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Contents

Shared Ecological Constraints between Britain and China on the Eve of the Industrial Revolution, How did Britain Breakthrough the Bottleneck?—A review of K. Pomeranz's *Great Divergence* 2
Jing Hoi Chan

A Mission From Jesus Christ: How was the First Modern Asylum Introduced into China? 8
Coco Sun

How was Chinese Porcelain Introduced into Europe through Import and Imitation? 15
Griffin Charlotte

The Impacts of the Columbian Exchange on Chinese Economy and Sino-European Trade in Ming Dynasty 20
Mary Lu

What are the Theories Underlining Acupuncture and What Role did it Play in the Development of Traditional Chinese Medicine? 29
Tin Chan

淺析中國古神獸「狐」的象徵意義 40
李心儀

Between Medicine and Politics: The Manchurian Plague of China, 1911-1919 44
Yim Pan Poon

An Introduction to Artemisia & Artemisinin: What are the Merits and Demerits of Modernising Traditional Chinese Medicine? 53
Sabrina Chann

懸置懷疑與知識 59
蕭瑞洋

跨學科研究與困惑的價值 62
陳曦

淺析宋代社會如何塑造華香文化 67
王安瀾

Editor's Note 編者的話

It is with great pleasure that we present the fourth edition of Bauhinia.

Published annually, Bauhinia showcases a sample of advanced academic research undertaken throughout the academic year by ISF students participating in The ISF Academy Shuyuan program and Cambridge-based Needham Research Institute's Scholars' retreat conducted each summer. The articles contained herein reflect the intellectual curiosity, learnings, and considered reflections of the featured student authors pursuing their own academic interests. They are published in either Chinese or English, according to the choice of the individual author.

The articles published in Bauhinia exemplify the aims and educational philosophy of that underpins The ISF Academy Shuyuan program. Serving as an 'academy within the academy', Shuyuan research projects offer learners in their final years of secondary education an opportunity to extend their academic interests beyond the mainstream school curriculum into disciplines typically reserved for university researchers. The ethos of Shuyuan features the development of advanced academic and research skills, including the framing of research questions, methodical collection of evidence, and deep analysis of often complex problems in a highly eclectic range of research fields.

In this edition, topics include: the introduction of Chinese porcelain manufacturing techniques, the impact of the Columbian Exchange on Sino-European trade, the discovery of artemisinin as a drug of last resort in the treatment of malaria, the politics of international cooperation in the management of the Manchurian Plague in the early 20th century, the first modern treatments of insanity in China, and a review of the fox in ancient Chinese symbolism. These articles are intended to showcase the research skills of the authors, to enlighten the reader, and perhaps to provoke further discussion and research in these important areas of human endeavour.

It is with considerable pride that the Editorial Board invites the reader to explore this fourth edition of Bauhinia.

The Bauhinia Editorial board

我們非常榮幸地向大家推薦這本由「書院」項目編纂的第四期《紫荊花》。

每年出版的《紫荊花》都展示出於過去一年，弘立書院學生在參與「書院」項目及每年夏天於劍橋李約瑟研究所參加學者研習的成果。本書的文章反映了學生作者於追求自己學術興趣時的求知慾、學習過程和個人反思。文章會根據作者的選擇，以中文或英文出版。

在《紫荊花》內發表的文章申明了弘立書院「書院」項目的目標和教育理念。作為「書院內的書院」，「書院」研究項目在中學教育後期為學生們提供了特別學的習機會，將他們的學術興趣拓展到主流學校課程之外，一般為大學研究人員進修的學科。「書院」的精神是發展高階的學術和研究技考，包括規建研究問題，井然收集證據，以及對高階研究領域中經常出現的複雜問題作深入的分析。

本期的主題包括：中國瓷器製造技術的介紹、哥倫比亞交易所對中歐貿易的影響、青蒿素作為治療瘧疾的最後藥物的發現、20世紀初滿洲瘟疫管理的國際合作，中國最初的精神病治療，以及淺析中國古神獸「狐」的象徵意義。這些文章旨在展示作者的研究技巧，啟發讀者思考，並希望能在人類一直奮鬥的重要領域中帶出進一步的討論和研究。

我們編輯委員會非常自豪地邀請各位讀者一同與我們探索這本第四期《紫荊花》。

紫荊花編委會

Shared Ecological Constraints between Britain and China on the Eve of the Industrial Revolution; How did Britain Breakthrough the Bottleneck?

A review of K. Pomeranz's *Great Divergence*

Jing Hoi Chan

This paper is about one very small aspect of one very big question: the Industrial Revolution. The Industrial Revolution was a time of change for Western Europe, and as described by Matthew White, a Research Fellow in History at the University of Hertfordshire, "the great age of steam, canals and factories that changed the face of the British economy forever". In Britain, it started in 1760s and ended somewhere between the 1820s to 1840s. This article will mostly be concerned with the eve of the "Industrial Revolution", around the 18th century. During this period, Britain went through a process of rapid technological innovations, large-scale industrialisation and economic take-off, while China's economy, until then more efficient than Britain's, remained predominantly agrarian. How could this divergence between the two nations be explained? The American historian Kenneth Pomeranz provided his answer to the question in his famous book *Great Divergence*, and this article offers to review Pomeranz's arguments, with a focus on the ecological constraints.

1. Shared ecological constraints between pre-industrial China and Britain

To set up the comparison, Pomeranz argued that scholars should be mindful of choosing units that are comparable in scale: for instance, instead of comparing modern-day sovereign states – Britain with India or China as a whole – we should rather compare Britain with China's economic core, the Yangzi Delta (Pomeranz, 7). He also used two frameworks. The first one is what he called "reciprocal comparison" (Pomeranz 8), which means we should look at a question from the perspectives of both countries that are being compared. For example, instead of just asking the question: Why did China not become Britain? We should also ask: Why did Britain not become China?

Another one of his frameworks is called "encompassing comparison", which means "comparisons between entities that are assumed to be systemically interrelated rather than truly separate" (Pomeranz 10). He does not look at nations as individual units, but the nation's role in a larger unit.

Using these frameworks, Pomeranz's analysis reveals some shared ecological constraints that both Britain and China faced during the 1750s, bearing in mind that these constraints are similar but their extent is different for each country. Here Pomeranz followed the analysis of the 18th century British political thinker Thomas Malthus (1766-1834), best known for his thesis of the "Malthusian Catastrophe", meaning a scenario in which population growth of a society outpaces growth of the production of the four necessities of life: food, fuel, fibre and building materials. Since food production growth is arithmetic, and population growth is exponential, Thomas Malthus believes once the human race passes the tipping point, there would be no turning back. The Industrial Revolution in Britain was able to escape this "tipping point" through their colonies (namely, America), and the inevitable was avoided.

One of the major shared constraints was deforestation. Malthus describes the four necessities of life as food, fuel, fibre and building materials, and wood is needed for three quarters of these necessities. Wood is needed to cook food, to use as fuel and also as a kind of building material (the other main one being stone at that time). This

caused severe deforestation. Even when countries such as Britain turned to using coal, which is more efficient, but very dangerous to mine, wood was still an important resource and trees were still being cut down for fuel, food and for housing. Coal will be talked about in more detail later in this paper.

During 1700s, in some areas of China such as Shandong, they faced very severe deforestation, with only 1.3% of the province covered in forest. Others are less deforested, such as Zhili (current Hebei), with 22.7% of its landmass covered in forest. Britain's deforestation was quite severe too, with only 7.3% of land covered by forest during the 1700s. Britain's forest percentage has been declining since the beginning of the last millennium (1000 B.C.) and only stopped declining and increased/recovered during the 20th century because that was when Europeans began to investigate ecosystems and started to understand the importance of trees, so they started to protect them and plant more.

Deforestation not only destroys ecosystems and habitats, but it also causes dust storms, soil erosion and landslides. With soil erosion, crop yield drops, aggravating the problem of food shortage caused by population growth. It has even been argued that it was because of the deforestation that during the late 18th century, many areas of Europe experienced unusual weather patterns. One unusual rainfall pattern is called the "European monsoon", in which a long period of drought is alternated by very sudden periods of heavy rainfall. This was detrimental as most of Europe did not have a sufficient irrigation system and they were not able to store the water, so a lot of crops either drowned or died of thirst. According to *Land Degradation and Society* by Piers Blaikie and Harold Brookfield, it was worse in 1781 to 1789, where there "was one unusually high climatic variability in western Europe" (Blaikie and Brookfield). In 1782, there was a "wet spring and summer"; in the next year, there were heavy thunderstorms. It was then followed by an "exceptionally cold winter" "followed by a rapid melt and spring hailstorms" (Blaikie and Brookfield)... And this was only the start of a decade of unstable weather.

Scholars are still uncertain what was the precise cause of the "European monsoon", but the fact that it was worse in "badly deforested areas" suggests that ecological pressure at least contributed to it (Pomeranz, 56). Trees help "moderate the seasonality of local rainfall patterns" (Pomeranz, 56) and if an area is too deforested, it would change the weather patterns.

From this perspective, Kenneth Pomeranz argued that 18th century China was better off than Britain because China turned to using other sources of fuel than wood, such as manure. The animal dung would be dried up to use as a kind of fuel as well as a soil fertiliser, and China tried using as much as manure as possible (as much as 40% of the soil fertilisers were manure). The quality of the manure is better in China, because they grew crops in a way that preserved the nutrients better. They also used crop residue as a fertiliser: by leaving the crop residues in the field rather than removing them for fuel, China significantly lessened the risk of losing soil over wind erosion.

The second shared ecological constraint between Britain and China is the shortage of arable land (land suitable for growing crops). Land is needed to grow crops and for building homes, and during the 1750s to 1850s, both China and Britain had a huge boost in population. One major difference was that Britain had a larger boost in the more developed areas whereas China had a population boost in the more rural areas, which puts strain on the resources because more people were sharing a smaller amount of resources. The rate of growth was not even throughout the 100 years: China's population growth was faster during the second half of the 18th century and Britain's population growth was faster during the first half of the 19th century, but as a whole from 1750s to 1850s, the overall population growth of Britain and China was more or less the same, with China's population density being higher than Britain.

Both countries were also faced with soil erosion, largely due to human deforestation. Northern China was even more exposed to this problem, as its soil, nutritious as it may be, is loose in structure and prone to be washed away once the vegetation is

gone, while southern China, closer to the equator, is more exposed to subtropical climatic hazards.

However, 18th century China had better land and water management than Britain, or even most of Western Europe (with the exception of the Netherlands).

Photo 1: Wet rice farming

Both China and Europe practised "crop rotation", which means to grow specific groups of crops or vegetables on a different part of a plot each year, in order to allow each plot to "rest" and restore its fertility in turn. However, crop rotation is believed to be more efficiently conducted in China than in Britain.

China also had more productive agricultural practices. For example, whilst most Northern Chinese dry farms have three nitrogen-fixing soybean plants in a six-year cycle by average, most western European farms only had two nitrogen-fixing clover crops (Pomeranz 227). Nitrogen, along with phosphorus and potassium, are elements that soil needs to stay fertile, therefore having more nitrogen-fixing plants are very important in enhancing soil fertility.

China also practised wet-rice farming in the South, creating its typical landscape of paddy fields. Wet rice farming worked well in southern China where they were growing crops intensively and continuously without rotation, because instead of having the soil carry the nutrients, the water does, allowing the nutrients to get into the plant more easily. The level of water could range from inches to meters, depending on the kind of rice grown. The great number of pigs also provided abundant dung as fertiliser.

The kinds of food a place grows also matter and does affect the fertility of the soil. Here again, South China appears better off than Britain, as it grows high calorie crops, especially rice. Nonetheless, a few (though not many) Western European countries did grow high calorie crops. Ireland and Belgium (both of which had dense populations) grew potatoes in their lowlands as well their highlands because they did not have other high-calorie food to feed their dense population.

Of course, no macro-region of China was completely independent. Three out of the eight or nine macro-regions in China (including Lower Yangtze) imported a large amount of goods such as food and timber from other regions of China; the lower Yangtze in particular imported a lot of bean-cake fertilisers from Manchuria (North- Eastern part of China). Cotton production also greatly depleted the soil. However, as a whole, China is self-sufficient enough to sustain its population even without imported fertilisers from outside. During the 19th century, China was still able to grow enough crops and other edible food sources containing nutrients and vitamin. On the contrary, by the 1800s, many European farmers were unable to sustain their crop growth without importing fertilisers.

2. How did Britain break through the bottleneck?

So why did Britain take-off whereas China didn't, when it was the Chinese who had more efficient and effective agricultural practices? What was Britain's advantage over China? One main reason, according to Pomeranz, was because Britain had colonies to turn to. The New World (America) produced both "land intensive products (cotton, sugar, and later grain, timber, meat and wool) and land-restoring products such as guano" (Pomeranz, 57). Europe, being the second smallest continent (after Oceania), was very dependent on its colonies. It was relatively scarce of people and land, and their colonies, especially America, provided them plenty of what they lacked.

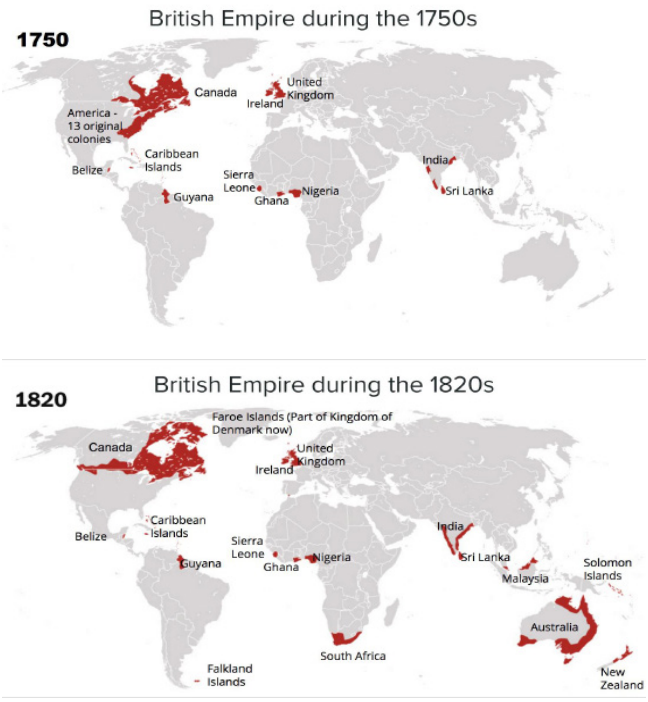

Figure 1. Maps showing the change in British Empire between 1750-1820

Britain particularly depended on imported fertilisers and brought crops from America to Britain. They also used human labour in America, and of course, not to forget the slave trade that was going on between Africa and the British colonies. Even though the British Government and the Act of Parliament abolished the slave trade throughout the British Empire in 1804-1806, the slave trade continued. It is encouraging that the British government decided to do something about the Slave Trade and decided to abolish it, but not everyone followed the rules and not everyone considered how other people feel about their actions and the consequences it brought. We have to face the fact that people, in their pursuit of profit, are sometimes ready to enslave other human beings and treat them like animals.

Another main reason was the location and quality of coal mines. Coal is a fossil fuel that is much more efficient than wood, thus overcoming the ecological constraint posed by the limited forests. Among the four main technological inventions of the Industrial Revolution - mechanised cotton spinning, iron, steel and railways - three involved coal. The Industrial Revolution was therefore largely dependent on coal, and may never have happened at such a large scale nor impacted the world so much without coal. Here lies one of the great divergences between Europe and China: in Europe, the largest coal deposit is fortunately located in Britain, near convenient waterways as well as a dynamic economy; China's location of coal – in the northern provinces such as Shanxi, far away from the economic center of the Yangzi Delta – was not very convenient for such a big country (Pomeranz 57-62).

China, of course, used charcoal for iron production. But since charcoal was made out of wood, it was costly, and further worsened deforestation. Additionally, it was hard to transport in large amounts between long distances because it "[tends] to break into smaller bits (or even dust) when moved very far" (Pomeranz, 60). Therefore, charcoal couldn't have been a viable substitute for coal to prompt an Industrial Revolution in China at the same scale as the one Britain experienced.

Moreover, coal in Britain and in China was different in quality, and prompted different technological inventions. Steam engines were invented in Britain because they needed to pump water out of the mine to dry the coal up. They were nicknamed "miner's friend" because they helped the coal miners making sure that the coal they mined was not wet when it was sold or used. China's coal, however, was too dry, and they needed to pump air into the mines so that the coal would not burn up in the mine. The steam engine sparked off a lot of other inventions such as trains, whereas pumping air into mines did not require an advanced technology. The fact that Britain needed inventions to make sure things were of high quality gave them the chance to develop that kind of advanced and modern technology that turned out to be central to the Industrial Revolution.

3. Conclusion and linking to modern society

To conclude, Britain only broke through the bottleneck of the shared ecological constraints – including deforestation and the shortage of arable land – because they could rely on colonies to provide what they lacked, such as fertilisers and manpower. They also had more conveniently located coal, as coal deposits were near waterways

where it can easily be transported to factories for use. China, however, did not have such luck with their geography as their coal deposits were located far away from the rivers and they were therefore hard to transport, especially considering the vastness of the country. China also did not have colonies to depend on. Nonetheless, from another perspective, China may not have needed an Industrial Revolution at that time because they had better agricultural practices, such as having more nitrogen fixing soybeans planted into the soil and practising wet rice farming.

However, there are also detrimental effects of the Industrial Revolution. Back in the late 18th century, the turn to coal could be seen as a solution to the most formidable ecological problem people then faced, namely deforestation. However, the massive use of fossil fuels such as coal, also created a new problem: greenhouse gas emissions. This led to long term effects including polluting the atmosphere and trapping heat within the atmosphere, causing large fluctuations in the climate. According to NASA, it has changed precipitation (rain) patterns, caused sea levels to rise due to the warmer global temperatures melting the ice in the polar regions, increased the intensity of droughts and hurricanes, as well as increased global temperatures (global warming).

As of 2014, coal is responsible for 39% of the world's carbon dioxide emissions, provides us 40% of the electricity we use, and kills thousands of coal mine workers every year (*Can Coal Ever Be Clean?, National Geographic*). It was an alternative to cutting down trees (which, as discussed above, does cause severe ecological problems), but other problems emerge from burning coal as a fuel.

Presently, China is undergoing a similar industrial change (beginning gradually from the 1950s to 1960s, then shooting upwards in the past 40 years – from 1970s onwards), and China is currently undergoing something similar to the European monsoon – having long droughts followed by violent rainfalls. This makes the Chinese industrialisation process since the past 40 years comparable to the Industrial revolution, but that is an entirely different topic and would not be covered in this paper.

Perhaps, without the Industrial Revolution, these problems would not have arisen. However, the Industrial Revolution was the gateway to modern technological advancements, and it depends on how we use our resources and what we do to maintain a healthy relationship with the environment.

Scientific and technological advancements have caused a colossal problem, but with people addressing and solving it, science can also be the solution. By developing more environmentally friendly solutions such as renewable energy (solar, wind, hydro and geothermal), the problem that is partially caused by us burning fossil fuels such as coal can be mitigated or solved.

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A Mission From Jesus Christ: How was the First Modern Asylum Introduced into China?

Coco Sun

Born in Duncansville, Ohio, John Glasgow Kerr graduated from Jefferson Medical College in Philadelphia in 1847. In 1853, a life-changing opportunity came; it was announced one day that a Chinese gentlemen was coming to America to hold a lecture on medical care in China. The man reported that "disease healing was solely dependent upon drugs without any recourse to operations, so that many suffers from curable ailments were sacrificed or disabled. The death rate in China was higher than in the whole of Europe."[1] Shortly after submitting an application to the American Presbyterian Board of Foreign Missions (APBFM) to go to China, Dr. Kerr arrived in Canton, China in 1854. Then, in 1898, restablished the Kerr Refuge, the first specialized medical facility for the treatment for the insane.

Though mentally-ill patients in both the East and the West are confined in familial or charitable institutions without medical treatment, medieval Europe established their first medical institution earlier on.[2] From this long tradition of confining the insane in religious-run hospices, modern asylums gradually developed since the 18th century where the insane could be therapeutically treated[3]. In China, where patients tended to be dealt in the family household, the very first institutionalized asylum was inaugurated in 1898 by Kerr. In this paper, I shall discuss how missionary investment during the late Qing dynasty has contributed to the implementation of psychiatric methods and how the first modern asylum was introduced and established during the late Qing dynasty.

1. Insanity in Traditional Chinese Society

How did traditional Chinese treat the insane?

Medically, influenced by the famous physician Zhu Zhenheng 朱震亨 (1281-1358), the popular pathology of madness in late imperial China was that mucus clogged the openings of one's heart, which in the traditional Chinese view was identified as the organ responsible for rational thinking, moral judgment, and the control of personal acts.[4] Insanity was treated as a physical, rather than psychic ailment, by means of purging and cooling, etc.

Legally, in the early periods of the Qing dynasty (1644-1911 CE), when the insane is held in custody for insanity-induced homicides, government also adopted medical measures to solve the problem, most often, by taking the pulse of the convict as it was believed that the insane displayed a particular pulse pattern. During the early 19th century, the death penalty was first introduced for insane homicides. However, as Qing officials were aware of the possibility that the insane committed a homicide without an existing declaration, the intrinsic touch of leniency still remained.[5]

Socially, according to missionaries' reports and hospital records during the Qing Dynasty, the Chinese believed the kinship-clan to be socially responsible for the insane. This meant allowing mad relatives to freely wander around the village under the watchful eyes of family members and neighbors,[6] or having the insane relatives locked up in a familial environment. Kerr once wrote, "[the boatwoman] who was found with an iron ring around her neck, to which was attached a chain connected with a ring on the floor of the boat."[7] This graphic description of how mentally-ill patients, like the boatwoman, were treated during the Qing Dynasty allows us to reflect on

1. Cadbury and Jones, 1935, p.102
2. "In Europe and America every State has asylums for the insane, and no cost or labour is spare to perfect the means for the care and comfort of this helpless class of the human family. In all this vast Empire *not a single asylum exists*, and those who are thus afflicted, whether among the poor or rich, are subject to hardship and ill-treatment in many forms, often resulting in premature death." Kerr. 1890. 69.
3. Scull, p.18-20, 43ff.
4. Zhenheng Zhu, *Jin Gui Gou Xuan* (Beijing: Zhongguo Yiyao Chubanshe, 2008), *Juan* 1.
5. "The [Qing] laws were always characterized with forbearance in comparison with the punishment for the same crime committed by a sane person." Zhang. 3.
6. Chiang. 73.
7. Kerr, M.N., undated letter, Presbyterian Archives, quoted from Szto 231.

the broader cultural and historical context in China compared to the West. Kerr also reported that, to avoid the 'loss of face', Chinese families cared for their insane kin rather than to face the humiliation of neighbours and acquaintances. In most cases, insane patients were shackled, caged, occasionally deliberately crippled, and in extreme cases killed.[8]

2. Missionary investment in the 19th Century

19th century missionaries were most concerned with finding the best way to preach the Gospel. Is medicine a legitimate means of evangelization or is verbal sermon the only means? In the New Testament, Jesus Christ is described as "the Great Physician" and healed the lame, blind, demon-possessed, and insane. Jesus described these miracles as "kingdom work," as healing and caring for the society's outcasts and marginalized.[9]

After the first Protestant missionary Robert Morrison traveled to China in 1807, many followed. Coincidentally, in 1834, when Morrison passed away, Rev. Peter Parker, M.D. arrived at Canton, where he became the first full time Protestant medical missionary in Canton. Similar to Morrison, Parker quickly immersed himself in intense language studies and cultural accommodation. It was a common practice among missionaries during the late Qing Dynasty to learn Cantonese and to immerse themselves into the local culture as much as possible. By November 4, 1835, Parker had already learned enough Cantonese to open and operate a medical infirmary with support from local merchants and the American Board of Commissioners for Foreign Missions. The forty-bed dispensary specialised in ophthalmology. The Ophthalmic Hospital, which enabled blind men to see again, is also a Christian symbol. Moreover, the new facility was the first of its kind and was the first step to exposing the Chinese to the curative effects of Western medicine within an institutional setting.

3. Purposes of Missionary Investment

Kerr, who arrived in Canton in 1854, had a strong sense of mission: he saw Western medical missionaries as a source of "a vast amount of knowledge" for the Chinese people "concerning the nature of disease and the methods of curing".[10] Kerr took great pride in his medical profession and in his own writing – *Medical Missions – At Home and Abroad*. Kerr recorded various acts of medical missions across the world, and especially in China. To explain the rationale behind the establishment of the John G. Kerr Refuge, Kerr's short review of medical practices in the East has suggested several purposes of missionary investment:

I. He held traditional Chinese doctors to be incompetent. "The physicians of all semi-civilised nations are entirely ignorant of anatomy and physiology. Not only so, but they have substituted for a true knowledge the most absurd theories, […] there has been no mind capable of rising above the traditions of the past, or of instituting such investigations as would lead to the discovery of the truth.".[11]

II. He believed Chinese medical theories as unfounded. The nature of disease is explained by "the influence of the planets, of the five elements – fire, air, earth, wood, and water, and the disturbance of the equilibrium between the Yam (*yang* 陽) and Yeung (*yin* 陰)."[12] The real virtues of the medical practice is not known, only the properties of simple and common medicines.

III. The lack of proper medical knowledge opened the way to superstitions. "Superstitious notions and practices control and pervert medicine in all unenlightened countries. The idols, astrologers and fortune-tellers are consulted in almost all cases of sickness. Disease is considered

8. Kerr. 1898.
9. Szto 152.
10. *Medical Missions – At Home and Abroad. Kerr. 1878. 3.*
11. *Medical Missions – At Home and Abroad. Kerr. 1878. 5.*
12. *Medical Missions – At Home and Abroad. Kerr. 1878. 5.*

to be the visitation of evil spirits […] To expel the one and pacify the other, charms and amulets are employed.".[13]

IV. In addition to reasons of medical transfer regarding the lack of standardized medical practices, Kerr also suggested that creating a hospital, as an act of benevolence, would contribute to the introduction of Christianity. Kerr wrote, "In unenlightened and unchristianized countries there are no benevolent institutions for the care of the sick and afflicted. […] in no land on the face of the earth where the Christian religion has not prevailed, are there any hospitals or asylums for the poor who are diseased in the body or mind."[14]

Based on Kerr's writings, it is evident that one of the reasons why Kerr decided to arrive in Canton to establish the first asylum is to demonstrate an act of benevolence based upon his Christian teachings. To a certain extent, it is possible to argue that Kerr succeeded and achieved his goal of rising above the "traditions of the past," creating a more civilized Refuge for the mentally-ill. He believes that physicians who were familiar with professional medical knowledge should "look abroad over the world to see that a large portion of the human race is destitute of the benefits of [medical] knowledge and this skill, […] a vase amount of suffering and misery [can be prevented and removed]"[15] and he accomplished such goal with the example of the John G. Kerr Refuge.

