The Alphabet Advantage: Why Europe Surpassed China Technologically

Matthew Bunday

December 9, 2011

One aspect of the history of technology has always struck me as strange. Why was it that whenever I heard of an ancient technology it was very often invented in China before in Europe, and yet, by the 20th century Europe was so advanced that it was able to defeat China in a series of battles? My argument is that the West gained an advantage because their languages all had character to morpheme ratios that were higher than Chinese. This gave the West an advantage when it came to making use of printing technology. Printing technology was invented first in China, but the huge number of characters required to write Chinese would have made printing impractical. I will now clarify a few important terms.

First of all, it should be clarified that there is no single language know as "Chinese". Although Chinese is often thought of as being a single language, it is really a family of related languages, which aren't even all mutually intelligible. An example of this is the difference between Mandarin and Cantonese. Even among those languages called "Mandarin" there are numerous local dialects.[1] For my purposes I will use "Chinese" to refer to all those languages with a huge vocabulary of characters and low character to morpheme ratios seen all over China.

A character is a basic unit of lexical marking, such as 'a'. A morpheme is the most basic component of meaning in a word. The difference between a word and a morpheme is that a word makes sense on its own, some morphemes do not. Some words are a single morpheme.[2]

To illustrate what is meant by a morpheme, considering the word "desensitize". This word consists of three different morphemes: 'de', 'sensit', and 'ize' each of which contributes a new piece of meaning to the word. The word 'at' contains only a single morpheme. Not that morphemes are not syllables, although a striking aspect of Chinese is that most morphemes are a single syllable (which in turns leads to many words being a single morpheme and a single syllable).

My hypothesis is that China wasn't able to reap the benefits of the printing press because of its language. How did Europe benefit from printing technology? As mentioned in class printing had many wide-ranging beneficial effects including the democratization of learning, the development of scientific study. It also lead to many reform movements, of which Martin Luther's is only one example, which shook up the status quo sufficiently to make huge breakthroughs.

For some perspective, let's compare the developments of technology in Europe and in China in the years between 1000 AD and 2000 AD. Francis Bacon wrote in his 1620 work the *Novum Organum*, "Printing, gunpowder and the compass: These things have changed the whole face and state of things throughout the world; the first in literature, the second in warfare, the third in navigation; whence have followed innumerable changes, in so much that no empire, no sect, no star seems to have exerted greater power and influence in human affairs than these mechanical discoveries."[3] Each of those technologies was invented in China before in the West.

The compass was also invented in China. The Chinese began using magnetic compasses for navigation between the 9th and 11th centuries.[8] Arabs and Europeans were subsequently introduced to the magnetic compass by Chinese sailors.[8] The compass was hugely important because it lead to the possibility of long term trade, such as along the silk road.[9] Without the compass it is unlikely that other crucial technologies, such as gunpowder would have spread as quickly as they did.

Gunpowder was formulated as early as the 9th century by Chinese alchemists.[4] There are various theories for how knowledge of gunpowder was spread to Europe. It may have traveled through the Silk Road, or been introduced by the Mongol invasion in the 13th century.[5][6] William of Rubruck who was a friend of Roger Bacon (who we've been introduced to in *The Religion of Technology*) is mentioned as a possible introducer of gunpowder, since he was an ambassador to the Mongols.[7] Gunpowder's importance is hard to overstate as it lead to a complete revolution in warfare.

One explanation given by historians for why China fell behind Europe is that China didn't develop science in the same manner as the Europeans did. This is true, however I will argue that it is because China did not develop the printing press that it didn't develop a modern sense of science the way Europe did. Comparing te scientific progress made in Europe to China we do not see that China lagged behind in science. Rather, we see the same trend as in other areas of technology. China had accurate astronomy including an understanding of how solar and lunar eclipses worked, an accepted theory of spherical celestial bodies, and more. Chinese alchemy is sometimes derided, but its development was never very different from European alchemy. Both were concerned with creating fanciful substances like an elixir of life, or transmuting less precious metals into gold. If anything, Chinese alchemy was more methodical, and as a result lead to more useful combinations of materials such as gunpowder.

As we have seen in class, there was no true notion of science in Europe until the great boon of printing. Before printing the development of technology was mostly empirical and developed without a theory of how the technology worked. It wasn't until enlightenment era thinkers such as Francis Bacon and Descartes began publishing books on deductive and inductive formal reasoning that science truly began to blossom, and people would not have been able to apply these techniques widely without the printed book spreading the techniques. I also think that the proliferation of books lead to more general theories of science, because researchers in specific areas of technology were able to see what other people

were working on in other fields technology. This allowed them to distill out the common element, a methodological approach towards technology we now call science.

In China reading and writing remained an exclusive domain of the elites. Although in Europe certainly not everybody could read, but access to written material was becoming vastly more open. As we saw in class, Martin Luther's reformation movement could not have gotten off the ground without more people reading the bible.As we know, it was the printing press that gave Europe so much freedom of information.

