The 'First Astronomical Point of Yunnan' and the Later Printed Edition of the National Geodetic Survey from the Kangxi Period of the Qing Dynasty

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Date: 2017-09-26T00:00:00+00:00

Abstract

Within the Yunnan University campus in downtown Kunming, the exact location of the "First Astronomical Point of Yunnan" can be identified. This designation refers to the latitude and longitude coordinates of Kunming derived through astronomical observation methods in 1934, representing a re-survey of data originally measured during the Kangxi period of the Qing Dynasty, aimed at obtaining more precise coordinates for downtown Kunming. The initial survey conducted in Kunming during the Kangxi era utilized a theodolite and was designated as geodetic surveying; it was not only a single point within that nationwide large-scale geodetic survey campaign but also one of 29 points measured with theodolites in Yunnan at that time. Additional points were interpolated between these 29 points through triangulation calculations performed by various surveyors, thereby completing the map of Yunnan. The initial survey in Yunnan was undertaken between the 53rd and 54th years of Kangxi' s reign (1714–1715). The initial survey of the Kunming point was conducted in 1714 under the direction of Fei Yin and Pan Ru, or alternatively in 1715 under Lei Xiaosi. This initial survey laid the groundwork for the subsequent re-survey and provided a comparative baseline, thereby possessing significant practical value in its own right. On a national scale, this measurement campaign standardized previously inconsistent surveying scales. Moreover, it furnished the world with a clear, specific numerical conception of the geographical location of Kunming and Yunnan.

Full Text

The First Astronomical Point in Yunnan and the National Geodetic Survey During the Kangxi Period of the Qing Dynasty

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Abstract

On the campus of Yunnan University in downtown Kunming, one can find the exact location of the "First Astronomical Point in Yunnan." This refers to the 1934 astronomical observation that determined Kunming' s latitude and longitude coordinates—a remeasurement of data originally surveyed during the Kangxi reign of the Qing Dynasty. The purpose was to obtain more precise coordinates for Kunming. The initial Kangxi-era measurement, conducted using a transit instrument, was part of a nationwide large-scale geodetic survey and represented one of 29 points measured in Yunnan using this method. Other points were calculated through triangulation by surveyors and used to compile the Yunnan map. The initial survey in Yunnan was conducted between the 53rd and 54th years of Kangxi (1714-1715) under the direction of Fei Yin and Pan Ru, or possibly in the 55th year (1716) under Lei Xiaosi. This pioneering measurement provided a basis for later remeasurement and comparative data, possessing significant practical value in its own right. Nationally, the survey unified previously inconsistent measurement scales and provided the public with a clear numerical understanding of Kunming' s and Yunnan' s geographical location.

Keywords: Geodesy; Astronomical point; Kunming coordinates; Textual research

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1. The Monument and Its Inscription

In downtown Kunming, on the campus of Yunnan University, a stone tablet stands beside the Wenjin Building. The inscription records Kunming' s geographical position and bears the large characters "China' s Early Geodetic Survey Benchmark," with explanatory text beside it. The tablet indicates that the point was originally measured between the 49th and 57th years of Kangxi (1710-1718) and remeasured in 1934. The initial data recorded a latitude of 25°06 for Yunnan Province' s Kunming County, west of the capital by 13°38 . The 1934 remeasurement by the observatory yielded coordinates of 25°03 21.19 N, 102°41 58.88 E. The site was designated as a Yunnan Provincial Cultural Heritage Protection Unit in 1987 and recognized by the Kunming Municipal

People' s Government as having important scientific research value as the exact location of the original latitude and longitude measurement.

The term "astronomical observation method" refers to what is now called astro-geodesy. The inscription means that this was the first point in Yunnan where astronomical positioning was used for actual measurement, historically significant for determining the location of this point on Earth. However, understanding the historical background of this geodetic survey requires further investigation.

2. Historical Background of Geodetic Surveying in China

In ancient China, people believed the Earth was flat and held the mistaken notion that a thousand-li difference in sundial shadow length corresponded to one cun (inch). During the Tang Dynasty, the monk Yixing refuted this error and began to understand the principle of longitudinal time difference, establishing the rule of adding in the east and subtracting in the west when calculating eclipses. In the Yuan Dynasty, the renowned astronomer Jamal al-Din created seven Western instruments, including a globe demonstrating that the Earth is spherical. Yelü Chucai introduced Arab map-making techniques to China, establishing a "three-part land" model. Jamal al-Din also brought numerous Arab maps, though unfortunately his work was not preserved. These developments laid the groundwork for the later large-scale geodetic survey initiated during the Kangxi period.