4. Establishment of the John G. Kerr Refuge

Although Chinese doctors paid close attention to emotional and mental disorders, no attempt has been made by the mid-19th century to develop a specialized medical institution for the purpose of psychiatric treatment. John G. Kerr, motivated by his Christian teachings on compassion and care towards the insane, believed the best environment to cure the insane was in a safe and structured environment. Without a separate space to handle one's insane kin, Kerr believed that families were forced to deal with difficult and dangerous cases at home.[16]

Long before Kerr came to Canton, he had envisioned establishing a Western social institution as to spread his Christian faith.[17] However, when Kerr arrived in Canton in 1854, before shifting his attention on treating China's insane, he was superintendent of the Canton Hospital founded by Peter Parker. In 1854, Canton was practically closed and remained so until the second opium war with Britain and France. There was also a strong anti-Christian sentiment among the population of Canton. During the second opium war, while Dr. Kerr went to America to attend a further course of lectures at the Jefferson Medical College, the Chinese attacked and burned down most of the foreign houses including the Canton Hospital and drove the foreigners and missionaries out of Canton.[18]

Later, in the 1872 Annual Report of the Canton Hospital, submitted to the Managing Committee of the Canton Medical Society, for the first time, Kerr proposed creating an "object lesson" of Christian compassion and Western benevolence for China's insane.[19] However, the Committee felt that building an insane asylum would be too costly. Also, the conservative Committee saw the proposal as outside the bounds of medicine and evangelization, rejecting Kerr's proposal of establishing an asylum in Canton.

After Kerr struggled for twenty-six years, the day finally came in 1897 when the way opened unexpectedly for Kerr to erect the first two buildings of the "Refuge for the Insane" after an anonymous donation was made by a Chinese citizen. The asylum was located at a rural suburb of Canton called Fong Tsuen as Kerr believed that the location was critical if the insane asylum was to truly provide "Refuge" from the exigencies of urban life. Kerr's selection of a rural location also reflected the Anglo-American thinking about segregation and curing. It was widely believed that medical treatment required a quiet and isolated location, similar to an oasis. The effort all seemed

13. *Medical Missions – At Home and Abroad. Kerr. 1878. 7.*
14. *Medical Missions – At Home and Abroad. Kerr. 1878. 8.*
15. *Medical Missions – At Home and Abroad. Kerr. 1878. 4.*
16. Scull. St. Martin's Press 1979.
17. Szto 135.
18. Selden 367.
19. Selden, 1937, p.707; *Canton Medical Hospital Annual Report*, 1872.

worth it. Firstly, a specialised and centralised medical space was available for the insane for the first time in Chinese history. It offered appropriate medical care for the insane, where they were not dealt as potential criminals. Secondly, the asylum provided an institutional alternative to China's kinship-clan system. With the establishment of the Kerr Refugee, households no longer had to bear the responsibility for taking care and sheltering their insane relatives without adequate social supports as psychiatric service. Professional care outside the kinship-clan sphere was now available.[20]

At the age of seventy-four, Kerr admitted his first few patients to the Refuge and these first patients had all been restrained in their family household for over two years. To Kerr, these helpless individuals symbolized the inadequacy of Chinese households to provide proper care.

Kerr knew that the Chinese perceived missionaries as "foreign devils" (*guilao* 鬼佬) and therefore, it was important for him to practice medicine with integrity and to display genuine piety in order to convince the Chinese of his sincerity.[21] Kerr's intentions of assisting the sufferings were heavily based on Christian ideals. In *The Native Benevolent Institutions of Canton* by Kerr, he wrote, "Attention to the sufferings and wants of those who cannot help themselves, as much indicates the development of the higher qualities of our nature as cold indifference to the miseries of men, women and children exhibit the predominance of selfishness and hard-heartedness."[22] Looking at the case of the Kerr Refuge, Kerr's motive was based on his attention to 'those who cannot help themselves,' namely the helpless patients that were chained and locked up under the eye of their relatives and neighbours. His efforts of gaining trust from the Chinese bore fruit. A Hong Kong newspaper wrote, "No missionary in South China has left behind him a grander work or more honoured name than Dr. Kerr"[23] Based on this newspaper report, it is clear that Kerr's talent and success has demonstrated an act of benevolence across international borders. Kerr's Refuge not only represented the "Holy Grail of scientific medicine for doctors," but also met the desire of families and society to shelter the seriously disturbed and ill.

5. Instruments and psychiatric methods used during late 19th century

Soon after the Refuge was built, Kerr passed away in 1901 and the responsibility of the superintendent was passed onto another medical missionary, Charles Selden. "Under Selden's regime, treatment at the Refuge consisted of a humanitarian approach (occupation, recreation, freedom within the grounds, respect for patients) combined with drugs." Specific drugs that were employed in the treatment were "hyoscine (a sedative and antispasmodic which may also have had antidepressant properties), paraldehyde (a sedative), and Erlenmeyer bromide (potassium bromide, an anticonvulsant and sedative used before the discovery of phenobarbital in 1927)."[24] Warm baths and methods of Selden's own invention were also employed for physical restraint with minimum discomfort to the patients. The treatments and their underlying principles were follows, quoted from the report of years 1907 and 1908:

Figure 1. Benjamin Rush's "Tranquilizer"

20. Szto 232.
21. Szto 136. *Canton Medical Hospital Annual Report*, 1872
22. Kerr 88.
23. Kerr, 1936, p.114
24. Pearson. 150.

Principles underlying treatment:

I. These people are ill. If they act and speak unreasonably, it is not their fault.

II. This is a hospital, not a prison.

III. Though insane, these patients are yet men and women – not beasts.

Treatment:

I. The power of persuasion with – in the necessary cases – the minimum of force.

II. Freedom with – in the few cases necessary – the minimum of restraint.

III. Out-of-door life, exercise, employment; rest, warm baths; kindness mingled with firmness with – in the necessary cases – the minimum of medicine.

Though no records have been left regarding specific types of instruments and methods used at the Kerr Refuge, it may be assumed that the Kerr Refuge employed similar psychiatric methods as other contemporaneous asylums around Europe and America, which he learnt from the Pennsylvania Hospital, America's first private medical facility. For one, the belief in the necessity of distinguishing purely mental from medical cases, and of a separate space for mad patients, was part of his training[25].

The founder of the Pennsylvania Hospital in 1755, Benjamin Franklin, was known to be the 'father of psychiatry.' Based on his experiences working at the Pennsylvania Hospital, he believed that all mental disorders were due to vitiated blood and thus, his systematic remedy was bloodletting.[26]

The second half of the 18th century and the 19th century was also a period when all around the Western world, in the United States, as well as in Germany, France, Belgium and England, medical doctors were experimenting with peculiar technologies in order to find a cure for insanity. Benjamin Rush also invented the 'Tranquilizer,' a contraption that purportedly calms both the mind and the body of those restricted in it. It consists of a chair and a padded box. The patient's head is encased in a padded box that disbarred sound and light, whereas his arms and legs are pinioned to the chair. Warm and cold water was applied to his head and feet.

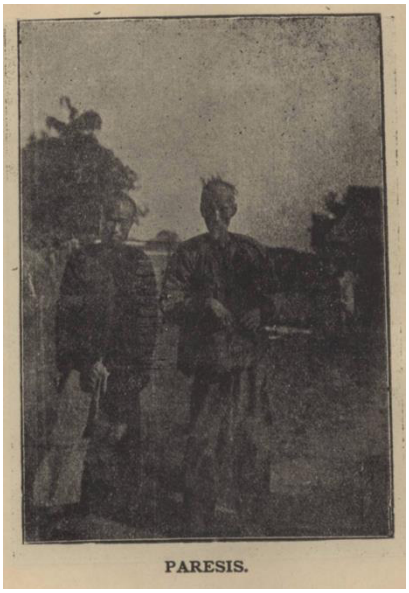

Figure 2. Photograph of a man with paresis from The Refuge's hospital report of years 1907 and 1908

We can hypothesize that Kerr might have transferred some of these strange apparatuses and methods to Canton such as the Tranquillizer. Though these contraptions might seem very alien to what we understand as psychiatry nowadays, they represented the start of a new era in psychiatry which generated new methodologies and theories about the mind and the brain.

In addition to hypotheses about the devices and treatment methods used at the time in the Refuge, it may also be hypothesized that Kerr and his fellow physicians such as Selden already have a basic understanding of the common syndromes and diseases of the time. This is evident in a hospital report of the years 1907 and 1908 as it mentions common diseases such as paraesis and catatonic stupor, a behavioral syndrome, along with corresponding photographs. Thus, it is evident that physicians such as Selden already has a basic understanding of the diseases related to humans' nervous system.

25. Chiang 6.
26. Porter 126-127.

Figure 3. Photograph of a woman with catatonic stupor from The Refuge's hospital report of years 1907 and 1908

6. Into the 20th century

After Selden took over the Refuge, a document published in 1912, *The John G. Kerr Refuge for the Insane*, written by Selden himself details psychiatric treatment in China during the early 20th century. It is reported that "since the opening in 1898 there have been admitted 1480 patients. At present there are 250 and more. [In 1911,] 239 entered; 196 were discharged. Of the latter, 97 went away well, being 40.5% of the number admitted, 49% of the number discharged."[27] The statistics provided by the superintendent at the time – Charles Selden himself – demonstrates the extent to which Kerr's Refuge has benefited Chinese civilization.

It is noted for several years since 1898, only private patients have been admitted to the asylum. However, in 1904, cases began to come from government officials including the police and District magistrate. "In the Refuge's early years, the Hong Kong authorities had an arrangement to transfer Chinese psychiatric patients there until a hospital for the care was provided in Hong Kong. All this suggests that the Refuge was meeting a need and that although it was not indigenous, institutional care had been shown to be acceptable."[28] In a report for the years 1907 and 1908,

Not only so, numerous photographs from hospital reports in the years 1907 and 1908 have shown patients participating in leisure activities such as sewing, breaking stone, and drawing water[29] – daily activities – demonstrating that patients were widely capable of immersing themselves in the familial environment of the institution.

From the Refuge's early years, patients are sent by officials from all over the country, namely, Hong Kong (香港), Amoy (廈門), Foochow (福州), Shanghai (上海), Chinkiang (鎮江), Tientsin (天津). Formerly, before officials began sending patients to the Refuge in Canton, "these patients, if dangerous, were locked up in the prisons along with the criminals. If not troublesome, they were set free in the streets of [China] to beg or steal, live or die unless happily friends appeared to claim them."[30] Though the Refuge has made every efforts in trying to accommodate all patients, in 1911, all five buildings of the asylum were full and crowded, and patients are often found sleeping in bathrooms, matsheds or on verandas. Hence, some patients were refused treatment, particularly criminals who were currently accommodated in prisons. However, in *The John G. Kerr Refuge for the Insane*, Selden claims that the Refuge attempts to take in as many family cases as possible because Selden believes that the "care of the insane in the homes is difficult and often dangerous, usually unwise and sometimes cruel."[31]

The low supply of institutionalised asylums in China and the high demand for medical treatment for the insane leads to the need for an additional building at the 1898 Refuge. These new buildings were not only meet for demand for the housing of patients, but also "fill in low, unhealthy land; provide good, clean water from the river; repair the older buildings; provide proper quarters for the attendants; erect new compound walls; replace the present poor entrance by one worthy of the institution,"[32] and make other needed improvements to the current state of the institution. These improvements will not only allow the Refuge to continually serve the Chinese civilization, but

27. Selden. 4.
28. Pearson. 150.
29. *Report for the years 1907 and 1908*. 8-10.
30. Selden. 2.

also allow for more Chinese medical practitioners and staff to be immersed in the Western treatment of the insane and mentally-ill.

7. Conclusion

The Kerr Refuge did not stem from a cultural or historical vacuum in traditional 19th century rural China, but was primarily the product of Western and Christian ideas. It was the institutional offspring of Western knowledge transfer during the Qing dynasty. Such medical knowledge transfer from the West to the East also provided a seed to further explore the establishments of specialized institutions around China by foreign medical missionaries. Kerr's example should inspire historians to study other cases of medical knowledge transfer in China. The 19th century was an era of substantial transfer of Western scientific and medical knowledge to China. Medical missionaries brought new ideas and knowledge to China, and as a result, introduced the Chinese to new ways of dealing with the insane, changing century-long practices and beliefs. This laid the foundation for the introduction of modern psychological knowledge into China. Further research can be extended to other major cities such as Beijing, to gain a more complete picture on the history of Western psychiatric knowledge into China.

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31. Selden. 4.
32. Selden. John G. Kerr Refuge for the Insane. 6.

How was Chinese Porcelain Introduced into Europe through Import and Imitation?

Griffin Charlotte

China was the earliest country in the world to develop ceramics that were glazed and fired under high temperatures. One of the most famous types of ceramics known to all is Chinese porcelain. Chinese porcelain is a hard, mostly white-firing and translucent ceramic, fired at temperatures of between 1,150C and 1,400C in kilns (Kerr & Wood, 60), and became so famous that "china" became synonymous with porcelain. The earliest record of Chinese porcelain in Europe was when the last Mongol emperor gave a porcelain vase, known as the Fonthill vase, to Pope Benedict XII in the mid 14th century (Kerr & Wood, 741). During the 16th century, when European traders first arrived, most Chinese porcelain was made in Jingdezhen, Jiangxi, which was recognised by many as the porcelain capital of the world. The vibrantly coloured artwork found on Jingdezhen porcelain was considered by the Western world to be exotic; they also possessed admirable physical traits and qualities, namely its translucency and durability. Jingdezhen porcelain could also withstand drastic fluctuations in temperature and last for generations with care. To create the ideal material for harnessing all these properties, centuries before anyone else, Chinese potters tested whiter and whiter ceramic materials and coaxed their kilns to higher temperatures. The potters explored the geology of their area and were lucky to find accessible places with the most suitable materials, most prominently the kaolin. Gradually, the ideal formula was developed by these Chinese potters.

Knowledge of China and the exotic goods found there were first obtained by Westerners when direct trade routes were opened between Europe and China, beginning with the Portuguese mastery of ocean voyage and exploration in the fifteenth century. In 1494, a treaty initiated by Pope Alexander VI was signed between Portugal and Spain, known as the Treaty of Tordesillas (Mungello, 7). The treaty proposed that the world would be evenly divided between Portugal and Spain, with a separation line running down the middle of the North Atlantic Ocean, with all land and waters to the west of the line belonging to Spain. Everything to the east of the line fell within Portugal's jurisdiction. This gave Portugal the authority to control the trade routes to Asia, thus making contact with China regularly. The information that the Portuguese explorers learnt on their voyages to the Far East then quickly circulated from Portugal throughout Europe.

After the Fonthill Vase was imported into Europe, the Portuguese followed the Dutch by importing increasing numbers of porcelain to Europe. Their direct trading routes to China and their trading settlement in Macau allowed the Portuguese to make imports easily of the highly prized Chinese porcelain.

A strong rival to Portuguese power at that time was the Vereenigde Oostindische Compagnie (Dutch East India Company, or VOC). The Dutch East India Company was the first to dominate, with many ships returning from China carrying large shipments of Chinese porcelain. An intense rivalry grew between the Dutch and Portuguese for Chinese porcelain. The Dutch also engaged in piracy and pillaged goods that the Portuguese ships were carrying. In 1602, a fleet of Dutch ships captured the Portuguese carrack, San Iago. The Dutch steered it to Amsterdam, the shipment of Chinese porcelain onboard becoming the first great treasure to reach Holland. The following year, the Dutch seized another Portuguese ship, the Santa Catarina, which held over a hundred pieces of porcelain (Brook, 63). Buyers from all over Europe flocked to Amsterdam to fight for pieces of porcelain and many were willing to pay exorbitant prices for the porcelain.

By the end of the 17th century, many European countries pursued trade with China, especially for their porcelain, with the British being one of the more determined and aggressive traders. They did this through the British East India Company, which was created in 1709 by merging the British Company with an earlier East India Company. It soon became one of the strongest European trading groups in Asia. Just over 20 years later, The British East India Company had achieved supremacy in trade with China, bringing back many pieces of Chinese porcelain to sell in the English market. This popularity and demand for porcelain by the British made Chinese porcelain a valuable trade good, thereby giving China great advantages in trade with the British. At the beginning of the 18th century, porcelain imported from China was cheaper and a more colourful alternative for the British, in comparison with making their own (Kerr & Mengoni, 13). British porcelain factories indeed grew in number and their wares provided competition for the Chinese imports, however Chinese porcelain sets continued to be ordered throughout the next century for their excellent and fine reputation.

Figure 1. Dish with arms of Valckenier of Amsterdam and landscape cartouches at King William Gate at Cleves, a Dutch town, and Batavia, 1735-40 (Kerr & Wood)

Europeans soon discovered they could ask for customised forms and designs of porcelain to be made and exported from China. European clients and merchants would request designs combining European and supposedly Chinese features to be reproduced on Chinese porcelain. Many of the pre-ordered designs were inspired by European designs, shapes and cultures to suit the client, such as the design in Figure 1. This occasionally meant that the designs were not always accurately replicated as the Chinese craftsmen had little interaction with Western culture and therefore did not always fully understand the designs they were being asked to produce. Additionally, as the Chinese craftsmen could not always write the European language in question, errors occurred (Kerr & Mengoni, 25), such as misspelling a family a name which would have proved problematic.

The export of Chinese porcelain to Europe ultimately led to the Europeans imitating Chinese porcelain and creating their own. Having acquired a taste for Chinese style porcelain, many European countries developed their ceramic industries to produce Chinese style porcelain and satisfy local demand.

One of the first successful attempts made by Europeans to imitate Chinese porcelain was in Florence from about 1575 to 1587, under the patronage and encouragement of Grand Duke Francesco I de Medici. The achievement of finding suitable materials is credited to Bernardo Buontalenti and Flamino Fontana, who found a slight difference from materials used in Chinese porcelain by using a stone paste. Although the porcelain produced was visually similar and effective, it was expensive to make and quite often deformed during firing. After the Grand Duke died, production of the Florentine porcelain halted.

The key problem for the Europeans was that they did not know what material was used by Chinese potters. Various theories were raised. In the mid-16th century, after the Florentine attempt to copy Chinese porcelain, two Italian scholars, Cardan and Scaliger, espoused views based on accounts made by the Portuguese missionary Duarte Barbosa. Barbosa, who had travelled to Asia, speculated that Chinese porcelain was made of ground periwinkle sea-shells and put underground to be refined for 100 years. At this point in time, it was safe to say the overall Western understanding of porcelain was very confused.

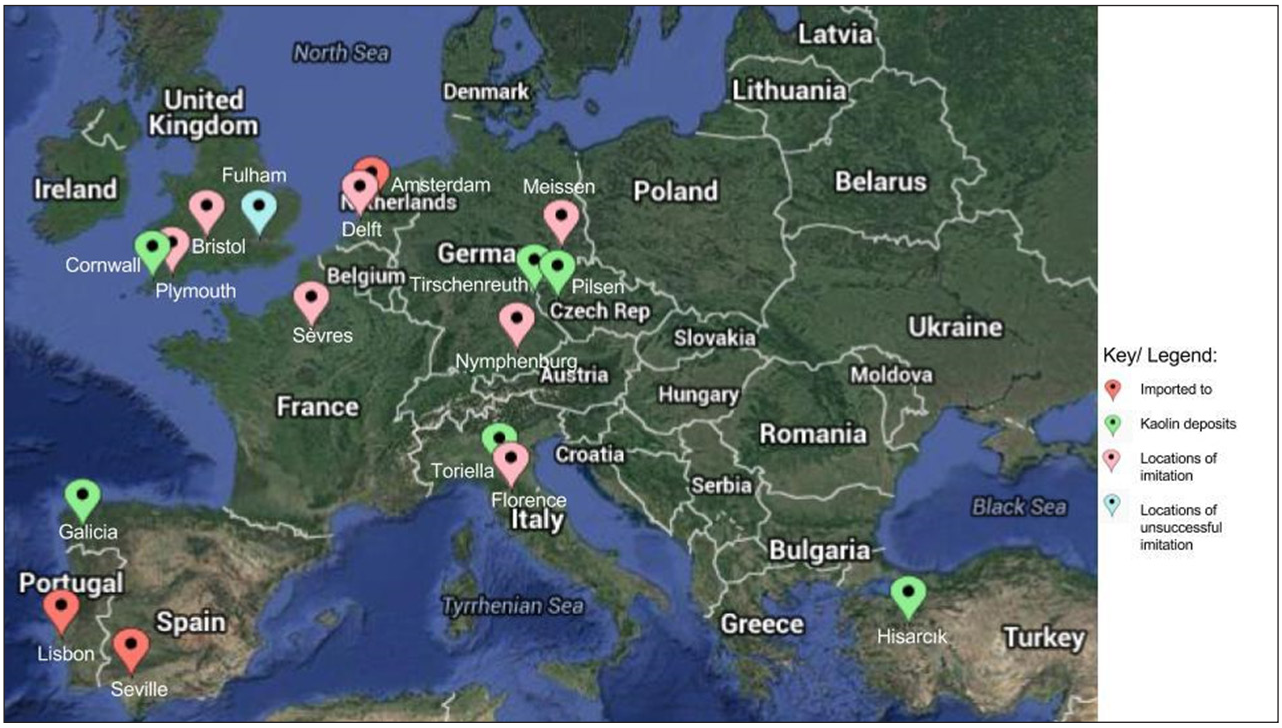

Figure 2. Map of the most important locations within Europe involved in the import and imitation of Chinese porcelain.

However, by the second half of the 16th century, accurate descriptions of porcelain technology were available in Europe, increasing amounts of imported Chinese porcelain and travellers' accounts. Gaspar de Cruz, a Dominican friar, was able to visit various porcelain-making locations in China and wrote descriptions of porcelain-making and the place that porcelain came from. He countered Barbosa's accounts on using ground sea shells. Father Alvarez Semedo expressed similar views in 1638, as he established the earliest mission and compiled maps of many regions in China. Finally, in 1712, Father Dentrecolles who lived in Jingdezhen for twenty years made an accurate description of the porcelain formula. These descriptions allowed Europeans to create porcelain that was closer to the Chinese porcelain made in Jingdezhen.

The other key problem for European imitators of Chinese porcelain was to locate raw materials. The Chinese had been using a clay mineral known as kaolin, first retrieved from Jiangxi province in China, where Jingdezhen is located. Many European countries did not have access to kaolin, or what was known to Westerners as 'china clay'. For the British, they first imported kaolin from Georgia and North Carolina in America. Later on, British pharmacist William Cookworthy looked for 'china clay' in England and found a clay mineral similar to kaolin, which was then used to make some very successful hard-paste porcelain. Other kaolin deposits were found all over Europe, such as in Galicia (Portugal), Hisarcık (Turkey), Pilsen (Czech Slovakia) and Tirschenreuth (Germany). (See Figure 2). Access to kaolin allowed European craftsmen to produce porcelain closer to that of Jingdezhen, by using materials that the Chinese had been using for centuries to create harder, stronger and more translucent ceramics.

In the first two decades of the 18th century, Chinese porcelain was to a large extent equalled in Europe, in a few ways even surpassed, after more than 1000 years since its first appearance in northern China. Johann Friedrich Böttger, a German, was seeking the secret to making gold in Saxony, 1700. However, once he started mixing various earths together to make strong and durable crucibles, through the course of baking the clay he discovered the art of making porcelain (The Literary Magazine, 1). In the late 17th century, German mathematician and physicist Ehrenfied Walther von Tschirnhaus carried out vital research, which made him ideal to supervise the porcelain research in Dresden by Böttger. In 1706,

the first porcelain was manufactured at Dresden and it was a hard, red stoneware, styled loosely on Chinese ware. In 1709, they were able to produce the first piece of white porcelain. The work of Von Tschirnhaus and Böttger was able to avoid the limitations of previous European attempts to imitate Chinese porcelain, by basing their new porcelains on refractory white-firing clays. Soon, the project outgrew its premises and all production was moved nearby to Meissen, giving the porcelain produced here the name of 'Meissen porcelain'. Meissen porcelain was extremely successful, as it was the first hard paste porcelain in Europe. The production of Meissen porcelain lasted until the Seven Years' War in 1756, which brought disaster to the country and company. The dauntless spirit of earlier times was lost and the heyday of Meissen porcelain was over.

As for British porcelain making, from the mid eighteenth century onwards, factories imitating Chinese porcelain multiplied. The first factory in England built specifically to produce porcelain was the Bow Manufactory of New Canton, in 1747 (Adams & Redstone). Porcelain made in the Bow factory mostly imitated Chinese porcelain or implemented facets of the style of Chinese porcelain. Many products that came from the Bow factory used images that were considered by Europeans to be typically Chinese, with such stereotypes as pagodas, flowers, or the colours blue and white, an example shown in Figure 3. These stereotypes were not always faithfully recreated and the artwork was not an accurate reflection of the Chinese elements, because, like their Chinese counterparts, the British craftsmen were not familiar with Chinese culture and society. They developed their own style of artwork and porcelain. The soft paste porcelain at Bow was produced with china clay imported from North Carolina, a key ingredient, and 'virgin earth' (bone ash) (Kerr & Wood, 764), to strengthen and whiten. Bow factory porcelain was successful, with the trading of the products being widespread both at home in Britain and overseas. Considered the major rival of the Bow Manufactory of New Canton, the Chelsea Porcelain Factory was opened during the 1950s, the exact date of establishment unknown. The Chelsea Porcelain Factory did not

Figure 3. Plate made in the Bow Porcelain Manufactory during the mid eighteenth century.

stick to imitating Chinese porcelain as much as the Bow factory, however it had a lot of East Asian influence, especially that of Japan.

In Britain, many riches were spent on making very prestigious objects, often with scant (barely sufficient or adequate) regard to cost. However, this did mean that the history of British porcelain making, including John Dwight and William Cookworthy, provides some of the closest matches to Jingdezhen materials. John Dwight experimented with many different materials and clays in Fulham, London. Although he had many unsuccessful attempts and experiments, they helped the development of porcelain in England and even Europe. William Cookworthy not only discovered kaolin in England for the first time, but also the ideal glaze for porcelain, as well as being responsible for different formulae of hard paste porcelain (Kerr & Wood, 760-761).

When the Industrial Revolution began in Europe, in the late 19th century, manufacturing output and factory production of ceramics was largely increased (Kerr & Wood, 770), which allowed Europeans to create even more porcelain. The British had already developed their own porcelain making capability, with some recipes, including those of Dwight and Cookworthy, standing very similar to the porcelain from Jingdezhen. Other

recipes, such as bone ash (from the Bow Factory), were unique types of porcelain that were unlike any porcelain made in East Asia or China. Many other European countries, such as Holland (Delftware) or Germany (Meissen), had also created successful imitations of Chinese porcelain. Wedgewood, selling of porcelain, establish a brand of retailing porcelain.

On the contrary, in China, "innovation and production were declining. This was mirrored by China's political and economic wane." (Kerr & Wood 770). As British porcelain manufacturing improved and increased, China was unable to supply new and fresh forms of porcelain. In addition, import duty was increasing, making trade unprofitable. Therefore, after almost four centuries of flourishing trade, Europe became less reliant on Chinese producers for porcelain, so the amount of porcelain imported from China into Europe started to decrease.

We have to remember the economic and social factors in Europe, such as the availability of raw materials or development of high temperature kilns, which caused Chinese porcelain to be imported to Europe in the first place. This then developed a market for porcelain and Europeans eventually discovering ways to replicate Chinese porcelain.

