



弘立書院  
THE ISF ACADEMY

# BAUHINIA

The Student Research Journal of the Independent Schools Foundation Academy  
1 Kong Sin Wan Road, Pokfulam, Hong Kong



Volume III, 2017

Editors: Ms. A. Christou, Mr. N. Forde, Dr. L. Gao, Dr. S. Griffin,  
Ms. D. Ibarra, Ms. R. Oser, Mr. S. D. Sun, Dr. H. Y. Wu, Dr. Y. L. Zhang

ISSN 2409-4064

## Contents

論知識形成過程中「精確性」與「簡明性」的取捨 陳嘉懿	2
In Knowledge, is there always a Trade-off between Accuracy and Simplicity? <i>Alexander Ng</i>	5
To What Extent is the Knower's Perspective Essential in the Pursuit of Knowledge? <i>Priscilla To</i>	9
認知網絡與知識 楊雨樂	12
Immortality in Early China through the Funerary Painting of <i>Mawangdui</i> 馬王堆 <i>Karie Kam</i>	15
Two Complete Genomes of Cellulose-digesting Bacteria Isolated from the Giant Panda ( <i>Ailuropoda Melanoleuca</i> ) Gut Microbiome <i>Matthew Lu</i>	21
To What Extent do the Concepts that We Use Shape the Conclusions that We Reach? <i>Sean Fontaine</i>	31
How Does Cicero Attempt to Overcome Xenophobia in the <i>Pro Archia</i> ? <i>Emily Zhang</i>	34
談《天龍八部》中的玉 陳暉庭	41
To What Extent was Nero's Legislation Beneficial to the Common Roman People? <i>Mark Lu</i>	45
To What Extent has Government Intervention in the Market for Private Hybrid Cars Promoted Sustainability by Correcting Market Failure in Hong Kong? <i>Katherine Chan</i>	49
Do Western and Chinese Chess Share a Common Origin? A Historical Enquiry <i>Katrina Lee</i>	60
William Chambers' Portrayal of Chinese Garden Design <i>Ernest Ng</i>	69



# Editor's Note

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

As with the two previous editions, *Bauhinia* showcases the academic endeavors of students as a result of the ISF Academy *Shuyuan*, the Needham Research Institute's Scholars' retreat, as well as essays taken from the IB Diploma Programme in the form of Theory of Knowledge essays and Extended Essays. We are delighted to present work produced in both Chinese and English.

*Bauhinia* aims to reflect the energy and restlessness of academic endeavor at ISF, but also the vision and values of the ISF Academy *Shuyuan*. Within *Shuyuan*, students are able to cherish excellent scholarship and work ethic; engage in deep reflection; develop an appreciation of cultural and historical contexts; and undertake academic action through research in a bilingual and multi-disciplinary setting.

This edition builds upon its predecessors, cairn-like, and demonstrates that the *Shuyuan* learning sanctuary continues to grow on its initial foundations. With the development of new courses and projects, *Bauhinia* serves as an important marker of our *Eight Virtues + One* ethos for our community.



Nicholas Forde  
Deputy Principal, Secondary  
Director of *Shuyuan*

我們非常榮幸地向大家推薦這本由「書院項目」編纂的第三期《紫荊花》。

與前兩期一樣，這本《紫荊花》研究刊物展示了弘立書院的學生在「書院項目」、李約瑟研究所的學術研習，以及國際文憑項目的知識論和拓展論文寫作中的一些成果。我們很自豪地向大家推薦這些中文和英文的原創作品。

《紫荊花》旨在反映弘立書院學生充滿能量的學術努力和他們不間斷的學術追求。它也具體地反映了弘立書院「書院項目」的願景和價值觀。學生能夠在「書院項目」裡提升他們的學術造詣，培育良好的研究興趣和得到反思的機會。同時，還能發展他們對文化和歷史背景的欣賞以及在雙語和多學科互動的環境下，開展研究性學術活動。

這本建築在前兩期成功基礎上的學術刊物，再次表明我們的「書院」作為一個學習的聖地，會不斷地成長壯大。隨著新課程和項目的發展，《紫荊花》也將成為我們的社區「八德一智」價值觀的一個重要標誌。



# 論知識形成過程中「精確性」與「簡明性」的取捨

陳嘉懿

知識的「精確性」指在認知過程中對認知對象的具體情狀進行精確描述；而「簡明性」則指對認知對象進行規律式、結論式的簡明概括。多數人認為追求知識的「精確性」與「簡明性」是兩個對立的原則，然而它們是否真的不可兼得？如何在知識的「精確性」與「簡明性」中找尋平衡？在認知過程中，「精確性」與「簡明性」必須同時成為必要條件嗎？取捨「精確性」與「簡明性」的標準是什麼？本文將以社會科學與數學科學這兩個不同知識領域為例，對以上知識論問題進行一些探究。

在社會科學中，心理學理論譬如「馬斯洛需要層次理論」是「捨精確求簡明」的最好例證。該理論以金字塔式模型將人的需要由下至上分為五個層次：生理、安全、社交、尊重與自我實現。<sup>1</sup>這一理論具有極強的「簡明性」，概括了人類首先滿足低層次需要、進而追求高層次需要這一發展規律。但此理論的侷限在於「精確性」不足：由於其論證方法偏主觀，導致結論難以驗證，<sup>2</sup>因此雖能大致展現趨勢，但應用於個體時往往出現極大偏差。美國作家梭羅的《瓦爾登湖》一書便提供了一個偏離「馬斯洛理論」的經典例證。作家為了追求生命的本真這一崇高理想，隱居在瓦爾登湖畔過著最原始的生活。這在「馬斯洛需要層次理論」中，似乎實現了最底層的生理需求以及最高層的自我實現需求。然而他的生活卻不包含任何與群體組織的交流，直接跳過了馬斯洛所定義的社交需

求一層。由此看來，「馬斯洛理論」多「簡明」、欠「精確」，有其偏頗之處。

類似地，在經濟學中也存在著諸多「捨精確求簡明」的例子。例如，「在其他條件不變的情況下（*ceteris paribus*）」是經濟學中的一個常用假設，它使得經濟學理論成為簡明的規律性概述，從而忽略了特例的存在。另外，經濟學中關於「需求（demand）」的定義也十分「簡明」。它指出，一個商品的價格與其需求量成反比，即價格的降低會導致需求量遞增，因此兩者有清晰的函數關係。然而「吉芬商品」的出現，直接證明了該陳述的「不精確」——這一類商品的需求量隨著價格上升而增加，直接違背了「需求」的定義。<sup>3</sup>

儘管社會科學中對知識的定義多是「捨精確求簡明」，但也有二者需共存的情況，如商業管理中的「資產負債表」。該表一方面在項目一欄內簡明記述資產種類以及各合計值，同時在期初、期末數兩欄內精確紀錄對應的數值，這樣既概括大致事實，又有具體數據可查，兼具「簡明」與「精確」。商業管理屬於實務性知識，其本身需要同時擁有兩種特性，這種情況下兩者間的「取捨」就不再適用了。

然而，不同於社會科學，在數學這一知識領域中，多數情況下「精確性」與「簡明性」同時存在，無需「取捨」。例如，算數基本定理中有一條如下：「任意一個大於 1 的自然數，都可以被表示為有限個素數（可以重複）的乘積，並且如果不

<sup>1</sup> 楊文登：《心理學史筆記》（上海：商務印書館，2012年），頁 175。

<sup>2</sup> 同上，頁 179。

<sup>3</sup> 曹永管：《趣味經濟學》（北京：電子工業出版社，2011年），頁 21。

計次序的話，表法是唯一的」。<sup>4</sup>在這裡，「大於1」與「有限」的條件、「可以重複」的註解以及「不計次序」的假設都無法省略。<sup>5</sup>若捨去任何一個，整句陳述會缺乏嚴謹性，進而影響該定理的「精確性」。又例如「多筆畫定理」：「設  $G$  是一個有  $2n$  個奇頂點的聯通網絡， $n > 1$ 。那麼  $G$  中的全部弧可以排成  $n$  條路，而且至少  $n$  條路。」<sup>6</sup>該定理運用未知數以及假設，使「頂點數量」與「路線數量」的關係簡單明瞭，同時亦在具體實踐中被證明正確。

以上兩個例子說明了數學知識中基本不存在「精確性」與「簡明性」的取捨，但少數數學概念仍需要「捨精確求簡明」。其中之一便是概率學中的正態分佈。它規定，以數學期望為中心，左右由內至外依次為正負第一方差（34.1%）、正負第二方差（13.6%）、正負第三方差（2.1%）等等。<sup>7</sup>而計算這些比重則採用了  $f(x) = \frac{1}{\sqrt{2\pi}\sigma} \cdot e^{-\frac{(x-\mu)^2}{2\sigma^2}}$  這一公式。<sup>8</sup>此處，無理數  $e$  的存在使實際數值為無限不循環，為了更清晰簡明地展示這一模型，正態分佈所使用的數值皆進行了四捨五入，實際上犧牲了定理的「精確性」。

同理，物理學中的歐姆定律指出，「在同一電路中，通過某段導體的電流跟這段導體兩端的電壓成正比，跟這段電路的電阻成反比」。此陳述中「電流」、「電壓」、「電阻」的關係簡單明瞭，注重知識「簡明性」的同時，卻忽略了另一重要條件，即「在常溫的情況下」。當溫度極低的時候，導體可以進入超導狀態，

而此時，導體的電阻消失了，電流也可以在沒有電壓的情況下形成。對這一重要條件的忽視，實則是在定律形成過程中，犧牲了知識的「精確性」。

在某一學科知識形成的過程中，學科特性往往決定了認知方法如何應用，進而影響「精確性」與「簡明性」的取捨。社會科學與數學科學都運用「推理」和「歸納」的認知方法，但兩個知識領域的不同需求導致知識特性有諸多差異。社會科學多涉及觀察人在社會因素影響下的行為以及心理，為尋找一個較為普遍的規律，在實驗中採用控制變量的方法。最終的歸納陳述無法考慮到每一個個體情況，涉及對結論的不完全歸納，所以在「推理」獲得知識的情況下，多數情況「捨精確求簡明」。然而，數學是以嚴謹性與簡潔性著稱的學科，在知識的形成過程中，多數情況下「精確性」與「簡明性」是同時存在的必要條件。而運用「推理」所獲得的數學知識同社會科學不同，它已經是考慮了每個個體情況後的普遍結論，兼顧了準確與概括兩個要求。故數學的定理、模型多是精確又簡潔的。

綜上所述，在知識的「精確性」與「簡明性」之間，研究者往往需要做一定取捨。其中「捨精確求簡明」這一方法在社會科學中被廣泛運用。但在數學科學中，知識的「精確性」與「簡明性」在多數情況並存。

<sup>4</sup> 顧沛：《數學文化》（北京：高等教育出版社，2008年），頁39。

<sup>5</sup> 同上。

<sup>6</sup> 同上，頁66。多筆畫定理證明詳參附註一。

<sup>7</sup> 正態函數分佈圖詳參附註二。

<sup>8</sup> Robert Haese et al, *Mathematics for the International Students: Mathematics HL (Core): For Use with IB Diploma Programme*. South Australia: Haese & Harris, 2011. Print. 819.

## 參考文獻

顧沛：《數學文化》（北京：高等教育出版社，2008年）。

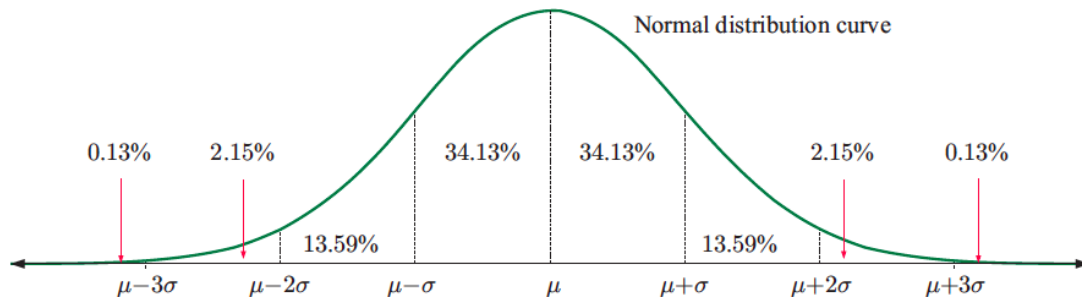
楊文登編，葉浩生校：《心理學史筆記》（上海：商務印書館，2012年）。

曹永管著，千太陽等譯：《趣味經濟學》（北京：電子工業出版社，2011年）。

Haese, Robert *et al.* *Mathematics for the International Students: Mathematics HL (Core): For Use with IB Diploma Programme.* South Australia: Haese & Harris, 2011. Print.

## 附註一：多筆畫定理證明

設  $G$  是一個有  $2n$  個奇頂點的聯通網絡， $n > 1$ 。那麼  $G$  中的全部弧可以排成  $n$  條路，而且至少  $n$  條路。證明：把  $2n$  個奇頂點分成  $n$  對： $A_1, B_1, A_2, B_2, \dots, A_n, B_n$ 。給  $G$  添上  $n$  條新的弧  $L_i = A_i B_i$ ，從而得到一個新的網絡  $G^*$ ，它是一個沒有奇頂點的聯通網絡。把  $G^*$  中的全部弧可以排成一條閉路  $Z$ ，然後從中把那  $n$  條新添的弧去掉。於是閉路  $Z$  被切成  $n$  段。每一段是  $G$  中的一條路，這  $n$  條路包含了  $G$  的全部弧。至少要  $n$  條路也不難證明。因為如果能排成  $q$  條路，而每條路最多有兩個奇頂點，那麼  $G$  中的奇頂點的個數將小於等於  $2q$ 。所以  $2n \leq 2q$ ，即  $q$  大於等於  $n$ 。證畢。（顧沛：《數學文化》，頁 66）



附註二：正態函數分佈圖 (Haese, *Mathematics for the International Students: Mathematics*, 820)

# In Knowledge, is there always a Trade-off between Accuracy and Simplicity?

*Alexander Ng*

There is often more than meets the eye in the knowledge we learn in science class. When I first heard the word “forest”, I learnt that a forest is simply a mass of trees growing on solid earth. In later years, I learnt about rainforests, pine forests and mangrove forests. Currently, I am learning about boreal forests, temperate deciduous forests and even a forest that has no trees – a kelp forest. In fact, according to the United Nations Environment Program, there are over 800 different definitions of forests globally (Achar 6). This intrigued me, for academic research into forests reveals them to be much more than simply a gathering of trees, and yet that is how they were defined and taught to me in school. This made me ponder exactly how much of my knowledge experienced a trade-off between simplicity and accuracy, and to what extent this trend is consistent. To evaluate this

statement, I will be using two areas of knowledge: the natural sciences and the arts.

The natural sciences are a branch of science concerned with the physical world, as we derive knowledge from natural phenomena through empirical evidence. We often learn scientific facts and theories in their simpler forms, omitting exceptions or qualifying statements. A good example of this would be the food chain. In an attempt to explain the predator/prey relationship between organisms in an ecosystem, the food chain defines plants as primary producers, and animals are divided into different tiers of consumers: primary, secondary, tertiary and quaternary. A consumer from a higher tier consumes one of the lower tier, as seen in Figure 1 below.

## The Food Chain

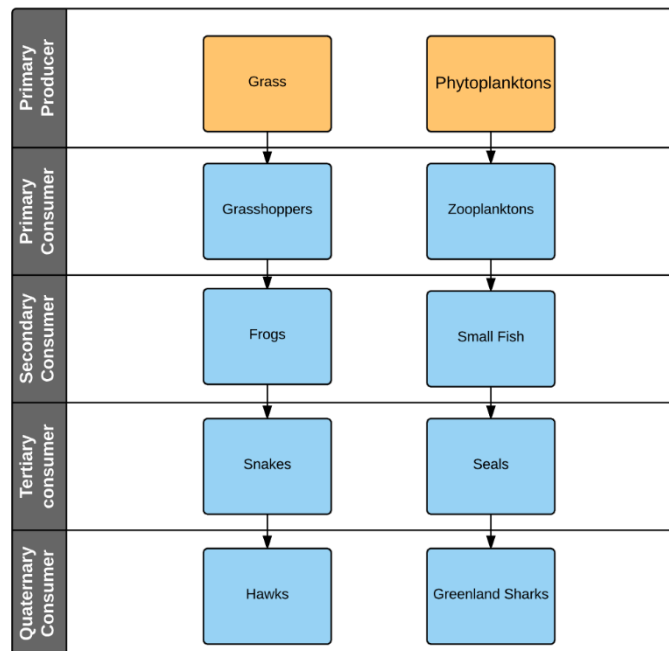


Figure 1: Food Chain (author’s own diagram)

In this diagram, one can see that, since a snake is a tertiary consumer and a frog a secondary consumer, frogs are eaten by snakes, and so on. However, in reality, interactions between flora and fauna are rarely one-sided. There are carnivorous plants, such as the sundew, that feast on consumers. This is not displayed in the food chain diagram as primary producers are not shown to consume consumers. This also applies to ants, for it is possible for a colony of ants to prey on and dismember predators, such as lizards, that would usually feast on them. There are also cases where the prey/predator relationship is mutual, such as a spider potentially hunting a praying mantis and vice versa. This example shows how the trade-off between simplicity and accuracy can occur within the natural sciences, when attempting to generalize a certain phenomenon for the sake of simplicity. However, simplicity is not always a rough generalization within the natural sciences. In fact, in the philosophy of science, simplicity of a theory is sought after. This is known as ‘Ockham’s Razor’ (Fitzpatrick). Other things being equal, simpler theories are better than complex ones. An effective example of equations being both simple and accurate is Isaac Newton’s Three Laws of Motion:

$$\begin{aligned} s &= vt \\ F &= ma \\ F_1 &= -F_2 \end{aligned}$$

These formulae explain the laws of motion in a plain and simple way, which a student of science can easily comprehend. However, anything that travels faster than light, or anything small enough to be subject to the laws of quantum physics, is exempted from the laws. The reason we seek generalizations is due to their application in the pursuit of knowledge. Through generalization, we can develop theories, which we can then apply to new situations that are similar to past encounters. However, as argued by Popper, verification of a theory is never possible in the natural sciences, as every possible instance can never be tested (Mayring). The statement ‘all metals expand when heated’ can never be proven because a new metal might be discovered. However, just one instance of a metal that does not expand when heated is sufficient to falsify the theory, hence bringing us

closer to the truth in the view of Popper. Therefore, even when scientists try to create simplicity through generalizing patterns in the natural world, there is an inherent flaw as exceptions to the pattern could always arise (Shuttleworth).

In the arts, simplicity and accuracy are not as well defined. This is because, unlike the natural sciences in which there is only one dominant paradigm to base accuracy and simplicity of knowledge upon, the arts can have multiple coexisting paradigms. In the theatrical arts, simplicity can be achieved through the director’s approach to theatre making. For example, if a director were to try and direct a naturalistic piece, then accuracy would be determined by how well the actor could perform and imitate the situation in character. In order to enhance naturalism, techniques such as the Stanislavsky system might be employed, including the “magic if” where an actor asks himself what he would do if he were the character. Actors observe the behaviors of people in a real life scenario, taking in every detail such as accent, gesture and clothing. In naturalism, staying true to reality and the script are the goals.

However, there are other theatrical conventions that aim for simplicity rather than realism to convey their messages. One such example is epic theatre. Also known as Brechtian theatre, it takes away most naturalistic elements and leaves behind the bare minimum of visual elements, in order to clearly remind the audience that they are watching a play and to not get emotionally connected. For this theatre convention, simplicity is integral to accuracy.

One problem when evaluating the statement made in the prescribed title is that the standards of “simplicity” and “accuracy” are subjective: they vary among individuals. Simplicity can be evaluated only by comparison. When something is simple, it means it is easier to comprehend in relation to something else. On its own, however, the complexity of knowledge becomes extremely difficult to gauge. According to the statement made in the prescribed title, simplicity is measurable. However, whether and how simplicity can be quantified objectively and precisely is a major philosophical problem.



Throughout history there have been numerous attempts to evaluate simplicity (Fitzpatrick), such as Ludwig Mies van der Rohe embracing the notion “less is more”. Mies is known for his emphasis on function over form, which focuses on the essentials. He strips down unnecessary details, leaving behind the bare essentials ("Mies: The Man, The Legacy"). However, he too faced significant challenges. What may appear simple to one person could be complex to another. For example, I personally find understanding symbiosis in nature simple but physics formulae difficult, whereas others might find the reverse. In the end, the simplicity of knowledge is based on individual understanding and comprehension rather than objectivity.

From the statement made in the prescribed title, the sub-knowledge question, “What qualifies as an accurate knowledge claim?” is raised. Similarly to notions of simplicity, accuracy can be difficult to measure and quantify. One could answer using the philosophical concept of pragmatism. The pragmatic truth test holds that if a knowledge claim works with satisfactory results, then it is true (McDermid). However, this is a problematic definition of “accuracy” since it does not require what is held as knowledge to be actually valid. For example, the equations of motion, otherwise known as the “SUVAT formula” calculate the motion of mass when air resistance is negligible. For the purposes of the IB Diploma, this is an acceptable level of detail. However, for university-level physics, air resistance must be factored into the equation, else the data is considered inaccurate.

One important point to note about accuracy is that its standards change alongside improving theories and paradigm shifts. While Charles Darwin’s visual observations would have been considered accurate in his time, due to the discovery of genetics, visual observations are no longer considered accurate enough in the field of zoology. The accuracy of the apparatus and other tools of measurement also affects the accuracy of results scientists are able to obtain. When Darwin was in the Galapagos Islands, he assumed as fact that certain birds from different islands were in fact of the same species, despite their slight differences. He based his assumptions on observations, and wrote about

his discoveries in the book *On the Origin of Species* (Watkins). However, with the discovery of DNA, improved and more accurate methods for the classification of organisms have emerged. If Darwin were to try and publish his findings today based on visual observations alone, they would likely be rejected because what would have been considered as detailed and accurate in the 19th century is no longer accurate by current measurements. New discoveries, such as birds being the descendants of dinosaurs (Singer) and humans being 35% genetically related to daffodils (“You’re One-third Daffodil”), would have never fit the old observation-centered paradigm. Thus, in accordance with Kuhn, a new paradigm based on genetics and other sophisticated methods was born (Radke). We can see that accuracy is not objective, but rather something subjective to its paradigm, technological breakthroughs, shared expectations within areas of knowledge, personal perspective and other factors.

In conclusion, the statement “In knowledge, there is always a trade-off between accuracy and simplicity” is inaccurate. While the forest example and food chain example indicate a trade-off between simplicity and accuracy, the Newton example and the Mies example do not. Accuracy and simplicity are not always mutually exclusive. They can co-exist.

## References

- Achard, Frédéric et al. *Vital Forest Graphics*. Arendal: UNEP/GRID, 2009. Print.
- Bitbol, Michel, Pierre Kerszberg, and Jean Petitot, eds. *Constituting Objectivity: Transcendental Perspectives on Modern Physics*. Berlin: Springer, 2009. Print.
- Chang, Wheijen, Beverley Bell, and Alister Jones. "Historical Development of Newton's Laws of Motion and Suggestions for Teaching Content." *Asia-Pacific Forum on Science Learning and Teaching* 15, 1 (2014): 1-13.
- Fitzpatrick, Simon. "Simplicity in the Philosophy of Science." *Internet Encyclopedia of Philosophy*. Web. Accessed 27 Feb 2016. <http://www.iep.utm.edu/simplici/>
- Hodanbosi, Carol. "The First and Second Laws of Motion." *National Aeronautics and Space Administration*. Web. Accessed 27 Feb 2016. [https://www.grc.nasa.gov/www/k-12/WindTunnel/Activities/first2nd\\_lawsf\\_motion.html](https://www.grc.nasa.gov/www/k-12/WindTunnel/Activities/first2nd_lawsf_motion.html)
- Mayring, Philipp. "On Generalization in Qualitatively Oriented Research." *Forum Qualitative Social Research/Sozialforschung* 8, 3 (2007). Web. Accessed 27 Feb 2016. <http://www.qualitative-research.net/index.php/fqs/article/view/291/641>
- McDermid, Douglas. "Pragmatism." *Internet Encyclopedia of Philosophy*. Web. Accessed 27 Feb 2016. <http://www.iep.utm.edu/pragmati/>
- "Mies: The Man, The Legacy." *Mies Van Der Rohe Society, Illinois Institute of Technology*. Web. Accessed 27 Feb 2016. <http://www.miessociety.org/legacy/>
- Radke, Nathan. "Kuhn's Paradigm Shift." *YouTube*. Web. Accessed 27 Feb 2016. <https://www.youtube.com/watch?v=3cp6pEzx3uw%5D>
- Shuttleworth, Martyn. "What Is Generalization?" *Explorable*. Web. Accessed 27 Feb 2016. <https://explorable.com/what-is-generalization>
- Singer, Emily. "How Dinosaurs Shrank and Became Birds." *Scientific American: Quanta Magazine*, 2 June 2015. Web. Accessed 27 Feb 2016. <https://www.scientificamerican.com/article/how-dinosaurs-shrank-and-became-birds/#>
- The Editors of Encyclopaedia Britannica. "Stanislavsky System." *Encyclopaedia Britannica*. Web. Accessed 27 Feb 2016. <https://global.britannica.com/art/Stanislavsky-system>
- Watkins, Graham. "Charles Darwin." *Galapagos Conservancy*. Web. Accessed 27 Feb 2016. [http://www.galapagos.org/about\\_galapagos/about-galapagos/history/human-discovery/charles-darwin/](http://www.galapagos.org/about_galapagos/about-galapagos/history/human-discovery/charles-darwin/)
- "'You're One-third Daffodil' - This and Other REALLY Useless Facts from Britain's Most Upmarket Intellectuals." *Daily Mail Online*, 23 Aug 2008. Web. Accessed 27 Feb 2016. <http://www.dailymail.co.uk/news/article-1048492/Youre-daffodil--REALLY-useless-facts-Britains-upmarket-intellectuals.htm>

# To What Extent is the Knower's Perspective Essential in the Pursuit of Knowledge?

*Priscilla To*

This essay concerns itself with postmodern ideas of how created knowledge is often highly dependent on the knower who creates it. The hidden assumption in this title is that the creation of knowledge is highly influenced by the knower's perspective, while the implied counter-claim is that the creation of knowledge is universal and is not associated in any way with the knower who created it. From this, the question has arisen: 'To what extent is the knowledge created in mathematics, the natural sciences, history and the human sciences affected by, and dependent on, the knower's perspective?' The knower's perspective is often determined by the knower's beliefs, values and personal experience, hence influencing and sometimes biasing the direction of the creation of knowledge. However, the knower's perspective is essential as it provides the motivation and method for the knower to pursue knowledge.

In mathematics, the pursuit of knowledge is often also highly influenced by the knower's perspective. Although some might argue that mathematics, as an axiomatic and deductive system, does not depend on the knower at all, the passion and striving for the pursuit of mathematical knowledge is, in fact, dependent on the knower. The emotional perspective of a knower can have great impact on their process of creating mathematical knowledge. Andrew Wiles demonstrated this idea with his intense motivation to solve Fermat's Last Theorem, which consumed many years of his life. He finally solved the theorem in 1994 and said that the moment he found the solution was "the most important moment of (his) working life" (BBC Horizon – *Fermat's Last Theorem*). Fermat's Last Theorem had remained a mystery to mathematicians for 350 years but, driven by his passion for solving this problem, Wiles successfully created new mathematical knowledge. As seen from Wiles' example, the pursuit of knowledge in mathematics demands

the knower's perspective for motivation and direction. Although mathematics is a highly logical area of knowledge, emotion plays a key role in influencing the knower's perspective, which is essential to the pursuit of such knowledge. Therefore, the knower's perspective is of paramount importance to the pursuit of knowledge in mathematics.

The natural sciences are another area of knowledge in which the knower's perspective is essential. While the scientific method exists to limit the knower's perspective influencing the outcome of experiments, confirmation bias necessarily exists, as scientists are motivated to prove their own hypotheses. To avoid confirmation bias, standardized scientific methods have been developed to ensure accuracy. Some examples are using 'cherry-picked' results, small sample sizes, uncontrolled variables and unrepeatable results. Despite the safeguards designed to limit the influence of the knower's perspective in the natural sciences, it is nonetheless important to determine the topic researched, develop a hypothesis and interpret results.

According to Craig Rusbult, five aspects influence a scientist's personal perspective. Firstly, for many scientists, the curiosity of how things work is a significant psychological motivation for their creation of knowledge. Secondly, the scientist's pursuit of knowledge is also affected by practical concerns, such as their hope for professional success or personal satisfaction. Thirdly, basic scientific concepts often act as general guide-lines for scientific theories, hence influencing the methods used by the knower. For instance, many astronomers prefer to use circular motion's constant speed in their theories, thus possibly limiting the pursuit of knowledge. Fourthly, society's subjective views or political goals also have an impact on the creation of knowledge. An example of this is the control of Russian biology in the 1930s-

1960s, during which period theories were ideologically corrected by the Soviet government. Fifthly, authoritative pressure or designed direction can alter a scientist's creation of knowledge. For example, funding has a huge impact on medical research in for-profit companies, where the marketing division might overrule the scientific aspect of the company, hence influencing its pursuit of medical knowledge (DeAngelis).

Joseph Rotblat's journey in creating knowledge in the natural sciences illustrates how one's personal context might influence the direction of pursuit of knowledge. In 1939, when he had the idea that technology could be used to split atoms and release large amounts of energy that might be used in an atomic bomb, Rotblat avoided further investigation because of his ethical and moral judgments of the potentially enormous cost to human life. However, because Rotblat lost his wife in the German occupation of Poland and feared that Germany would develop its own atomic weapons, he later joined the Manhattan Project that aimed to develop an atomic bomb for use by the Allies. However, in 1944 he left the project after learning that the Germans had abandoned their atomic weapon research. As can be seen, Rotblat's direction and motivation in the pursuit of atomic weapon knowledge was highly influenced by his personal context. Therefore, although the methods used in the natural sciences aim to eliminate the influence of the knower's perspective, their point of view is essential as it provides motivation and direction to the pursuit of scientific knowledge.

Similarly to both mathematics and the natural sciences, the knower's perspective is essential to the pursuit of knowledge in history, yet it differs from those two areas as the knower's perspective not only provides motivation for the pursuit of knowledge, but also serves as a method in the creation of such knowledge. The method of history, historiography, is the analysis, evaluation and interpretation of historical sources. Therefore, the interpretations of historical events can vary, and often do, as perspectives on the causes and consequences of historical events differ. McCullagh has argued that even if the historian is entirely neutral towards a historical event, "...historians are still

products of their culture, language, concepts, beliefs, and attitudes so that the possibility of an impartial, fair description of past events still remains unattainable" (McCullagh 52). Ankersmit similarly suggested that, although historians use historical evidence, they always use their previous knowledge and cognitive imagination to interpret the historical information, hence proving that the knower's pursuit is dependent on the knower's perspective (Ankersmit).

Robert Service's post-revisionist and liberal perspective on Russian history led to his critical analysis and interpretation of Bolshevik leaders such as Lenin, especially in the way he handled disaster and change after 1917. He wrote that "Lenin was cunning and untrustworthy, he was also dedicated to the ultimate goal of communism. He enjoyed power; he lusted after it" (Service 330). The use of negative adjectives, such as "cunning" and "untrustworthy", to describe Lenin shows Service's own perspective, which in turn influenced how he ranked the significance of particular historical events. As can be seen, the methodology of this area of knowledge requires the knower to use their perspective to determine the significance of the sources and to interpret the historical information. Because the creation of historical knowledge is based on the historian's analysis and interpretation, the creation of knowledge in history, to a large extent, is affected by and dependent on the knower's perspective.

