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# 宋代的儒学与科学 CONFUCIANISM AND SCIENCE IN THE SONG DYNASTY

乐爱国　著
LE AIGUO

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# 宋代的儒学与科学

# Confucianism and Science in the Song Dynasty

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# 内容简介

宋代儒学是中国儒学发展史上的一座高峰；宋代科学是中国古代科学发展的高峰。本书通过对宋代儒学与宋代科学的关联性的研究，深入探讨宋代儒学对于宋代科学发展的影响；具体阐述宋代各个时期著名儒家学者对于自然知识以及科学的重视和研究、宋代儒学精神与思想对宋代科学家及其科学研究的影响；尤其是通过对著名科学家沈括、兼通科学的儒者郑樵以及大儒朱熹的个案分析，展现宋代儒学与科学的密切关系以及宋代儒学对于科学的影响，并进一步分析宋代儒学对于科学发展所起的作用。

# Abstract

In the Song Dynasty, the development of Confucianism was in great prosperity, and the development of science was at the peak of ancient science in China, also. Through the study related with Confucianism and science in the Song Dynasty, this book explores the impact of Confucianism in the Song Dynasty upon science in that period of time in a profound way, and elaborates as well as the emphasis and study of famous Confucian in each period on nature and science, and the influence of spirit and thought of Song Confucianism on Song scientists and their relative investigation. Besides, it exhibits the intimate relationship between Song Confucianism on science, and analyzes the effect of Song Confucianism on the development of science especially by case studies of the famous scientist — Shen Kuo, the Confucian proficient in science — Zheng Qiao and the well-known Confucian — Zhu Xi.

This book includes nine sections:

Chapter 1. Confucians' Attitude towards Natural Knowledge in the Initial Stage of Song Dynasty;

Chapter 2. The Development of Song Confucianism and the Study on Nature by Confucians in the North Song Dynasty;

Chapter 3. Shen Kuo: A Scientist Possessing the Spirit of Song Confucianism;

Chapter 4. Zhen Qiao: A Famous Confucian and Scientist;

Chapter 5. Zhu Xi's Idea of Investigating Nature and His Study of Science;

Chapter 6. The View of Nature of Schools of Hu Xiang. Xiang Shan and Zhe Dong;

Chapter 7. Thought of Investigating Nature by Neo-Confucianis in the Final Stage of Song Dynasty;

Chapter 8. The Influence of Neo-Confucianism on the Development of Science in the Final Stage of Song Dynasty;

Chapter 9. Relationship between Song Confucianism and Science.

# 作者简介

乐爱国　男，1955 年 11 月生，浙江省宁波市人。1983 年毕业于华东师范大学哲学系；1986 年毕业于复旦大学哲学系，获硕士学位。现为厦门大学哲学系教授、博士生导师。长期从事中国古代哲学及其与科技关系的研究。已出版学术专著多部，主要有：《儒家文化与中国古代科技》（中华书局，2002 年）、《管子的科技思想》（科学出版社，2004 年）、《道教生态学》（社会科学文献出版社，2005 年）、《中国传统文化与科技》（广西师范大学出版社，2006 年）、《王廷相评传》（合著，南京大学出版社，1998 年）等；发表学术论文《〈管子〉与古代数学》、《朱熹格物致知论的科学精神及其历史作用》、《儒学与中国古代农学》、《〈周易〉对中国古代数学的影响》、《儒家文化背景下的中国古代科技》等百余篇。

# 序

宋代是中国古代知识与文化最为繁荣的时期之一，在文学、历史、社会以及政治等诸多主题，都表现出欣欣向荣的局面，出现了大量的著作以及各种讨论和争论。然而，最为重要的是，随着这个时期主要儒家学者在确立重要问题和文本的依据上所发生的观点上的改变，儒家哲学从根本上得以重新定位。这就导致了我们称之为"新儒学"，或"道学"的出现，并自宋代之后，一直影响着中国的知识界。