This paper is focused on the development of the porcelain trade between China and Europe, in particular Britain in the 16th-18th century. However, the power balance between China and Britain has greatly changed since then. In the intervening period, the Opium Wars, the 1911 Xinhai Revolution, and the reform and opening-up of China in the 1970s (改革開放) have occurred, while British familiarity with Chinese goods and culture has increased. Is Chinese porcelain to this day still regarded as a unique and exotic treasure? The image of China in British minds today is changing again with the rise of China as an economic power. And porcelain remains an important export item for China. In this context, is Chinese porcelain still regarded as a unique and exotic Chinese product? In recent years, antique Chinese porcelain has commanded high prices at international auctions, in line with other historical Chinese art and artefacts. Whether this will encourage interest in Chinese porcelain, both older pieces and contemporary, remains to be seen.

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The Impacts of the Columbian Exchange on Chinese Economy and Sino-European Trade in Ming Dynasty

Mary Lu

Introduction

The "Columbian Exchange", a term coined and popularized by the historian Alfred. W. Crosby (Crosby) refers to a series of biological, cultural and economic exchange of food crops, ideas, trade goods, and precious metals between the Old World and the New World. It occurred in the 15th and 16th centuries, after Christopher Columbus's voyage to the America in 1492.

On the evening of October 11, 1492, two months after Christopher Columbus's departure from Spain, the Italian navigator caught sight of a beam of light flashing from a distant island. At first, the Europeans on the ship Santa Maria thought the island far in distance was the coast of Asia, but "the strangeness of fauna and the distinctiveness of the human inhabitants of these islands" struck them (Crosby 2). The discovery of the New World, the Americas, had amazed and impressed men in the Old World in numerous ways since 1492. The huge difference between two worlds piqued European curiosity, and soon led to the discoveries of American food, plants and silver.

The discovery of the New World not only had countless impacts on European countries, which were directly involved in the colonization of America in the 15th and 16th centuries, but also had a profound influence on Asian countries, such as China. Columbus's voyage in the late fifteenth century coincided with a period when Chinese merchants, craftsmen, and sailors became more frequently and vigorously engaged in maritime activities. Thus China met America through Sino-European trade.

American trade goods, such as silver and food plants, were introduced into China in the 16th and 17th centuries by the Portuguese and the Spanish. Chinese silk textiles and porcelain were also brought to America by the Spanish. Silver from the New World was brought to China to purchase Chinese goods, such as porcelain and silk textiles, increasing silver circulation within China and exerting a huge influence on the Ming economy. American food plants, such as maize, potatoes and peanuts, were brought by Spanish merchants coming from the Philippines to China, making possible the reclamation of poor and mountainous lands, increasing the food supply and supporting the population growth in China. In addition, thanks to the in-flux of American silvers through Sino-European trade, Ming Chinese society experienced a sharp increase in commercialization. Coastal areas, such as Jiangnan, Guangdong and Fujian, became trade entrepots and key linking points between China and the Europe.

In his pioneering book, Crosby focused on the biological exchange of plants and animals between America and European countries as well as that of diseases. This paper, however, mainly discusses the exchange of goods between the New World and China and focuses on the economic impacts of American silver and food plants that were introduced into China during the Age of Discovery. Particular attention is paid to the effects of Columbian exchange on China instead of its impacts on the New World.

Early Sino-European trade and the Chinese economy before 1492

The purpose of Columbus's voyage was to find "a shorter, faster and less expensive route to East Asia" (Twitchett 377). As he wrote in his diary on 21 October 1492, nine days after his arrival in the New World,

"But I have already decided to go to the [Chinese] mainland and to the city of Quisay [Hangzhou 杭州], and give your Highnesses' letters to the Great Khan and ask for a reply and return with it."

Indeed, the mission of Columbus's voyage was to sail across the Atlantic Ocean, reach East Asia, establish good relations with China and the Moluccas, and to bring back to Europe trade goods, such as silk, porcelain, gold, pepper, and spices. In fact, back in the Song Dynasty (960-1279), between the tenth and the thirteenth century, long before the Columbian Exchange, China already established lucrative trade with other parts of "Asia, East Africa, the Mediterranean trading area, and even the major markets of Europe" (Twitchett 376), and there was an increasing flow of exchange goods, such as silk and porcelain, which explains the motivation of Columbus's voyage and the reason why Chinese trade goods were highly valued by the Europeans in the later Renaissance. Many historical records also show evidence of the flourishing commercial trades between China and the West back in the early ages (Twitchett 379).

Well before the Spanish and Portuguese navigator could reach China, China was involved in a series of commercial exchange with the Europeans, though less directly, through Silk Road. Marco Polo, preceded by Christian missionaries and envoys, travelled along the Silk Road to China in the early fourteenth century to exchange foreign goods for Chinese silk textiles and porcelain. However, due to Ottoman subjugation of the Byzantines in 1453, the Silk Road was blocked, resulting in the sharp reduce of commercial contacts between the East and the West. Private maritime trade was entirely prohibited for some years. Despite that, memories of great profits and the intimate commercial exchange in earlier centuries stimulated two of the greatest voyages of discovery by Columbus and Vasco de Gama.

One of the greatest scholars of his time, the Florentine cosmographer Paolo dal Pozzo Toscanelli, once wrote "enthusiastically about the wealth and potential of China" (Twitchett 378).

"[The south of China] is very populous and very rich, with a multitude of provinces and kingdoms, under one prince who is called Great [Khan]. [China] is worth seeking by the Latins, because great wealth may be obtained from it, gold and silver, all sorts of gems, and spices"

In the early 15th century, a European diplomat described the Chinese goods as "the richest and most precious out of all, for the craftsmen are reputed to be the most skillful by far beyond those of any other nation"(Twitchett 379). In the 1460s, European monarchs and leaders began collecting Chinese silk and porcelain in earnest. Lorenzo de' Medici, the ruler of the Florentine Republic, received his first porcelain in 1487.

American silver into China and the Ming monetary system

In exchange for the massive amount of Chinese silk and porcelain that were flowing to the West through extensive foreign trades, a substantial amount of American silver, introduced by the Spanish and the Portuguese, circulated in major cities of China. The introduction of American silver not only facilitated rapid monetary growth but also enhanced the efficiency of foreign exchange.

There are a number of reasons why foreign silver was prized by the Chinese merchants and traders in Ming China. First of all, purchasing Chinese goods, such as silk and porcelains, particularly those of high quality, was not always easy during the first half of the sixteenth century, partly because Europeans did not have any "barter commodities" to trade with China (Twitchett 378), thus the Chinese government preferred to be paid in silver. Why American silver, instead of European silver?

This brings us back to the Spanish colonization of the New World, and their discovery and exploitation of large silver mines during the 1540s. The newly discovered American silver not only solved the problem of silver shortage in Europe, the so-called "bullion famines" in the central Europe in the early 15th century, but also stimulated more Sino-European trade activities, and helped to balance the European demand for Chinese goods. (Twitchett 388)

American silver arrived in China in a context of monetary instability of the late Yuan and early Ming period, which contributed to the increasing demand for American silver. Both the late Yuan Mongol government and the early Ming government issued paper money, but the mismanagement of the monetary system caused it to devalue rapidly (Twitchett 381). The overproduction and massive issuance of paper money caused the hyperinflation and the instability of the monetary and fiscal system (Twitchett 382). In the beginning of the Ming dynasty, Chinese traders "refused worthless paper money and demanded payment in physical silver instead, for the currency of commercial transactions and foreign exchange" (Bentley 225). Moreover, in the early Ming, "the country's gold-silver ratio narrowed from 1:10 to about 1:4" (Twitchett 383), causing an enormous increase in silver demand, as well as the overvaluation of silver. In the mid-fifteenth century, Chinese bullion mining was followed by a sharp decline in silver production (Table 1), causing the Chinese merchants to become dependent on a silver import to maintain monetary circulation and economic stability within China. (Twitchett 386)

The Chinese hunger for silver exerted a powerful influence on the emerging global economy.

During the Yongle reign (1403-1424), China became the world's largest silver sink in the world and entered a new monetary age where silver became the dominant currency for foreign exchange, as the emperor "actively encouraged government controlled foreign trade, which resulted in increased silver imports from other parts of Eurasia"(Twitchett 385). Domestic bullion mining was insufficient to serve as "subsidiary currency for the world's most sophisticated economy"(Atwell 78), particularly after the sharp decline of domestic silver mining in the 1440s, from 1,277,863 taels in the previous decade to 289,752 taels (Table 1). Chinese economy grew vigorously in the 1570s, while the bullion production was extremely low and inadequate. The increased imports of American silver into China significantly helped to stabilize the Ming economy. Europeans also benefited from the silver trade for they not only discovered the superior quality of Chinese handcrafts, but also found them less expensive than those from Europe. After Spanish conquered the Philippines during the 1560s and made Manila their capital, Guangzhou became a prosperous and flourishing port of a vigorous and lucrative trade between the New World and China, European ships were frequently found near coastal cities, shipping Potosi and New world mines to China and silk textiles back to the West, as William. L. Schurz wrote (Twitchett 401),

"Silks in every stage of manufacture and of every variety of weave and pattern formed the most valuable part of their cargoes. There were delicate gauzes and Cantonese crepes, velvets and taffetas and the fine damask, rougher grains and heavy brocades worked in fantastic designs with gold and silver thread. Of silken wearing apparel, there were many thousand pairs of stockings in

MING GOVERNMENT REVENUES FROM DOMESTIC SILVER MINING 1401-1520*

	Taels	Kilograms (*a*)	Annual average in kilograms
1401-10 (*b*)	1,299,167 (+)	48,719 (+)	5,413 (+)
1411-20	2,905,602	108,960	10,896
1421-30	1,993,591 (+)	74,760 (+)	7,476 (+)
1431-40 (*b*)	1,277,863 (+)	47,920 (+)	5,324 (+)
1441-50 (*b*)	289,752	10,866	1,811
1451-60 (*b*)	363,454	13,630	2,272
1461-70	614,680 (+)	23,051 (+)	2,305 (+)
1471-80	589,248 (+)	22,097 (+)	2,210 (+)
1481-90 (*c*)	802,396	30,090	3,009
1491-1500	530,552	19,896	1,990
1501-10	325,200	12,195	1,220
1511-20	329,200	12,345	1,235

Table 1

each cargo, skirts and velvet bodices, cloaks and robes & kimonos. And packed in the chests of the galleons were silken bed coverings and tapestries, handkerchiefs, tablecloths and napkins, and rich vestments for the service of churches and convents from Sonora to Chile. Nearly all this was of Chinese workmanship."

The rapid increase in foreign exchange and commercial contacts, triggered by the demand-supply chain of New world silver, caused rapid growth of silk and porcelain industries in coastal cities such as Quanzhou, Guangzhou and Suzhou. The population of Suzhou grew dramatically in the late 16th century and reached a total of 500,000, becoming one of world's largest and richest cities. The increased silver imports from the America also led to the "widening of gold-silver ratio" in China, since the adequate supply of foreign silver stabilized the monetary system and prevented the overvaluation of silver (Table 2). "In 1620s, The silver-gold ratio changes paralleled similar changes in the New World", reflecting the Ming empire's gradual integration into an emerging world economy (Twitchett 401). (Twitchett 384)

Year	China	Spain
1596	7·50	12·12
1604	—	12·12
1609	—	13·13
1615	—	13·13
1620	8·00	13·13
1622	—	13·13
1627-44	10·00-13·00	13·13-15·4
1643	—	15·45

Table 2: Bimetallic ratios of silver to gold
(Unit of silver to one unit of gold)

American silver, in exchange for Chinese trade goods, was introduced to China by the Spanish mainly via two sea routes. The more significant one, known as the Manila-Acapulco galleon trade route, ran from Spain through North Atlantic Ocean to Acapulco on the west coast of Mexico, the same route as Columbus travelled in 1492. American silver, brought by the Spanish, was then shipped from Acapulco through the North Pacific Ocean to Manila, the capital city of the Philippines, where the Spanish government began their colonization during the late 1560s and early 1570s. Manila soon became the trading centre of Sino-Spanish activities and the entrepot of the Manila-Acapulco Galleon trade route. In 1571, the first cargo of Chinese goods was sent to the New World through the Pacific Ocean, establishing the indirect Sino-American trade. Two years after the direct Sino-Spanish trade in the Philippines had begun, two galleons of Chinese goods, including "712 pieces of Chinese silk and more than 22,300 pieces of fine gilt China and other porcelain ware" (Artwell 73), returned to Mexico. The galleon Santa Ana was said to be carrying "a cargo of Chinese silks, porcelains, gold which was worth more than two million pesos" (Twitchett 391) from Manila back to Acapulco. After American silver was brought to Manila by the Spanish, some of it was brought back to the mainland by Chinese merchants living and trading in the Philippines. It was estimated that the Chinese population grew from 40 in 1570 to more than 15,000 Chinese in 1586 and to 30,000 in 1603, (Twitchett "Relations" 357), illustrating the flourishing trading activities between China, the West and the New World. Among this growing population were many unemployed artisans from China who found work in the Philippines in the 1580s, since porcelain was sold double the price in China (Twitchett 406). The rest of the silver in Manila was shipped directly by the Spanish to coastal cities in China. "In 1602, officials in Mexico informed the Spanish crown that, although the silver shipped from Acapulco to the Philippines usually amounted to 5 million pesos (143,750 kilograms) a year, in 1597, the total sent to Manila had reached the astonishing sum of 12 million pesos"(Twitchett 392). In the early 1630s, "five to six times the legal amount of silver" was shipped from the New World to Manila, leading to the mutual dependence (Twitchett 392).

The second sea route, through which American silver was imported to China, also ran from Spain to New World. However, instead of directly shipping American silver to Asia, it was sent back to Spain and transported into its neighboring country Portugal illegally, from there it loaded and shipped around the Cape of Good Hope to Goa, then to Malacca and Macao through Sino-Portuguese trades. Even though the Portuguese

"arrived in the Canton Estuary in 1517 August, under Fernao Peres De Andrade, who made every effort to establish good relations with the Chinese authorities" (Twitchett Relations 336), the Sino-Portuguese trade did not flourish until 1567, when emperor Muzung abolished the law restricting and limiting foreign maritime trades. During the late 16th and early 17th centuries, Portuguese vessels "carried between 6,000 and 30,000 kilograms of silver annually from Goa to Macao" (Artwell 74). And by 1636, four Portuguese galleons shipped more than 75,000 kilograms of silver to Macao. During Muzung's reign (1566-1572), Portuguese merchants "flocked to Macau and the southeastern coast where they trade several hundred thousand taels of American silver" (Twitchett 406) every year with the Chinese, to purchase porcelains and silk. "Macao experienced the heyday of its prosperity, serving as a key linking point between the growing worldwide network of European sea routes and the overheated energies of the economy and society of late Ming China, and playing an especially crucial role in the export of raw silk and silk fabrics to Portugal in return for large quantities of American Silver"(Twitchett Relations 348). (Twitchett 403)

Evidence of the massive importation of American silver in the Ming dynasty include silver receipts recorded by the Ming central government (Table 3), which shows a steep rise in the 1571, from 86,250 kilograms to 116,250 kilograms in silver revenues(Twitchett 403). This occurred the same year in which the first cargo of Chinese goods was sent to America. It was also the fourth year after the end of the ban over maritime trades, known as the *Haijin* 海禁. American silver soon produced visible impact on Chinese domestic economy. Most importantly, the Single Whip taxation reform (*yitiao bian fa* 一條鞭法), a fiscal law promulgated in the 1581, allowed land taxes, labour service obligations to be commuted into silver payments (Twitchett 403). Given the low level of Chinese domestic bullion production at that time, and that Single Whip reform was first conducted in coastal provinces like Fujian, it seems reasonable to suggest that this reform was made possible by foreign silver.

At the same time, the impact of China trade on Western society was also patent. By the 1540s, the Lisbon elite in Portugal was said to have been "wearing Chinese silks, drinking Chinese tea, and placing special orders for Ming porcelains"(Twitchett 394). At the same time, citizens of Lima, located on the southern coast of America, were wearing silks that were "of the most fine and costly quality (Twitchett 401). A similar example occurred where silk dresses known as China Poblana Became the "national dress" of Mexican women.

Despite its positive effects in the early 16th century, American silver somehow undermined the economy in the last few decades of Ming dynasty. The Chinese reliance on American silver soon led to the vulnerability of the Ming economy. When the New World bullion production fell in the 1630s, Chinese economy consequently suffered disequilibrium and fluctuation. The disruptions of

1565	2,200,000 (+)	82,500 (+)	1620	5,830,246 (+)	218,634 (+)
1567	2,014,200 (+)	75,533 (+)	1621	7,552,745 (+)	283,228 (+)
1568	2,300,000 (+)	86,250 (+)	1622	4,968,795 (+)	186,330 (+)
1569	2,300,000 (+)	86,250 (+)	1623	7,893,137 (+)	295,993 (+)
1570	2,300,000 (+)	86,250 (+)	1625	3,030,725 (+)	113,652 (+)
1571	3,100,000 (+)	116,250 (+)	1626	3,986,241 (+)	149,484 (+)
1573	2,819,153 (+)	105,718 (+)	1628	7,064,200 (+)	264,905 (+)
1577	4,359,400 (+)	163,478 (+)	1630‡	9,136,357 (+)	342,613 (+)
1578	3,559,800 (+)	133,493 (+)	1631	12,249,195 (+)	459,345 (+)
1580	2,845,483 (+)	106,706 (+)	1634	12,812,000 (+)	480,450 (+)
1581†	3,704,281 (+)	138,911 (+)	1637	16,700,000	626,250
1583	3,720,000 (+)	139,500 (+)	1639	20,000,000	750,000
1585†	3,700,000 (+)	138,750 (+)	1641	21,451,736 (+)	804,440 (+)
1586†	3,890,000 (+)	145,875 (+)	1642	23,000,000 (+)	862,500 (+)
1589	3,270,000 (+)	122,625 (+)	1643	21,300,000 (+)	798,750 (+)

Table 3: Silver receipts of the Tai-Tsang vault

commercial trades were further exacerbated by the wars against the Manchus, ultimately leading to the downfall of the Ming Dynasty.

American food plants into China during the Columbian Exchange

Though the primary motivation and incentive of Sino-European trade was to exchange silver for Chinese silk and porcelain, some New World food plants were brought to China by merchants as byproducts. The author of *The Columbian Exchange: Biological and Cultural Consequences of 1492*, Alfred W. Crosby, believes the "most important impacts of the Columbian Exchange were biological in nature" (Crosby 1). Indeed, in the 15th and 16th centuries, after the discovery of America, some previously unknown food plants were introduced to the Old World, such as peanuts, potatoes, tomatoes, maize, chili peppers, and sweet potatoes, were introduced into China.

New World food crops, such as potatoes and maize, can be grown in highlands, low temperature regions, infertile, barrens soil unsuitable for growing indigenous Chinese food crops. By allowing mountainous land to be cultivated, New World food crops substantially increased food supply and crop yields in China.

I. Potatoes

Potatoes originated in Peru, Ecuador and Andean Plateau. As potatoes contain high caloric and nutritional value, sufficient amounts of vitamins and minerals, it became a core staple in many countries, including China, soon after its diffusion in the Old World. In 1973, China ranked second with an annual potato production of 36,025,000 tons (He 29). The introduction of potatoes played a significant role in population increase in China.

Potatoes were likely introduced to China through two sources, Manila-Acapulco galleons and Dutch galleons, taking into account that potatoes were likely introduced to China more than once in the 16th and 17th centuries. As expounded above, Manila-Acapulco sea route was mainly conducted by the Spanish, who sent trading ships from Seville to the New World, then to Manila and Macau. The earliest reference to the production of potatoes in Spain was the first cultivation of the staple in Spanish Canary Islands in 1570s, and "by 1580s potatoes were seen as a source of sustenance" (Bentley 119) in Malaga. Despite the scarcity of historical evidence on the exact date and source of potato production in China, it seems reasonable to suggest that one of the sources of importation was the Spanish sailors, who brought potatoes to Manila and mainland China on Spanish galleons, while trading a massive amount of silver annually with Chinese merchants and the government. However, evidence also suggests that potatoes may have been first introduced to Taiwan during Dutch colonial rule from 1624 to 1662. Potatoes were "cultivated as early as 1603 by Dutch settlers on the Penghu Islands, and later produced in Taiwan" (He 25). In 1650, Henry Struys, a Dutch who visited Taiwan, noticed the vast amount of potatoes that were produced on the island, called "He Lan Dou 荷蘭豆" (Holland beans). The primary motive of Dutch colonization of Taiwan was to establish trade with China. Therefore, there were inevitably frequent contacts between Dutch Formosa and the Mainland China, and it seems plausible that through those commercial contacts, potatoes were introduced to coastal provinces, such as Fujian. A historical document from China (*Song Xi Xian Zhi* 松溪縣志) provided evidence of potato cultivation in a mountainous area of northern Fujian in the early 18th century, which was the earliest record in mainland China. In the late 18th century, there were two Chinese local gazetteers (*Qi Zhou Zhi* 蘄州志and *Yun Xi Xian Zhi* 鄖西縣志) recording the potato production in inland provinces, namely Hubei and Hebei provinces.

II. Maize

Though maize is not as rich in calories and nutrients as the potato, it was the most widespread New World food crop in China between the 16th and the 18th centuries. Some estimates that maize accounted for a significant population increase of "approximately 14.12%" in China from 1776 to 1910 (Chen 7). After its diffusion in China, maize became the most popular food crop "only after rice

and wheat—the traditional staples for thousands of years". One of the reasons for the success of maize in mainland China is indisputably its adaptability to the extreme environment. Maize could be easily cultivated "in the entire basin surrounding the Huai River, the middle and the lower Yangzi region and the North China plain" (Chen 11). Compared to potato, which is only suitable to 10% of the soil in China, Maize can be grown in over 55% of the land (Chen 11).

The earliest historical record of maize in China was found in *Henan Gong Xian Zhi* 河南鞏縣志 in 1555, in which maize was recorded as *Yumai* 玉麥 at the end of the frumentum list. There are many other local chronicles and annals in the 16th-18th centuries that contain records of maize, including *Yunnan Dali Fu Zhi* 雲南大理府志 in 1563, *Liu Qing Ri Zha* 留青日札 in 1572, recorded by Ming litterateur Tian Yi Heng 田藝蘅(He 26). In most cases, these records only give evidence of the existence of maize (Yumai) in different regions but lack the actual amount and extent to which maize was produced and cultivated. In spite of that, we can still learn from those sources that maize was first introduced in Henan, Yunnan, Jiangsu and Fujian provinces. Later historical records, such as *Guangxi Tong Zhi* 廣西通志 and *Lanzhou Fu Zhi* 蘭州府志from Qing dynasty, all show that maize was highly valued and widely planted in China. In the 18th century, maize became the most important staple and food crop in mountainous areas in China due to its drought-resistance. As a result, Ming China experienced a steep rise in agricultural productivity "from under 140 catties per mu of land in 1368 to about 240 catties by the middle of the 19th century" (Chen 14).

The earliest introduction of maize to China was made by the Portuguese and Burmese through an overland route in the early 16th century. The Portuguese began its colonization in India in 1505, thus it is likely that maize was brought by the Portuguese to India, and then by Indians to Myanmar through frequent commercial exchange. Following the appearance of maize in Burma, it is fairly certain that maize was introduced into Yunnan by the Burmese, as the two regions are closely located to each other and had close exchange and contact. The fact that Yunnan was one of the earliest provinces to grow maize further corroborates the hypothesis of the overland introduction. In addition to the overland route, there could have been another sea route of introduction, as in 1572, Tian Yiheng 田藝蘅 writes in *Liu Qing Ri Zha* 留青日札that "maize was introduced into Hangzhou, Zhejiang and into other coastal provinces several years before". Moreover, when the Spanish ambassador Martin de Herrada travelled to the southern Fujian and passed Zhangzhou, Quanzhou and Fuzhou along his way, he also witnessed the cultivation of maize in these areas. In sum, maize was possibly introduced into China through both overland and sea routes around the1550s.

III. Peanuts

The earliest record of the introduction of peanuts into China was "found in a treatise (zhong yu fa) on the methods of cultivating and planting taro", written by a native Suzhou scholar Huang Xingzeng (1490-1540) (He 191).

"There is another kind of taro whose flowers are on the vine like stem. After the flowers fall, the pods begin to develop [underground]. It is called Luo Hua Sheng (peanuts)."

In 1538, peanut was listed as a local crop in *Chang Shu Xian Zhi* 常熟縣志, [County gazetteer of Changshu]. In 1587, a local Fuzhou scholar Wang Shi Mao王世懋 recorded in his treatise on notes on gardening methods (*Xue Pu Za Shu* 學圃雜疏) that "taro, peanuts originated in Jiading. Peanuts are especially easy to grow". In 1608, it was recorded in treatise *Xian Ju Xian Zhi* 仙居縣志 that "the seed of Zhejiang peanuts all originated from Fujian". Though it is generally accepted that in the first half of the 16th century, peanuts were first introduced into coastal regions of Shanghai, Zhejiang and Fujian, the exact place cannot be determined. Portuguese was possibly the source of introduction of peanuts, for in the early 16th century, Fujian established frequent trade with the Portuguese after their arrival in Macao in 1517. After the Portuguese were expelled from the Canton estuary, they began illegally trading

with Chinese merchants in Ningbo, Zhangzhou and Fujian. Fujian soon became the entrepot of the Sino-Portuguese private trade and peanuts were likely introduced from the hand of the Portuguese to Fujian merchants. Moreover, Shanghai was at that time frequently trading with "cotton dealers from the southern Fujian" (He 192). Peanuts were likely brought to Shanghai through the cotton exchange Therefore, Fujian and Shanghai were likely two of the earliest places for peanut cultivation.

In sum, American food crops were introduced into China during the Columbian Exchange by Europeans through Sino-European trade and exchange. The introduction of American food plants enabled Chinese farmers to produce food from soils that were previously thought to be sterile due to their altitude, aridity, sandiness and other factors. A lot of these New World food plants mature faster, have better nutrition value, and are able to tolerate environmental stressors and diseases. As a result, it reduced hunger and famine in China and helped improve nutrition values in food and promote sustainable agriculture. American food crops were accountable for, though not fully, the population explosion from 13 million in 1500 to 400 million in 1900 (Chen 4). Since New World food plants demand different soils, weather and cultivation techniques from indigenous Chinese crops, they "do not compete with old crops but rather complement them" (Nunn 169). In addition, Many of those New World staples, such as chili peppers, became culinary centerpieces and played an important role in the evolution of local cuisine in China.

Conclusion

The discovery of the New World in 1492 was indisputably a turning point in the global history, as it connected the entire eastern hemisphere with a New World, which was unknown to the Old World before his voyage. The great discovery also triggered substantial economic and cultural exchange between old world countries. Precious metals and food plants in America were exploited by the Europeans and transported to many of the Old World countries, such as China, thus greatly changing the economic conditions in these regions. American silver, shipped to China by the Europeans during the Columbian Exchange, played an important role in the economic development of China and Sino-European relations in Ming dynasty. First of all, it provided a solution to fiscal and monetary crises which can be traced back to the instability of the Yuan monetary system. As a consequence of the international bullion flow, China transformed and entered a new monetary era where silver became the dominant currency in the country. The abundant supply of American silver stabilized the Ming economy by satisfying the demand of Chinese merchants for trade. While American silver was imported from Europe to China through Spanish, Portuguese and Dutch galleons, Sino-European trade reached its peak and flourished as never before. The intense demand for silver on the Chinese side, and the equally intense demand for Chinese luxury goods on the European side stimulated commercial exchange. The huge population expansion in Manila illustrates this flourishing trade. However, this deluge of foreign silver was not an unmitigated blessing. In the late Ming dynasty, as China was too dependent on the importation of foreign silver through commercial trade, the monetary system became extremely fragile, leading to an economic and fiscal collapse in the country.

