

ARISTOTELIAN LOGIC IN CHINA—A CASE STUDY OF THE CHINESE TRANSLATIONS OF EUCLID'S *ELEMENTS*

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Abstract: Chinese logic and Aristotelian logic are very different. The communication between these two language games is generally difficult. But, the attempt to understand the unfamiliar and the novel are commonalities of human beings. To understand different ways of thinking, effort must be made from both sides. The evidence that strongly supports this argument is the discourse between Jesuit and Chinese mathematicians in 17th century China. They applied a common rule, Pointing Out, which make it possible, while doing geometry, for Aristotelian logic to be understood gradually by the Chinese. This dialogue is an excellent example of keeping space open for the sense of wonders. This is the hope for human knowledge.

Introduction

THIS PAPER discusses how Aristotelian logic was introduced to China via three editions of the translation of Euclid's *Elements*, Matteo Ricci and Xu Guangqi, *Jihe Yuanben Books I-VI*, 1607; Alexander Wylie and Li Shanlan, *Jihe Yuanben Books I-XV*, 1865; and Lan Jizheng and Zhu Enkuan, *Jihe Yuanben*, 2003. Making the Chinese understand Aristotelian logic is a long and difficult process. Traditional Chinese logic is the logic of the practice; it studies how to distinguish a strong argument from a weak one in a changing world instead of a world with the pre-fixed order. The latter is the presumption of Aristotelian logic. Chinese logic discerns how to define a thing in associations instead of the relations of terms, which are determined in the order of a hierarchical system of classification of genus and species. Again, the latter is a characteristic of Aristotelian logic. A strong feature in Chinese logic is pragmatism. For Chinese scholars, gaining the pragmatic benefits is inseparable from doing logical reasoning, including doing mathematics. Studying the relations among particular objects or concrete concepts is much more attractive to Chinese logicians and mathematicians than studying how to purify universal terms or abstract concepts from particular objects. These differences are the reason why Aristotelian logic was first recognized by the Chinese through the study of the geometry book, *Jihe yuanben*, instead of the study of Aristotle's work on logic, such as *Mingli tan* (Francisco Furtado and Li Zhizao 1631), a translation of Aristotle's *Categories*, which was not popular among the Chinese even until last century.

In this paper, I shall analyze why the Chinese prefer to accept Aristotelian logic through learning geometry instead of learning Aristotle's *Categories*. I shall explore the bridge that communicates Jesuits' and Chinese mathematicians' logical thinking in the first *Jihe yuanben*. My standpoint is that the logical gap between Aristotelian

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logic and Chinese logic has existed since Ricci and Xu started their translation. However, they applied the rule of “指 *zhi*, Pointing Out” in Chinese logic or “Ostensive Definition” in Aristotelian logic in *Jihe yuanben Book I-VI*. They added many diagrams to illuminate the basic geometry definitions. This work was carried on by Li Shanlan in doing the entire *Jihe yuanben Book I-XV*. Pointing out or ostensive teaching of concepts establishes an association between a Chinese geometrical term and an object. It brings the universal or abstract terms (which are lacking in Chinese logic) in Euclid’s *Elements* down to earth. The Pointing Out rule functions as the bridge in continuing the discourse between Aristotelian logic and Chinese Logic. Though the Pointing Out rule has serious limitations, which, in fact, has made Aristotelian logic a “Chinese-Aristotelian” logic, applying this rule is the starting point of teaching the traditional Western way of thinking in China. After four hundreds years, the third edition of *Jihe yuanben* carries the mission of representing the essence of Euclid’s *Elements* and reintroducing Aristotelian logic to the Chinese. It is also an attempt to overcome the limitations caused by the Pointing Out rule, or the influence of traditional Chinese logic. My conclusion is that the discourse between two different language games¹, like children studying basic words, starts with pointing out or ostensive teaching. The Pointing Out rule brings the hope of mutual understanding, though not completely. This case study of the Chinese translations of Euclid’s *Elements* represents the path of how Chinese may accept Aristotelian logic little by little. It also shows the potential possibilities of the communication between the two language games.

