Innovation Made in Ancient China

The label “Made in China” is not necessarily synonymous with first-class goods today. Indeed, it is generally associated with cheap merchandise or very poor mass-produced copies. And yet, for a very long time, the Middle Kingdom was viewed as a stronghold of culture and inventiveness.

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The innovation culture and copying in China are two topics that have long fascinated sinologist Dagmar Schäfer, who heads an independent junior research group at the Max Planck Institute for the History of Science in Berlin. Schäfer began her examination of this highly contrary characteristic of Chinese culture in the context of a seminar she gave while completing her German postdoctoral lecturing qualification. “The students were asked to explore the following questions: Is Chinese society simply not innovative, or what does the widespread copying and minimal development of the country’s own patents say about the innovation culture of the People’s Republic, for example in the phase of economic modernization? And what was the situation in Imperial China?”

Six Hundred Years of Paper Chaos

This also raised the questions as to which innovations arose when, and how and when they were acknowledged, protected and disseminated in a given culture. Schäfer also recognized the importance of the role played by the textualization of technical knowledge – a topic that would lead the researcher to the history of the Middle Kingdom and become part of her current research project.

The project leader describes the wide-ranging material available to her as follows: “In addition to the private writings of Chinese scholars of the period – that is, their essays and monographs – we mainly use archive material, imperial documents, family genealogies and local histories, as well as objects from museums and other collections.” Some of the texts are published official standard works, while others are purely private in nature; some of the objects are nondescript and mundane, and many others originate from the collections of official institutions, such as the Palace Museum, the First Historical Archive and National Library in Beijing, and the Chinese Academy of Sciences. Some of the material also comes from Taiwan, as documents taken by supporters of Chiang Kai-shek on their flight from Communist China are stored there.

Porcelain is practically synonymous with the technological achievements of old China. The manufacturing process was developed in the 7th century.
So the Berlin researchers can hardly complain about a lack of material for their project. “The archives contain material from 600 years of record keeping,” says Schäfer. Literally and literally clogged with correspondence, delivery notes, household registers and printed technical documents ranging from texts about architecture, bridge building and silk manufacture in general to specific regulations for jujube trees and prayers for the construction of houses and palaces. The historian is enthused by the variety of the texts alone, which in itself says a lot about everyday life in China in the past, and, more significantly for Dagmar Schäfer and her team, about the highly differentiated treatment of technical expertise that served a wide variety of purposes.

 Particularly the archives of the Imperial Palace hold many surprises for the researchers. They had been closed to foreign scholars since imperial times, but access is gradually being granted now, albeit to a very limited extent, as Dagmar Schäfer discovered during a visit to the Palace Museum. “I saw many, many doors, of which one at most was opened.” Clearly, the Palace Museum is not quite ready to divulge all of its secrets just yet. The First Historical Archive provides somewhat more substantial survivals of historical fare, and is currently involved in the digitization of parts of its inventory. “Many of these things have never been seen by anyone,” says Schäfer. The researchers are imposing order on this deluge of archive material and printed texts with the help of a database. Once the general inventory has been completed, it will be time to get to the heart of the matter: What do the historical documents reveal about the forms and functions of knowledge management in old China? What role is assigned to technology and its transformation, progress and preservation? The project is still under way. But without giving too much away, Dagmar Schäfer can already reveal that “technology was embedded in wide-ranging cultural traditions in old China.”

 The researchers in Berlin are particularly interested in documents subject of these texts. Her project attempts to establish how technical innovations are received in general, and when technical things and practices were valued as important insights and recorded in the written culture of China. This leads to other questions, such as how existing lore and also obsolete knowledge were viewed in the course of the appropriation of the new. The ways in which old and new things are assessed depend on many factors, including societal, cultural and historical circumstances. For example, in the past, inventions were not necessarily celebrated as valuable innovations. “As was the case in Europe, ‘new’ was not necessarily a positive attribute, and anything that was old was usually seen as better,” explains Dagmar Schäfer. “The researchers in Berlin are particularly interested in documents in which technical descriptions were integrated into in- instructions for running private house- holds and the state, in social treatises, cosmological studies and political discussions. This was not a whimsical deviation from the main topic, but a component of the text clearly planned by the author. The practical applicability of the content was either not intended at the outset or re- treated into secondary importance over time while the context gained in significance,” says Schäfer.

 By way of example, the researcher refers to a 1094 document by Su Song, the engineer of an astronomical clock powered by a water wheel for Kaifeng, the capital city of the Song dynasty. While he provides a detailed description of the enormous mechanical clock developed by him with text and diagrams, “he was not primarily concerned with conveying technical details. Su Song was canvassing for the attention and support of the Emperor. In his treatise, he stipulates the obli- gations of the son who wished to engage in the study of the skies.” The treatise on military strategy published in 1561 by Qi Ji-guang (1528 to 1587), a successful General of the Ming dynasty, is another example of how the textualization of technical knowledge is not necessarily followed by its practical application. In addition to his focus on traditional martial arts, Qi Ji- guang also devotes his attention in this work to western weapons and provides a detailed description of the designs of a harquebus (a match- lock gun) with an accurate illustra- tion of the attachment screw and nut that locked the gun’s serpentine, or matchlock device. His officers may well have adopted his strategic instructions, but the information about the weapon design with its bolt and screw gathered dust and lay unused in the archive.

