

ATLAS OF SCIENCE AND TECHNOLOGY THROUGH THE HISTORY OF CHINA

# 中国古今科技图文集

COMPILED BY CHINA SCIENCE AND TECHNOLOGY MUSEUM

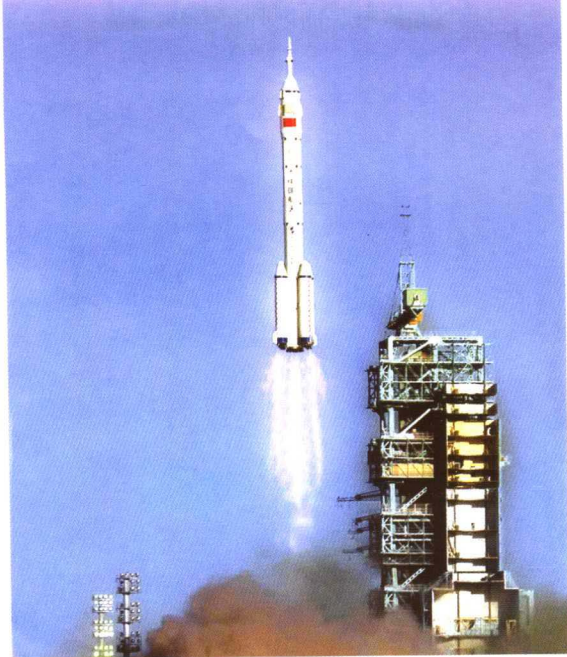
中国科学技术馆 编



中国科学技术出版社

CHINA SCIENCE AND TECHNOLOGY PRESS





N092-64

1

2005

# 中国古今科技图文集

ATLAS OF SCIENCE AND TECHNOLOGY THROUGH  
THE HISTORY OF CHINA

中国科学技术馆 编

COMPILED BY CHINA SCIENCE AND TECHNOLOGY MUSEUM



中国科学技术出版社

CHINA SCIENCE AND TECHNOLOGY PRESS

北京

BEIJING

**图书在版编目(C I P)数据**

中国古今科技图文集 / 中国科学技术馆编. —北京:  
中国科学技术出版社, 2005.5  
ISBN 7-5046-4028-X

I. 中… II. 中… III. 科学技术—中国—图集  
IV. N092-64

中国版本图书馆 CIP 数据核字(2005)第 035716 号

**中国科学技术出版社出版**

北京市海淀区中关村南大街 16 号 邮政编码: 100081

电话: 010-62103210 传真: 010-62183872

<http://www.kjpbooks.com.cn>

科学普及出版社发行部发行

北京盛通彩色印刷有限公司印刷

\*

开本: 889 毫米 × 1194 毫米 1/16 字数: 430 千字 印张: 19.25

2005 年 5 月第 1 版 2005 年 5 月第 1 次印刷

印数: 1-2000 册 定价: 280.00 元

---

(凡购买本社的图书, 如有缺页、倒页、脱页者, 本社发行部负责调换)

# 《中国古今科技图文集》

*ATLAS OF SCIENCE AND TECHNOLOGY THROUGH THE HISTORY OF CHINA*

## 编委会

Board of Editors

主 编 王渝生

Editors-in-Chief Wang Yusheng

副 主 编 李春才 吕建华

Assistant Editors Li Chuncai Lü Jianhua

编 委 (按姓氏笔画顺序)

王兴宽 朱幼文 连 毅 张 瑶 郑艳秋

杨 军 贾彤宇 隗京花 韩小群 褚凌云

Members (Ordered in Strokes of Chinese Surname)

Wang Xingkuan Zhu Youwen Lian Yi Zhang Yao Zheng Yanqiu

Yang Jun Jia Tongyu Wei Jinghua Han Xiaoqun Chu Lingyun

英文翻译 (按姓氏笔画顺序)

冯凯伦 孙江莉 张家继 金 强

周 鹏 欧建成 夏 涵 舒杭生

English Translator (Ordered in Strokes of Chinese Surname)