In the human sciences, any knowledge created is always affected by the knower's point of view, as this is also an area that demands the knower's perspective of the application of a modified scientific method to the pursuit of knowledge. Unlike the natural sciences, where there is an attempt to eliminate or limit the knower's perspective to avoid confirmation bias, the human sciences depend on the knower's observation, participation, and understanding of key concepts and their interpretation of results. In particular, anthropology is a discipline within the human sciences that depends heavily on the perspective of the knower. In the pursuit of knowledge, anthropologists "intellectualize what they've seen and heard, put it in perspective and write about it" (Russell 258).

Participant observation, a qualitative method which involves “active looking, improving memory, informal interviewing, writing detailed field notes, and perhaps most importantly, patience” (DeWalt and DeWalt 21), is a technique used by anthropologists.

Renato Rosaldo, an American cultural anthropologist, argued that it is almost impossible for researchers to be fully detached from their studies and believed that the knower’s “life experiences both enable and inhibit particular kinds of insight” (Rosaldo 19), while also advocating the capability of passion, frustration and depression to contribute to the pursuit of knowledge in anthropology. One example he provided is that of Jean Briggs, an anthropologist who studied the Canadian Inuit. Briggs exploited her anger, frustration and solitude to sympathize with the subjects of her study, which allowed her to comprehend the mentality and values of the Canadian Inuit. The human sciences, therefore, are highly dependent on the knower’s perspective in the creation of knowledge.

In conclusion, after evaluating the significance of the knower’s perspective in the pursuit of knowledge in four different areas of knowledge, it can be seen that the created knowledge is highly dependent on the knower. Every knower has their own context, emotions and motivations surrounding their pursuit of knowledge and it is, therefore, inevitable that their perspective is to some extent integrated into the knowledge created. Moreover, while the methodologies of some areas of knowledge require the perspective of the knower, other areas of knowledge demand the knower’s perspective to provide motivation and direction in the pursuit knowledge. Thus, the pursuit of knowledge is highly dependent on the knower’s perspective. Therefore, the knower’s perspective is to a large extent is essential in the pursuit of knowledge. As IB learners, we must be aware of these sometimes hidden influences and biases in the knowledge we learn, but we must also be open-minded to, and accepting of, different opinions and views in order to have a comprehensive understanding of any subject under investigation.

## References

- Ankersmit, Frank R. "The Origins of Postmodernist Historiography" in *Historiography Between Modernism and Postmodernism*, edited by Jerzy Topolski, 87-118. Amsterdam: Rodopi, 1994. Print.
- BBC Horizon - *Fermat's Last Theorem*. Dir. Simon Singh. Perf. Andrew Wiles. 1996.
- Bernard, H. Russell. *Research Methods in Anthropology: Qualitative and Quantitative Approaches*. 5th ed. Lanham, MD: AltaMira, 2011. Print.
- DeAngelis, Catherine D. "The Influence of Money on Medical Science." *The Journal of the American Medical Association* 296, 8 (2006): 996-998. Print
- DeWalt, Kathleen Musante, and Billie R. DeWalt. *Participant Observation: A Guide for Fieldworkers*. Lanham, MD: Rowman & Littlefield, 2011. Print.
- Kawulich, Barbara B. "Participant Observation as a Data Collection Method." *Forum Qualitative Social Research/Sozialforschung* 6, 2 (2005). Web. Accessed 6 Jan 2016. <http://www.qualitative-research.net/index.php/fqs/article/view/466/996>
- Lacono, Jessica, Ann Brown, and Clive Holtham. "Research Methods – A Case Example of Participant Observation." *Electronic Journal of Business Research Methods* 7, 1 (2009): 39-46. Print.
- McCullagh, C. B. "Bias in Historical Description, Interpretation, and Explanation." *History and Theory* 39, 1 (2000): 39-66. Print.
- McCullagh, C. B. *Justifying Historical Descriptions*. Cambridge: Cambridge UP, 1984. Print.
- Rosaldo, Renato. *Culture & Truth: The Remaking of Social Analysis*. Boston: Beacon Press 1993. Print.
- Rusbult, Craig. "Cultural Influence in Science: Causes and Effects." *The American Scientific Affiliation: A Network of Christians in the Sciences*. Web. Accessed 14 Feb 2016. <http://www.asa3.org/ASA/education/science/cp.htm#i>
- Service, Robert. *Lenin: A Biography*. Cambridge, MA: Harvard UP, 2000. Print.

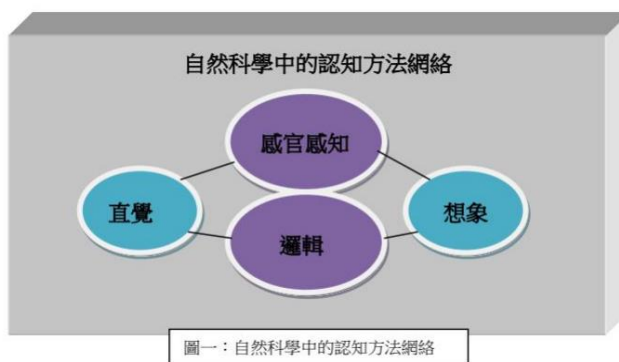
# 認知網絡與知識

楊雨樂

「在獲得知識的過程中，每個知識領域都會利用一個認知方法網絡（network）」——依此觀點，獲取知識的過程中，諸多認知方法不會被單一應用，而是像網絡般，多方面幫助認知者獲取最可靠、最全面的知識結論。由於認知「網絡」具有多點、連接和交互性，由節點和連線構成等特徵，<sup>1</sup>不同的認知方法在認知者獲取知識的過程中應是相互連接、交互使用的。由此延伸出一系列問題，例如在一個知識領域中，某些認知方法是否較其它方法更為主要？認知方法可否被單一應用？多種認知方法是否會在認知過程中發生衝突，繼而帶來對知識結論的負面影響？此篇論文將會就開篇引述的觀點及其延伸出的問題進行論述與探討。

自然科學中元素的發現及整合無疑是認知方法網絡運用的結果。《西方科學——化學與生物》一書詳細介紹了元素的發現過程。「使用電解法……還原單質從而發現新的元素」<sup>2</sup>——可見，元素發現過程的第一步便是通過實驗，運用感官感知來進行的。「……將元素還原出來，如果這種化合物裏含有新元素的話，就能輕易被發現了。」<sup>3</sup>——在這裏，實驗和邏輯推理被同時運用。「……科學家們想到，這些元素之間是不是有什麼關係呢？」<sup>4</sup>——科學家們運用直覺和以經驗為支撐的邏輯推理得出這樣的猜想，直覺雖不及感官感知及邏輯推理具有強大的認知力量，但後來的

研究無疑證實了元素之間存在聯繫的事實。「……將元素按原子量的大小依次排列，每行七個，發現每隔六個元素有許多相似的性質……像音樂中的八度音階，故稱之為元素的八度律。」<sup>5</sup>——不管是按照大小排列，還是發現每隔六個元素所存在的相似性質，研究者都運用了邏輯以發現潛在規律。由這些規律聯想到音樂中的八度音階，將所觀察到的規律通過想像與另一知識領域建立聯繫並以此命名，體現了想像這一認知方法在實際科學研究中的運用。由此不難發現，自然科學中，研究者在獲得知識的過程中運用了認知方法網絡，以感官感知和邏輯推理為核心，加上直覺與想像的適時應用，完善了對於新知識的探索 and 發現。



<sup>1</sup> 百度百科：「網絡」

（<http://baike.baidu.com/view/3487.htm>），2015年12月訪問。

<sup>2</sup> 文聘元：《西方科學：化學與生物》（香港：明窗出版社，2003年），頁52。

<sup>3</sup> 同上，頁53。

<sup>4</sup> 同上。

<sup>5</sup> 同上，頁54。

但是，自然科學中也存在著單純依靠邏輯推理就得出知識結論的現象，由此推翻認知過程中必須通過認知方法網絡以獲得知識的觀點。伽侖略的相對性原理中提到「任何力學實驗都不能區分靜止和勻速運動的慣性參考系」，<sup>6</sup> 否定了以感官感知為主所進行的實驗的必要性。此原理的出現沒有依靠任何實驗，使用單純的邏輯公式推理便得出了這個有力的知識結論。由此可見，自然科學中知識的獲得，並不一定要依靠認知方法網絡。某些自然科學中的理論是可以憑藉邏輯推理這唯一的認知方法而獲得的。

總體而言，自然科學知識大多形成於認知方法網絡的運用，例如感官感知與邏輯推理；但也不排除個別情況下不需使用認知網絡。

藝術中的認知過程又如何？愛德華·蒙克創作的《吶喊》是一幅有影響的名畫。想要理解畫作所表達的內容，需要運用感官、情感及想像三種認知方法所形成的綜合網絡。首先，看畫要用眼睛。它的顏色和線條是人們理解這幅畫的基礎。繼而再運用想像，人們注意到畫面中身形扭曲的人圓睜的雙眼和凹陷的臉頰，帶給人死亡和骷髏的聯想。於是，畫中形似尖叫鬼魂的形象，會幫助人們體會到作品中鬱悶、壓抑、恐懼的情感。

在文學作品的解讀中，認知方法網絡的運用也很常見。以《追風箏的孩子》這部小說為例，讀者必須先要對文本進行通讀，之後為了更深入地了解人物的內心，如理解阿米爾為何要選擇背叛哈山，想像力和情感的參與是必不可少的。有人說，阿米爾是個冷血的傢伙，但若設身處地去感受阿米爾內心的掙扎，就不難發現他成

長的經歷中，伴隨着非常複雜的內心矛盾。僅此仍不足以全面領悟作品的主旨。讀者看到小說中反覆出現的意象，如風箏、兔唇、彈弓等，都需再以歸納推理的方法加以分析，因為它們都是可以被解析的隱喻。由此可見，獲得藝術和文學知識的過程中，語言、想像、情感以及邏輯推理所形成的認知網絡，與自然科學中呈等級狀（推理為主）的網絡不同。藝術認知的網絡中，各種認知方法相輔相成，構建了一個平行的認知平台。

藝術的不同認知方法並不僅以相互幫助的形式存在。它們也會相互衝突，甚至破壞認知網絡的形成。以戲劇為例，布莱希特的戲劇理論限制了觀眾的情感參與，意在使觀眾得到理性的認知，它倡導的是戲劇觀賞過程中理性的邏輯思考。布莱希特認為，「必須用清醒的思維把觀眾引導到他們的現實世界中來」。<sup>7</sup> 這樣的結果，引起了觀眾情感與邏輯認知的強烈衝突。以《大膽媽媽和她的孩子們》為例，這是一部為反法西斯鬥爭服務的作品。布莱希特認為，相較於簡單作用於觀眾情感以讓人痛恨法西斯暴行、同情人物遭遇的戲劇效果，在邏輯認知的層面讓觀眾認識啞女行為的社會意義，從大膽媽媽的行動中汲取教訓，才是作品要實現的最終目的。也就是說，邏輯認知在此與情感認知產生衝突，意在成為核心的認知方法。情感雖在戲劇觀賞過程中被無可避免地使用，但在布莱希特的戲劇理論中，卻應盡量被邏輯取代。所以，在觀賞《大膽媽媽和她的孩子們》獲得知識的過程中，不同的認知方法可能出現不協調的情況。它們可能互相抵觸，甚至妨礙認知網絡的形成。

<sup>6</sup> 百度百科：「相對性原理」  
（<http://baike.baidu.com/view/364972.htm>），  
2015年12月訪問。

<sup>7</sup> 新浪博客：「這就是布莱希特」  
（[http://blog.sina.com.cn/s/blog\\_6cb9c9250101babj.html?tj=2](http://blog.sina.com.cn/s/blog_6cb9c9250101babj.html?tj=2)），2015年12月訪問。

## 參考文獻

總的說來，在自然科學和藝術兩大知識領域中，人們會使用多種認知方法組成的網絡去獲得知識。自然科學中，認知方法網絡在使用中大多存在一定的等級，常常以感官感知與邏輯推理為主，想像與直覺為輔。但是，以相對性原理為例，也存在著不需使用認知網絡，單單使用邏輯推理便可作為唯一認知方法的某些極端情況。在藝術領域，認知方法所形成的網絡呈平行狀並且無等級之分。多種認知方法的結合使用方能獲取最全面的知識。其中也有一些較為特殊的例子，如在布萊希特的戲劇理論中，觀眾的邏輯與情感認知產生衝突，妨礙了認知網絡的形成。

文聘元：《西方科學：化學與生物》（香港：明窗出版社，2003年）。

卡勒德·胡賽尼：《追風箏的孩子》（台灣：木馬文化，2013年）。

百度百科：「相對性原理」  
（<http://baike.baidu.com/view/364972.htm>），2015年12月訪問。

百度百科：「網絡」  
（<http://baike.baidu.com/view/3487.htm>），2015年12月訪問。

新浪博客：《這就是布萊希特》  
（[http://blog.sina.com.cn/s/blog\\_6cb9c9250101babj.html?tj=2](http://blog.sina.com.cn/s/blog_6cb9c9250101babj.html?tj=2)），2015年12月訪問。



# Immortality in Early China through the Funerary Painting of Mawangdui 馬王堆

*Karie Kam*

The human lifespan is but a miniscule instant within the infinite expanse of time and, since time immemorial, the Chinese have been questioning heaven, its inhabitants, life, and death. Rulers met extravagant expenses to pursue immortality, to achieve an otherworldly state of being, or to extend their time in the physical dimension. This essay will tackle the question of how views of immortality are reflected or depicted in the ancient texts and funerary artifacts of the early Han dynasty, namely the funerary painting *Shengtiantu* 升天圖 in Tomb No.1 of Mawangdui (2nd c. BCE).

In modern times, numerous scholars have studied Chinese concepts of immortality in various ways, as this topic overlaps with the religion of China and, in turn, the very culture of this civilization. Beginning with a broader area of research, the Han civilisation of China provided sufficient background knowledge of the society of the time for this paper. Moving into a slightly more specific range of scholarship, *Science and Civilisation in China* Vol. 5. 2 by Joseph Needham and *Picturing Heaven in Early China* by Lillian Lan-ying Tseng gave an idea of what the early Chinese thought about immortality and how they recorded and carried out these beliefs. In addition, Michael Loewe's *Ways to Paradise* included a detailed explanation and interpretation of the funerary painting of Mawangdui Tomb No. 1. Another scholar, Yü Ying-Shih, has also written two articles closely related to this subject of Han dynasty immortality, "Life and Immortality in the Mind of Han China" and "O Soul Come Back!" Both of these texts discuss in depth how the concept of immortality evolved over the Han dynasty.

One more notable resource is an article written by K. E. Brashier, "Han Thanatology and the Division of Souls." This piece consolidates other scholars' work, including the work of the two significant academics mentioned above, researches the topic, and gives an opinion of

how the Han viewed *hunpo* 魂魄, or the soul, in relation to death, illness, and ancestral worship. Though not directly related to the funerary painting, a clear understanding of how the soul was understood is essential to understanding immortality and afterlife. Other useful resources include the Mawangdui archaeological report, which explained many of the details and artifacts buried with the tomb, and a large photographic report of the findings in the tomb.

## Defining Life, Death, and the Human Soul

While questioning what immortality is, one must question how death is defined. In times before the Han dynasty the *hun* 魄 and *po* 魂 were believed to join in harmony within the human body to create life, and separate at the moment of death (Loewe 10). They are the essences of life, representing opposite forces of yin and yang respectively, and which separated into earth and heaven respectively. This concept of *hun-po* dualism became widely popular in the Han dynasty in both elite and popular culture. The belief may have originated from as early as the third century B.C., as it is mentioned in Chuci 楚辭 *Zhaohun* 招魂, or "Summoning of the Soul" (Yu 375). It was tradition that people would attempt to beckon the *hun* 魄 back to the earth, warning it of the dangers of the journey to paradise and tempting it with the safety of the tomb, to join with the *po* and bring the deceased back to life. Of course, these attempts would result in failure, and the family would accept the inevitability of death and turn to guiding the *hun* safely into paradise. However, there are also sources in which the soul is referred to collectively as *hunpo*, and is said to rise as a whole into the realm of the Yellow God.

“黃神生五嶽，主生人錄，召魂召魄，主死人籍。”(東漢熹平二年 173)

The Yellow God governs the Five Marchmounts,  
He controls the registers of the living,  
Summoning the spirit souls (*hun* 魂) and the  
vital souls (*po* 魄),  
He controls the files of the dead. (Seidel 30)

Depending on the different theories of how the painting from Mawangdui Tomb No. 1 is structured, these concepts of the *hun* and *po* play different roles. One theory is that the sections of the painting represent the underworld, earthly realm, and the heavens and, in this theory, the *hun* and *po* would have separated. Others theorize that the painting is structured as a journey from the earthly world directly to the heavens, and in this case the *hunpo* would have risen as a whole.

### Defining Immortality

Yü Ying-Shih states in *Life and Immortality in the Mind of Han China*, that the Chinese concept of immortality contains some subtle differences which its English equivalent fails to convey. To organize these concepts, they can be grouped into ‘material immortality’ and ‘spiritual immortality’.

In the subgroup of material immortality, Yü Ying-Shih describes three types of immortality. “*Changsheng* 長生” implies a long life, or longevity (*changshou* 長壽), which may be considered one of the most ancient and universal worldly desires of the Chinese people, as it is found to be the most mentioned in prayers even as early as the Zhou 周 dynasty. (Yu, 82). As the desire for a long and fulfilling life intensified, people began wishing for “*busi* 不死”, or no death, in the spring and autumn 春秋 period. Lastly, “*baoshen* 保身“ is defined as the preservation of the body.

In a spiritual or otherworldly respect, there are an additional three definitions for immortality which surfaced at that end of the Warring States 戰國 period. “*Dushi* 度世” involves transcending into another world other than the

physical realm. This may involve transcending into heaven after death as a *hun* 魂, which is depicted in the “*Shengtiantu* 升天圖” as well. “*Dengxia* 登遐”, was the ascension to a distant land in the physical world, and “*chengxian* 成仙”, may simply be explained as becoming an immortal in heaven or the immortal’s abode (Yu, 87).

### The funerary painting *Shengtiantu* 升天圖 in 馬王堆

*Shengtiantu* was unearthed from the Mawangdui Tomb No. 1 in Changsha 長沙, on the edge of the Han dynasty empire. The tomb housed a noblewoman of 50 years named Xinzhui 辛追, the wife of Licang 利蒼, Marquis of Dai and Chancellor of the Changsha kingdom. Her corpse, even after such a long period of time, was intact and moist, her muscle soft and elastic and her internal organs still complete. Judging from the archaeological evidence, the successful preservation of the body was most likely due to the immense effort put into building and filling the coffins - four intricately painted coffins - which were buried in charcoal and clay deep in the ground. The corpse lay with artifacts of all kinds to guide the deceased lady’s soul into a comfortable abode (*Fu*). The funerary painting was found face down upon the innermost coffin, attached to a jade *bi* 璧 ring, with the top of the “T” shape aligned with the head of the deceased. The latter arrangement, according to Loewe, was decided upon in order to bring the symbols of the painting in as close a contact as possible with the deceased (Loewe 30).

Regarding the nature of this painting, Lillian Tseng summarizes the opinions of different scholars: “Some associate the painting with *feiyi*, a term mentioned in the funerary inventories found in the tomb, but have different interpretations of the term. Whereas Tang Lan proposes that *feiyi* is a curtain-like cloth hung on a door, Shang Zhitan suggests that it is a garment that helps the soul fly to heaven. Others acknowledge the banner format and link the painting with *mingjing*, a name banner used to identify a corpse in a coffin, as recorded in the ritual canons. The archaeological report

published in 1973 chooses the *mingjing* hypothesis over the *feiyi* hypothesis, giving the former “an official sanction of sorts” (Tseng 172).

The theme of the intricate painting was to conduct the soul to Heaven or call it back, so as to set the deceased at rest in the underworld. Thus, the painting may be interpreted as a representation of the journey into paradise, guiding the reader’s eyes from the bottom, which shows the underworld, to the top of the piece, which shows Heaven. One issue important to mention at this point is that the artist of the painting had obvious consummate skill, and every detail would likely serve the purpose of illuminating the theme of the painting, or tying it into important mythology that the people believed in. Thus, it is important to first understand what each symbol means, or could possibly mean, before analyzing the whole in the context of immortality.

### Upper Tableau

A tableau of six figures standing upon a rectangular platform may be observed. The woman in the center, leaning on a stick, can be identified as the deceased or her soul departing for her journey to Heaven. There is a pattern on the platform that corresponds with the top edge’s pattern on the second coffin layer. The dragons intertwining a jade *bi* are also seen in both designs, beneath the pattern. This may imply that the coffin represents the final platform on which the deceased bids farewell before setting out on its journey, the last link between the *hun* and the earth. Moreover, the jade *bi* through which the two dragons intertwine is significant as it denotes themes of immortality, and is said to let the *hun* pass through to leave the earth (Tseng). The jade *bi* set near the painting verifies the importance of this detail, it being a bridge between the spiritual and physical.

### Dragons

Intertwined through the jade *bi*, synchronized blue and red dragons soar through both the underworld and the earthly world. Their bodies together form a vase shape that joins the lid of the vase, the platform with a fleur-de-lis-esque

shape on top, and the bottom of the vase, the lower tableau with seven figures. We can once again be certain that the artist did not create this shape without purpose. Thus, it may be deduced that this shape represents *Penglai* 蓬萊, the island of the vase and the abode of various creatures blessed with immortality. In addition to the formation of the vase shape, the intertwining of the two dragons may have also been made to evoke the concept of Yin and Yang.

### Lower Tableau

Moving further down the painting, there is a tableau of seven figures, mentioned previously. As with most of the objects in this painting, there is much speculation about the meaning of this tableau and what it depicts. Some say that it depicts the deceased’s family having a banquet, citing a part of *Zhaohun* 招魂, a poem in Chuci 楚辭: (“招魂”)

“魂兮歸來！何遠為些。

O soul, come back! Why must you go so far?

室家遂宗，食多方些。

Your family has gathered, with a great feast.”

However, this hypothesis can be debated. There is a composition of five pots in the foreground of the tableau, two on the left and three on the right. The motif can also be spotted in the upper tableau, wherein there are two servants bowing on the left and three on the right. Further upwards in the painting, the snake-tailed woman has five cranes to her sides, two on the left and three on the right. This may be evidence that the painting depicts the deceased herself in her journey to paradise, not other beings, and thus calls in to question the first hypothesis.

### The sun and the moon

In the top left and right corners, the moon and the sun are depicted. They allude to different myths, the moon containing a rabbit and a toad, with a woman riding close to it on a dragon, and the sun containing a two legged bird and eight discs tangled amongst a tree below it.

Additionally to the modern folklore of the rabbit in the moon, both a rabbit and a toad were believed to reside in the moon at the time, the myth being the result of lunar pareidolia. The symbolism of the rabbit and toad in the moon strongly relate to themes of deathlessness and immortality. The rabbit is said to pound the elixir of life using a mortar and pestle, while the toad is related to the renewing of the moon and can thus be related to birth and rebirth. Some believe that the female figure on the dragon is in fact Chang'e 嫦娥, who is the goddess of the moon and is also associated with the elixir of life, and the myth of the nine suns (her husband being the archer who shot down eight of the crows that carried the suns). The significance of the animals in the moon and the nine suns in the composition of the painting is evidence for this claim. In a later version of the story, Chang'e fled to the moon as an immortal, just to be transformed into a toad. Perhaps the images are meant to be read as two scenes, wherein Chang'e is first travelling to heaven, and then living in the moon as a toad.

The black bird depicted in the red sun can be linked to a myth in which Houyi 后羿 shot down nine suns from the sky, leaving just one. In this case, it would tie in with the myth of Chang'e, who happened to be the wife of the archer. However, there are only nine suns in the painting, and it is unlikely that the artist would deliberately hide the disc behind another element, because of the habit of the artist of putting everything out where people can notice it. One very significant passage can be found in Chuci: (“遠遊”)

朝濯髮於湯谷兮，

In the morning I washed my hair in the Valley of the Morning,

夕晞余身兮九陽。

In the evening I dried myself on the coast of heaven (literal translation: the nine suns)

The word *yuanyou* 遠遊 may refer to a celestial journey, in which a wanderer escapes from the corruption of humanity to seek a state of purity. Thus, this passage can be interpreted within the context of the painting as a significant stage of the celestial journey. The story of Houyi shooting down the nine suns may not be

appropriate to the themes of the painting, and there appears to be no sign that they might hint at the death of the birds, which would have some link to the theme of death and deathlessness. Regarding the *Fusang* tree among which the eight discs reside, the *Shanhaijing* 山海經 mentions that the tree grew on the side of the Valley of the Morning, which was mentioned in the previous quotation from Chuci. Perhaps the purpose of picturing these two elements of mythology, the *Fusang* tree and the nine suns, is to signify the celestial journey that the deceased will embark on, and what one might find on the journey to paradise (Loewe 52).

### Central Figure

One of the most significant elements in the composition of the painting is the snake-tailed woman in the top piece that depicts heaven. There are a few theories about this, three of which are quite probable. Professor Doi Yoshiko describes Nüwa as the goddess who created mankind, and who is one of the more significant goddesses. She suggests that the very creation of man denotes the idea of deathlessness, and that the artist used the image of Nüwa, a symbol of the creation of man, to convey the idea of the deathless world (Yoshiko 88).

Another scholar, Kuo Mo-jo, suggests that Nüwa is a supreme goddess whose presence reflects a matriarchal society, and hypothesizes that only in later times, when the Confucian ideals of patriarchy became emphasized, was her counterpart Fuxi 伏羲 introduced (Kuo 3). This would mean that Nüwa was a goddess of high importance, responsible for the creation of mankind, and would thus deserve her place in the center of the painting's composition. However, there is no sufficient textual evidence to conclude for sure that the superiority of Nüwa was the dominant belief at the time, so this hypothesis remains unconfirmed.

The final theory that seems probable in this context is that the figure is a depiction of the deceased in the final stage of her spiritual journey, amongst the hosts of heaven. In the context of a 'spiritual journey', this theory is possible, and the snake tail would likely

symbolize the countess “sloughing off her mortal coil as easily as a snake sheds the skins that it discards” (Loewe 52).

### Conclusion

It can be inferred from the analysis of the painting’s elements that the artist used them to signify the themes of deathlessness and immortality. From the depiction of the deceased on her celestial journey through the earth and heavens in search of paradise, to the various creatures that make up the celestial world of heaven and the island of Penglai, the artist gives the piece meaning outside of a tribute to the deceased lady by bringing together symbols from their different mythological beliefs. The purpose of the painting, to guide the deceased through the perilous journey into heaven, is illuminated and, through this, one is able to understand the process involved in spiritual immortality in the early Han dynasty.

According to all the different theories, the deceased countess is depicted at least once throughout the painting, and the two-three motif on top of that helps one grasp how strongly the early Chinese believed in life after death. From this, scholars are able to understand the strong beliefs regarding the afterlife in early Chinese culture, and how these beliefs developed as the Chinese civilization developed.

Even today, we give gifts and offerings to our ancestors as if their spirits could still interact with the human world, to ensure their guardianship over descendants, and to show respect for those who came before us. In the tomb of Mawangdui, these traditions do not seem much different. Items were placed in the tombs for use in the afterlife, and the painting was used to show and provide a link between the spiritual world, or paradise, and the physical world that spirits cannot touch.

The value of *hun* and *po*, the desire for life in paradise after death, and respect for the gods, immortal creatures, and ancestral spirits are all reflected in a single silk painting made in the early Han dynasty. As such, even though scholars can infer many religious practices and

beliefs from this intricately painted silk piece, there is still much to be explained. Many creatures on the painting are not clearly identifiable and some are unknown to modern scholars. Even with clear identification, there are still many debates over what message or myth the artist intended to portray, or how the symbols may differ from the Chinese mythology that we understand today. These questions will remain unanswered until further discoveries.

### References

- Brashier, K. E. "Han Thanatology and the Division of 'Souls'." *Early China* 21 (1996): 125-158. Print.
- Doi, Yoshiko. "Hakuga No Etoki." *Shūkan Asahi* (1972): 88. Print.
- Fu, Juyou, Songchang Chen, Shiyi Zhou, and Kefeng Chen. *Mawangdui Han Mu Wen Wu*. Changsha: Hunan Chu Ban She, 1992. Print.
- Loewe, Michael. *Chinese Ideas of Life and Death: Faith, Myth and Reason in the Han Period (202 BC-AD 220)*. London: Allen & Unwin, 1982. Print.
- Loewe, Michael. *Ways to Paradise: The Chinese Quest for Immortality*. London: Allen & Unwin, 1979. Print.
- Needham, Joseph, Wang Ling, and Gwei-Djen Lu. *Science and Civilisation in China: Chemistry and Chemical Technology*, part 5. London: Cambridge UP, 1974. Print.
- Tseng, Lillian Lan-ying. *Picturing Heaven in Early China*. Cambridge, MA: Harvard U Asia Center for the Harvard-Yenching Institute, 2011. Print.
- Seidel, Anna. "Traces of Han Religion in Funeral Texts Found in Tombs" in *Dōkyō to Shūkyō Bunka 道教と宗教文化*, edited by Kan'ei Akitsuki, 21-57. Tokyo: Hirakawa Shuppansha, 1987. Print.
- Puett, Michael J. *To Become a God: Cosmology, Sacrifice, and Self-divinization in Early China*. Cambridge, MA: Published by the Harvard U Asia Center for the Harvard-Yenching Institute, 2002. Print.
- Yu, Ying-Shih. "Life and Immortality in The Mind of Han China." *Harvard Journal of Asiatic Studies* 25 (1964): 80-122. Print.
- Yu, Ying-Shih. "'O Soul, Come Back!' A Study in The Changing Conceptions of The Soul and Afterlife in Pre-Buddhist China." *Harvard Journal of Asiatic Studies* 47, 2 (1987): 363-395.

Appendix

The funerary painting *Shengtiantu* 升天圖 in Tomb No.1 of Mawangdui



---

# Two Complete Genomes of Cellulose-digesting Bacteria Isolated from the Giant Panda (*Ailuropoda Melanoleuca*) Gut Microbiome.<sup>1</sup>

*Matthew Lu*

---

## Abstract

Can genomic DNA extraction, DNA sequencing, and bioinformatics tools be used to successfully sequence and assemble complete genomes for cellulose-digesting bacteria isolated from the giant panda (*Ailuropoda melanoleuca*) gut microbiome?

The method used to carry out this investigation began with genomic DNA extraction. A CTAB protocol was used to minimize the amount of residual polysaccharides and proteins that would lead to impurities in the DNA and failure of the sequencing process. Then, the Illumina Next-Generation Sequencing (NGS) platform, which can yield high-throughput information, provided segments of DNA ready for assembly into a whole genome sequence. A BLAST result of the genome sequence revealed the species and genus of each bacterial strain. Thus, species identification was completed. Annotations for the genome were requested through the National Center for Biotechnology Information (NCBI) genome annotation software.

This extended essay demonstrates that two complete genomes of cellulose-digesting bacteria can successfully be sequenced and assembled from the giant panda gut microbiome. Successful genomic DNA extraction was confirmed by whole genome sequencing, which showed 95% matches with strains of *Klebsiella variicola* and *Klebsiella pneumoniae* for ‘La’ and ‘Lc’ respectively. On the NCBI’s website, the BLAST function confirmed this percentage and established both genomes as related to specific genera and species of bacteria. Successful filling of gaps in the genome sequences (biogaps) with segments of DNA (contigs) was confirmed to an accuracy threshold, after assembly, of over 65% for all combined contigs. This measure of accuracy for the sequences of both ‘La’ and ‘Lc’ was confirmed by bioinformatics tools including DNASTAR’s ‘Seqman’ application. The genomes were then submitted to NCBI, and were confirmed as complete when detailed annotations were released for both genomes. Bacterium isolate ‘La’ was formally named as *Klebsiella variicola* Strain HKUOPLA and ‘Lc’ renamed *Klebsiella pneumoniae* Strain HKUOPLC.