 Up to the 18th century, this technol- ogy was used mainly in western weapons. “Although Qi Jiguang’s documentation made the technical information available and disseminated it, the information did not be- come dissociated from its context – in other words, the attachment screw was not used for other pur- poses, nor did it inspire other inno- vations,” explains Dagmar Schäfer. Not all inventors came from the upper echelons of society like the scholar Su Song and General Qi Ji-guang. In many cases, they were craftsmen from ordinary back- grounds of the kind who were the consummate masters of their trades and crafts, but unable to read or write. Like their fathers and forefa- thers, they passed on their knowl- edge orally. “This was common practice in trades and crafts at the time,” says Schäfer. Therefore, they have the – not always voluntary – services of scholars and senior offi- cials of the imperial court to thank for the fact that their knowledge was recorded in documentary form. In view of its importance for the de- velopment of the economy, the em- perors of the Song dynasty and, to an even greater extent, those of the Ming dynasty declared manual trades and crafts a matter of priority, and made their mandarins per- sonally responsible for the flourishing of certain trades.

 The researchers repeatedly found documents of a technical nature dat- ing from as far back as the 10th cen- tury, and ranging in topic from high- ly specialized descriptions of ink manufacture and the extraction of sugar to the weaving of silk fabrics. They also repeatedly encountered documents in which technical de- scriptions were integrated into in- structions for running private house- holds and the state, in social treatises, cosmological studies and political discussions. This was not a whimsical deviation from the main topic, but a component of the text clearly planned by the author. The practical applicability of the content was either not intended at the outset or retreated into secondary importance over time while the context gained in significance,” says Schäfer.

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 Transfer of innovative technologies from the private to the state sector.

 The Max Planck researchers encountered comprehensive material on this state-motivated knowledge transfer in petitions to the throne and local reports of the Ming and Qing periods. The material basis of their research was complemented by collections such as MING JINGSHI WENBIAN, edited by Chen Zilong (1608 to 1649), and HUANCHAO QING JINGSHI WENBIAN by He Changlin and Wei Yuan. Schäfer explains the significance of this collection for the history of science in the following terms: “This enables us to record the state’s influence on the exchange of information by tradesmen chronologically as a factor that historically shaped China’s innovation culture.”
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Thus, the Daode tangru (“Supplement to the Instructions on Great Learning”), (1506), a political manual for senior officials compiled by Qiu Jun (1421 to 1495), demonstrated that the perception and control of knowl-
edge of trades and crafts became an issue of considerable importance for the academically educated elite. “Qiu Jun’s discussion provides an excellent example of the subtle and multi-lay-
ered process involved in the development of the intellectuals’ self-concep-
tion vis-à-vis the manual workers.” Schäfer elaborates further on the in-
terpretation adopted by the project, explaining that the Ming Emperor Zhu Yuanzhang challenged the self-
conception of his officials through the systematic integration of trade and craft workshops into state-run operations: “He ultimately forced them to concern themselves with operations: “He ultimately forced them to concern themselves with operations: “He ultimately forced them to concern themselves with operations: “He ultimately forced them to concern themselves with operations: “He ultimately forced them to concern themselves with operations: “He ultimately forced them to concern themselves with operations: “He ultimately forced them to concern themselves with processes, as they contained strict rules for building and expanding roof structures that display, in their graphical form, a striking simi-
larity with the natural model and the highly stylized architectural art.

A Lack of Young Researchers

In contrast to the abundance of other documentation available to
them, the researchers’ lengthy quest for proper architectural plans and drawings in the archives proved fu-
tile. “It was thought that they simply did not exist in old China,” says the Berlin-based sinologist. That was the situation until 2005, when an exhi-
bition focused public attention on the search for the building plans, and they were finally found among the geographical maps. “That was a real light-bulb moment for us,” she says. This approach to classification is also indicative of a particular perspective on things.

Master builders in old China didn’t really need detailed drawings. All they needed was the diameter of a certain beam to be able to work out the other dimensions.

Crafts like weaving saw a boom in old China. It was the job of the imperial officials to obtain specialist knowledge from the master craftsmen and make it available to the state.

“The twists and turns that could
result from this as the force of habit is not without ba-
sis. However, as the history of the re-
ception of both of these works in old China shows, this form of control of knowledge and its application does not function without limitation. Over time, they were stripped of their prac-
tical applicative nature and became
icons endowed with a quasi-religious
status. Schäfer describes how the pragmatists of the time approached these bibles of trades and crafts thus: “People pretended that they were ob-
serving the rules, but actually used different approaches.”

Moreover, the example of the ar-
chitectural manual Yingzaohanshi clearly demonstrates how the creative
the officials had to be in the textual-
ization of the practical craft-based
knowledge. Because this expertise was traditionally passed orally in old China, there was no correspond-
ing written terminology for building work. The authors thus had to con-
sider the characters they would use to create a specific written architec-
tural language.

As Schäfer’s colleague Feng Jiren
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author of Yingzaohanshi frequently made use of botanical terms. Schäfer re-
counts her colleague’s discoveries as follows: “For example, he often used
the word ‘ma’, which means ‘flower stem’, for a certain type of column.” The author also made use of the language of flowers in de-
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THE STRUGGLE FOR SPECIALIST KNOWLEDGE

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