Feng Kailun Sun Jiangli Zhang Jiaji Jin Qiang

Zhou Peng Ou Jiancheng Xia Han Shu Hangsheng

英译审订 冯志杰

English Texts Finalized by Feng Zhijie

责任编辑 许 英

Executive Editor Xu Ying

封面设计 赵 鑫

Cover Designer Zhao Xin

责任校对 林 华

Executive Proofreader Lin Hua

责任印制 王 沛

Printing Supervisor Wang Pei

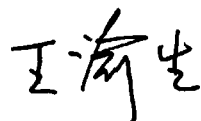
# 序 言

在人类发展的历史长河中，中国作为四大文明古国之一，在自然科学和工程技术领域曾取得过辉煌的成就。中华民族的科学发现和技术发明几乎涵盖了所有的学科领域，特别是以天、算、农、医为代表的科学体系和以“四大发明”为代表的技术成就，在人类发展的历史进程中曾产生过深刻的影响；其中有的还远播到世界各地，或为当地人民所直接采用，或激发了他们进行相关的研究并产生了自己的发明。中国科学院外籍院士、英国著名科学史家李约瑟（Joseph Needham, 1900 – 1995）曾指出，在古代和中古代科学技术发明的许多重要方面，中国人成功地走在那些创造出著名“希腊奇迹”的传奇式人物的前面，和拥有古代西方世界全部文化财富的阿拉伯人并驾齐驱，并在公元3世纪到13世纪之间保持了一个西方所望尘莫及的科学知识水平。

只是到了近代，由于中国封建社会长期发展所形成的超稳定社会结构，严重阻碍了生产力的发展，科学技术的发展也滞后了；而欧洲则出现了文艺复兴、宗教改革，爆发了资产阶级革命，崛起了资本主义生产方式，也产生了近代科学革命，从而使科学技术得以迅猛发展，逐渐把中国远远地抛在了后面。从鸦片战争到中华人民共和国成立的100多年来，由于帝国主义的侵略，中国又逐渐沦为半殖民地半封建社会，科学技术更是受到了极大的摧残。但是，中国的革命先驱、志士仁人，中国的科学家、工程技术人员，在极其困难的条件和恶劣的环境中，不断探索着民富国强、科技发展的道路。中华人民共和国成立迄今50多年来，中国的科技发展经历了一条充满艰辛与曲折、奋斗与辉煌的历程。当今改革开放的中国，神州大地，科技腾飞，我们正在实施科教兴国战略，实现着中华民族的伟大复兴。

古人云，以铜为鉴，可正衣冠；以古为鉴，可知兴替。本书撷取了中国古代科技中天文、指南针、火药、造纸与印刷术、青铜冶铸、陶瓷、机械、纺织、建筑、中医中药和近现代航空、航天、能源、水利工程、生命科学、农业高新技术等方面的成就，编成《中国古今科技图文集》一书，以约30万文字和540余幅图片联袂展现出中国科技发展宏伟画卷之一隅，以期能为继往开来聊尽绵薄之力，并就正于方家和读者诸君，祈望各位不吝指教。

中国科学技术馆馆长、研究员  
中国科学院理学博士、教授



2005年3月16日于北京

# *F O R E W O R D*

**I**n the long process of history of humankind, China as one of the four ancient civilizations of the world once made splendid achievements in natural science and engineering technology. The scientific discoveries and technological inventions made by the ancient Chinese covered nearly all disciplinary fields. In particular, the Chinese nation's scientific system represented by astronomy, calendar, agriculture and medicines, as well as the technological achievements represented by the Four Great Inventions, once produced a profound impact on the historical process of human development. Some of them spread out to different parts of the world where they either were directly adopted by the local people or inspired them to conduct related researches and make their own inventions. As pointed out by Dr. Joseph Needham (1900-1995), the late foreign academician of the Chinese Academy of Sciences and an internationally renowned British sinologist, in many important areas of scientific discoveries and technological inventions of the ancient and medieval times, the Chinese were well ahead of the legendary figures who had created the famous "Greek Miracles" and were on a par with the Arabs who practically owned all the cultural wealth of the ancient Occidental World. Between the 3rd century and the 13th century, China maintained a level of scientific knowledge which was too advanced to bear any comparison in the West.

Unfortunately, in modern times China lagged behind in science and technology due to its super stable social structure formed in the long process of the feudal society, which proved to be a grave hindrance to the development of productive forces. At the same period of time, the Renaissance, the Reformation and the bourgeois revolution successively took place in Europe, which gave rise to the capitalist mode of production, as well as the modern scientific and technological revolution. As a result, Europe witnessed rapid advancement of science and technology, gradually leaving China far behind in this arena. For more than 100 years from the Opium War to the founding of the People's Republic of China, due to the invasion by the imperialist powers, China gradually fell into a semi-

colonial and semi-feudal society, and its scientific and technological development was greatly impeded. However, even under extremely difficult conditions and the adverse circumstances, the Chinese revolutionary forerunners, patriots, scientists and engineering technicians never stopped exploring the road to a strong and prosperous China and to the advancement of science and technology. Over the past half century since the founding of the People's Republic of China, the development of science and technology in China has gone through a course full of difficulties and hardships, as well as struggles and glories. Since its initiation of reforms and opening up a quarter of a century ago, China has been developing rapidly in science and technology, with the implementation of the strategy for revitalizing the nation through science and education, towards the great rejuvenation of the Chinese nation on the Divine Land.