Abbreviations: BLAST, Basic Local Alignment Search Tool; CMC, carboxymethyl cellulose; CTAB, cetyl trimethylammonium bromide; HKU, Hong Kong University; IUCN, International Union for Conservation of Nature; NCBI, National Center for Biotechnology Information (USA); SDS, sodium dodecyl sulfate; TE buffer, 10 mM Tris-Cl, 1 mM EDTA, pH 8.0.

---

<sup>1</sup> The work initially described in this Extended Essay was subsequently published in two papers:

Matthew Guan-Xi Lu, Jingwei Jiang, Lirui Liu, Angel Po-Yee Ma, and Frederick Chi-Ching Leung. “Complete Genome Sequence of *Klebsiella variicola* Strain HKUOPLA, a Cellulose-Degrading Bacterium Isolated from Giant Panda Feces.” *Genome Announcements*, 3(5) (2015): e01200-15. doi: 10.1128/genomeA.01200-15 PMID: PMC4611693

Matthew Guan-Xi Lu, Jingwei Jiang, Lirui Liu, Angel Po-Yee Ma, and Frederick Chi-Ching Leung. “Complete Genome Sequence of *Klebsiella pneumoniae* Strain HKUOPLC, a Cellulose-Degrading Bacterium Isolated from Giant Panda Feces.” *Genome Announcements*, 3(6) (2015): e01318-15. doi: 10.1128/genomeA.01318-15 PMID: PMC4972777

## 1. INTRODUCTION

The diet of the giant panda (*Ailuropoda melanoleuca*) is almost entirely made up of bamboo leaves and shoots. However, the animal lacks the biological capability to digest cellulose, an important component of bamboo (*Iacurci*). Therefore, researchers have hypothesized that the digestion of cellulose necessary for supporting the giant panda diet is carried out by its gut microbiome (e.g. Zhua *et al.*).

Bacteria from feces are used in place of gut isolates because the giant panda is on the International Union for Conservation of Nature's (IUCN) list of Threatened Species (Lü *et al.*). This investigation involved two bacterial samples obtained from giant panda feces, 'La' and 'Lc'. Both were qualitatively confirmed to have cellulose-digesting enzymes. Cellulose-digesting bacteria can be applied to the creation of biofuels because 'second generation' biofuel production typically involves degrading lignocellulosic waste.

The fecal samples were obtained from Ocean Park, which is a government-funded amusement park in Hong Kong that also has a nature conservation program. Three giant pandas reside there in an ex-situ conservation program designed to promote breeding. Trained workers provided fecal samples that had been naturally excreted by a panda named "Le Le".

### Scientific Basis

There are billions of microbes in the giant panda gut. Determining which digest cellulose requires an array of tests. Prior to the investigation carried out for this paper, preliminary lab work was completed as part of a summer internship.<sup>2</sup>

Strain 'La' and 'Lc' were identified by the formation of a decolorized ring in growth medium containing CMC-Congo red. Subsequently, both strains were grown under aerobic conditions in a basal-salt medium with Grade 1 Whatman filter paper provided as the only carbon nutrition source (Gupta *et al.*). These

tests qualitatively confirmed the presence of cellulose-digesting enzymes.

For this investigation, genomic DNA of the bacteria was extracted and used for whole genome shotgun sequencing using Illumina NGS platform. Annotation of the genome was completed by NCBI (National Center for Biotechnology Information).

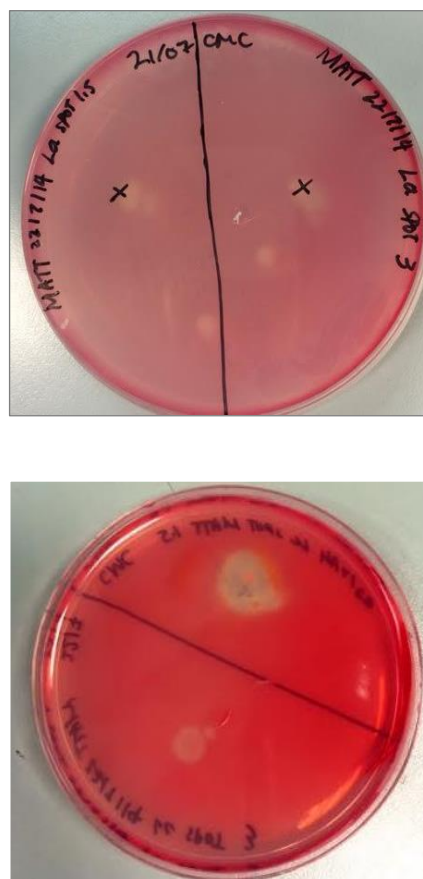


Figure 1: Decolorized rings in CMC-Congo red agar plates show the presence of cellulose-digesting enzymes in 'La' (left) and in 'Lc' (right).

### 1.2 Significance

Despite great potential in the field, many remain sceptical about the future of biofuels. In their book *The Biofuel Delusion*, Mario Giampietro and Kozo Mayumi argued that biofuels are not a long-term replacement for fossil fuels since any energy source with an output:input ratio below 5:1 cannot be viable (Giampietro and Mayumi 236) and the highest projections for biofuels have output:input ratios at 1.8:1. They also found that the six biggest publicly traded US ethanol producers have lost over US\$8.7 billion

<sup>2</sup> Under Prof. Frederick C.C. Leung at the School of Biological Sciences, University of Hong Kong



in market value since 2006 (Giampietro and Mayumi 245).

On the other hand, Ragauskas *et al.* offered an insightful study into how biofuels might become a viable alternative energy source. Nevertheless, there is a common misconception that biofuels produce less carbon dioxide than fossil fuels. Although both ethanol and biodiesel yield 25% more energy than that invested in their production (Hill *et al.*), these biofuels still produce large amounts of carbon dioxide. The goal is to produce biofuels, as part of a carbon cycle, that leave less carbon dioxide in the atmosphere than combusted fossil fuels.

Figure 2 illustrates how biofuels can come close to attaining carbon neutrality, or a zero net carbon footprint (ecolife.com). According to Ragauskas *et al.*, “we need research and development to increase the impact, efficiency, and sustainability” of biofuel production (484) and that research attention should be moved towards “biomaterials [that] typically have higher amounts of cellulose and hemicellulose” (487). This relates directly to my investigation into cellulose-digesting bacteria with potential biofuel production applications. Holzman also argued that “Cellulosic feedstocks offer the promise of biofuels that are nearly carbon neutral if grown on marginal lands” because he calculated that, per hectare of cellulose-rich crops, between 2 and 5.5 metric tons of carbon dioxide is removed from the atmosphere and stored in the soil each year.

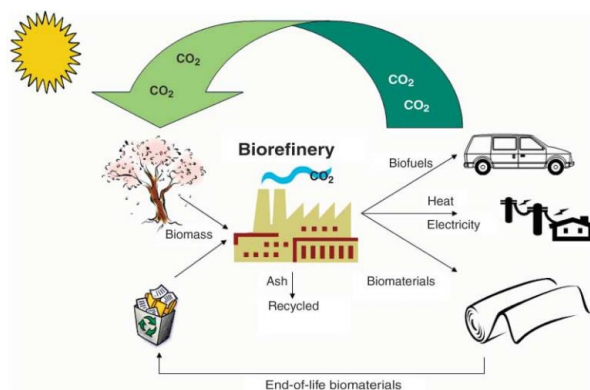


Figure 2: Biofuels can be naturally integrated into the carbon cycle (Ragauskas *et al.* 485)

## 2. METHOD

### 2.1 Investigation Aims

1. The successful extraction of genomic DNA from both bacterial isolates ‘La’ and ‘Lc’.
2. The complete assembly of genomes for ‘La’ and ‘Lc’, with species identification done through the use of a Basic Local Alignment Search Tool (BLAST).
3. Submission to the NCBI for annotations and assembly confirmation (if the sequence is accepted, then the sequence can be confirmed as complete).

### 2.2 Hypotheses

A CTAB protocol used for genomic DNA extraction will yield pure enough genetic material to attain a percentage match of over 90% similarity to an officially published fully sequenced strain of bacteria. Common protocols for DNA extraction are not effective in removing residual polysaccharides that may interfere with key enzyme reactions during the extraction (Wilson 208). The CTAB protocol is designed to remove polysaccharides and proteins that may lead to an impure sample of genetic material (Wilson 208).

Null: CTAB protocol used for genomic DNA extraction will not yield genetic material pure enough to attain a percentage match of over 90% similarity to an officially published sequenced strain of bacteria.

Gaps in the genome sequence, obtained after whole genome sequencing, can be filled by small segments of DNA (‘contigs’) to reach an accuracy threshold of over 65% for all assembled sections.

Null: Contigs from whole genome sequencing will be too inaccurately sequenced to reach an accuracy threshold of over 65% (recommended by HKU guidelines) after their assembly.

The genome sequences can be successfully assembled into consensus sequences as determined by NCBI’s 12 annotations.

Null: The genome sequences cannot be assembled into consensus sequences, and

accuracy of the sequences will be too low for NCBI to complete all 12 of genome annotations or species identification based on BLAST results.

### Investigation Aim 1: Genomic DNA Extraction

This procedure is adapted from a protocol by Wilson (208-212) for the “Preparation of Genomic DNA from Bacteria” using CTAB to extract genomic DNA for whole genome sequencing.

Genomic DNA must be extracted precisely in order for whole genome shotgun sequencing to be completed. Several protocol modifications were also made to increase the amount of genomic DNA extracted from the bacteria samples. Namely, a 2% CTAB/0.7 M NaCl solution will be used; the 10% sodium dodecyl sulfate (SDS) cannot be shaken before the procedure; Step 2 (centrifugation) is repeated; after addition of CTAB/NaCl and incubation at 65 °C (step 7), the mixture is allowed to cool to room temperature before commencing the next step; and, extraction with phenol/chloroform/isoamyl alcohol precedes addition of chloroform/isoamyl alcohol (order reversed from that of Wilson).

#### Procedure

Inoculate a 5 µL liquid culture with bacteria strain ‘La’. Grow it in a Luria broth medium for optimal growth at 37 °C incubation temperature. Leave it to saturate for 2 nights.

Spin 1.5 mL of the ‘La’ culture in a microcentrifuge for 2 minutes, or until a compact pellet forms at the bottom of the capsule containing the liquid culture.

Re-suspend pellet in 567 µL TE buffer by repeatedly pipetting the culture. Add 30 µL of 10% SDS and 3 µL of 20 mg/ml proteinase K to give a final concentration of 100 µg/mL proteinase K in 0.5% SDS. Mix thoroughly and incubate for 1 hour at 37 °C. Add 100 µL of 5 M NaCl and mix thoroughly. Add 80 µL of CTAB/NaCl solution. Mix thoroughly and incubate for 10 minutes at 65 °C.

Allow the mixture to cool down to room temperature before the next step.

Add an equal volume of phenol/chloroform/isoamyl alcohol (25:24:1 v:v:v), mix thoroughly, and spin in a microcentrifuge for 5 minutes. Two distinct layers can clearly be seen. Transfer the aqueous, viscous supernatant to a fresh test tube, leaving the lower layer behind.

Add 0.7 to 0.8 mL of chloroform / isoamyl alcohol (24:1 v:v) to the supernatant and mix thoroughly. Spin for 4-5 minutes in the microcentrifuge. Add 0.6 µL of 35% isopropanol to precipitate the nucleic acids (there is no need to add salt since the NaCl concentration is already high).

Shake the tube until a white DNA precipitate is visible at the bottom of the tube. Transfer the pellet to a fresh tube containing 70% ethanol. This can be done by heat-sealing a glass pipette tip and bending it into a hook that can pick up the pellet. Spin the pellet in 70% ethanol for 5 minutes to reform the pellet. Remove the supernatant and redissolve the pellet in 100 µL of TE buffer.

### Investigation Aim 2: Whole Genome Sequencing

The genomic DNA of strains ‘La’ and ‘Lc’ was extracted using the CTAB protocol from pure, aerobic cultures in Luria broth. Their quality and quantity were, respectively, examined and measured using a NanoDrop2000 spectrophotometer (Thermo Scientific) and the Quant-iT PicoGreen dsDNA kit (Invitrogen). A 2x300 MiSeq library and a MiSeq 8 kb paired-end library were constructed and sequenced with the Illumina MiSeq (Illumina) at the Bioinformatics Centre, Nanjing Agricultural University.

From the server, no fully assembled genomes could be obtained because the process of whole genome sequencing required the filling of

'biogaps' between individually sequenced segments of DNA (contigs). These segments were digitally represented on the server and combined to form viable (or often non-viable) pathways between major DNA segments. By using a bioinformatics tool called VisANT, such contigs could be mapped out (Figure 3), thus helping to fill the biogaps between the major contigs.

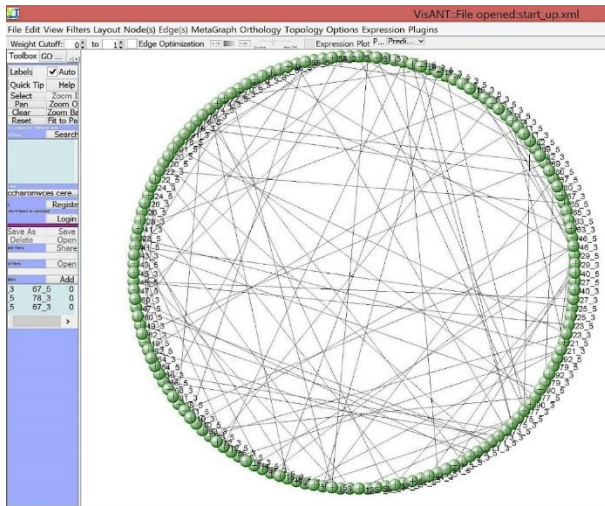


Figure 3: Contigs for 'La' were mapped using VisANT

From this map, I identified pathways between 'contigs' to fill genome sequence gaps. On the software Putty, I created several files using the data from Newbler. These files identified between which main contigs existed gaps. For 'La', there were gaps between contigs 1 through 18; for 'Lc', there were gaps between contigs 1 through to 16. Pathways linking contigs eventually allowed for all the gaps to be filled. FASTA files of the gaps were then created and uploaded to Seqman assembly software along with the adjacent large contigs.

Smaller contigs, usually below 100,000 base pairs, were often found making up the biogaps. A trial and error mapping process had to be completed before both genomes could be assembled for further analysis.

### Investigation Aim 3: Species Identification Through NCBI Submission

Species identification was then completed. The two consensus FASTA files (a type of text file) were uploaded onto the NCBI BLAST web page, which compares the uploaded genome to all genomes in the NCBI database.

## 3. DATA PROCESSING

After filling biogaps and assembling the complete genomes, the DNA sequences for 'HKUOPLA' and 'HKUOPLC' were organized into two complete FASTA files that were uploaded to NCBI. Once NCBI confirmed and annotated both genome sequences as complete, all specific data points could be organized.

### 3.1 Results Tables

The comprehensive annotations from NCBI show that the genome is complete (see Table 1 and Table 2).

Genome Specifics	Value	Bioinformatics Tool Used
Reads longer than 250 base pairs (bp) Mean quality score $\geq 30$	1,238,299	Illumina MiSeq platform
Number of large contigs	36	Newbler version 2.7 assembly software program (Roche)
61-fold coverage (nucleotide bases)	5,062,551	Newbler version 2.7 assembly software program (Roche)
Chromosome size (bp)	5,090,052	Seqman software (DNASTAR)
G+C content	58.04%	Editseq.exe (DNASTAR)
Number of genes in genome	4,757	Sequin software (NCBI)
Predicted coding sequences (CDS)	4,614	Sequin software (NCBI)
Pseudogenes	31	Sequin software (NCBI)
Frameshifted genes	12	Sequin software (NCBI)
tRNAs	84	Sequin software (NCBI)
rRNAs	25	Sequin software (NCBI)
ncRNAs	3	Sequin software (NCBI)

Table 1: *Klebsiella variicola* HKUOPLA Complete Sequencing Data

Genome Specifics	Value	Bioinformatics Tool Used
Reads longer than 250 base pairs (bp) Mean quality score $\geq 30$	768,637	Illumina MiSeq platform
Number of large contigs	20	Newbler version 2.7 assembly software program (Roche)
40-fold coverage (nucleotide bases)	5,056,441	Newbler version 2.7 assembly software program (Roche)
Chromosome size (bp)	5,088,873	Seqman software (DNASTAR)
G+C content	57.14%	Editseq.exe (DNASTAR)
Number of genes in genome	4,962	Sequin software (NCBI)
Predicted coding sequences (CDS)	4,764	Sequin software (NCBI)
Pseudogenes	92	Sequin software (NCBI)
Frameshifted genes	43	Sequin software (NCBI)
TRNAs	79	Sequin software (NCBI)
RRNAs	24	Sequin software (NCBI)
ncRNAs	3	Sequin software (NCBI)

Table 2: *Klebsiella pneumoniae* HKUOPLC Complete Sequencing Data

Strain Name	Total Genes	Predicted Coding Sequences (CDS)	Frameshift Genes Present	Calculation	Probability
HKUOPLA	4,757	4,614	12	$12/4757 = 0.00252$	0.252%
HKUOPLC	4,962	4,764	43	$43/4962 = 0.00832$	0.832%

Table 3: Frameshift probability in coding sequences

### Calculating Probability of Frameshift Genes in Coding Sequences

Frameshift mutations may alter vital cellulose-digesting enzyme coding regions. The probability of this occurring is assessed in Table 3.

### 3.2 Species Identification

The results of species identification (Investigation Aim 3) were:

‘La’, now named HKUOPLA (Hong Kong University Ocean Park La), was identified as *Klebsiella variicola* by comparing its sequence to the nucleotide database in NCBI using BLASTn, which showed the highest identity, 95%, to strain At-22 (NCBI accession number CP001891) (Rosenblueth *et al.*). The genus *Klebsiella* is facultative anaerobic, having both a respiratory and a fermentative type of metabolism. Most strains produce acid, gas, or 2,3-butanediol as the major end product of glucose fermentation (Robinson *et al.* 1107).

‘Lc’, now named HKUOPLC (Hong Kong University Ocean Park Lc), was identified as *Klebsiella pneumoniae* using BLASTn, which showed the highest identity, 95%, to strain ATCC 43816 KPPR1 (NCBI accession number CP009208) (Broberg *et al.*). The genus *Klebsiella* is facultative anaerobic, having both a respiratory and a fermentative type of metabolism. Most strains produce acid, gas, or 2,3-butanediol as the major end product of glucose fermentation (Robinson *et al.* 1107).

## 4. CONCLUSION

### 4.1 Data Analysis

#### *Data for Investigation Aim 1*

BLAST results quantified the purity of the genome sequences. Both results reveal a high level of purity for the genomic DNA extracted. ‘La’ (renamed HKUOPLA) attained a 95% similarity to a fully sequenced strain of *Klebsiella variicola*, and that ‘Lc’ (renamed HKUOPLC) attained a 95% similarity to a fully sequenced strain of *Klebsiella pneumoniae* in terms of genetic makeup. Genetic makeup from HKUOPLA shares 93% similarity with two different strains of *Klebsiella variicola* published genomes in the database. HKUOPLC shares 91% similarity with four fully sequenced strains of *Klebsiella pneumoniae*.

#### *Data for Investigation Aim 2*

Genome assembly yielded one consensus sequence for each bacterial sample. The data reveals that the assembly accuracy threshold never failed to surpass the 65% limit. The BLAST results were also used to identify sample ‘La’ as a strain of *Klebsiella variicola*, based on the sequenced genome with the most similar genetic makeup (a strain named At-22) published on the NCBI genomes database. The results for ‘Lc’ identified it as a strain of *Klebsiella pneumoniae*, based on the published genome with the most similar genetic makeup (strain ATCC 43816 KPPR1).

### Data for Investigation Aim 3

All 12 NCBI annotations for both strains of bacteria are shown in Table 1 and Table 2. Three trends can be noted: the chromosome size for HKUOPLA is 5,090,052 base pairs, similar to the 5,088,873 base pair chromosome size of HKUOPLC. The G+C content of HKUOPLA is 58.04%, very close to the G+C content of HKUOPLC, which is 57.14%. Lastly, HKUOPLA has 4,614 predicted coding sequences, which is quite similar to the 4,764 of HKUOPLC.

## 4.2 Evaluation of Hypotheses

### Evaluating Null Hypotheses

1. Null hypothesis 1 is rejected. CTAB protocol was used for genomic DNA extraction, and the result was successful whole genome shotgun sequencing and 95% purity based on BLAST results for both strains of bacteria. The data obtained from this investigation supports H1.

2. Null hypothesis 2 is rejected. Genome assembly using bioinformatics tools successfully created consensus sequences. Accuracy threshold did not fall under 65%. The high percentage match (95%) of both genomes to existing genomes confirmed species identification. HKUOPLA was identified as a strain of *Klebsiella variicola* and HKUOPLC was identified as a strain of *Klebsiella pneumoniae*. The results therefore support H2.

3. Null hypothesis 3 is rejected. NCBI completed all 12 annotations for both genome sequences, as evidenced below:

Complete genome sequence of *Klebsiella variicola* Strain HKUOPLA:

<http://www.ncbi.nlm.nih.gov/nucore/CP012300>

Complete genome sequence of *Klebsiella pneumoniae* Strain HKUOPLC:

<http://www.ncbi.nlm.nih.gov/nucore/CP012252>

Hypothesis 3 is therefore supported by this investigation.

### Evaluating Possible Uncertainties

#### 1. Mean Quality Score

The mean quality score (or Phred score) is a measure of the accuracy of DNA sequences produced by the genome sequencing process. The Illumina NGS platform produces a score based on the probability that each individual nucleotide base is inaccurately called. NCBI annotations provided mean quality scores of 30 for both genome sequences, indicating that the average accuracy of each individual nucleotide in my genome sequences was 99.9%, with a 0.1% uncertainty (Table 4).

#### 2. Frameshifted Genes

Because genes code for cellulose-digesting enzymes, knowing whether or not frameshift mutations (possibly sequencing mistakes) could have occurred is very important. The statistical probability that the coding genes are frameshifted genes has been calculated using the NCBI annotations (Table 3), with frameshift probabilities for HKUOPLA and HKUOPLC of 0.252% and 0.832% respectively.

In conclusion, the probability that frameshift mutation occurred for CDS genes is very low for both HKUOPLA and HKUOPLC and the likelihood of uncertainties is significantly reduced.

Mean Quality Score	Probability of Incorrect Base Call	Accuracy
10	1 in 10	90%
20	1 in 100	99%
30	1 in 1000	99.9%
40	1 in 10000	99.99%
50	1 in 100000	99.999%
60	1 in 1000000	99.9999%

Table 4: Mean Quality Score Table (*Quality Scores for NGS*)

### 4.3. Discussion

This investigation yielded two previously unidentified cellulose-degrading bacteria strains from the giant panda gut (*Klebsiella variicola* HKUOPLA and *Klebsiella pneumoniae* HKUOPLC). These strains could perhaps be used to assist the production of biofuels from lignocellulosic waste.

DNA sequencing results for cellulose-digesting bacteria strains will provide researchers a better understanding of cellulose digestion and possible molecular genetic pathways to renewable sources of biofuels. Dr Ashli Brown, State Chemist and MSCL Director at Mississippi State University has explained, “If you can use a microbe that efficiently breaks down biomass naturally and as efficiently as pandas do, and convert them into sugars that could be converted to oils and other chemicals, production costs for alternative fuels would be cut tremendously” (Ritter).

The United States Department of Energy (DOE) has assessed that there are currently 1.4 billion hectares (ha) of land available in the world for bioenergy supply (Nakada *et al.*) and the amount of bioenergy crops produced could reach 1.1 billion dry tons by 2030 in the United States (Ritter). Enzyme bioprospecting could lead to profound breakthroughs in producing cellulosic ethanol biofuels efficiently and cost-effectively. Pandas digest bamboo in only approximately four hours, while cows (that also ingest cellulose) take between one and three days to digest grass (Ritter). Because pandas are genetically carnivores, enzymes used in bamboo digestion come exclusively from microbes living in the gastrointestinal tract (Ritter). If my bacteria, HKUOPLA and HKUOPLC, can produce enzymes to convert 1.1 billion tons of bioenergy crops and additional crop waste into eco-friendly fuel with, as Holzman states, “rising conversion plant efficiency”, it could prove a major environmental and scientific break-through.

### 4.4 Future Research and Improvements

Increasing the number of trials and specific measurements of results could have increased overall reliability of results.

An extension of this work would be to publish the whole genomes of *Klebsiella variicola* HKUOPLA and *Klebsiella pneumoniae* HKUOPLC in a peer-reviewed journal. Researchers would then be able to access the data and immediately identify two strains that may be applied to producing biofuels.

In the past, researchers have identified multiple cellulose-digesting microbes in the giant panda gut, but few have applied such bacteria to the conversion of cellulose to glucose to create biofuel. Ethanol, a versatile biofuel, can be produced through the fermentation of lignocellulosic biomass rather than from grain or corn and cellulose-digesting enzymes can aid this anaerobic process. Whole genome sequencing completed in this investigation could be used to pinpoint these enzymes. Certain microbes, such as those present in the giant panda gut, can produce enzymes that hydrolyze the glycosidic bonds of cellulose  $(C_6H_{10}O_5)_n$  into glucose molecules  $(C_6H_{12}O_6)$ , which can then be fermented into ethanol in the presence of yeast  $(C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2)$  to produce cellulosic biofuel.

### Acknowledgements

This investigation was carried out at the University of Hong Kong (HKU) School of Biological Sciences in the laboratory of Professor Frederick Leung. Some sequencing work was completed at Nanjing Agricultural University with the help of Jingwei Jiang. Practical work was completed under the supervision of doctoral candidate Lirui Liu.

## References

- Broberg, Christopher A., Weisheng Wu, James D. Cavalcoli, Virginia L. Miller, Michael A. Bachman. "Complete Genome Sequence of *Klebsiella Pneumoniae* Strain ATCC 43816 KPPR1, a Rifampin-Resistant Mutant Commonly Used in Animal, Genetic, and Molecular Biology Studies." *Genome Announcements* 2.5 (2014): e00924–14. *PMC*. Web. 30 Aug. 2015.
- ecolife.com. "Definition of Carbon Neutral." *Carbon Neutral*. n.p., n.d. Web. 11 Oct. 2015. <<http://www.ecolife.com/define/carbon-neutral.html>>.
- Giampietro, M., and Koza Mayumi. "Living in Denial." *The Biofuel Delusion: The Fallacy of Large-Scale Agro-Biofuel Production*. London: Earthscan, 2009. 236-45. Print.
- Gupta, Pratima, Kalpana Samant, and Avinash Sahu. "Isolation of Cellulose-Degrading Bacteria and Determination of Their Cellulolytic Potential." *International Journal of Microbiology* 2012 (2012): 1-5. *International Journal of Microbiology*. Web. 30 Aug. 2015. <<http://www.hindawi.com/journals/ijmicro/2012/578925/>>.
- Hill, J., E. Nelson, D. Tilman, S. Polasky, and D. Tiffany. "Environmental, Economic, and Energetic Costs and Benefits of Biodiesel and Ethanol Biofuels." *Proceedings of the National Academy of Sciences* 103.30 (2006): 11206-1210. Print.
- Holzman, David C. "The Carbon Footprint of Biofuels: Can We Shrink It Down to Size in Time?" *Environmental Health Perspectives* 116.6 (2008): A246–A252. Print.
- Iacurci, Jenna. "Giant Pandas Meant to Eat Meat, Not Bamboo." *Nature World News RSS*. n.p., 20 May 2015. Web. 06 Sept. 2015. <<http://www.natureworldnews.com/articles/14778/20150520/giant-pandas-meant-to-eat-meat-not-bamboo.htm>>
- Quality Scores for NGS*. Tech. Illumina, 31 Oct. 2011. Web. 1 Nov. 2015. [http://www.illumina.com/documents/products/technotes/technote\\_Q-Scores.pdf](http://www.illumina.com/documents/products/technotes/technote_Q-Scores.pdf)
- Kennedy, Suzanne. "DNA Precipitation: Ethanol vs. Isopropanol." *Bitesize Bio*. N.p., 23 June 2015. Web. 17 Sept. 2015. <<http://bitesizebio.com/2839/dna-precipitation-ethanol-vs-isopropanol/>>
- Lü, Z., D. Wang, and D.L. Garshelis. "Ailuropoda Melanoleuca." *Ailuropoda melanoleuca (Giant Panda)*. The IUCN Red List of Threatened Species, 30 June 2008. Web. 30 Aug. 2015. <<http://www.iucnredlist.org/details/712/0>>
- Nakada, Shunichi, Deger Saygin, and Dolf Gielen. *Global Bioenergy Supply and Demand Projections - A Working Paper for REmap 2030*. Working paper. International Renewable Energy Agency, Sept. 2014. Web. 30 Aug. 2015. [http://www.irena.org/remap/IRENA\\_REmap\\_2030\\_Biomass\\_paper\\_2014.pdf](http://www.irena.org/remap/IRENA_REmap_2030_Biomass_paper_2014.pdf)
- Ragauskas, Arthur J., Charlotte K. Williams, Brian H. Davison, George Britovsek, John Cairney, Charles A. Eckert, William J. Frederick Jr., Jason P. Hallett, David J. Leak, Charles L. Liotta, Jonathan R. Mielenz, Richard Murphy, Richard Templer, and Timothy Tschaplinski. "The path forward for biofuels and biomaterials." *Science* 311.5760 (2006): 484-489.
- Ritter, Stephen K. "To Make Better Biofuels, Scientists Mine Microbiomes." *Chemical & Engineering News* 90.49 (2012): 13-16. Web. 30 Aug. 2015. <<http://cen.acs.org/articles/90/i49/Make-Better-Biofuels-Scientists-Mine.html>>.
- Robinson, R. K., Carl A. Batt, and P. D. Patel. "'K.'" *Encyclopedia of Food Microbiology*. San Diego: Academic, 2000. 1107. Print.
- Rosenblueth, Mónica, Lucía Martínez, Jesús Silva, and Esperanza Martínez-Romero. "*Klebsiella variicola*, A Novel Species with Clinical and Plant-Associated Isolates." *Systematic and Applied Microbiology* 27.1 (2004): 27-35. Web.
- Wilson, Kate. "Preparation of Genomic DNA from Bacteria." In *Current Protocols in Molecular Biology*. New York: John Wiley & Sons, 2003. 208-12. Print.
- Zhua, Lifeng, Qi Wu, Jiayin Dai, Shanning Zhang, and Fuwen Wei. "Evidence of cellulose metabolism by the giant panda gut microbiome." *Proceedings of the National Academy of Sciences* 108.43 (2011): 17714-17719. Print.



---

# To What Extent do the Concepts that We Use Shape the Conclusions that We Reach?

*Sean Fontaine*

---

Possible equivocality in interpreting this question makes it necessary to define key terms prior to the development of an argument. A ‘concept’ is defined in this essay as a system of coherent ideas used to view or explain something; the most common forms of such are theories, laws and models (Ghose and Dudovskiy). ‘Conclusions’ will be defined as knowledge claims made based on synthesis of information. In the context of this paper, the verb ‘shape’ describes the scale of effect that concepts have on conclusions. This essay evaluates the claim in the essay title within the human and natural sciences.