在新儒家的思想和实践中，有一些因素促进了新儒家学者对于自然现象以及科学技术诸学科的兴趣。首先是"格物"学说，这是自宋代之后儒家认知与道德践履的基础。由于新儒家把"格物"定义为探讨"物之理"，由于天下之物皆有其理，并体现一个普遍的理，即天理，所以，对于他们来说，每一事物都是值得研究的。自然界的"物"，包括物体和现象，并不排除在"物"的概念之外，这样，关于自然现象的知识和理解就在他们的格物践履中具有了一定的地位。

把自然现象与某些重要的哲学术语和概念相联系，也会使得新儒家学者对它们产生兴趣。比如，"天"这一概念受到重视，使得天文历法这一涉及自然之天的学科变得重要。另一方面，地理和风水则与"天地"的另一半联系在一起。作为儒家的礼的组成部分，音乐的重要性使得与之相关的律吕学变得重要。同样，《易经》以及其中的思想和卦象受到重视，可以使那些运用其知识而形成的象数、占卜和炼丹等学科变得重要。炼丹，尽管是那些道士专家所从事的技艺之一，但对于儒家学者来说，也是很重要的，因为它往往被看作是得"道"的一种手段，尤其是在"内丹"中。

那种所谓自然界中潜藏着道德法则的思想也起了重要的作用。在北宋，这种古老的思想再次得到了重视，并导致对于天地自然的兴趣越来越高，因为天地自然提供了一种"道德的宇宙论基础"。历来只是集中于人文与社会问题的儒学讨论，对某些宇宙论问题表现出极大的兴趣，新儒家思考的领域得以扩大，包括了自然界的大多数领域。

儒家学者常常要对被认为是圣人所写的——或至少包含圣人重要思想的——经典所述及的自然物体和现象作出论说，尽管他们实际上所重视的是对于圣人大义的阐释。科学技术各学科的知识还出现在儒家学者所广泛研读的其他文本中，特别是经典的标准注释以及官方的史书中，而后者几乎总是包含了有关天文、历法、乐律、地理以及礼乐方面的论述。儒家学者对这些注释和论述的

有关部分进行了研究，而且，他们的理解往往达到了一个相当高的水平。

最后，这些学科的某些知识，对于许多为官的儒者来说，是非常重要的，因为他们履行官职实际上需要这样的知识。尽管行政机构中确实有一些部门完全从事于某些专门学科的研究，拥有许多专家，但是，只有具备广泛知识的官员才能更好地面对那些涉及专门知识的工作，不管怎么说，他们必须管理和监督手下的那些具有专门知识的官员。

由于以上因素，加上其他可能的因素，宋代许多儒家学者的确显示出对于科学技术各学科的非常广泛的兴趣和知识。然而，他们大多数对于自然界的兴趣只是第二位的——次于他们所最关心的道德与社会问题。在这个方面，某些儒家的观念以及自以为是也起了某些作用。

而且，就我们最初所谈到的"格物"学说而言，尽管强调要探讨许多具体事物，但是，"格物"践履根本没有涉及认知程序。事实上，作为格物的结果而获得的对于物之理的把握，被看作是心之理与物之理之间的一种"共鸣"。甚至许多个别事物的理，并不是格物践履的真正目标，格物践履的最终目的在于通过许多个别的理达到天理。因此，格物中最关键的步骤在于从那些个别事物的理上升到一个普遍的天理。显然，这一步骤肯定包含了某些超出纯粹认知过程的东西。按朱熹的话说，人除了"明"和"理会"，还需要"工夫"和"养"。因而，儒家学者的道德与认知践履集中于他们对理的探讨之中，而格物践履中的认知因素则融进了其最终的道德目标。格物正是为了维护道德，避免过错。

以上所概述的是我对乐爱国教授的大作所述及内容的背景的一个大致看法。乐教授是少有的长期致力于宋代儒家知识学研究的学者。尽管这个方面对于理解宋代新儒家的广泛研究领域和多方面的潜能是非常重要的，但是，现代学者几乎完全忽略了这个主题，而一直把他们的注意力集中于道德和形上学问题。从某种意义上说，这些现代学者一直延续了中国元、明时期和韩国朝鲜时期用窄化方式定位新儒家学者的倾向。在这样的情况下，我非常高兴地了解到乐教授，并早在几年前就发现了他的研究工作，而且终于在去年与他相会于西子湖畔。

