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Newsletter edited by Susan Bennett

The Emperor's New Mathematics

The story of Western learning (*xixue* 西學) in China begins where Joseph Needham's account of mathematics ends, when Jesuit missionaries entered China around 1600 in the wake of European overseas expansion. Over the last decades historians have striven to construct a narrative of Western learning that goes beyond the traditional "China versus the West" dichotomy and retrieves the complex processes by which scientific knowledge and practice circulated both within the Chinese empire and across Eurasia in the early modern age.

The book I have completed during the six years I spent at the Needham Research Institute (*The Emperor's New Mathematics. Western science and imperial authority in China during the Kangxi reign (1662-1722)*. Forthcoming 2011, Oxford University Press) is part of that effort. In the hope of opening a new perspective on the much researched subject of Western learning in China, I have made two choices: firstly, I put its appropriation by the imperial state after the advent of the Manchu Qing 清 dynasty in 1644 at the centre of the narrative; secondly, whereas emphasis had so far been laid on Euclidean geometry, I focus on the role of calculation in Chinese mathematics of that period.

Illustration of the method for measuring with a water-level, from the lecture notes used by the Jesuits to teach mathematics to Kangxi, the *Celiang gaoyuan yiqi yongfa* 測量高遠儀器用法 (Practice of instruments for measuring heights and distances), Ms 75-80D, f. 34 by permission of the Bibliothèque Municipale de Lyon.

My first choice has brought to the fore the second ruler of that dynasty—rather than any missionary or scholar— as a central actor in relation to the mathematical sciences. From the moment he began to rule as emperor, Kangxi 康熙 (r. 1662-1722) sought to play a role in matters where science and mathematics were key. As a teenager, he forced a return to the use of Western methods for astronomical calculations. In middle life, he studied astronomy and mathematics in person, with Jesuits as his teachers. In his last years he sponsored a great compendium on mathematics, astronomy and musical theory, and set several of his sons to work on this project. All this activity formed a vital part of his plan for establishing Manchu authority over the Chinese.

My second choice has revealed the extent to which the Jesuits working for the emperor tailored their teaching to suit his needs, as well as the competition between the methods they taught him and some proposed by Chinese scholars of the time—first and foremost by Mei Wending 梅文鼎 (1633-1721). Mathematics as expounded in the imperial compendium then appears as the result of imperial arbitration of this competition.

A broad range of sources shed light on "the emperor's new mathematics", ranging from manuscript lecture notes prepared for him by his Jesuit tutors, to Chinese officials' accounts of the emperor's careful staging of his mastery of astronomy, and including Jesuits' accounts of their tutoring, the European works they used for that purpose, and correspondence in Manchu between Kangxi and one of his sons concerning the compilation of the compendium on the mathematical sciences. Supplementing the manuscript materials I had collected earlier, the collections of the Institute's Library and the Cambridge University Library provided a wealth of primary sources and most of the secondary literature on the subject as well as an ideal working environment. Relying on all these materials, my book sets out to explain why and how Kangxi made the sciences a tool for securing the foundations of empire, in a way that makes him unique among rulers of major states in the early modern world.

Catherine Jami (CNRS, Paris)

Digging up ancient Chinese mathematics

Until a few decades ago, the earliest known Chinese book dealing with mathematics at any length was the *Jiu zhang suan shu* 九章算術 "Calculation procedures in nine sections", commonly called in English "the *Nine Chapters*". This text gives a systematic account of methods of calculation under a nine-fold division of topics. In the third century CE, the earliest commentator on this book, Liu Hui 劉徽, speculated that it might have very ancient origins, but in fact no one mentions the *Nine Chapters* before the Eastern Han 漢 dynasty (25-220 CE), and there are no earlier contemporary references to anybody writing or studying a systematic text on mathematics of any kind. The situation changed in 1983, when archeologists opened a tomb at Zhangjiashan 張家山 in Hubei province, apparently closed in 186 BCE, and discovered a collection of writings on bamboo strips. Amongst these were 190 strips, once bound together by string into a roll, bearing on the back of one of them the label 筭數書 *Suan shu shu* 'Writings on Reckoning'. Scholars had to wait 17 years for a transcription and (eventually) photographs of this material to be published, but when the contents of the strips were revealed their implications were fascinating. It became clear that the person who put this collection together was not trying to write a systematic text like the *Nine Chapters*, but was simply collecting and assembling a large number of short units of text about calculation, often occupying just one strip, some of them bearing a short title, followed by a statement of a problem and an explanation of how to solve it. Sometimes the unknown writer thought it worthwhile to assemble several explanations, presumably from different sources, saying the same thing in slightly different words. For further details, see my translation available online at: http://www.nri.org.uk/suanshushu.html

The back of one of the bamboo strips bears the label *shu* 數 *'Numbers/numbering'* near its upper end: reproduced by permission of the Yuelu Academy, Hunan University