There have been a number of proposed explanations of why China did not develop the printing press. Among them are that China didn't develop similar technologies that in Europe lead to the printing press. Two pieces of European technology that bear strong resemblance to the printing press were the linen press and the grape press. China did not have linen presses because they used silk as their primary fabric instead of linens. China also didn't have wine presses because there were no grapes in China. This argument feels weak to me, however, because the principles of motion involved in a press of any sort were clearly not unknown to the Chinese. Chinese technology included the conversion of rotary motion to linear motion.

A more likely hypothesis is that movable type wasn't enough of an advantage given the vast number of Chinese characters to bring about the invention of a printing press. Movable type was first invented in China by Bi Sheng in 1040. It was recognized that "If one were only to print two or three copies, this method would be neither simple nor easy. But for printing hundreds or thousands of copies, it was marvelously quick" by the Chinese scholar Shen Kuo who wrote about it not long after its invention.[10]

The problem with using movable type in Chinese is one of logistics. The process Bi Sheng used is described by Shen Kup, "As a rule he kept two forms going. While the impression was being made from the one form, the type was being put in place on the other. When the printing of the one form was finished, the other was then ready. In this way two forms

alternated and the printing was done with great rapidity." To make more forms at a time would have been very difficult, because one couldn't anticipate how often a single character would be used, so one didn't know how many type blocks to make. In English we could simply make more than enough of each letter, and have no worries. In Chinese it would have been prohibitively expensive to make many type blocks for each of the numerous characters that existed. An example of the difficulty encountered by early Chinese printers is the undertaking of Wang Zhen in 1298. He printed one hundred copies of his book "Records of Jingde County" a book cataloging more than 60,000 Chinese characters. The prospect of keeping track of and organizing such a large collection of characters to be reused in printing books is a daunting prospect. The continued use of woodblock printing in China after the development of movable type indicates that movable type probably just wasn't very efficient for the Chinese. In the time it might take a person to find a character that he needed among the collection of some 30,000 characters he owned, he could just carve the character and be done with it.

This raises an interesting issue. If the Chinese writing system was so difficult and unfavorable to use, why has it survived? There is historical evidence suggesting peasants wished to change it at many points throughout history. This is evidence by the discovery of peasant scripts where a small set of characters is used repeatedly for their phonetic value rather than their traditional meanings. These developments were likely squashed by the prevailing intellectual elite in China. Ancient China had a very interesting political climate because traditional Confucian thinking lead to the governments being filled with intellectuals. This had numerous benefits for China, but it also had drawbacks. Due to the elite status of learning, the government often restricted the freedom of information. An example of this is Confucian doctrine against the commercialization of printing. Ruling governments preferred to control such enterprise and continue the elitist traditions of Chinese writing.

To see how history might have turned out differently we can look at the example of Korea,

which is very illuminating. Korea, like Japan, gained knowledge of printing through China. The difference in Korea is that Sejong the Great, a fifteenth century monarch, invented an alphabet for Korean called *hangul* that had 24 characters. He designed this for use by the common people, who had difficulty learning to read and write the Chinese script that prevailed in Korea at the time. This lead to the development in Korea in the 15th century of a printing press that operated in a similar manner to Gutenberg's press.

In conclusion, the printing press was an astonishing piece of technology that lead to a great revolution in Europe in terms of science and technology. I argue that, in opposition to many other hypothesises, the primary reason China did not have a similar revolution was not a deficit in technology nor in science. Rather, a linguistic barrier to the democratization of knowledge was inherent to ancient Chinese, and this made it difficult for early pioneers of Chinese printing to make as great use of their technology as Europeans did. To make matters worse, the prevailing Chinese culture in government made it difficult for a reform in the Chinese language to occur. Chinese could certainly be written with an alphabet, a system for this exists and is widely used today called *pinyin*, but unlike in Korea this development did not occur until much too late.

References

[1] William C. Hannas, *Reflections on the "Unity" of Spoken and Written Chinese and Academic Learning in China*. Sino-Platonic Papers Issue 62 (December 1994).

[2] Mark Liberman, *Linguistics 001 Lecture 7: Morphology*. University of Pennsylvania Linguistics Department (September 2011).

[3] Francis Bacon, *Novum Organum*. London: Longmans (1857-74) Translated by James Spedding.

[4] Brenda J Buchanan, *Gunpowder, Explosives and the State: A Technological History.* Aldershot: Ashgate (2006).

[5] John Norris, *Early Gunpowder Artillery: 1300-1600.* Marlborough: The Cronwood Press (2003).

[6] Kenneth Chase, *Firearms: A Global History to 1700.* Cambridge University Press (2003).

[7] John M. Hobson, *The Eastern Origins of Western Civilization.* Cambridge University Press (2004).

[8] Robert Temple, *The genius of China: 3,000 years of science, discovery & invention (3rd edition).* London: Andre Deutsch (2007).

[9] Richard Bulliet, Pamela Kyle Crossley, Daniel Headrick, Steven Hirsch, Lyman Johnson, David Northrup *The Earth and Its Peoples: A Global History, Volume 2 (5th edition).* Cengage Learning (2010).

[10] Joseph Needham, *Science and Civilisation in China: Paper and Printing.* Cambridge: Cambridge University Press.