三十多年来，我自己一直致力于有关宋代知识学思潮问题的研究。但我所关注的是朱熹这一位思想家，而乐教授则涉及到宋代绝大多数的儒家学者。他所讨论的对象不仅包括像欧阳修、张载、吕祖谦和朱熹这样的大思想家，也有其他著名人物，像蔡襄、薛季宣、魏了翁和黄震等。他还讨论了我们称之为"科学家"的人物，比如秦九韶、杨辉、李冶和苏颂等。

乐教授的大作对大量的思想家都进行了讨论，因而不可能对每一个人物都做出详细的论述，而只能专题讨论其中的三位思想家：沈括、郑樵和朱熹。但这部书

是一个好的开端。他收集了所有这些思想家的许多资料，其中有些资料常常是第一次引起我们的注意。他不仅讨论了他们关于自然界的知识，以及他们对于这种知识的态度，而且还就他们在宋代儒学思想发展中的地位和重要性提供了资料，并对他们之间的互动也进行了讨论。

乐教授在收集资料并试图予以梳理方面做出了艰苦的努力。作为多年来的研究成果，这部大作对于那些兴趣于自然知识在宋代儒家学术中的地位的读者来说，无疑是一个有价值的资料库。对我个人来说，读这部著作是一个特别快乐且受益匪浅的体验，因为我能够感受到乐教授在如此之多的宋代儒家学者身上所看到的东西，正是我自己在过去几十年来的研究工作中在朱熹身上所发现的。我相信其他读者也可以从中找到自己满意的东西，可能与我的感受不同，但肯定是有收获的。

金永植*

2007 年 4 月于静裕斋

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* 金永植先生曾于 1973 年在美国哈佛大学获化学博士学位，并于 1980 年在普林斯顿大学获科学史博士学位，曾任国际东亚科学、技术与医学史学会主席，现为韩国首尔国立大学奎章阁韩国学研究院院长、科学史与科学哲学教授。

# Foreword

Song (宋) was a time of great intellectual and cultural prosperity. There were flourishing activities——writings, discussions, and debates——in literary, historical, social and political subjects. The most important, however, was the fundamental reorientation of the Confucian philosophy, with changes in the views of major Confucian thinkers of the period as to what constituted important problems and texts. This led to the emergence of what we call "Neo-Confucianism" (新儒學), or "the School of the Way" (道學), and it came to dominate the Chinese intellectual world ever since the Song times.

There were elements in the neo-Confucian ideas and practices that motivated the Confucians to have interest in natural phenomena and the scientific and technical subjects. First, there was the doctrine of "investigation of things" (*gewu* 格物), the basis of the Confucian intellectual and moral endeavors from Song on. Since the Confucians took the term *gewu* to mean investigating "the *li* of things" (物之理), and since every "thing" (*wu* 物) in the world has its *li* (理) which is a manifestation of the single universal *li*, i. e. the heavenly *li* (天理), for them every thing was worth investigating. The "things"——objects and phenomena——of the natural world were not excluded from their conception of *wu*, and thus, knowledge and understanding of natural phenomena did have a place in their *gewu* endeavor.

Association of natural phenomena with some key philosophical terms and concepts also made Confucians to have interest in them. Importance of the concept of "heaven" (天), for example, made calendrical astronomy (曆法), the subject dealing with the physical heaven, important. Geography (地理) and "geomancy" (風水), on the other hand, were connected with the other half of the term "heaven and earth" (天地). Significance of music as part of Confucian rituals (禮) made the related subject of harmonics (律) important. Similarly, importance of the *Book of Changes* (易經), and the ideas and diagrams in the classic, could be translated into importance of the subjects of "images and numbers" (象數) and

divination (占卜) and alchemy (煉丹) which used them. Alchemy, although it was among the techniques practiced by Taoist adepts, was important for Confucian scholars also, because it, especially in the form of "the inner alchemy" (内丹), was often considered a means to attain "the Way" (道).

