Georeferencing the Yujitu

The *Yijitu* (Map of the Tracks of Yu) is the earliest extant map based on the *Yugong* (introduced below). Engraved in stone in 1136, the map measures about one meter to a side. It was carved into the face of an upright monument on the grounds of a school in Xi'an so that visitors could make detailed rubbings using paper and ink. These rubbings could be taken away for later reference. The stone plaque thus functioned as something like an immovable printing block, remaining in Xi'an while copies of its map found their way further afield. Harvard University holds one such rubbing made from the original stone, and has generously granted permission for the use of this unusually clear image, which shows more detail than any previously published version. (Reproductions of this map and a similar Zhenjiang example from 1142 are published in Cao Wanru *et al*, *Atlas of Ancient Maps in China: Zhan Guo-Yuan*, Beijing: Wenwu chubanshe, 1990, plates 54-59 and discussed in the appended text. See also Joseph Needham's "Geography and Cartography" in Volume Three of *Science and Civilization in China*, Cambridge University Press, 1959, p. 547.)

The *Yugong* is a chapter in the *Shangshu* 尚書 or Book of Documents, one of the classical texts which was traditionally believed to have been personally edited by Confucius. While it claims to be a record of the sage-king Yu's suppression of a flood that ravaged the world in the 21st century BCE, the *Yugong* also served for many centuries as a textual outline of ancient topography. Many of the earliest surviving geographical texts and printed maps were produced by scholars trying to make this book's heavily condensed enumeration of territories and place names easier for readers of their day to understand.

The *Yujitu* takes as its base layer a river network charted on a regular grid of squares representing 100 *li*, or about 33 miles, to a side. This network is liberally plotted with mountain names. It is not entirely a physiographic map, however, as a constellation of cities extends over its surface. A small square at the upper left lists the map's contents as: "Names of mountains and rivers from the *Yugong*, names of provinces and prefectures from past and present, and mountain and river names and toponyms from past and present." Thus it takes the names of natural features recorded in the ancient text of the Yugong, which was believed to cover the entire physical sphere of classical Civilization, then plots these places alongside towns and cities from the beginning of the dynastic period up to the present. It does this without mentioning political or administrative boundaries from the time it was engraved. This depiction of the historical sphere of civilization, carved in an age when the world it depicts was riven by political fragmentation and instability, might have been intended at another level as a wistful call for the reunification of this space under a single virtuous and stable dynasty.

When the *Yujitu* was carved in Xi'an, the city was under the short-lived rule of Liu Yu 劉豫, who ruled as a local puppet of the Jin dynasty from 1130 to 1137. Liu's tiny kingdom would only have covered a small portion of this map. There are no boundaries of contemporary states marked on its surface. This is not a "national" map in the sense we would understand the term today, as demarcating the territory of one or more nation-states. It functions as a diachronic depiction of cultural space, reflecting the endurance of Confucian culture and its transcendence of any particular dynasty's borders. The map's historical qualities, even what we might today define as mythological aspects, are inseparable from its

technical qualities, even though it is its technical appearance that first strikes the modern viewer.

The *Yujitu* has long been cited as a technical marvel; it looks surprisingly modern, even though contemporary records leave no doubt that it is a product of the twelfth century (indeed, probably copied from a now-lost eleventh century original). Such impressions of technical precision can be superficial, though; how can we test its accuracy? One way is to "rubber sheet" it over a modern map to see how and where it is distorted. In this case, 37 points on the *Yujitu* were linked to coordinates on Google Earth using ArcGIS software.

The courses of rivers change, the most obvious examples being the Yellow River and the Huai, so establishing links based on river features is obviously not optimal. The points linked to modern coordinates are primarily city sites, mountains, and coastal sites lying far from the river deltas. There are some blatant errors on the map; for example, Ya prefecture on the island of Hainan is placed at the opposite end of the island from its true site. This is a clerical error, since other contemporary sources have it in the right place. For our purpose it doesn't make sense to input this type of mistake into ArcGIS, but it should be noted in any discussion of the map's accuracy.

We find that the cartographer treated the *Yugong* as something of a sacred text. Information already thought to be incorrect at the time the map was carved remains in place, perhaps because of misgivings about challenging a Confucian classic. For example, Cao Wanru has shown that rather than having the Yellow River originate in the Kunlun Mountains, a common belief at the time, it is shown as beginning at a place called Jishi, the origin given in the *Yugong*. If we were georeferencing based on river courses, we would face a dilemma because the map shows courses already thought to be incorrect at the time it was made! Any discussion of "accuracy" would have to incorporate the intellectual context behind decisions like this.

The northeastern part of the map is extraordinarily distorted, pushed down to ensure that the Liao River remains on the map, as is the southern edge and the island of Hainan. In selecting points to link, these distortions at the edge of the map, which may also have been influenced by the desire to fit it into a square, have not been allowed to weigh down the data accumulated from links in more central locations. Because of the way Google Earth works, this does not hide the distortion at the edges from you; it is possible simply to adjust the opacity of the map and allow the terrain underlying the map to show through. It is thus possible to see at a glance that a vast central region can be overlaid on the modern globe with little distortion, while the regions closer to the edge grow increasingly warped.

The compilers of the *Yujitu* found ways to tiptoe around cases where the *Yugong* is particularly obscure. One striking example is the Heishui, or Black River. It is only vaguely described in the *Yugong*, which mentions that it passes Sanwei Mountain and flows south into the sea. The *Yujitu* shows Sanwei Mountain in the far northwest, in what is now Gansu, then the river conveniently goes off the map, swinging back into the southwest before entering the sea in the south. We have no way of knowing whether the Heishui recorded in the *Yugong* was originally based on vague knowledge of some real river, or even on mythology - at the time the *Yugong* was originally composed not much was known about the far southwest - but by the 12th century it was well understood that a river basin came through this area, which had been visited at that point by numerous monks and diplomats. The compilers of this map, in a bit of georeferencing of their own, decided to equate the southern portion of the vaguely described Heishui from the *Yugong* with one of these rivers. How

exactly it could get from central Asia down to the south was a problem that could be glossed over by taking its course off the edge of the map.

If the Heishui recorded in the *Yugong* was indeed based on knowledge of a river down this way, the question is, which one? It is misleading to entirely omit the Heishui from analysis of the map's accuracy, but to equate it with a specific river would also be misleading, implying more specific knowledge than the cartographers actually possessed. In the georeferenced map, it is left un-linked, simply allowing the viewer to see that it vaguely matches the direction and location of a series of rivers in this region. The *Huayitu*, a less "scientific" map that was carved on the other side of the same stone in Xi'an several years later, looks much more primitive at first but actually conveys a somewhat more realistic sense of the river networks of the southwest.

By fusing the world of the ancient *Yugong* text to a form of representation that approached the technical state of the art for its time, the *Yujitu* served a particular goal that we overlook if we examine only the ways in which it agrees with modern cartography. The *Yujitu*'s futuristic appearance for a 12th century map camouflages the fact that for some areas it actually clings to a textual tradition rather than incorporating the newest data available. The nature of this map makes it difficult to tally its culturally shaded intentions with the objective expectations of historical GIS software, for it was originally intended not only as a tool for teaching geography in a strict sense, but as a reference for situating the toponyms that students would encounter as they read the Classics and later dynastic histories. It was not meant simply to be an accurate map; it mapped out the legacy of a culture on the face of the land. It exemplifies ways in which cultural context either "distorts" (from our perspective as georeferencers), or "informs" a map (as we might say if we were Confucian students preparing for an exam).

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