Concepts used in the human sciences serve the purpose of providing explanations for observations made in the study of humanity. This can be seen in Sociology, a field which is open to exploration through a multitude of concepts. One frequently used concept is structural-functional theory, which views society as a complex, interconnected system that has evolved so that each part works together as a greater functional whole (Kingsbury and Scanzoni 195). The theory can easily be applied to a number of sociological studies, including that of the study of Chinese census data from the years 2000 to 2014 that shows China experiencing a rapid “increase in the nuclear family” (Xu and Xia 31) with the progression of time. A sociologist using structural-functional theory would attempt to explain this phenomenon with the argument that the nuclear family is that which is most functional – *i.e.* it fosters “societal survival by producing new members” who, through exposure to the familial environment, learn to become “functioning members of society” (Kingsbury and Scanzoni 196). The probable conclusion to be reached on the topic of China’s large and growing nuclear demographic, therefore, would be that the increased functionality of the nuclear family in comparison to other forms has allowed for a shift towards nuclear households to naturally occur.

However, there are many concepts and theories that, if applied to the same sociological studies, might produce vastly different conclusions and explanations. One such ‘concept’ is the Marxist view of families, which holds that nuclear families are not present due to any inherent functionality but, rather, exist as a means of oppression that serves capitalism by giving people a temporary “sanctuary” from “workplace oppression” and offering “the prospect of profit to capitalists by buying consumer goods” (Covington 112). Thus, the probable conclusion reached by Marxist sociologists in explaining the prevalence of nuclear families in China is that this type of family model is the one that best allows for the maintenance of capitalist oppression and has therefore gained prevalence due to China’s continued efforts to move towards a full free market economy.

Whilst it is difficult to disprove each argument and conclusion individually, it is clear that some of the most widely referenced concepts within sociology can lead to conclusions that are near polar opposites. Therefore, it can be concluded that concepts in sociology can help determine the conclusions reached.

Interestingly, this is true for more than just the above example. Concepts used in the human sciences will always shape conclusions reached. This is due to a fundamental ideological and methodical divide surrounding two metatheories - positivism and interpretivism. The positivist outlook relies on use of quantitative data and scientific evidence to draw conclusions. In contrast, the interpretivist outlook relies on qualitative data based on a micro- approach focusing on the thoughts and choices of the individual (Dudovskiy). The base assumption for interpretivism is that society is not quantitatively modelable and that, therefore, positivist methods within the human sciences produce flawed results – and vice versa for exponents of positivism.

As most social science is conducted through either a positivist or interpretivist lens, concepts will invariably influence both data collection and interpretation. This can be seen in two recent sociological studies carried out in the United Kingdom to assess public attitudes towards volunteering in communities to prevent crime. The first, a British Institute for Criminal Policy Research report published in 2011, adopted an interpretivist approach to data collection through focus groups, and concluded that there was a widespread reluctance to volunteer in crime prevention due to “practical concerns about the difficulties of volunteering” in the UK (Jacobson and Kirby 27). The second study, carried out in 2010 by the European Policy Centre, adopted a positivist approach to data collection through surveys and statistical analysis. In spite of a near identical research area, the study concluded that a majority of British people – 58% - would “be likely to get involved in policing and crime prevention” (Harrison, Sibley, Theodoropoulou, & Guerzoni 13). While acknowledging some slight differences between the studies, it is fair to assume that the ‘concept’ used in approaching each study had a defining effect on the conclusion reached. This is always the case in the human sciences, as even in cases when mixed methods are used, the base positivist or interpretivist outlook of the scientist will have a determining effect on which data is seen as most valuable. Thus, all studies in the human sciences are affected by concepts, and all concepts necessarily shape the conclusions drawn from them.

As with the human sciences, concepts used in the natural sciences often determine the conclusions that are reached from them. This can be most frequently seen in fields of ongoing scientific research and dispute. One such field is gerontology, the biological study of human aging, which is dominated by two conflicting meta-theories. The first group is characterized by damage theories, which claim that aging occurs as a result of continuous external forces that gradually damage and prevent cells and organs from functioning. The second group contains the programmed theories which hold that both aging and deterioration are genetically programmed to occur with the passing of time. Both attempt to explain why aging and its symptoms occur, and

both are backed by fragments of valid yet inconclusive evidence (Jin 1-2).

In a 2010 study, biologists Boskey and Coleman proved that bone strengthening followed by deterioration occurs in the lifetime of a human being (Coleman and Boskey 1-11). In attempting to explain bone deterioration with age, a damage theorist might cite free radicals theory, which states that bone deterioration occurs as a result of constant damage to bone cells from the reactions caused by the oxygen free radicals produced naturally during metabolism (Jin 1). On the other hand, a programmed theorist would cite endocrine theory, which asserts that the body is genetically programmed to produce lower quantities of hormones during old age, including the estrogen that is secreted in early stages of life to maintain bone thickness and compressive strength (Jin 2). While both claims are partially supported by evidence, the conclusions drawn by scientists working in this field are invariably shaped by the ‘concept’ used to interpret and explain data. Therefore, in the natural sciences the use of different concepts can sometimes have a defining effect on the conclusions drawn.

Although it is tempting to assume that concept rarely plays a defining role in the gathering of basic scientific fact, this is simply not the case. Take the existence of the atom as an example. Despite being proven as an incontrovertible fact through experiments spanning thousands of years, it would be incorrect to make the claim that our understanding of the atom has not been massively shaped by various concepts across the years. Physicist Thomas Kuhn’s book *The Structure of Scientific Revolutions* views the natural sciences as always operating within paradigms that with time and the accumulation of conflicting evidence are replaced with a new paradigms in a continuous cycle (Van Norden 1). Kuhn furthers this claim by asserting that all scientific knowledge is affected by such paradigms and their shifts and that the understanding of a scientific concept is invariably linked to the understanding of a “network of concepts” (Cooper 86-87) within a paradigm. Returning to the example of the atom, Kuhn argues that, although the word ‘atom’ may have remained constant notwithstanding paradigm shifts, very little else in our concept of the atom has.

The ancient Greeks' understanding of the atom was that it was the "smallest unit of matter" (Cooper 87) that made up everything in the physical realm. With time and multiple paradigm shifts, knowledge of the atom has expanded to include understanding of electrons, protons, and neutrons. Though the wording has remained constant, the Greek scientist and modern scientist are talking about fundamentally different ideas. Moreover, the two would reach vastly different conclusions to simple questions such as whether or not an atom could be split. Therefore, Science – even at its seemingly most basic level – is under the constant effect of a network of concepts in the form of paradigms.

Examination of the use of concepts to reach conclusions provides evidence that concepts, without exception, shape conclusions drawn. However, the extent of the effect from concept to concept varies massively and, therefore, no generalization as to the exact degree of effect a concept will have on a conclusion can be made. Nonetheless, it is still true that concepts affect the conclusions we draw, often to a much greater extent than may be apparent to the knower. Thus, it is the job of the individual to recognize the assumptions and flaws present within the concepts used in the gaining of knowledge, and it is imperative to differentiate a concept from a standalone model of the truth. All concepts hold value, and it is often only by exposing oneself to a range of concepts that one is able to open up a full range of possible conclusions from which one may make a valid knowledge claim.

## References

- Coleman, R., and A.L. Boskey. "Aging and Bone." *Journal of Dental Research* 89, 12 (2010): 1333-1348. Print.
- Cooper, Rachel Valerie. *Psychiatry and Philosophy of Science*. Montreal: McGill-Queen's UP, 2007. Print.
- Covington, Peter. *Success in Sociology: AS Student Book AQA*. Buckinghamshire: Folens, 2008. Print.
- Dudovskiy, John. "Interpretivism (Interpretivist) Research Philosophy." *Research Methodology*. Web. Accessed 7 Jan 2016. <http://research-methodology.net/research-philosophy/interpretivism/>
- Ghose, Tia. "'Just a Theory': 7 Misused Science Words." *Scientific American: The Sciences*, 2 Apr 2013. Web. Accessed 7 Jan 2016. <https://www.scientificamerican.com/article/just-a-theory-7-misused-science-words/>
- Harrison, Eric, Elissa Sibley, Sotiria Theodoropoulou, and Benedetta Guerzoni. "What Do They Want?" *European Policy Centre* (2010). Web. Accessed 23 Feb 2016. [http://epc.eu/documents/uploads/pub\\_1211\\_what\\_do\\_citizens\\_want.pdf](http://epc.eu/documents/uploads/pub_1211_what_do_citizens_want.pdf)
- Jacobson, Jessica and Amy Kirby. *Public Attitudes to youth Crime: Report on Focus Group Research*. Institute for Criminal Policy Research. Home Office, UK Gov, 2012. Print.
- Jin, Kunlin. "Modern Biological Theories of Aging." *Aging and Disease* 1. 2 (2010): 72-74. Print.
- Kingsbury, Nancy, and John Scanzoni. "Structural Functionalism" in *Sourcebook of Family Theories and Methods: A Contextual Approach*, edited by Pauline Boss et al, 195-221. New York: Springer, 1993. Print.
- Van Norden, Bryan W. *Notes for Thomas Kuhn's The Structure of Scientific Revolutions*, 25 Feb 2015. Web. Accessed 7 Jan 2016. <http://faculty.vassar.edu/brvannor/Kuhnhelp.pdf>
- Xu, Anqi, and Yan Xia. "The Changes in Mainland Chinese Families During the Social Transition: A Critical Analysis." *Journal of Comparative Family Studies* 45. 1 (2014): 31-53. Print.

# How Does Cicero Attempt to Overcome Xenophobia in the *Pro Archia*?

*Emily Zhang*

## Abstract

This essay investigates the research question, ‘How does Cicero attempt to overcome Roman xenophobia in the *Pro Archia*?’ The investigation was primarily carried out through a detailed analysis of the original text in Latin and in English. The research was conducted through literary analysis of the primary source and the study of related secondary literature, including journal articles and research papers.

This essay also includes a detailed section discussing the political background and social context of Cicero’s contemporary time, as well as the impact of the Social War on Archias’ case. In this contextual section, Cicero’s career, Roman political conflicts of the time, Roman patriotism and the details of the case and its jury are examined.

The essay concludes that Cicero attempts to overcome Roman xenophobia by using *digressio* (digression), *memoria* (list of past deeds to aid recall) and other rhetorical devices in this speech and by accentuating the importance of Greek culture and literature and its contribution to the greatness of Rome, while still pandering to Roman patriotism and propaganda. In the speech, *digressio* is employed by Cicero to address the significance of literary study, thus suggesting that it is important for Roman society to welcome and protect Archias, a Greek poet, as a Roman citizen and regard him as a cultural asset. Cicero uses *memoria* to refer to historical precedence and related cases that resemble Archias’ situation, such as Greek cities competing to claim Homer as their citizen, thus suggesting that the jury should adopt similarly complimentary and embracing attitudes towards Archias.

## Introduction

The research question of this essay is ‘How does Cicero attempt to overcome xenophobia in the *Pro Archia*?’ This essay explores ancient xenophobia, specifically Roman xenophobia as it manifests itself in anti-Greek attitudes. The “*Lex Plautia Papiria*” (Watt 4) expelled all foreigners from Rome and it is this law that was invoked by the prosecution in the case against the Greek poet Archias, whom Cicero defended in 62 BCE. However, Archias “claimed Roman citizenship under the terms of the *Lex Plautia Papiria*” (Watt 4), passed in 89 BCE, and so had been living in Rome for twenty-seven years as a Roman citizen by the time the case was brought against him. Therefore, there could have been underlying xenophobic attitudes in Rome that enabled this case to be brought to court in the first place, as the *Lex Plautia Papiria* was used by both the prosecution and the defense.

This research is significant because we can still see examples of xenophobia and similarities to Archias’ case manifesting in the world today; Hong Kong being no exception. For example, in 2015, the Hong Kong Government sent back a twelve-year-old boy who had been living in Hong Kong illegally for nine years with his grandmother, with only a Chinese passport. The issue was hotly debated between the political parties, resulting in the boy being deported. Not only that, the grandmother “who helped her twelve-year-old mainland grandson live illegally in Hong Kong for nine years was spared an immediate prison sentence and granted bail” (Siu), but she was still found guilty of breaking the law. The case shows the chronic conflict between Hong Kong people and Mainland Chinese people. Hong Kong people enjoy their privileges as Hong Kong citizens, do not allow anyone illegally to claim Hong Kong citizenship and guard their visa and citizenship requirements very closely. The verdict shows the stance of Hong Kong society towards such illegal

immigration, and its manifestation as a form of xenophobia, even though Hong Kong people and Chinese people are ethnically the same.

Furthermore, modern xenophobia in the United States can be seen as racial discrimination, mostly against African Americans. Many political parties and various communities continually debate racial discrimination within the United States, including the controversial practice of affirmative action.

Although I would not completely equate the potential Roman xenophobia which possibly led to Archias' trial with modern racism, both reflect the same obstacles when dealing with foreign races. Modern and ancient governments have perennially struggled with how to deal with xenophobia and racism best in multi-racial, mixed communities. Many modern countries have immigration schemes and laws restricting movement; and this speech is an example of how these issues were addressed in an ancient context. In the *Pro Archia*, Cicero acknowledges and attempts to overcome the underlying xenophobia of the jury to help him win the case. The Roman jury would have been made up of "the upper echelons of society and they were, perhaps inevitably, concerned with matters of most relevance to that elite" (Cartwright and Wasson), namely preserving the *status quo* and having conservative attitudes, which by default would perhaps have been xenophobic and resulted in them zealously guarding Roman citizenship. This speech is therefore significant because of the social issues it addresses, which are still significant and evident today.

Furthermore, within the context of Latin language and classical literature, Cicero is influential through his speeches and political ideology. The speech is therefore also important as a display of Cicero's effective forensic methods and oratorical skills, and is an accolade to literature and poetry; thus the speech contributes to the study of literature, poetry and law court speeches, both then and now.

In order to answer the research question, several related and important issues need to be addressed, such as: the political background and social context in which the speech was made;

the audience to whom the speech was addressed; the legal details of the case itself; and the rhetorical techniques employed by Cicero in order to attempt to overcome the natural biases of his aristocratic Roman jury. According to Bell, the purpose of this speech was to be "a partial record of a complex dynamic between actor and audience" (Bell 2). In an attempt to address these issues, a stylistic and content analysis of the speech is therefore necessary.

The *Pro Archia* forms the main primary source of this study, with some references to other works by Cicero and contemporary critics. In order to judge my own conclusions, I referred to a wide range of secondary literature, focusing on such topics as the Roman census and law, rhetorical devices, and historical investigations. Using this methodology, I derived lines of argument based on historical matters and rhetorical techniques. Thus, it becomes clear that Cicero attempts to overcome Roman xenophobia in this speech by focusing on the fact that his client was a talented poet, not a foreigner *per se*, and therefore deserved both the support and protection of all civilized people, including the jury and Roman society more widely, as poetry and literature are universal symbols of civilization.

## Political and Social Context

### On Cicero

When Cicero delivered this speech in 62 BCE, he had already thwarted the famous Catalinian conspiracy of 61 BCE, which aided him in becoming a politically ascendant and revered *novus homo* (new man) in the Senate, and also grew his self-confidence in his political position, as well as in his oratorical art. Cicero delivered this speech in the year after his consulship, being hailed as *pater patriae* (father of his country).

This speech was delivered to a jury, composed of upper class elites, and to the judge, possibly the brother of Cicero. Thus, one might think that Cicero had no real danger of losing the case due to his familial and noble ties. In addition, as mentioned, Archias had been a Roman citizen for twenty-seven years, so there was no genuine

threat of Archias being found guilty. As an experienced politician and lawyer, there was no reason for Cicero to suppose that he would lose Archias' case, especially since the points of law at issue were clear. As a result, Cicero addressed the case itself in a minimal part of the speech, whereas in the rest of the speech, he chose to discuss the importance of literature and to advocate that poets should be valued more than any other professionals in society.

### On Archias and the political conflict

In this legal case, Cicero was defending his own teacher, Archias, from an accusation that could have meant the removal of his Roman citizenship. In ancient Rome, "when foreigners and ex-slaves received Roman citizenship, it was customary for them to adopt the *praenomen* and *nomen* gentile of their patrons or previous owners" (Arnott 1). The fact that Archias had adopted a Roman name, Aulus Licinius, shows that Archias had followed the expected custom and become an official part of Roman society by changing his *praenomen*.

Despite the legal accusation against Archias himself, the case can actually be linked to a political 'tug of war' between two political sides - one side led by Lucius Licinius Lucullus (L.L.L.) and the other by Pompey, who were political rivals, since L.L.L. stood for conservative ideas and Pompey for reforming ones. In many ways, this was a frivolous lawsuit and formed part of a series of minor political harassments between two political factions in Rome at the time: the controversial Pompeians and the conservative Lucullians. It is generally believed that Archias' trial was just another political harassment brought by the side of Pompey that Cicero defended. Thus, Archias, the *xenos* (foreigner), was just a pawn in a wider Roman political game, used by the Pompeian side to oppose L.L.L., since Archias was a poet working for the family of L.L.L.

### On Roman patriotism and the Social War

Another social issue addressed by Cicero in the speech is the patriotism of the Romans. As Lind points out, "the national pride of the Romans

grows steadily deeper from the time of *Ennius* to *Horace*" (Lind 1). While Roman national pride, or patriotism, can be traced back to the early years of the Roman Kingdom, the conflict relevant to this case originated in the Roman Social War (91-89 BCE), also known as the Italic War. This war was mainly fought between the Romans and their allies in central and southern Italy. Whilst these Roman allies had fought alongside the Romans in previous wars, they had grown jealous of "Roman citizenship and the privileges it conferred" (Editors of Encyclopedia Britannica), as they were denied these citizen rights.

As a result of the war, the Roman Republic had to pass the *Lex Plautia Papiria*, which granted citizenship to those who had not taken up arms against Rome, in order to reward those who had been loyal to Rome and had not engaged in the Italic War. On the other hand, the need for the introduction of the *Lex Julia* and *Lex Plautia Papiria* thereafter, exhibited Roman xenophobia; how the Romans zealously guarded their citizenship; and how Roman citizens were paranoid about being attacked by foreigners and not being able to protect their sovereignty. Thus, the *Lex Plautia Papiria* was used against Archias in this lawsuit within a larger political backdrop.

It was precisely this paranoid Roman patriotism, rooted within every Roman citizen, which manifested itself as the xenophobia of the time. The Romans believed that they and Rome were superior to other nations - a belief sustained and fueled by their undeniably strong national pride and Roman propaganda - and xenophobia could easily manifest itself as a result. When the Romans compared themselves with other nations, especially conquered races such as the Greeks, the foreigners became the lower-ranked races. All of this can be said to reflect the origins of Roman xenophobia, which therefore needs to be borne in mind when considering Archias' case.

### On the case and the audience

Contemporary Roman readers would generally not have been interested in a petty legal case such as this, due to its obvious frivolous grounds. However, because of Cicero's inclusion of a

*digressio* (here, a lengthy encomium of literature, discussing the virtue of literature generally and of Greek poetry specifically, as well as the virtue of the Roman people), rather than him wholly and solely addressing the legal case at hand, modern readers are interested in the speech as a display of Roman appreciation for Greek literature and how it was seen to contribute to Roman culture. The *digressio* also shows that Cicero had every confidence that he would win the case as he could devote so much time to it.

In summary, Cicero was facing the xenophobia of the jury when defending the Greek poet Archias, since Roman citizens usually believed in their utmost superiority to other cultures. Cicero's client, Archias, who had been a part of Roman society during a time in which Romans claimed to admire Greek culture and art, was accused of falsely claiming to be a Roman citizen. In great civilizations and societies, like the Roman Empire, people often fear sharing their resources and culture with foreigners that are different to them, as the aforementioned Hong Kong case reflects. The Romans, Archias' jury included, guarded their citizenship zealously - as Hong Kong people do today. Therefore, as a *xenos*, Archias, was accused of calling himself Roman, the potential, underlying xenophobia of the jury was what Cicero needed to attempt to overcome in his speech, so that Archias would avoid punishment and instead be valued and welcomed into Roman society again.

## Investigation

### *Digressio*

During the *exordium* (introduction), or the first part of the speech, Cicero quickly addresses the case and presents his evidence that can help him win. He closes the case shortly after he presents his evidence using *argumentum ad rem* (argument to the matter), trying to prove that Archias is not guilty. Cicero then uses a large portion of the speech, the *digressio*, arguably, to attempt to overcome any potential underlying xenophobia of the jury against Greeks.

Cicero's use of *digressio* in this speech is regarded as "the finest panegyric of literature that the ancient world offers us" (Watts 1). This may be the reason this speech has been more important and influential for the past centuries than it would have been, as the legal grounding of the case was limited. Therefore, it might not have been popular compared to other judicial speeches. Cicero shows his profound appreciation of literature, and it serves as the greatest attraction in the *digressio*. For example, Cicero says, "*ego vero factor me his studiis esse deditum*" (Cicero 20), meaning that nobody should be ashamed of having affection for literature, including him or his Roman audience.

In his *digressio*, Cicero addresses Archias by his Roman name and attempts to emphasize his 'Romanness'. He also stresses the grandeur of Rome, which is highlighted and immortalized in other literature too, arguably in a similar manner to Virgil's later *Aeneid*. After highlighting the greatness of Rome and its citizens, Cicero moves on to acclaim Greek literature, poetry and art, in order to focus on the fact that Archias is a talented poet, who produces excellent literature, such as epigrams and a poem praising Cicero and his career. Thus, Cicero argues, Romans should not discriminate against him for being foreign, but should praise him for his literary talent and contribution. Cicero concludes that Archias was an asset to Roman society through his literary work, albeit written in Greek.

Another reason why Cicero may have decided to pursue *digressio* in his speech instead of focusing on the case at hand is the popularity he gained through the earlier, high profile Catalinian conspiracy, which had already given him the credibility to win Archias' case. Therefore, he was simply using this opportunity to entertain his audience, and moreover himself, and possibly even to attempt to address a greater issue, namely Roman xenophobia against Greeks.

The *digressio* addresses the impressiveness of Rome and its civilization. Cicero highlights his audience's patriotism, whilst also acknowledging their underlying xenophobia. He also seems to understand that xenophobia is dependent upon patriotism. Thus, he tries to

stress Roman greatness through his use of language, as seen in the later part of the speech where he praises literature and art. For example, in section VII.16, Cicero says, “*ex hoc esse hunc numero, quem patres nostri viderunt, divinum hominem Africanum, ex hoc C. Laelium, L. Furium, moderatissimos homines et continentissimos, ex hoc fortissimum virum et illis temporibus doctissimum, M. Catonem illum senem...*” (Cicero 24). In this sentence, he uses repetition of ‘*ex hoc*’ followed by superlatives, such as ‘*moderatissimos*’, ‘*continentissimos*’, ‘*fortissimum*’, and ‘*doctissimum*’; thus emphasizing the great significance of Roman civilization and the Roman people.

Cicero’s use of *memoria* in his *digressio* illustrates past examples of exemplary, idolized Roman men and their admiration of literary works; thereby suggesting that his contemporary audience should adopt a similar complimentary attitude to literature and authors. Firstly, the individuals mentioned by Cicero in this regard all conform to a certain type. All the men mentioned are of noble Roman lineage, admire literature and display the virtues of bravery and temperance, which are virtues and values admired by Cicero and his audience: “*Cato*”, “*Ennius, Maximus, Marcellus*” or “*Fulvius*” (Cicero 30). Cicero also imposes the idea that “*pleni sunt omnes libri, plenae sapientium voces, plena exemplorum vetustas*” (Cicero 22), associating literature with nobility and noble actions. Cicero mentions these men in order to have a ‘bandwagon effect’ on his audience, so that they admire literature too, and provide the “connection that Rome should not reject Archias, or, by implication, that Rome should be pleased to honor Archias with citizenship” (Wallach 324). Secondly, these men are mentioned to make Archias seem more Roman, by seamlessly associating him with these great Romans. Furthermore, by citing the example of Alexander the Great, Cicero hoped the jury might associate Archias with the historical grandeur of Alexander the Great and value Archias’ work in a similar way - both men being Greek and *xenoi*. For example, in section X.24, he says “*quam multos scriptores rerum suarum magnus ille Alexander secum habuisse dicitur*” (Cicero 32).

Instead of addressing the lawsuit at hand, Cicero decides to emphasize ancient literary examples and provides precedents for how other cities have competed to claim great poets, such as Homer, as their citizens because of their literary prowess, thus suggesting that the jury should follow this precedent. Through sign-posting these cities, Cicero is able to accentuate that poets are the symbols of pride for profound civilizations. For example, in section VII.25, Cicero points out, “*Homerum Colophonii civem esse dicunt suum, Chii suum vindicant, Salaminii repetunt, Smynaei vero suum esse confirmant, itaque etiam delubrum eius in oppido dedicaverunt*” (Cicero 26). In this section, Cicero explicitly points out famous Greek cities like “*Colophon*”, “*Chios*”, “*Salamis*” and “*Smyrna*”, to appeal to his audience.

Moreover, Cicero compares Archias’ past treatment in other cities with his treatment in Rome. Cicero mentions “*primum Antiochiae – nam ibi natus est loco nobili*” (Cicero 10), a city that was highly respected for literature and refined artists at the time. This city was rapidly stirred by Archias’ arrival because of his literary genius. Furthermore, Cicero points out that “*itaque hunc et Tarentini et Regini et Neapolitani civitate ceterisque praemiis donarunt*” (Cicero 10), and that Archias was elevated in the city because of his fame. Thus, Cicero emphasizes that Archias is a poet, thereby allowing him to be seen as ‘supra-national’, meaning that his identity is not merely Greek, but also a poet who lives in Rome; and his nationality should not limit his talent. The Roman people should welcome, love and protect Archias as a great poet, not discriminate against him as a foreigner.

In the next section in the *digressio*, the *confirmatio* (main body of the speech), Cicero lists many Roman names that associate Archias with significant Romans of the time. Archias was sheltered by and had worked for many Roman families, whom Cicero lists in the speech, including “*Metello illi Numidico et eius Pio filio*”, “*M. Aemilio*”, “*Q. Catulo et patre et filio*”, “*L. Crasso*”, “*Lucullos*”, “*Drusum*”, “*Octavios et Catonem, et toam Hortensiorum domum*” (Cicero 12). Not only do these names show Archias’ connections within Rome, but also show the audience that, judging by his wide Roman



connections, Archias is no different from a Roman citizen. Citing his Roman links is important for Archias because “connections such as these are advantageous for a literary man and reflect favorably upon the poet” (Wallach 318).

### Rhetorical Devices

Throughout the speech, Cicero uses many rhetorical devices to persuade his audience to find Archias not guilty. Once Archias is found not guilty of falsely claiming Roman citizenship, Archias would not be a *xenos*, but an accepted Roman citizen.

In the first sentence of the speech, Cicero starts with a *tricolon*, repetition of three, of “*si*”: “*si quid est in me ingenii, iudices...aut si qua exercitatione dicendi...aut si huiusce rei ratio aliqua ab optimarum...*” (Cicero 6). This use of a *tricolon* at the beginning of the speech is to emphasize Cicero’s humility, and show how he devotes his life to literary studies and works. By saying this, Cicero addresses his own literary interest, which is relevant to the subject of his *digressio*. This also sets the tone of the speech, showing how Cicero adores literature, thus suggesting to his audience that Cicero respects Archias for playing a major role in aiding Cicero’s success in his judicial career.

Furthermore, the sentence construction used by Cicero in: “... *earum rerum omnium vel in primis hic A. Licinius fructum a me repetere prope suo iure debet*” (Cicero 1), namely putting “*debet*” - the only verb in the sentence - at the end, achieves the effect of emphasizing the action of “keeping back” (“*debet*”). He therefore highlights the fact that Archias “possesses” the right to claim Roman citizenship. It is interesting that Cicero puts the important verb at the end of a sentence because it is the last word his audience hears before the short pause between two sentences.

In addition, Cicero uses superlative adjectives to aggrandize Archias and flatter his audience in order to “make the hearers *dociles*, that is, ready to receive the important information intelligently” (Leon 35). For example, in section II, Cicero says “*ut me pro summo poëta atque eruditissimo homine dicentem, hoc consursu*

*hominum litteratissimorum*” (Cicero 8). The use of “*summo*”, “*eruditissimo*”, and “*litteratissimorum*” highly flatters the poet himself and puts Cicero’s audience in a superior position, since Cicero praises them as the “best”, “most cultivated” and “distinguished”. Such flattery of his audience helps Cicero to please them, so that he can stand in an advantageous position in the lawsuit. Cicero successfully flatters his Roman audience, thereby encouraging them to accept his argument and recognize Archias as a Roman citizen, rather than a *xenos*.

### Conclusion

In the judicial speech, the *Pro Archia*, Cicero addresses citizenship issues in Rome concerning a Greek poet living there, Archias, and the speech can also be linked to Roman xenophobia. Cicero first presents convincing arguments relevant to the lawsuit and then he concludes the case swiftly by providing the necessary evidence. After that, he deviates from the case and begins to glamorize Roman civilization and the greatness of the Romans, as well as highlighting the significance of literature, art and poetry. Multiple rhetorical devices adorn the speech in order to help Cicero to persuade the jury and add further entertainment to the speech. Finally, Cicero then links back to Archias and his alienation in Rome, stressing how important poets are to culture and civilization and why they should not be overlooked or dismissed, no matter their race, but protected and welcomed.

Some might argue that Cicero won the case because he was an impressive speaker, while others might argue that it was because he was a prominent political figure at the time, had connections, and the judge was his brother. It must be borne in mind, however, that examination of the speech is limited because there is no surviving prosecution speech, which makes Cicero’s speech our sole perspective for this case. Nevertheless, Cicero won the case and therefore seems to have overcome the jury’s xenophobia against Greeks, or at least against one Greek, Archias. He understood his Roman audience’s xenophobia, acknowledging it along with their extreme patriotism, which was a natural result of the omnipresent Roman

propaganda at the time. As discussed in the Investigation, Cicero used *digressio*, *memoria*, *argumentum ad rem*, syntax, diction and rhetorical devices to win the case. In doing so, Cicero also promoted the awe of Romans and accentuated the significance of literature, such as that written by Greek authors, to attempt to overcome his Roman audience's xenophobia. Cicero wanted his audience to regard Archias as a talented poet, not a *xenos* wanting Roman citizenship.

Some questions remain unanswered, however: where did Cicero's own xenophobia lie? Would he himself have been xenophobic to some extent if he was able to recognize his audience's xenophobia? Certainly, he would have possessed a degree of xenophobia as he was able to deliver such a successful speech and secure Archias' acquittal from a Roman audience with potential, underlying xenophobic tendencies. If not, he would not have been able to emphasize the glamor of the Romans or highlight Archias' 'Romanness' throughout the speech as successfully or effectively as he did. Admittedly, Cicero was trying to defend Archias' claim to Roman citizenship, being a talented Greek poet. However, there is no evidence to show that Cicero meant to defend all *xenoi* in general or all professions of *xenoi*.

Archias' case can be linked to the recent case in Hong Kong discussed in the Introduction. In both cases, the defendants were *xenoi*, the Chinese boy and Archias, trying to claim citizenship in another country, but the outcomes of the two cases were completely different. Archias was acquitted, but the boy was deported and his grandmother was found guilty. Nevertheless, the case in Hong Kong reflects the modern relevance of the *Pro Archia*, showing a different outcome to the same migration issues, namely people from other cultures and countries wanting to live somewhere else. Ultimately, Cicero's speech reflects the underlying xenophobia of the Roman Empire and can be used and borne in mind when considering modern tensions between cultures and dealing with prevalent migration problems today, which evidently are not new issues, as seen in the *Pro Archia*.

