



Science in
Ancient
China

中国古代科学

王慧◎编著



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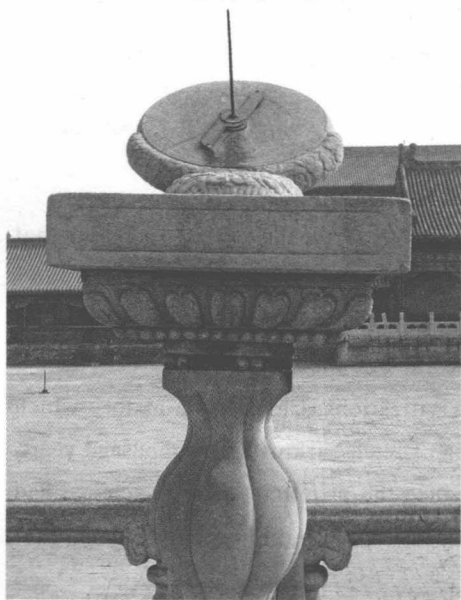
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科学，是反映现实世界各种现象的本质和规律的知识体系。中国是世界四大文明古国之一，拥有上下五千年的文化历史。自原始社会时期开始，中国古代科学就已经起步。经过漫长的历史发展，中国古人在天文学、地理学、数学、医药学和农学等

Science is the knowledge system that reflects the nature and objective laws of all sorts of phenomena in the real world. As one of the Four Great Ancient Civilizations, China has a history which can stretch back over five thousand years. Since the primitive society, science had started sprouting in ancient China. After





方面取得了许多科技成果，并创造了许多个世界第一。这其中既有对圆周率值的计算，对天体的精确观测，也有给全世界带来深远影响的造纸术、印刷术、火药、指南针等。

本书从天文学、地理学、数学、医药学、农学等五大科学领域，系统地为大家介绍中国古代科学方面的知识。

a long history of development, numerous outstanding scientific accomplishments were achieved and inherited regarding to the areas of astronomy, geography, mathematics, medicine, agronomy and etc. And many of the world's No.1 inventions or improvements were created, including the calculation of π , the accurate astronomical observation, as well as the Four Great Inventions (papermaking, printing, gunpowder and compass) that exerted great influence to the whole world.

This book introduces the science in ancient China systematically from five major scientific fields of astronomy, geography, mathematics, medicine and agronomy.

