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History of Technology 1712

Midterm Question #1

Section 2

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Different Paths: China and the West

Introduction:

For many Centuries China was the most technologically advanced civilization in the world. Its technical achievements included the development of: gunpowder and cannon, paper and printing, ships of exploration (“Junks”), water power technologies, clockwork, magnetic compasses, astronomical instruments, silk weaving, horizontal loom, and the spinning wheel (Burke, p.68 and Layton p. 45,52,67). Yet, despite its technical accomplishments China remained essentially unchanged for hundreds of years. However, when these technologies entered into the Western World they promoted social change, economic expansion, world exploration, trade, empire, and laid the foundations for the Industrial Revolution. The following discussion deals with some of the key Chinese innovations presented above, and explores why their influence was so different in China and in the West.

Paper and Printing:

Cai Lun invented paper for the Chinese in 105 BC (Layton, p.67). By 868 AD the Chinese had developed printing using wood blocks and a water based ink. In contrast Europe did not gain the technology of paper production until the Twelfth Century. Yet, despite its late start the West was to see an information explosion when John Gutenberg invented his famous printing press in 1448.

The social effect of paper and printing in China was limited, by comparison to the West, but was important none the less. Europeans were amazed to learn of the paper money exchanged in China. By 985 AD the Chinese had produced a gigantic printing of the entire Buddhist scripture, the Tripitaka (Layton, p.67). The Chinese government also produced a massive set of

encyclopedias which were then distributed to Temples of Confucius across the country. Literary examinations based on the encyclopedias, and stressing literature, poetry, and philosophy, were taken by individuals trying to obtain government positions. As such, students scoured through the reference works, and were tutored for the examinations by teachers, in effect creating miniature universities.

However, the nature of the Chinese language, and the method used for printing, limited the effect of printing for change. Because of the “hieroglyphic” nature of the Chinese language a separate ceramic type had to be produced for each of the 40,000 words needed to produce a reasonable work (Layton, p.68). Also, because a water based ink was used, no pressure was required to print text on a page. This meant that a printing press was not necessary or practical, and all printing was done by hand. This lack of labor saving devices was supported by the humanistic bias and contempt for technology held by many Chinese. The Chinese government held these views and supported a policy of no unemployment among its people. Because technology was viewed as something that would take away people’s jobs, mechanizing Chinese industries was very difficult.

The complexity of the Chinese language also meant learning to read was a life-long task. This coupled with the high price of printing (associated with no labor saving devices) led to a low literacy rate. Most of the literate were government officials, due to the training required to obtain their jobs in the first place. The high price of printing also meant most printing had to be government sponsored. These factors all contributed to the fact that printing tended to reinforce the status quo, and inhibited originality along with heterodox writing (Layton, p.68).

The impact of printing was drastically different in Europe. The alphabetic script made reading easier and also meant far fewer different characters had to be produced. Also, an oil based ink was used which required a press for printing. With the invention of the Gutenberg Printing Press (including such things as a reusable mold used to make all the standardized movable metal type, and an easily available screw press) the West found itself in an information explosion. This was because of the low start up cost involved in becoming a printer, the fact that books could now be produced very cheaply due to the mechanization, and finally the high literacy rate due to so few characters. Where as printing was government run and acted to suppress new ideas in China, it was privately run and used to spread new ideas in Europe. While

some existing institutions used it for bureaucracy and to spread government proclamations, laws, sermons, etc. it also spread social, political, and religious criticism, accounts of the new voyages of exploration, nautical almanacs, scientific works, and even advertisements for products. As such, paper and printing caused little change in China while they promoted social change, economic expansion, world exploration, trade, and empire in the West.

Gunpowder and Cannon:

In 1250 AD Roger Bacon published a recipe for making gunpowder (Layton, p. 45). Within several Centuries the European nations were producing the sophisticated cannon they would use to control vast portions of the world. Yet, gunpowder had first emerged around 500 AD in China (Layton, p.45), and had resulted in little change. Even by the late 17th Century, and with technical assistance from a variety of Europeans, China still failed to produce effective cannon (Cipolla, p.113-117).

Gunpowder and fire-works were first used by the Chinese in religious ceremonies. It was thought that the loud noises would scare away the little demons called Shan-sao. By the Tenth Century, the Chinese were beginning to use gunpowder for warfare (Cipolla, p.104). They developed several types of defensive weapons including rockets, missiles, grenades, and small bombards. Because China's needs were defensive in nature (keeping out the barbarians), there was little pressure for the technology to advance.