## References

- Arnott, Geoffrey. "The Praenomen of Archias." *Hermes* 99, 2 (1971): 254–255. Print.
- Bell, Andrew J. E. "Cicero and the Spectacle of Power." *The Journal of Roman Studies* 87 (1997): 1–22. Print.
- Cartwright, Mark, and Wasson, D. L. "Roman Law." *Ancient History Encyclopedia*. Ancient History Encyclopedia (2013). Web. Accessed 23 Aug 2015. [http://www.ancient.eu/Roman\\_Law/](http://www.ancient.eu/Roman_Law/)
- Cicero (Marcus Tullius) and Watt, N. H. *Orations: Pro Archia, Post Reditum in Senatu, Post Reditum Ad Quirites, de Domo Sua, de Haruspicum Responsis, Pro Cn, Plancio*, translated by N. H. Watts. Cambridge, MA: Harvard UP, 1989. Print.
- Cicero (Marcus Tullius). *Pro A. Licinio Archia Poeta Oratio*, edited by James Smith Reid. Cambridge: Cambridge UP, 1879. Print.
- Leon, Harry J. "The Technique of Emotional Appeal in Cicero's Judicial Speeches." *The Classical Weekly* 29, 5 (1935): 33–37. Print.
- Lind, L. R. "Concept, Action, and Character: The Reasons for Rome's Greatness." *Transactions and Proceedings of the American Philological Association* 103 (1972): 235–283. Print.
- Siu, Phila. "Mercy and Justice: Hong Kong Grandmother Who Hid Undocumented Grandson for Nine Years given Suspended Jail Sentence." *South China Morning Post*, 7 Sept 2015. Print.
- The Editors of Encycloaedia Britannica. "Social War: Roman History." *Encyclopaedia Britannica*. Web. Accessed 14 Sept 2015. <https://global.britannica.com/event/Social-War-Roman-history>
- Wallach, Barbara Price. "Cicero's *Pro Archia* and the Topics." *Rheinisches Museum für Philologie* 132, 3/4 (1989): 313–331. Print.

# 談《天龍八部》中的玉

陳曄庭

金庸在《天龍八部》裡多處提到玉和其他玉製物品。為甚麼他創作了這麼多和玉有關的意象呢？這些意象的內涵是甚麼？這些意象和佛教教化有甚麼關聯？意象彼此間是獨立的還是構成一個整體？本文試圖解答以上這些問題。

玉自古就受中國文化重視，被認為集天地之精華，具有種種正面的意義。讀金庸的《天龍八部》，讀者首先感到的卻並不是玉的高尚純潔，而是它所引發的貪念與殺機。作品中三個有關玉的意象，就與佛教中的貪、嗔、癡三毒有關。

## 玉壁之貪

《天龍八部》第一卷中無量劍派東宗與西宗比劍，勝者得在之後五年裡居住於劍湖宮內，而這劍湖宮後山有一座湖，湖邊一塊被稱作「無量玉壁」的巨大光滑的石頭是個謎。書中是這樣描寫的，「只見瀑布之右一片石壁光潤如玉……後來瀑布水量減少，才露了這片琉璃、如明鏡的石壁出來。」<sup>1</sup>此處的環境描寫為玉壁塑造了神祕感，一個簡單的比喻句將玉壁與明鏡進行對比，顯示玉壁純淨無瑕的本質。周圍山水的映襯，更是帶來一種空靈之感。但在作品中，純淨的玉壁招來的不僅是種種惡念，特別是為接下來的人之貪念作出鋪墊。

西宗與東宗爭鬥多年，卻是爭奪二宗均不了解的一面玉壁，實屬可悲。當鐘靈問起玉壁時，左子穆想到的卻是與西宗聯手保密：「無量玉壁？難道無量山中有什麼寶玉、寶壁麼？倒沒聽見過。雙清師妹，

你聽人說過麼？」<sup>2</sup>對白顯出左子穆故作不知。被識破後他仍試圖隱瞞，道玉壁「只是一塊又白又光的石頭罷了」。<sup>3</sup>此處的細緻描寫揭示了人物心理，描寫左子穆為保護貪圖的事物，能夠暫時撇開敵意，且不惜以撒謊掩飾貪慾，可見這面玉壁對他有多麼大的誘惑。玉壁引發了人性的貪念。貪，乃佛教「三毒」之一。貪毒指的是人們貪著各種事物，和名利，貪得無厭，無法自拔。<sup>4</sup>

再看，鐘靈聽得神農幫眾欲「查明『無量玉壁』的真相」，<sup>5</sup>倘若「不把無量劍殺得雞犬不留」<sup>6</sup>便要「人人抹脖子」。<sup>7</sup>作者在此處運用了暴力性語言，赤裸裸表明人物為得到劍法欲造殺機，倘若得不到則不惜自盡的扭曲思想。原本一塊玉，這裡頓時成為了「慾」的化身。

更有甚者，「（東宗）太師父沉迷於玉壁劍影，反將本門劍法荒疏了，也不用心督率弟子練劍，因此後來比劍便敗西宗」。<sup>8</sup>這反映了人在「貪」的慾念前，只識眼前貪著之物，容易忘卻周圍的事物。不僅東宗太師父，西宗太師父也是如此。她同為貪著玉壁上的武功，日日在玉壁前面徘徊，盼仙影出現。並且最終「對著玉壁出神，越來越憔悴，過不上半年就病死了」。<sup>9</sup>在死前，她還「不許弟子們移她回入劍湖宮」，<sup>10</sup>「斷氣之時，雙眼還是呆

<sup>2</sup> 同上。

<sup>3</sup> 同上。

<sup>4</sup> (明)一如法師等：《大明三藏法數》（臺北：台灣新文豐出版有限公司，1977年），頁7。

<sup>5</sup> 金庸，《天龍八部》，頁18。

<sup>6</sup> 同上。

<sup>7</sup> 同上。

<sup>8</sup> 同上，頁17。

<sup>9</sup> 同上。

<sup>10</sup> 同上。

<sup>1</sup> 金庸：《天龍八部》（廣州：廣州出版社，2014年），頁17。

呆的望著玉壁」。<sup>11</sup>這裡的描述顯得誇張，卻更深刻地引出了玉和「貪毒」的聯繫。

更諷刺的是，無量劍派與神農派都為獲得玉壁上呈現出來的劍法而不擇手段。由此引發的諸多衝突便是建立在貪念的基礎上。當他們後來得知，其實並無神仙於玉壁上練劍之事，仙人練劍只不過是水月鏡花，之所以會有影子，是因為月亮先將影子映在隔湖的一塊玉壁上，再映到這塊玉壁上。多年前有人在這塊玉壁前練劍，其影子反射到玉壁上才被誤認為仙人。無量劍派與神農派如癡如醉地追求玉壁上的武功，貪愛不已，作者對此進行了深刻的諷刺。

金庸的《天龍八部》是「寫人的一部作品」。<sup>12</sup>在曲折的情節和熱鬧的武功背後，他傳達的是人被貪念所蒙蔽，無謂地追求，看不清眼前事物的悲劇。無量玉壁的意象，象徵著人間誘惑和貪念，是「無明」，為書中許多人物煩惱和痛苦的根源。如此一來，「玉」便脫離了我們常識中的純潔形象，在此處成為「慾望」的象徵。金庸在處理這一段情節時，顯現了人性的可悲，也流露出悲憫。

### 玉璽之嗔

《天龍八部》第四十三回，慕容博、慕容復、段譽、蕭峰與及父蕭遠山等人在藏經閣中，談話間提及慕容父子的身世。讀者因而得知二人為鮮卑後代，而慕容復一心一意想要「興復大燕，奪還江山」。<sup>13</sup>此時，慕容博命兒子將大燕國的傳國玉璽取出，隨即又命他將族譜取出。那玉璽以「黑玉雕成」，且「雕琢精緻，邊角上卻頗有破損，顯是頗歷年所，多經災難」。<sup>14</sup>

此玉璽特徵有二：其一是黑，其二是破損。玉璽的深黑色帶來一種神秘感，象徵著慕容復內心之黑暗；精緻破裂則暗示慕容復雖貴為公子，精通武功卻人格破裂。如此一來，玉璽成了慕容復的性格化身。

慕容復只需「伸手入懷」<sup>15</sup>便能取出大燕玉璽——他將玉璽和族譜二物隨身攜帶。簡單的動作表現了他對興復大燕的堅定志向。作者在此處使用了象徵手法：玉璽上雕著那「一頭形態生動的豹子」，<sup>16</sup>便是權力，威嚴及力量的象徵。慕容復這個人物的塑造，成了佛教三毒之中「嗔」的代表。

《成唯識論》中說，「嗔者，於苦，苦具，憎恚為性，能障無嗔，不安穩性，惡行所依為業。」<sup>17</sup>慕容復名字裡的「復」字，除了復國亦有復仇的涵義。他性格暴戾，為了興復大燕不擇手段。先為駙馬之位將段譽推入井中，後來還犧牲表妹王語嫣，更為了大理皇帝之位，殺了對自己忠心耿耿的家臣。種種惡行，皆因嗔心而起，人受嗔恨控制，容易迷失自我，且難以從已生的嗔恨中自拔。慕容復胸懷報復，百計千方，卻屢屢受挫，導致最後陷入瘋癲狀態，這其實是他被嗔毒所控導致。

在這個人物身上，玉璽顯現出了強烈的象徵意義：它不僅象徵了慕容氏復燕的野心，也是引人起嗔恨心的禍源。在佛教看來，嗔恚是三毒中的大惡。

### 玉像之癡

書中還有很多值得玩味的關於玉像的描寫。

<sup>11</sup> 同上。

<sup>12</sup> 同上，頁 4。

<sup>13</sup> 同上，頁 1704。

<sup>14</sup> 同上。

<sup>15</sup> 同上。

<sup>16</sup> 同上。

<sup>17</sup> 玄奘：《成唯識論》（高雄：台灣佛光文化事業有限公司，1997年），頁 11。

段譽不慎跌入無量山劍湖之畔的石洞中，看到一座玉像，忙說「對不住，對不住！我這般瞪眼瞧著姑娘，忒也無理」，<sup>18</sup>「明知無禮，眼光卻始終無法避開這對眸子」。<sup>19</sup>這顯現了凡夫皆有的「無法自主」之病。段譽對神仙姊姊的癡迷，恰好對應了佛教三毒中的「癡」。關於癡的表現，《成唯識論》卷六中說：「於諸理事迷暗為性，能礙無癡，一切雜染所依為業」，<sup>20</sup>又說「諸煩惱生，必由痴故」。<sup>21</sup>

書中有很多細節可以顯示段譽之「癡」。不少誇張手法的頻繁運用，例如段譽「眼光再也離不開玉像」<sup>22</sup>以及段譽說的「神仙姊姊，小生段譽今日得睹芳容，死而無憾」，<sup>23</sup>凸顯了他的「癡」態，把他被玉像所控制的情景描繪得淋漓盡致。更有甚者，「(段譽)心中著魔，鼻端竟似隱隱聞到麝般馥郁馨香，由愛生敬，由敬成癡。」<sup>24</sup>此段描寫，簡直把他的「痴」態感官化了。段譽看到玉像後感嘆道「死而無憾」，<sup>25</sup>揭示出人在「癡」的狀態下的非理智心態。「也不知看了多長時間」<sup>26</sup>一句，表現了時間流逝，和「痴」態下人們的無以自主。

段譽此人並無擁有他人的想法，這也是貪與癡最大的分別。段譽說道，為了讓神仙姊姊活過來跟他說一句話，他甘心「死一千遍，一萬遍」。<sup>27</sup>這已不是單純的貪愛，而是身心已被完全控制住了的「愚痴」。這種完全放棄自己理智的瘋癲，

讓他心甘情願去膜拜玉像，向它磕頭，還道這是「天經地義之事」。<sup>28</sup>

玉像在書中還對應了主要人物，王語嫣。段譽後來遇到王語嫣，覺得她和石洞裡的玉像十分相像，忍不住稱她作神仙姊姊。他心裡道：「段譽啊段譽，你既遇到了這位姑娘，而她又是早已心屬他人，你這一生注定是要受盡煎熬，苦不堪言的了。」<sup>29</sup>段譽說的一點也沒錯，旅途中他為王語嫣赴湯蹈火，為了她的安全願意犧牲自己性命，為了她的幸福願意去爭駙馬，娶一個他從未見過的公主。在段譽眼中，玉像就是王語嫣，王語嫣就是玉像。這正是佛教中所謂的「無明」，是沒有智慧的愚痴。

### 段譽斷玉

書中貪、嗔、癡的代表，分別為玉璧、玉璽及玉像。另一個值得注意的細節，是段譽與「斷慾」諧音。而在新版《天龍八部》中，確有段譽「斷欲」的情節安排。這段情節營造了劇情的反轉，即段譽看破三毒，而語嫣卻深陷無明，二者的強烈對比，突出了書中的佛教意蘊。

段譽對王語嫣如癡如醉，其中原因後來有所交代。他應王語嫣的要求，領眾人到石洞中，再次看到神仙姊姊後突然醒悟：「並不是語嫣有什麼魔力迷住了我，全是我自己心生『心魔』，迷住了自己。」<sup>30</sup>正是心魔作祟，折磨著段譽。王語嫣的形象在此處產生了變化。此時的她不但妄想「永遠駐顏不老」，<sup>31</sup>更因貪著長春功將玉像打破，形象破滅。當段譽勸道「人的色身是無常的」，<sup>32</sup>王語嫣卻無法參悟，只回應「我不要無常」。<sup>33</sup>在她把玉像推倒

<sup>18</sup> 金庸：《天龍八部》，頁 55。

<sup>19</sup> 同上。

<sup>20</sup> 玄奘：《成唯識論》，頁 32。

<sup>21</sup> 同上。

<sup>22</sup> 金庸：《天龍八部》，頁 55。

<sup>23</sup> 同上。

<sup>24</sup> 同上，頁 57。

<sup>25</sup> 同上。

<sup>26</sup> 同上。

<sup>27</sup> 同上。

<sup>28</sup> 同上。

<sup>29</sup> 同上，頁 686。

<sup>30</sup> 同上，頁 2005。

<sup>31</sup> 同上。

<sup>32</sup> 同上。

<sup>33</sup> 同上。

的同時，之前讓讀者憐愛的王語嫣形象被徹底顛覆，反而是原本無明的段譽，此時擁有了大智慧。

這一人物形象對比具有某種張力，王語嫣將玉像推倒是一種象徵，如佛教中的所謂「破執」。段譽看破貪、嗔、癡，正是要帶給讀者的頓悟。

《天龍八部》一題究竟何意？金庸在釋名裡已做過解釋。佛教裡的天龍八部指：天、龍、夜叉、乾闥婆、阿修羅、迦樓羅、緊那羅、摩呼羅迦這八類護法神。<sup>34</sup> 其中每個神都可對應書中的不同人物。好比天眾的代表為喬峰，因他首領的地位與天神一致，亦如天神般難逃一死。龍眾的代表為段譽，因他貴為皇帝，又如龍王般自幼向佛。夜叉的代表可以是四大惡人，因他們作惡多端，卻也有人性的一面。而阿修羅的代表或許為王語嫣，因女阿修羅相貌極其端正，卻惟恐天下不亂，性子暴躁，到處惹禍。金庸並當然沒有對號入座地分派人物。他只「借用這個佛教名詞，以象徵一些現世人物」，<sup>35</sup>而這些人物「心中都有『貪嗔癡』三毒」。<sup>36</sup> 金庸便是抱著一顆悲憫之心看待這些受苦的眾生，這就使得這部作品呈現出了強烈的悲天憫人情懷。

通過以上分析，我們發現《天龍八部》中作者精心編織了一個玉的意象組合。玉璧為「貪」；玉璽為「嗔」；玉像為「癡」。三者的結合，構成了佛教的所謂世間「三毒」。作為三者的牽引之物，「玉」也就可以解讀為「慾」了。佛教思想在書中的無聲滲透，不僅為小說帶來藝術效果，更提高了思想的深度。

金庸自言：「《天龍八部》這八種神道精怪，各有奇特個性和神通，雖是人間之外的眾生，卻也有塵世的歡喜和悲苦」。<sup>37</sup> 金庸在《天龍八部》中寫眾角色的苦，並非對他們的冷嘲熱諷。相反，他表現的是一種悲天憫人的情懷。

### 參考文獻

金庸：《天龍八部》（廣州：廣州出版社，2014年）。

丁福保：《佛學大辭典》（新北：台灣法鼓佛教學院，1922年）。

（明）一如法師等集注：《大明三藏法數》（台北：台灣新文豐出版股份有限公司，1977年）。

玄奘：《成唯識論》（高雄：台灣佛光文化事業有限公司，1997年）。

梵悟：《佛教的掃除貪嗔癡三毒》（香港：香港佛教聯合會，2010年）。

<sup>34</sup> 丁福保：《佛學大辭典》（新北市：台灣法鼓佛教學院，1922年），頁13。

<sup>35</sup> 金庸：《天龍八部》，頁4。

<sup>36</sup> 同上。

<sup>37</sup> 同上。

# To What Extent was Nero's Legislation Beneficial to the Common Roman People?

Mark Lu

## Abstract

Nero is one of the most infamous Julio-Claudian Emperors, known for allegedly murdering his wives and mother and setting fire to Rome. His reputation as a wanton tyrant often overshadows any consideration of him being a good emperor in terms of his legislative measures. This dossier will examine to what extent Nero's legislation was beneficial to the common Roman people. To avoid a biased perspective, a range of literary sources documenting Nero's legislation throughout his reign is examined.

## Source Investigation

*“Domitus Nero, patre Domitio Ahenobarbo genitus, matre Agrippina, imperavit annos tredecim. iste quinquennio tolerabilis visus. unde quidam prodidere Traianum solitum dicere procul distare cunctos principes Neronis quinquennio. hic in urbe amphitheatrum et lavacra construxit.”*

‘Domitus Nero, the son of Domitius Ahenobarbus and Agrippina, ruled for thirteen years. He seemed tolerable during his quinquennium. For which reason some writers reported that Trajan was in the habit of saying that the reigns of all other emperors fell far behind Nero's quinquennium. He built an amphitheater and baths in the city.’<sup>1</sup>

While the source's author, Victor, wrote about Nero nearly three centuries after his death, his work bears some credibility as many of his accounts are similar to those of Suetonius, who lived closer to Nero's time. The ‘quinquennium’ (L.2) refers to a period of five years, which several scholars argue dates to the first five years of Nero's reign (Thornton 570-582). During this period, Nero sought to associate himself with the values of Augustus by showing his love for the people. He established himself as a public builder to advance his popularity with his citizens. Public buildings, such as the baths, were important sites for entertainment, business and socializing for all Romans, thus appealing to and benefiting the

common people also. Moreover, buildings such as these would serve as a lasting testament of Nero's generosity. However, the new buildings would have also kept the public distracted from Nero's more questionable personal conduct.

*“formam aedificiorum urbis novam excogitavit et ut ante insulas ac domos porticus essent, de quarum solariis incendia arcerentur; easque sumptu suo exstruxit. afflicti supplicii Christiani, genus hominum superstitionis novae ac maleficae; vetiti quadrigariorum lusus, quibus inveterata licentia passim vagantibus fallere ac furari per iocum ius erat; pantomimorum factiones cum ipsis simul relegatae.”*

“He devised a new form for the buildings of the city and in front of the houses and apartments he erected porches, from the flat roofs of which fires could be fought; and these he put up at his own cost. Punishment was inflicted on the Christians, a class of men given to a new and mischievous superstition. He put an end to the diversions of the chariot drivers, who from immunity of long standing claimed the right of ranging at large and amusing themselves by cheating and robbing the people. The pantomimic actors and their partisans were banished from the city.”<sup>2</sup>

This source is highly reliable because Suetonius, as the private secretary to Emperor Hadrian, would have had access to a range of primary sources from Nero's time including some which other historians would not have. In this source,

<sup>1</sup> Legislation on Infrastructure: *Incerti Auctoris Epitome de Caesaribus*, S. Auctor Victor 5. 1-5

<sup>2</sup> Legislation on Public Safety: *Lives of The Caesars*, Suetonius Book VI. Nero, Ch. 16.

Suetonius presents Nero as a public benefactor because he addressed threats and annoyances to Roman livelihoods. Increased fire protection gave Romans peace of mind, while the persecution of Christians united Romans against a perceived common nuisance. Also, Nero's banishment of pantomime actors was due to their unpopularity, as Romans tended to blame actors and playwrights for public disorder. Finally, Nero's punishment of riotous chariot racers showed his commitment to the people's security over his own preferences, as he was himself a fervent chariot racer.

*“item ut litigatores pro patrociniis certam iustamque mercedem, pro subsellis nullam omnino darent praebente aerario gratuita; utque rerum actu ab aerario causae ad Forum ac recipiendos transferrentur et ut omnes appellations a iudicibus ad senatum fierent.”*

“Further, that clients should put down a fixed and reasonable fee for the services of their advocates, but nothing at all for benches, which were to be furnished free of charge by the public treasury; finally as regarded the pleading of cases, that those connected with the treasury should be transferred to the Forum and a board of arbiters, and that any appeal from the juries should be made to the senate.”<sup>3</sup>

The mandated ‘mercedem’ (L.1) refers to the *Lex Cincia*, a Roman law, revived under Nero's reign, which prohibited forensic orators from receiving payment after pleading a case. This was significant because the removal of forensic orators shifted the focus of cases from the eloquence of the orator to the substance of the argument. Through implementing the *Lex Cincia*, Nero sought to rectify the flawed legal system of his predecessor, Claudius. Claudius had zealously exerted jurisdiction over the majority of legal cases, causing pleaders who aligned with him to command large bribes. Hence, Nero also relinquished some of his jurisdiction to the Senate to judge legal cases in order to avoid further cases of bribery. The common people benefited from both these moves, as they were

able to seek justice using an increasingly fair judicial system.

*“tum formam futuri principis praescripsit, ea maxime declinans, quorum recens flagrabat invidia. non enim se negotiorum omnium iudicem fore, ut clausis unam intra domum accusatoribus et reis paucorum potentia grassaretur; nihil in penetibus suis venale aut ambitioni pervium; discretam domum et rem publicam. teneret antiqua munia senatus, consultum tribunalibus Italia et publicae provinciae adsisterent: illi patrum aditum praeberent, se mandatis exercitibus consulturum.”*

“He then outlined the character of the coming principate, the points which had provoked recent and intense dissatisfaction being specially discountenanced:— "He would not constitute himself a judge of all cases, secluding accusers and defendants within the same four walls and allowing the influence of a few individuals to run riot. Under his roof would be no venality, no loophole for intrigue: the palace and the state would be things separate. Let the senate retain its old prerogatives! Let Italy and the public provinces take their stand before the judgment-seats of the consuls, and let the consuls grant them access to the Fathers: for the armies delegated to his charge he would himself be responsible.”<sup>4</sup>

Tacitus endeavors to free himself from bias but, as a supporter of the Senate, exhibits bias in *The Annals* against Nero. As in Source III, Nero made a partnership with the Senate to avoid making the mistakes of Claudius' dictatorship. He initially allowed the Senate to govern the Italian provinces, giving Romans a political voice. However, in the latter years, Nero extended his jurisdiction to encompass the entire empire. Thus, despite Nero's seemingly good intentions for the people via this government policy, there was no lasting benefit.

<sup>4</sup> Legislation on Governance: *The Annals*, Tacitus Book XIII, Ch.4

<sup>3</sup> Reforming the Legal System: *Lives of The Caesars*, Suetonius Book VI. Nero, Ch. 17



*“eodem anno crebris populi flagitationibus, immodestiam publicanorum arguentis, dubitavit Nero, an cuncta vectigalia omitti iuberet idque pulcherrimum donum generi mortalium daret. sed impetum eius, multum prius laudata magnitudine animi, attinere seniores, dissolutionem imperii docendo, si fructus, quibus res publica sustineretur, deminuerentur: quippe sublatis portoriis sequens, ut tributorum abolitio expostularetur. plerasque vectigalium societates a consulibus et tribunis plebis constitutas acri etiam tum populi Romani libertate; reliqua mox ita provisa, ut ratio quaestuum et necessitas erogationum inter se congruere. temperandas plane publicanorum cupidines, ne per tot annos sine querela tolerata novis acerbitatibus ad invidiam verterent.”*

“In the same year, as a consequence of repeated demands from the public, which complained of the exactions of the revenue-farmers, Nero hesitated whether he ought not to decree the abolition of all indirect taxation and present the reform as the noblest of gifts to the human race. His impulse, however, after much preliminary praise of his magnanimity, was checked by his older advisers, who pointed out that the dissolution of the empire was certain if the revenues on which the state subsisted were to be curtailed:— “For, the moment the duties on imports were removed, the logical sequel would be a demand for the abrogation of the direct taxes. To a large extent, the collecting companies had been set up by consuls and plebeian tribunes while the liberty of the Roman nation was still in all its vigour: later modifications had only been introduced in order that the amount of income and the necessary expenditure should tally. At the same time, a check ought certainly to be placed on the cupidity of the collectors; otherwise a system which had been endured for years without a complaint might be brought into ill odour by new-fashioned harshnesses.”<sup>5</sup>

Nero may have considered abolishing all indirect taxes in order to set up free trade within the empire. Yet practicality prevailed over his good intentions as the public treasury heavily depended on imperial subventions.<sup>10</sup> Nero did, however, address protests over unfair tax

collectors by making all taxation processes public. Furthermore, he mandated that taxes could not be collected after one year and that all surtaxes invented by contractors would be abolished.<sup>10</sup> These policies gave merchants greater economic mobility, stimulating trade and economic growth that benefited all Romans by raising their standard of living.

*“eo in tempore Nero Anti agens non ante in urbem regressus est, quam domui eius, qua Palantium et Maecenatis hortos continuaverat, ignis propinquaret. neque tamen sisti potuit, quin et Palatium et domus et cuncta circum haurirentur. sed solacium populo exturbato ac profugo campum Martis ac monumenta Agrippae, hortos quin etiam suos patefacit et subitaria aedificia exstruxit, quae multitudinem inopem acciperent; subvectaque utensilia ab Ostia et propinquis municipiis, pretiumque frumenti minutum usque ad ternos nummos.”*

“Nero, who at the time was staying in Antium, did not return to the capital until the fire was nearing the house by which he had connected the Palatine with the Gardens of Maecenas. It proved impossible, however, to stop it from engulfing both the Palatine and the house and all their surroundings. Still, as a relief to the homeless and fugitive populace, he opened the Campus Martius, the buildings of Agrippa, even his own Gardens, and threw up a number of extemporized shelters to accommodate the helpless multitude. The necessities of life were brought up from Ostia and the neighbouring municipalities, and the price of grain was lowered to three sesterces.”<sup>6</sup>

After personally housing the homeless, Nero established a stable supply of rations. He secured smooth entry for supply ships by constructing a canal from Ostia to Rome, a faster route than the winding Tiber. Similar to Source V, Nero also used economic incentives to encourage an influx of crops. He provided increased personal guarantees for ships ferrying crops over rough waters and exempted provincial importers from tax. Additional grain reserves from Egypt and corn from Moesia were made available. The rapid inflow of food was Rome’s lifeline, preventing

<sup>5</sup> Economic Legislation: *The Annals*, Tacitus Book XIII, Ch. 50

<sup>6</sup> Humanitarian Legislation: *The Annals*, Tacitus Book XV, Ch. 39

rampant starvation whilst benefiting all Romans by allowing them to rebuild after the Great Fire.

“μόνος γὰρ δὴ οὐδένα τρόπον ἐφείδετο χρημάτων, οὔτε δίδους οὔτε λαμβάνων. διὰ μόνην μέντοι ταύτην τὴν ὕβριν καὶ ἀπέθανε τὴν εἰς τὸν εὐνοῦχον. ὀργισθεῖς γὰρ ἐξήνεγκεν αὐτοῦ τὰ βουλευμάτων τοῖς περὶ αὐτόν· καὶ οὕτως ἀπέστησαν ἀπ’ αὐτοῦ καὶ ἠνάγκασαν ὄτω ποτὲ τρόπον ἀπολέσθαι αὐτόν· οὐδέπω γὰρ καὶ νῦν τοῦτό γε δῆλόν ἐστιν· ἐπεὶ τῶν γε ἄλλων ἔνεκεν οὐδὲν ἐκώλυεν αὐτὸν βασιλεύειν τὸν ἅπαντα χρόνον, ὃν γε καὶ νῦν ἔτι πάντες ἐπιθυμοῦσι ζῆν. οἱ δὲ πλεῖστοι καὶ οἴονται, καίπερ τρόπον τινὰ οὐχ ἅπαξ αὐτοῦ τεθνηκότος, ἀλλὰ πολλάκις μετὰ τῶν σφόδρα οἰηθέντων αὐτὸν ζῆν.”

“For Nero was the only man who was utterly regardless of money both in giving and in taking. It was solely on account of this wantonness of his, however, that he lost his life — I mean the way he treated the eunuch. For the latter in anger disclosed the Emperor's designs to his retinue; and so they revolted from him and compelled him to make away with himself as best he could. Indeed the truth about this has not come out even yet; for so far as the rest of his subjects were concerned, there was nothing to prevent his continuing to be Emperor for all time, seeing that even now everybody wishes he were still alive. And the great majority do believe that he is, although in a certain sense he has died not once but often along with those who had been firmly convinced that he was still alive.”<sup>7</sup>

Unlike the other authors analyzed in this dossier, Dio Chrysostom was a young man when Nero died, and thus his account bears a degree of first-hand insight. While the upper echelons of Roman society welcomed Nero's demise, the plebs remained loyal and mourned his death. The period of civil war following his reign juxtaposes the high degree of stability enjoyed under Nero. The plebs reminisced when games and food were plentiful, on how Nero revitalized the economy by employing many in his rebuilding programs after the Great Fire. It is Nero's legacy of benefiting the common man that preserved the hope of his reappearance and the continuance of his reign.

## Conclusion

While Nero's legislation was at times motivated by personal gain, it nonetheless played a key role in benefiting the lives of the common people on several levels. He instituted economic and legal reforms that boosted the economy and reduced corruption. While he struggled to relinquish power, Nero secured vital rations to revive Rome after the Great Fire. While sources like Tacitus are biased against him, the majority of sources used in this dossier reflect the general theme that Nero's legislation benefited the common Roman by raising their quality of life, leaving a legacy of popularity and benevolence. At the end of this investigation, the question remains: Why, in spite of his beneficial policies, does Nero's legacy remain so negative?

## References

- Champlin, Edward. "Nero Reconsidered." *New England Review* (1990-) 19, 2 (1998): 97-108. Print.
- Chrysostom, Dio. "21: On Beauty" in *Discourses 12-30*, translated by J.W. Cohoon, 273-290. Cambridge, MA: Harvard UP. Print.
- Edwards, Catharine. *The Politics of Immorality in Ancient Rome*. Cambridge: Cambridge UP, 1993. Print.
- Griffin, Miriam T. *Nero: The End of a Dynasty*. New Haven: Yale UP, 1985. Print.
- Hind, J. G. F. "The Middle Years of Nero's Reign." *Historia: Zeitschrift Für Alte Geschichte* 20, 4 (1971): 488-505. Print.
- Newbold, R. F. "Some Social and Economic Consequences of the A.D. 64 Fire at Rome." *Latomus* 33, 4 (1974): 858-869. Print.
- Suetonius. *Lives of the Caesars, Volume II*, edited by J. C. Rolfe. Boston: Harvard UP, 1917. Print.
- Tacitus. *Tacitus: Annals 13-16.*, edited by John Jackson. Boston: Harvard UP, 1937. Print.
- Thornton, M. K. "The Enigma of Nero's Quinquennium: Reputation of Emperor Nero." *Historia* 22 (1973): 570-582. Print.

<sup>7</sup> Nero's Legislative Legacy: The 21<sup>st</sup> Discourse: *On Beauty*, Dio Chrysostom Sections 9-10

# To What Extent has Government Intervention in the Market for Private Hybrid Cars Promoted Sustainability by Correcting Market Failure in Hong Kong?