American food plants, transported to China through the same trade routes as silver, also had a profound effect on the Chinese agriculture. New World crops not only reduced famine, as they were rich in nutrition, calories and vitamins, but also allowed infertile soil to be cultivated. American food crops exerted a long-term influence on China, as the country became the world's largest potato, tomato and chili pepper producer centuries after the Columbian Exchange.

The aim of this paper is to elucidate and explicate some of the impacts of the Columbian Exchange on one of the Old World countries, China. However, there are many questions still waiting to be explored in the future. These include, firstly, other American food plants that were introduced into China during the Columbian Exchange, such as sweet potatoes, chili peppers and tomatoes; secondly, the economic impacts of Sino-European trade on the New World and the West, including the slave trade triggered by the Columbian Exchange; thirdly, the reason

why China, a prosperous country which owned silk, tea and other traditional handcrafts highly valued by the Europeans, stagnated after the 18th century, allowing Europe to surpass its economy; and finally, the impact of the Ming-Qing transition and Qing Dynasty isolationist policies on Chinese economy.

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What are the Theories Underlining Acupuncture and What Role did it Play in the Development of Traditional Chinese Medicine?

Tin Chan

Abstract

Built upon almost 2,500 years of traditional knowledge, acupuncture is one of the best-known components of Chinese medicine. Commonly contrasted with Western medicine, Traditional Chinese medicine (abbrev. TCM) is becoming increasingly popular today; not only in Asia, but also in Western countries.

The relevant doctrines of TCM are deeply rooted in historical texts, one of which is *The Yellow Emperor's Inner Canon* (*Huangdi neijing*, 黃帝內經) written during the Han Dynasty (Lu, Gwei-Djen and Joseph Needham, 13). It summarizes dialogues between the Yellow Emperor and QiBo, (岐伯), his minister and doctor. In which, key medical concepts and techniques of acupuncture are discussed, *e.g.* the idea of *qi*, 氣 (sometimes translated as "vital energy") and its relationship with the *jing luo* 經絡 (often translated as meridians and collaterals). These concepts aid in the understanding of acupuncture's therapeutic effect. Modern acupuncture builds on the theory delineated in the classical texts, along with an accumulation of experience, borrowing knowledge from other medical systems, especially modern Western medicine. Fundamentally, acupuncture consists of inserting needles into specific points on the body that stimulate therapeutic responses.

Over the past few decades, much research into acupuncture has been done to determine its clinical efficacy. In this paper, we shall look at the origin and historical development of acupuncture, and how it may be applied in today's medical world.

Introduction: *qi* and blood circulation (Han Dynasty and modern)

While Western medicine puts emphasis on the anatomical structures of the human body, Chinese physicians conceptualize the body as a functional, holistic whole with interactive components. It is believed that this interaction, often referred to as one's bodily soildity — *qi* 氣, is vital to one's well-being.

To understand *qi*, one must understand the definition of acupuncture: it is a TCM intervention where needles stimulate different points (acupoints) on the body. It is believed that the stimulation of acupoints can strengthen the *qi* and its ability to regulate the function of the viscera (五臟六腑) so to increase immunity (Ni, 52).

Qi is commonly known as the "needling sensation", the tactility when a needle punctures the acupoint. Multiple sensations described by patients include soreness or ache (酸), tingling or numbness (痲), distention or pressure (張), and heaviness (腫). The term "needling sensation" is generic of the patients' responses. . A formal definition of *qi* is the intangible substance by where "one's disease lives", and can be classified into pathogenic *qi*, which is harmful, and anti-pathogenic *qi*, which defends against pathogens (Kawakita *et al.*, 192). *Huangdi Neijing* also states that *qi* be affected by the way the acupuncturist administers the needle puncture. The increased sensation of *qi* is felt by the acupuncturist's "needle grasping", as "tense, tight, and full" (J.Z. Yang, 1) like "a fish biting onto the bait" as described in ancient literature.

Nowadays, efforts have been made to quantify the concept of *qi*, specifically the relation between the *qi* sensations and how it may be quantified by clinical efficacy. This includes several research studies in order to examine the mechanisms of *qi* sensations through neuroimaging techniques (see Section 6).

Section 1: *Jing Luo* system

The term *jing luo* (經絡) first appeared in the *The Yellow Emperor's Inner Canon*. It is defined as a system that can "control human life, yet it is where disease and pathogens live. Thus, the *jing luo* are a series of pathways that circulate *qi* to regulate the physiological activities of the *zang fu* or viscera (see Section 2). Specifically, the acupoints are where the *qi* is connected to the internal visceras. Puncturing certain points can regulate the flow of *qi*, curing the illness of an associated viscus.

The *jing luo* system is constituted of two parts: *jing* and *luo*. *Jing* refers to *jing mai* (經脈) and represents the meridians, different series of acupoints (see Figure 1.1). *Luo* refers to *luo mai* (絡脈) and represents the collaterals, the branches of the main meridians.

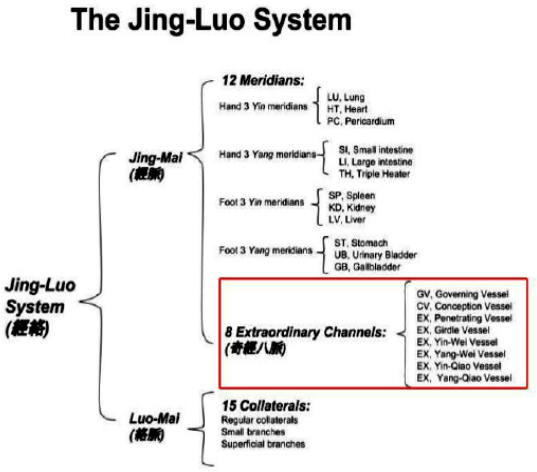

Figure 1.1 Levels of organization In the jing luo system. The addition of the eight extraordinary channels (in modern day) is boxed in red.

The *jing luo* system we know today was discovered through a series of trial and error by ancient Chinese medical practitioners (Ni, 26). As technology rapidly developed overtime, the types of needles used in acupuncture (see Section 3) also grew in variety, hence advanced the discovery of additional acupoints, which expanded the *jing luo* system greatly.

There are a total of 12 regular meridians, where they include the Three Hand *yin* and *yang* meridians and Three Foot *yin* (陰) and *yang* (陽) meridians (see Section 2). Each meridian is associated with an organ. However, these organs should not be perceived as individual anatomical parts, but as bodily networks functioning interdependently (Ni, 28). This means that meridians cannot be observed anatomically. There are 15 collaterals parallel to the meridians where they are divided into regular, small, and superficial collaterals, varying in size and length.

The eight extraordinary channels (see Fig. 1.1) were introduced afterwards, though little is known about their origins. The first record of them was in a book called *Qi Jing Ba Mai Kao* 奇經八脈考 (1572), written by Li Shi-zhen (李時珍, 1518-1593), famous doctor from the Ming Dynasty. However the application of these channels did not flourish till acupuncture diodes were discovered from 1970s onwards.

These eight channels have three differences from the 12 regular meridians. Firstly, these channels are not associated with the *zang fu* viscera. They are also not related to each other as are the 12 meridians. Furthermore, most of these channels do not have their own acupoints, with the exception of the *du mai* (督脈，governing meridian) and *ren mai* (任脈，conception meridian). In fact, their acupoints overlap with the regular meridians (Kawakita *et al.*, 207) and act as storage vessels or reservoirs of energy, assisting the regular meridians. Moreover, they acquire similar functions to the meridians. This occurs because they balance the *qi* by forming a conduit that connects, coordinates, and facilitates communication among the 12 regular meridians (Kawakita *et al.*, 211). For example, the major purpose of the *dai* meridian 帶脈 is to store and control the *qi* of the gallbladder.

Clinical techniques nowadays utilize the eight extraordinary channels, both in Eastern and Western acupuncture. One of the well-known techniques is an "ion pumping chord" treatment developed by Dr. Yoshio Manaka (1911-1989), a famous Japanese acupuncturist. This treatment uses uni-directional diodes to stimulate the eight extraordinary channels. This has been clinically shown to activate one's intrinsic bioelectrical system (Matsumoto, 10). The diodes were originally developed to treat burns, but were found useful in stimulating the extraordinary channels.

This is a significant example that demonstrates how modern technology can be incorporated with ancient medical theories of the meridians and collaterals. Dr. Manaka's work is influential to the development of acupuncture, as it builds on the theory of the eight extraordinary channels, increasing the credibility of acupuncture as a clinically efficient technique.

Section 2: Meridians and collaterals, connection to visceras (五臟六腑) and *Yin* and *Yang*

Each of the 12 meridians is connected a particular viscus The meridians and the viscera share an interior-exterior relationship as stated in *Huangdi neijing*.

As outlined above, the 12 regular channels are associated with certain viscera. (Note: though the viscera use the same name as Western anatomical organs, they are only guidance as to where the viscera region is.) The viscera listed are categorized as *yin* and *yang* based on their functions or locations (see Fig. 2.1). Acupuncturists can use the information to analyze what may have caused the disease, and treat the right acupoints in order to suppress/incite the *qi* of that viscus.

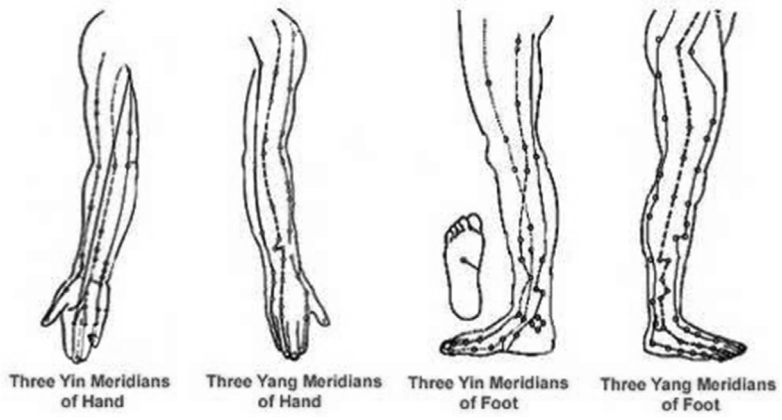

Figure 2.1 Meridian systems of the foot and hand

- The Three Hand *yin* Channels – lung, pericardium, heart. (*zang* viscera)
- The Three Hand *yang* Channels – large intestine, triple burner, small intestine (*fu* viscera)
- The Three Foot *yin* Channels – spleen, liver, kidney (*zang*)
- The Three Foot *yang* Channels – stomach, gall bladder, bladder (*fu*)

By stimulating certain acupoints, physicians can regulate the *qi* of the corresponding viscera. The *zang*, *yin* viscera's essential functions consist in manufacturing and storing *qi* and blood, while the *fu*, *yang* viscera's essential functions are to transmit and digest substances, as well to evacuate the pathogenic *qi*.

It is believed that health is achieved when the body is in harmony, also known as a dynamic equilibrium. This means that all the *qi* in each viscera are in an holistic harmony. Hence, harmony is crucial to the establishment of *yin yang* theory. However, disharmony signifies the deficiency or excess of *yin* and the *yang*. (Ni, 113) hence allowing disease to arise because the balance in *qi* has been disrupted. When *yin* is in excess, the *yang* is damaged, leading to the development of a cold disease (*e.g.* a cold). This is referred to as the body being *liang*凉 (cool), meaning that the *qi* is weak. When *yang* is in excess, the *yin* is likewise damaged, leading to the development of a warm disease (*e.g.* measles). This is commonly referred to as the body being *re*熱 (hot), meaning that the *qi* is stagnant and clotted (Ni, 126).

All acupoints can be classified as *yin* or *yang*. Acupoints above the waist are more *yang* than those below the waist. Therefore, *yang* gets stronger as they move up the body. In addition, the left and right of the body can also affect *yin* and *yang*. The left body is the *yang* side, while the right body is *yin* side (Ni, 121). This concept originates from *Huangdi neijing*, as it states: "one would gain more *qi* from the sun by facing east." Since the sun is as source of *yang*, the left side of the body, facing east, is *yang* as the sun rises from the east.

However, the body may not always be in a dynamic equilibrium of *yin* and *yang* though one may seem physically fit. There may be subtle shifts between *yin* and *yang*, and are affected by behavior or emotion. For instance in emotion, when one is angry, *yang* may dominate; when one has calmed down and resumed to a calm state, *yin* may become dominant (Ni, 124).

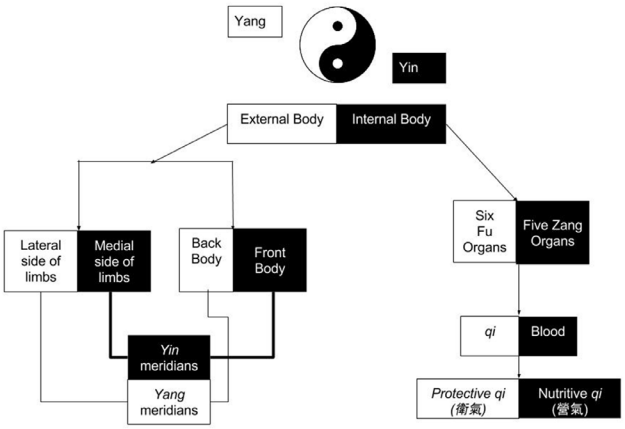

Figure 2.2 Yang and yin relationships in bodily components

Building upon these techniques, acupuncture stimulation nowadays is also aimed at replenishing the depleted *yin* or *yang*. Acupuncture practitioners attempt to determine the origin of the imbalance, and correct it through stimulating acupoints, and sometimes moxibustion (colloquially known as cupping). This restores balance thus health in the body. This is a much more modern approach to treating disease - practitioners can combine adjunctive therapies to acupuncture, whereas in past, only stimulating acupoints were know, hence a limited therapeutic effect was achieved.

Section 3: Nine needles, acupuncture puncturing techniques

Since ancient times, people observed that massage using sharp objects could relieve pain. As time progressed, people began puncturing their body surfaces with sharp objects (*e.g.* stones or twigs) at specific points to relieve pain (Unschuld, 21).

The earliest archeological evidence of an acupuncture tool dates to the Neolithic period. Archeologists found a quadrilateral, pyramid-prism shaped stone at 4.5 cm length which had a sharp but rounded tip. Historians believe that this was the acupuncture tool that ancient texts called the *bian shi* (扁石) which was used for treating boils and aches on the body (Unschuld, 24). This was one of the very first needles attempting at acupuncture.

Figure 3.1 Bian-shi, an archeological drawing (Lo, 112)

Acupuncture needles evolved overtime as forging techniques in China advanced, such as from the bone needles made from animals (approximately 8000 years ago) to the the metal needle invented during the Shang Dynasty (1600-1100 B.C.). The metal needles were much more advanced since it allowed for a deeper and precise insertion, whereas ancient needles could only strike the surface of the skin (Unschuld, 34).

The systemization of needles did not really occur until the Han Dynasty, as shown by the archeological excavations in the Han tomb in Hebei province. There were nine copper needles found, five coated with gold and four coated with silver. These needles were 6-8 cm in length approximately, and 2 millimeters in diameter (中國國家博物館, 1) as shown in figure 3.2.

Figure 3.2 Needles from the Han tomb in Mancheng Han tomb (中國國家博物館, 1)

The *Huangdi neijing* mentions a categorization of "nine needles", which differ in shape and function:

1. Arrow headed needle (鑱針) used for superficial skin diseases
2. Round needle (圓針) used for massage and muscular pain
3. Blunt needle (鍉針) used for vascular and febrile diseases
4. Sharp needle (鋒針), used for abscesses and carbuncles.
5. Sharpround needle (圓利針), also used for abscesses and certain acute conditions.
6. Sword needle (鈹針) used to pierce abscesses to drain pus.
7. Filiform needle (毫針), used as normal application on acupoints.
8. Long needle (長針), used for deep needling to the muscle level, to treat chronic rheumatism, sciatica, etc.
9. Large needle (大針), used for swelling of the abdomen.

Overtime, the quality of the needles improved as a result of the advancement of technology thus acupuncture became increasingly popular. Needles became much thinner and sharper to puncture the meridian more precisely (Unschuld, 32). The needles in the Ming Dynasty (see Fig 3.3.) were made of copper alloys, mainly with zinc. Other metals *e.g.* steel, silver, tin were also used.

Figure 3.3 Archeological drawing of needles from Ming and Qing Dynasty (汲古山房, 1)

In the 20th Century, foreign impacts also contributed to the standardization of acupuncture needles. For example, the invention of a "guide tube" (see Figure 3.4) that came from Japan helped improve the accuracy of puncturing. Though there were still many types of needles, only the filiform, long and sharp needles are used by mainstream practitioners today.

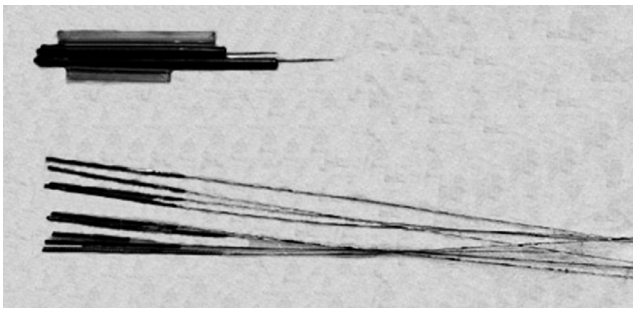

Figure 3.4 Guide tube and Long needle (汲古山房, 1)

Nowadays, the practice of acupuncture is much more widespread. As a result, the manufacturing of needles became cheaper and accessible. In contrast to the Han Dynasty, needles were over 10 times thinner in diameter, ranging from 0.2mm to 0.4mm. Made from stainless steel, needles were one-time use, largely eliminating the risk of infection.

The thinner diameter, varied materials and better sterilization of acupuncture needles show the development of technology since the Han Dynasty, as well as the increasing importance of hygiene in modern medical practice. These improved equipment have also contributed to acupuncture being more widely practiced.

Figure 3.5 Disposable sterilized acupuncture needles used in Chinese clinics (汲古山房, 1)

Section 4: Acupoint nomenclature

In Chinese nomenclature, acupoints are named after three criteria:

1. Anatomical position – named based on their location on the body
2. Therapeutic effect – named based on their therapeutic effect. For example, *duan-xue* (斷穴) translated literally means "interruption-acupoint", in which its function is to treat hemorrhage, the escape of blood from ruptured blood vessels.
3. Symbolism – name suggests the meaning of the point's location. For example, *long-hui* (龍會穴) means "dragon meeting", and is located between the eyebrows.

In Western nomenclature, a meridian numbering system was developed to name the 12 meridians and 8 extraordinary channels, based on the corresponding *zang fu* organs. This can be seen in Table 4.1 and 4.2 (Appendix).

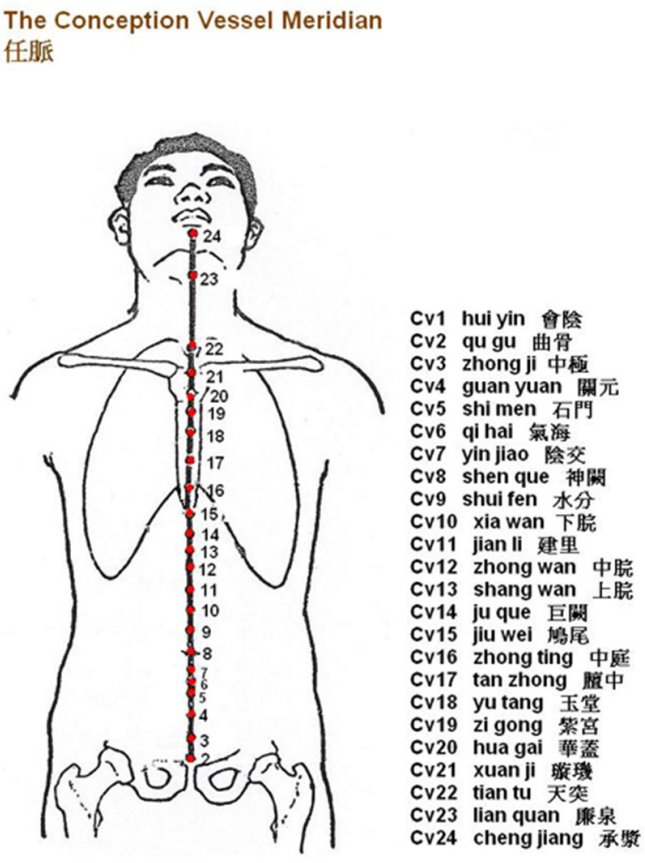

Figure 4.1 Conception vessel (CV) Meridians diagram

An example of how this meridian numbering system can be seen in Figure 4.1: each acupoint is given a number, in which the order ascends in the direction of Yin: "CV1, CV2, CV3, …". This helps practioners to locate the points, as well as to locate specific acupoints.

Section 5: Diagnostic techniques – then and now

To determine what type of treatment should be used, practioners must first diagnose the disease. Though there are many diagnostic techniques, *e.g.* energy levels (see below), pulse taking, etc. as explained in *Huangdi neijing*, using the cosmological cycles was one of the most popular methods.

In the Han Dynasty, it was believed that human body and other natural phenomena corresponded to nine cosmological bearings. For example, the human skin corresponded to the heaven/sky, just as the sky envelops the earth's environment. Another example is the body's system of collaterals corresponds to the landscape; the channels are similar to the rivers and streams flowing through land. Other cosmological bearings include the earth, man, seasons, sound, scales, heavenly bodies and wind.

The Han Dynasty practitioners therefore observed one's daily routine (*e.g.* diet, exercise, etc.) as well as phenomena in the macrocosms (*e.g.* seasonal changes, revolution of stars in the sky, etc.) to diagnose the patient's cause of disease. In essence, it was believed that natural factors such as geography and weather can affect one's disease. For example, in Eastern China, the climate is mild and maritime; hence many people eat fish, a food where the Yang *qi* is in excess. This stagnates the flow of blood. They also eat savory (salty) foods. The excess salt dehydrates the body and makes the blood congealed. This is why people who live in the East have dark colored skin, and suffer from carbuncles and boils due to hypertension or high blood pressure (Ni, 152). Thus stone needles are used more often on Eastern Chinese people to release the excess Yang *qi* from the body.

Today, acupuncture diagnosis uses pulse diagnosis. In fact, this diagnostic method is briefly mentioned in the *suwen*, a significant part of the *neijing* that focuses on natural law and the relationship between health and disease. This method is used to determine the severity of diseases based on pulse symptoms, characterized by the axis energy levels — the extent of *yin* and *yang* within that energy level (Diamond, 121):

There are six different energy levels: Tai yang, Yang ming, Shao yang, Tai yin, Shao yin, Jue yin. One important note is that the *yin* and *yang* are unrelated in this case; they simply indicate which is in imbalance.

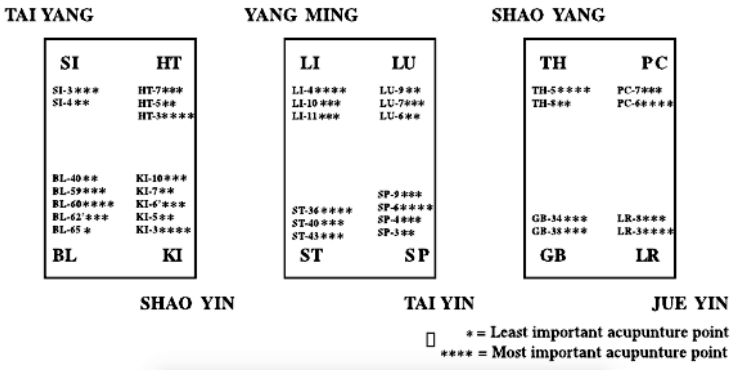

Figure 5.1 Principal meridians (Diamond, 120)

In the yang energy levels, the Tai yang stage has the greatest yin and shows a weak but constant pulse. The Yang ming stage has less yin and shows a weak but rapid pulse. The Shao yang stage has the least yin and shows an unstable and weak pulse.

In the yin energy levels, the Tai yin stage has the greatest yang and shows a weak pulse. The Shao yin stage has lesser yang and shows an extremely faint and weak pulse. The Jue yin stage has the least yang and shows a frail and indefinite pulse.

As one may see, ancient diagnostic techniques relied more on the concept that the body worked as a holistic whole, and therefore took into account other factors such as the cosmological, which were different the body's symptoms. But nowadays, perhaps affected by the scientific nature of diagnosis in Western medicine, practitioners use more palpable approaches such as taking the pulse, checking the color of the tongue, etc. which can be seen as a more evolved diagnostic technique.

Section 6: Acupuncture and related scientific research in the West

Acupuncture is undeniably effective in treating acute pain and diseases. There is therapeutic as well as some clinical evidence that indicates that acupuncture is not "hocus-pocus". However, many western scientists and doctors doubt the actual results of acupuncture, that it may be only a result of the placebo effect, in that the notion of acupuncture being effective may cause a complex stimulation of hormones in the patient.

In general, when people are being "treated" by a placebo method, the placebo effect can actually change blood flow patterns in the cortices of their brains (Briggs *et al.*). In order to test whether this held true in acupuncture, studies used sham acupuncture to emulate the effects of acupuncture to test the placebo effect. In studies such as Roxana *et al.* and Carlsson and Bengt, they showed that the placebo effect does play a statically significant effect, but not as much as the actual acupuncture technique itself.

However there is also much evidence to support the clinical efficacy of acupuncture: there are multiple attempts to explicate acupuncture using Western medical concepts, in modern anatomical terms.

Acupuncture may have an effect on the body's stress response system, otherwise known as the hypothalamus-pituitary-adrenal (HPA) axis due to the release of psychological hormones, which may explain why patients report lower stress levels after treatment. ß-endorphins – peptide hormones that stimulate the opiate receptors – may be the reason behind the effect of acupuncture on inhibiting pain. Endorphins are released in response to a wide range of phenomena. Similar to morphine, endorphins are sedative hormones that diminish the perception of pain and stress in one's body, In a double-blind study done by Roxana *et al.*, results show that there are elevated levels of ß-endorphin in the blood when acupuncture is being performed (Roxana, 1). Furthermore, when participants were given real and sham acupuncture, real acupuncture showed a more statically significant effect on depression

than sham acupuncture, hence showing that the placebo effect had not taken effect. However, this may be an inaccurate theory because the patients were already in stress and pain, which could have already induced the secretion of endorphins well before the acupuncture was practiced.