3. The Kangxi National Geodetic Survey Project

Kangxi was the feudal ruler who most valued science and led by example in studying it. After unifying Taiwan, suppressing the Dzungar rebellion, and signing the Treaty of Nerchinsk with Russia, he gradually recognized the importance of maps as crucial tools in warfare. To accurately map the entire country, observations had to be connected nationally. Following the suppression of Wu Sangui' s rebellion and the completion of an unprecedented national unification, the conditions were ripe for a large-scale geodetic survey covering the entire nation.

In 1708, Kangxi formally ordered Chinese and Western scholars to collaborate, sending the French Jesuits Bouvet, Jartoux, and others to conduct trial measurements along the Great Wall. The results far surpassed old maps, and Kangxi was highly satisfied. In 1709–1710, he added the German priest Fabre Bonjour and others to survey the Northeast. In 1711, he dispatched two teams simultaneously: one led by Pierre Jartoux to Shanxi and another by Jean-Baptiste Régis to Shandong. In 1712, the Portuguese priest Xavier-Ehrenbert Fridelli and others were sent to Henan, while teams were also dispatched to Khalkha Mongolia. In 1713, the Portuguese priest Jean-Francois Cardoso and others went to Jiangxi. After surveying, local maps were drawn immediately.

The survey work in Yunnan encountered obstacles. In late 1714, Pan Ru died in the Awa mountain region of southwestern Yunnan, and Fei Yin fell seriously ill en route, causing the work to halt. When news reached Beijing, Kangxi ordered Régis to Yunnan to take over. By 1715, Fei Yin had recovered, and he and Régis were ordered to continue work in Guizhou and Hubei. They returned to Beijing on New Year' s Day 1717, having spent only about a year on the three provinces' work. Historical records show that by the end of 1716, all provincial surveys were completed except for Tibet, where the team was blocked. Du Demei, who had recovered from illness in Beijing, was tasked with compiling the national map, which took about a year. From the 48th year of Kangxi (starting measurements in the Northeast) to the 57th year (1718), the *Imperial Complete Atlas* (*Huangyu Quanlan Tu*) was completed.

Based on this overview, the tablet' s recorded dates are generally correct. For Yunnan' s survey, we can be more precise: given that Pan Ru died in the Awa mountains in late 1715, this must have occurred while returning from measurement. Two possibilities exist: if the survey proceeded from north to south, the Kunming point was measured in 1714 by Fei Yin and Pan Ru; if it entered Yunnan from Sichuan, went west, then turned north to Kunming, the observation could be dated to 1715 under Régis. Since Régis was back in Beijing by New Year's 1717, and the three provinces' work took little time, the former possibility seems more likely, though definitive conclusions remain elusive.

4. Methodology and Scope of the Kangxi Survey

Historical records, though brief, are generally clear. The 1708 Great Wall trial survey used the transit instrument. The national survey with the transit instrument included 630 points total (excluding the Hailongguan point now in Myanmar). In Yunnan, 29 points were measured directly with the transit instrument, while numerous others were calculated through triangulation. The points formed a network: from Weixi Tacheng in western Yunnan southward to Jinghong, and southeast to Wenshan. Given the transportation difficulties of that era, such extensive surveying and mapping could not have been completed by a few individuals in a few months.

Each province drew maps based on measurements. First, multiple transit instrument points established a network of benchmarks with known latitudes and longitudes. Within this network, 分区图 (zonal maps) were drawn, and triangulation was used to progressively determine relative positions for infill points. These zonal maps were then assembled into a unified large map by aligning their latitudinal and longitudinal orientations. This assembly, though complex, followed systematic principles.

The survey mobilized substantial manpower. The names mentioned above represent only some of the foreign participants. Chinese participants included Bai Yingtang and others. *The Veritable Records of the Great Qing Emperor Shengzu*, Volume 261, records that Suo Zhu was specially ordered to determine Kunming County' s true meridian, indicating significant Chinese involvement. Yunnan' s maps were drawn as two sections (north and south) with latitude ranges of 21°30 -28° and longitude ranges of W10°07 -18°28 for the north sheet and W10°45 -19°30 for the south sheet.

5. The 1934 Remeasurement

The 1934 remeasurement was initiated by the Yunnan Provincial Department of Education, National Yunnan University, and the Kunming Yide Observatory. He Yao, president of Yunnan University, oversaw the project. Beginning at 7 PM on December 19, a 60-degree altitude instrument, astronomical clock, and radio receiver were used for trial observations, followed by four nights of formal measurement. Shen Wenhou observed while Pu Guangzong recorded, totaling 200 star observations.

