Understanding how spatial relationships change over time is fundamental to the study of history. But how do we create a historical GIS useful to many disciplines and appropriate to many historical periods? This is the basic problem of the China Historical GIS project.¹ The China Historical GIS (CHGIS) aims to provide the basic infrastructure for spatially enabled historical research. It is a platform for organizing data with temporal and spatial attributes (population, tax quotas, military garrisons, religious networks, regional economic systems, family history, and so on), representing them graphically and analyzing their relationships.

The data in the CHGIS covers more than 2,000 years—from 222 BC to AD 1911—from the Qin dynasty’s establishment of the first centralized empire to the fall of the Qing, the last traditional dynasty. This long period witnessed important changes in administrative structures, economic processes, and culture. The area to be covered changed over time; it cannot be defined by the international borders of the People’s Republic of China today and must include multiple regimes simultaneously. The population of the area covered is large, from about 50 million at the start of the database to about 500 million at the end. It had diverse patterns of settlement, social organization, and ethnic identities. Finally, the sources most important to creating a GIS and to spatial analysis changed over time. We have confronted difficult questions about the kinds of data fundamental to other kinds of data, how they relate to existing historical sources, and how our representations of basic spatial information relate to past conceptions of space and place.

The final CHGIS will consist of three elements. The first and most important is a continuous time series of the administrative hierarchy from the capital down to the county, because historical data was collected and reported through the administrative hierarchy. The second element is major nonadministrative settlements, particularly the market towns that proliferated during the last millennium. The third element is historical coastlines, rivers, lakes, and canals.

The China Historical GIS must consider how spatial data was collected and reported, because the GIS is intended to accommodate the kinds of data found in historical sources. We are aided by traditions of geographical record keeping and cartography that originated before the starting point of the CHGIS datasets and became more sophisticated and detailed over time.² This essay will explain the nature of Chinese sources and how we designed the CHGIS to suit them. It begins, however, by considering more basic questions raised by this research about how people conceived of the space for which they collected data and how their perceptions of space changed, because these issues affect how a GIS represents spatial...
relationships. I will argue that in earlier history, administrative space was conceived as a hierarchy of administrative central places (points) rather than as bounded territorial units (polygons). The chapter then discusses the importance of including more than just administrative hierarchy in this GIS by discussing the transformations in Chinese society approximately one thousand years ago that resulted in a dramatic quantitative and qualitative increase in local spatial data.

CONCEPTIONS OF PLACE AND SPACE
The CHGIS intends to establish a common base for the history of an area occupied by successive regimes beginning with the Qin dynasty in 222 BC. For convenience, we refer to these regimes as “Chinese dynasties,” but some were empires founded by people, such as the Mongols and Manchus, who conquered Chinese territory. For the history of conceptions of space and place, we can draw on a cumulative tradition of texts and maps written in Chinese that located the origins of civilization in the remote past and typically sought to relate the geography of the present to the geography of the past. Table 2.1 (pages 30-31) gives the chronology of dynastic periods, notes the existence of different kinds of geographical sources, and offers an overview of the size of the territorial administration during the period covered by the CHGIS database.

Check marks signify the existence of “Treatises on Geography” in the official dynastic histories, other national administrative geographies, physical geographies, local gazetteers, and national and local maps. The number of province, commandery or prefecture, and county level units are given for selected years. Blank entries indicate that no data is available for a given dynasty and category.

The physical versus the political
The earliest comprehensive geographic text is the “Tribute of Yu,” a chapter in the Book of Documents from the late Zhou period. It tells how the (legendary) sage king Shun of a millennium and a half earlier, seeking a worthy successor, tested Yu by assigning him the task of controlling the great floods that had inundated the land. Yu succeeded and became king in turn. The “Tribute of Yu” is both a foundational geography and a grand assertion of the human ability to bring order to the landscape and its inhabitants: Yu changes river courses, levels the plains, drains the marshes, registers the local products, assesses the quality of the fields, determines the appropriate crops, and describes the inhabitants.
<table>
<thead>
<tr>
<th>Dynasty (Legendary Rulers)</th>
<th>Beginning</th>
<th>Ending</th>
<th>Treatise on Geography</th>
<th>Other national administrative geographies</th>
<th>Local gazetteers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xia (uncorroborated)</td>
<td>-21st c.?</td>
<td>-16th c.?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shang</td>
<td>ca.-1600</td>
<td>-1045</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zhou</td>
<td>-1045</td>
<td>-256</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warring States</td>
<td>-475</td>
<td>-221</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Qin</td>
<td>-221</td>
<td>-206</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Han</td>
<td>-202</td>
<td>220</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Three Kingdoms</td>
<td>220</td>
<td>280</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jin</td>
<td>265</td>
<td>420</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sixteen Kingdoms</td>
<td>304</td>
<td>439</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northern and Southern Dynasties</td>
<td>420</td>
<td>581</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sui</td>
<td>581</td>
<td>618</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tang</td>
<td>618</td>
<td>907</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Five Dynasties and Ten Kingdoms</td>
<td>907</td>
<td>979</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liao</td>
<td>916</td>
<td>1125</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jin</td>
<td>1115</td>
<td>1234</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Song</td>
<td>960</td>
<td>1279</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Yuan</td>
<td>1206</td>
<td>1367</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ming</td>
<td>1368</td>
<td>1644</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Qing</td>
<td>1616</td>
<td>1911</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extant maps</td>
<td>Year for count of administrative units</td>
<td>Number of provinces</td>
<td>Number of commanderies or prefectures (jun, zhou, fu)</td>
<td>Number of counties (xian)</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------------------------</td>
<td>---------------------</td>
<td>-----------------------------------------------------</td>
<td>--------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-210</td>
<td>49</td>
<td>319</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>7</td>
<td>99</td>
<td>1,341</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>140</td>
<td>103</td>
<td>1,088</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>262</td>
<td>168</td>
<td>1,073</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>281</td>
<td>193</td>
<td>1,098</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>612</td>
<td>193</td>
<td>1,241</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>740</td>
<td>328</td>
<td>1,473</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>1111</td>
<td>300</td>
<td>1,193</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1208a</td>
<td>254</td>
<td>738</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>1330</td>
<td>13</td>
<td>1,127</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>1582</td>
<td>19</td>
<td>1,144</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td>1820</td>
<td>18 core</td>
<td>276</td>
<td>1,215</td>
<td></td>
</tr>
</tbody>
</table>