I. A Brief Review of Aristotelian Logic in China

Aristotelian logic was seriously introduced to China via the Chinese translation of Euclid’s *Elements Books 1-VI*, *Jihe yuanben* 幾何原本 in 1607. The first edition of *Jihe yuanben Book I-VI* (C. Clavius’ 1574 edition)² was a cooperative effort between Italian Jesuit, Matteo Ricci (1552-1610), founder of the Chinese mission in the 16th-17th centuries, and Chinese mathematician, Xu Guangqi 徐光启 (1562-1633), a scholar of the prestigious Imperial Hanlin Academy. Exactly 250 years later, the rest of the nine books (Books 7-15) of *Elements* was translated by Protestant missionary Alexander Wylie and Chinese mathematician Li Shanlan 李善兰 (1811-1882) in 1857

¹I use this term in a Wittgenstein sense. Wittgenstein treats language as a co-ordinate system. He calls the whole of language, consisting of language and the actions into which it is woven, the “language-game” (Wittgenstein, *Philosophical Investigations*, 5e7). He thinks that in different logical co-ordinate systems, analogous to different geometries, “it is as impossible to represent in language anything that ‘contradicts logic’ as it is in geometry to represent by its co-ordinates a figure that contradicts the laws of space, or to give the co-ordinates of a point that does not exist” (Wittgenstein, *Tractatus*, 3.032, 11).

²Before Mateo Ricci and Xu Guangqi’s translation, a Chinese mathematician, Qu Taisu 瞿太素 translated Book I of the *Elements*, but this work was not preserved. See Peter M. Engelfriet’s *Euclid in China*, 132, 1998

(Playfair's English version). The entirety of Euclid's *Elements* (15 Book version) was published by Zheng Guofan 曾國藩 in 1865. A new Chinese translation of Euclid's *Elements*, *Jihe yuanben* (Thomas Little Heath's 1956 English version) appeared again in 2003, which was completed by Chinese modern mathematicians, Lan Jizheng 蘭紀正 and Zhu Enkuan 朱恩寬. In the preface of Lan and Zhu's, *Jihe yuanben* (2003, Sanxi Science Press), it states, "Years and years, millions of people received the training in logic through the study of Euclid's *Elements*, and from there they walked into the palace of science" (Lan 蘭 and Zhu 朱 2003, 1).

In 1603, before *Jihe yuanben Books I-VI* was published, Ricci, in fact, had introduced several typical Aristotelian concepts, such as the four types of cause, the four elements, being, and the ten categories in his Chinese theological work, the *Tianzhu shiyi* 天主實義 *The Full Meaning of the Lord of Heaven* (See Engelfriet, 1998, 70-71). Not much later after *Jihe yuanben Book I-VI* was published, the other Chinese scholar, Matteo Ricci and Xu Guangqi's close friend, Li Zhizao 李之藻 also worked with the Jesuit Francisco Furtado and translated Aristotle's *Categories* into Chinese. The title of the book was *Mingli tan* 名理探, which was published in 1631. But the work that introduced Aristotle to the Chinese was not very successful. While Ricci' and Xu 's *Jihe yuanben Book I-VI* as an important mathematics book later was taken up as part of *Siku quanshu* 四庫全書 (compiled between 1773-1781), a huge collection of imperial manuscripts, neither Ricci's *Tianzhu shiyi* nor Li Zhizao's *Mingli tan* was included in the collection. Aside from the public's reaction towards the above books, the two Chinese translators' responses to each of their works were also different. After finishing the first six books of *Jihe yuanben* in six months, Xu Guangqi was enthusiastic, and wanted to complete the entire book.³ By contrast, Li Zhizao spent five years working on *Mingli tan* "with an obvious consequent loss of interest" (Wardy 2000, 72).⁴ In his *A History of Chinese Mathematics*, Jean-Claude Martzloff summarizes, "From the very beginning, Aristotle had no success in China" (Martzloff 1987, 116).

