

科普英语注释读物  
《科学的演进》系列丛书

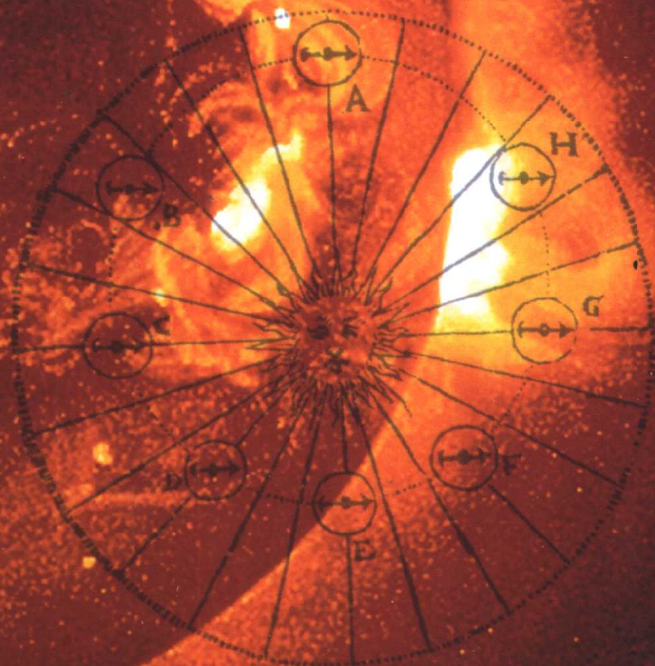
# 运动中的宇宙

— 哥白尼和太阳系

**Moving Heaven and Earth**

— Copernicus and the Solar System

John Henry 著



重庆大学出版社

本书由英国 ICON 公司授权出版  
北京版权代理有限公司代理  
版贸核渝字 2002 第 3 号

Text copyright © 2001 John Henry

The author has asserted his moral rights.

No part of this book may be reproduced in any form, or by any means, without prior permission in writing from the publisher.

### 图书在版编目 (CIP) 数据

运动中的宇宙:哥白尼和太阳系 = Moving Heaven and Earth: Copernicus and the Solar System / (英) 亨利 (Henry, J.) 著; 钟原越导读. — 重庆: 重庆大学出版社, 2002. 10

(科学的演进系列丛书)

ISBN 7-5624-2726-7

I. 运... II. ①亨... ②钟... III. 宇宙学—自然科学史—英文 IV. P159-09

中国版本图书馆 CIP 数据核字 (2002) 第 068027 号

《科学的演进》系列丛书

运动中的宇宙 — 哥白尼和太阳系

John Henry 著

钟原越 导读 向朝红 审定

责任编辑: 赵娜 方天隆 版式设计: 杨古月

\*

重庆大学出版社出版发行

出版人: 张鸽盛

电话: (023) 65102378 传真: (023) 65103686

网址: <http://www.cqup.com.cn>

全国新华书店经销

重庆华林印务有限公司印刷

\*

开本: 850 × 1168 1/32 印张: 6.375 字数: 114 千

2002 年 10 月第 1 版 2002 年 10 月第 1 次印刷

印数: 1—5 000

ISBN 7-5624-2726-7/N · 6 定价: 12.00 元

## 序 言

美国政府在普及文化知识的过程中,曾实施了 RIF (Reading Is Fundamental),即“阅读是最基本的”计划。阅读不仅让我们获得各种各样的知识,也是培养、巩固和提高语言技能,特别是阅读理解能力的重要手段。

在外语学习中,阅读也受到普遍的重视。著名应用语言学家克拉申(Krashen)曾提出输入假设(Input Hypothesis):认为第二语言的习得必须有可理解的输入(Comprehensible Input);同时,语言输入还需要达到足够的量(Adequate Exposure)。在我国,阅读已成为绝大多数英语学习者学习英语的主要方式,教材是接触英语的主要媒介。众所周知,英语语言浩如烟海,要想把英语学好,光靠阅读教材是远远不够的,必须有足够的课外读物作为补充。目前,我国市场上的英语课外读物虽然琳琅满目,但科普读物较少,面向大学生和研究生的科普读物则更加匮乏,难以满足需求。《科学的演进》系列丛书正是在这种背景下引进的。