The idea that there is a moral order underlying the natural world also played a significant role. This ancient idea gained a renewed importance in the northern Song, and led to a growth of interest in the natural world of heaven and earth that provided a kind of"cosmic basis of morality". Confucian discussions, formerly centered around human and social problems, showed profound interest in certain cosmological issues, and the scope of the neo—Confucians'speculations broadened to cover much of the natural world.

Confucian scholars frequently commented upon natural objects and phenomena referred to in the classics supposedly written by——or at least containing the intentions of——the sages (聖人), although their actual concern was with elucidating the sages'intentions. Knowledge of scientific and technical subjects was also present in other texts widely studied by Confucian scholars——the standard commentaries of the classics and the official dynastic histories, in particular. The latter almost always included treatises on astronomy, calendars, harmonics, geography, as well as on rituals and music. Confucians studied relevant portions of these commentaries and treatises, and their understanding often reached a considerable level.

Finally, knowledge of some of these subjects was important for the Confucians many of whom were officials, because it was actually needed for performing their official duties. Although the civil service did include offices devoted to specialized branches and filled by specialists, generalist officials could still face tasks involving specialized knowledge and, in any case, had to manage and supervise the specialist officials who worked under them.

Owing to the above factors combined, and possibly to other factors, many Song Confucians indeed showed a very broad range of interest and knowledge in various scientific and technical subjects. Yet, the interest of most of them in the natural world was only secondary——secondary to their primary concern with moral and social problems. Certain Confucian ideas and assumptions played some roles in this respect also.

Again, it is the doctrine of *gewu* to which we turn first. In spite of the emphasis on investigating many concrete things, the *gewu* endeavor did not primarily involve intellectual procedures. In fact, man's understanding of the *li* (理) of things, achieved as the result of *gewu* was considered a kind of "resonance" between the mind's (心) *li* and the things' *li*. Yet, the many *li* of individual things and events was not the real aim of the *gewu* endeavor, the ultimate purpose of which was to reach the heavenly *li* via the many individual *li*. The key step in the *gewu*, then, lay in moving from those individual *li* to reach the one heavenly *li*. Clearly, the step must involve something more than a purely intellectual process. In Chu Hsi's(朱熹) words, one needs "laborious efforts"(工夫) and "nourishing" (養) in addition to "knowing" and "understanding". Thus moral and intellectual endeavors of Confucians converged in their search of *li*, and the intellectual elements of the *gewu* endeavor were fused into its ultimately moral aims. It was to uphold morality and to avoid errors that one investigates things.

What I have outlined so far is roughly my view of the context in which the content of Professor Le Aiguo's (樂愛國) present book is set. Professor Le is a rare scholar who has been working on this aspect of the Song Confucian learning. In spite of its importance in understanding the broad scope and rich potential of the Song neo－Confucianism, this topic has been almost completely ignored by modern scholars, who have focussed their attention on the moral and metaphysical problems. In a way, these modern scholars have been continuing the tendency of narrowing down that characterized the neo－Confucian scholars in the Yuan and Ming China, and in Joseon (朝鮮) Korea. In this situation, I was very pleased to hear from Professor Le and find out about his work several years ago. I finally met him in Hangzhou last year.

I myself have been working on this context of Song intellectual climate for the past thirty years or so. But whereas my focus has been on one thinker, Chu His(朱熹), Professor Le covered a great number of Song Confucians. Those he discussed include not only such major thinkers as Ouyang Xiu(歐陽修), Zhang Zai(張載), Lu Zuqian(吕祖謙), and Chu His(朱熹), but also less well known figures like Cai Xiang(蔡襄), Xue Jixuan(薛季宣), Wei Liaoweng(魏了翁), and Huang Zhen(黄震). He also discussed figures whom we can consider as "scientists," Qin Jiushao(秦九韶), Yang Hui(楊輝), Li Ye(李冶), and Su Song(蘇頌)

for example.