目 录 Contents



天文学

Astronomy 001

宇宙学说

Cosmological Theories 002

天文观测

Astronomical Observations 008

天文历法

Astronomical Calendars 015



地理学

Geography 025

古代地理学概述

Overview of Ancient Geography 026

古代地理学著作

Ancient Works on Geography 034





数学

Mathematics..... 057

算筹与筹算

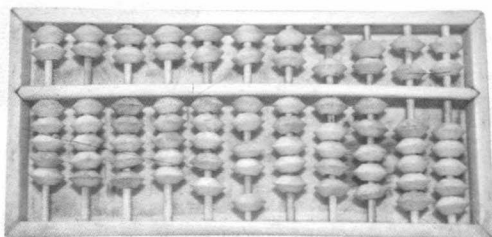
Counting Rods and Rod Arithmetic 058

算盘与珠算

Abacus and Abacus Arithmetic..... 061

古代数学著作

Ancient Works on Mathematics 066



医药学

Medicine..... 073

中医理论

Theories of Traditional Chinese Medicine 074

中药学

Science of Chinese Pharmacology 092

古代医学典籍

Ancient Canons of Traditional

Chinese Medicine 097



农学

Agronomy 111

农业生产与二十四节气

Agricultural Production and 24 Solar Terms 112

农学家与著作

Agriculturists and Works on Agronomy 123

水利灌溉工程

Water Conservation and Irrigation Projects 132

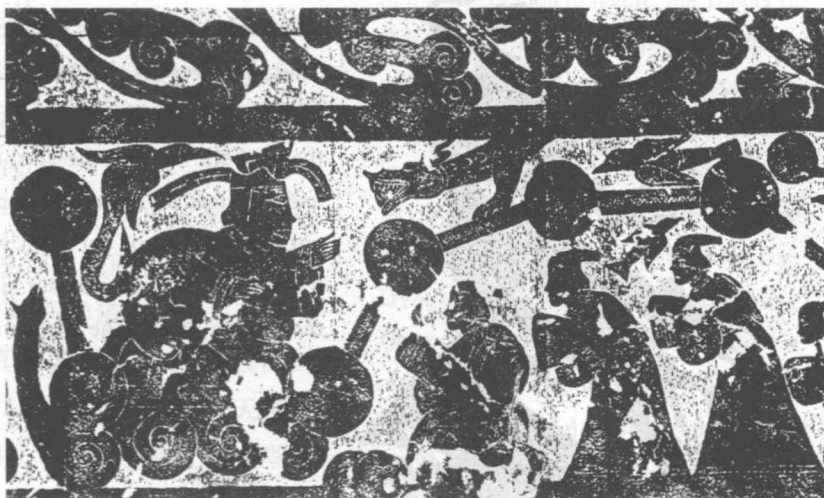


天文学

Astronomy

中国是世界上天文学起步最早、发展最快的国家之一。早在6500多年前，中国古人就已经掌握了二十八宿、北斗七星及日月变化的规律。在宇宙学说、天文观测、天文历法和仪器制作四个方面，中国古代的天文学都取得了重大突破。

China is one of the countries with an earliest start on the study of astronomy and the greatest development. As early as over 6,500 years ago, ancient Chinese had mastered the regular changing pattern of the 28 Chinese Lunar Mansions, the Big Dipper and the variations of the sun and the moon. The astronomy in ancient China has achieved major breakthroughs in four areas of cosmological theory, astronomical observation, astronomical calendar and instrument production.





> 宇宙学说

“盖天说”是中国古代最早的一种宇宙学说，即天是圆的，像一把张开的大伞覆盖在地上，地是

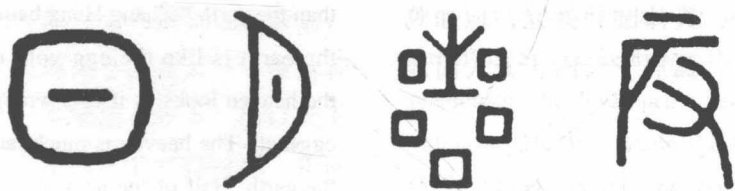


> Cosmological Theories

The Theory of Canopy Heaven is the earliest cosmological theory in ancient China. According to this theory, the heaven is round, like an open canopy covering the earth which has a square shape like a chessboard, while the sun, the moon and the stars are passing back and forth like reptiles on the canopy. Thus, the theory is also known as Theory of Round Heaven and Square Earth. The theory believes that the sun, the moon and the stars do not really come in and out, but just out of our sight when they leave far away and into our sight when they move close. The theory reflects a

• 张衡像

Portrait of Astronomer Zhang Heng



• 日、月、星、辰（甲骨文）

甲骨文是迄今为止中国发现的年代最早的文字，出现在殷商时期。

The Sun, the Moon and the Stars (Oracle)

Oracle is so far the earliest Chinese characters found in China, which emerged in the Shang Dynasty (1600 B.C.-1046 B.C.).

003

Astronomy
天文学



方的，像一个棋盘，日月星辰则像爬虫一样在天空来回经过，因此又称“天圆地方说”。“盖天说”认为，日月星辰的出没，并非真正的出没，而只是离远了就看不见，离得近就看见了。它反映了人们认识宇宙结构的一个阶段，是中国古人在描述天体的视运动方面的最初尝试。

由于“盖天说”只是古人根据对自然的观察所得出的浅显理论，并不能解释诸如日月星辰东升西落的真正原因，因此在战国时期（前475—前221）“浑天说”逐渐产生。东汉时期的天文学家张衡（78—139）在其著作《浑天仪注》中明确提出“浑天说”这

stage when human cognize the structure of the universe, and is the first attempt of ancient Chinese to describe the apparent motion of celestial bodies.

Derived by the ancients on the basis of the observation of nature, the Theory of Canopy Heaven was too plain to explain why the sun, the moon and the stars rise from the east and sink in the west. Thus, in the Warring States Period (475 B.C.-221 B.C.), the Theory of Sphere Heaven gradually emerged. In the Eastern Han Dynasty (25-220), astronomer Zhang Heng (78-139) explicitly put forward this more advanced cosmological theory in his book *Notes on Armillary Sphere*: “The sphere heaven is like an egg. Celestial bodies are round like beads while the earth sits lonely within the heaven just

一更加先进的宇宙理论：“浑天如鸡子，天体圆如弹丸，地如鸡子中黄，孤居于天内，天大而地

as the yolk of egg; the heaven is larger than the earth.” Zhang Heng believes that the earth is like the egg yolk of while the heaven looks as if it is wrapped with eggshell. The heaven is much larger than the earth. Half of the heaven is covering above the earth and another half under the earth. That's why half of the 28 Chinese Lunar Mansions appear when another half of them disappear. Zhang Heng also believes that the universe is infinite and that there are many things about it human do not know yet. He accordingly made

• 北京古观象台

北京古观象台始建于元代，原名“司天台”，清代时，更名为“观象台”。北京古观象台以仪器精美、观测准确而著称。

Ancient Observatory in Beijing

The ancient observatory in Beijing was built in the Yuan Dynasty (1279-1368). It was originally called *Si Tian Tai*, which was changed to *Guan Xiang Tai* (meaning observatory in Chinese) in the Qing Dynasty (1644-1911). The observatory is famous for its exquisite instruments and precise observations.