本系列丛书由在英国和新西兰著名大学讲授科学史的教师撰写,英国 ICON 公司 2002 年出版,共 13 册,内容涉及天文、地理、数学、计算机、医学、生物学、哲学



和历史学等领域。作者们通过讲述科学发展的历史,在让读者领略科学研究的乐趣、矛盾和斗争,增强人们战胜困难的信心和勇气的同时,也让读者学到了地道而实用的现代英语。

在保持原著原文不变的前提下,为帮助读者阅读和理解,本丛书以导读和注释的形式增添了三个部分内容:即 Guiding Questions(引导性问题),Footnotes(脚注)和 Reflection(反思)。Guiding Questions 置于一章之前,以调动读者的思维,激活读者大脑的认知图式(Cognitive Schemata),使读者在阅读过程中处于积极认知的状态;参照我国大学生的英语水平,Footnotes 为同页的生词注释了国际音标、词性和词义,并对相关的文化背景和语法难点作了简短的解释;章末的 Reflection 是对该章内容的小结,也是对 Guiding Questions 中部分问题的回答。读者可根据自己的需要,决定 Guiding Questions 和 Reflection 的阅读顺序。本系列丛书可作为大学生及研究生的英语课外读物,也是广大英语爱好者自学英语的理想材料。

最后需要说明的是,本丛书的内容仅仅是一家之言,如读者能由此而激起阅读的热情和对科学的兴趣,那就是我们最大的欣慰。另外,由于导读者水平有限,如有不妥之处,敬请批评、指正。

向朝红

2002 年 8 月

# Contents

## Acknowledgements

<i>Science or insanity?</i>	2
<i>Nothing new under the Sun</i>	6
<i>Astronomy rules, OK?</i>	13
<b>2 Why Did Copernicus Say the Earth Moves?</b>	16
<i>Heavenly orbs</i>	17
<i>Science or art?</i>	23
<i>Ptolemy and the decline of cosmology</i>	35
<i>How to avoid a crisis: the medieval stand-off</i>	44
<i>How to create a crisis: Nicolaus Copernicus, cosmologist</i>	58
<b>3 Who Was Copernicus?</b>	69
<i>Why Copernicus?</i>	70
<i>Life and times</i>	71
<i>Renaissance man</i>	82
<i>Renaissance mathematician</i>	96
<b>4 What Was the Reaction?</b>	103
<i>Small beginnings</i>	104



	<i>Copernicus and the astronomers</i>	105
	<i>Copernicus and the Churches</i>	115
	<i>Copernicus and the Aristotelians</i>	136
<b>5</b>	<b>What Difference Did it Make?</b>	147
	<i>A world of difference</i>	148
	<i>One physics or two?</i>	151
	<i>How the Earth moves</i>	155
	<i>Space : the final frontier</i>	170
<b>6</b>	<b>Last Words</b>	176
	<b>Glossary</b>	182
	<b>Further Reading</b>	192

科普英语注释读物  
《科学的演进》系列丛书

# Moving Heaven and Earth

## — Copernicus and the Solar System

---

### 运动中的宇宙 — 哥白尼和太阳系

*John Henry* 著

钟原越 导读  
向朝红 审定

重庆大学出版社

## ■ *Science or insanity*<sup>①</sup>?

Death and taxes are often said to be the only certainties, but there's something else. The Earth certainly doesn't seem to be moving. No matter what the scientists tell us about the way the Earth rotates on its axis, so that someone standing at the equator<sup>②</sup> is moving around the centre of the Earth at a speed of over a thousand miles per hour, it all seems perfectly still. We all believe what we are told about the Earth's revolutions<sup>③</sup> around the Sun, covering a distance of about 584 million miles in a year (which is another 66,000 mph or more), but we are taking it on trust<sup>④</sup>— we can't feel ourselves moving.