Though no Chinese understood Aristotelian logic at the beginning, *Jihe yuanben*, as a mathematical text and source of logical training, became more and more popular in China over the last four hundred years. Today, the logic system of geometry that *Jihe yuanben* introduced is still the crucial foundation of the high school texts in

³In Ricci's preface of *Jihe yuanben*, he said, after the first six books were finished, Xu Guangqi "yi fang rui, yu jing zi. Yu yue, 'zhi, xian qing chuanci.' 大史 意方銳, 欲競之。余曰: 止。先請傳此" ("The great scholar was very enthusiastic and wanted to complete the whole translation, but I said: 'No, let us first circulate this in order that those with an interest make themselves familiar with it'" (Engelfriet 1998, 460).

⁴Li Zhizao said that during the five years, " Because the language was so rarefied, thorns have come into my throat, and several times on account of difficulties I have set aside my pen (屢因苦難擱筆)" (Wardy 2000, 152).

China (Lan and Zhu 2003, 650) . By contrast, studying Aristotelian logic itself is still considered as difficult work. If the Chinese were able to accept the logic in *Jihe yuanben*, then why did they ignore Aristotelian logic itself for so many years? If this ignorance was caused by a gap between Chinese logic and Aristotelian logic, then, how could it be possible that the gap exists merely between Chinese logic and Aristotelian logic, but not the Aristotelian logic in Euclid's *Elements*?

I shall argue that it is a fact that there is a gap between Chinese logic and Aristotelian logic, and this gap exists also between the logic in Chinese mathematics and that of Euclidean mathematics. However, in working this book, *Jihe yuanben*, the Jesuit and Chinese mathematicians found a “bridge,” or a common rule, which both Chinese and Aristotelian logicians and mathematicians accepted. This rule is 指 *zhi*, Pointing Out/Ostensive Definition. This rule functioned as a bridge that links the two different language games and made the discourse possible. When the language games went beyond the mathematical content introduced by *Jihe yuanben*, such as in the field of pure theoretical Aristotelian logic, the rule failed to function. No bridge links the discourse between the language-game players. In other words, Chinese logicians failed to locate the certain kind of the Aristotelian terms, categories, propositions and even syllogisms in their own logical system, such as using universal terms or universal propositions. This resulted in the unsuccessful introduction of Aristotelian logic to China. In following, I shall take Ricci and Xu's *Jihe yuanben Books I-VI* as an example to analyze the gap between Chinese and Aristotelian logic and demonstrate how rule, 指 *zhi*—Pointing Out, functions.

II. The Gap between the Logic in Ricci and Xu's *Jihe yuanben Books I-VI* and that in Euclid's *Elements*.

When Ricci and Xu translated the title of Euclid's *Elements*, they put the terms “*jihe*, 幾何” before *yuanben* (basic elements). According to Peter Engelfriet, originally, “the term *jihe* was not intended to mean geometry at all, but it referred to the Aristotelian category of Quantity, one of the ten categories of Aristotle's *Categories*” (Engelfriet, 1998, 139). Quantity (*jihe*) can be broken down into discrete quantity (number, *shu* 數) and continuous quantity (magnitude, *du* 度). Measures and Numbers are, in fact, the content of general mathematics.⁵ In the preface of *Jihe yuanben*, after Xu criticizes that the Chinese in the later Ming dynasty lost their “rock-solid traditions” of learning mathematics, Xu Guangqi states:

⁵In *Euclid in China*, Peter Engelfriet has a detailed explanation of why Ricci and Xu chose the Chinese words “*jihe*, 幾何” to translate “geometry.” He quotes from the beginning of *Jihe yuanben*, “In all matters pertaining to calendrical methods, geography, music, the crafts and arts, there is Measure (*du* 度) and there is Number (*shu* 數). This is all subordinated to one of the ten categories (*shi fu* 十府), the category of Quantity (*jihe fu* 幾何府)” (Engelfriet 1998, 138-142).