Building on these hormone theories, noninvasive neuroimaging techniques have been used to investigate the mechanisms of acupuncture. In the study of Hui *et al.* 2009., by using blood-oxygen-level dependent (BOLD) fMRI, intense signal was observed in the limbic system when acupuncture needles were administered to create a strong "needling sensation" of *qi*. This suggested a link between neural activity and *qi*, that *qi* may be a result of the electrochemical signals released when acupoints are stimulated. This is related to the concept of "bio-electricity", which studies the electric currents that flow in nerve impulses. Nuclear-magnetic-resonance (NMR) based metabolomic techniques demonstrated that acupuncture stimulation can change the levels of leucine, lactate, glucose, etc.(Wu *et al.* 2010). However, all these are proof-of-principle studies done on a limited number of subjects (48 healthy subjects), thus the theories cannot be generalized to a more general population.

But other theories better explain why acupuncture has been shown to work well on the nausea and vomiting. In the 1950s, the nerve reflex theory was proposed by Ishikawa and Fujita *et al.*, suggesting that the body's periphery (skin) is connected to the internal organs through a reflex called the viscero-cutaneous reflex. If the periphery is stimulated with acupuncture needles, the blood flow pattern to the stomach and abdomen is reversed, which could explain the effect on nausea and vomiting.

Despite these theories, the main clinical implementation of acupuncture in Western medicine today is in anesthesia - the use of acupuncture needles to administer insensitivity to pain, especially during a surgery. There are many advantages of acupuncture anesthesia over the conventional general anesthesia, which involves the use of drugs or gases that may offer potential side effects. In acupuncture anesthesia, the general patient does not lose consciousness and can communicate with the surgeon. This would not be possible under general anesthesia, where one may fall asleep or have numbness in their nerves. In addition, acupuncture anesthesia does not pose risks that commonly found with general anesthesia. For example, if a patient had to be operated with nil per os (nothing through mouth), acupuncture anesthesia would prove to be less problematic than general anesthesia (Lu DP, 10-16) This is also not to mention that there also other advantages, such as cheaper equipment used, as well as no monitoring personnel is needed (Lewith, 1).

Conclusion: The combination of western medicine and TCM

It is clear that acupuncture has become a fundamental technique of modern TCM. Over 3000 years of accumulation in ancient doctrines, a multitude of experience has been accumulated into treating a wide range of diseases. Different acupuncture theories have also contributed to modern acupuncture as it has been spread to different countries: Japan, multiple regions of East Asia, America, Canada, etc. An example of this is Dr. Manaka, and his technique of using diodes to treat the eight extraordinary meridians. In fact, some have accepted acupuncture as a clinically effective therapy.

Acupuncture was built on the ancient doctrines since the Han dynasty. Han practitioners followed the traditional clinical practice in TCM - a diagnosis was used to confirm the disease, and the corresponding treatment was prescribed. Specifically, they used their knowledge of the cosmological cycles and macrocosms, as well as the diet and daily habits of the patient to diagnose the disease, and then administered acupuncture stimulation accordingly, based on the system of acupoints - the *jing luo* system - as well as the concepts of how the meridians related to certain viscera, to cure the patient. This knowledge was developed by generations of practice and experience and condensed mainly into the *Huangdi neijing*, and the basic principles of acupuncture have been passed down as the ancient dogma of acupuncture till today.

Acupuncture was not introduced to the Western world until the 1500-1700s. The Dutch East India Company, while pursuing merchant trading of the Ming Dynasty monarchy, brought acupuncture procedures back to Europe. This was the very first recorded introduction of acupuncture into the Western world. One result of this was the development of the Western hypodermic needle from Chinese acupuncture needles. Sporadic clinical reports in Europe have recorded the use of acupuncture needles to relieve pain (Lu DP, 54-57).

Acupuncture impressed the American public when the President Nixon's trip to China in 1972. Upon his return, Major General Walter R. Tkach, of the U.S. Air Force and physician to President Nixon, wrote an article in the July 1972 issue of Readers Digest: "I Watched Acupuncture Work," (Tkach WR, 146-148) which helped make acupuncture popular in the U.S.. Prior to Mr. Nixon's trip to China, James Reston, the vice president of The New York Times at that time, had an appendectomy performed in Beijing under acupuncture anesthesia. As a result, he remained conscious during the entire procedure (NY Times, 1972). Dr. Samuel Rosen, a New York surgeon, observed acupuncture being used as anesthesia during his visit to China and reported that he could not explain medically nor scientifically the anesthesia he had witnessed.

Since then, teams of U.S. physicians have been sent to China to witness acupuncture anesthesia being applied in open-heart surgery, renal surgery, dental extraction, etc. The physicians witnessed successful surgical operations that were performed using acupuncture anesthesia. They were not only intrigued at that the fact that the patients were fully conscious and responsive to the surgeons' movements, but also amazed by the fact that needles were placed in acupoints irrelevant to the surgical sites since it seemed that there was no apparent relationship between the acupoints and anatomical organ (Lu DP, 54-57).

In 1972, the first cases using acupuncture anesthesia in the U.S. for surgical operations were performed at the Hospital of Albert Einstein College of Medicine in The Bronx, New York. The surgeries involved a successful skin graft operation (Berger J, 1972). Nevertheless, the clinical efficacy of acupuncture was still doubted.

Since the year 1970s, acupuncture anesthesia has been used for many surgical procedures. Thousands of open heart operations have been performed under acupuncture, with a success rate of >90% (Reina, 1). In fact, many surgeons have considered acupuncture anesthesia as a safer method than general anesthesia, as explained in Section 6.

However, there are many acupuncture concepts that do not have an equivalent in Western medicine, causing it to be hard to understood by Western medical practitioners, thus the debates of acupuncture as a globally proven technique to treat diseases is still unsettled. This is because there are many "grey areas" between both medical systems; Western medicine is deeply rooted in human anatomy with physical evidence, and has specific focuses on each and individual natomical system. TCM is the opposite: it is deeply rooted in the concepts of one's state of health, and focuses on the body as a functional, holistic whole, yet there is no physical evidence that clearly demonstrates the concepts of *qi*. To many scientists, this is the main reason that they unwilling to accept acupuncture thereby modern TCM in general. Nevertheless, it is still undeniable that acupuncture is clinically effective. Many researchers believe that there is an ultimate convergence point that can be reached in both Western medicine and TCM, that the "grey" area of medical knowledge is only "science that cannot be explained yet".

With consideration of the next few decades, may acupuncture finally be able to be explained in modern scientific terms? Even so, Is this really the correct path for TCM? Though being able to explain acupuncture in modern Western scientific terms ultimately is an excellent achievement for the merging of TCM and Western medicine, and can help acupuncture become more accepted; on the other hand, TCM may have lost its unique, cultural significance built on what is worth 3,000 years of medical corpus knowledge.

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Appendix

Table 2.1 Categorization of the zang and fu viscera

Yin interior viscera (Zang 臟)	Yang external viscera (Fu 腑)
Heart	Small intestine
Liver	Gall bladder
Spleen	Stomach
Lung	Large intestine
Kidney	Urinary bladder
Pericardium	Triple burner

Table 4.1 Abbreviations and number of points for the 12 meridians (WHO, 2-6)

Corresponding Viscera	Abbreviation	Number of points
Heart	HT	9
Large Intestine	LI	20
Small Intestine	SI	19
Lung	LU	11
Pericardium	PC	9
Triple Burner	TB	23
Gall Bladder	GB	44
Kidney	KD	27
Liver	LV	14
Stomach	ST	45
Spleen	SP	21
Urinary Bladder	UB	67

Table 4.2 Abbreviations and number of points for the 8 extraordinary meridians (WHO, 2-6)

Channel Name		Abbreviation	Number of points
Du (督脈)	Governing Vessel	GV	24
Ren (任脈)	Conception Vessel	CV	28
Chong (衝脈)	Penetrating vessel	EX	Extra (overlap with meridians)
Dai (帶脈)	Girdle vessel	EX	Extra
Yang Qiao (陽蹻脈)	Yang Mobility vessel	EX	Extra
Yin Qiao (陰蹻脈)	Yin Mobility vessel	EX	Extra
Yang Wei (陽維脈)	Yang Mobility vessel	EX	Extra
Yin Wei (陰維脈)	Yin Mobility vessel	EX	Extra

淺析中國古神獸「狐」的象徵意義

李心儀

引言

從《吳越春秋》等早期文獻中，我們不難看出古人賦予狐的那種濃郁的祥瑞色彩。在早期歷史文獻記載中，「狐」與鳳、龍、龜、麟等都是祥瑞的代名詞。然而，隨著一個個朝代的滅亡及興起，「狐」的象徵意義也隨之起伏，游離在瑞獸與精怪之間。元代以來，《搜神記》，《武王伐紂書》、《封神演義》等故事中那魅惑人心，禍國殃民的狐妖形象便已深入人心，使得狐成為禍亂人間的代名詞。狐狸不單是一種生物學範疇上的動物，也是一個個隨著時代不停改變的，反映了時代變化的，具有文化意義的象徵體。本文按時間順序，梳理從遠古到近代狐的形象更迭以及變化的原因，從而通過狐的形象，透析不同時代人的思想觀念的變化。

狐爲瑞獸

隋唐之前的文獻和考古遺址中，都有大量將狐狸與龍鳳龜麟一般視為瑞獸的記載。郭璞注《山海經・大荒東經》，「有狐九尾」雲：

太平則出而為瑞。〔1〕

也許這等現像是因為九尾狐與漢代盛行的西王母信仰有著緊密的關係。西王母是一位天界的神仙，除了有長生不死的能力之外，還能在日常生活中賜福於人，是位能夠解百姓於水火，消災攘難的女神 。

狐狸之所以與西王母有聯繫，是因為九尾狐常常被視為她的配神。現代考古發掘更是給予了我們不少實物為證，如：山東滕州市桑村鎮大郭村出土了一副東漢時的西王母畫像石，而畫上方左處便是一條九尾狐。（見附錄1）〔2〕陝西靖邊也出土了另一副畫像石，是東漢的作品，而在此畫像圖的右上角西王母身旁，刻著白兔搗藥，三足鳥，以及九尾狐的模樣。（見附錄2）〔2〕郫縣東漢磚室墓同樣也曾出土了三具石棺，其中兩具棺上都隱約有九尾狐的模樣。其中一具是九尾狐與三足鳥一起立與西王母座前；而另一具則中部有刻有西王母坐於龍虎座上, 左邊仍是九尾狐。〔3〕

漢畫和墓刻中之所以不斷地刻畫著西王母的形象，是因為人們希望在死後能夠向西王母求得飛升，並為子孫求得福祉。三足烏和青鳥都是不死之鳥；蟾蜍代表著子孫延續；而九尾狐則是清平之世的象徵。這些瑞獸作為配神與西王母一起刻進了歷史中。

所以，在漢代，狐與麒麟，鳳凰等祥瑞異獸一般，都是像徵祥瑞的動物。如麒麟，鳳凰，龍等瑞獸，他們也像徵了盛世到來、賢君出世或聖人到來的吉兆。

《孫氏瑞應圖》：王法修明，三才所得，九尾狐至。〔4〕

《河圖稽耀鉤》：黃帝之生，先致白狐。〔4〕

三國《魏略》：文帝受禪，九尾狐見於譙都。〔4〕

這幾條文獻也都印證了《吳越春秋・越王無餘外傳》中所訴的「其九尾者，王者之證」。

其實，古時人們普遍認為天人合一，上天會根據世間所發生的各種善惡而降下種種吉祥或災殃的怪異示兆於人，作為啟示或前兆。這種思維模式曾被廣泛地應用，並曾被用做於國家施政的重要依據。而像狐，鳳，龍，麟等祥瑞之物也普遍被用為君王粉飾太平，歌功頌德的一種政治手段：

漢代固封《白虎通德論・封禪》：

德至鳥獸則鳳皇翔，鸞鳥舞，麒麟臻，白虎到，狐九尾，白雉降，白鹿見，白鳥下。〔5〕

瞿曇悉達《開元占經卷一百一十六》中提到東漢曹植《上九尾狐表》：

黃初元年十一月二十三日，於鄄城縣北見眾狐數十，首在後，大狐在中央，長七八尺，赤紫色，舉頭樹尾，尾甚長大，林列有枝甚多，然後知九尾狐，斯誠聖王德政和氣所應也。〔6〕

這些行為，都被歸為「動物對賢者的忠誠」。〔7〕這便是「德及鳥獸」。以德服「獸」，吸引珍奇動物來到統治中心，而非使用暴力手段來統治。總而言之，獵人可以憑藉武力追捕征服動物；而聖人卻靠德行吸引，教化異獸這可正是證明了聖主賢君的仁愛、道德、以及權威。

據說，九尾狐還為東夷部落歸順於周王朝做出了一番預兆：

《宋書・符瑞志》：九尾狐，文王得之，東夷歸焉。〔4〕

「古人認為，如果天下太平，社會興盛，政治清明，國家統一，則會出現白狐，九尾狐。」〔4〕由於被賦予的特殊祥瑞色彩，它化身為一種政治象徵物，因而從春秋到魏晉南北朝，將白狐、九尾狐作為祥瑞進貢的記錄屢見不鮮。《逸周書》雲：「成王時青丘貢九尾狐。」不僅如此，據《魏書・靈徵志》記載，從北魏太和二年直到東魏武定三年的67年間內，進貢白狐，九尾狐等罕見狐類的便有27次，幾乎三年不到便會有一次。

由此可見，狐直到魏晉南北朝地位都十分崇高。這等地位如此崇高的神獸，又是如何墮落成精怪的呢？

狐爲妖獸

追溯歷史，最早將狐狸視為妖邪的文獻來自《山海經》：

青丘之山，有獸焉，其狀如狐而九尾，其音如嬰兒，能食人，食者不蠱。〔8〕

山海經雖然把狐形容成了一種食人的物種，卻沒有把狐過度妖魔化。狐真正被妖化始於魏晉南北朝時期。東晉干寶《搜神記.阿紫》條引《名山記》雲：「狐者，先古之淫婦也，其名曰阿紫，化而為狐。」東晉葛洪《神仙傳》也記載道：「王遙者，字伯遼。鄱陽人也，有妻無子，頗能治病，並無不癒者。亦不祭祀，不用符水針藥，其行治病，但以八尺布帀敷坐於地，不飲不食，須臾病癒，便起去。其有邪魅作禍者，遙畫地作獄，因召呼之，皆見其形物入在獄中，或狐狸龜蛇之類，乃斬而焚燒之，病者即愈〔9〕。」

這兩條記載分別顯示了晉代人們對狐的認知。《搜神記》的記載顯示了：首先，狐乃上古之獸，而當時人們有物老為怪的觀念，其次，狐在當時便與淫婦等形象聯繫了起來；而《神仙傳》中的記載則表明了當時人們認為狐與狸，龜，蛇等都屬於「邪魅作禍者」，乃是不祥的象徵。這是和之前我們所看到的神獸、瑞獸非常不同的一種形象。

從唐代開始，將狐狸作為精怪的文學作品也越來越多了。白居易《古塚狐－戒豔色也》中提到：「狐假女妖害猶淺，一朝一夕迷人眼。女為狐媚害即深，日長月增溺人心。何況褒姐之色善蠱惑，能喪人家覆人國。」〔10〕白居易在詩詞中把「能喪人家覆人國」的姐己與褒姒這兩個用美色把君王迷惑得亡國喪身的王妃們比為狐精，可見在當時人們的認知中，狐妖形像已與紅顏禍水聯繫在一起了。

宋及其往後的朝代，九尾狐也完全成為精怪的代表。宋代有太平廣記中的各種狐妖，以及趙令疇的《侯鯖錄・卷八》：「錢塘一官妓，性善媚惑，人號曰九尾野狐。」〔11〕而元代的《武王伐紂書》中則塑造了最著名的狐妖形象——殷商紂王的寵妃九尾狐妖蘇妲己。妲己在歷史上確有其人。據《國語・晉語》記載：「殷辛伐有蘇，有蘇氏以妲己女焉。」左丘明《左傳》記載：公元前1047年間，商紂王舉兵攻打有蘇部落，部落不得已向紂王帝辛獻出了牛羊、馬匹及美女妲己。從此，帝辛沉迷於妲己的美色，荒廢朝政，對她言聽計從，甚至到了「妲己之所譽貴之，妲己之所憎誅之」〔12〕的地步。最終，商被周所滅。紂王在摘星樓中自焚而死，而妲己也被殺。

而小說《武王伐紂書》中的妲己也是一條千年九尾狐精。小說的最後，「太公一手擎著降妖鏡，向空中照見妲己，真性化為九尾狐貍，騰空而去。」〔13〕

隨後，明代許仲琳在《武王伐紂書》等文本基礎上加工而成的《封神演義》也將妲己說成九尾狐狸精附體：「妲己的魂魄，已被狐狸吸去，死之久矣。乃借體成形，迷惑紂王，斷送他錦繡江山。」這些小說都把把女色，女禍的觀念推向了極致[14]。

結語

狐狸的象徵意義從古至今，在瑞獸到妖獸之間，反差巨大。細究其中原因，可總結的有以下兩點，可能可以在一定程度上解釋狐的地位變化的原因。

首先要考慮狐是自然界實際存在的動物。北京大學中文系教授李零曾在《出山與入塞》中提出過中國古代時出現的神獸形象可以大致被分成兩類：「一類是寫實的動物，一類使用不同種類的動物（特別是飛禽和走獸）誇張變形、混合而成，即純屬想像的動物。」〔15〕而狐顯然屬於前者，它更頻繁地出現在人們的日常生活中，更加常見，因而可能比起難得一見的純想像的動物更難以保住自身神聖的地位。狐狸本身的天性可能更強化了這一趨勢。狐狸是一種晝伏夜出、夜間覓食的動物，也是一種雜食類動物，會在荒郊野外築巢，吃人們上墳的的貢品等，會更容易讓人們把它與死亡，鬼怪以及靈異現象聯繫起來。這些可能都是狐狸從瑞獸之位跌落的原因。

其次，可能是佛教的影響。佛教自漢朝時從印度傳入，到唐朝已逐漸落地生根，與道教一起成為了主流的宗教信仰。然而在佛教故事中，狐的形象卻不怎麼高尚。唐代佛教典籍《法苑珠林》〔16〕中零零總總記錄了幾十則狐妖故事，如卷四十二有兩則狐妖禍害人間的故事，卷六十七則記錄了一個狐妖因為娶不到國王的女兒便要作怪的故事。佛教書籍中的故事通過僧人的宣講，在民間廣泛流傳，又與本土的傳說結合，形成了新的文化形象。或許佛教故事加快了狐的形像變化。

最後，我們也需要記住，狐狸的形像從來都不是單一而是多元的。即使是在狐廣受尊崇的漢代，也有對狐的形像有負面理解。東漢許慎《説文解字》便提到説：「狐,祆獸也，鬼所乘之」，認為狐身上有妖氣，是妖魔邪道。而在唐朝，儘管「狐為精怪」説法十分盛行，但沈既濟的《任氏傳》中的狐妖任氏卻是一位容顏艷麗，忠誠勇敢的女子。即使在面對強暴欺辱時，她也能夠盡力反抗，並最終運用自己的聰敏説服了欺凌者。〔17〕與白居易的《古塚狐》相反，《任氏傳》中的任氏是以堅貞，忠於愛情的形像出現的。再如清代蒲松齡著名的《聊齋誌異》，狐女們在這個文本中常常以一種美麗動人，勇敢善良的形像出現，只是多了一些古靈精怪的「狐性」而已。比如在故事《嬰寧》中的狐女嬰寧，總是以一副笑語盈盈，溫和柔善的模樣出現在觀眾眼前，卻在嬉笑間用木頭懲戒鄰家登徒子，使其喪命。〔18〕這些狐女不是沒有妖性，而只是在蒲松齡的筆下變得更有人情味罷了。所以説其實狐狸的形像一直都是帶有兩面性，並不是以絕對的善或絕對的惡出現在世人眼前的。今天，在大部分中國人將狐視作精怪的同時，也有東北松花江流域的達斡爾人等崇拜狐，信奉狐圖騰，禁忌獵殺狐狸，甚至忌諱直呼其名。達斡爾人尊稱狐狸為大仙、仙家佛、沙熱・巴日肯（黃色之神）等，〔19〕堅信他們民族的起源是民族男祖與狐狸化身的女子婚配的結果。狐狸的這些複雜的文化意義都值得我們進一步探究。

附錄

附錄1

附錄2

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Between Medicine and Politics: The Manchurian Plague of China, 1911-1919

Yim Pan Poon

Introduction

Along with the Plague of Justinian and "the Black death", the Third Plague Pandemic has been referred to as one of the three deadliest pandemics in human history; Manchurian Plague (1911-1919) was one of many in the Third Plague Pandemic. It killed up to 12 million people in China, caused a financial loss estimated to around $7,000,000 Chinese silver dollars, and its severity—along with the political undercurrents—made possible the first-ever international medical conference in China.

The primary reason why historians took so much interest in the Manchurian Plague is because of its exceptionally high death rate. However, beyond that, the Manchurian Plague is also remembered for creating lasting changes on China's foreign and domestic policies, establishing public health as a State responsibility, and catalyzing the introduction of Western Medicine amongst Traditional Chinese Medicine practitioners and the Manchurian government. According to historian Sean Lei, "in terms of accelerating China's acceptance of modern medicine, no event has been celebrated more than the containment of the Manchurian Plague at the end of Qing Dynasty"(Lei, 21). The first part of this paper will outline the rundown of the Manchurian Plague from its outburst to its recession.

The Manchurian Plague is also an exceptional event because it encapsulates layers upon layers of political, economic and cultural tensions: the plague unfolded mainly in a region already blighted by Russian and Japanese colonial ambitions; the plague was carried to an unprecedentedly large area by the seasonal migration of keen Chinese marmot hunters; the plague ignited cultural and medical clashes between different countries with regards to the most effective way of containing the plague. The defining role the Manchurian Plague had played in modern Chinese history at large deserves our close investigation. The second part of this essay will focus on the political undercurrents of the plague, specifically the domestic situation of Qing China and the encroachments on land made by Japan and Russia.

1. Rundown of the Manchurian Plague and its significance for medical history

To form an idea of the dire devastation caused by the Manchurian Plague, we shall refer to a description written by a correspondent of *The Lancet* in China:

> Human activity in this place seems to have completely died out; the streets are empty and deserted and all the houses are left desolate. Those who were not struck by the plague in the town itself fled terror-stricken and were overtaken by the black epidemic outside of the town. The bazaars and markets are closed. Dogs alone roam in the streets, howling and feeding on the corpses of their former masters. The stench is horrible. The hospitals are abandoned. There are no ill people any more and no medical men—all have died. Only on a few beds lie the dead bodies of those who expired last. (Correspondent in China, *The Lancet*, qtd. in Summers 1)

According to *The Lancet*, the plague was first documented to have taken nine lives on 26th October and four more the next day in a village near Manchuria station (British Delegate 14). The Manchurian plague then broke out in a larger scale on October 28th, 1910 in the railway town on the Sino-Russian border called Manchouli, resulting in 582 deaths (Andrews 97). On 8th of November,

according to a report in the *North-China Herald*, "The plague has reached Harbin… and the Russian Sanitary Department is taking preventive measures. So far only Chinese have suffered." (Correspondent, qtd. in Summers 14)

Prior to the plague, around 100,000 coolies rushed to Manchuria, as the rising demand for skin and fur on the European Market provided incentive for China's impoverished grass-root class to seek livelihood in marmot hunting (Andrews 97). However, many of these laborers went into this business without sufficient knowledge of the animal or of the disease that they turned out to carry (Nathan 2). Therefore, the laborers were generally unable to recognize a sick marmot; some even ate marmots for food (Report of the International Plague Conference, 22). Plague was thus transmitted from animal vectors to humans. Furthermore, the time period when the plague started was coincidentally around Chinese New Year, hence many marmot workers were set on travelling back to their home for celebration— and in doing so, they unknowingly carried the disease home.

Russian Sanitary Executive Committee was efficient in response to the first symptom of plague. Within the following two weeks: they have established "observation and isolation barracks, appointed sanitary officers, provided compensatory destruction of infected articles, begun preparation of lectures and pamphlets in Chinese, and invited medical aid from Russia."(Nathan 18). They disinfected or burned vacant homes and their contents, gave controlled laundry, water, trade, and set up police cordons around local Chinese villages. By January 20th, 1911, they effectively minimized the number of deaths of Russians to around fifty in North Manchuria (Nathan 19).

However, the effectiveness of Russian fight against plague begs the question of why "only Chinese has suffered" (Correspondent, *North-China Herald* 705). Although Russians were rigorous in protecting their people and preventing the plague from spreading towards Russia, they were less zealous in protecting the rest of Manchuria. Little effort was put into limiting the spread of plague to Chinese and Japanese-controlled area; Russian authorities also effectively drove some infected Chinese back to Chinese controlled area. It was only around January, when both China and Japan requested Russia to limit the sale of tickets for Chinese Eastern Railway to coolies, did they start instituting quarantine indiscriminately (Nathan 19).

Indeed, probably due to infected Chinese worker expulsed by the Russian, on January 2nd, 1911, the plague reached Mukden, causing 2,571 deaths in total, and Changchun, 3,104 deaths (Summers 19). There were daily reports of casualties in newspapers by mid-January in 1911; in plague hospitals, the death rate was 100%. It was greatly feared that the plague would spread southward to the densely populated cities, i.e. Beijing and Shanghai: the *North-China Herald* even raised false alarm in its 20th January 1911 issue that "the Plague has penetrated the Great Wall" (Summers 19).

Pressured by both the local elite and the foreign powers, the Qing court sent a Chinese physician, through the Ministry of Foreign Affairs, to investigate on the plague on its behalf. The brilliant physician, Dr. Wu Lien-The 伍連德 (1879-1960), was a Malaysia-born, Cambridge graduate Chinese Doctor equipped with most up-to-date and top-notch education. Dr. Wu's contribution was crucial in several respects. First, he established firmly that the plague was pneumatic in nature rather than bubonic; he found *Yersinia pestis* exclusively in the lungs of diseased Japanese woman during a postmortem inspection, which suggested that the bacilli were transmitted airborne (Lei 25).This was an important discovery, as it made clear that the bacilli were transmitted through person-to-person contact. There were mainly two forms of plague recognized then: bubonic, which symptoms include swelling, especially in the armpit and groin area, and pneumonic, which is primarily seen to have respiratory related symptoms. Pneumonic plague can be transmitted from one human to another without the involvement of vectors; rather, it transmits through mere inhalation of air that contains the bacteria *Yersinia Pestis*. Bubonic plague, on the other hand, requires vectors and

spreads through inoculation by fleas that fed on infected rodents.

Before the arrival of Dr. Wu, it was widely believed by the local Russian and Japanese doctors that the plague is bubonic and thus transmits through animal vectors. Some Russian experts became "so fixated on this diagnosis that they started a program of rat catching and dissection" (Summers 21). Dr. Kitasato Shibasaburo (1853-1931) was the most insistent of them all. As he identified the causative organism (*Yersinia Pesti*) of the Hong Kong bubonic plague prior the Manchurian plague, he was fully confident in his ability and disregarded Dr. Wu's suggestion. Pressed by Dr. Kitasato, the Japanese focused on eliminating rats; by the end of February, they were catching more than twenty thousand rats and mice in Dalian (Summers 74)

The pneumonic plague "was something that had been completely novel to Chinese until three or four months before the epidemic began" (Xiliang, 4), and also very rare outside of China: the foreign doctors were no less clueless to the idea of pneumonic plague than any local Chinese practitioners. When Dr. Wu discovered the plague's pneumonic nature—hence its ability of airborne transmission—he created a gauze mask that stops direct transmission through air and insisted both the health workers and the general public to wear it for self-protection. Yet despite Dr. Wu's effort, the foreign doctors from Japan, Russia, and France, confident in their knowledge, dismissed the idea of pneumonic plague as a mere derivative phenomenon and refused to wear the masks.