The "Tribute of Yu" contains two contradictory perspectives on the land. The dominant one is essentially physical geography. It sees regions in terms of mountains, rivers, climate, and soil, and includes the local people as part of the natural landscape. From this vantage, government is imposed upon a preexisting natural geography and must organize itself around it. The other perspective, very briefly mentioned in the "Tribute" and possibly a later addition, is political geography. It supposes that a political center organizes the world into a series of concentric zones at set distances from the capital (figure 2.1), simply ignoring the natural landscape.

The physical and political perspectives reappear in the "Treatises on Geography," the section of the official dynastic histories devoted to accounts of the administrative system of the empire. The introduction to the "Treatise" in the Jin dynasty (265–420) history, for example, begins with the creation of the world, the initial existence of human beings as part of the natural landscape, and the gradual development of civilized life. In this text, the physical universe is the primary context: landscape features mark the empire's extent, and governing requires propitiating the spiritual powers in the landscape.⁴

In the past the primordial embryo had no image, the plain element flowed into form, and by responding to what was in heaven some became leaders. Of this [time] the /Book of Rites says: "In the winter they lived in mounds and caves, in the summer they lived on twig platforms and nests. They drank blood and ate [the meat of things with] feathers and fur; they had yet neither hemp nor silk."⁵ Then Fireman invented fire-making. Baoxi began the project [of government], he transformed his clan and continued the legacy. Yan continued the glorious project and marked out territory [for farming] in the unknown. They all were part of a single plan. The Yellow Emperor then went east to the sea and south to the great river; he climbed into emptiness and ascended Mount Tai. Reaching the Kun range [in the west] he pulled on the reins, at the Kong mountains he asked about the Way. He preserved it all on bamboo slips so that nothing would be mistaken. King Gaoyang relied on the spirits particular to the place. King Diku accorded with heaven and performed the ceremonies. East past Crooked Tree [Mountain], west across the Flowing Sands, north to the Dark Mounds, and south to Jiaozhi,⁶ in all that the sun and moon passed through, everywhere that cart and boat could reach, none were not subjects of the King and they did not depart from this realm.⁷
The Jin dynasty failed in its attempt to reestablish a unitary centralized empire, but it saw a burgeoning of interest in religious experience and the natural world. Against this, the introduction to the “Treatise on Geography” in the history of the Sui dynasty (581–618) begins with the supremacy of political power, which dominates the natural world and organizes territory as it sees fit.

Since antiquity all the sage kings who received the mandate to govern have marked out the capital and measured the lands so as to set the axis for humanity. Above they were in correspondence with the orbits of the planets; below they divided the mountains and rivers. They created borders and they drew boundaries; they established a capital and they bestowed fiefs.\(^8\)

After almost four centuries of division, the Sui had reestablished a single centralized empire, uniting northern and southern dynasties. The introduction bears witness to its own effort to reorganize the empire administratively.

**FIGURE 2.1**
The “Five Dependencies” scheme for the organization of territory in the “Tribute of Yu.” Concentric squares in bands of 500 li (1 li = 1/3 mile) radiate from the Royal Domain. However, the bulk of the text is devoted to a description of the natural geography, which does not fit this scheme.
A spatial understanding of the empire involved the administrative and the physical because administrative centers were located in the midst of mountains and rivers. Yet in practice, geographers could give primacy to one perspective. We can see this in two maps of approximately the same date, both presenting themselves as cartographic representations of the "Tribute of Yu." The first (figure 2.2) is from Shui Anli's Ready Charts of Geography through the Ages, the earliest extant printed historical atlas in human history, finished at the end of the eleventh century. Shui Anli's goal in his atlas is to establish correspondences between past and contemporary and administrative places. The atlas includes a rough representation of coasts and rivers, but the focus is on the identification of administrative places rather than physiographic space. Contrast this with another "Map of the Traces of Yu" from the same period (figure 2.3), which gives priority to the representation of physical geographic space.
FIGURE 2.3
"Map of the Traces of Yu" 禹跡圖. This rubbing of an engraving was made in 1136 but shows the Yellow River course as of 1060. The legend states that it is scaled at 100 li (approximately 30 miles) to the square. It names rivers and mountains found in the "Tributes of Yu" chapter in the Classics, as well as past and present names of administrative units to the prefectural level. For a redrawing, see Cao Wanru, Zhongguo gudai ditu ji, vol. 1, plate 56.

Courtesy of The Photograph Collections, Fine Arts Library, Harvard College Library.

FIGURE 2.2
"Map of the Traces of Yu" 禹跡圖. The Nine Regions in the "Tribute of Yu" are labeled in white on black. The prefectural designations are of the eleventh century. The accompanying text explains who Yu was and notes the diverse view of the location of his capital.