Those of us who have read a little further, or who have watched more programmes on Discovery Channel, or who once bumped into a friendly astronomer, might also have learned that we, together with the Sun, are circling around the centre of our galaxy<sup>⑤</sup> at an even more unimaginable speed — roughly 350,000 mph — and that the galaxy it-

---

①insanity /in'sænəti/ *n.* 精神错乱

②equator /i'kweɪtə/ *n.* 赤道

③revolution /revə'lʊ:ʃən/ *n.* 旋转

④take ... on trust 对……不加考察信以为真

⑤galaxy /'gæləksi/ *n.* 银河



self is whizzing<sup>①</sup> through space on a trajectory<sup>②</sup> resulting ultimately from the Big Bang<sup>③</sup> that created our universe ( see the ' Glossary ' section at the end of this book ). But we cannot feel any of this.

It's not just a question of how it feels either. If our senses don't tell us the Earth is moving, it is also true that, for technical purposes, it actually makes sense to assume the Earth is stationary<sup>④</sup>. If you look in a textbook on navigation, for example, you'll see it assumes that the Earth is stationary, and that all the heavenly bodies are revolving around the Earth. The authors of such manuals probably know better than you or me that the Earth is perpetually<sup>⑤</sup> performing a series of complex motions, but they also know that you don't need to know this to steer your boat by the stars. On the contrary, it makes things simpler if you assume the Earth is still and only the stars, and your boat, are moving. Therefore, it is wrong to assume that technical demands must inevitably lead us to a belief in the motion of the Earth. They don't.

So *how on Earth* did we ever come to believe in the motion of the Earth? If our senses and our

---

①whizz /wiz/ *v.* 呼啸而过

②trajectory /'tædʒektəri/ *n.* 轨道

③Big Bang 大爆炸学说(宇宙产生途径假设模式的通俗说法)

④stationary /'steɪʃənəri/ *adj.* 固定的

⑤perpetually /pə'petjuəli/ *adv.* 永恒地



common sense tell us that the Earth is not fast but steadfast<sup>①</sup>, and if it is a requirement of a practically useful technical art like navigation that the Earth be considered stationary, why and how did we ever come to believe that the Earth is whizzing through space with such phenomenal<sup>②</sup> speeds? If we just set aside for a minute what we have taken on trust since we were schoolchildren, the idea that the Earth is moving just seems totally crazy. It can't *really* be moving, can it?

Yes it can, and what's more we now all believe that anyone who *denies* the motion of the Earth must be a crank<sup>③</sup> or a fool. So how has it come about that it is now crazy to deny what actually seems to be a crazy idea? The short answer is that we all now recognise the intellectual power and authority of science. Even if we don't know much about the details, we know that a moving Earth is bound up with the latest astronomical and cosmological<sup>④</sup> ideas, which in turn are bound up with well-established theories of modern mathematical physics. We also have a strong sense, even if we can't follow the technical demonstrations, that this

---

①steadfast /'stedfɑ:st/ *adj.* 固定的

②phenomenal /fi'nɒminəl/ *adj.* 显著的

③crank /kræŋk/ *n.* 古怪的人

④cosmological /kɒzmɒ'lɒdʒikəl/ *adj.* 宇宙论的

same edifice<sup>①</sup> of mathematical physics has led to most, if not all, of the high technology that is now such an indispensable part of our lives. It is part of our scientific worldview that the laws of nature are so all-pervasive<sup>②</sup> and so interconnected with one another that to reject the claim that the Earth moves would somehow have to entail<sup>③</sup> not only, say, a denial that we ever landed men on the Moon, but also that television sets work.

But, of course, there hasn't always been this kind of faith in the power and pervasiveness<sup>④</sup> of scientific knowledge. Like everything else, our modern worldview has its history and its historical origins. If it is possible at all to pinpoint<sup>⑤</sup> a single initial source from which the modern physical sciences developed and spread out, explaining more and more aspects of our world as they did so, and leading to more and more technical innovations, the most likely contender<sup>⑥</sup> for the starting point would be Nicolaus Copernicus's (1473 — 1543) claim that the Earth is in motion.