Because of the great number of thinkers discussed in the book, Professor Le could not afford to discuss each figure in detail. He could devote a full chapter to only three of them—— Shen Kuo(沈括), Zhen Qiao(郑樵), and Chu His(朱熹). But the book is a good starting point. For all of these thinkers he collected many passages, frequently bringing them to our attention for the first time. He discussed not only their knowledge about the natural world, but also their attitudes to such knowledge. And he did not forget to provide information about their places and significance in the development of Confucian thought in the Song. He also discussed interaction among them.

As the result of many years of Professor Le's painstaking efforts of gathering materials and trying to make sense of them, the book is a valuable store of information for the readers who are interested in the place of natural knowledge in the Song Confucian learning. To read this book was a particularly happy and rewarding experience for me personally, because I could see Professor Le find in so many Song Confucian scholars the very features I found in Zhu Xi in my own work over the past few decades. I am sure that the other readers will find their own satisfaction, different from mine, but nevertheless rewarding.

Yung Sik Kim

# 目　录

# 导　论

## 一、问题的提出

关于宋代文化，著名学者陈寅恪先生指出："华夏民族之文化，历数千载之演进，造极于赵宋之世。"[①]这个论断得到了诸多学者的认同。邓广铭先生说："宋代的文化，在中国封建社会历史时期之内，截至明清之际的西学东渐的时期为止，可以说，它是已经达到了登峰造极的高度的。"[②]漆侠先生认为，"在我国古代经济文化发展的总过程中，宋代不仅它的社会经济发展到最高峰，而且它的文化也发展到登峰造极的地步"。[③] 宋代文化之所以达到登峰造极的高度，其中有两个最为重要的因素：一是宋代儒学进入了新的发展阶段；二是中国古代科学技术在宋代取得了前所未有的进展。[④]

宋代儒学继先秦儒学、汉唐儒学而来，规模宏大，气势磅礴，大师辈出，学派林立。范仲淹、胡瑗、孙复、石介、欧阳修、李觏、王安石、司马光、苏轼、周敦颐、邵雍、张载、程颢、程颐、朱熹、张栻、陆九渊、吕祖谦、叶适、陈亮、真德秀、魏了翁、何基、王柏、黄震、王应麟等诸大儒前赴后继；高平之学、安定之学、泰山之学、庐陵之学、荆公新学、温公之学、苏氏蜀学、象数学、濂学、洛学、关学、闽学、湖湘学派、象山学派、东莱学派、永嘉学派、永康学派、西山学派、东发学派、深宁学派等诸多学派相继崛起。先是欧阳修对儒家经典的作者以及注疏的大胆怀疑，并根据自己的解释，创立义理之学；继而，宋初三先生胡瑗、孙复、石介也直接从儒家经典本身来理解和发挥经学的义理；范仲淹则通过推行庆历新政，改革科举，兴办学校，使儒学得以复兴，因而成为宋学初创时期的领头人。此后，宋学进入了发展时期，形成了以王安石为

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① 陈寅恪：《邓广铭〈宋史职官志考证〉序》。见陈寅恪：《金明馆丛稿二编》，北京，三联书店，2001年，第277页。

② 邓广铭：《北宋文化史述论·序引》，北京，中国社会科学出版社，1992年，第1页。

③ 漆侠：《宋学的发展和演变》，石家庄，河北人民出版社，2002年，第3页。

④ 除了儒学和科技之外，还有宋代教育的发展和史学的兴盛。王曾瑜在《宋代文明的历史地位》一文中指出："宋神宗时，在太学实行三舍法，即外舍、内舍和上舍的升级制度，这是中国以至世界教育史上的首创，实为现代教育分级制的先河。北宋对前代的教育分科有所发展，在太学之外，先后建立武学、律学、医学、算学、书学、画学等……无疑是高等教育实行分科的萌芽。"王曾瑜还引陈寅恪所言"中国史学莫盛于宋"，并且认为，"宋代是中国古代史学的鼎盛期"。见王曾瑜：《宋代文明的历史地位》，《河北学刊》，2006年第5期。