Shui Anli, Ready Charts of Geography through the Ages, printed in the twelfth century.
One implication of this difference will be pursued below: the physical geography perspective gave priority to the depiction of extensive physical space marked by mountains and rivers, whereas the administrative perspective was more concerned with the places that served as seats of government in the administrative hierarchy. Again, these were not exclusive perspectives. Administrative geographies typically noted the outstanding mountains and the major river in a jurisdiction. Nevertheless, some scholars such as Zheng Qiao 鄭樵 (1104-62) argued that physical geography provided a more consistent way of understanding space through time than did the ever-changing hierarchy of administrative places.11

**Place and space in representing the administrative hierarchy**
Maps today depict administrative entities as territorial units with clearly marked boundaries. In the United States, administrative units are likely to have names different from the town in which the administrative seat of government is located. But this has not been the typical assumption in China’s history. From early times, the administrative seat defined the administrative unit, rather than a clearly bounded territorial unit. To illustrate, if the state of Massachusetts were in China, its administrative seat would be called Massachusetts rather than Boston. In earlier historical sources, the state would be depicted on a map by the point location of its administrative seat. In China, the national capital was the seat of the court (chao 朝), the center of power and wealth, and for much of history, a planned city. It was the “pivot of the four quarters,” standing against the uncultivated wilds (ye 野), just as the light of the “son of heaven” in a central plain was in the midst of the forces and deities in the darkness of the surrounding mountains.12 The depiction of administrative units, which obviously had jurisdiction over surrounding villages, is evident in the two maps in figures 2.2 and 2.3 (pages 34 and 35), where the prefectures are named points rather than territories.13 This was not because a national map of limited size impeded the depiction of boundaries. Surviving county and prefectural maps from the thirteenth century represent prefectures and counties as central places. An example from 1261 (figure 2.4) depicts physical features (mountains, rivers, and lakes) graphically and the prefectural and county seats planimetrically, as square, enclosed cities. Even the subcounty administrative units that were territorial units without fixed seats (the “township” or “canton” xiang) are merely labeled.

The difference between this square map and one that depicts an administrative unit as bounded territory is evident in two maps of the same place from 1892.
FIGURE 2.4

General map of Jiankang Prefecture (modern Nanjing) in 1261. East is at the top. The large, walled square (lower left) is the prefectural seat. County seats are smaller squares. Cantons and other features are only labeled. This is a later tracing of the original map; it preserves a note in the upper right specifying the scale of the grid but does not show the grid.

From Jingding Jiankangzhi (1809 ed.).
Figure 2.5A is a traditional page-filling square of a county: it shows the seat and physical features and labels of subcounty cantons. It characteristically magnifies the county seat and locates the county relative to the surrounding counties by cartouches along the perimeter at the eight compass points (N, NE, E, etc.) reading "north to Yiwu county," and so on. Figure 2.5B, which comes from the same source, shows roads connecting villages to the county seat. For the first time in the case of this county, the map also represents the administrative unit as bounded space.¹⁴

Although there were precedents, the popularity of depicting the county as isolated bounded territory became popular in the nineteenth century and is probably due to the influence of European cartography.¹⁵

In her review of studies of the "Treatises on Geography" (di li zhi) in the dynastic histories, Vera Dorothea-Lichtmann offers the following proposition:

The term di li (which I propose to translate as "terrestrial organization") is a conception of an orderly administrative territorial division established by the ruler and aimed at symbolizing world order. The geographical matters are then presented in the context of the so-called "world-making" activities of the ruler with the aim of establishing an orderly hierarchical organization of the terrestrial space."¹⁶

Leaving aside for the moment the question of organizing terrestrial space, the important insight here is the idea of administrative hierarchy. This sense of a hierarchy of administrative central places continued in China. Even today, a villager likely sees the village as subordinate to the county (by which the county seat is meant) rather than as being "in" the county.¹⁷ The administrative hierarchy to which a given settlement belonged mattered because the government saw itself as governing through a hierarchy of administrative centers.

Into the eleventh century, national geographic treatises were written from the perspective of the central government; they focused on the resources local government could command. Li Jifu’s Maps and Treatises on Commanderies and Counties in the Yuanbe Reign Period from 806–814 is still extant, although its

**FIGURES 2.5A and B**

Yongkang County, Jinhua Prefecture, Zhejiang Province. Figure 2.5A shows military installations (with flags) but not villages and makes no attempt to suggest the actual dimensions of the county, as depicted in figure 2.5B.

*From Yongkang xianzhi (1892 ed).*
accompanying maps have been lost. For each prefecture, it gives the name, rank, population, total number of cantons (defined at the time as units of five hundred registered households) in the prefecture, its administrative history, the goods it supplied to the court, and the distance by road and river to the surrounding prefectural capitals. For each county, it gives its rank, the origin of its name, the major river and source of the flow, and significant mountains. Recognizing that the prefecture extends through space, Li Jifu's work gives the extent of the prefecture measured east to west and north to south but does not try to define boundaries. It locates points in space (as do later works) by giving the direction and distance from the prefectural seat to surrounding prefectural seats and from the county seat to the prefectural seat. Figure 2.6 illustrates this for one prefecture.

**FIGURE 2.6**

Distances between Wu zhou 宋州 (previously Dongyang jun, later Jinhua fu) and surrounding prefectures (zhou) circa AD 1000, according to the *Taiping huanyu ji* (1793 ed.), 97.5b–10b. In this map, all distances have been converted to miles. The distances given in the text are travel distances (actual distances based on straight lines between points on a modern map are given in parentheses). The original text gives both directions by the eight compass headings and the distances in *li* 里 (e.g., "Southeast to Tai zhou 612 li").

*China Historical GIS.*
This does not mean that Chinese historians and administrators could not conceive of boundaries or space as bounded territory. Beginning in the eleventh century, for reasons that will be discussed later, greater attention came to be paid to the territorial extent of prefectures in both geographies and maps. Although surveying techniques for measuring direct distance were known at this time, extant maps and geographies did not yet attempt to depict the boundaries of administrative units.