As an ancient Chinese saying goes, by using a mirror of brass, you may see to adjust your attires by using antiquity as a mirror, you may learn to foresee the rise and fall of empires. With 540 pictures and their explanatory texts, *Atlas of Science and Technology through the History of China* presents a corner of the breath-taking panorama of the development of science and technology in the country by compiling the outstanding achievements in astronomy, compass, gunpowder, papermaking, printing, bronze smelting and casting, machines, textile, architecture, traditional Chinese medicine and pharmacology, modern and contemporary aviation and aerospace, energy, hydraulic works, life science, and agricultural high technology etc. through the history of China. It represents our humble dedication to carrying forward our ancestors' cause and forging ahead into the future, and in view of this, we sincerely wish to solicit comments and criticism from scholars, experts and readers.

Director-General/Researcher  
China Science and Technology Museum  
Doctor of Science/Professor  
The Chinese Academy of Sciences  
Beijing  
March 16, 2005





# 目 录



## 上篇 古代科技

■ 第一章 天 文	3/
一、中国古代的天象纪事	4/
二、中国古代的天体测量成就	7/
三、古代历法	18/
■ 第二章 指南针	21/
■ 第三章 火 药	29/
■ 第四章 造 纸	39/
一、纸发明前的书写纪事材料	40/
二、最早的纸	41/
三、造纸原料的发展	43/
四、造纸工艺流程的发展	43/
五、古纸的加工技术	45/
六、造纸术的外传	48/
■ 第五章 印刷术	49/
一、印刷术的出现	50/
二、雕版印刷的发明和发展	52/
三、纸币印刷	57/
四、彩色套印	59/
五、活字印刷术的发明和发展	63/
六、金属活字印刷	67/
七、印刷术的外传	68/
■ 第六章 青铜冶铸	69/
一、先进的采矿技术	70/
二、日臻完善的青铜冶炼	72/
三、高超的铸造工艺	74/
四、精美绝伦的青铜器	77/
■ 第七章 陶 瓷	87/
一、古代陶器	88/
二、古代瓷器	102/
■ 第八章 机 械	119/
■ 第九章 纺 织	137/
一、蚕丝的开始利用	138/
二、原始的纺织技术	140/
三、天上取样人间织——丝绸纹样的演变	145/
四、色彩斑斓的刺绣	151/

■ 第十章 建 筑	157/
一、从巢居到宫室	158/
二、建筑材料	166/
三、寺和塔	169/
四、桥 梁	173/
五、城市规划	175/
六、民 居	178/
七、园 林	180/
■ 第十一章 水利工程	182/
■ 第十二章 中医中药	188/



## 下篇 近现代科技

■ 第十三章 航 空	207/
■ 第十四章 航 天	221/
一、运载火箭与卫星	222/
二、载人航天	230/
■ 第十五章 水利工程	236/
■ 第十六章 能源科技	247/
一、煤 炭	248/
二、石油和天然气	250/
三、太阳能	257/
四、风 能	261/
五、地热能	263/
六、核 能	263/
■ 第十七章 生命科学	266/
一、人类基因组计划	268/
二、杂交水稻基因组计划	269/
三、家蚕基因组“框架图”	272/
四、医用转基因动物	273/
五、克隆动物	274/
■ 第十八章 农业高新技术	276/
一、植物细胞工程育种	277/
二、染色体工程	278/
三、转基因农作物	279/
四、杂交水稻	283/
五、航天育种	285/
六、转基因动物	286/
七、动物胚胎工程	288/
八、生物农药与肥料	289/
九、饲料添加剂	291/
■ 参考文献	292/
■ 后 记	294/

