

THE BRILLIANT GEOGRAPHER OF MING DYNASTY, XU HONGZU AND HIS CONTRIBUTIONS TO SCIENCE^①

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ABSTRACT: Xu Hongzu (1587-1641) initiated a new orientation on the study of geography, i.e., systematically observing natural phenomena and describing geographical conditions. Basing his analyses upon simple yet precise measurements and comprehensive descriptions of geographical conditions, he investigated the relationships between the various geographical phenomena and made a comparative study of the different geographical features of various different regions. Thus, he broke through the limitations of classical Geography and promoted the development towards modern Geography.

KEY WORD: Xu Hongzu, natural phenomena observation, geographical conditions description, modern geography

Xu Hongzu(1587-1641), whose another given name was Zhenzhi, was also styled Xu Xiake. He was a native of Jiangyin, Nanzhili (present Jiangyin County, Jiangsu Province) and lived in the Ming Dynasty. At the age of 20, he embarked on geographical explorations—an undertaking which he was to carry on during the next 30 years or so. In his explorations, he covered the greater part of China, tirelessly probing into the mysteries of the nature. the places he explored were often desolate, wild mountain regions where even fishermen and woodmen seldom went or the depths of forests where birds and apes hid themselves.

He travelled during the day and at night he would write down something about his travels by the dim light of a derosene lamp. Every night he would faithfully describe the

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landscape, and the local conditions and customs of the places through which he had travelled that day, and would also record his own observations.

He has left us the precious 600,000-word and multi-volume work—Xu Xiake's Travels^[1-2]. It gives a vivid description of the natural landscapes and social history of China 300–400 years ago. From his book it can be seen that he initiated a new orientation on the study of geography, i. e. , systematically observing natural phenomena and describing geographical conditions^[3]. Basing his analyses upon simple yet precise measurements and comprehensive descriptions of geographical conditions, he investigated the relationships between the various geographical phenomena and made a comparative study of the different geographical features of various regions. Thus, he broke through the limitations of classical Geography and promoted the development toward modern Geography.^[4]

I. XU HONGZU'S EDUCATION, LIFE AND WORK

As early as the Song Dynasty (11th–13th century A.D.), Jiangyin, Xu's birth place, was already a famous trade port. In the mid-Ming Dynasty (15th–17th century A.D.), commodity economy was flourishing in Jiangyin and this place became well-known for its textile industry and trade. Xu Hongzu was born in a scholarly family. The family's financial situation had declined when in his father's generation. Their financial situation, however, improved again when his mother encouraged the family to engage in textile production and vegetable cultivation. Their fabrics competed successfully on the market^[5].

His mother was full of curiosity about the landscape in various parts of the country, which made a deep impression on the young Xu Hongzu. In the later years, every time he returned home after a long journey, he would recount with delight to his mother his experiences during his travels and the new things he had seen and heard. His mother would listen to his stories with keen interest and would sometimes raise interesting questions which stimulated him to observe more closely and describe more accurately the geographical conditions and features of different places. His mother was his first appreciative friend in his career as a geographer.

Xu Hongzu's father was fond of gardening. He disliked conventional social activities and preferred to devote himself to arranging rockeries and ponds, growing flowers and other plants, building pavilions and so on. He also often travelled and took pleasure in beautiful sceneries.

During his childhood, Xu Hongzu was a close observer of nature; he was fond of travelling and became familiar with the names of many kinds of animals and plants. At the age

of 14, Xu Hongzu began to read widely. Books on history and geography, travel accounts and local chronicals fascinated him most and within a few years, he became known as a learned scholar.

When Xu Hongzu was 17, his father was threatened by a group of rich and powerful men, and as a result, died after being bed-ridden for some time. Xu Hongzu decided to devote himself to investigating the geography of China, instead of following a career in the officialdom which would have brought literary honours official rank and a handsome salary. Throughout his life, he persisted in his chosen course, striving to obtain a genuine knowledge during his 30 years of exploration.