The focus on central places, the limited resources of government, and above all the nature of the tax system, which registered land and population separately, helped explain the lack of interest in delineating administrative boundaries. The population was registered according to decimal-based systems of ten to a thousand households. The register, not the village, was the unit of registration. Land parcels were measured and their productivity assessed in order to assign the tax burden of each parcel. In the north China plain into the eighth century, registers were used for the equitable distribution of lands to taxpayers. Once land was redistributed through the private market, this was done to grade households by wealth and collect land tax from the owner of each parcel. However, correlating the land registers with the population registers depended on recording all land transactions or regular cadastral surveys, neither of which happened. Land registers could have provided a basis for defining administrative units as bounded territory, but only if all land was farmed in some fashion. The idea of creating new maps to serve as an integrated guide to land and population did occur to some. For example, Yuan Xie 袁燮 (1144–1224) proposed that each unit of ten households should draw a map with paddy and dry fields, mountains and rivers, and roads. The inhabitants of the area depicted would write their names and livelihood on the map and presumably identify the fields they owned. The maps would be collected and merged at the next level of the administrative system until finally a map of the entire county was created. For Yuan, a complete county map could serve as an information management system: "In taxation, legal disputes, and arresting bandits, things could be decided simply by turning to the map." Yuan’s proposal supposes a hierarchical population registry system within the county; it does not suppose a clearly defined hierarchy of territorial units below the county. Given the private market in land, over time the land held by households in a given registration group would change so that to depict their registration unit as bounded space would make it even more difficult to collect taxes. This suggests that unless there were natural barriers such as rivers or mountain ranges that created clear lines of jurisdiction, people at the time...
thought of the territorial boundaries that divided administrative units as flexible zones. From an administrator’s perspective the real question was who he had to collect taxes from. He had to know which settlements fell under his jurisdiction and what property was held by the inhabitants of those settlements; he did not need absolute boundaries.

This preference for zones of jurisdiction was sometimes true at the national level as well. Militarized borders had lines of control at a given moment, but these lines also shifted as troops moved back and forth. In the late eleventh century, faced with multiple hostile states to the north, the court debated defining the northern border as a zone or a line. The proponents of a zone carried the day with the argument that ambiguity reduced conflict. 23 Two twelfth-century national maps of the relations between the Song and the surrounding states identify prefectural seats but do not draw national boundaries. 24 Neither does the great map of the Eurasian landmass, the Amalgamated Map of Great Ming from 1389, which extends from the Pacific to the Atlantic Ocean. 25

For much of the last millennium, demarcating boundaries was the exception rather than the rule. Some sixteenth-century national maps imply national borders by drawing provincial borders. 26 The Enlarged Terrestrial Atlas of circa 1553 includes a series of provincial maps that show provinces as isolates and mark prefectures as bounded territory rather than as prefectural seats alone. 27 The national geography of 1820 outlines the borders of prefectures, although not of the counties. 28

Most prefectural and county gazetteers, which began to appear in large numbers in the twelfth century, remained oriented toward the administrative seat, noting the direction and distance to mountains, bridges, reservoirs, markets, and religious sites as measured from this one central point. But some depicted the county as bounded territory. Such works typically identified subordinate administrative units within the county as spatial units within the county and located features within these spaces. Figure 2.7 is from a gazetteer that depicts counties as bounded space in semi-isolation.

This map adopts the perspective of physical geography rather than administrative geography. It depicts mountains, rivers, and the natural villages along the major road, but it gives only the county seat (the square in the lower middle) and ignores administrative divisions within the county. Although some argued that
the county should be treated as a "natural" spatial unit rather than a series of points networked to the administrative seat, this did not become the dominant view until the nineteenth century under the influence of European surveying techniques and cartography. The author of a similar county map from 1823 states that it was

FIGURE 2.7
"Boundary Map of Boluo County" 博羅 縣 境之圖, Guangdong.
From Huizhou Fuzhi 惠州府志 (1595 ed.).
influenced by the Qing empire maps of 1718 created by the Jesuits with European surveying techniques (figure 2.8).\(^{30}\)

The gazetteer used this map as a template for other maps, such as one showing administrative districts within the county drawn as bounded spatial units, although without geographical exactness. Even today, the government frequently alters the administrative hierarchy and reorganizes administrative units within the county. Although contemporary cartography follows the Western style of depicting units as bounded space, the government is only now systematically using modern surveying techniques to define county boundaries exactly.

![Map of Jinhua County](image)

**FIGURE 2.8**

Overview of Jinhua County, from the *Jinhua xianzhi* 金華縣志 (1823 ed.), said to be influenced by the Jesuit maps of the Qing empire of 1718.

*From Jinhua xianzhi 金華縣志 (1823 ed.).*
From historical conceptions to a historical GIS—points and polygons
Tracing changes in the administrative hierarchy is fundamental to creating a GIS for Chinese history because the government collected data according to its administrative structure. The central government ruled territory through a system of prefectures and subordinate counties. Centrally appointed officials governed this system, supervising locally hired personnel according to legal and administrative codes. (By the thirteenth century, a provincial administration had also emerged.) Local governments maintained the road and postal station network and systems for land and household registration, justice, and security. By the thirteenth century, it had become common in the south of China to create “local gazetteers” for counties and prefectures to preserve extensive local data. China has the longest continuous historical record in human history. The combination of central and local records has provided a massive amount of data with spatial attributes. A bilingual historical GIS will make much of this data available for scholarship without first requiring sinological training.

The importance of the administrative system to the organization of historical information has led to three fundamental design decisions: (1) to build the GIS around the administrative structure, (2) to keep track of this structure by tracing all known changes (in name, location, and place in the administrative hierarchy) in administrative units in a continuous time series rather than documenting selected slices-in-time, and (3) to make extensive use of points in representing administrative units visually. CHGIS is thus a base GIS because it provides the fundamental database: the record of changes in the administrative units and the changes in the points, lines, and polygons that represent them. We must first correctly identify and locate the administrative units that reported data; without that we lack a reliable means of spatially analyzing data such as population records. CHGIS thus depends ultimately on time-consuming historical geographical research, even with the aid of important slice-in-time printed historical atlases and studies of changes in administrative units. It is succeeding thanks to the senior historical geographers at the Center for Historical Geography at Fudan University, many of whom took part in the compilation of the *Historical Atlas of China* under the late director Tan Qixiang. Their work contains extensive notes, included in the CHGIS database, which quote from primary sources, cite secondary sources, and justify all their choices.
How should CHGIS represent administrative units? The Chinese historical record suggests that we should conceive of them for much of history as a hierarchy of points extending from the capital down to the counties. Further, we should understand that the data collected by a prefecture or county refers not necessarily to a bounded space but to data collected from settlements within the reach of the local government. Conceiving of the county as bounded territory became less problematic once population increased and marginal lands were brought into cultivation so that settlements filled the area, a process that took place in the south from the eighth century on. A historical GIS for China can better represent administrative units as points rather than following the Western convention of representing them as polygons, a tradition that takes advantage of (but is perhaps also limited by) two centuries of mathematical cartography. CHGIS can extend backward in time because the “points” at which administrative seats were located can be determined with a fair amount of accuracy, as can the start and end dates for administrative units.33