# CONTENTS



## Part I ANCIENT SCIENCE AND TECHNOLOGY

■ Chapter 1 <i>Astronomy</i>	3/
I . Historical Records of Astronomical Phenomena in Ancient China	4/
II . Astrometric Achievements in Ancient China	7/
III . The Chinese Ancient Calendar	18/
■ Chapter 2 <i>Compass</i>	21/
■ Chapter 3 <i>Gunpowder</i>	29/
■ Chapter 4 <i>Papermaking</i>	39/
I . Writing and Recording Materials before the Invention of Paper	40/
II . Invention of Papermaking	41/
III . Development of Papermaking Materials	43/
IV . Development of Technological Process of Papermaking	43/
V . Paper Processing Technique in Ancient Times	45/
VI . Papermaking Extension to Overseas	48/
■ Chapter 5 <i>Printing</i>	49/
I . Origin of Printing	50/
II . Invention and Development of Block Printing	52/
III . Paper Currency Printing	57/
IV . Color Overprinting	59/
V . Invention and Development of Type Printing	63/
VI . Metal Type Printing	67/
VII . Printing Extension to Overseas	68/
■ Chapter 6 <i>Bronze Smelting and Casting</i>	69/
I . Advanced Mining Technique	70/
II . Ever Improving Bronze Smelting	72/
III . Superior Casting Techniques	74/
IV . Bronze Wares Unparalleled in Beauty	77/
■ Chapter 7 <i>Ceramics</i>	87/
I . Ancient Pottery	88/
II . Ancient Porcelain Wares	102/
■ Chapter 8 <i>Machines</i>	119/
■ Chapter 9 <i>Textile</i>	137/
I . The Origin of Silk Utilization	138/
II . Primitive Weaving Technology	140/
III . Evolution of Silk Weaved Patterns	145/
IV . Colorful Embroidery	151/

■ Chapter 10 <i>Architecture</i>	157/
I . From Nest Residence to Splendid Palace	158/
II . Building Materials	166/
III . Temples and Pagodas	169/
IV . Bridge Building	173/
V . The Planning of Cities	175/
VI . Civilian Residence	178/
VII . Gardens	180/
■ Chapter 11 <i>Hydraulic Works</i>	182/
■ Chapter 12 <i>Traditional Chinese Medicine and Pharmacology</i>	188/



## Part II MODERN AND CONTEMPORARY SCIENCE & TECHNOLOGY

■ Chapter 13 <i>Aviation</i>	207/
■ Chapter 14 <i>Aerospace</i>	221/
I . Carrier Rockets and Satellites	222/
II . Manned Spacecrafts	230/
■ Chapter 15 <i>Hydraulic Works</i>	236/
■ Chapter 16 <i>Energy Science and Technology</i>	247/
I . Coal	248/
II . Petroleum and Natural Gas	250/
III . Solar Energy	257/
IV . Wind Power	261/
V . Geothermal Energy	263/
VI . Nuclear Energy	263/
■ Chapter 17 <i>Life Science</i>	266/
I . Human Genome Project	268/
II . Hybrid Rice Genome Project	269/
III . Frame Map of Silkworm( <i>Bomhyx mori</i> ) Genome	272/
IV . GM (Genetically Modified) Animals for Medical Use	273/
V . Clone Animals	274/
■ Chapter 18 <i>Agricultural High Technology</i>	276/
I . Plant Cell Engineering	277/
II . Chromosome Engineering	278/
III . Genetically Modified /Transgenic Plants	279/
IV . Hybrid Rice	283/
V . Plant Space Breeding	285/
VI . Genetically Modified/Transgenic Animals	286/
VII . Animal Embryo Engineering	288/
VIII . New Biological Pesticides and Fertilizers	289/
IX . Feed Additives	291/
■ <i>Reference</i>	292/
■ <i>Afterword</i>	295/

# 上篇 古代科技

*PART I ANCIENT SCIENCE AND TECHNOLOGY*







# 第一章 天文

## *Chapter 1 Astronomy*

中国是世界上天文学发展最早的国家之一。据文献记载，远在4000多年前，尧帝时就设有司天官。随着社会的进步，古代天文学得到迅速的发展。在天象观测方面，公元前16世纪中国就有天象的文字记载，相继留下的关于太阳黑子、彗星、流星、新星、日月五星的记事以及各种星图、星表，内容丰富，年代连续，其中许多还是世界上最早的记录；在天文学理论和天文仪器方面，创造了像浑天说这样颇有见识的宇宙观，发明了浑仪、简仪等光照后世的测天仪器；在历法方面，早在公元前16世纪至前11世纪，中国就已经有了原始历法，经过不断改革完善沿袭至今，它既照顾了朔望月，又考虑了回归年，是别具一格的阴阳合历。

China is one of the countries that started their astronomy earliest in the world. Historical records showed that the officer entitled "Imperial Astronomer" was appointed during the reign of Emperor Shun four thousand years ago. With the progress of the society, the astronomy developed rapidly in ancient China. The written records of sky phenomena observation can be dated back to about 1600 BC in China. As for the phenomenon observation, the ancient Chinese made chronological records of sunspot, comet, meteor, nova, the five planets including the Sun and the Moon in solar system, and various star atlas and catalogues. The records were both rich in contents and continuous in times, and many of them were the earliest in the world. As for astronomical theory developing and instrument making, the ancient Chinese astronomers established the theory of sphere-heaven, a universal view with deep insight, and invented a number of astronomical instruments with far-reaching influence, such as armillary sphere and abridged armilla etc., which was crowned eternal glory. As for the calendar development, the ancient Chinese designed the primitive calendar as far back as 16th-11th centuries BC. Gradually revised and improved, the Chinese calendar still has been using today. It is a unique calendar in which both lunar month and calendar were taken into account in its development.