*Katherine Chan*

## Abstract

This Extended Essay investigates the research question, ‘To what extent has government intervention in the market for private hybrid cars promoted sustainability by correcting market failure in Hong Kong?’

A combination of primary and secondary research was carried out to conduct this investigation. In terms of primary research, two surveys and five interviews were conducted. The first survey was targeted towards current car owners in Hong Kong and was concerned with evaluating the price elasticity of demand for hybrid cars. Five interviews were then conducted with sales representatives from car dealerships that supported the evidence for the elastic demand of hybrid cars. The second survey was concerned with assessing the effectiveness of government advertising for the scheme.

In terms of secondary research, data was sourced from the Hong Kong government website, newspaper articles were analyzed, and data on hybrid car prices were collected. Furthermore, data about the Japanese government’s schemes to promote hybrid cars and their effects were also analyzed to serve as a comparison.

This investigation concludes that the Hong Kong government’s ‘Tax Incentives Scheme for Environment-friendly Petrol Private Cars’ was very effective in promoting environmental sustainability by encouraging consumption of hybrid cars. Although the scheme would have had a greater influence if it had been advertised more, the effectiveness of the scheme was largely due to the fact that the tax concession encouraged people to consume hybrid cars, which pollute less and therefore help correct market failure.

## Introduction

The context of this investigation is Hong Kong’s notorious air pollution. A study conducted by the Hong Kong Environment Bureau in 2013 found that in Hong Kong, days with the highest Air Quality Index values correlated with days when cars emitted high levels of  $NO_2$  (“A Clean Air Plan for Hong Kong”). Through its 2013 ‘Clean Air Plan’, the government has been seeking to improve Hong Kong’s air quality. One of the major components of the plan was the ‘Tax Incentives Scheme for Environment-friendly Petrol Private Cars’, which sought to improve air quality by encouraging consumption of hybrid cars (“Tax Incentives for Environment-friendly Petrol Private Cars”).

The Scheme ran from 1 April 2007 until 31 March 2015, when the government decided that emissions had been reduced to a large enough extent (“Tax Incentives for Environment-friendly Petrol Private Cars”). However, according to an article published by the South China Morning Post in July 2015, “Hong Kong [has been] shrouded in higher-than-normal pollution as “very high” [Air Quality Health Index] levels of pollution remain. This indicates that there is risk towards “children, the elderly, and people with respiratory illnesses” (Lau, “Health Warning Issued”).

Therefore, this investigation is significant because it is important to assess the impact of the Hong Kong government’s scheme on the hybrid car market. This topic is also worthy of

investigation because studying how effective this scheme will provide insight into whether or not the Hong Kong government (or other governments) should use similar schemes in the future. Therefore, to allow for in-depth and meaningful analysis, the research question, *‘To what extent has government intervention in the market for private hybrid cars promoted sustainability by correcting market failure in Hong Kong?’* was formulated.

### Methodology

#### Primary Research

Approaching consumers is the most effective way to gain insight into consumer behavior. Two surveys were conducted. The first survey had 40 respondents and used current real values to identify the price elasticity of demand for hybrid cars. Five interviews were then conducted with sales representatives from car dealerships in Hong Kong to support the evidence for the elasticity of hybrid cars.

The second survey included responses from 40 owners of traditional cars and 40 owners of hybrid cars and was concerned with how effective the government was in advertising the scheme. The survey asked respondents a variety of questions about their own experience with their cars, which shed light on consumer priorities.

#### Secondary Research

Secondary research was conducted to better understand the car market as a whole and its implications for Hong Kong. Research was conducted to estimate the value of the negative consumption externalities of cars, the measures the Hong Kong government took, and how much more fuel hybrid cars save. In addition, research was conducted on Japan’s hybrid car market to compare the effectiveness of the Hong Kong government’s efforts to those of the Japanese government.

### Economic Theory

#### I. Market Failure

Market failure occurs when the market fails to achieve allocative efficiency, which is common

because the free market allocates either too many or too few goods and services to production of what is deemed most “socially desirable” (Tragakes 101).

The car industry in Hong Kong, like nearly all industries in the world, experiences market failure because “the free market fails to realize allocative efficiency” (Tragakes 101). In addition, there are further negative consumption externalities that result from the market for cars. In this case, the market failure is caused by negative consumption externalities that arise from consumers purchasing cars that create negative side effects on third parties whose interests are not taken into consideration. Cars create negative consumption externalities because the pollution emitted affects all members of society, not only the people who own cars (for example, air pollution resulting in respiratory illnesses). This is illustrated in the diagram below.

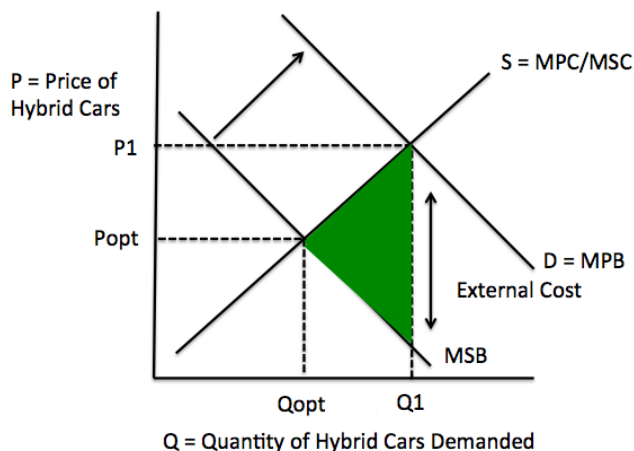


Diagram 1 – Negative Consumption Externality for Traditional Cars (Researcher’s own graph)

In Diagram 1, the marginal private benefit (MPB) curve represents how much traditional car buyers demand and the marginal social benefit (MSB) curve represents the benefit to society from consuming one more car. The socially optimum level is the point Popt, Qopt where MSC=MSB. However, the market equilibrium is where MPC=MPB at Q1 and P1. Hence, there is an over-allocation of resources on traditional cars. The green shaded area represents the welfare loss due to the overconsumption of traditional cars.

Therefore, to correct the allocative inefficiency, the Hong Kong government decided that the free market for cars needed government policies to create incentives for people to consume hybrid cars instead of traditional cars.

## II. Government Intervention

On 1<sup>st</sup> April 2007, the Hong Kong government launched the “Tax Incentives Scheme for Environment-friendly Petrol Private Cars’ to encourage the use of environment-friendly petrol private cars with low emissions and high fuel efficiency”. This scheme included a 30% reduction in the First Registration Tax (FRT) with a cap of HKD \$50,000 from April 2007 to June 2011, when the concessions for FRT and cap were raised to 45% and HKD \$75,000 respectively. However, the review of the scheme in 2014 showed that “emission [from cars was becoming] limited” (“Tax Incentives for Environment-friendly Petrol Private Cars”). Therefore, since emissions were declining, the government decided to terminate the scheme on April 1 2015.

A second scheme, the ‘Profits Tax Deduction for Capital Expenditure on Environment-friendly Vehicles’, was introduced in June 2010. This scheme allowed businesses with “environment-friendly vehicles to deduct the capital expenditure incurred under profits tax” and continues to run today (“Profits Tax Deduction for Capital Expenditure on Environment-friendly Vehicles”). However, this investigation will not focus heavily on this scheme because, although both commercial and private cars cause emissions, the scope of this investigation only focuses on a detailed analysis of private cars.

## III. Value of Externalities

Sustainability is the maintenance of the environment and the economy to ensure the ability to satisfy needs and wants in the future (Tragakes 122). Hence, it crucially depends on environmental preservation. Negative externalities from cars create pollution that impact sustainability because pollution could undermine Hong Kong’s competitiveness and lower economic growth in the future. Sustainability would be affected because pollution would make Hong Kong a less attractive place to high-skilled workers, which would impact the level of human capital. Therefore, it is important to analyze the value of the negative externality created by cars to assess how necessary government intervention is.

Diagrams 1 and 2 show that because traditional cars emit more pollution, they have a higher external cost to society than hybrid cars. To qualify the difference, research about how much more environmentally sustainable hybrid cars are was conducted. In addition, in order for the reduction in taxes to be effective in bringing the market to the socially optimum point, the reduction in costs that the government grants to hybrid cars must make them a better proposition for buyers than traditional cars. Hence, understanding the value of externalities is helpful in estimating the effectiveness of the reduction in tax in increasing allocative efficiency.

Private Car Cost	Rate of Tax
On the first \$150,000	40%
On the next \$150,000	75%
On the next \$200,000	100%
On the remainder	115%

Table 1: First Registration Tax for Private Cars in Hong Kong (“Guidelines for Importation and Registration of Pure Electric Vehicle and Plug-in Hybrid Electric Vehicle”)

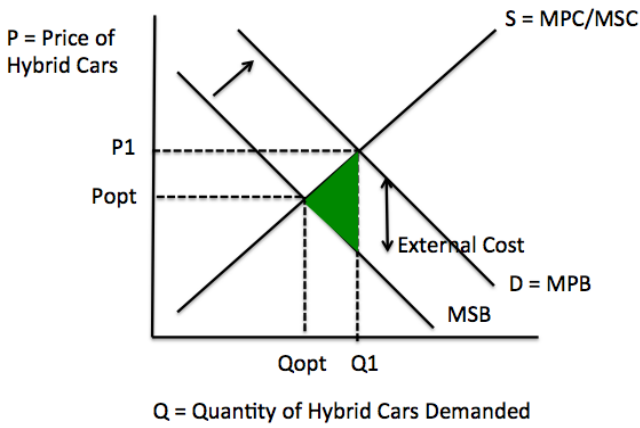


Diagram 2: Negative Consumption Externality for Hybrid Cars (Researcher’s own graph)

**IV. Price Elasticity of Demand (PED)**

PED is a “measure of the responsiveness of the quantity of a good demanded to changes in its price” (Tragakes 47) and is used to determine whether the demand for a good is elastic or inelastic. PED is calculated using the following formula:

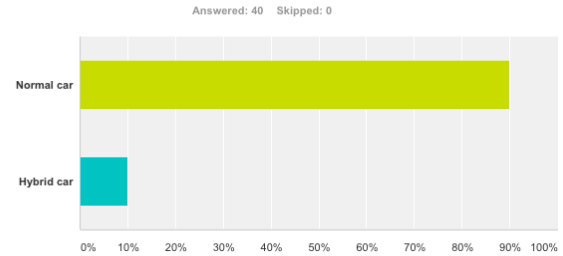
$$PED = \frac{\text{percentage change in quantity demanded}}{\text{percentage change in price}}$$

In this study, PED will be used to assess the effectiveness of the government intervention by identifying whether the demand for hybrid cars is elastic or inelastic. Elastic demand means that the quantity demanded of a good is relatively responsive to price and inelastic demand means that the quantity demanded of a good is relatively unresponsive to price.

**Research and Analysis**

**I. Calculation of the Price Elasticity of Demand for Hybrid Cars in Hong Kong**

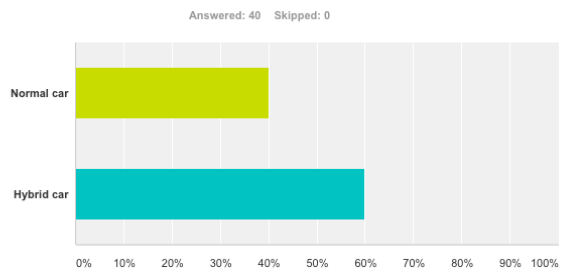
If you were to buy a new car now, would you choose to buy a normal car or a hybrid car?



Answer Choices	Responses	Count
Normal car	90.00%	36
Hybrid car	10.00%	4
Total		40

Chart 1: Consumer preference for hybrid vs conventional cars

If the price of the hybrid car was decreased by \$75,000, would you choose the hybrid car or the normal car?



Answer Choices	Responses	Count
Normal car	40.00%	16
Hybrid car	60.00%	24
Total		40

Chart 2: Consumer response to price when considering hybrid and conventional cars

The results from a survey (shown above) on 40 random car owners in Hong Kong were used to determine the PED value for hybrid cars in Hong Kong. The value HKD \$75,000 was used because it was the amount of First Registration Tax that could be reduced when purchasing a hybrid car.

The average price for a hybrid car in Hong Kong is HKD \$491,369 and was calculated by finding the current prices of government approved hybrid cars from the document “Type Approved Environment-Friendly Petrol Private Car Models

as at 31 March 2015”. This average price includes the amount of FRT.

$$PED = \frac{\frac{24-4}{4}}{\frac{416369-491369}{491369}} = - 32.8$$

PED values neglect the negative sign, so the final answer is PED = 32.8, meaning that the PED for hybrid cars in Hong Kong is elastic. The figure calculated is very elastic because a sample size of 40 was used since there was limited available information.

Nevertheless, the hypothetical information is corroborated by the interviews conducted with sales representatives from Lexus, Toyota, Audi, Volkswagen, and Ford. All the salesmen noted that they did notice “significant increases” in overall hybrid car sales. Furthermore, the sales representatives from Toyota and Lexus particularly noted that hybrid car sales have dropped significantly since the scheme was terminated in April 2015; the Toyota salesman estimated this drop at 50%. This research supports the evidence that in general hybrid cars have an elastic demand in Hong Kong.

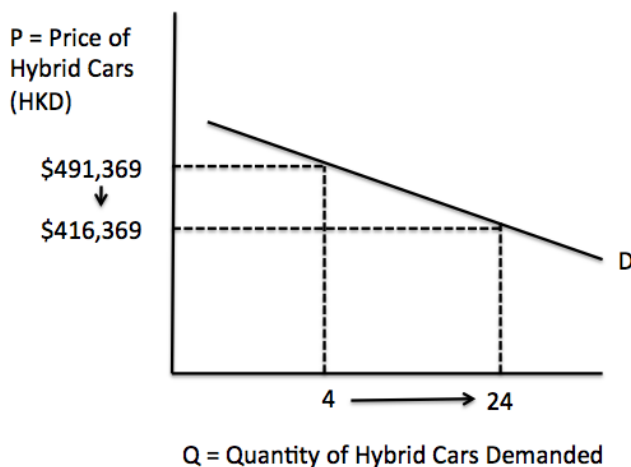


Diagram 3 – Price Elasticity of Demand for Hybrid Cars in Hong Kong (Researcher’s own graph)

Diagram 3 shows that a HKD \$75,000 deduction in price significantly affected consumers in Hong Kong. A 15% drop in price (from HKD \$491,369 to HKD \$416,369) caused a 500% increase in demand.

A survey conducted on 40 traditional car owners was used to better understand the reasons

behind the elasticity of hybrid cars. The reasons found can be split into the following categories:

**Substitutes**

Hybrid cars are easily replaced by traditional diesel or petrol cars, which are usually cheaper. Prior to the HKD \$75,000 reduction in price, many people saw it as better value for money to simply buy a traditional car instead. Therefore, a reduction in the cost for hybrid cars immediately causes an increase in the quantity of hybrid cars demand.

**Luxuries**

Luxury goods are goods that are often have elastic PED values and are deemed ‘non-essential’. Owning a car in Hong Kong is definitely a luxury because of the many expenses that come with owning a car. It is estimated that buying a second hand car and maintaining it for five years would cost an estimated HKD \$626,000 (Ap, ‘Big Spender’s Guide’), a large sum of money that many people simply are not willing to pay. Furthermore, some respondents to the survey stated that they would not consider a hybrid car simply because they want to “utilize Hong Kong’s public transport system more”. Therefore, since cars in general are luxury goods in Hong Kong, it is understandable that hybrid cars have an elastic demand, since most people are able to live without them.

**Proportion of Income Spent on Hybrid Cars**

When survey respondents were asked if they would consider purchasing a hybrid car, 59% of the respondents cited an expensive price as the main reason they would not purchase a hybrid. When Hong Kong’s median annual domestic household income of \$282,000 (“Hong Kong: The Facts”) is compared to the average price of a hybrid car (\$491,369), it is clear that a hybrid car would generally takes up a large proportion of income for most people in Hong Kong. Thus, it is understandable that hybrid cars have an elastic demand.

Since the PED for hybrid cars is elastic, government intervention can have a significant effect on consumer’s purchasing choices. This concession has proven to be an effective way to create incentives for consumers to purchase

hybrid cars over regular cars in an attempt to correct market failure. Therefore, the government’s scheme did make hybrid cars more appealing by reducing their prices. In turn, this helped promote environmental sustainability because more hybrid cars allows for the preservation of goods to satisfy needs and wants in the future.

**Value of Hybrid Cars’ Negative Consumption Externality**

When the government launched its ‘Clean Air Plan’ in 2013, it stated that Hong Kong as a whole had “poor roadside air quality” that was “mainly caused by vehicles”. This problem was essentially due to the number of vehicles on the streets increasing at an alarming rate, and was starting to pose health risks for people due to the high levels of NO<sub>2</sub> on the roadsides. From 1999 to 2013, NO<sub>2</sub> on the roadsides increased by 20%. These high levels of NO<sub>2</sub> are a large contributing factor towards Hong Kong’s high Air Quality Index (AQI), as it was observed that days when the AQI exceeded 100 (signaling that the air was ‘unhealthy for sensitive groups’) correlated with days that had high levels of NO<sub>2</sub> at the roadside (“A Clean Air Plan for Hong Kong”).

The light brown portion in Chart 3 shows that in 2013 it was predicted that there would continue to be an increase in the number of private vehicles in Hong Kong. Therefore, since people would inevitably continue purchasing cars, a step towards environmental sustainability

would be to encourage these consumers to purchase hybrid cars instead. This replacement of traditional cars would decrease the net market failure as compared to the free market.

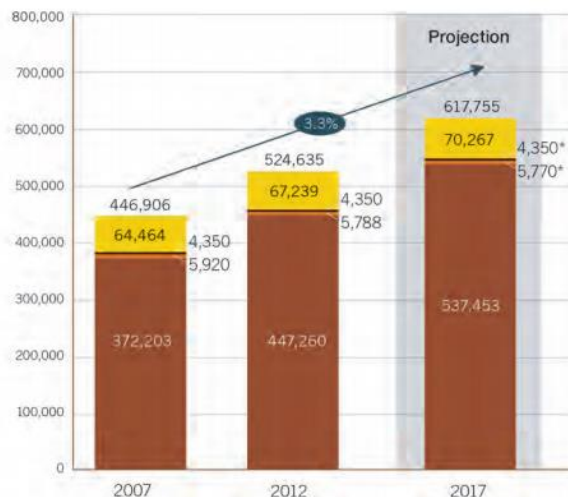


Chart 3: Projection of registered vehicle numbers to 2017 (“A Clean Air Plan for Hong Kong”)

Table 2 proves that hybrid cars are much more fuel efficient, as they emit fewer pounds of greenhouse gas compared to traditional cars. Since these statistics are only for a 100-mile trip, over time a lot of fuel could be saved.

Overall, since roadside pollution in Hong Kong is the main contributing factor behind Hong Kong’s high AQI, encouraging the consumption of hybrid cars would promote sustainability because hybrid cars allow better preservation over time, which preserves the level of human capital, therefore ensuring that the stream of income of future generations is not threatened.

Vehicle	Greenhouse Gas Emissions (pounds of CO <sub>2</sub> equivalent)
Traditional	99 lb CO <sub>2</sub>
Hybrid Electric	51 lb CO <sub>2</sub>
Plug-in Hybrid Electric	61 lb CO <sub>2</sub>

Table 2: Emissions and Fuel Cost for a 100-Mile Trip (“Emissions from Hybrid and Plug-In Electric Vehicles”)



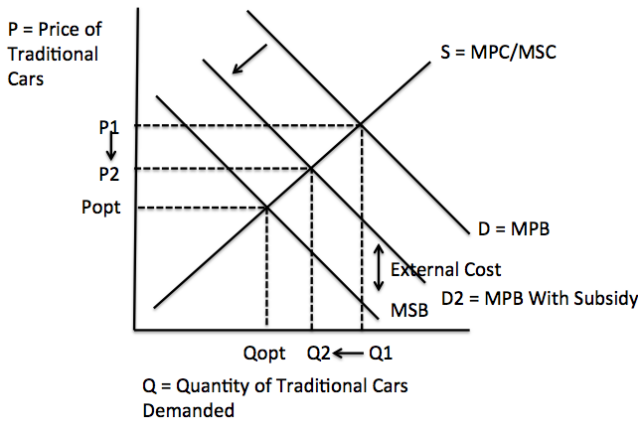


Diagram 4: Hybrid Cars Correcting Market Failure (Researcher’s own graph)

Diagram 4 shows that subsidizing hybrid cars causes the MPB for traditional cars to shift to the left because more people choose to buy hybrid cars over traditional cars. Thus, the subsidy makes the ‘external cost’ of traditional cars smaller because there are less CO<sub>2</sub> emissions overall. The curve does not shift all the way to the MSB curve, however, because there are still people who will inevitably choose to purchase traditional cars.

**III. Analysis of the Public’s Awareness to the Government’s Scheme**

It is important to assess the general public’s awareness of the government’s scheme because market failure cannot be corrected if people are unaware of the benefits in place.

The Environmental Protection Department of the Hong Kong government originally announced that the ‘Tax Incentives Scheme for Environment-friendly Petrol Private Cars’ would commence on April 1<sup>st</sup> 2007 through a press release. There was another press release when the concession for FRT was raised in April 2011. The information about the scheme was subsequently available on the government’s website. The last press release about the scheme was on 24<sup>th</sup> February 2015, when the government announced that the scheme would be terminated on April 1<sup>st</sup> 2015 (“Tax Incentives for Environment-friendly Petrol Private Cars”).

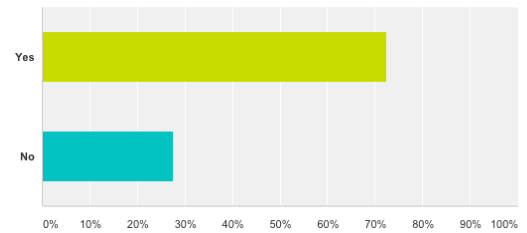
To test the effectiveness of the advertising of the government’s scheme, a survey was conducted on 40 traditional car owners and 40 hybrid car owners. Participants were asked whether they

had heard about the scheme, whether or not the scheme influenced their decision to purchase a traditional or hybrid car, and if they would consider purchasing a hybrid for their next car.

**Traditional Car Owners Results**

Have you heard about the government’s ‘Tax Incentive Scheme for Environment-friendly Petrol Private Cars’?

Answered: 40 Skipped: 0

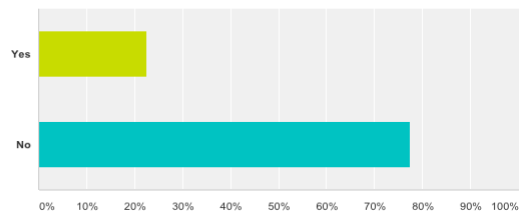


Answer Choices	Responses
Yes	72.50% 29
No	27.50% 11
Total	40

Chart 4: Consumer awareness of government incentives

Did knowing about this scheme make (OR would knowing about this scheme have made) you want to buy a hybrid car over a regular car?

Answered: 40 Skipped: 0



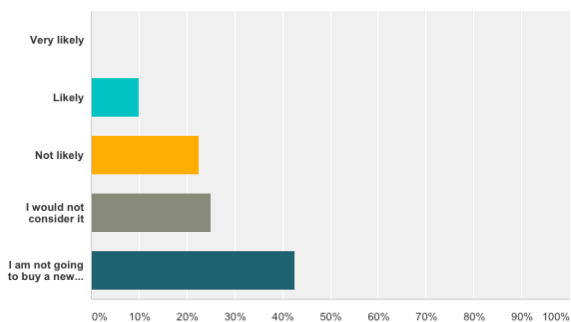
Answer Choices	Responses
Yes	22.50% 9
No	77.50% 31
Total	40

Chart 5: Consumer response to government incentives

Chart 4 shows that 27.5% of the respondents said that they had not previously heard about the government’s scheme. However, 55% of these respondents who answered ‘no’ stated that the scheme would have convinced them to choose a hybrid car over a traditional one. Therefore, if there had been more press coverage or other forms of publicity about the scheme, more people could have bought hybrid cars.

**Are you planning on buying a new car soon? If so, how likely is it that you will buy a hybrid car?**

Answered: 40 Skipped: 0



Answer Choices	Responses
Very likely	0.00% 0
Likely	10.00% 4
Not likely	22.50% 9
I would not consider it	25.00% 10
I am not going to buy a new car soon	42.50% 17
Total	40

Chart 6: Consumer purchasing intentions

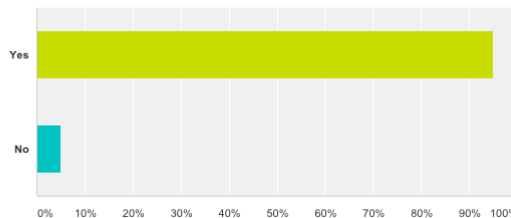
Respondents were asked to give a short explanation for their answer choice, and these are shown in Chart 6. Of the 22 people looking to buy new cars, 56% of them said that they would not consider buying a hybrid car because it is still too expensive. Although these people did not purchase hybrid cars, this shows that they were indeed aware of the scheme, which suggests effective advertising.

Charts 7 and 8 show that 95% of the people with hybrid cars were aware of the government’s scheme and 100% of current hybrid car owners would purchase a hybrid again with the scheme. Of the 2 respondents who said that they had not heard about the scheme, one stated he had purchased his hybrid car over 8 years ago, possibly before the scheme even started in 2007. The other respondent stated that he was planning to forego his car as he had been utilizing Hong Kong’s public transportation system more. Therefore, it can be assumed that essentially all the people who bought hybrid cars were aware of the scheme. When hybrid car owners were asked why they chose to purchase hybrid cars, 29% specifically said that the government’s scheme encouraged them to.

**Hybrid Car Owners Results**

**Have you heard about the government’s ‘Tax Incentive Scheme for Environment-friendly Petrol Private Cars’?**

Answered: 40 Skipped: 0

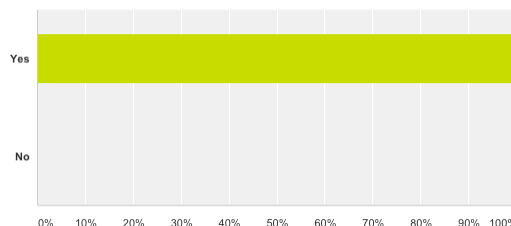


Answer Choices	Responses
Yes	95.00% 38
No	5.00% 2
Total	40

Chart 7: Consumer awareness of government incentives

**Did knowing about this scheme make (OR would knowing about this scheme have made) you want to buy a hybrid car over a regular car?**

Answered: 40 Skipped: 0

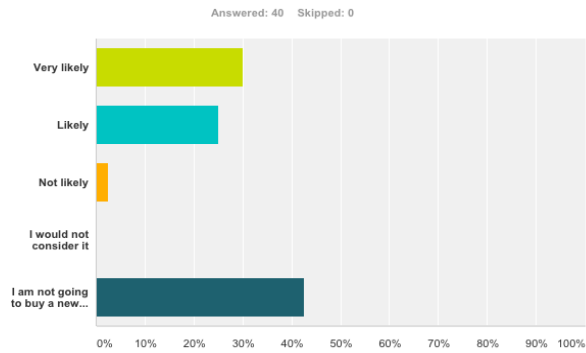


Answer Choices	Responses
Yes	100.00% 40
No	0.00% 0
Total	40

Chart 8: Effect on consumers of government incentives

Chart 9 shows that almost everybody who currently has a hybrid car would purchase another hybrid for their next car. The one respondent who selected ‘Not Likely’ was the same respondent who wanted to utilize public transport more. Out of the 15 respondents who gave reasons for their choices, 33% said that they would chose to buy a hybrid car because it is more environmentally friendly. However, 20% of these respondents did mention that it is now ‘less likely’ that they would purchase another hybrid car since the government scheme ended.

Are you planning on buying a new car soon? If so, how likely is it that you will buy a hybrid car?



Answer Choices	Responses	Count
Very likely	30.00%	12
Likely	25.00%	10
Not likely	2.50%	1
I would not consider it	0.00%	0
I am not going to buy a new car soon	42.50%	17
<b>Total</b>		<b>40</b>

Chart 9: Consumer purchasing intentions

Overall, because there were people who bought hybrid cars solely because of the scheme, the concession was advertised quite effectively. However, if the scheme was carried on, there would definitely be fewer negative consumption externalities. One reason the government may have stopped the scheme is because the opportunity cost (the loss of other alternatives) was too high in terms of revenue that it could have otherwise gained from collecting tax.

#### IV. Comparison of the Hong Kong Government’s Scheme to the Japanese Government’s

To most effectively assess how well the Hong Kong government promoted environmental sustainability, it is vital to compare its efforts to that of a country famous for its fleet of hybrid cars. According to the International Council of Clean Transportation, Japan has the “highest penetration of hybrid cars worldwide”. Japan’s success in promoting hybrid cars is accredited to the Japanese government’s “fiscal incentives for fuel efficient vehicles”, which have proven to be very effective as over 60% of new cars bought today in Japan are hybrids (Rutherford). It must be noted, however, that other factors (such as the Japanese market having more hybrid cars) would have affected the demand for hybrid cars as well.

The source also showed that from April 2009 to September 2010 and then from April to September 2012, the Japanese government took great measures to promote hybrid cars. Purchasing hybrid cars completely exempted consumers from taxes and registration fees, including the acquisition tax, tonnage tax, and automobile registration tax. In addition to the tax concessions, consumers also received JPY ¥100,000 (HKD \$6,025) from the subsidy program. From September 2012 onwards, the subsidy scheme was terminated but the tax incentives still remain.

Although this may seem like a large contrast to the Hong Kong government’s policy, which only included a concession in FRT for private cars, Hong Kong hybrid car buyers actually saved more money under Hong Kong’s scheme than Japanese car buyers did under theirs.

The source estimates that a Japanese car buyer purchasing a car under the Japanese government’s scheme would save ¥188,700 from an original price of ¥2,500,000, or around 7.5%. However, when the Hong Kong government provided the greatest FRT concession, buyers could save HKD \$75,000 from an original average price of HKD \$491,369, or around 15%. It must be noted that Hong Kong hybrid car buyers are saving more money because Hong Kong has a much higher tax rate for cars.

This comparison suggests that Hong Kong’s method of intervention has the potential to be very effective. The Japanese government’s example suggests that if Hong Kong offered a greater tax break then more people would be encouraged to purchase hybrid cars. However, opportunity cost to the government must be noted as well. If the government were to reduce tax, then it would lose potential revenue it could have used to subsidize other merit goods.

Overall, In terms of the amount of benefits offered, the Hong Kong government’s scheme was definitely able to compete with Japan’s.

#### Conclusion

This investigation answers the question ‘To what extent has government intervention in the market for private hybrid cars promoted sustainability by correcting market failure in

Hong Kong?’ by concluding that the ‘Tax Incentives Scheme for Environment-friendly Petrol Private Cars’ had a significant effect on the hybrid car market in Hong Kong by encouraging consumption of hybrid cars and promoting environmental sustainability.

Since it was found that the price elasticity of demand for hybrid cars in Hong Kong is elastic, government intervention in the form of a tax concession would be effective in encouraging consumption.

Furthermore, through a comparison and analysis of the fuel consumption for traditional cars and hybrid cars, it was found that hybrid cars pollute significantly less. This indicates that consumption of hybrid cars over traditional cars would correct an extent of the market failure by reducing net market failure, which in turn, promotes environmental sustainability.

In addition, through a comparison of the Hong Kong government’s scheme with that of the Japanese government’s, it was found that the Hong Kong government’s method had the potential to be very effective.

However, it was also found that the Hong Kong government did not effectively promote the scheme, as there were people who stated that they would have bought hybrid cars if they had known about the tax concessions available.