One of the main aims of this book is to explain

---

①edifice /'edifis/ *n.* 体系

②all-pervasive *adj.* 遍及各个方面的

③entail /in'teil/ *v.* 使(事件、行动)成为必需;需要

④pervasiveness /pə'veisivnis/ *n.* 无所不在

⑤pinpoint /pin'point/ *v.* 查明

⑥contender /kən'tendə/ *n.* 竞争者



how it was that a highly technical astronomical theory, far beyond the mathematical competence and the understanding of all but a very few people, came to have such far-reaching repercussions<sup>①</sup>. Along the way we will come to see why it was Copernicus's claim (first published in the middle of the 16th century) that was to have this seismic<sup>②</sup> impact, rather than one of the various earlier suggestions that the Earth might be in motion.

### ■ *Nothing new under the Sun*

Earlier suggestions? Yes, Copernicus's assertion that the Earth is in motion is historically the most important, but it wasn't the first. Indeed, the suggestion is almost as old as theoretical astronomy itself. Although there is abundant evidence that attempts to keep track of the heavenly bodies (and to use the knowledge of their movements for calendrical, astrological, ritualistic and in some cases navigational purposes) date back to prehistoric times, as far as we know the Ancient Greeks were the first to try to understand how the heavenly bodies were moving. This marked the beginning of theoretical astronomy. At about the same time as

---

①repercussions /ri:pə'kʌʃən/ *n.* 反响

②seismic /'saɪzmik/ *adj.* 地震(引起)的

the Greeks, the Babylonian<sup>①</sup> civilisation also regarded the study of the heavens as having the utmost importance. But they seem to have concentrated exclusively<sup>②</sup> on making accurate records of heavenly movements in order to discover the various repetitive cycles and thereby make accurate predictions. The Ancient Greeks, however, wanted to know what was going on in the heavens. What was it that accounted for the movements of the heavenly bodies?

Some Ancient Greek astronomers and philosophers seriously considered that the Earth might be in motion. Copernicus himself mentions some of these in the preface of his book, *On the Revolutions of the Heavenly Spheres*<sup>③</sup>, which he published in 1543. Quoting from a summary of the ideas of the Greek philosophers that had been written in Ancient times, Copernicus tells his readers that Hicetas of Syracuse (5th century BC), Ecphantus the Pythagorean (c. 400 BC), and Heraclides of Pontus (c. 390 — 339 BC) proposed that the Earth rotated on its axis, and that Philolaus the Pythagorean (fl. c. 475 BC) believed that the Earth, together with the Sun and the Moon, rotated around a great fire at the centre of the world system. The

---

①Babylonian /bəbi'ləʊnjən/ *adj.* 巴比伦的

②exclusively /ik'sklʊ:sɪvli/ *adv.* 专门地

③On the Revolutions of the Heavenly Spheres 《天体运行论》



Greek astronomer most associated with the idea of a moving Earth, Aristarchus of Samos (c. 310 — 230 BC), was originally mentioned by Copernicus too, although his name was inadvertently<sup>①</sup> left out as the result of last-minute editing of the manuscript.

In any case, Copernicus's great innovation is hardly diminished by these scanty<sup>②</sup> reports of Ancient beliefs. For one thing, the reports are merely passing comments, entirely lacking in detail. The hard work of providing the precise geometrical<sup>③</sup> models required to make sense of a system in which the Sun was at the centre and the Earth in orbit still had to be undertaken by Copernicus. Besides, it's impossible to be sure, but the evidence suggests that Copernicus had already hit upon the idea that the Earth was in motion, and he then looked back to see if any of the Ancients had proposed the same idea. To us, this may seem like a strange thing to do. Why would Copernicus want to detract<sup>④</sup> from his own achievement by pointing out that others had had the idea before him?