# 一、中国古代的天象纪事

## I . Historical Records of Astronomical Phenomena in Ancient China

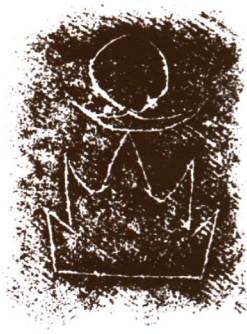
早在新石器时代,中国的先民们就注意到物候与天象的周期变化有密切的联系,于是开始了对日、月等天象的观察。此后,中国人长期不断地辛勤致力于天象的观察和记录,取得了辉煌的成就,至今对于现代天文学的研究仍起到重要的作用,是一份极为珍贵的文化遗产。

As early as the New Stone Age, Chinese ancestors noted the close relationship between the periodic changes of phenology and the sky phenomenon, and had begun observing the Sun, the Moon, and the other sky phenomenon. Since then the ancient Chinese made efforts in observing and recording the sky phenomena over a long period of time and obtained the brilliant achievements. As the most precious cultural heritage, their discoveries still play an important role in the research of the modern astronomy today.

### 1. 天象刻纹陶尊 Pottery Brew Vessel with Engraved Sky Phenomena

距今4500年左右。山东省莒县陵阳河大汶口文化遗址出土。古人用作祭祀日出,祈保丰收的礼器。目前对其刻文大致有四种解释:①释为“旦”;②释为“灵”;③释为“日、月、山”;④释为原始部族的族徽。这几种解释都与太阳有关,说明中国人很早就开始了对太阳的观测。

Unearthed at Dawenkou of Lingyang River in the Juxian County, Shandong Province, this ancient wine vessel was made about 4500 years ago. It was used for offering sacrifices to the Sun and pray for the bumper harvest year. Four explanations about the engraved pattern on the vessel have been given nowadays: it means (a) "Dawn"; (b) "the Spirit"; (c) "the Sun, the Moon and mountains"; and (d) "an emblem of clan of ancient people". All these explanations are related to the Sun, showing that the ancient Chinese had long since begun to make observation of the Sun.



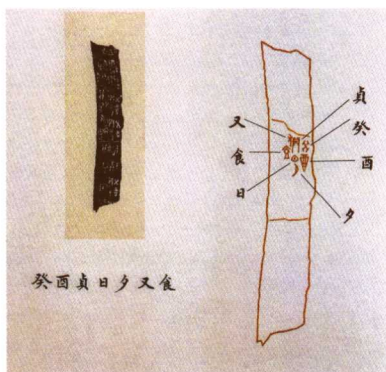




## 2. 日食甲骨 Oracle Bone with Inscriptions of Solar Eclipse

商代（约前 17 世纪初—前 11 世纪）晚期。河南省安阳出土。商代刻在龟甲和兽骨上的文字被称为甲骨文。这片牛骨上的文字“癸酉贞日夕又食”，说明早在 3000 多年前，中国就有关于日食的观测记录。

This oracle bone was unearthed in the Anyang City, Henan Province, dating back to the late Shang Dynasty (about the beginning of 17th century BC-11th century BC). The inscriptions on cattle bones or tortoise shells during the Shang Dynasty were called the oracle bone inscription. The inscriptions on this cattle bone means “A solar eclipse occurred again on the day of Gui-You.” (Gui-You, the tenth day of the sexagesimal system of traditional Chinese calendar), indicating that the ancient Chinese had made the observation records of solar eclipses over three thousand years ago.



## 3. 月食甲骨 Oracle Bone with Inscriptions of Lunar Eclipse

商代（约前 17 世纪初—前 11 世纪）晚期。河南省安阳出土。牛骨上刻有“壬寅贞月又食”，记录的是公元前 1173 年 7 月 2 日发生的一次月全食。

It was unearthed in the Anyang City, Henan Province, dating back to the late Shang Dynasty (about the beginning of 17th century BC-11th century BC). The inscriptions on this cattle bone means “A lunar eclipse occurred again on the day of Ren-Yin.” (Ren-Yin, the 39th day of the sexagesimal system of traditional Chinese calendar), recording that a total lunar eclipse occurred on the second of July, 1173 BC.