II. XU HONGZU'S CONTRIBUTIONS TO GEOGRAPHY

1. On the basis of on-the-spot investigations, Xu Hongzu described in detail the geographical conditions of the Yunnan-Guizhou Plateau and its Five Ridges (spanning the borders on one side between Henan and Jiangxi, and on the other between Guangdong and Guangxi), thus corrected the mistaken views and vague conceptions previously held about these places.

2. He was one of the first in the world to put forward the scientific concept of watershed. He also correctly estimated the ratio between the drainage area of the Changjiang (Yangtze River) and Huanghe River (Yellow) River as 2:1.

3. He independently observed and recorded the erosion and sedimentation of water currents. In addition, he divided erosion into different forms such as vertical downward erosion, horizontal sidewise erosion and so on.

4. Making use of the methodology of comparative study popular in modern Geography, Xu Hongzu found that of two rivers with both the same datum plane and almost the same altitude of their sources, the one whose source has a shorter distance away from the datum plane or which has a greater speed of flow will cause greater erosion. This scientific conclusion was based upon precise measurements of altitude and distance. 5. The area of Karst topography in southern China, one of the largest Karst areas in the world, occupies approximately one third of the total area of Karst topography in the country. Over 350 years ago, Xu Hongzu made the first comprehensive, systematic and scientific investigation of Karst topography. He classified and named these topographic features, describing the character of each category. The categories are as follows (1) dints and karrens, (2) karst fissures, (3) sink holes, (4) karst funnels, (5) karst depressions, (6) karst shafts, (7) karst basins, (8) blind valleys, (9) dry valleys, (10) karst bridges, (11) karst lakes, (12) karst

springs, (13) karst mogotes, (14) peak-forests, (15) karst caves, and so on. He also observed and analysed the differences between the karst topography in different areas, and determined the places in which each type was found. He studied the forms and configurations of the karst topography in different regions and determined their respective distribution and demarkation lines. In Europe, it was not until the 1830s that French geographers Virlet (1834) and Th.Lyll (1839) began to investigate karst. This was 130–200 years later than Xu Hongzu's studies on karst topography^[6].

Xu Hongzu explored more than 300 caves, thus outdid any other individual geographer of the world in the number and types of caves. He studied the geographical location of each cave, the depth from the earth's surface, the configurations, the mechanisms of corrosion, erosion and collapse, the hydrographical conditions, the airflow and wind speed, the secondary sediments—their types, forms and causes, and so forth. In short, his studies were thoroughly comprehensive, his descriptions vivid and his interpretations scientific. He recorded position, depth distances, size and breadth of the chambers and the paths in these chambers, interior landscape and so on. These calculations are remarkably similar to the measurements taken with scientific instruments. In Europe, it was not until the 19th century that two Russian geographers described the caves in the Urals. Xu Hongzu was the first in the world to formulate the theory that stalacties and stalagmites are formed by the evaporation—sedimentation of drops of water. More than 100 years after he put forward this theory, Russian geographer expressed a similar theory in his book *On Strata* published in 1763^[7].

6. Xu Hongzu also studied various mountain areas, analyzing the relationship between altitude climate and vegetation. He pointed out that as the climate gets increasingly colder, the vegetation in mountain areas changes, from evergreen broadleaf forests to mixed coniferous and broadleaf forests, from mixed coniferous and broadleaf forests to coniferous forests, from coniferous forests to bushes, from bushes to naked ground with no vegetation. He was aware that the weather becomes colder as one moves further north. He also observed the ecology of mountain vegetation, noting down that growing plants in strong sunshine have thick stems with short distance between small joints and many branches, and the most common plants are often creepers and vines^[8].

7. In addition, he noted the difference in temperature and degree of humidity at the same time of each year between mountain areas, river valleys and plains. Thus, he ascertained the influence of topography on climate. He also noticed that precipitation is relatively high on the windward of a mountain slope, whereas on the leeward slope there are dry, hot winds and the precipitation is very low^[9].