There has been discussion of whether this kind of writing was typical of the form taken by Chinese mathematical literature in the early imperial age under the Qin 秦 (221-206 BCE) and Western Han (206 BCE – 9 CE) dynasties. Some, like the present writer, think it may have been. Others believe that although we so far have no direct historical or archeological evidence of the existence of systematic books on calculation like the *Nine Chapters* before the Eastern Han, they must have been there somewhere. Historians were therefore intrigued by the recent news that the Yuelu Academy 岳麓書院, part of Hunan 湖南 University, Changsha 長沙, had purchased from a Hong Kong dealer a further collection of bamboo strips, said to be of Qin date and to contain mathematical material. The back of one of these strips bore a label consisting of the single character *Shu* 數, 'Numbers' or 'Numbering' (see illustration). I was delighted to be invited to participate in an international workshop held in Changsha from September 22-23, at which participants were shown the strips and given access to a preliminary transcription. While discussion of this material will no doubt continue for some time, it seems clear that this new material bears a close family resemblance to the *Writings on reckoning*. While in the case of the latter we do have some evidence that the person with whom the text was buried was a not particularly distinguished government official, the fact that the *Shu* collection was not scientifically excavated means we have much less context to go on. But the fact that almost all the problems stated and solved in both collections have at least some motivation in such matters as tax gathering, field mensuration and other official concerns suggest that they originate in the same social milieu.

Here are a few examples of the kinds of material that the *Shu* collection contains: to begin with, no less than four different ways to calculate the area of a circular field, assuming $\pi = 3$:

> *Method for a round field: let the round multiply the round [i.e. square the circumference], and let twelve make one [i.e. divide by 12]. One method: halve the round and halve the diameter, and the field is defined [by multiplying them]; [or] the diameter multiplies the round, and let four make one [i.e. divide by 4]; [or] let half the diameter multiply the round, and let two make one [i.e. divide by 2].*

The volume of a 'round pavilion' (a cone with the top sliced off) is given as:

> *Method for multiplying a round pavilion: Take the upper circumference, and take the lower circumference ... multiply each by itself. Then by the upper circumference multiply the lower circumference, multiply [the combined results] by the height, and form 1 from 36 [i.e. divide by 36].*

Once more, the assumption is that $\pi = 3$. The most surprising feature of the text is this problem, which may have been solved using the so-called Pythagoras theorem – found in the *Nine Chapters*, but not in the *Writings on Reckoning*:

> *... There is a round log [partly] buried in the ground [lying horizontally]. We do not know its size. Cutting [into the part above the ground], if we go 1 cun into the timber we get a width of 1 chi [1 chi = 10 cun]. Question: how big is the circumference of the timber? Then: halve the width to get 5 cun, let it be multiplied [by itself]; take the depth 1 cun to be the divisor, then increase it by the depth, and that is the diameter of the timber.*

Although I can give no details here, it seems that there may be more materials of this kind to be revealed to the scholarly world in the near future. This is likely to be an exciting decade for historians of Chinese mathematics.

Christopher Cullen

Exciting Encounters of the Chinese kind

In 2007, the Needham Research Institute took a bet on my CV and offered me a four-year studentship for the Department of History and Philosophy of Science at the University of Cambridge. I promised to produce a dissertation about the Chinese mathematician Wu Wen-Tsun 吴文俊 (*1919) and the affection he has developed since the 1970s for traditional Chinese mathematics. NRI resources, coupled with other research libraries in Cambridge, turned out to be surprisingly exhaustive for this topic, but it was clear that the most precious evidence (such as Wu Wen-Tsun himself) had to be sought in China.

I had already spent three weeks in Beijing in 2008, at the very beginning of my PhD course, and had met Wu Wen-Tsun at a lunch. Yet much more could be done. Vague plans for another longer trip began to take shape when the 12th International Conference on the History of Science in China was called to Beijing for the end of June 2010, and the International Conference on the History of Modern Mathematics to Xi'an for mid-August.

These two conferences were both memorable and stimulating. In Beijing, I witnessed the impressive scope and depth of current research on the history of Chinese science, and was confronted from many different perspectives with the topic of Chinese scientific tradition and its value, central to my dissertation. The meeting in Xi'an was a seamlessly organised international gathering, which provided a valuable opportunity to meet famous historians of mathematics from Europe and America in a friendly single-session setting. This event enabled me to add a comparative dimension to my wider interests about 20th century Chinese mathematics.

On my arrival in Shanghai on June 4 I was warmly welcomed by Prof. Ji Zhigang 纪志刚 from Shanghai Jiaotong University, where Wu Wen-Tsun had studied during the period 1936-1940. The hospitality of Prof. Ji, his colleagues and students of the Department of History and Philosophy of Science set up high standards for the rest of the trip. These standards were uniformly met: Prof. Hu Cheng 胡成 at Nanjing University arranged for me to have access to the No. 2 Historical Archives of China, and thus to documents about Wu's work in the Institute of Mathematics, Academia Sinica, in 1946-7. Prof. Lü Lingfeng 吕凌锋 at the University of Science and Technology of China enabled me to have full use of their facilities, including access to electronic journals that will fuel my writing for the rest of my PhD days.

