It necessitates the extraction of well-stratified radiocarbon dating materials from archaeological sites yielding late Erlitou ceramics. With the new wiggle-matching technique of calibration, it may be possible to build a fine chronology documenting the absolute dates of the termination of Erlitou style ceramics in the Wuluo Valley.

The settlement pattern of the Upper Erligang phase resembles that of the Erlitou map with minor variations. Shaochai reemerged as a secondary center, although no tertiary center was present in the study area. The Erligang style ceramics eventually adopted by all the people in the studied area.

The major concern of this paper is the control strategies of complex societies, particularly that of the state. Nevertheless, the comparison of the settlement patterns of four different phases of the lower Yi-Luo Valley deepens our understanding of the locational arrangement of the administrative centers of a tribute economy and other operating cultural processes.

Conclusion

The information approach to the study of social complexity keeps us focused on the fundamental differences between different types of complex societies. Chiefdoms and states are political forms, therefore, their difference has to be defined in the political field. The regulators of the chiefdom are generalized agents in that their capacity is highly constrained. Once the information processing limit has been reached, the chiefdom reaches its growth limit. The regulators of the state are specialized agents in that their individual capacity might be constrained, but the state can easily add both horizontal agents and hierarchical levels of control to process the information. Theoretically, there is no limit for the growth of the state. This difference in control strategy is viewed as the evolutionary threshold of complex societies. A chiefdom has to solve the problem of information bottleneck in order to develop into a new stage of evolution. The driving forces (population pressure, warfare, trade regulation, class conflict, risk management, etc.) behind the political change are the factors that build a mounting pressure. The permutation and the strength of each of these factors differ from society to society. Nevertheless, in order to develop into a state, all chiefdoms have to solve the problem of structural constraints pertaining to information processing. It seems that they use the same strategy of installing a hierarchically organized control structure.

Equipped with a sharpened conceptual apparatus, I have offered a new perspective on the study of the development of complex societies in the Yi-Luo Valley. In the archaeological study of the formation of early states in China, our attention has been overwhelmingly focused on finding the archaeological corollaries of the political centers, the seats of ancient kings, of the Xia-Shang era during the second millennium BC. Much have been revealed by the excavation and subsurface probing of the internal structure of Erlitou and Yanshi. Yet, we have overlooked the questions of broader organizational implication: What was the power structure of these early states? How did these urban centers support themselves? What was the relationship between the centers and smaller villages in the countryside? What were the strategies used by the centers to regulate the tribute? Answers to these questions are indispensable for the understanding of the nature and development of complex societies. The present effort is a small step in this direction.

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