小。”他认为地就像一个鸡蛋黄，而天则好似一个鸡蛋壳包裹着它，天很大而地很小。且天一半覆盖着地上，一半覆盖着地下，所以天上的二十八星宿才会时隐时现。张衡还认为宇宙是无极限的，有许多是人类不知道的。他据此制作了观测天象的仪器浑仪，根据浑仪所观测的天象而制定的历法十分精确。张衡还创制了可以演示宇宙天体运动的浑象，进一步证明了“浑天说”的可信度。到了唐代，“浑天说”逐渐代替“盖天说”成为古代天文领域的指导理论。

除了“盖天说”、“浑天说”，还有另外一个令世人瞩目的宇宙理论学说——“宣夜说”。在战国时期，“宣夜说”就已出现。“宣夜说”认为无限的宇宙中充满着气体，所有天体都在气体中漂浮运动，日月星辰的运动规律是由其本身的特性所决定，并非被固定在某个球体坚硬的外壳轨道上。

“盖天说”、“浑天说”、“宣夜说”等宇宙学说较之欧洲的早期宇宙学说，例如古希腊学者欧多克斯提出的“地心说”，波兰

an astronomical observation instrument, the Armillary Sphere. By using the Armillary Sphere to observe the celestial phenomena, he developed a very precise calendar. He also made the Celestial Globe to demonstrate the movement of cosmic objects, which further proved the credibility of the Theory of Sphere Heaven. By the Tang Dynasty (618-907), the Theory of Sphere Heaven gradually took the place of the Theory of Canopy Heaven and become the guide theory in ancient astronomy.

In addition to the Theory of Canopy Heaven and the Theory of Sphere Heaven, another cosmological theory also wins the attention of the world: the Theory of Infinite Space, which has emerged since the Warring States Period (475 B.C.-221 B.C.). This theory believes that the infinite universe is filled with gas, and all celestial bodies are floating and moving in the gas. The sun, the moon and the stars have the laws of motion determined by their own characteristics, so they are not fixed on orbits of a hard sphere's shell.

All the above cosmological theories appeared earlier than that developed in Europe, such as the Geocentric Theory put forward by ancient Greek scholar



天文学家哥白尼在1543年所提出的“日心说”，出现的时间都要早。这三大宇宙学说奠定了中国天文学的理论基础。

Eudoxus and the Heliocentric Theory put forward by Polish astronomer Copernicus in 1543. The three cosmological theories have laid the theoretical foundation for Chinese astronomy.

盘古开天辟地

中国古代神话传说中，盘古是生活在混沌之中的神。他不能忍受这样的生活，于是就用一把神斧将混沌劈开了。混沌分成了天与地，盘古用自己的身躯横在中间，以防止天与地重新合并。天不断上升，地不断下沉。随着天地的不断移动，盘古的身躯在慢慢拉长，终于有一天他再也支撑不住而倒下了。他的左眼变成了太阳，右眼变成了月亮，眼泪变成了星星，汗珠变成湖泊，血液变成了江河，筋脉变成了道路，毛发变成了草原和森林，呼出的气体变成了清风和云雾，发出的声音变成了雷鸣。人们将盘古尊为开天辟地的创世之神。

盘古开天辟地的神话，是中国古人对宇宙的最初猜想，表明原始社会的人们对宇宙还没有一个清楚的认识。

Pan Gu Created the Heaven and the Earth

According to ancient Chinese mythologies, Pan Gu was a god lived in the chaos. He could not stand this kind of life, so he used an holy axe to split off the chaos, dividing it into the heaven and the earth. To prevent the heaven and the earth from reconsolidating, Pan Gu erected his body between them. As a result, the heaven continued to rise and the earth continued to sink. With the constant movement of the heaven and the earth, Pan Gu's body was stretched gradually, and then one day he could no longer stand anymore and fell down finally. His left eye turned into the sun, right eye turned into the moon, and tears into stars, sweats into lakes, tendons and vessels into roads, hair into grasslands and forests, exhaled gas into breeze and clouds, and his voice into thunders. Therefore, people respect Pan Gu as the Creator of the heaven and the earth.