8. In his diaries, he also recorded in detail the weather conditions in the Yunnan Plateau during the period from September 1638 to January 1641. His diaries show that the annual rainfall in the Yunnan Plateau during that time was approximately double the present annual rainfall. He also recorded that in the winter of 1616, the Yellow Mountains (Huangshan), China's famous scenic area, were snow-clad for at least three and a half months. On the contrary, the Yellow Mountains are rarely covered with snow in winter nowadays. His diaries contain descriptions of various local products and other information, which are the concerns of human geography^[10].

In summary, Xu Hongzu's achievements rank him among the world's pioneers in modern Geography.

III. XU HONGZU'S THOUGHT AND ITS INFLUENCE

Xu Hongzu's thought was reflected in his diaries. He declared that the various geographical phenomena influence and condition one another, that every region has its own distinctive geographical features, and that in order to understand these features, one has to go to different places, collect and analyze the relevant data.

After Xu Hongzu died, an Italian geographer named P. Martinus Martini S.J. used Xu's travelogues in compiling *Novus Atlas Sinensis* (New Atlas of China), printed in Amsterdam. The atlas includes 17 maps and 171 pages of written descriptions.

Xu Xiake's *Travels* is a book of immense value to the study of geography. Yet the significance of this book was not fully recognized for a long time. Around 1940, however, a group of Chinese scholars who returned to China after studying abroad finally paid tribute to the book's importance to Geography. Since then this book and its contribution to the development of modern Geography have been the subject of much scholarly interest.

CHRONOLOGY

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| 1587 | Born on January 15 in Jiangyin |
| 1601 | Collected and read books about history, geography and travelling, and cherished aspirations of undertaking geographical explorations. |
| 1604 | Decided to devote himself to geographical explorations. |
| 1607 | Visited the Taihu Lake and other historical spots in Jiangsu Province thus starting his career as an explorer-geographer. |
| 1609 | Climbed Mount Tai, visited the birth place of Confucius in Qufu (in Shandong), and the birth place of Mencius in |

- Zouxian County (in Shandong), climbed the Che Mountain.
- 1613 Visited Luoja Mountain via Zhejiang Province, made his first trip to the Yandang and Tiantai Mountains.
- 1614 winter Visited Nanjing.
- 1616 Visited the Baiyue and Yellow Mountains in Anhui Province, and the Wuyi Mountains in Fujian Province.
- 1617 Made a trip to the Shanjuan and Zhanggong Caves in Yixing, Jiangsu Province.
- 1618 Visited the Lushan Mountains in Jiangxi Province, made another trip to the Yellow Mountains.
- 1620 Visited the Jiuli Lake in Xianyou County, Fujian Province.
- 1623 Visited the Songshan Mountains in Henan Province, the Huashan Mountains in Anhui Province, and the Wudang Mountains in Hubei Province.
- 1628 Made his third trip to Fujian Province and climbed the Luofu Mountains.
- 1629 Made a trip north to Beijing and the Panshan Mountains in Tianjin.
- 1630 Visited Fujian for the fourth time.
- 1632 Visited again the Tiantai and Yandang Mountains.
- 1633 Made his second trip to Beijing; went to the Hengshan and Wutai Mountains in Shanxi.
- Sept. 1636–June 1640 Made his arduous "10 thousand-Li Trip" to the southwestern part of China. During this trip, he travelled remote and backward areas inhabited by minorities, and explored the sources of the Changjiang and Zhujiang (pearl) Rivers. He passed through Jiangsu, Jiangxi, Hunan, Guangxi, Guizhou and Yunnan, reaching Zhongdian of Lijiang and Tengchong (Yunnan), the border area between Yunnan and Burma. His great achievements were chiefly made during this exploration.
- Feb. 1641 Fell ill and died in his native place.

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