At the same time, cartographers and GIS researchers in China and abroad expect that a GIS will represent administrative units as bounded territory. Area also figures importantly in density analysis. CHGIS can address this in two ways. For recent history, we can take recourse to the mathematical cartography that Chinese geographers began to use widely in the late nineteenth and early twentieth centuries to create county boundaries for circa 1911, the end of the database coverage. Working backward in time, approximate county boundaries for some areas can be drawn, although these boundaries will not be highly exact at a 1:1,000,000 scale. County boundaries and physical features have proved particularly useful in approximating prefectural boundaries, which CHGIS seeks to provide for all periods. Although the introduction of mathematical cartography helped establish the idea of using clearly delineated boundaries, researchers should consider treating all CHGIS administrative boundaries as approximations and use point data whenever possible.

The second method for approximating county areas is to maximize the point coverage by including as many settlements within the county as possible, thus allowing the use of Thiessen polygons to give approximate areas. Increasing the point coverage within an administrative unit produces correspondingly better approximations of the area of the administrative unit.

The value of increasing the point coverage goes beyond improving the representation of administrative space. Maximizing the number of points is the best means of taking into account the extraordinary increase in locally preserved data in local gazetteers from the twelfth century on.
LOCAL DATA AND THE FUTURE COURSE FOR THE CHINA HISTORICAL GIS

For the first millennium of CHGIS coverage, most of the available historical data comes from sources compiled by the central government and relates to the county and prefecture as administrative units. For the second millennium, particularly for southern China, it is often possible to identify the administrative units and villages within the county. The most important attributes of the tens of thousands of named places outside the administrative seat were economic, familial, cultural, and religious rather than administrative. Geographies and maps best represented the administrative system, but collected data also recorded various nonadministrative networks. It is precisely information about nonadministrative places that has made possible G. William Skinner’s “Hierarchical Regional System” model for the analysis of contemporary Chinese society and earlier periods.

The background to the appearance of local data lies in the transition from the Tang (617–907) to the Song (960–1279). Into the ninth century, the North China plain dominated what we consider China. The plain contained most of the population, produced the largest share of tax revenues, and provided most government officials. Its contested northern border was the focus of foreign relations and a major site of military expenditure. Regional systems analysis becomes important when other regions began to rival North China demographically, economically, and politically. This happened in the ninth and tenth centuries, when the south gained population and divided into regional kingdoms as the Tang dynasty (617–907) disintegrated.

Beginning in the twelfth century, one important consequence of these changes was the appearance of local histories, known as local gazetteers. The Tang dynasty had been led by a state-sponsored aristocracy of great clans that, having become divorced from their earlier local power bases, made government service the family occupation. The Tang ideal was a unified hierarchy of power, wealth, social status, and culture centered on the court. At least in the north China plain, the government controlled the land, redistributing it to farmers in return for an assessment per adult of a set amount of tax in kind and labor. Trade was strictly controlled and long-distance trade was largely limited to luxury goods. Three things happened as this centralized system deteriorated. First, as a private land market emerged, the state lost control of the land and changed its tax system to tax households according to their land and wealth. Second, the state stopped restraining commerce and learned to tax it. As a market economy took shape, the state increased the money supply.
In 740, the annual mint had been about 275,000 “strings” (nominally 1,000 coins) of bronze cash. By the 1080s, the annual mint was about 4.5 million strings. Third, the identity of the national elite changed from a group of families of aristocratic pedigree to a national elite of “literati,” men educated in local state schools and private academies and chosen for office through competitive examinations. Although only a few were chosen, there was a dramatic expansion of the educated elite: in the mid-thirteenth century, as many as 450,000 people participated in local examinations in the triennial examination cycle, out of whom only about 600 went on to obtain the highest examination degree.

State institutions did not expand, either to employ the larger elite or to maintain services to the larger population, to reflect population growth. The later imperial government’s role in society, economy, and culture was limited. At the local level, the growing number of well-to-do educated local families filled the gap. Officials and their immediate kin, the most privileged elements in society, thus belonged to a national elite constituted by local literati elites, groups of families that kept up literati education and social practices but, because members rarely served in government, remained locally resident. They supported the state but also defended local interests in the face of state demands.

The local gazetteers, the most important source for detailed information about local physical, administrative, social, religious, cultural, and economic geography and history, incorporated the earlier form of local data compilation and added a new layer. Prior to this, local administrative units compiled local records for their own purposes (of which only a few remnants remain). In contrast, local literati were generally the compilers of local gazetteers. Their communities wanted histories of the places in which they resided and the social, economic, and cultural world in which they lived, in addition to the records of local government. Thus, for example, local gazetteers began to have extensive sections devoted to local biography, educational institutions, literary selections, and examination registers. Gazetteers represented a confluence of interests between local officials and local elite families, those with the ability to educate their children, organize local defense militias, establish water conservancy pacts, and contribute to schools, bridges, walls, and religious institutions.