The foreign doctors, as Sean Lei put, "learned the hard way about the pneumonic nature of the plague" (Lei 26). Soon after, the French doctor Gérald Mesny, a senior member of the Chinese antiplaque team, became infected "as he visited the Russian epidemic hospital without wearing a mask", even when he came into close contact with very ill patients (Lei 26). The death of this senior expert six days later convinced people the pneumonic nature of Manchurian plague, thus "almost everyone in the street was seen to wear one form of mask or another"(Hirst 221).

Another crucial contribution of Dr. Wu was the establishment of a draconian quarantine system. This was, in the words of the Viceroy of Manchuria Xiliang 錫良 (1853-1917), "the most extreme and brutal policies seen in four thousand years" (Xiliang 8), which effectively stopped the plague from spreading further. In a telegram sent to Vice Minister of Medicine, Wu said that all efforts "may be concentrated upon the movement and habits of man" (Wu, Lien-teh 22). In order to separate those who were showing symptoms of infection from those who were not, Dr. Wu replaced the previously untrained police force with six hundred trained policemen (Wu, Lien-teh 19). He also asked for the restrictions on movement in and out of the Great Wall. Dr. Wu policed human movement by deploying nearly "twelve hundred soldier outside and six hundred policemen inside Harbin"(Lei 29), making sure no citizen is moving from one place to another without permission.

Wu's measures did not go without triggering strong resistance from the local population, who questioned, "…Why burn good clothes and bedding?" (Christie 248). Another typical native response to separation quarantines based on their beliefs was that "All will die whose time has come… why take people away to isolation stations?"(Nathan 10). The quarantine measures did not sit well with the Chinese cultural value, and to make matters worse, there was no definite cure for the plague from those who enforce said quarantines. No one who has gone into the plague hospital had come out (Nathan 13). However, these measures were effectual. As neither traditional Chinese nor modern Western medicine at that time could provide efficient cure for those already infected, fighting the plague meant stopping the plague from further spreading: Wu's policy of restricting human movement, burning their homes and belongings, and taking away suspected relatives was truly draconian, yet it was proven to be the most effective method (Lei 30).

Out of all of Wu's policy, most noticeably progressive was the mass cremation of corpses, which did not go less contrary to Chinese tradition than the systematic quarantine. In January, the frozen soil became impractical for traditional

Chinese burials. The number of infectious corpse accumulated outside of Harbin amounted to around two thousand (Nathan 8). In fact, upon first arrival to the infected area in January of 1911, Dr. Wu, became intensely concerned with the possibility of rats getting infected by eating the dead bodies, which would provide the pneumonic plague with an additional animal vector (Nathan 21). He wired an emergency petition to the emperor to ask for permission for mass cremation of plague casualties (Nathan 8). Changchun authorities, after the announcement of imperial edict, soon followed suit (Huang, qtd. in Nathan 8), cremating a thousand corpses in a few weeks; some rural villages even followed the city's example spontaneously to cremate the dead (Stanley, qtd. in Nathan 8). Many of the major cities adopted the emergency cremation measure quickly and effectively. Taking into account that cremation was regarded as an offense to the Chinese tradition of ancestral reverence, the permission promptly issued reflected Qing government's support and trust for Dr. Wu's medical ability (Wu, Lien-teh 28-29).

While Dr. Kitasato still strongly believed the nature of this plague to be bubonic—to the extent of saying the practice of wearing masks "unnecessary and exaggerated"(Wu, Lien-teh 29), the significance of Dr. Wu's draconian measures were indisputable: within just thirty days of his antiplaque campaign, the number of deaths per month in Harbin dropped from 3413 to 0 (Lei 30). "The daily death rate began to fall…[and] the medical team impressed observers as being more efficient" (Nathan 17). The plague—by mass cremation and draconian quarantine measures—receded quickly with the gradual support of locals (Nathan 11).

2. The Manchurian Plague as a Political Clash

The Manchurian Plague was a landmark event in the history of modern medicine, in which not only different medical theories, but also different conception of public health policy were laid bare. However, to fully understand the Manchurian plague, it is also crucial to know that Manchuria then was a region of contested sovereignty. It was fought for discretely between Qing China and two imperial powers: Japan and Russia. From the rundown of the Manchurian Plague, we can already see that the tripartite management of railways played as important a role as the lack of knowledge. Ineffective governance also shared responsibility in the exceptional death toll of the plague. In other words, the stakes of the crisis were as much medical as political.

The best way to explore these international political tensions is to look at the railway. The introduction of railroad made long distance migration possible to the mass majority, entailing new opportunities of a better life for the grass-root classes. The marmot hunters all travelled by train to the Manchuria-Russia border. This by itself was a benefit for those workers; but the ability to transport a huge mass over long distance also made the plague ever more deadly and explosive. The most affected settlements and cities – Manchouli, Harbin, and Changchun – were all railway hubs. However, the railways, although all located in Qing China's territory, were not owned by one unified authority. The Chinese Eastern Railway (CER) was owned by Russia, the Southern Manchurian Railway (SMR) was owned by Japan, and the Qing regime owned the Chinese Imperial Railway (CIR). The tripartite management, which went with conflicting geopolitical interests, medical traditions and cultural values, made plague containment ever more difficult. To understand the origin of the conflicts surrounding the sovereignty and management of the railways between China, Russia and Japan, we have to go back to the year 1890s.

Figure 1: Tripartite Railway Management in Manchuria
Source: from The Cambridge History of China:
Volume 11: Late Ch'ing, 1800-1911, Part 2.
New York: Cambridge University Press, 1980. Andrews 98

2.1 Imperial Russia's Encroachment on Manchuria

Russia started coveting railway rights in Manchurian since the early 1890s, when the Trans-Siberian railway was extending towards the Pacific. China's defeat by Japan in 1894 and the latter's increasing influence over Chinese territory prompted Russia to step in and forced Japan to renounce its Manchurian conquest (Quested 81). In 1896, the Chinese Prime Minister Li Hongzhang 李鴻章 (1823-1901) signed the secret accord with Russia in St. Petersburg, Russia, allowing Russia to construct a railway that ran across Northern Manchuria and links Vladivostok to the Trans-Siberian. (Quested. 82, Summers 34)

Therefore, between 1897 and 1903, Russians built Chinese Eastern Railway (CER) across Manchuria. Russian settlements grew along the railway; most noticeable was the new Russian town Harbin with 60,000 people by 1903. Harbin, the city most heavily hit by the plague in 1911, was an epitome of Russian presence in Southern Manchuria: two-thirds of its population was Russian (Quested 82), up to 95 percent of the land was owned by the Russian railway company, and the architectural style was in fashion with Imperial Russia at that time (Summers 35). Considering Harbin started as a fishing village of only about 6 houses in 1895, Russia certainly succeeded in building Russian influence in China.

In its starting years, the railway construction seemed to be a combined effort of China and Russia, maintaining a "façade of a joint Sino-Russian enterprise"(Quested 82). Yet soon enough in 1898, Russia, like many other European powers such as Germany and Britain, became more aggressive in expanding its control of Manchuria. In December of 1897, Tsar Nicholas II ordered the occupation of Port Arthur and Dalian (Summer 36); after much negotiation, a new Sino-Russian agreement was signed, settling upon a 25-year lease of Port Arthur issued to Russia. In addition, Russia also pressured China to allow it to build a branch line of CER, namely the South Manchurian Railway (SMR). Like Harbin, the Russians placed great importance on Port Arthur and Dalian. Port Arthur served as a militarized naval base while Dalian became an international commercial hub. Dalian, when first leased to Russia in 1898, was a barren fish village just like Harbin. Yet the Russians had built it to "one of the finest cities in the Orient" (Clyde 13). In addition, Russia disregarded the Chinese customs for international port of Dalian in its period of lease, benefiting from commercial gains by making Dalian a free commercial port (Summer 37). From there, the Qing regime relied less on Russia, as "the hollowness of the fictitious Russo-Chinese Alliance was exposed" (Quested 82). The Qing government later realized the railways functioned not only as a route for trades, but also more alarmingly, as a route for military intrusion; nonetheless, Russia has already long secured its position in Southern Manchuria.

The Russian settlements along the CER gave Russian authorities the legitimate right to be concerned with the containment of the plague, yet in the meantime, the very Russian settlements threatened China's sovereign right of Manchuria and provided grounds for cultural and medical discrepancies. In fact, one of the most controversial agreements of the Port Arthur Lease that resurfaced many times during plague control activities was that the CER "shall never, under any form, serve as a pretext for the seizure of Chinese territory or for an encroachment on the sovereign rights of China."(Clyde 72)

2.2 Japanese Expansionism

Japan, similar to Russia, also wanted a piece of "The Chinese Cake". In 1904, Japan conducted a sudden attack on Port Arthur of which was then leased to Russia. This attack took the Russians by surprise, and the subsequent Treaty of Portsmouth consecrated the Japanese victory in the Russo-Japanese War (1904-1905). Hence Japan overtakes the South Manchurian Railway (SMR) and its respective trade concessions in Manchuria (Andrews 97). Similarly, prior to the Russo-Japanese War, Japan's victory in the Sino-Japanese War of 1894 imposed upon China to cede to Japan the suzerainty of Korea, Taiwan, the Pescadores Islands, and most significantly certain parts of the Liaodong Peninsula in Southern Manchuria (1895 Treaty of Shimonoseki).

The Japanese main deputy, Goto Shinpei 後藤新平(1857-1929), was the former chief of Civil Affairs in Taiwan (which Japan took control over after Sino-Japanese war). It was in Taiwan that he developed successful tactics of colonization, including ways of undertaking military actions under the disguise of civil matters. While the Treaty of Portsmouth specified that Japan was only allowed to exploit the SMR for commercial and industrial purpose, Goto used the railway to control Manchurian agriculture. For example, as the exportation of soybean from China to Europe inevitably passed through the SMR which stretched from the commercial port Dalian to the center of soybean production in Changchun, Japan took huge benefits by monopolizing the entire transportation, exportation and exploitation of Chinese soybeans (Rujivacharakul 79).

Figure 4. French postcard titled "The Chinese Cake," caricaturing the outcome of the Portsmouth Peace Conference in 1905. *From left:* Emperor William II of Germany; Émile Loubet, president of the French Republic; Nicholas II, czar of Russia; Emperor Meiji of Japan; Theodore Roosevelt, president of the United States; and King Edward VII of the United Kingdom.

Japan also recognized the potential in the railways as a means to establish long-term influences in Manchuria. In Goto's mentor General Kodama's words, "The most essential post-war policy in Manchuria is to carry out numerous secret projects under the pretext of running a railway" (Tsurumi 112). Regardless to what the secret projects are, Japan certainly succeeded in building the façade of having "nothing to do with politics and military" (Hayase 107): the SMR Company promoted aggressive modernization such as building hospitals, roads, steamship lines and schools alongside the railway zone (Summer 43). Such constructions were made to further Japanese influence and to foster, in Goto's words, military preparedness behind cultural projects"(Hayase 115). Goto specified what the "cultural project" consisted of:

> We have to implement a cultural invasion with a Central Laboratory, popular education for the resident populace, and forge other academic and economic links. (Ito Takeo 14, qtd. in Summers 45)

Under Goto's leadership, the Japanese "cultural invasion" started with the Research Office of South Manchurian Railway. This office conducted research on a diverse range of topics: history, ethnography and economic condition of both Manchuria and Korea (Hayase, 115). Japan viewed the accumulation of knowledge under the

auspices of the railway company as a means to foster colonization of these regions.

Besides land annexation, with sub-article 3 of Treaty of Portsmouth, Japan and Russia were permitted to position a restricted number of soldiers in their respective railway stations. Their supposed purpose was to guard the stations, yet it was obvious the stationed troops functioned not only for securing trade and mineral resource (Andrew 88). To quote Summers, Japan and Russia recognized the potential use of railway guards as "a cover for future military buildups" (Summers 42). This article echoes Japan's ideal of "military preparedness behind cultural projects" (Hayase 115). Although its nominal sovereignty still belongs to the Imperial Qing government, in reality, major parts of Manchuria has already fallen under control of Russia and Japan, not to mention the colonial ambition of other foreign powers such as Britain and France. Qing China was under pressure from many sides.

Japan and Russia's ambition for China is clear: their well-defined policies, aggressive encroachment, and infrastructural projects are all forms of power. Such accumulation of soft power made plague control not only a matter of medical differences between doctors of different beliefs, but also a clash of conflicting national interest and sovereign rights. All in all, with the understanding of the two encroaching foreign powers, we can argue that conflicting sovereignty made large-scale plague control exceedingly difficult. In the context of suffering from multiple foreign intrusions, the plague can even be seen as one more of the grim events inflicted upon China by foreign powers. However, ultimately, it was Qing government action, through its deputy Dr. Wu Lien-teh, that put the plague to an end; consequently, China's first public health service grew out of the crisis. From this perspective, one can argue that the anti-plague campaign of 1911 was a continuation of the Qing regime's modernization process that has started since the 1860s.

2.3 Qing Domestic Policy

From the 1860s to 1895, Qing China had started the Self Strengthening Movement to modernize China, with a particularly emphasis on heavy industry and military technology. Multiple previous events, such as Second Opium War (1860), has already exposed China's backwardness in technology, therefore a group of enlightened high officials pushed through the construction of railway, modern university system, and adoption of Western-style army and navy etc. ("The Self-Strengthening Movement."). Viceroy Xiliang and Western-trained Chinese doctors like Wu Lien-teh are precisely the products of this time. Qing China was already on its way of modernization, hence the open-mindedness of Chinese officials to new, Western medical practices:

> "We Chinese have believed in an ancient system of medical practice, which the experience of centuries had found to be serviceable for many ailments, but the lessons taught by this epidemic… have compelled several of us to revise our former ideas of this valuable branch of knowledge" (Xiliang 4)

As stated earlier, when the Manchurian plague broke out, Qing government was inadequately equipped with knowledge on the subject. The Hong Kong plague in 1894 was bubonic, warranting very different containment measures. In the words of Dr. Wu, "this [plague] was the first extensive outbreak of the exclusively pneumonic variety that has occurred for ages"(Mukden Report 19), requiring unprecedented quarantine measure.

Given the unseen nature of the plague that took even the Western medical experts by surprise, as we discussed earlier, Qing imperial government's reaction was quick: Dr. Wu was sent one month after the first report of the plague to implement draconian quarantines which effectively contained the plague. This is all the more impressive, when we consider that politically, the Qing Imperial government was at its final years in 1911; Dr. Sun Yat Sen was attempting to overthrow the Qing regime by fomenting armed revolution in the southern provinces. Prior to this revolution, the Boxer Revolt in 1900 has caused the Qing Dynasty to pay more than $330 million in reparation to foreign powers (History.com).

In some ways, we may even argue that the anti-Plague campaign of 1911 was a milestone in Qing government's struggle to become a modern

government. Modern government can be defined by a government's abilities to mobilize financial and human resources in defense of national interest, internationally and domestically. Unlike modern government that can be intrusive and brutal in pursuit of its aims, traditional Chinese ideal of governance was leniency and limited intervention into civil affairs. For this reason, until 1911, the Imperial Chinese state did not impose forceful public health measures (Benedict 130). However, during the Manchurian Plague, as imposed by Dr. Wu, the Plague Prevention Service exercised draconian quarantine measures—allowing police to burn people's properties and belongings, forcefully separating people from their relatives and abruptly interrupting people of their normal life (Lei 30). Although it was described as the "most extreme and brutal policies seen in four thousand years" (Xiliang 8), the plague finally receded. Here lies an interesting paradox: by acting in a brutal and merciless, even inhumane way, the Qing State managed to defend the public interest and its sovereign rights efficiently. It would be interesting to investigate into the fines line between forceful defense of national interest and respect for individual rights by the successive later governments of 20th century China.

3. Conclusion

As the plague receded in April 1911, the Chinese government invited a medical team of twenty doctors from the following countries: Austria-Hungary, France, Germany, Great Britain, Italy, Japan, Mexico, Netherlands, Russia, and the United States to a medical conference. The agenda of this conference was to find a vaccine for the pathological bacteria in prevention of future reoccurrences. The Mukden Conference a milestone in China's medical history because it was the first international scientific conference held on Chinese soil and chaired by a Chinese: Dr. Wu Lien-Teh. It was also from then on that systematic health work and public health were effectively established as a national responsibility in China (Summers 21, 41)

Dr. Wu himself, in his memoir *Plague Fighter*, said, "the consideration shown…by the imperial family gave a great fillip to scientific medical practice throughout China."(Wu Yu-lin 37). The imperial edict granting mass cremation was to be a milestone in establishing modern public health service in China. Soon after the Mukden Conference, China established the North Manchurian Plague Prevention Service in 1912. It was an act not only out of fear for another plague explosion, but also for fear of foreign interventions again. Medical and political concerns were again closely intertwined. The Chinese government's follow up action reflect Qing, and the Republican government's awareness on the issue of public health being a political responsibility of a sovereign government vis-à-vis its people. The following is Dr. Wu's account in the North Manchurian Plague Prevention Service Report:

> In October [1911] the revolution broke out, and the Manchurian Customs were hypothecated to the payment of the Loans and Boxer Indemnity. The Manchurian Customs Revenue thus passed into the control of the representatives of the [foreign] Powers in Peking who at first refused to continue this Service. Six months then passed, and now, as a result of representations from the Wai Chiao Pu [Waijiao Bu 外交部, Ministry of Foreign

> Affairs], a dispatch, dated September 19th, 1912, has been received from the Diplomatic Body, saying that the sum asked for, namely, Roubles 78,000, has been sanctioned, and work could commence at once. (North Manchuria Plague Service Reports 1)

Although the medical sciences have immensely developed since 1911, many problems fought in the Manchurian plague are still fought today. These problems may not necessarily be medical problems, but rather, it is the relationship between transnational demand on public health and the protection of sovereignty.

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An Introduction to Artemisia & Artemisinin: What are the Merits and Demerits of Modernising Traditional Chinese Medicine?

Introduction

In 2015, Artemisinin received international recognition when Tu Youyou, the original discoverer of the compound received the Nobel Prize in Physiology and Medicine. This drug is one of many which have been developed through fusion of Chinese and Western medicine. This article provides background knowledge on malaria, Artemisia and Artemisinin. It covers how the drug is currently benefiting the wider population, the science behind how the drug works and how the drug is used today. It then gives an account on the Project 523, giving insight on the adventure researchers took and challenges they faced when developing the drug. Through the lens of Artemisinin, the pros and cons of modernizing Traditional Chinese medicine are then discussed.

1. What is Malaria, Artemisia, and Artemisinin?

Malaria is a fatal mosquito-borne disease ("Nobel Prize") caused by single-cell parasites, known as *Plasmodium falciparum* (Malaria). Parasites enter the bloodstream and destroy red blood cells in peripheral capillaries, causing anaemia (Editorial Board). In cases of cerebral malaria, red blood cells become sticky and form clumps in capillaries (Editorial Board). This causes microcirculatory arrest, resulting in comas (Editorial Board). Symptoms of malaria include intermittent fevers, lingering heat in joints and bones, muscle pains and brain damage.

Taking into account the money each country spends on treatment, the loss in investment and tourism and the absenteeism in school and work caused by malaria, Africa loses an estimate of $12 billion to the disease annually. Through a survey done in 2011, 72% of companies in sub-Saharan Africa express that they are negatively affected by malaria. It is estimated that government spending on malaria costs an approximate of 5-6% of the country's GDP and that an average household loses 25% of its income to the disease ("What Is the Economic Impact").

Artemisia is part of the Compositae family. It is the generic term which *Artemisia annua, A.lancea and A. apiacea* fall under ("Nobel Prize"). Although all three types of Artemisia possess active antimalarial properties, *Artemisia* annua, or sweet wormwood, is the most abundant in the compound and is the herb used in modern day medicine (Zhang). This weed-like plant is a ruderal and grows in a vast variety of terrain (Hsu).

Artemisinin, also known in Chinese as *qinghaosu* 青蒿素 is the active antimalarial component found in *Artemisia annua* (Hsu). Artemisinin is extracted from the leaves of the plant and appears in the form of colorless crystals (Editorial Board).

The search for this drug began in the 1960s when chloroquine resistant parasites appeared (Yu & Wen). Chloroquine, an extract from the South American cinchona tree bark (Editorial Board), is a drug used to treat general types of malaria. Artemisinin is used only to cure chloroquine resistant malaria (e.g. cerebral malaria) due to its high cost.

Although the drug is costly, it reacts fast and has low toxicity (Yu & Wen). According to the RSTMH, parasite clearance time ranges from 25.8 to 43.8 h (Editorial Board). It is the most effective anti-malarial drug. Artemisinin can also be stored for long periods of time. "Parenteral formulation is stable at room temperature for at least 4 years." (Editorial Board)

Due to the high cost of ACTs, patients in economically impoverished epidemic areas such as Africa, South Asia and Eastern Mediterranean ("Frequently Asked Questions") are unable to access ACTs. In most parts of Africa, quinine continued to be used as a monotherapy and as first-line therapy even one year after the introduction of ACTs (Sella).

The development research group of the World Bank expressed that "a delay (even by two years) in instituting a subsidy for ACTs would exacerbate resistance engendered by use of AMT and PMT prior to the introduction of a subsidy, and would lead to faster resistance to ACTs." The World Bank proposed to provide a global subsidy in 2005 so that patients would only have to pay a low price for therapy (Laxminarayan, Over, & Smith, 2005)). Even after considering that increasing affordability of the drug may cause potential misuse and cause parasites to more quickly become resistant to the treatment, it was concluded that there are "optimal subsidy levels at which the marginal cost-effectiveness of treatment and the number of deaths averted are greatest." After this proposal, however there has been no documentation of further action taken on a global subsidy.

Artemisinin is usually given in the form of artemisinin based combination therapies (ACTs). Artemisinin is activated when exposed to heme (iron) from the biosynthetic pathway of malaria parasites or the digested hemoglobins of RBCs in the bloodstream (Arnaud). Once activated, Artemisinin binds to 124 different proteins in parasites and warps the membranes, mitochondria, endoplasmic reticulum and nucleoplasm (Yu &Wen). This thwarts several cellular processes in malarial parasites. Trophozoites lose cytoplasm, causing parasites to degenerate and eventually die (Yu & Wen). The multiple targets of Artemisinin make it difficult for parasites to become resistant to the drug and makes the compound highly reactive (Arnaud). Artemisinin has a close to 100% response rate to malaria ("Nobel Prize").

In ACTs, Artemisinin serves to reduce majority of the parasites and keep symptoms at bay as it is a quick reactant ("Q&A"). The partnering drug, often derivatives of Chloroquine, such as mefloquine, then eliminate the remaining parasites ("Q&A"). This increases cure rates and the effectiveness of the drug (Editorial Board). Artemisinin works best given in the form of ACTs as Artemisinin does not persist in the body and malaria has high recurrence rates if the drug is used on its own. The rapid absorption of Artemisinin also means rapid excretion (Zhang).

Artemisinin can be taken orally, in the form of tablets, oil, oil suspensions and water suspensions or in the form of intramuscular injections (Wu). The user must not stop taking the drug even when symptoms have subsided as the recrudescence rate is high if the drug cycle is not completed (Zhang).

2. The Discovery of Artemisinin

The discovery and development began during the War of Vietnam in the 1960s. This was a war between North Vietnam and South Vietnam. The North was backed by communist allies, especially the People's Republic of China, whilst the South was backed by anti-communist allies, especially the US. China was heavily involved in the war and provided North Vietnam with considerable financial support, food and military personnel. This was a gory war, with an estimate of 800,000 to 3.1 million deaths, 25,000 out of which were caused by malaria.

During the War of Vietnam, the appearance of Chloroquine resistant malaria became a prevailing issue. With the support of Chairman Mao Zedong and Prime Minister Zhou Enlai, the Project 523 was launched in 1967. It aimed to find a new anti-malarial drug to aid Vietnamese allies and China's own troops (Zhang). With the support of the central State, Project 523 involved people from "scientific research units, clinical medical units, educational units and drug manufacturing units" (Zhang).

Researchers in Project 523 were divided into two subsections: the study of chemical compounds and the study of traditional Chinese medicine.

In the early 1970s, part of the Chinese herbal medicine team from Beijing, Shanghai and Sichuan worked to modify the ß-dichroine, an

extract from the drug Radix dichroae, which possesses antimalarial properties but also causes severe vomiting.

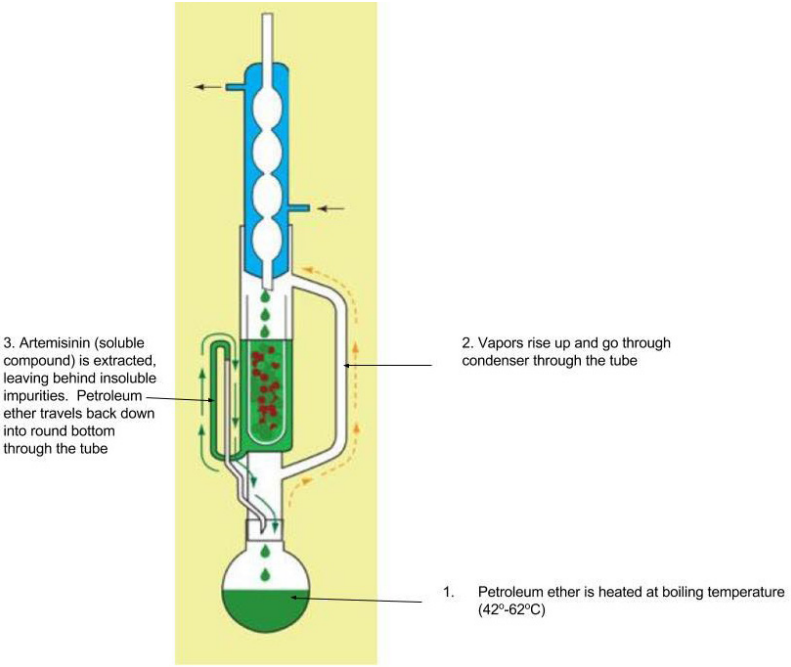
During this time, scientists from the Military Academy of Medical Science collaborated with scientists of the Beijing Institute of Materia Medica, one of which was Tu Youyou. Ethanol extracts of ancient and current Chinese herbal medicines were made, one of which was Artemisinin. However, laboratory experiments on rodents only showed 60-80% positive results for the drug (Zhang).

Researchers faced a great obstacle when finding the optimal way for extracting Artemisinin. In 1971, however, through reviewing ancient scripts, scientists came across the "肘後預備急方" in which they found the preparation method of soaking the plant and ingesting the juice: "take a handful of Qinghao, soak in two litres of water, strain the liquid and drink". This is said to be able to treat "lingering heat in joint and bones", "exhaustion due to fever" and acute convulsions caused by cerebral malaria (Hsu).