The myth of Pan Gu's Creating the Heaven and the Earth indicates that people in the primitive society do not have a clear understanding of the universe, and the myth is just their primary imagination of the universe.



• 盘古开天辟地

Pan Gu Created the Heaven and the Earth





> 天文观测

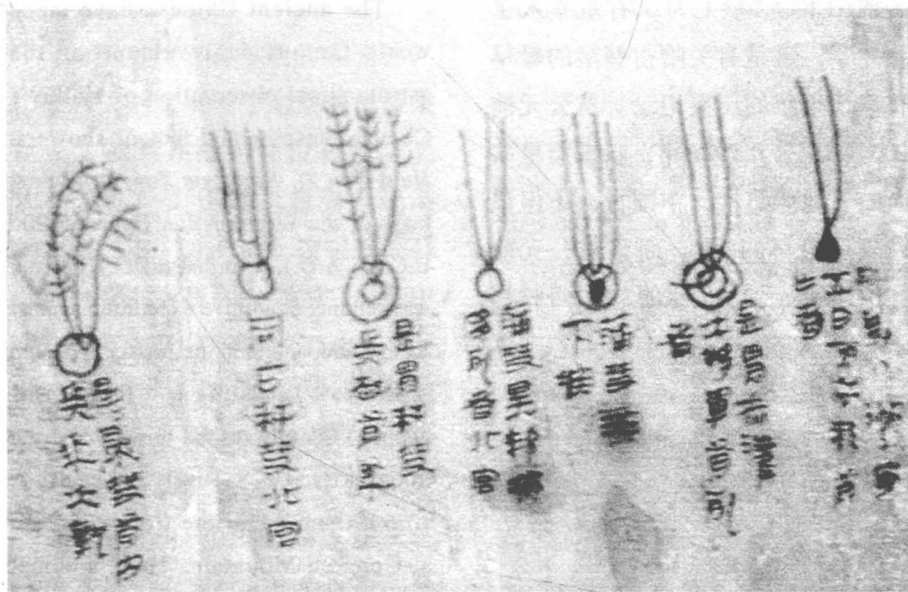
人类早期对于日月星辰的认知十分有限，常常认为世界万物的存在都是神的旨意。中国古人很早就开始“夜观星象”，用其现象和变化来对照国家的命运兴衰。每个朝代的皇帝都自诩是“天子”，即上天的儿子，因此为了彰显自己的尊贵，设立了专门的天文机构用来占卜上天的旨意。秦代、汉代设“太史令”，唐代设“太史局”（后改称“司天台”），明清时期则设“钦天监”。历史上许多著名的天文学家本身也是占星师。

中国古代在哈雷彗星、太阳黑子和流星雨的天文观测上，所取得的成就举世闻名。西汉时期的古籍《淮南子·兵略训》中记载：

“武王伐纣，东面而迎岁，至汜而

> Astronomical Observations

Early human's knowledge about the sun, the moon and the stars was very limited, and they often thought that everything in the world was the will of God. At a very early stage, the ancient Chinese started the observation of astrology at night, as a means of divining the fate of the country. Emperors of each dynasty praised themselves as the Son of Heaven, so as to highlight their dignity. Special astronomical institutions were established to divine the will of Heaven. In the Qin Dynasty (221 B.C.-206 B.C.) and Han Dynasty (206 B.C.-220 A.D.), the government applied the position of imperial astronomer (*Taishi Ling*, ancient position in charge of recording history, managing books, calendric system and ritual ceremony); then in the Tang Dynasty (618-907)



• 《天气气象杂占》（汉 帛书）

这幅帛书上记载了天文观测到的彗星图像，绘制有不同形状的彗尾，是世界上最古老的彗星图。

Silk Manuscript: *Miscellaneous Divinations on Astronomy and Meteorology* (Han Dynasty, 206 B.C.-220 A.D.)

This silk manuscript recorded the observed comet images with different tails of comets, which are the world's most ancient comet images.

水，至共头而坠，彗星出，而授殷人其柄。”周武王领兵讨伐施行暴政的商纣王期间，天空中出现了彗星，自西向东划过天空。这颗彗星就是哈雷彗星。据此，历史学家推测出武王伐纣之年应该在公元前1057年。在春秋时期的史书典籍《春秋》中记载，鲁文公十四年

it applied the administrative office of Astronomical Bureau (*Taishi Ju*, later called Administration of Heavenly Observatory, *Si Tian Tai*); and in the Ming Dynasty (1368-1644) and Qing Dynasty (1644-1911), it set the office of Imperial Astronomical Bureau (*Qin Tian Jian*). Many famous astronomers in history were also astrologers.