Also, Chinese institutions, and cultural values hindered the development of these weapons. The Imperial Court feared internal bandits and uprisings as much as any foreign enemy (Cipolla, p.118). As such, they did their best to limit the dispersion of gunnery knowledge within China. "To the majority of the scholar-officials...nothing could be less attractive than noisy weapons and military innovations" (Cipolla, p.120). All of Chinese society reflected this "intense contempt for soldiers and military matters" (Cipolla, p.121). Their contempt for cannons was displayed in 1626 when Yuan Ch'ung-huan placed his Fukienese cook in direction of his artillery

This can be contrasted against the attitudes found in the West, where Europeans had a taste for cannon. Bell makers found nothing morally wrong with converting their trade from church bells to the new terror weapons of warfare. The development and manufacture of

cannons received a high level of national priority among the emerging European nations which were trying to knock down the Feudal System (literally by knocking down castles). In essence the West was undergoing a social revolution which was complementing, and being complemented by the technological revolution of cannon.

The manufacture of cannons soon became a major industry in Europe. Countries like England which found new ways of producing high quality cheap cannon (cast iron in this case) gained political power, and the economic strength that was to lay the foundations for the Industrial Revolution. Also the advanced nature of European cannon, coupled with the full rigged ship, meant that they were destined to control the oceans. As such, gunpowder and cannon caused little change in China while they promoted social change, economic expansion, world exploration, trade, and empire in the West.

Ships and Navigation:

The Chinese developed ships, called “Junks”, which were superior to the Western full rigged ships in several ways. Their sails consisted of thin spars which held the sail shape (a major advantage over a lateen sail which being triangular lost half its area) and the hull was compartmentalized so one hole would not sink the ship (these ships were for more than just fishing)! Along with the magnet compass and celestial navigation the Chinese were positioned to make their own voyages of discovery, which they did!

Around 1400 AD Chinese Admiral Zheng He led seven trading expeditions to the Indies, India-Ceylon, and Africa (Layton, p.53). These explorations penetrated as far as the Red Sea, and they would have discovered Europe had the Suez Canal existed. But these voyages of discovery were vastly different from their European counterparts. First, they were huge government sponsored enterprises which were overburdened with bureaucracy, and resulted in vast financial losses. Next, the Chinese government feared the power of the merchants and kept them surprised. Finally, China had no interest in establishing colonies (Layton, p.54). As such, the last Chinese exploration left the Indian Ocean in 1433. Soon after this China dismantled its impressive navy and turned in upon itself.

When Europe gained their sea worthy full rigged ship, the magnetic compass, and celestial navigation they used them to colonize, trade with, and enslave vast portions of the

globe. The European governments had much riding upon the Maritime success of their empires. Because of this they devoted vast resources to improving shipping, and relevant sciences (such as astronomy and cartography). The desire to find sea routes to the East (and thereby going around the Italian middle men) encouraged such establishments as Prince Henry's nautical research and development organization.

But whereas China suffered economical losses by having their government control naval exploration and trade, the Europeans left it to free enterprise and reaped vast profits. Trading companies formed followed by banks, insurance, stock exchanges, corporate forms, and limited liability (Layton, p.53). Technology together with free enterprise proved to be an incredible vehicle of change. Ships, exploration, and navigation caused little change in China while they promoted social change, economic expansion, world exploration, trade, and empire in the West.

Water Technologies and Other Innovations:

The Chinese waterways and irrigation system had always been critical for China. Early in its history China had undertaken vast irrigation schemes which took centralized planing and control. This resulted in the enormously bureaucratic system of government and a rigid social structure which made movement between classes virtually impossible (Burke, p.68). When the Chinese began to develop water wheels on the river system, the Chinese government made a conscious decision to remove the new mills which were blocking trade, irrigation, and causing the undesirable effect of unemployment. Because of a lack of a power revolution China was not in position for an industrial revolution.

However, the West had seen a long period of increasing dependence on inanimate power such as that supplied by water wheels and wind mills. The knowledge gained about gearing and other mechanical principles helped Europe with the development of more complex machines such as the weight driven clock, and the new heat engines which were soon to emerge. Once again we see China suffering from immense technological stagnation. Their highly conservative culture and society could not change, while the West changing radically and was positioning itself for the Industrial Revolution.

Conclusions:

The contrast of China and the West is a very dramatic one. With China we see a very civilized, and advanced nation with many original technological achievements. Why was it that China did not come to dominate the world, as Europe eventually would? It is certainly not because of lack of technological innovations. The answers lies in the mind set of the Chinese nation.

China viewed itself as the center of the universe. It was “civilized” while the rest of the planet was occupied by “barbarians.” Because of this inward view, China had no desire to colonize portions of the planet. This view also made it impossible for China to import foreign inventions. The social structure and massive bureaucracy also limited any chance of change. It was virtually impossible for individuals to raise their social status, therefore there was no incentive to exploit technology for change. The Chinese government distrusted merchants and would not allow the forces of free enterprise, which drove the West, to take hold. China therefore was unable to reap the benefits of its technological achievements.

In contrast, Europe imported these technologies and used them to exploit change wherever possible. In the dynamic West, social and technological innovations complemented each other, and lead to a “feed-back model” where the rate of change was rapidly accelerated. Thus while China remained essentially unchanged by its technological innovations, Europe seized upon the same technical achievements to promote social change, economic expansion, world exploration, trade, empire, and to lay the foundations for the Industrial Revolution.

Works Cited

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