Researchers thus hypothesised that the high temperature at which they were experimenting the extraction destroyed the active ingredient and replaced the use of ethanol with a substance with a lower boiling point: ether. The crude ether extraction had a 100% success rate, which was reported at the national 523 project meeting on March 1972. Even today, using petroleum ether remains the most effective way of extraction.

Artemisinin is extracted from dried leaves of the plant through the use of a soxhlet extraction apparatus. Artemisinin is extracted and insoluble impurities are left behind ("Soxhlet Extraction").

This form of extraction was found to be especially effective as it allows for mass production. Continuous cycles can be run without the need of supervision. The process is also effective as the solvent is reused over and over again ("Soxhlet Extraction"). It has "all the desired characteristics: short flow times, high yield, low capital cost, easy purification, simple operation, steady production process, no need for special equipment or testing agents, and with end products of high purity." (Zhang, p.62)



The active element of the crude ether extract was separated and clinical trials were conducted from 1972 to 1973. The antimalarial properties of Artemisinin were confirmed and the drug proved to have no apparent toxic side effects.

However, what remains a conundrum from these historical records is that A. apiacea, the species of Artemisia containing less antimalarial properties, was preferred over A. Annua. It is suggested that the different way of preparation allows larger amounts of artemisinin to be acquired from A. apiacea when the herb is used in its entirety (Hsu). "The soaking of the entire fresh plant in water and its subsequent wringing out must have resulted in an emulsion of water, flavonoids and other etherical oils contained in stem and leaves which may have facilitated the extraction of the Artemisia sesquiterpenes" (Hsu). In April 1973, Zhan Eryi and Luo Zeyuan from the Yunnan Institute of Materia Medica successfully isolated A. Annua crystals. Today, A. Annua is more widely used for the extraction of artemisinin.

Based on the success in Beijing and Yunnan, A. Annua became the focus of the 1974 antimalarial Chinese medicinal herbs research project. Further work on identifying the chemical structure, improving extraction techniques, testing and clinical trials was executed (Zhang, p.31).

From June to October 1976, large-scale clinical trials with unpurified, crude extracts of A. Annua took place in Jiangsu province. Results showed that the malaria mortality rate had decreased by 50% during one year. Of the 240,000 people the drug was tested on, 89% were successfully cured.

In the late 1970s, A. Annua was desperately needed for military use at the country borders. In response, scientists attempted the first large-scale production scheme for Artemisinin and tested production capabilities. The production task was successful.

In the 1980s, the spread of multidrug resistant malaria continued to spread. The WHO urgently needed a new anti-malarial drug and established a 5 year long collaboration with China. However, in September 1982 WHO carried out GMP inspections in factories and commented preclinical pharmacology, disinfection procedures and toxicology studies were all far behind international standards.

Altogether, the project 523 has given rise to fourteen antimalarial drugs.

Now, the semi- synthetic derivatives of Artemisinin are used as the base of ACTs.

3. The Pros and Cons of Modernizing Artemisinin

Modernizing Artemisinin has allowed synthetic derivatives to be developed and has made the drug more affordable for epidemic countries in poverty. As there is less than 1% of artemisinin found in *Artemisia annua*, the herb must be put through several processes in order to extract the compound: Artemisinin (Weathers, Arsenault, Covello, Mcmickle, Teoh, & Reed). The extensive lead-time and poor bioavailability of Artemisinin greatly limited the effectiveness of the drug (Whirl-Carrillo,. McDonagh, Hebert, Sangkuhl, Thorn, Altman, & Klein). As there is an 18 month lag between the initial requisition and the eventual supply of Artemisinin which is dependent on weather and harvest, the supply of Artemisinin is unknown, causing dramatic fluctuation in prices (Paddon, & Jay p. 355). As of 2005-2008, a kilogram of artemisinin cost 120-1,200 USD ("Report of the 2008"). The fluctuating cost prevents wide use of the drug in many endemic areas where the average per capita healthcare expenditure is under 100$ (Paddon, & Jay p. 357). However, with recent developments in synthetic biology, the Semi-synthetic Artemisinin Project[1] was able to develop more reliable artemisinin derivatives such as artesunate, artemether and arteether (Whirl-Carrillo,. McDonagh, Hebert, Sangkuhl, Thorn, Altman, & Klein): derivatives which are now used as the base of ACTs.

Modernizing Artemisinin has also allowed it to become standardized and allow the drug to be used more safely and efficiently. In order for drugs to be sold in the mass market, they must be approved by public authorities (such as the Food and Drug Administration, or FDA, in the US) to ensure that quality and drug dosages are standardized. Processes run by the FDA include quality control of crude drugs, assessments of stability, safety and efficacy. Without having medicine dosages standardized, drugs would be misused, would be ineffective and may even cause harmful side effects to mis-users. For example, artemisia in Chongqing contains 0.2% of artemisinin, whilst ones in Yunnan contain only 0.02%. If the regional status of artemisinin was not authenticated and all types of artemisinin were assumed to contain the same concentration of artemisinin, then users would be taking vastly different dosages of the drug.

However, having Artemisinin standardized means that drugs can be bought over the counter at pharmacies and would no longer be personalized. The belief of everyone having a different "background", "ying" and "yang", "qi" and meridians will also play a diminishing role in medicine. Medics and patients will begin studying chemical components of Chinese drugs instead of understanding the way drugs interact with the qi and viscera of patients. Overall, taking out the cultural aspect of Chinese medicine. Progressively, Chinese medicine will move towards being developed through laboratory experiments and will be developed using "modern methods".

The Beijing government has already established incubators to modernize not only ACTs, but also other Traditional Chinese Medicines. 202 herbal plants are already beginning standard operating procedures ("Herbal Medicine"). Modernization vanguards have also looked at using technology to replace the human component of TCM. For example, using instruments to classify the pulse beat instead of touch.

Artemisinin is but one of the many traditional Chinese medicines which have been modernized and westernized. Other examples include aspirin, a compound found in willow bark which was commonly used 2,000 years ago by the Chinese to cure colds, fevers and hemorrhages (Goldberg). Is modernizing TCM the right way for medicine to develop in? Modernizing Traditional Chinese Medicine allows drugs to save more lives, become safer and standardized. However, this is at the cost of the cultural aspects of Traditional Chinese Medicine.

[1] "The project was funded by a grant from the Bill and Melinda Gates Foundation in 2004" (Paddon, & Jay p.357) which aimed to provide "an alternative source of artemisinin to stabilize the supply and price of antimalarial combination therapies (ACTs) for patients in the developing world"

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懸置懷疑與知識

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「懸置懷疑」這一概念來源於戲劇，意為個人自願將懷疑擱置，從而相信一種不符合現實、或是不合理的事物。由於戲劇的情節、劇本往往是脱離現實的，因此「懸置懷疑」在戲劇中尤為重要。例如小說《哈利波特》就是基於一個充滿幻想事物的虛構世界，因此，讀者在閱讀小說時需要擱置懷疑，從而相信小說設定中的種種「不合理」與「荒誕」。由此可見，懸置懷疑是欣賞大多數文學戲劇的前提條件。然而，這一概念在除了戲劇外的領域還有用武之地嗎？其在創造知識與獲取知識的過程中起到什麼作用?在各個領域的運用又有何不同呢?本文將剖析「懸置懷疑」這一概念，並以較為宏觀的視角審視這一看似抽象又神秘的概念對於知識的重要性。

説到知識，人類的知識可被劃分為八個知識領域，分別為：自然科學、人文科學、歷史、藝術、宗教、倫理道德、數學、與土著知識。由於篇幅的限制，本文將選取自然科學與歷史這兩個看似無甚關聯的知識領域進行探討。通過對這兩個知識領域的探討，也足以達到舉一反三之效，一窺「懸置懷疑」在知識創造與獲取中的作用。

自然科學注重「邏輯」和「理性」，科學家通過一套嚴謹的方法來驗證理論。例如，生物學家巴斯德（Louis Pasteur, 1822-1895）設計了「鵝頸瓶實驗」，他將殺菌過的營養基分別放置於完好的鵝頸瓶和「無頸」的瓶子中，然後通過對比兩組瓶子中微生物的生長狀況，得出了「微生物不可自然產生」的結論，其實驗結果為細胞學説提供了有力的證據[1]。經過其他科學家的檢驗，細胞學説最終被認可。上述的過程不需要「懸置懷疑」，反而尤其需要懷疑精神與批判性思維來找出錯誤，而這一嚴謹的方法則是自然科學中獲取知識的主要途徑。這樣看來，「懸置懷疑」似乎與自然科學所需求的強烈的批判性思維和懷疑精神相矛盾。

而細想之，自然科學中的許多理論含有「懸置懷疑」。科學家追求以簡明的公式來解釋自然現象，而這些公式卻常常建立在虛構的理想狀態上——為了簡化公式，或是忽略誤差，或是「扭曲現實」。現實中器材精度的限制導致了許多誤差。例如計算熱量的公式：$q=mc\Delta t$[2]。假設溫度計測出水溫變化為2.5°C，而實際上水溫變化了2.501°C，這0.001°C的誤差往往就被忽視了。因此自然科學中的許多公式是基於誤差不存在的假設，用一種理想化的視角看待事物。而這不正是懸置了對於實驗誤差的懷疑，從而沉浸於一個理想化的世界嗎？

科學家有時還「扭曲現實」以便於解釋某些現象。例如「理想氣體狀態方程」（Ideal Gas Law）：$pV=nRT$。這一公式描述了氣體的體積、溫度、以及壓力這三者之間的關係。而在公式中，氣體的質量和分子的體積直接被視為零[3]。雖然在正常室溫下，兩者的影響微乎其微，但在極度高溫高壓的環境，這兩者的影響將會被放大，影響公式的準確性。化學家們對於氣體質量及分子體積的刻意忽視正是擱置了對這一不足的懷疑，建立一個虛構的環境，從而簡化公式，便於人們的理解。

懸置懷疑對自然科學的影響還存在於更宏觀的方面——範式轉移，即從舊到新知識體系的轉變。達爾文的進化論就是一個典例。當達爾文發表《物種起源》，提出「進化論」這一觀點時，就連頂尖的科學家都認為其荒謬不堪。因為在這之前的數十個世紀，「上帝造物」這一説法一直被視為真理，人們認為所有物種從始至終都保持著上帝最初設計的樣子，因而不存在「進化」。然而，「進化論」最終之所以被接受，很大程度上歸功於懸置懷疑。當時少數科學家不被傳統觀念所禁錮，擱置了對進化論的懷疑，親自驗證，並一定程度上證明了其理論。當理論開始被少數權威科學家認同，逐漸越來越多的人也懸置了懷疑，接納了這一理論。一個新的、有悖「常理」的觀點難免顯得荒謬，而正是懸置懷疑賦予了這些新觀點存活的空間，推進新知識的產生以及舊知識的推翻，對自然科學知識領域有著巨大的影響。

1. IB Biology Course Book p254
2. IB Chemistry Course Book p357
3. IB Chemistry Course Book, p435

除了自然科學，「懸置懷疑」在歷史中也有些意想不到的運用和影響。

在歷史知識領域中，人們通過史料學習歷史，因此史料的準確性尤為重要。而史料中常包含許多錯誤和偏見，例如《三國志》作者陳壽雖親曆三國時期，但因其創作時代近，有許多史料還未披露；同時，陳壽是晉臣，晉是承魏而有天下的，因此難免夾帶了政治影響。《三國志》中也多有曲筆、回護西晉司馬政權的做法。例如關於高貴鄉公被弒之事，在許多史書如《漢晉春秋》等所載是「高貴鄉公曹髦見司馬昭跋扈專橫，專權禍國，心不能甘」，於是發兵親討司馬昭，然而卻反被司馬昭謀害。而《三國志》中對此卻付之闕如，只寫「高貴鄉公卒，年二十」[4]，而刻意省略了其被司馬昭暗算的死因[5]，回護司馬政權。面對這樣的曲筆，懷疑精神和嚴謹的學術態度就顯得尤為重要。因此為了得到更準確、完整的知識，不應該懸置懷疑，而應該抱有懷疑、探究史料的準確性。

然而，有人學習歷史是為了「以史為鑑」，而不在於探究真相。這類人群讀史時則會懸置懷疑，抱有相信的態度。雖然史料中可能包含錯誤，例如在《The Americans: Reconstruction to the 21st Century》一書中記載《1492 Columbus first reaches North America.》[6]（1492年哥倫布到達了北美）。經考證，哥倫布到達的是南美而非北美。這一錯誤並不影響讀者對於歷史的整體理解，讀者仍能體會到哥倫布出航的重大意義及其對大航海時代開拓性作用。由於其目的不同，抱著懸置懷疑的態度反而更能輕鬆有效地學史、達到其目的。

此外，新知識的產生需要懸置懷疑。歷史中有許多假設因缺乏證據，無法被證實為知識。懸置懷疑則幫助人們擱置懷疑，尋找證據支持假設。例如，中國最早的文字源於商代的甲骨文，而甲骨文中沒有記錄可考的、發生於夏朝的事件。這就引來了對夏朝存在的懷疑，從前國際學界也否認夏朝的存在。而中國許多歷史學家堅信夏朝的存在，懸置了關於夏朝的種種懷疑，經過不懈的考古努力終於在1959年發現了二里頭遺址，發現大量宮殿、居民區、銅器等遺跡，為夏朝的存在提供了有力的證據。隨著證據的增加，「夏朝存在」這一假設也會逐步進化為知識。因此，懸置懷疑給予一種信念，使人相信假設的可能性，促進證據的發現，從而推動知識的產生。

在面對歷史文獻時，不僅讀者要懸置懷疑，作者寫作時也要懸置懷疑。近代的史書中常常出現對歷史人物心理、性格等方面的描述。例如在《萬曆十五年》這一由黃仁宇所著的關於明神宗朱翊鈞書中就寫到「接近他的人可以看出，皇帝陛下越來越感到生活的單調和疲勞／他對生活的厭倦已經越出了內心世界而要見諸行動了。」[7]這類歷史知識具有溫度和情感，它們源於作者的推理和想像，極具主觀性。面對這樣的史料，讀者更是需要懸置懷疑從而更好地接觸歷史、體會歷史。而作者在寫作這類史料時也需要懸置懷疑。作者寫作前需要閱讀大量的資料，然後通過推理和想像還原歷史人物。這一過程中，作者閱讀資料時需要懸置懷疑，塑造歷史人物時也要擱置對於時代因素等的懷疑，沉浸於歷史人物所在的歷史情境，體會、並想像人物當時的心情與遭遇，從而通過這種懸置懷疑的方式創造並獲得知識。

綜上所述，「懸置懷疑」在除戲劇外的其他知識領域也有所運用和體現。其在自然科學中的運用為科學家通過擱置對於誤差等的懷疑，從而達到理論的簡明與普及性。此外，其也是范式轉移的必要條件之一，幫助自然科學知識的進步和更新，因此其在自然科學中起到相當重要的作用。而在歷史知識領域，「懸置懷疑」不僅推進新歷史知識的產生，在閱讀史書時還幫助許多讀者更輕鬆有效地學習歷史。此外，懸置懷疑使人們更好的體會歷史人物的心理，幫助作者將冷冰冰的史實以具有情感溫度的方式重現。由此看來，「懸置懷疑」在自然科學與歷史知識領域中的運用各有特色，運用廣泛，頗為重要。因此，「懸置懷疑」這一概念不止存在於文學戲劇，其在其他知識領域也佔有一席之地，發揮著舉足輕重的作用。

4. 《三國志》魏書，陳壽著
5. 《漢晉春秋》習鑿齒
6. “The Americans: Reconstruction to the 21st Century”, McDougal Littell, Gerald A Danzer, 2010. p459,
7. 《萬曆十五年》，黃仁宇著，三聯書店出版社，1997年， p174。

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跨學科研究與困惑的價值

陳曦

內容摘要

學科的專業化趨勢，使科目分支的指數化增加。傳統科目理論研究的不斷深入，一方面提高了知識研究的深度與廣度，也在另一方面出現「一騎絕塵」，拉大了理論知識和現實應用的距離。因此，採用跨學科的方法來研究各類知識，解決複雜的現實問題成為了近現代學術研究的一種趨勢。然而，人們對於跨學科研究的評價卻褒貶不一。有思想家認為「跨學科解決了所謂的現實問題，卻削弱了傳統科目的研究深度」，「跨學科研究的效率底下並且耗費龐大資金」，「跨學科研究只能帶來不必要的困惑」，「跨學科不是簡單的知識重疊，是知識的互補現象」[1]。針對這些議論，本論文從跨學科研究的歷史出發，舉例分析「困惑」在跨學科研究中所主導的作用。

一、初探學科（Disciplines）的形成史和跨學科（Interdisciplinarity）的由來

要想了解跨學科研究在當前所面臨的理論上的挑戰，必須站在歷史的角度，從後往前摸索。我們看到，「學科」這一概念的出現，在某種程度上已經造就了「跨學科」的歷史必然。早在古希臘時期，哲人們便嘗試著給所獲得的知識加以分類，而史上初試分類的便是亞里士多德了。亞里士多德將所有的知識按照性能進行了空間性的劃分，其中scientia泛指一切探索事物起源的學科，doxa則指議論性科目，ars指藝術，而techne指所有創造性的作業[2]。到了公元前300年，古羅馬哲人斯多亞在亞里士多德對知識劃分的基礎上，對知識進行了更加仔細的劃分，從而衍生出邏輯學、物理學、倫理學以及更注重實際工程的分類。後人更進一步將二人的知識分類做了一個概括性的總和，即Artes Liberales。其中不僅包括了理論知識也包括了實踐知識，如此對知識的粗略劃分大概持續到17世紀初。17世紀初期，一位叫做Francis Bacon的法國人以一份關於科學的調查問卷，革命性地顛覆了當時人們對現存知識的認識。Bacon的調查提供了有效的知識種類數據，使當時的百科全書編纂家們對學科進行了分等級的劃分[3]。對自然歷史/科學、哲學和數學進行等級的劃分，在科目的形成之中是最根本的（primary development）。而之後在18世紀初所出現的次級發展（secondary development），則是在等級劃分好的科目下作相應的知識儲備。17世紀下半葉，自然科學經歷了前所未有的快速發展，自然科學的信息量大量增加，多種學術數據的急速積累推進了學者們對數據進行分類的重要性，以增加在不同領域裡研究的效率。在如此一個知識爆炸的時期，原本混亂的知識在被有序的進行整理的同時也面臨著制度化整合（institutionalisation）。知識與數據的特殊化（specialisation）使有著共同研究課題和相似研究方法的學者們能夠聚在一起，來實現知識內部的「人以群分」。這意味著特定學術圈中的特定學者分享著特定的學術雜誌，在特定的機構里工作並使用著特定的學術語言。直到1830年，第一間大學性學術機構在德國形成，象徵性的給予不同知識以「科目」的概念。縱觀歷史，今天的物理、生物、化學、社會科學、心理學和經濟學這些研究門類，也不過只是兩百多年以前的產物。這些知識的系統和製度化，也一直影響著當今世界的知識格局。

知識從最初混合混沌的形式發展到被分類定義，成為具體科目的過程就像地圖中疆域的界線一般，由於具體語言、方法與理論限定的原因，一個學科領域的學者很難涉足另外一個領域。如此僵化的知識格局逐漸面臨著新的挑戰，就如同《牛津跨學科手冊》中所指出的那樣，「社會、政治、知識和經濟問題的解決不在於越來越多的知識積累。今天所需要的是更好地了解知識領域之間的聯繫，更好的把握學

1. 《備受爭議的概念：跨學科的歷史及文化碰撞》，斯文・埃里克・拉森，譯者：王敬慧，《跨學科與當代大學學科建設》，2018年1月
2. "The Oxford Handbook of Interdisciplinarity", Robert Frodeman and Julie Thomson Klein, p. 15, 2010
3. "The Oxford Handbook of Interdisciplinarity", Robert Frodeman and Julie Thomson Klein, p. 15, 2010

術界向社會轉化的方式，以更好地了解持續的知識生產中的危機與機遇。[4]」雖然「跨學科」是一個新的當代表述，但是跨學科作為一種研究現象卻絕非新潮。 「所有事物都是一個大的研究領域的不同方面[5]」這樣的觀點早在古希臘時期就已經出現。亞里士多德認為區分知識的唯一因素即他們所研究的是現實的不同部分，而對知識的分類並非是將學科孤立出來，如此的孤立主義不但降低了知識的複雜性，同時長期來看忽視了其與倫理學的關係，使知識不能再最大程度上服務於人類，提高社會福祉[6]。生物倫理學的出現正是印證了這個道理，這也是為什麼上文指出學科的孤立主義在一定程度上恰恰造成了跨學科研究的趨勢。

讓我們再將視角轉向「跨學科」一詞。在詞彙分類學（taxonomy）裡，「跨學科」（interdisciplinarity）這一類（genus）詞出現於二十世紀末，意味著整合、合作、知識錯綜複雜的狀態，領域之間的相互批評，以及解決問題的方式。它的象徵意義（typology）被發表於經濟合作與發展組織（OECD）於法國召開的1972年度的國際峰會上[7]。但是「跨學科」卻只是三種詞中的一種，其他包括了「多學科」（mutidisciplinarity）和「貫融學科」（transdisciplinarity）[8]。跨學科程度的不同決定了詞的種類，而本文所關注的「跨學科」則更多的關注與知識的整合、互動、聯繫與混合，這樣的跨學科程度介於多學科和貫融學科之間。

二、困惑（confusion）的由來與價值

過往知識的歷史展示了一個知識從混合走向分立的過程。既然所有事物都是一個大的研究領域的不同方面，為什麼打破科目的結構性進行跨學科的研究會使人們產生困惑呢？困惑（confusion）從何而來，指的是什麼？在跨學科知識的形成之中起到了什麼作用？為了解決以上問題，便需回答一個更加關鍵的問題：所有的跨學科研究都會產生困惑嗎？對這個問題的答案是肯定的，法國哲學家奧古斯特・孔德對這個問題做過簡要的論斷：「跨學科所產生的困惑是誇大專業化所帶來的有害影響」（the pernicious effects of an exaggerated specialism）。孔德將現階段所產生的困惑來源總結為下面四種分類：協調（coordination），質量分析（quality assessment），溝通（communication），文化（culture）[9]。其中，困惑也有著十分廣泛的理解，比如認知層面的矛盾（辯證矛盾和邏輯矛盾）以及悖論，和現實層面上溝通與理解上的困難及項目建設上的現實難題。

自然科學疆域以內的跨學科研究通常不存在認知層面的困惑如矛盾及悖論，原因是在自然科學中，不同科目所有的實驗技術和理論都可以互通或互補，採用跨學科的方法通常會產生明晰並有應用價值的新知識。那是因為在自然科學領域，每一門科目都涉及物質、能量和它們關係的相互變化[10]，因此所有科目的研究對像在原子層面都是相同的[11]。就拿微生物學作個比方，在現代微生物學當中，單純使用傳統生物學的實驗技術（例如解剖和觀察）是不足以提供科學家任何有效的研究數據。因此，獨立科目研究的局限性萌生了生物信息學，生物化學和生物物理學等跨學科方式。比如説史丹佛大學的一篇題為「腸微生物：將空間組織連接到功能」[12]的研究，就演示了科學家採用跨學科的研究方式來利用生物化學探針、物理空間呈像技術和現代宏基因組學測序技術來發現腸道細菌定位的原則。在這一情景中採用跨學科的方法來研究微生物學不但沒有產生認知層面的困惑，還能產生清楚的知識，原因是自然科學中的知識理論和實驗技術可以互通來使用。再將鏡頭放大來看可以發現，近年的化學諾貝爾獎得主的研究成果都是利用了跨學科的方式。 2017年度的化學諾貝爾得主就是利用物理學原理來發明低溫電子顯微鏡（cryo-electron microscopy），以用在對溶液中生物分子的高分辨率結構測定之中[13]。從這個例子中可以發現，現代科學的跨學科研究不僅僅是並用單個科目的理論與技術，而是解構和重組現有的理論與技術來研究新的知識領域。相

4. 《大學中的“科學”與“文化”：重疊？衝突？還是互補？》，米列納・札克，譯者：季丹，《跨學科與當代大學學科建設》，2018年1月
5. 《備受爭議的概念：跨學科的歷史及文化碰撞》，斯文・埃里克・拉森，譯者：王敬慧，《跨學科與當代大學學科建設》，2018年1月
6. 《備受爭議的概念：跨學科的歷史及文化碰撞》，斯文・埃里克・拉森，譯者：王敬慧，《跨學科與當代大學學科建設》，2018年1月
7. “The Oxford Handbook of Interdisciplinarity”, Robert Frodeman and Julie Thomson Klein, p. 15, 2010
8. “The Oxford Handbook of Interdisciplinarity”, Robert Frodeman and Julie Thomson Klein, p. 15, 2010
9. “The Oxford Handbook of Interdisciplinarity”, Robert Frodeman and Julie Thomson Klein, p. 15, 2010
10. “Natural Science.” Merriam-Webster, Merriam-Webster, www.merriam-webster.com/dictionary/natural%20science. Accessed 26 Feb. 2017.
11. Gottlieb, Michael A., and Rudolf Pfeiffer . “The Relation of Physics to Other Sciences.” The Feynman Lectures on Physics Vol. I Ch. 3: The Relation of Physics to Other Sciences, California Institute of Technology, www.feynmanlectures.caltech.edu/I_03.html. Accessed 26 Feb. 2017.
12. Tropini, Carolina, Kristen A. Earle, Kerwyn Casey Huang, and Justin L. Sonnenburg. “The Gut Microbiome: Connecting Spatial Organization to Function.” Cell Host & Microbe, vol. 21, no. 4, 2017, pp. 433—442., doi:10.1016/j.chom.2017.03.010. Accessed 26 Feb. 2017.
13. “The Nobel Prize in Chemistry.” Nobelprize.org, 2017, www.nobelprize.org/nobel_prizes/chemistry/.