The results proved more precise than the original data. The observatory also measured the true meridian and established a permanent marker at the site, designating it as Yunnan' s First Astronomical Point. Pu Guangzong, one of the initiative' s originators and observers, kept detailed work logs. Using a radio to receive time signals from the Manila Observatory to calibrate the astronomical clock, he recorded daily apparent right ascension and declination data for 16 stars based on the French *Connaissance des Temps* (astronomical almanac). After obtaining data from December 19-23 during clear weather, he wrote to Li Mingzhong at the Astronomical Institute about data processing methods and calculated the final results after receiving a reply: 102°41 58.88 ± 1.95 E, 25°03 21.19 ± 0.08 N.

A copper ring engraved with the final observation results was placed in a small hole at the center of the observation platform, sealed and covered with a protective cement layer. The stone tablet was designed by Pu Guangzong and erected as a permanent marker.

[FIGURE 1] Remain of the first astronomical point in Yunnan
[FIGURE 2] Astronomical Point of Yunnan University inscription of HE Yao (located left of the observation platform)
[FIGURE 3] Results of the re-measurement in 1934

6. Discussion and Clarifications

The term "First Astronomical Point" requires further discussion. Some, represented by Bai Yongxing, interpret it as the only original latitude-longitude measurement site from the early Qing geodetic survey, claiming the Yunnan University point is the original Kangxi observation site. This interpretation, based on the stone inscription, constitutes a misreading that ignores the final sentence stating the point was designated as "First Astronomical Point" only after the 1934 remeasurement.

The original Kangxi measurement location remains uncertain. One theory places it on Wuhua Mountain, but this cannot be verified. However, given the small size of the city at that time, the measurement point would have been within city limits, not in the suburbs, making any location not far from the Yunnan University site.

The inscription' s coordinates contain three elements: latitude (called "North Polar Height" in the text), longitude ("West of the Capital"), and elevation. In the Kangxi era, there was no internationally unified prime meridian; each country established its own. Kangxi designated the meridian passing through Tiananmen as the prime meridian, with locations east or west of it expressed as degrees east or west of the capital. Latitude was determined through astronomical observation of celestial bodies, while longitude was calculated by observing lunar eclipse phenomena simultaneously at the prime meridian and observation site using synchronized chronometers to determine the time difference convertible to longitudinal difference. Whether Kunming' s longitude used this method is unverifiable, though time constraints likely precluded waiting for lunar eclipses.

The 1934 remeasurement proved more accurate than the 200-year-old original data. A 1938 measurement by Liu 朝阳' s team on Denghua Street in Kunming using astronomical methods yielded longitude of 102°46 , which when converted (116.4° - 13°38 = 102°46) showed the 1934 remeasurement had minor errors but was remarkably precise given the hardware limitations of the time.

7. Significance and Evaluation

Do the Kangxi-era coordinates still hold meaning? They have at least three aspects of significance. First, this nationwide field survey unified historically inconsistent measurement scales and, for the first time, linked length units to longitudinal degrees—an innovative achievement that proved Earth is an oblate spheroid by showing arc lengths vary with latitude. Second, it provided a numerical understanding of Yunnan' s geographical location. Though coarse by modern standards, the data enabled practical applications like sundial construction for local timekeeping. Third, the measurement itself pioneered scientific practice and established a foundation for future work.

The inscription' s claim that this is "the only original latitude-longitude measurement site besides Beijing Observatory" may be debatable but is ultimately inconsequential. However, the inscription contains three flaws: miswriting Yunnan Prefecture as Yunnan Province, mixing Chinese characters with Arabic numerals and modern mathematical notation (which fails to reflect historical authenticity—the original would have used Chinese numerals throughout), and a one-minute error in recording the original longitude as 13°38 instead of the historically documented 13°37 .

8. Conclusion

The "First Astronomical Point" in Yunnan University, established through 1934 astronomical observations, represents a remeasurement of coordinates originally surveyed during the Kangxi period. The initial measurement can be dated to the

53rd year of Kangxi (1714), conducted by Fei Yin and Pan Ru, or possibly the 54th year (1715) under Lei Xiaosi. During the Kangxi geodetic survey, 29 points in Yunnan were measured directly with transit instruments, while numerous others were calculated through triangulation to compile Yunnan' s map in two sections (north and south). The latitude range was 21°30 -28°, with longitude measured west of the Beijing Tiananmen meridian baseline at 10°07 -19°30 (the inscription incorrectly records 13°38). Though coarse by modern standards, the original measurement pioneered scientific practice, unified national measurement standards, and provided practical location data. The 1934 remeasurement, while still containing minor errors, represented a significant improvement in precision.

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Note: Figure translations are in progress. See original paper for figures.