Overall, although the scheme could have been more effective if more advertising had been used, it was very effective in correcting market failure in the private hybrid car market. The government, therefore, was able to promote sustainability. Further research could be conducted to answer the unresolved question of how the hybrid car market could have been impacted even more if the scheme had remained in effect. Furthermore, additional studies that concern both the government’s tax incentive scheme and its profit tax deduction scheme could be conducted to analyze the overall effectiveness of the government intervention in the hybrid car market.

### Evaluation

A central assumption of this investigation was the generalization of hybrid cars, as there are undoubtedly some that pollute a lot less than

others. However, in this study, an average was taken.

A limitation to this investigation is the lack of information on the price and quantity of hybrid cars sold, as this affected the PED calculation. To be perfectly accurate, the PED calculation would have needed to include all the cars sold in the market. However, the government does not publish this information. Although the Transport Department was contacted to ask for the information, it stated that it did not have the data needed. Individual car dealerships were also contacted but they stated that their sales figures were confidential. Therefore, it was only possible to calculate the PED with a sample size and find qualified sales representatives to support the conclusion. Thus, a limitation is the small sample size. The hypothetical nature and sample size of 40 meant that any change in quantity demanded would have been significant, which is the reason for the bias towards a high PED value.

A second limitation is that the value of the negative externality was only measured in terms of greenhouse gas emissions. It was not measured in terms of other factors affected by cars (such as the people’s health) because the data was not published.

In addition, the comparison with the Japanese government’s intervention only analyzed what each government did, without holding other factors (such as culture and income) constant.

### References

- "2014 (MPV Series) Toyota Passenger Car Price List." *Crown Motors* (2014). Web. Accessed 18 Sept 2015. [http://www.crown-motors.com/eng/price/images/Toyota%20MPV%20Price%20List%202014%20\(English\)\(Jan%2018,%202014\).pdf](http://www.crown-motors.com/eng/price/images/Toyota%20MPV%20Price%20List%202014%20(English)(Jan%2018,%202014).pdf)
- "2014 Nissan Price List." *Automomo Hong Kong* (2015). Web. Accessed 18 Sept 2015. <http://www.automomo.hk/wp-content/uploads/2015/02/Nissan-commercial-Jan-2015.pdf>
- Ap, Tiffany. "Big Spender's Guide to Hong Kong." *South China Morning Post*, 25 Feb 2013. Web. Accessed 17 Sept 2015. <http://www.scmp.com/business/money/spending/article/1156347/big-spenders-guide-hong-kong>
- "Audi Passenger Car Price List (Model Year 14)." *Autonomo Hong Kong* (2013). Web. Accessed 19 Sept 2015. <http://www.automomo.hk/wp-content/uploads/2013/03/Audi-MY14-Full-range-pricelist.pdf>

"BMW Concessionaires (HK) Limited." *Automomo Hong Kong* (2015). Web. Accessed 18 Sept 2015. <http://www.automomo.hk/wp-content/uploads/2015/02/2015-BMW-Full-range-Jan-26.pdf>

"Can a Hybrid Save Me Money?" *U.S. Department of Energy. U.S. Environmental Protection Agency*. Web. Accessed 17 Sept 2015. <https://www.fueleconomy.gov/feg/hybridCompare.jsp>

*A Clean Air Plan for Hong Kong*. Hong Kong: Environment Bureau, 2013. *Environmental Bureau*. The Government of the Hong Kong SAR, Mar 2013. Web. Accessed 18 Sept 2015. [http://www.enb.gov.hk/en/files/New\\_Air\\_Plan\\_en.pdf](http://www.enb.gov.hk/en/files/New_Air_Plan_en.pdf)

"Emissions from Hybrid and Plug-In Electric Vehicles." *Alternative Fuels Data Center* (2015). Web. Accessed 17 Sept 2015. [http://www.afdc.energy.gov/vehicles/electric\\_emissions.php](http://www.afdc.energy.gov/vehicles/electric_emissions.php)

"Emissions from Hybrid and Plug-In Electric Vehicles." *U.S. Department of Energy. U.S. Environmental Protection Agency* (2015). Web. Accessed 18 Sept 2015. [http://www.afdc.energy.gov/vehicles/electric\\_emissions.php](http://www.afdc.energy.gov/vehicles/electric_emissions.php)

Gorzelany, Jim. "Cars That Can Last For 250,000 Miles." *Forbes Magazine*, 14 Mar 2013. Web. Accessed 17 Sept 2015. <http://www.forbes.com/sites/jimgorzelany/2013/03/14/cars-that-can-last-for-250000-miles/>

"Guidelines for Importation and Registration of Pure Electric Vehicle (PEV) and Plug-in Hybrid Electric Vehicle (PHEV)." *Transport Department*. The Government of the Hong Kong SAR (2014). Web. Accessed 17 Sept 2015. [http://www.td.gov.hk/en/public\\_services/licences\\_and\\_permits/vehicle\\_first\\_registration/guidelines\\_for\\_imp\\_reg\\_of\\_peg\\_and\\_phev/index.html](http://www.td.gov.hk/en/public_services/licences_and_permits/vehicle_first_registration/guidelines_for_imp_reg_of_peg_and_phev/index.html)

"Honda Price List (Year of Manufacture 2015)." *Automomo Hong Kong* (2015). Web. Accessed 18 Sept 2015. [http://www.automomo.hk/wp-content/uploads/2015/02/2015-Honda-Jan-26\\_price-list\\_letter\\_H\\_version.pdf](http://www.automomo.hk/wp-content/uploads/2015/02/2015-Honda-Jan-26_price-list_letter_H_version.pdf)

"Hong Kong: The Facts." *Information Services Department*. Hong Kong SAR Government (2015). Web. Accessed 10 Nov 2015. <http://www.gov.hk/en/about/abouthk/factsheets/docs/population.pdf>

"Infiniti Models Price List 2015." *Infiniti Hong Kong* (2015). Web. Accessed 18 Sept 2015. <http://www.infiniti.com.hk/etc/medialib/hk/documents.Par.21704.File.tmp/2015%2007%2010%20Full%20line%20pricelist.pdf>

Lau, Chris. "Health Warning Issued as Hong Kong Air Pollution Expected to Hit 'Serious' Levels." *South China Morning Post*, 6 July 2015. Web. Accessed 17 Sept 2015. <http://www.scmp.com/news/hong-kong/health-environment/article/1833424/health-warning-hong-kong-air-pollution-expected>

"Lexus 2015 Manufacture Price List." *Lexus Hong Kong* (2015). Web. Accessed 18 Sept 2015. [http://www.lexus.com.hk/data/files/Lexuspricelist%202015-N%20\(June%2010%202015\).pdf](http://www.lexus.com.hk/data/files/Lexuspricelist%202015-N%20(June%2010%202015).pdf)

"Mazda 2015 Price List." *Automomo Hong Kong* (2015). Web. Accessed 18 Sept 2015. [http://www.automomo.hk/wp-content/uploads/2015/02/Mazda-General-Price-List\\_20150527-finalized.pdf](http://www.automomo.hk/wp-content/uploads/2015/02/Mazda-General-Price-List_20150527-finalized.pdf)

"Mitsubishi Full Range Price List." *Automomo Hong Kong* (2012). Web. Accessed 18 Sept 2015. <http://www.automomo.hk/wp-content/uploads/2012/04/Mitsubishi-Full-range-price-list.pdf>

"Porsche Price Summary - Model Year 2014." *Automomo Hong Kong* (2014). Web. 18 Sept 2015. <http://www.automomo.hk/wp-content/uploads/2014/02/Porsche-Price-Summary-MY15-2014.9.18-updated.pdf>

"Profits Tax Deduction for Capital Expenditure on Environment-friendly Vehicles." *Environmental Protection Department*. The Government of the Hong Kong SAR (2015). Web. Accessed 17 Sept 2015. [http://www.epd.gov.hk/epd/english/environmentinhk/air/prob\\_solutions/Profits\\_Tax\\_Deduction\\_EFV\\_Models.html](http://www.epd.gov.hk/epd/english/environmentinhk/air/prob_solutions/Profits_Tax_Deduction_EFV_Models.html)

Rutherford, Dan. "Hybrids Break Through in the Japan Auto Market." *The International Council of Clean Transportation* (2014). Web. Accessed 17 Sept 2015. <http://www.theicct.org/blogs/staff/hybrids-break-through-japan-auto-market>

Shay, Christopher. "Why Electric Cars Aren't Selling." *The Wall Street Journal*, 31 Jan 2011. Web. Accessed 17 Sept 2015. <http://blogs.wsj.com/hong-kong/2011/01/31/why-electric-cars-arent-selling/>

"Suzuki Manufacture Year 2014 Price List." *Suzuki Hong Kong* (2014). Web. Accessed 18 Sept 2015. <http://www.automomo.hk/wp-content/uploads/2014/02/Suzuki-IML-2014-Price-List-12-06-14.pdf>

"Tax Incentives for Environment-friendly Petrol Private Cars." *Environmental Protection Department*. The Government of the Hong Kong SAR (2015). Web. Accessed 17 Sept 2015. [http://www.epd.gov.hk/epd/english/environmentinhk/air/prob\\_solutions/environment\\_friendly\\_private\\_cars.html](http://www.epd.gov.hk/epd/english/environmentinhk/air/prob_solutions/environment_friendly_private_cars.html)

"Toyota 2015 Passenger Car Price List." *Crown Motors* (2015). Web. Accessed 18 Sept 2015. [http://www.crownmotors.com/eng/price/images/Toyota%20PC%20Price%20List%202015%20\(English\)\(Feb%206,%202015\)R.pdf](http://www.crownmotors.com/eng/price/images/Toyota%20PC%20Price%20List%202015%20(English)(Feb%206,%202015)R.pdf)

Tragakes, Ellie. *Economics for the IB Diploma*. Cambridge: Cambridge UP, 2012. Print.

"Type Approved Environment-Friendly Petrol Private Car Models as at 31 March 2015." *Environmental Protection Department*. The Government of the Hong Kong SAR (2015). Web. Accessed 18 Sept 2015. [http://www.epd.gov.hk/epd/sites/default/files/epd/english/environmentinhk/air/prob\\_solutions/files/PTD\\_EFcar\\_list\\_e\\_as\\_at\\_31.3.2015.pdf](http://www.epd.gov.hk/epd/sites/default/files/epd/english/environmentinhk/air/prob_solutions/files/PTD_EFcar_list_e_as_at_31.3.2015.pdf)

"Volvo Price List 2015." *Automomo Hong Kong* (2015). Web. Accessed 18 Sept 2015. <http://www.automomo.hk/wp-content/uploads/2015/02/Volvo-Price-list-150121.pdf>

# Do Western and Chinese Chess Share a Common Origin?

## A Historical Enquiry

*Katrina Lee*

### Introduction and Literature Review

Chess is a strategic board game that alludes to the historical battlefield that soldiers, war animals, and generals have historically fought on. It is a model of a battle between two sides, representing two nations, two countries, or two warlords and their armies. Each side ultimately aims to capture the king of its opponent, as his death terminates the battle.

In modern times, the globally recognized version of chess is titled Western chess or International chess. In China, there is a distinguishable yet similar version named Chinese chess, or in Chinese, “象棋” (*Xiangqi*), which in direct translation is “elephant chess”. For centuries, it has been a popular sport enjoyed by the old and young, and even in today’s modern society, chess is played “on the white marble steps, under the shady elms of public parks, [and even] at the corners of narrow alleys” (Tu 43) in China. It is a game of strategy, determination, worthy sacrifices, and forethought.

The term for Chinese chess - “象棋” - has raised questions, since elephants were never perceived as a common animal in ancient China. What is the rationale behind the name elephant chess? Up until the time of writing, no satisfactory answer has been given to this question. Elephants are of a religious, military and cultural meaning in India, and occupy a prominent place in Indian iconography. This partially substantiates the widely accepted theory that Western chess first existed in India. Thus, can we assert that Chinese chess, like Western chess, also originated in India?

What are the noteworthy similarities and differences between Chinese and Western chess? Did chess make its first appearance in India or China?

Though historians and researchers have drawn varying conclusions about the origins of chess, direct supporting archaeological evidence is utterly lacking. William Jones (1746-1794), the first person to formulate theories on the history of chess, argued in his book *The Indian Game of Chess* that “Hindustan was the cradle of chess, [both Chinese and Western chess], and that the game has been known since ancient times by the name of *chaturanga*” (Jones 195). Jones supported his argument first by demonstrating the many similarities between Western and Chinese chess. He then noted that, unlike India, China did not possess a large elephant population but that the Chinese version of the game was named elephant chess. Hence, Jones reached the conclusion that Chinese chess originated in India. Following in his footsteps, H. J. R. Murray in 1913 and Henry A. Davidson in 1949 also concluded that Western and Chinese chess are descendants of an Indian chess game that radiated north, east and west. The great Chinese historian Hu Shi was also an advocate of this hypothesis.<sup>1</sup>

To the contrary, a general *Source Book for the History of Chinese Sports* “中國體育史 - 參考資料”,<sup>2</sup> edited by the *Chinese Sports Union* “運動技術委員會”, claims that Chinese chess originated in China, and the writers highlight primary evidence that indicates war elephants were greatly employed in ancient Chinese battles, especially during the Shang Dynasty. However, no party has yet established any direct textual or archaeological evidence of chess pieces or manuals to conclusively support their respective arguments. Therefore, no hypothesis can be proven true.

<sup>1</sup> 胡適：《考作象棋的年代》

<sup>2</sup> 中國國家體委，運動技術委員會：《中國體育史參考資料》 - 第三輯（中國：人民體育出版社）

This essay aims to re-examine whether Chinese chess shares the same Indian origin as Western chess. Three hypotheses are stated below:

1. Chinese chess was an entirely native invention of ancient China;
2. The basic components and the key concepts of Chinese chess all originate directly or indirectly from Indian chess;
3. The Chinese invented a basic military board game, and subsequently incorporated Indian elements.

Before examining the hypotheses, we will examine the fundamental similarities and differences between the two kinds of chess, the origins of Western chess, and the development of the distinctive features of Chinese chess through history.

### The Similarities and Differences Between Chinese and Western Chess

Chinese chess and Western chess are two distinguishable yet similar types of chess. Their similarities and differences can be summarized as follows:

	Western Chess	Chinese Chess
<b>Placement of Pieces</b>	Rooks or chariots are set off to the side; Knights or horses are placed one position in towards the king; Bishops or elephants perch right next to the knights or horses; The king stands in a middle lane; Pawns or foot soldiers are positioned as the most advanced pieces.	
<b>Board: Design and Color</b>	The board is checkered; the white and black squares are alternately placed on the board. The chess pieces are positioned on the squares.	No color feature; instead, the Chinese chessboard is constructed of ten black horizontal and nine vertical lines, in which the intersections mark the chess pieces' positions. A river labelled the Chu-Han Frontier River “楚河漢界” is located in the middle, representing the demarcation between the Chu and the Han, the two rival polities of China in the 3rd century BCE.
<b>King</b>	1.) The king's movement is restricted to only one square in any direction.	1.) The king is confined to his nine-spot headquarters, and can move one step in any direction within his headquarters. 2.) “The kings shall not meet” (“王不見王”); the two kings may not stand vertically opposite without an intervening piece, or one king is able to capture his opponent.
	Significance: In the older days of war, kings and generals led their armies in the field. Therefore “it is natural that chess would feature the king in a prominent central position” (Davidson 21). Additionally, his limited ability to move portrays how the king was too valuable to wander freely around the field, and could not exercise too much power. This applies to both types of chess.	

<p><b>Foot Soldiers or Pawns</b></p>	<p>1.) The eight pawns aligned in the first row are allowed to advance two squares forward on their first move, and are then limited to only one step forward until they reach the base lane.</p> <p>2.) When pawns reach the opponent's base lane, they are granted promotion to any other piece except for the king.</p> <p>3.) The pawns can only capture one frontal square diagonal to them, symbolizing how the foot soldiers in war normally kill their enemies with the sideway thrust of his spear.</p>	<p>1) <i>Bing</i> “兵” or the foot soldiers are allowed to advance one square forward until they cross the Chu-Han Frontier River, where they are also allowed to move and capture horizontally.</p> <p>2.) Foot soldiers are not granted the opportunity to promote to another piece when reaching the base line.</p>
<p>Pawns or foot soldiers are the most numerous and most easily sacrificed component, yet are also the backbone of the force.</p>		
<p><b>Horses or Knights</b></p>	<p>The horses in Chinese chess move just like Western knights - that is one step forward, backward or sideways, and then one step in a diagonal direction. (However, differently to Western knights, the horses cannot crossover an intersection that is occupied by another piece.)</p> <p>Significance: The movements of the horse in chess mimics the ability of a horse to “jump over obstacles and the prancing oblique move” (Davidson 51).</p>	
<p><b>Chariots or Rooks</b></p>	<p>The chariots and rooks, both perpendicularly and horizontally, cover the full range of the board, taking the role of a powerful and offensive piece.</p> <p>Significance: Chariots were a quick unit used for fierce and long-distance assaults in battles.</p>	
<p><b>Elephants or Bishops</b></p>	<p>1.) Like the bishop, the elephant also moves diagonally over the board. However, the elephant's field in Chinese chess is narrowed down by the river.</p> <p>2.) The bishop in Western chess was originally an elephant.</p>	
<p><b>Other Differences</b></p>	<p>The queen is the most powerful and threatening piece on the Western chessboard. It lies beside the king, and has the power of both a rook and a bishop. Thus, the queen is perpendicularly, vertically, and horizontally dominant.</p>	<p>1.) <i>Shi</i> “士”, or scholars, are the pieces which act as the bodyguards of the King, also confined to a nine-spot headquarter.</p> <p>2.) The canons “炮/砲” move like the rook. However, they are only capable of capturing a piece when another piece is posted in between them and their target. This symbolizes the canons' ability to soar over pieces.</p>

In spite of the many disparate visual features of Western chess and Chinese chess, many elementary properties from both types are distinctively similar. Is this mere coincidence, or is this the result of having shared the same origin - India - a country famed for its elephants?

**Short History of Western Chess**

It is widely recognized that the origin of modern international chess was in India, and that it descends from a similar chess game called *chaturanga*, played by inhabitants of India in the sixth century. This is supported by the first



reference to the game of chess in Indian literature, in the Sanskrit romance *Harshacharita*, a biography of the Indian emperor Harsha, written by a seventh century Indian writer, Banabhatta (Davidson 215). It is also supported by a Persian book of the sixth century, “*Karnamak - i - Artakhstatr - i - Papakan*”, which contains references to how chess was exported from India to Persia. Therefore, the dominant theories on the radiation of chess from India are based on geographical proximity and the existence of cultural contact, with two textual records as sole documentary evidence.

Western chess first appeared during the Sanskrit Period of 550 to 700 AD. Its Indian name, *chaturanga*, means the four arms, or the four chief sections of an army. This is also related to “the armies of old India, [as they] were made up of four well-defined components: elephants (which later became bishops), chariots (rooks), infantry (pawns), and cavalry (knights)” (Davidson 79).

Elephants were the most significant type of animal used for battle in India, stationed just off the centre, next to the King. The other pieces used in *chaturanga* include the king, infantry soldier, the counsellor (or *mantri*), the horse, and the chariot. The pieces most different from modern Western chess are the elephant and the counsellor. Almost identical to the guard in Chinese chess, the counsellor hovers near the king, and is only allowed to move one diagonal step at a time. The elephant was the ancestor of the modern bishop, yet, more powerfully than the modern bishop, it also has the ability to move into five alternative squares, “one square forward or one square diagonally” (Davidson 8),<sup>6</sup> which was intended to represent the power of the elephant’s five limbs - its four legs and trunk. Moreover, as an infantry soldier reaches the last square, it is promoted to a counsellor, the weakest of the major pieces. This represents how an enlisted man commissioned in battle might be promoted to a second lieutenant.

During the 6th century, specifically during the reign of Chosroes (531 - 579 AD), flourishing commercial and cultural contacts between India and Persia permitted the game to spread to Iran.<sup>8</sup>

*Chaturanga* emerged in Persia between 700 and 800 AD. In the Persian version of the game, the ability of the elephant (or *pil* in Persia) to move forward was withdrawn. Instead it was empowered to move two squares diagonally instead of one, confining the elephant to squares of one color.

The Arabs’ invasion of Iran in 641 AD allowed for a synthesis of Saracen (Arab) and Persian cultures. It has been hypothesized that this takeover of Iran brought chess to Arabia. The Arabs contributed to the establishment of modern chess, developing “an enormous literature of chess tactics” (Davidson 13)<sup>8</sup> within the period 800 to 1000 AD.

The medieval period (1000 to 1600 AD), was when chess “cross[ed] from the Muslim world by three main routes: a) Spain from North Africa; b) Italy by means of trade routes across the Mediterranean; c) from Asiatic Turkey to European Turkey and up through Balkans” (Davidson 13). All of the three transmission processes into Europe were completed by the 11th century. Within this timespan, the elephant became a bishop.

Chess, as played in Europe in the 13th century, was very similar to the Arabic game. However, by the 13th century, an alteration of the chessboard color had become the rule. This can be seen in the 13th century medieval sermon *Quaedam Moralitas de Scaccario*, which states that “All the world is but a chessboard of which one part is white, the other black, being the two states of life and death, praise and blame” (Davidson 416).

Through development and modification, and by the 17th century, European chess evolved to become virtually identical to modern International chess. Checkmate became essential for victory and one could no longer win by capturing all of his opponent’s pieces except for the king; the pawn was given the ability to move two squares for its first move; castling was introduced; the bishop was granted the ability to move any number of squares diagonally; and the *mantri* transformed into the queen - incorporated with its modern powers.

These new rules illustrate the influence of the European cultural and historical background. The rook was a portrayal of the mobile towers that kings would retire to for protection. Castling is not seen in Chinese chess or *chaturanga*, and this coheres with the historical fact that mobile towers as tactical devices only made an appearance in the late European times. Additionally, the transformation of the counsellor into the queen was, in fact, due to linguistic distortion. *Ferz* meant counsellor in medieval French. It was first altered to *fercia*, then *fierge*, and then, by phonetic approximation or sound-shift, to *vierge*, the French for virgin. Virgin, a term associated with females, gave rise to queen. Castling and the queen are only extant in Western chess.

### Records of Chinese Chess

Chinese historians and archaeologists have argued about whether chess was invented in the late Qin Dynasty by Han Xin 韓信 (230 – 196 BCE), a well-known general, or during the Han or Tang Dynasties. However, these theses are only based on legends recorded in later sources, or on the mere appearance of the term *Xiang qi* in textual sources: we cannot determine whether the game in question corresponds to Chinese chess as we know it today.

The first secure record of Chinese chess is found in a tale entitled *Ceng Shun* “岑順” in *Xuan Guai Lu* 《玄怪錄》,<sup>11</sup> a 9th century collection of tales from the Tang Dynasty (618 – 907 AD). In this tale, Chinese chess is described through a scholar’s dreams of Lilliputian chess pieces in battle.

The Chinese tale tells of a poor scholar named Ceng Shun who had to lodge in a deserted house. He claimed that he would often hear sounds of battle late at night. And one evening a warrior clad in heavy armour appeared and asked him whether he would help his kingdom defeat its enemy. Ceng agreed. He eventually caught sight of cavalry that were only a few inches tall, and met the king of those Lilliputian soldiers, who was also tiny in stature. He watched the rival forces use cavalry, chariots and infantry in the battle. In Ceng’s dreams, he witnessed horses galloping diagonally across the field, the king

confined to his court, the chariots advancing in every direction in a boundless field, and the infantry only moving step by step. “天馬斜飛度三止，上將橫行系四方。輜車直入無迴翔... 兩軍俱有一馬，斜去三尺止。又鼓之，各有一步卒，橫行一尺”(Niu 123).<sup>3</sup>

Even though the story itself is not likely to be true, as can be seen, the way chess pieces moved in the dream corresponds to modern Chinese chess, showing that a similar, if not identical, game already existed during the Tang Dynasty.

Subsequently in the story, and through the fuddle of alcohol, Ceng tells his family members about his bizarre dreams. His family members then dig under Ceng’s house and identify an ancient tomb loaded with bronze chessmen on a board, as Ceng had seen in his dreams. The exquisite bronze chess pieces were of the king, infantry, chariots, horses, catapult, and arrows, as partially enumerated at the end of the tale.

（“是古墓也。墓有磚堂，其盟器悉多，甲冑數百，前有金床戲局，列馬滿枰，皆金銅成形，其乾戈之事備矣”）(Niu 123).<sup>4</sup>

This description of the different chess pieces in the tale also further suggests that a game similar to today’s Chinese chess and including pieces such as the king, infantry, chariots, horses, and catapults already existed during the Tang Dynasty.

The twenty wooden chess pieces were found in a sunken Southern Song Dynasty (1127-1279 AD) boat in Fujian Province are the first physical evidence of Chinese chess, while during the Yuan Dynasty (1279-1368 AD), Chinese chess was depicted in the wall painting *Yi Qi Tu* “奕棋圖” in a temple to a water deity in Hongdong county, Shanxi province (洪洞縣水神殿壁畫).<sup>5</sup> The painting clearly depicts two government officials playing a game on a board structured

<sup>3</sup> 牛增儒、李復言：《玄怪錄》（北京：中華書局出版社）頁 123

<sup>4</sup> 牛增儒、李復言：《玄怪錄》（北京：中華書局出版社）頁 123

<sup>5</sup> 中國國家體委，運動技術委員會：《中國體育史參考資料》- 第三輯（中國：人民體育出版社）頁 350

similarly to modern Chinese chess. The center demarcating river, unique to Chinese chess, reveals that the board game illustrated is indeed Chinese chess.

### Hypotheses

Three mutually exclusive hypotheses can be formulated about the origin of Chinese chess. Hypothesis one states that Chinese chess is a purely native invention and has no decisive foreign influences. Chinese chess is composed of the following elements: a king, two chariots, two horses, two elephants, two bodyguards, two canons/catapults, five foot soldiers, the Chu-Han Frontier River, and the “kings shall not meet” rule. Therefore, in order to assess this hypothesis, the following questions need to be addressed: can all the aforementioned elements have been invented in China, and by the Chinese alone? My answer is yes.

In both ancient China and India, conflict and discord would often give rise to battles and wars. During combat, each side would set a battle formation employing different types of military forces. During the Spring and Autumn period (770 - 221 BCE), Chinese militaries were mostly composed of infantry and chariots, with an increasing use of cavalry.<sup>6</sup> During the Qin Dynasty (221 - 206 BCE), ground forces developed to consist chiefly of chariots, cavalry and infantry. This was maintained for at least one thousand years, until towards the end of the Tang Dynasty.<sup>7</sup>

Several historians have supported an Indian origin of Chinese chess on the basis that China has never been a country noted for the use of elephants in warfare. However, archaeological evidence suggests quite the opposite. Elephants were abundant in ancient China. The elephants’ habitat still covered virtually the whole of China’s territory up to the end of the Shang Dynasty (1111 BCE). Furthermore, although the elephants’ habitat gradually shrank as they moved south to warmer zones during the time of the Tang Dynasty, when Chinese chess made

its first appearance in *Xuan Guai Lu*, elephants were still common within China.

There is also historical documentation of the use of war elephants during particular Dynasties in ancient China. Two eminent scholars, Luo Zhenyu 羅振玉 and Wang Guowei 王國維, have demonstrated that, during the Shang Dynasty, there were elephants both north and south of the Yellow River, which were employed in warfare. The fact that elephants occupied the heart of China during the Shang Dynasty would have allowed for the use of war elephants.

Over the centuries, from the fall of the Shang Dynasty to the rise of the Song Dynasty, there were still occasional uses of war elephants. The Spring and Autumn period warriors from Chu 楚 region (today’s Hunan), used them against their enemies in 506 BCE. The southern state of Liang 梁 (南朝) employed them armed with cutlasses in 554 AD, and the southern Han (南漢) used an elephant corps in the great battles of 984 and 971 AD. Therefore, it is probable that the Chinese chess piece *Xiang* “象”, elephant, also originates from China.

Further in support of Chinese chess as a wholesome native invention, there are elements that are distinctive to Chinese chess, which can be unequivocally traced back to Chinese historical events. These include the rule that the Kings shall not meet “王不見王”, “楚河漢界”, the Chu-Han Frontier River, and “炮/砲”, and the catapults/canons (refer to “differences and similarities”, above).

The rule “Kings shall not meet” was established on the basis of a significant dispute between 項羽 (Xiang yu) and 劉邦 (Liu bang), two ancient Chinese generals. Liu and Xiang were fighting for the title of emperor. In one of their most vicious battles, they stood in confrontation, separated by Guangwu Mountain, while Liu imprecated curses on Xiang. Xiang’s fury erupted and he shot an arrow at Liu, almost taking his life. Thus, when the two kings in Chinese chess face directly opposite of each other with no other pieces interposing between them, one will be terminated.

<sup>6</sup> 金玉國：《中國戰術史》（中國：解放軍出版社，2008）頁 48

<sup>7</sup> 金玉國：《中國戰術史》（中國：解放軍出版社，2008）頁 161

The middle lane of the Chinese chess board is labelled “楚河漢界”, the Chu-Han Frontier River, or Xiang and Liu. In 213 AD, Xiang and Liu signed a truce and agreed the west of Henan province would belong to Xiang, while the east would be Liu’s territory. “楚河漢界” is the term that refers to the boundary between the two generals.

Chinese chess includes two catapults/cannons that are absent in International chess. Catapults were widely used in use in Chinese warfare by the Tang Dynasty (618-907AD), and gunpowder, as one of the four major Chinese innovations, “四大發明”, allowed firearms and eventually cannons to become an important component of the Chinese army by the Ming Dynasty (1368-1644AD). Therefore, history does allow for a Chinese creation of the catapults/cannons on a chessboard.

As China had the potential to invent the many fundamental elements of its chess, this hypothesis is entirely plausible.

The second hypothesis is that the conceptual foundations of Chinese chess originated in India, while separate features regarding the history and culture of China were incorporated later. In order to check the plausibility of this thesis, we must examine the intercourse between China and India before the Tang Dynasty which might have enabled such an import.

Though it is evident that elephants have been used in ancient Chinese warfare, such military use of elephants has not been popularly recognized. Thus, it is also probable that the thriving exchanges between ancient China, India, Arabia and Persia, long before the first record of Chinese chess in the Tang Dynasty, created the opportunity for the Chinese to progressively acquire ancient chess, the elephant game “象棋”, from the Indians, Arabs or Persians.

According to Henry A. Davidson, “the agencies of large popular movements possible for the transmission of chess were war, international trade, the quest for learning, and religious pilgrimages.” Indeed, through the Silk Road, the Chinese had much interaction with India, Arabia and Persia by way of trade, war, and religious

pilgrims, leaving all the probabilities open for the introduction of chess into the country.

Trade along the Silk Road started as early as 138 BCE, when Zhang Qian went on a mission to visit the Yue-Zhi, an ancient Indo-European people in Central Asia. However, on his way he was captured by the Xiong-nu, or the Huns, and was detained for ten years. Zhang escaped, made his way to the Yue-Zhi, and managed to avoid recapture as he returned to China by way of the Pamir Mountains. In 128 BCE, “Zhang Qian speculated that the safest route to the Central Asian markets might be through India, since the northern routes were controlled by the Huns.” Moreover, in 116 BCE, Zhang Qian was credited with increasing Chinese awareness of India and other lands to the west - an awareness that soon brought about regular communication with Parthian Iran, a country which would go on to adapt chess from India.

In 115 BCE, when Zhang Qian returned to the Han capital from his second mission, the knowledge was in place to allow the expansion of central Asian sections of the Silk Road. It was through this road that Buddhism was later introduced from India to China in the second half the 1st century AD. Zhang Qian’s work allowed greater interaction between China and its neighbouring countries to take place, especially those (Persia in particular) that are known to have acquired chess from India.