似的，現代科學的計算機化也是同樣演繹了這樣的現象。科學家們並非簡單的將計算機技能疊加在科學當中，而是將科目之間的理論與方法加以整合來探索未知領域。生物信息學的出現以及20世紀末人類宏基因組的發現就是基於跨學科的方法。因此，總結來看，現代科學的跨學科研究是不可避免的，一位西方學者Catherine Westfall就將這種現象命名為「重組科學」[14]。但必須承認的是，項目建設上的現實難題無疑是「重組科學」未來發展的一大阻力。原因很簡單，歷史上過度的科目孤立化給現階段跨學科的科學家們造成了協調與溝通上的難題。好比生物學家和物理學家各有一套不同的語言與研究思維模式，因此在大型項目的現實操作中，要想實現零阻礙的學術交流是有一定挑戰的。因此，在自然科學的跨學科研究中，困惑的產生無時無刻不警示著人們過度科目孤立化的危害，同時鼓勵著人們接受跨學科的研究方式去探索更加複雜的，全面的新知識。

同時，人文學家們能夠採用跨學科的方法通過利用領域甲的理論與實驗方法來彌補領域乙的理論缺陷。像是結合了經濟學與心裡學的行為經濟學，便是利用了心理學中以觀察和實驗為依據的研究方式來補足經濟量化模型過度簡易的漏缺[15]。一項來自麻省理工大學的經濟學研究顯示，給員工增加獎金並不可以達到像自由市場經濟模型中所說的那樣來提高工作效率，而是在很大程度上削弱了員工的創造力和自我驅動力，那是因為站在心理學的角度，個體並不能持續做理性的分析來將效益最大化[16]。因此，結合心理學案例來作分析的實驗技術可以補足經濟學理論所存在的漏洞，兩者結合體行為經濟學便是提升了經濟模型的複雜度使其與現實接軌，並且創造了新的理論與研究方法。但是由於科目內部語言與研究思維模式的差異，將高度量化的經濟學和相對傳統的心理學結合起來研究仍舊面臨着學者們協調與溝通的挑戰。但是不同於自然科學，如此的困惑在人文科學的研究中更能夠查明一個學科中所存在的理論或方法漏洞，使得學者們可以相互補足。上述的例子討論了在一個大科目疆域內的跨學科研究與其困惑產生的原因和作用，可以發現這些例子中所出現的困惑都屬於實際操作層面的而非認知層面的矛盾及悖論。下面接著討論跨學科研究在多個大疆域之間的應用以及其產生困惑的情形。

在《牛津跨學科手冊》中，所有和數學產生交叉連繫的跨學科都被屬於「根本交叉」（root interdisciplinarity）[17]。數學的作用在於利用公理和規則推理來判斷對錯，它的研究範圍包括了世間所有事物的規律和順序，無論它是屬於結構，空間，或是改變的範疇。數學被認作是一切知識的基礎，因為它本身呈現了一種知識的本質狀態，也就是邏輯。因此，採用數學來跨學科研究其他學科一直是歷久彌新的研究方式。古希臘天文學家托勒密就應用了圓形幾何於地球運行軌道的計算。而後期，伽利略則是在數學的跨學科研究上更進一步。伽利略認為所有物理理論的形成都應該有數學作為證明基礎，否則理論不成立。但是，越靠近本質級別的研究就更能夠引發認知層面的困惑即所謂矛盾及悖論。那是因為首先數學是個近乎完美的計算工具，而其所研究的現實世界是不完美的，有瑕疵的。比如說托勒密的天文研究就基於假設行星運行軌道是完美的圓形一樣，當然後期的幾何發展能夠促進天文學家們作更精確的研究，但是數學這個學科作為一門研究工具只能恰如其分的預測客觀的自然現象，而非精確的描述它。當然，有人可能會反駁這個觀點，認為微積分與現代統計學的發展是人們利用數學來接近真相的最好方式。但這樣的論點卻存在悖論，那是因為它與直觀相衝突。先來聊聊微積分，微積分就妙在他能夠捕捉一個連續沒有中斷事物無限小的瞬間，所以它只能被應用在一個連續沒有中斷的情境中[18]。但是，到目前為止，人們還沒有明確的知悉我們所知的時空是否是連續性的。因此，這裏數學與其所應用的自然科學之間存在一種辯證矛盾，即客觀事物的矛盾在思想上的表現。從這裡可以看出，數學在很大程度上只能被用在預測另外一個科目的理論而非清楚的描述它，這裡的悖論即可被看作一種理論與現實的誤差，激勵著學者們不斷的探索，去接近真理。

以上的篇章提及了現代科學的計算機化。事實上，自然學科的計算機化是非一個科目對另外一個科目的重疊研究，而是科目之間的相互影響。比如說計算機心理語言學就是結合了語言學、心理學，和人工智能去建立人腦如何利用

14. “The Oxford Handbook of Interdisciplinarity”, Robert Frodeman and Julie Thomson Klein, p. 15, 2010
15. Baddeley, Michelle. “Keynesian Psychology and Behavioural Macroeconomics: Theory and Policy.” The Economic and Labour Relations Review, vol. 28, no. 2, 2017, pp. 177—196., doi:10.1177/1035304617706849. Accessed 26 Feb. 2017.
16. BENABOU, ROLAND, and JEAN TIROLE. “Intrinsic and Extrinsic Motivation.” Review of Economic Studies, vol. 70, Jan. 2003, pp. 489—520., www.princeton.edu/~rbenabou/papers/RES2003.pdf. Accessed 26 Feb. 2017.
17. “The Oxford Handbook of Interdisciplinarity”, Robert Frodeman and Julie Thomson Klein, p. 15, 2010
18. “The Oxford Handbook of Interdisciplinarity”, Robert Frodeman and Julie Thomson Klein, p. 15, 2010

語言的模型。反之，當下非常火的人工智能則也是藉用了腦神經科學的理念去建立運算法則模型，通過輸入運算法則大量的數據去得出規律，從而產生有效的數據分析[19]。人工智能或者說機器學習現在已普及應用至人們生活的方方面面例如交通、醫學等領域。但是，就像神經學家不全面理解大腦神經網絡的複雜原理一樣，計算機科學家也對計算機「學習」數據和得出結論的過程無從知曉。在這類情境中，融合知識的理論能夠產生有效的決定，但是知識領域之間的運作關係卻呈現出一種「黑盒」狀態，原因則是對此領域理解的膚淺導致了科學家對於該知識如何運作的迷茫。如此的困惑可以指出兩個重要的問題。首先，機器學習中算法的不可解釋性，「窮盡局部的採樣特性」，「不明確的非線性」導致了機器學習的理論喪失了科學理論原本應該擁有的簡潔與優美[20]。第二，以因果性的視角來看，現在的人工智能並不能稱之為科學，其產生的結論並非可以被認可成知識。愛因斯坦認為任何科學研究都基於兩個假設，首先自然界的規律確實存在，第二這種規律是可以認識的。因此，推理則是將科學轉化成秩序的重要認知方式。但是，現在的科學家並不能利用推理來解釋現有的算法模型，那也是為什麼機器學習所產生的知識和得到廣泛認可的科學理念是相衝突的。但是，如此的困惑卻並非一件壞事，它時時刻刻警示着科學家們科學的探索是無窮盡性的：機器學習中的「黑盒」很可能暗示著一個未知的領域，同時也鼓勵著不同領域的專家們做更加深入的探究以發現更為簡潔與優美的算法。

在知識論的學習中，人們知悉所有的學科都共有這一套認知體系，它在所有學科中發揮著極其重要的作用，但是因為研究事物與目的的不同，不同的學科在認知方面會有截然不同的側重點。所以，一切學科既有獨立存在的必要性，於此同時它們之間又是重疊和互通的。亞里士多德認為學科和認知方式應橫向而非縱向去理解。因此，生物倫理學的出現顯得並不突兀了，科學和倫理學本就是一對連體嬰兒罷了。生物學和倫理學兩者看似並沒有直接的聯繫，更沒有共有的研究方法和理論，所以對很多人來說，如此的跨學科研究存在著很大的矛盾，但是正因這一矛盾的存在才給研究者帶來無限的動力。近年生命科學研究的飛速進步，實現了基因編輯、免疫、器官克隆、大規模工廠養殖等技術的成熟，並對提高人們的生活與生產效率打下了無法衡量的基礎。但在其發展的同時卻引發了一系列涉及道德倫理的問題，比如「生物是否具有道德地位？」　「患者是否有權了解真相？」等　。就拿1951年發生的海拉細胞事件作具體的例子。科學家是否有權利在沒有經過患者同意的情況下將病人海拉的腫瘤細胞作為培養基　？在科學研究的角度，海拉的宮頸癌細胞可以直接導致抗癌藥物的研發，因此從歷史的角度來看海拉細胞對於現代醫學和人類福祉的貢獻是無價的。但是站在倫理學的角度，每個個體都是一個生命，他人無從侵犯。因為科學家和倫理學家有著不同的知識理論和核心目標，兩者很難達成一份暫時給予雙方公平利益的解決方案，因此產生困惑是必然的。不過在這個情境中，困惑的存在並不代表倫理學可以無限度的干涉科學研究，來造成科學研究過程的停滯不前。那是因為，隨著科學的發展，「倫理學需要將人的因素置之於新的形式進行思考，在保持不損害公理的前提下革新自己的理論。」而應對倫理學的製約與開放，生物研究者應該與倫理學家達成一定協議，在最大程度上提高人類生活福祉。因此，困惑在此並非壞事，而是更深層地促進了兩個科目之間的相互合作與理解，來推動兩者的研究效率和達到更精確的質量。

總結

綜上所述，「學科從未作為單一的或唯一的現象，而是作為一組互相依賴的單元出現[24]。」而困惑一方面作為學科極端孤立化的必然後果，比如在自然科學領域和社會科學領域跨學科研究中多種現實操作上的困難，在另一方面卻是學科範式轉移與知識發展複雜化的前提。以上討論涉及了數學在自然科學中的應用，指出利用數學方法來解釋現實世界的誤差以及其如何激勵數學與科學家們不斷提升他們的研究方法的長處。同時，上面的文字也提到了計算

19. “The Unexamined Mind; AI in Society.” The Economist (US), 17 Feb. 2018, pp. 70—72. Accessed 26 Feb. 2017.
20. 熊 鴻凱. 人工智能技　下　真理和生命的可解　性. China Academic Journal Publishing House , 2017, wemedia.ifeng.com/28210462/wemedia.shtml.
21. 熊 鴻凱. 人工智能技　下　真理和生命的可解　性. China Academic Journal Publishing House , 2017, wemedia.ifeng.com/28210462/wemedia.shtml.
22. Gordon, John-Stewart, “Bioethics,” The Internet Encyclopedia of Philosophy, ISSN 2161-0002, https://www.iep.utm.edu/bioethic/#SH3b. Accessed 26 Feb. 2017.
23. “Bioethics: Introduction to Henrietta Lacks with Author Rebecca Skloot.” HarvardX, 19 Apr. 2017. Accessed 26 Feb. 2017.
24. 《備受爭議的概念：跨學科的歷史及文化碰撞》，斯文・埃里克・拉森，譯者：王敬慧，《跨學科與當代大學學科建設》，2018年1月

機在各個學科中的廣泛應用以及其與多重學科的相互結合與影響，如此跨學科所造成的困惑很可能在一定程度上象徵著一個未知和尚待開發的科學領域。我們看到，倫理學與科學的相互結合，以及其中所存在的困惑如何造成兩個學派之間的相互理解，以創造更全面與複雜的知識體系，全面提升人民生活福祉。人們應該站在歷史的角度更開放的面對不同領域知識的碰撞，正確地面對知識「困惑」，並把它看成是新知識誕生的前奏和土壤。

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淺析宋代社會如何塑造華香文化

王安瀾

華香，顧名思義，便是華夏人所使用的香。香，也不只局限於求神拜佛時使用的線香。各種香料混合得來的合香、烹調美食時使用的香料、甚至於散發著芬芳味道的香草，都可以被歸類於「香」的範圍內。

從古至今，香的身影便頻繁的出現在華夏人民的生活中。從《離騷》中的「扈江離與辟芷兮，紉秋蘭以為佩」到溫庭筠《更漏子・玉爐香》中的「玉爐香，紅蠟淚，偏照畫堂秋思」，香一直在人的生活中佔據著極大的地位。據宋代《陳氏香譜》記載，當時的香藥種類足有一百餘種，廣為人知的龍腦香、麝香、沈水香等更是在中唐時期前便出現於宮廷之中。《舊唐書》本紀第十八下曾記：「宮中每欲行幸，即先以龍腦、鬱金藉地。」。這一文記極大體現了香藥在王公貴族中的受歡迎程度。但是一直因為貨源有限，香藥一直是達官貴人的玩物。只有到了宋代，香藥的身影能夠出現於萬眾交易的大相國寺中[1]，成為平民亦可使用的日用消耗品。

宋朝作為是中國歷史上商品經濟、文化教育、科學創新高度繁榮的時代，人民生活安逸，這樣的安居樂業也使得人民有更多的閒情逸致去探究香藥在日常生活中的用法，甚至將其轉換成為了宋代人民生活中不可或缺的一員。因此，通過分析宋代社會如何塑造香文化可以使我們更深的理解後世華香文化形成的歷史。

海上絲綢之路與香的原料

與漢唐所使用的，穿越連綿沙漠輸送珍奇物品的陸上絲綢之路不同，宋王朝使用的是破開驚濤駭浪達到目的地的海上絲綢之路。導致陸上絲綢之路斷絕的主要原因有二：一、絲綢之路的必經之道被西夏、吐蕃、遼及其他游牧民族佔據，宋商無法通過這條道路順利運輸貨物前去中亞各國進行貿易；二、宋皇室大部分領地位於我國東南，而中國東南沿海地區山多平原少，馬車貨物來往不易，使用陸路與遠隔千里的西域國家進行貿易不如位處中原的漢唐王室容易。此時商人們藉用東南沿海的地理條件，借助每年冬夏兩季都會幫助商隊前往目的地的季風，開闢了海上絲綢之路。海上絲綢之路允許了宋商隊抵達更遠的目的地，獲得更多的利益。在與宋皇室互通貿易的五十八國中過半皆盛產香藥，如吉蘭丹（馬來西亞）、蘭無裡（印度蘇門答臘），大食（阿拉伯），波斯（伊朗）等。這些國家，如波斯、大食、天竺等皆是出產宋代香方所需的主香的產國：檀香「出崑崙盤盤之國、南天竺、海南與三佛齊國」；沈水香是「唐本草雲出天竺單于二國」；龍腦則「出婆律國，亦出波斯國」[2]。其中，檀香在《陳氏香譜》所錄的147份香方中出現107次；沈水香出現83次；龍腦香出現83次。因此，我們可以推斷說如果沒有海上絲綢之路的繁盛貿易，約莫一半的宋代香方將面臨著原料不足而無法製作的難題，甚至可能會導致這些香方失傳的危險。由此我們可以看出宋代海上絲綢之路貿易之繁盛直接影響了可以輸入中原香藥的數量、質量及中原香藥貿易市場的興衰。

1. 孟元老，《東京夢華錄》，中州古籍出版社，1127年。
2. 周嘉胄，《香乘》，九州出版社，1614年。

市場貿易方式與香的用途

不僅如此，宋代的經濟特點和城市文化也直接影響了香藥流入平民市場的方式及數量。在宋以前，我國流傳的商業經營方式一直是流傳了千年的坊市製，一種將「坊」（即居民區）與「市」（即商業交易區）嚴格分開的制度，並在交易時間上亦有限制。《大唐六典》曾記載：「凡市以日午，擊鼓三百聲而眾以會；日入前七刻，擊鉦三百聲而眾以散」。不僅如此，唐政府於景龍年間頒布的詔令還規定：「諸非州縣之所，不得置市」[3]。這一制度使城市商業活動在時間和空間兩方面都受到巨大的限制。坊市製到了宋朝則全面瓦解，新興的宋朝城市格局改變，商舖和居民區融合在一起，而非坊市製時那樣的分離。《東京夢梁錄》二卷中《朱雀門外街巷》一節有錄：「出朱雀門東壁，亦人家。東去大街、麥稭巷、狀元樓，餘皆妓館，至保康門街。其御街東朱雀門外，西通新門瓦子以南殺豬巷，亦妓館。以南東西兩教坊，餘皆居民或茶坊」。這一記載顯示出當時的居民區與商業街都是緊緊相連的。這樣的佈局大大刺激當朝的經濟活性，使各種貿易更加容易。由於城市不再宵禁，夜市也開始出現。《夢梁錄》曾記錄了當時夜市的盛況：「杭州大街，買賣晝夜不絕，夜交三四鼓，遊人始稀，五鼓鐘鳴賣早市者又開店矣」。此外，《東京夢華錄》中記載的「相國寺每月五次開放，萬姓交易」一段亦表明周期性的市場也逐漸成為主要貿易場所。首都之外的城市貿易也開始繁榮如《塵史》記載：「成都九月九日為藥市，詰旦，盡一川所出草藥異物與道人畢集」。新興的、以貨物集散為主體功能的「鎮」也開始出現。《宋史地理志》記載：「睢陽當漕舟之路，定陶乃東運之衝」、「營丘東道之雄，號稱富衍，物產尤盛。」、「（河北路）鎮、魏、中山皆為雄鎮雲。」。更有學者指出當時的宋朝管轄下擁有1875個鎮，許多雄鎮的人數總和早已突破了四位數[4]。這樣的繁盛便利的經濟體系容許了更多的香料流入宋代市場，而居民們在這樣富足安逸的生活狀況下，也有閒暇和富餘的財力以享受香料，並為其開發出許多的用途。而在這之中，使用香料料理飲食佔了很大的比重。《游宦紀聞》卷二曾記載蜀人使用香料料理食物的方法：

「蜀人以榲桲切去頂，剜去心，納檀香、沈（沉）香末，並麝少許。覆所切之頂，線縛蒸爛。取出俟冷，研如泥。入腦子少許，和匀，作小餅燒之，香味不減龍涎。[5]」

廣州人使用香料料理食物則是在製作香藥檳榔上的。《嶺外代答》食用門「食檳榔」一章有記：

「自福建下四川與廣東、西路，皆食檳榔者。客至不設茶，惟以檳榔為禮。其法，斫而瓜分之，水調蜆灰一銖許於蔞葉上，裹檳榔咀嚼，先吐赤水一口，而後啖其餘汁。少焉，面臉潮紅，故詩人有「醉檳榔」之句。無蜆灰處，只用石灰；無蔞葉處，只用蔞藤。廣州又加丁香、桂花、三賴子諸香藥，謂之香藥檳榔。[6]」

四川、廣州都是宋代南方經濟和海路貿易發達的受益者，那裡的人會「納檀香、沉香末，並麝少許」來製作香藥餅子，亦會使用「丁香、桂花、三賴子諸香藥」來製作檳榔。

待到了首都汴京臨安一帶，香的用途又繁複了起來。不僅平民會用其製作香糖果子、香棖元等，宋皇室也會用香來釀造一種「香勝龍涎」的香酒，於十五夜賜予百姓。

3. 王溥，《唐會要》，中國哲學書電子計劃，https://ctext.org/wiki.pl?if=gb&chapter=840048，2018年3月8日。
4. 寧越敏、張務棟、錢今昔，《中國城市發展史》，安徽科學技術出版社，1994年12月，227頁。
5. 張世南，《游宦紀聞》，網易云閱讀，http://yuedu.163.com/source/b0fa42a38be448f2a6a66ce807248a96_4 ，2017年12月27日。
6. 周去非，《嶺外代答》，網易云閱讀，http://yuedu.163.com/source/62e7fecd4ae043178c21129f9a3a530c_4，2017年12月27日。

為了滿足首都顯貴們的享樂需求，香的配飾用途也被發掘了出來。對於當時的宗室貴戚等人，佩戴香球香囊亦成為了一種風尚。《老學庵筆記》曾記載過宗室女眷入京時佩戴香球的盛況：

「京師承平時，宗室戚里歲時入禁中。婦女上犢車，皆用二小鬟持香球在旁，而袖中又自持兩小香球。車馳過。香煙如雲，數里不絕，塵土皆香 。[7]」

雖然「香煙如雲，數理不絕，塵土皆香」這樣的盛況很有可能是誇大，但是是一次出行便持四個香球的舉動足以證明當時的香球配飾是多麼的重要，並可能在當時皇室奢靡風氣的帶領下成為了一種時尚。

而香囊，雖沒有造出「塵土皆香」的盛況，卻在宋時期成為了賞賜，成為供奉時所需的物品之一。《宋會要輯稿職・蕃夷七》曾記下過吳越忠懿王錢俶獻給宋太宗的供奉：「……凡獻銀絹綾錦乳香……之外……又有香囊、酒瓷諸什器，莫能細數。[8]」至於賞賜，《武林舊事》卷三「端午」一節記載過端午節期皇上賞賜后妃香囊的境況：「……及分賜后妃諸大璫近侍翠葉、五色葵榴、金絲翠扇、真珠百索、釵符、經筒、香囊、軟香龍涎佩帶，及紫練、白葛、紅蕉之類。[9]」

而宋人在用香上從未止步於使用小型裝飾品。實際上，熏衣的首選並非小巧玲瓏的香囊香球，而是使用蒸氣技術將香味附著於服飾上的熏籠及熏衣香。《避暑錄話》便曾記載過一件關於北宋名臣趙抃與熏衣的趣事：

「趙清獻公（趙抃）好焚香，尤喜薰衣，所居既去，輒數月香不滅。衣未嘗置於籯，為一大焙，方五六尺設薰爐，其下常不絕煙，每解衣投其間。[10]」

熏衣的風尚也被考古發現所證實。2016年被發現的屬於宋太祖七世孫趙伯澐的墓葬中出土了一件香爐及十餘根四五厘米長，1厘米寬的不規則香片。學者們根據墓葬中其他的隨葬品（投龍玉璧、水晶環佩、笏板等）推斷出這些香片有極大可能性是用來「剃須熏衣」的熏衣香片[11]。出土文物和文獻資料共同證實了當時香的普及——無論老少貴賤，人人都好用香。

文人士大夫與香的推廣

宋朝作為一個經濟實力高速發展的王朝，人民生活安居樂業，對於精神層面的追求亦自然提高。在這段時間，一個對華香文化的推廣做出巨大貢獻的階層—— 宋代士大夫階層飛速崛起。宋士大夫是指靠自身人文素養而崛起成為社會精英的一群人。此時的士大夫們對家國天下皆有很強的責任感，認自身為社會責任的承擔者，如橫渠四句的「為天下立心，為生民立命，為往聖繼絕學，為萬世開太平」。而在如此重擔之下，他們需要通過另一種追求來將自我拉出因社會責任帶來的壓力—— 一種類似魏晉名士們「簡約雲澹，超然絕俗」的灑脫、磊落、自得、閒適的精神境界。然相比於魏晉時期文人們的放浪形骸，宋朝的士大夫階層身體力行儒家文化的「修身齊家治國平天下」理念，使他們無法通過魏晉名士的方法（服五石散等）達到該境界。於是，香，作為與天地溝通的橋樑，擁有「感格鬼神、清淨心身、能除污穢、能覺睡眠、靜中成友、塵裡偷閒、多而不厭、寡而為足、久藏不朽、常用無障」[12]的品格，成為了宋文人四大雅事：「焚香、掛畫、插花、品茗」之首，變成了宋士大夫們達到精神完滿境界的媒介。對於這群人來說，焚香，如讀書，寫詩，填詞一般，是組成他們風

7. 陸游，《老學庵筆記》，網易云閱讀，http://yuedu.163.com/source/78bb6ab5-70ac-468c-8fec-4fdb8f38d9d6_4，2017年12月27日。
8. 《宋會要輯稿》，中國哲學書電子計劃，http://ctext.org/wiki.pl?if=gb&res=741924&remap=gb，2017年12月27日。
9. 周密，《武林舊事》，中國哲學書電子計劃，http://ctext.org/wiki.pl?if=gb&res=24518&remap=gb，2017年12月27日。
10. 葉夢得，《避暑錄話》，中國哲學書電子計劃，http://ctext.org/wiki.pl?if=gb&res=875923&remap=gb，2017年12月27日。
11. 《香盒與沈香：南宋那些綺麗的香事》，人民政協網，https://kknews.cc/zh-hk/culture/om95geo.html， 2016年12月9日。
12. 陳敬，《陳氏香譜（四庫全書-文淵閣本）》，中國哲學書電子計劃，https://ctext.org/wiki.pl?if=gb&res=757942，2018年4月9日。

雅人生必要的一部分。如果沒有香，他們的生活則會變得暗淡無味。他們對香的喜愛在創作的詩文當中也有反映。

李清照的《醉花陰》如此寫道：

「薄霧濃雲愁永晝，瑞腦消金獸。佳節又重陽，玉枕紗櫥，半夜涼初透。東籬把酒黃昏後，有暗香盈袖。莫道不消魂，簾捲西風，人比黃花瘦。」

本詩使用「瑞腦」（及龍腦香）作為開篇意象，一方面描繪了士大夫階層的精緻生活，營造出哀傷的意境，另一方面表現出香在士大夫階層中日常生活的使用，側面證明了宋朝文人墨客士大夫們對於香的喜愛。

北宋洛中八俊之一的陳去非更是以香做主角，創作了《焚香》來歌頌香的美好：

「明窗延靜晝，默坐消塵緣；即將無限意，寓此一炷煙。 當時戒定慧， 妙供均人天；我豈不清友， 於今心醒然。 爐煙裊孤碧，雲縷霏數千；悠然凌空去， 縹緲隨風還。 世事有過現， 熏性無變遷；應是水中月， 波定還自圓。」

這些文人雅士們享受香給他們創造的風雅環境、以香為主題題詠的同時，也自創香方、記錄與香文化有關的知識以傳諸後世。魏國公韓琦曾創合香「韓魏公濃梅香」（後被黃庭堅改為返魂梅香）；蘇軾任杭州知府時曾創「東坡聞思香」；于靖康年間擔任諫議大夫一職的洪駒父亦曾自創過「洪駒父百步香」[13]。除此之外，士大夫們為了更好的能夠收集、整理所有在歷史上出現過的香料、香方、與香有關的詩詞典籍，他們創造了一個在宋之前從未出現過的文學體系——香譜。香譜在蒐集關於華香文化的資料這一過程中起到了至關重要的作用。就拿最著名的《陳氏香譜》舉例——《陳氏香譜》一共分四卷[14]，第一卷是關於所有香料原材產地、用處、氣味及與其有關的食物的簡介；第二卷是關於不同香印的用途（如報時）及各種合香香方中所需的香料原材及製作方法；第三卷仍為合香香方所需的香料原材及製作方法及香具（香爐、香壺、香盤等）的標準；第四卷則是各種香制飾品食品的製作方法及各種與香有關的地點、典故、器具、詩詞歌賦的合集。由此可見，香譜所收集到的資料完整全面，是香文化的百科全書，為香道愛好者制定了一套涵蓋了原材到製作方式的法則，教導後世香的使用者如何選材、如何調香、如何焚香，這在今天，依然被東亞各國的香道實踐者所奉為圭皋。可以說，如果沒有香譜這一文學體系的誕生，華香文化將不會如現在一樣，就算間隔了將近半個世紀的斷層期仍然有軌跡可尋，規則可遵。

結語

現今二十一世紀，我國正經歷一場「古代文化復興熱」，而在諸多文學典籍，詩詞歌賦中頻頻出現的「華香文化」自然被人重視起來。然而，如今的華香文化究竟是經歷了怎樣的塑造，變革才成為了現今的樣子？這是我們需要追尋的答案。

宋朝在其得天獨厚的地理條件下通過海上貿易引入了更多新奇珍稀的香料原材，大大豐富了香料原材的種類及數量。這一條件加上當時的經濟變革，使得宋朝成為中國歷史上經濟貿易的高峰，從而將香從王公貴族手中帶入了市井，給予香文化更大的變革空間，使其的用途更加親民且多元。同時，文人士大夫階層的崛起使得香文雅的一面被發掘出來，並通過詩詞廣泛流傳。不僅如此，這些人的喜愛導致了香譜的誕生，使得香道的長期傳承能夠擁有一種標準，一種規則。三者合一，塑造出了現在華人心醉的華香文化。

13. 洪芻，《香譜（百川學海本）》，中國哲學書電子計劃，http://ctext.org/wiki.pl?if=gb&res=411350&remap=gb，2017年12月27日。
14. 陳敬，《陳氏香譜（四庫全書-文淵閣本）》，中國哲學書電子計劃，https://ctext.org/wiki.pl?if=gb&res=757942，2018年4月9日。