These were shorter stopovers, followed by six full weeks in Beijing. Here I was helped by Prof. Zhang Baichun 张柏春 Director of the Institute for the History of Natural Sciences, but most unforgettably by Prof. Li Wenlin 李文林 of the Academy of Mathematics and Systems Science, Wu Wen-Tsun's workplace since 1952. Board and lodging, access to the Academy library and to its archives, meetings and interviews with Wu Wen-Tsun (see photo) and his distinguished students, would all have been extremely difficult or impossible to arrange without Prof. Li's kindness.

But not only professors can be friendly! Dr. Xiong Weimin 熊卫民, Dr. Guo Jinhai 郭金海 and Dr. Zhao Zhenjiang 赵振江 from IHNS gave me much valuable advice and useful literature. I am also grateful to to Jiang Xi 姜曦 (Beijing University of Science and Technology), for the provision of uncountable material amenities and constant readiness for a chat.

The trip was fully and very generously supported by the Needham Research Institute where I hold the Soon-Young Kim Studentship in the History of East Asian Science and Technology. I am very thankful for this opportunity and hope to show the benefits it gave me in my work.

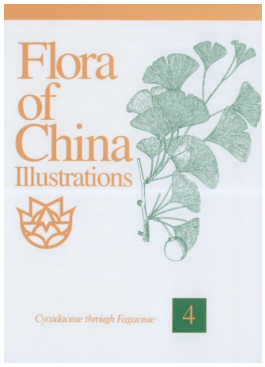
As the Czech saying goes, it's good everywhere but best at home. The bucolic scenery of West Cambridge almost forces you to write!

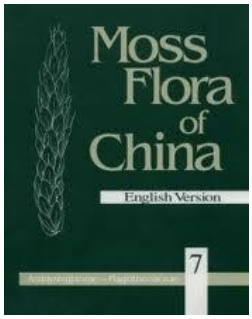
Jiři Hudeček
Needham Research Institute and Department of History and Philosophy of Science, University of Cambridge

Library News

I am pleased to announce that Dr. Needham's collection of 1200 photographs from his time as Director of the Sino -British Science Co-operation Office 中英科學合作館 in China from 1943-1946 are now available on our website at http://www.nri.org.uk/JN_wartime_photos/home.htm . The site includes Chinese language versions of the pages, as well as indexes of persons and institutions. We very much hope that interested parties may be able to provide us with further information about some of the as yet unidentified persons in the pictures.

Acquisitions of books for the library continue, and, as always, we are extremely grateful to all those who have made donations over the past year. One set of books stands out. Over the past few years, the Missouri Botanical Garden has been sending us copies of their magnificently produced *Flora Of China*. We have received the 17 volumes in the series published to date, each with its accompanying volume of illustrations (pictured), as well as 7 volumes of the *Moss Flora of China*. All are being given pride of place in our K.P. Tin Hall. We are extremely grateful to Dr. Peter Raven, President of the MBG, for this most generous gift.





I have visited China twice in the past year. The first was a short trip to Shanghai Jiaotong University in late November 2009 to attend the conference to celebrate the 10th anniversary of their Department of History and Philosophy of Science. The second, in the summer of this year, to Nanjing Agricultural University, where I visited their excellent Institution for Chinese Agricultural Civilization 南京农业大学中华农业文化研究院, and Beijing to attend the 12th International Conference on the History of Science in China. These occasions were of great value both for the acquisition of new books and keeping up-to-date with developments in our field.

SEMINARS

We have been stimulated by the usual rich assortment of presentations in our regular Friday text-reading seminar series. Topics have ranged from funerary genres in Early Medieval China to Korean mathematics and physics education in Japan. We are very grateful to all the speakers and attendees for their part in enriching the academic activities of the Institute. For the current program of seminars, see http://www.nri.org.uk/seminars.html

WORKSHOPS

Two larger scale workshops also took place in the Institute over the past year. As part of the IIAS/NRI workshop series, from 3-4 December 2009 the Institute hosted *Genealogies of Science in Asia: Cross-cultural Appropriation*, with 16 speakers from Europe, China, Korea and the USA. Then, from 24-28 March 2010, *Research Training in Old Chinese: History and Historiography,* one of a special series of meetings for training doctoral students, was held here in conjunction with the Faculty of Asian and Middle Eastern Studies.

John Moffett, Librarian

Don't try this at home ...

Sometime in the 9th or 10th centuries Zheng Siyuan 鄭思遠 wrote an alchemical book called *Zhen yuan miao dao yao lue* 真元妙道要略 'Essentials of the Mysterious Way of the True Origin'. This contains a list of dangerous procedures, including this one: 有以硫黃、雄黃合硝石，并蜜燒之，焰起燒手面，及燼屋舍者: 'Some have combined sulphur and realgar with saltpetre, and heated them with honey [so that] flames have burst forth, burning their hands and faces, even to the point of reducing their houses to cinders'. (See SCC V:7, 112). So when making a programme about explosions for BBC TV, 'Explosions: how we shook the world', the obvious thing was to try it ... outdoors of course. Zheng Siyuan clearly knew what he was talking about.

Christopher Cullen