The writing of local gazetteers was part of the growing interest in using locality to catalogue the nation’s cultural history. The first privately compiled national geographies drew on national records and local gazetteers and culled literati writings to give accounts of famous local sights, customs, stele inscriptions, and biographies. Two of the earliest are still extant: Wang Xiangzi’s (襄之) two-hundred-chapter Record of the Best Sights of the Realm (勝域紀勝) and Zhu Mu’s (祝穆) seventy-chapter
Finest Sights of the Realm (方舆胜览). Collections of local biographies and literary writings also became popular. Beginning in the fourteenth century, state-compiled national geographies reflected this change and new "unified gazetteers" summarized the contents of cultural geographies and local gazetteers.

Although only thirty gazetteers remain from the Song and Yuan (1279-1368) periods, most southern prefectures and many counties had their own gazetteers by the late thirteenth century. By the end of the sixteenth century, much of the north was producing local gazetteers. They were cumulative, with later editions incorporating much of the material from earlier editions. Today, more than 8,000 editions of gazetteers are extant, totaling 125,000 chapters. In short, we have data-rich sources, covering the area inhabited by about 90 percent of the population, for between four and eight centuries. Beginning in the 1980s, all counties once again began to publish local gazetteers.

What are our priorities as we look ahead to the work of adding nonadministrative point data to CHGIS? As historical gazetteers become published as searchable databases, we face the prospect of integrating large amounts of local historical data into spatial analysis. Market towns, lineages and lineage villages, and religious networks are three of the most promising areas of interest.

Market towns
From early times, settlements were connected vertically to local government through administrative systems to register land and population. By the eleventh century, they were coming to be linked vertically and horizontally through market networks. The growth of the private market economy created regional hierarchical economic networks that no longer corresponded to administrative hierarchy.

Sources vary for historical market towns. For some periods, merchant route books provide a geographical source grounded in the commercial economy rather than the state apparatus. Local gazetteers record market towns too, and research has shown that in many places, market towns continued from the Song period through later history, outlasting every dynasty.

Lineages and lineage villages
In the eleventh and twelfth centuries, a new vision of kinship appeared, in which descendants of a common founding or migrant ancestor were encouraged to maintain kinship ties. The result was extended networks of kin organized into lineages or descent groups that maintained their own membership records. In some places and for some periods, a single lineage dominated villages, as is true today. Because
successful lineages segmented and branches grew in new areas, lineage networks spread not only within a county or canton but also across administrative boundaries. By the fourteenth century, the compilation and updating of lineage "genealogies" had become commonplace. These works have survived in large numbers and are being recompiled once again today. By the sixteenth century, the ancestral halls of powerful lineages had become centers of village life. Lineage genealogies offer a major (but often highly unreliable) nonadministrative resource for studying local society and maps of lineage villages, land parcels, and graves. Some local gazetteers also provide evidence. Figure 2.9 is a map of a canton from a county gazetteer in which villages are identified not by village name but by the surname of the dominant lineage.

Gazetteers rarely provide such a graphic account of dominant lineages, but the current revival of interest in compiling genealogies and in family history suggest that
if CHGIS can add point data for historical settlements, it will become possible to study the spatial distribution of lineage networks.

Religious networks
Records of religious sites are a third abundant source of spatiotemporal point data that reveal nonadministrative networks. Despite the state's occasional attempts to suppress them, monastic institutions and local shrines continued to proliferate. Monastic institutions depended on patronage, either state gifts of revenue from land or private patronage. Periods of private economic growth were also periods of temple building, for example during 1100–1400 and 1550–1700 (and once again today). Buddhist institutions were important to local cultural life and the local economy. In some instances, a Buddhist monastery became the site of a settlement and market town. Like Buddhism, Daoism was also a national religion, although it was institutionally much smaller. Buddhist and Daoist institutions formed various kinds of networks as a result of the sources of patronage or traditions of doctrine and practice.

The growth of market and lineage networks was accompanied by the emergence of regional deities. Temples devoted to a local god might spread throughout a region. Networks of shrines devoted to figures such as Five Manifestations (五顯), King Zhang (張王), Zitong (梓童), and the Heavenly Consort (天后) appeared, and local supporters successfully sought official recognition from the court. During the last millennium, hierarchies of local gods and temples appeared and cults often became the vehicle for local leadership. Cults often provided an alternative form of social organization and in some places have been able to impose taxes in support of religious activities on the local community.

FIGURE 2.9
Zhizhe Township (or Canton) in Yiwu County, Jinhua Prefecture, depicting named mountains, rivers, bridges, roads, religious sites, academies, and lineage villages. Lineage villages are marked by houses with names, either a single surname (e.g., Hu, Wu, Bao) or a choronym (i.e., a place name plus surname, such as Shantou Shen, or the Shen lineage of Shantou). Although these villages are known by different names today, many of them are still inhabited by descendants of the families noted here. The gazetteer has a map for each of its townships.

From Yiwu xianzhi （1596 ed. Rpt. 1640); translated.
Many gazetteer maps include leading religious institutions, and some include comprehensive lists of religious sites. From these, it is clear that religious institutions dominated the landscape to a far greater extent than did local government, providing the bulk of public space. Gazetteer maps give uneven coverage but contain more extensive lists than a map of customary size could represent. The 1480 Jinhua prefectural gazetteer, for example, lists 824 religious establishments in its eight subordinate counties, each identified by name, travel distance, and direction from the county seat, and often the date of founding. These can be plotted in a GIS. However inexact, such maps tell us something about the spatial distribution of religious sites: those deemed worth recording are overwhelmingly Buddhist, they are for the most part located at the periphery of the county rather than the capital, and (something that would only be apparent with a GIS) they are located in the hills rather than in the populated plains. A historical GIS lets us study the spatial pattern of religious sites in a natural geographic and demographic context and in an administrative context.

SOME THOUGHTS ABOUT HISTORICAL GIS

This case study has made a series of related arguments.