During the 7th and 8th centuries of the Tang Dynasty, most likely before the first Chinese record of chess, “China [was] remarkably receptive to new people, new thoughts, and new goods” (Vollmer 65). The Tang Chinese emperors and their people grew curious enough to explore the world outside of China. “The empire accepted, and often adapted, all manner of objects brought to China by embassies, merchants, and pilgrims from Sasanian Iran, the Mediterranean lands, India, and Southeast Asia.” (Vollmer 65)

Indeed, we have already seen that the earliest secure record of Chinese chess dates to the Tang Dynasty. The Tang Dynasty (618 – 901AD) was opulent and many foreigners of varying religious persuasions arrived in China. Amongst the

foreigners were many Buddhist pilgrims from India, as well as Arab merchants and traders. In the early 7th century, before Ceng's tale in *Xuan Guai Lu*, "Buddhist missionaries and pilgrims such as the Chinese monks Fa Xian and Xuan Zang, brought new religious icons and tracts from India, as well as India's latest theories in astronomy, mathematics, medicine and philosophy" (Vollmer 46). It is plausible that the pilgrims and missionaries also brought Indian chess and manuals. As Indian contributions to the arts, as well as Persian and Arabian ideas, were said to be assiduously studied by Chinese scholars, the Chinese could have obtained similar variations of chess from any of the three countries.

Furthermore, a statement regarding the implementation of the canon chess piece can be noted in "Documentation on the history of Buddha", Volume 22: "Creation of Chess" 《佛祖歷代通載》卷二十二: "制象棋".<sup>8</sup> The fact that chess was mentioned in documentation relating to Buddha, firmly suggests the idea of chess having been recorded by the Chinese Buddhist pilgrims from India, the cradle of Buddhism.

It is true, that Chinese chess presents distinctively Chinese historical events, such as the Chu-Han Frontier River placed in the middle of the board (楚河漢界), the kings not being allowed to be face each other directly, (王不見王), and the additional chess piece "炮、砲".

Nevertheless, both Chinese chess and chaturanga contain strikingly similar features which make the transmission theory probable. In chaturanga, the king is also accompanied by a counsellor or *mantri*, where Chinese chess has two "scholars" or "士" beside the king. Chinese chess is also similar to chaturanga in its lined-board and absence of castling. These features are non-existent in European chess. Indeed, in modern International chess, the counsellor piece has transformed into the queen, the chessboard

has become checkered, and castling is permitted. However, this should not affect our discussion of the possible influence of Indian chess on China. Firstly, the checkerboard is a European innovation, unknown to the early Indians, Arabians and Persians. It was the homophony of *ferge* and *vierge* that accounted for the feminization of the counsellor in European chess. Lastly, the Western rook is responsible for castling in order to portray a typical European king's court, where the king could retire into a mobile tower (rook). All these transformations are deeply rooted in medieval European history. In summation, the fact that there are particular features shared by chaturanga and Chinese chess makes it difficult not to assume that Chinese chess emerged from chaturanga.

The third hypothesis is that the Chinese invented a basic military board game, and subsequently incorporated Indian elements. The evidence needed to support this hypothesis has already been approached in the discussion of the previous two hypotheses, and will not be repeated again; indeed, the very same evidence can be used to support a different hypothesis. Is it possible that a chess-like board game was invented in China prior to any contact with India? The answer is yes. The Chinese were very capable of creating the game. The frequent battles in China could have acted as a stimulus for the creation of chess, and also explain why there was an incorporation into the game of Chinese military components - chariots, cavalry, infantry and cannons - the Chu-Han Frontier River, and the rule "king cannot see king". Nothing forbids the thought that the basic rules of Chinese chess, though similar to their Indian counterparts, were independently invented. It is plausible that Indian influences acted upon an already mature Chinese game - in the form of the elephant. We can formulate the hypothesis that Chinese chess was invented on a basis of Chinese culture and later implemented an Indian element.

<sup>8</sup> 《佛祖歷代通載》卷二十二: "制象棋", 注云: "...唐相國牛僧孺用車馬將士, 加炮代之為機矣"。頁 545

## Conclusion

Through developing the various hypotheses, I have delved deep into how people's inquisitiveness, global interactions, and a country's historical events, can significantly affect the country's cultural development.

Up to the time of writing, no archaeological evidence or written records provide definite answers to questions surrounding the origin of Chinese chess. Based on China's ancient culture, geographical vicinity, and intercourse with neighboring countries, all three hypotheses concerning the origin of Chinese chess are possible: that the ancient Chinese invented the whole of Chinese chess; that Chinese chess developed from Indian chess, or that Chinese chess is a hybrid of both Indian and Chinese features. They contradict each other, yet exploring their possibilities opens up a compelling perspective of China's past cultural diversity.

Similarly to the dispute surrounding the existence of a black swan, even if solid archaeological evidence of chess with an indisputably prolonged history is found, one would still be unable to assert that it constituted the *very* first documentation or chess piece. Perhaps earlier evidence of chess just has not been retrieved. Therefore, although we have essentially narrowed down the possible origins of Chinese chess to India or China itself, no hypotheses can yet be proven. I will maintain a neutral standpoint, while awaiting new discoveries in the future.

## References

- Davidson, Henry. *A Short History of Chess*. New York: Greenberg, 1949. Print.
- Elvin, Mark. *The Retreat of the Elephants*. New Haven: Yale UP, 2006. Print.
- Jones, (Sir) William. *The Indian Game of Chess*. Edinburgh: Private printing for the Aungervyle Society, 1883. Print.
- Schafer, Edward H. *The Golden Peaches of Samarkand: A Study of Tang Exotics*. Oakland: University of California Press, 1985. Print.
- Tu Ching-Ming. "Hsiang Chi, Chinese Chess." *China Reconstructs: Index to Nos. 1-6*. 1954. Print.
- Vollmer, John E., E. J. Keall, and E. Nagai-Berthrong. *Silk Roads - China Ships*. Ontario: Royal Ontario Museum Toronto, 1983. Print.
- 胡適：《考作象棋的年代》
- 金玉國：《中國戰術史》（中國：解放軍出版社，2008）
- 牛增儒、李復言：《玄怪錄》（北京：中華書局出版社）
- 張如安：《中國象棋史》（中國：團結出版社，1998）
- 中國國家體委，運動技術委員會：《中國體育史參考資料》- 第三輯（中國：人民體育出版社）
- 周家森：《象棋與棋話》（中國：文物出版社）

# William Chambers' Portrayal of Chinese Garden Design

*Ernest Ng*

## Introduction

Sir William Chambers (1732-1796) was a Scottish-Swedish architect best known for the Pagoda at the Royal Botanic Gardens at Kew, Surrey. From the young age of 17, Chambers embarked on multiple voyages to Canton (Guangzhou) as the supercargo of the Swedish East India Company and was one of the few Westerners who visited China in his time. Chambers studied architecture formally in Paris and Rome and, in 1757, he published *Designs of Chinese Buildings, Furniture, Dresses, Machines, and Utensils* (abbreviated below as *DB*), a book containing many designs Chambers had sketched while in Canton. *DB* was a huge success due to its detailed descriptions and largely authentic illustrations devoid of the whimsy found in previous "Chinoiserie" publications. Subsequently, in 1772, Chambers published *A Dissertation on Oriental Gardening* (abbreviated below as *DG*), supposedly a more in-depth and academic disquisition on Chinese garden design, which was equally successful. Chambers' conception of Chinese gardens spread to continental Europe as a result, and Chambers was invited to redesign Kew Gardens, where the aforementioned Pagoda still stands today.

Why Europeans were trying to imitate Chinese aesthetics was simple: China had been widely regarded as one of the most powerful countries in the world since the 16th century, when European traders first reached the Chinese coast. "By standard criteria such as size, population, agriculture, commerce, wealth, sophistication, technology, military might, cuisine, learning, literature and the fine arts, the Ming dynasty presided over the greatest nation in the world," wrote D. E. Mungello in *The Great Encounter of China and the West, 1500-1800* (Mungello 3). However, China's geographical remoteness from the Western world and its strict regulation of maritime trade meant that it was difficult for Europeans to access the country. Those who

were fortunate enough to enter China and make it back "returned with tales that surpassed the imaginings of [Europeans]," stated Dawn Jacobson in *Chinoiserie* (Jacobson 7). These new tales, added on top of older ones told in *The Travels of Marco Polo*, which "[presented] a land of wise government and elaborate courtesy, teeming with exotic natural phenomena and bursting with treasures" (Mungello 13). Mungello stated that "the notion that China was a land unlike any other, inhabited by people whose manners and conduct were unknown elsewhere, found fertile soil in the Western mind."<sup>2</sup> So much so, in fact, that Europeans unable to travel to China were seized with a frenzy to obtain Chinese objects. However, as Chinese objects were rare and expensive, European craftsmen decided to satisfy this demand by imitating Chinese aesthetics. Such artifacts were known as "chinoiserie". Jacobson argued that the Chinoiserie movement's very being "depended on an imperfect and romantic understanding of China", as most Europeans had never been to China and were not familiar with Chinese culture (Jacobson 15). In fact, Chinese art was frequently confused with styles from other East Asian countries, such as Japanese lacquer. According to Jacobson, "Goods from China, Japan, Siam and India were assigned random attributions in a spirit of topographical indifference engendered by the belief that it was all so outlandish out there that little purpose would be served by precision" (Jacobson 31). The perceived "outlandishness" of Chinese culture caused it to be considered fashionable, allowing radical and unorthodox Western thinkers to package their ideas as "Chinese" in the hope that their fellow countrymen would be more willing to accept them. Yue Zhuang explained this phenomenon succinctly: "Allegorical Chinese images were often adopted by European authors in the seventeenth and eighteenth centuries because of the general model-effect or cultural superiority that China enjoyed at the time. As previous scholars have noted, the Chinese

models adopted by Europeans functioned as mirrors or disguises for certain values that were inherent in the Western non-orthodox tradition. As models, the Chinese subjects served as a justification for those Western values” (Zhuang).

The Chinoiserie movement consisted largely of distorted and inaccurate images of China. Chambers was unique in that he was one of the few 18<sup>th</sup> century European architects who had actually travelled to China, therefore his observations of Chinese gardens were considered to be well informed. Chambers was widely regarded as an expert on Chinese aesthetics, as evident in the extreme popularity of his two works among European readers (*DB* was translated into French the same year it was published in English). Despite his success, this essay argues that while Chambers’ understanding of Chinese garden design as illustrated in *DB* was mostly correct though superficial. *DG*, on the contrary, was not an authentic account of Chinese garden design, but a vehicle for Chambers to express his discontent with conventional English garden design and to promote his aesthetic ideals. Two aspects of Chambers’ aforementioned works will be discussed in this essay: 1.) the debate between straight and curved lines in Chinese gardens; 2.) Chambers’ views on the Sublime and the Beautiful.

### **Straight & Curved Lines in Chinese Gardens**

Jacques Boyceau (ca. 1560-1633), Louis XIII’s superintendent of royal gardens, wrote in his definitive guide to French classical garden design *Traité du jardinage selon les raisons de la nature et de l’art*, that “the principal reason for the existence of a garden is the aesthetic pleasure which it gives to the spectator” (de la Baraudière). Olivier de Serres (1539-1619), a French landscape architect of the same period, added that “gardens should be seen from above, either from the walls, or from terraces raised above the parterres” (De Serres). This is why examples of the *jardin à la français* (French formal garden), such as those of Versailles, featured shrubs cut into geometric shapes and arranged in symmetrical parterres next to a straight path extending to the horizon, thereby creating the impression of grandeur.

In the preface to *DG*, Chambers criticized the *jardin à la français*, along with “the gardens of Italy, Germany, Spain, and of all the other countries where the ancient (Renaissance) style still prevails,” for being “too refined and too extravagant a deviation from nature”, and the naturalistic English gardens, for their “poverty of imagination in the contrivance” where “so closely is vulgar nature copied in most of them” that they “differ very little from [the] common field” (Chambers, *Designs of Chinese Buildings*, viii).

Chambers offered Chinese garden design as an alternative, saying that “their [Chinese gardeners’] aim is to imitate [nature] in all her beautiful irregularities [...] their skill consists in struggling with the imperfections and defects of nature [...] and in producing, in spite of every obstacle, works that are uncommon, and perfect in their kind” (Chambers, *Dissertation*, 15). However, he also asserted that “they [Chinese gardeners] are not so attached to her [nature] as to exclude all appearance of art: on the contrary, they think it [...] necessary to make an ostentatious show of their labour” (Chambers, *Dissertation*, 16) This matches the view introduced in the classical book of Ming Dynasty Chinese garden design, *Yuan Ye* 園冶, by Ji Cheng 計成 (1582-1642), which dictated that gardens should appear natural despite being manmade (“雖由人作，宛自天界”). Chambers believed that the ethos of Chinese garden design was to “imitate nature as closely as possible while using design to remedy the imperfections of nature”, thus refining nature and creating an idealized landscape (Chen *et al.*, n.p.).

Chambers also stated that Chinese gardeners “avoid all regularity in [their] works, observing nature according to her operations”. In *DB*, he noted that “the Chinese generally avoid straight lines”. Rivers were “seldom straight, but serpentine, and broken into many irregular points,” and visitors “are led, by winding passages cut in the groves to a variety of scenes” (Chambers, *Designs of Chinese Buildings*, 15). Chambers added that Chinese gardeners “take care to avoid an exact parallelism in these walks” and “in their crooked walks, they carefully avoid all sudden unnatural windings, particularly the regular serpentine curves, of



which our English gardeners are so fond; observing, that these eternal, uniform, undulating lines, are, of all things, the most unnatural, the most affected and most tiresome to pursue” (Chambers, *Dissertation*, 55).

Chambers noticed that Chinese gardens consisted of irregular landscapes and curved paths, which was true of 18th century Chinese gardens in general. Chambers’ observations are similar to those of Osvald Sirén (1879-1966), a Swedish art historian who specialized in 18th century Chinese art, who stated in his book *Gardens of China* that “the designers of Chinese gardens tried to avoid everything that might give the impression of stiffness or symmetry.” Furthermore, Sirén observed that “the paths in Chinese gardens seem in their design to have been dominated by an irregularly winding and undulating system of lines” (Sirén 10), hence the lack of straight avenues.

However, while Chambers’ observations that Chinese gardens were not dominated by geometrical forms and symmetric designs was valid, his conclusion that “the Chinese are not fond of walking” as “we seldom meet with avenues or spacious walks [in Chinese gardens] as in our European plantations”<sup>13</sup> was obviously incorrect. There were deeper philosophical underpinnings of Chinese gardens that Chambers failed to acknowledge. All three schools of ancient Chinese thought, Confucianism, Taoism and Buddhism, advocate the belief that nature and human beings are part of an integral whole and should become as one (天人合一). Ideal Chinese gardens, therefore, combine the best of beauty in nature with human-created beauty (art/design), and are seen as representations of the nature-and-human-as-one belief. Chinese gardens, therefore, place great emphasis on the serene *yijing* 意境, “an environment imbued with emotions to form a mental image”. Ji Cheng stated in *Yuan Ye* that a wide variety of harmoniously arranged natural elements in the garden can allow even the smallest of rocks to evoke emotions (“片山多致, 寸石生情”), creating scenes which are tranquil even in the busiest of cities (“能為鬧處尋幽”). According to Chinese garden design scholar Chen Cong-Zhou 陳從周 (1918-2000),

even the smallest of movements in leaves and rocks could affect the composition of garden scenes, and a misplacement of even a single branch could ruin the *yijing* of an entire scene.

The effect of a serene *yijing* in Chinese gardens is created through the process of 借景 (*jiè jǐng*) - which literally translates as “to borrow a view” - a process utilized to create Chinese gardens which Chambers disregarded. Chambers stated that the Chinese “never copy nor imitate each other...saying, what has once been seen, operates feebly at a second inspection; and that whatever bears even a distant resemblance to a known object, seldom excites a new idea” (Chambers, *Dissertation*, 104). However, Chambers was mistaken, as Chinese garden designers often took inspiration from views they enjoyed when designing scenes and replicated these scenes in their creations. The first and foremost priority of garden designers, according to Ji Cheng, is to successfully “borrow a view” (“借景, 尤為則造園者首重之務”). Ji stated that there are no rules for how a view should be “borrowed”, as a view can be “borrowed” as long as the designer is moved by it (“因地借景, 並無一定來由, 觸景生情, 到處憑人選取”). He added that gardens need not be big, as many sensations can be achieved through the theory of 小中見大 (to see much in a small space). Through the philosophy of “seeing much in a small space”, Ji noted that the essence of many pleasant views from near and far can be presented in harmonious arrangements visible to the viewer regardless of the garden’s topology (“園雖別內外, 得景則無拘遠近……極目所至, 俗則屏之, 嘉則收之, 不分町疃, 盡為煙景”).

This, as discussed by the modern scholar Chen Congzhou, means that areas should be subdivided in order to create an illusion of space. The scenes in gardens do not necessarily have to be visual and tangible, but that other sensations such as the wind and the aromas of flowers should also contribute to the experience of enjoying the garden. The beauty of Chinese gardens is the timelessness of both their visual and non-visual views, which offer much room for rumination. This is why, according to Sirén, Chinese gardens can be compared to landscape

paintings using the media of the horizontal scroll, as both are “regarded as a kind of enchanted pleasure ground, from which [one] seeks a way out in vain” (Sirén 10). The sinuous paths of Chinese gardens lead the viewer “farther and farther into a composition that is never completely revealed...[and] as the successive sections unfold themselves, the beholder is enticed always farther into the ideal world of the painter and captivated more and more by the changing sections of the picture” (Sirén 4).

These misconceptions can be attributed to Chambers’ architectural upbringing in France, where the *jardin à la français* prevailed, together with the fact that Chambers never studied Chinese garden design formally and was forbidden from visiting anywhere in China other than Canton. Indeed, Chambers noted with regret in *DB* that “if I was permitted to range over the whole [Chinese] empire, no doubt I could have swelled my work with more examples.” He anticipated the objection that “the suburbs of a seaport (Canton) cannot furnish the proper means for deciding the taste of a nation”. Yet he justified himself by arguing that “when we reflect that Canton is one of the most considerable cities in Asia, and in many respects inferior to none in China, that objection will lose much of its weight.” (Chambers, *Designs of Chinese Buildings*, ii)

To summarize, although Chambers learnt from the Chinese the aesthetic value of curved lines and the importance of meticulousness to creating garden views, he failed to acknowledge the importance of *jiejing* and *yijing*. Because of this, the influence of Chinese gardening on the English landscape garden and the *jardin anglo-chinois* (what became of the Chinese-influenced English landscape garden when it reached France and was combined with French aesthetics) is both valid and superficial.

### The Sublime and the Beautiful in Chambers’ Chinese Garden

Building on his fame established thanks to *DB*, Chambers published *DG* in 1772, which also reached a wide audience. Chambers packaged his ideas in a Chinese guise: one section of *DG* is

ostensibly written from the perspective of Tan Chet-Qua, a Chinese artist who visited Europe during Chambers’ time, and features Tan reiterating Chambers’ ideas on Chinese garden design. However, Chambers never met Tan and only used his name for the narrator of the section of *DG*. This can be seen as an attempt to spread his unorthodox ideas to as wide an audience as possible.

These intentions are illustrated by descriptions in Chambers’ publications which strike a Chinese eye as being utterly alien. Chambers classifies scenes in Chinese Gardens into three types: the enchanted, the pleasing, and the horrid. Enchanted scenes aimed to create a sense of surprise in the viewer through devices such as rapid streams passing underground, “the turbulent noise of which strikes the ear of the new-comer, who is at a loss to know from whence it proceeds” and “monstrous birds and animals” introduced into the scene (Chambers, *Designs of Chinese Buildings*, 15). Pleasing scenes were adapted for different times of day and year, which “constantly practice sudden transitions, and a striking opposition of forms, colours and shades” (Chambers, *Designs of Chinese Buildings* 15), allowing the viewer to “enjoy the scene in its perfection”. Chambers gave examples of viewers being led “through dark caverns and gloomy and passages, [and] on a sudden, struck with the view of a delicious landscape, enriched with everything that luxuriant nature affords most beautiful” (Chambers, *Designs of Chinese Buildings*, 18). Chambers described “lofty woods, where serpents and lizards of many beautiful sorts crawl upon the ground”, and “flowery thickets, where he is delighted with the singing of birds, the harmony of flutes, and all kinds of soft instrumental music...every flower or shrub that flourishes...all uniting to form the finest verdure, the most brilliant, harmonious colouring imaginable” (Chambers, *Dissertation*, 28). The iconic curved lines used in Chinese gardens caused “new arrangement of objects...which [present] themselves at every change of direction” and facilitate the creation of surprises, as “the repetition [of change in direction] creates [a sense of] incertitude of the mind where these repetitions will end...preventing that state of languor in which

the mind naturally sinks by dwelling long on the same objects.”

As for the “horrid” scenes, Chambers described them thus: “Their scenes of terror are composed of gloomy woods, deep valleys [sic] inaccessible to the fun, impending barren rocks, dark caverns, and impetuous cataracts rushing down the mountains from all parts...the buildings are in ruins; or half consumed by fire, or swept away by the fury of the waters: nothing remaining entire but a few miserable huts dispersed in the mountains; which serve at once to indicate the existence and wretchedness of the inhabitants”. There were “...inscribed, on pillars of stone, pathetic descriptions of tragical events, and many horrid acts of cruelty, perpetrated there by outlaws and robbers of former times” (Chambers, *Dissertation*, 41) and “from time to time he (the visitor) is surprised with repeated shocks of electrical impulse, with showers of artificial rain, or sudden violent gusts of wind, and instantaneous explosions of fire; the earth trembles under him, by the power of confined air; and his ears are successively struck with many different sounds, produced by the same means; some resembling the cries of men in torment; others the roaring of bulls, and howl of ferocious animals, with the yell of hounds, and the voices of hunters; others are like the mixed croaking of ravenous birds; and others imitate thunder, the raging of the sea, the explosion of cannon, the sound of trumpets, and all the noise of war” (Chambers, *Dissertation*, 43).

Chambers even mentioned at one point “submerged habitations” and “spacious halls built entirely under water” (Chambers, *Dissertation*, 73). To a Chinese person, these descriptions may seem very foreign, because nowhere in Chinese literature are the terrors of Chinese gardens mentioned. In fact, Ji Cheng stated in *Yuan Ye* that it is every garden designer’s aim to create the illusion that one has retreated to nature in the fashion of a hermit or an old farmer (“歸林得意，老圃有餘”), and that having the ability to enjoy a leisurely life while surrounded by nature is a blessing endowed by celestial beings (“尋閒是福，知享即仙”). Thus, the Chinese garden was meant to be a serene setting for meditation, and terrifying

visitors with grotesque imagery would have betrayed its purpose.

To set these astonishing ideas of the “Chinese garden” in context, it should be noted that, when *DG* was published in 1772, Chambers found himself at a turning point between two movements. The Age of Enlightenment was in decline in Britain, as skepticist philosophers such as Kant and Hume questioned the empirical nature of the Enlightenment, arguing that the world was experienced subjectively through the eyes of people and that man was unable to understand the world objectively. This contributed to the rise of Romanticism, which emphasized subjectivity and emotions over rationality. The idea of the “sublime” was developed in this movement. Edmund Burke (1729-1797), in *A Philosophical Inquiry into the Origin of Our Ideas of the Sublime and the Beautiful*, stated that “the passion caused by the great and sublime is astonishment, and astonishment is that state of the soul in which all its motions are suspended, with some degree of horror [...] No passion so effectually robs the mind of all its power of acting and reasoning as terror; and whatever is terrible with regard to sight, is sublime” (Burke 54) “Sublime” objects were vast, dangerous and had the ability to terrify; the horror and fear caused by the sight of the object was thought to lead to visceral feelings of awe and reverence. Chambers stated that “Chinese gardeners are not only botanists, but also painters and philosophers, having a thorough knowledge of the human mind...it is not in China, as in Italy and France, where every petty architect is a gardener” (Chambers, *Dissertation*, 13).

According to Zhuang Yue, who has commented extensively on the philosophical underpinnings of Chambers’ garden design, “These ‘Chinese’ philosopher-gardeners may be seen as mirrors [of]...British philosophers (e.g. Edmund Burke & Lord Kames [Henry Home]) whose works on aesthetics were written from the perspective of the operation of the senses” (Zhuang n.p.) and had a huge influence on Chambers’ view on garden design. The “beautiful” and “sublime” were not valued as mere aesthetic objects but as constituting the living environment that played an important role in shaping the human

imagination” Zhuang, par. 6). Specifically, it was believed that the environment could impact the human soul physiologically, by causing fibers of the soul to inherit a healthy condition and to oscillate. A sublime landscape, by causing a tensing of the muscles through intense emotions, “was a site for molding British citizens' sensations... [and to] counteract the emasculating effect of the excessive commodities produced by commercial society” (Zhuang n.p.), which would deprive Britons of their vigor. The sublime scenes in Chambers' Chinese gardens placed Britons in the shoes of soldiers going through an arduous journey in order to be strengthened, to “expose the body of British subjects through the purification of war, [and] to create a new martial identity” (Zhuang n.p.).

According to the same Romanticist philosophy, luxurious and “pleasing” scenes in Chambers' Chinese gardens were assigned other philosophical virtues. They “expressed civility, comfort, fashion, taste, and moderation” and “stimulated new ways of thinking about a more civilized way of life”. These pleasing scenes functioned “as an incentive for individual and social-economic improvement” (Zhuang n.p.), as Romanticist philosophers such as Hume had stated that the purpose of luxury was to gratify the senses. The “pleasing” scenes Chambers described also corresponded with ideas of the “beautiful”. Burke defined the beautiful as “those qualities in bodies by which they cause love, or some passion analogous to it.” The beautiful created pleasure in the mind of the viewer.

When *DG* was published, many of Chambers' contemporaries ridiculed Chambers for not delivering an authentic account of Chinese garden design. Chambers admitted this in a letter to his friend Frederick Chapman, a Swedish naval architect, noting that, because *DG* was “a system of my own which as it was a bold attempt of which the success was very uncertain, I fathered it upon the Chinese who I thought lived far enough off to be out of reach of critical abuse.” This illustrates how Chambers used Chinese gardening as a vehicle to express his thoughts, as he knew that his thoughts would be too radical to be taken seriously. In fact, Chambers stated that “if a successful poet

can step down from the clouds for half an hour to read fifty pages of sublunary nonsense (referring to *DG*) I should be very glad to hear his opinion.”

Chambers added that “gardeners, like poets, should give loose to their imagination, and even fly beyond the bounds of truth, whenever it is necessary to elevate, to embellish, to enliven, or to add novelty to their subject” (Chambers, *Dissertation*, 21). Chambers had an even greater ambition for “England abound[ing] with commons and wilds, dreary, barren, and serving only to give an uncultivated appearance to the country...they may easily be framed into scenes of terror, converted into noble pictures of the sublimest cast” (Chambers, *Dissertation*, 131) His vision was for Britain to become “one magnificent vast Garden, bounded only by the sea” (Chambers, *Dissertation*, 134) - an empire which matched his preferred aesthetics. Chambers did not feel the need to create an authentic image of Chinese gardens. Instead, he was using Chinese aesthetics to package his ideas of the Sublime and the Beautiful into garden designs which engaged visitors, honed their martial abilities and cultivated their characters.

Despite the criticisms it received, *DG* became extremely popular as the English landscape garden spread to continental Europe. An example of this is the *folie de Chartres* (now Parc Monceau) in Paris, designed by Louis Carrogis Carmontelle, which featured attendants dressed in Oriental costumes and ruins similar to those Chambers had described in *DG*. The design of the garden was intended to “reserve the charm that one encounters entering the garden, and to renew it with each step, so that the visitor in his soul will have the desire to revisit the garden every day” (Jarrassé *et al.* 77). The *folie de Chartres* was intended to engage and revitalize the viewer similarly to Chambers' ideal garden. Although, by the end of the 18th century, “Chinoiserie and the rococo style were overwhelmed by the French Revolution of 1789 and its return to classicism” (Mungello 100). Chinoiserie continues to be used today to a lesser extent in lacquered screens, china cups and curtains decorated with Oriental flower patterns.

## Conclusion

As one of the few architects who visited China during his time, Chambers was seen (with good reason) by his contemporaries as an expert on Chinese garden design. However, his understanding of Chinese gardening was limited as he never formally studied Chinese garden design. Thus, Chambers failed to understand the spiritual undertones of Chinese gardens and the reasons for their naturalistic appearance. During his career, Chambers was less concerned with providing readers with authentic accounts of Chinese garden design than by using Chinese garden design as a vehicle to express his ideas of the ideal garden. Chambers' descriptions of terrifying and pleasing scenes in Chinese gardens therefore correspond with ideas of the Sublime and the Beautiful as mediums through which the character of Britons could be improved. Although Chambers' influence on the chinoiserie movement in Europe was vast, what was spread across Europe was Chambers' ideal Chinoiserie style of gardening and not an authentic Chinese style.

## References

- Appleton, William Worthen. *A Cycle of Cathay*. New York: Columbia UP, 1951. Print.
- Baraudière, Jacques Boyceau De La. *Traité du Jardinage selon les Raisons de la Nature et de l'art*. Paris: Chez Michel Van Lochom, 1638. Print.
- Burke, Edmund. "Of the Passion Caused by the Sublime and Terror." *A Philosophical Enquiry into the Origin of Our Ideas of the Sublime and Beautiful*, 53-55. London: R. and J. Dodsley, 1757. Print.
- Chen, Miao-miao, Xia-qing Zhu, Yu-nan Guo, and Xin Wang. "威廉·錢伯斯和他的中國園林觀. (Sir William Chambers and His Perceptions of Traditional Chinese Gardens)." *Journal of Beijing Forestry University*(Social Sciences) 13, 3 (2014): 44-49. Print.
- Clifford, Derek Plint. *A History of Garden Design*. New York: Praeger, 1966. Print.
- Chambers, William. *A Dissertation on Oriental Gardening*, 2nd edition. London: W. Griffin, 1773. Print.
- Chambers, William. *Designs of Chinese Buildings, Furniture, Dresses, Machines and Utensils*. London: W. Griffin, 1757.
- De Serres, Olivier. *Théâtre D'architecture Ou Mesnage Des Champs*. Paris: MDC, 1600. Print.
- Jacobson, Dawn. *Chinoiserie*. London: Phaidon, 1993. Print.
- Jarrassé, Dominique, and Jacques Lebar. *Grammaire Des Jardins Parisiens: De L'héritage Des Rois Aux Créations Contemporaines*. Paris: Parigramme, 2007. Print.
- Mungello, D. E. *The Great Encounter of China and the West, 1500-1800*. Lanham, MD: Rowman & Littlefield, 1999. Print.
- Sirén, Osvald. *Gardens of China*. New York: Ronald, 1949. Print.
- Zhuang, Yue. "'Luxury' and 'the Surprising' in Sir William Chambers' *Dissertation on Oriental Gardening* (1772): Commercial Society and Burke's Sublime-Effect." *Transcultural Studies* 2 (2013). Web. Accessed 9 Nov 2015. <http://heiup.uni-heidelberg.de/journals/index.php/transcultural/article/view/10072>.
- 陳從周. 園韻. 傷害: 上海文化出版社, 1999. Print.
- 計成, and 陳植. 園冶註釋. 北京: 中國建築工業出版社, 2009. Print.
- 謝選駿. "謝選駿: 从园林历史看第二期中国文明的存在." 博讯新闻网. 博讯新闻网, (2014).  
Web. Accessed 9 Nov 2015.  
<http://www.powerapple.com/news/articles/1408225>

blank page  
空白頁