We have to remember that Copernicus lived in a different age and shared the general assumptions of his age, just as we share the general assumptions

---

① *inadvertently* /ɪnəd'vɜ:təntli/ *adv.* 出于疏忽地

② *scanty* /'skænti/ *adj.* 不充足的

③ *geometrical* /dʒiə'metrikəl/ *adj.* 几何学的

④ *detract* /di'trækt/ *v.* 减损, 去掉

of ours. We now all believe in progress, and assume that science will lead to new discoveries and new improvements in our lives, new and previously undreamed of ways of exploiting nature for our benefit. But this attitude towards scientific knowledge developed after Copernicus's time. Nobody in his day thought about scientific progress in this way. Wisdom was not something waiting to be discovered in the future, it was something that had once existed in the past, and needed to be recovered. This was an idea that derived essentially from religious beliefs. It was taken for granted that Adam, the first man, knew all things. This is what was meant by the comment in the book of *Genesis*<sup>①</sup>(2, verses 19 — 20) that he named all things. If you know the name of something you know its essence, its very nature. It was believed that this knowledge began to be lost after the Fall<sup>②</sup>, after the disobedience<sup>③</sup> of Adam and Eve, when they were cast out of the Garden of Eden<sup>④</sup>. It was not lost straight away, however, but gradually, over the succeeding<sup>⑤</sup> generations.

This was why the period during which the

---

①Genesis 《创世纪》

②the Fall 人类的堕落

③disobedience /disə'bi:diəns/ *n.* 违抗

④Garden of Eden 伊甸园

⑤succeeding /sək'si:diŋ/ *adj.* 随后的

Ancient Greek philosophers flourished could be regarded as a Golden Age. They were closer in time to the Fall of man and therefore knew more things, had forgotten less, than the people of later ages. If, like Copernicus, you came up with a novel<sup>①</sup> idea, it was important to see if there were any hints of it in the past. If there were not, it surely indicated that your idea could not have been part of ancient wisdom and therefore couldn't be true. So Copernicus needed to know about Ecphantus, Heraclides, Hicetas and Philolaus, and he needed to tell the readers of his book about them. This attitude to the past was taken so seriously that Copernicus's theory was often called the Pythagorean<sup>②</sup> theory.

The fact that none of the claims about a moving Earth ever caught on among the majority of Greek astronomers and philosophers was not too damaging to Copernicus. It was simply a matter of suggesting that the Pythagoreans were more in tune with<sup>③</sup> the original wisdom of Adam, but that most of their contemporaries had already become too ignorant to recognise it.

It wasn't only the Ancient Pythagoreans who argued for a moving Earth. There were two major

---

①novel /'nɒvl/ *adj.* 新奇的

②Pythagorean /paɪ'θæɡəri:n/ *adj.* 毕达哥拉斯的

③in tune with 与……一致



statements about the possibility much closer to Copernicus's own time. The first was put forward by a French philosopher of the 14th century by the name of Nicole Oresme (c. 1320 — 82). Oresme was not a professional astronomer; what he did was simply to show that the arguments put forward by the Ancient Greek philosopher Aristotle<sup>①</sup> (384 — 322 BC) to prove that the Earth must be stationary were by no means certain. In so doing Oresme indicated that the Earth might well be moving without us being able to notice its movement. But he makes it perfectly plain that he didn't really think it was moving. He simply wanted to show that Aristotle's arguments for the necessary stability of the Earth were not as forceful and undeniable as everyone seemed to think. Aristotle was the most dominant<sup>②</sup> and influential philosopher in Oresme's day, and everyone deferred<sup>③</sup> to his opinions, so Oresme's dissent<sup>④</sup> from Aristotle was little more than an intellectual exercise to show that it was possible to disagree with this Ancient authority. Once again, therefore, it would be unfair to let Oresme steal Copernicus's thunder<sup>⑤</sup> as being the

---

①Aristotle /'æristɒtl/ *n.* 亚里士多德

②dominant /'dɒmɪnənt/ *adj.* 占支配地位的

③defer /di'fɜː/ *v.* 服从

④dissent /di'sent/ *n.* 持有异议

⑤steal someone's thunder 抢去别人的功劳