Any historical GIS would seem to need a spatial thread running through history, recognizing that such continuity can be achieved only by accommodating change. The Chinese case achieves that continuity by tracing changes in the administrative hierarchy. It is a justified approach, because administrative hierarchy effectively collected and reported data with spatial attributes.

But how should we represent the administrative hierarchy spatially in a GIS? Our intuition, one supported by work on historical GIS for Europe and the United States, is that administrative units are polygons. Summarizing conclusions derived from a recent collection of studies on historical GIS, Anne Kelly Knowles writes that “accurate spatial boundaries are key to all calculations derived from geographically located data. Without using historically correct and accurate unit area boundaries, one cannot tell whether statistical changes reflect changes in population, changes in boundary lines, or both.” But what do we do when we have a lot of data but lack accurate unit area boundaries, as is the case for most of Chinese history?

Practical and conceptual answers seem to make sense. In practical terms, expedient methods generate approximate, provisional boundaries for modes of analysis based on measurement of area. These approximations will improve over time as the amount of point data increases. To do this, we must maximize point data available for many
regions for the last millennium. Moreover, the same sources that allow us to increase point coverage and better identify the territory under a particular jurisdiction also allow us to develop information about economic, social, and religious networks that were not a function of the administrative hierarchy.

The expanded acquisition of point data will help us ensure that CHGIS, which is meant to be the common base of history for two thousand years, can serve many fields and their methodologies, not all of which depend on measuring area. However, exploring economic, social, and cultural networks requires identifying point locations and considering the attribute data associated with those points. For earlier periods, we cannot assemble the breadth of attribute data used in Skinner’s hierarchical regional system model for contemporary China. We have only begun to explore the possibilities for spatial datasets in Chinese history.

In conceptual terms, greater reliance on point data is justified. This case study has introduced evidence that the administrative hierarchy was conceived as hierarchies of central places rather than as bounded territory, which governed through its ability to register populated settlements and landholdings of the inhabitants. In other words, administrative units were not purely conceived of as bounded territory. Administrative geographies and early cartography support this view. Administrative places were located in space relative to other administrative places, and the notable physical features of the landscape within the jurisdiction were recorded. However, a strong sense of precisely bounded territory was lacking except when it was crucial to define, as was the case along roads, where one jurisdiction ended and another began.

A belief in sovereign territory has been part of the conception of the modern nation state and makes the idea of bounded territory seem natural. This fits with modern cartography, making it possible to draw absolute boundaries irrespective of the realities of geography. This does not fit much of the history of China. We may also ask how appropriate it is to the history of Mediterranean civilization before the fifteenth century. If bounded territories are misleading or otherwise inadequate, then the development of historical GIS for the premodern West will also have to deal in points rather than polygons.

This does not mean that the top-down, point-based administrative perspective was the only possibility in China before the adoption of Western cartography. From the start, the natural geographical discourse in China supposed a world influenced but not determined by the administrative perspective. Moreover, the rise of local gazetteers, a consequence of social, economic, cultural, and institutional changes during the Tang–Song transition from the eighth through the twelfth century,
brought something akin to a bottom-up perspective: an intensive examination of the elements of local society. Gazetteers recognize the administrative perspective. But at the local level, they see it in the context of a locality with its own historical landscape. A GIS for Chinese history must take into account such historical shifts in sources and spatial conceptions. Ultimately, inhabitants adopted administrative units imposed on the landscape then tried to make them their own and give them a history they would define. As this happened, ideas about bounded space became more prevalent, even if boundary-making was not seen as fundamental to administration.

A guiding principle in our creation of a historical GIS for China has been the need to take into account characteristics of the Chinese historical record. Ultimately, CHGIS should become part of a historical GIS for the Eurasian landmass. The idea of a national historical GIS works for an era of nation states. But for earlier periods, when populations moved, tribal confederations and sedentary states rose and fell, and power was contracting and expanding, our spatial understanding of history would surely benefit from the many perspectives of a world historical GIS. When that day comes, the China Historical GIS project will provide one vital piece of a more complex whole.
NOTES


5. Citing the “Li yun” chapter of the *Book of Rites*.

6. Citing the “Virtue of the five emperors” chapter of the *Book of Rites*.


10. In this Shui does in graphic form what Ouyang Min does in narrative form in his *Extended Record of the Realm* from the 1120s; see Ouyang Min 歐陽忞, *Yudi guangji* 奧地廣記 (Chengdu: Sichuan da xue chu ban she, 2003).

11. Zheng Qiao 鄭樵, *Tong zhi* 通志 (Beijing: Zhonghua shuju, 1987), 541.4A. However, this led Zheng to ignore what he certainly knew: that rivers, particularly the Yellow River, had changed course over time.


13. This is true for all of the maps in Shui Anli’s historical atlas.

NOTES (CONTINUED)

15. For the adoption of European methods see Iwo Amelung, "New Maps for the Modernizing State: Western Cartographical Knowledge in Late 19th Century China," in Graphics and Text in the Production of Technical Knowledge in China: The Warp and the Weft, ed. Francesca Bray, Vera Dorofeeva-Lichtman, and Georges Mâtellic (Leiden: Brill, forthcoming). As Zou Zhenhuan points out in his authoritative study of Western geography in China, Western knowledge introduced in the late Ming did not have a transformative impact; see Zou Zhenhuan 趙振遠, Wan Quing xifang dili xue zai Zhongguo: yi 1815 zhi 1911 nian xifang dili xuezhu de zhuangbu yu yingxiang wei zhongxi 晚清西方地理學在中國: 1815至1911年西方地理譜的轉播與影響為中心 (Shanghai: Shanghai guji chuban she, 2000).


18. Taking the section on Wu zhou as an example, see Li Jifu 李吉甫, Yuanbe jin xian tu zhi 元和郡縣圖志 (Wanying dian ju zhen ban ed.), 27.4b–7a. Later examples include Yue Shi’s The Taiping Reign Period Record of the World from 976–983 and Wang Cun’s extremely summary Treatise on the Nine Regions in the Yuanfeng Reign Period from 1078–85. See Yue Shi 楊湜, Tai ping huanyu ji 太平環宇記 (1793 ed.), 97.5b–10h. Wang Cun 王存, Yuanfeng jiyu zhi 元豐九域志 (1784 ed.), 5.16a–b.

19. Wang Cun, Yuanfeng jiyu zhi (Beijing: Zhonghua shuju, 1984), 5.212–19, a national administrative geography from 1078–85, for the first time gives distances from the prefectural seat to the border of the adjoining prefecture. The overview maps of Jiankang Prefecture from 1261 depict the prefecture and county seats graphically and labels boundary points between counties; see Zhou Yinghe 周應合, Jingding Jiankang zhi 景定建康志 (1809 ed.). In both cases, I assume that the distances and points are given with reference to roads between administrative seats.

20. The great polymath Shen Guo 沈括 (1031–1095) argued that by using surveying techniques and twenty-four rather than eight compass headings it was possible to measure the “as the bird flies” distance between points. The value of this, he claimed, was that with a table of directions and distances a scaled map could be drawn when necessary. See Needham, Science and Civilisation, vol. 3, 576; and Yee, "Cartography in China," 113–17.


22. Song shi 宋史 (Scripta Sinica ed.), 400.12146. Noted in Needham, vol. 3, 518. A similar argument is found in a late twelfth century handbook for local officials; see Zhou xian tifang 州縣提防 (Congshu jicheng ed.), 2.22.

24. Huang Shang's map from 1190 covers the territory of the Song dynasty and two northern states, the Jin dynasty of the Jurchens and the Xia dynasty of the Tanguts. It names 368 prefectures, 623 military bases, 73 rivers, 27 lakes, 180 mountains, and 24 passes, but it does not draw state boundaries; reproduced from Cao Wanru, Zhongguo gudai ditu ji, vol. 1, plate 72. The same holds for an earlier map covering international relations, the "Map of the Chinese and the Tribal Peoples" 华夷图, engraved in 1136 but describing the situation as of 1117; reproduced and discussed in Cao Wanru, Zhongguo gudai ditu ji, vol. 1, plates 54–6.


28. For examples, see the maps included in the Jiaqing Zhongxiu Da Qing yitong zhi 嘉慶重修大清一統志.

29. For one such example, see Timothy Brook's study of the cartography of Ye Chunji, contemporary with the author of the Boluo County map in figure 2.7. Brook notes that this model was not followed until the nineteenth century. See "Mapping Knowledge in the Sixteenth Century: The Gazetteer Cartography of Ye Chunji," The Princeton University, Gesti East Asian Library Journal 7:2 (1994): 5–32. Note that in the 1763 edition the Boluo County gazeteer reverts to a traditional administrative seat-centered perspective on the county in its maps and dispenses with borders. Cf. fig. 10, a late 16th century map that also adopts a bottom-up perspective.

30. This is the "Map of the Complete Vista of the Imperial Realm" (Huangyu quanlan tu 皇舆全览图), cited as the source for overview map of Jinhua County. See Huang Jinhsheng, Jinhua xianzhi 金华縣誌 (1823 ed.); juanshou 9b.

31. Various printed maps exist that claim to show the spatial distribution of population at various points in Chinese history without, however, providing the level of spatial detail that would allow one to check the figures for accuracy. As an example, see Hans Bielenstein, "Chinese Historical Demography, A.D. 2–1982," Bulletin of the Museum of Far Eastern Antiquities 59 (1987): 1–288.

32. The authoritative historical atlas is Tan Qixiang 論其強 ed., Zhongguo lishi ditu ji 中國歷史地圖集, 8 volumes (Shanghai: Ditu chubanshe, 1982–1987). The most important single source for changes in administrative units is Zhang Minggeng and Zhang Mingju 张明庚 张明聚 eds., Zhongguo lidai xingsheng qibian: gongyuan qian 211–gongyuan 1911 nian 中國歷代行政區劃; 公元前 211 – 公元1911年 (Beijing: Zhongguo Huaqiao chuban she, 1996).

33. CHGIS has rules for dating that reflect the degree of precision found in the historical record.

34. One of the unique aspects of the CHGIS database is the "Part-of-Table," which makes it possible to see what administrative unit a given place belonged to in the administrative hierarchy. Probably the most important decision that must be made in extending this downward concerns the levels of hierarchy that should be included as the institutional system changes. For example, because in the middle period the "canton" (xiang 乡) played a significant role in village administration, it makes sense to list known villages as "part of" both a particular canton and a particular county. The CHGIS database has been constructed so that a village can be listed both as "part of" a canton and "part of" a county without creating any conflict.
NOTES (CONTINUED)


39. Gao Congming 高聰明, Song dai buobi yu buobi liutong yanjiu 宋代貨幣與貨幣流通研究 (Baoding: Hebei daxue chuban she, 1999), 103.

40. G. William Skinner points out that the centrally appointed bureaucracy and the total number of counties and prefectures did not grow with the population, which increased from 100 million at the end of the eleventh century to 450 million by the end of the nineteenth. See his "Introduction: Urban Development in Imperial China," in The City in Late Imperial China, ed. G. William Skinner (Stanford: Stanford University Press, 1977), 3-32.


47. These route books and the vision of the nation implied by them is the subject of Du Yongtao, “Translocality, Place Making, and Cultural Formation: Huizhou Merchants in Late Imperial China, 1500-1800” (PhD diss., University of Illinois, Urbana-Champaign, 2005).


49. The Shanghai Library holds over 2,000 editions of genealogies for Jinhua Prefecture alone.

50. Following Wolfram Eberhard, “Temple Building Activities in Medieval and Modern China: An Experimental Study,” *Monumenta Serica* 25 (1964): 254-318. These conclusions were based on case studies of religious sites recorded in local gazetteers, Jinhua was one of the cases.