The *Jihe yuanben* is the Ancestor of Measures and Numbers; it is that by which one exhausts all the aspects of the square, the round, the plane and the straight, and by which one completely covers the use of compasses, carpenter's square, water-level and measuring rope (Engelfriet 1998, 294).

Xu Guangqi believes that learning *Jihe yuanben* will lead the Chinese people back to *de* 德, virtue that the ancient sages set up⁶. In his *Jihe yuanben zaji*, he says:

In dedicating oneself to study, there is theory (*li* 理) and there is practice (*shi* 事). [For both] this book had much to offer: it can help someone who studies the theory to improve his concentration (lit. “drive off floating *qi* 氣”) and to refine his intellect; for someone who applies himself to practice it can provide him with fixed methods, and it can bring out his creativity. Therefore, everybody should study it [this book] (Engelfriet 1998, 294)

How Euclidean geometry could be employed to lead the Chinese people back to their virtues is a question way beyond any Euclidean scholar's imagination. But, Xu clearly states in the conclusion of *Jihe yuanben zaji*, studying *Jihe yuanben* will “bring the people of this world to return to solid practice (*shiyong* 實用)” (Engelfriet, 1998, 294). “Solid practice” is the field that Chinese mathematicians and logicians are interested in and working for. It is the virtue that Chinese ancient sages set up. In the “solid practice,” the category of Quantity in Chinese mathematicians' minds refers to the employment of Measures and Numbers in music, calendar, astronomy, geography and so on. Unlike the category in Aristotle, Quantity in Chinese mathematics was not understood as a genus that could be predicated, but rather as the characteristics found in various particulars. Chinese mathematics deals with the logic in practice merely. In the framework of traditional Chinese mathematics and logic, what Xu Guangqi describes in the above quote is clearly pragmatic. Xu hopes that, by learning Euclidean geometry, the Chinese could be led back to solid pragmatic ground.

Reaping pragmatic benefits is clearly not the expected consequence of either Euclidean geometry or Aristotelian logic. Joannes Stobaeus (around 500 A. D.) recorded a story of Euclid and one of his students. After this student learned the first principle, he asked what he would get after he studied geometry. Euclid said, “Give this man three pennies and let him go. He wants to get the benefits from geometry.”⁷ This story says that the pre-condition for one to learn geometry is giving up any pragmatic purpose. The common belief is that the logic in *Elements* has a clear

⁶In regards to the work of ancient sages, Xu refers to *He Tu* 河图 and *Luo Shu* 洛書, Lu Ban 魯般's and Mozi 墨子's approaches in the preface.

⁷See Lan and Zhu, *Jihe yuanben*, 2003, 2. and T. L. Heath, *A manual of Greek Mathematics*, 1931, 203.

cutting line from the logic in practice. Based on Aristotelian deductive logic, Euclid's *Elements* is organized into the form of propositions, derived via deductive chains from "first principles." Using as few "first principles" as possible, Euclid develops out a paradigm of scientific reasoning in geometry, which describes an abstract paradigm. Mateo Ricci, a Jesuit born at the end of the Middle Ages, received strict training in Aristotelian logic and Euclidean geometry at the Roman College, where Euclid was studied mainly as an adjunct to the works of Aristotle (Engelfriet, 1998, 18-23). He knew clearly that to Aristotle, the goal of science was the acquisition of certain and infallible knowledge. The idea of classification of disciplines set an order of genus and species for each branch in science. Geometry was offered as a paradigm to meet the order. It required that demonstrations should be cast in syllogistic form. In the preface of *Jihe Yuanben*, Ricci says:

The principles of nature are subtle and hidden, while human capacities are limited. If one is not based on what is already understood to deduce what is not yet known how would one be able to extend one's knowledge? ...Number and Measure, in abstraction from the physical particularity of objects, lead to the school of arithmetic and that of geometry respectively (Engelfriet 1998, 454).

Here, Ricci describes the framework of Aristotelian syllogism. Knowledge should be secured on premises that we have known to be true, since Aristotelian logic is a logic of terms with strict classification and rules. A syllogism is a deductive proof implying the order of the hierarchical system of classification. If all the premises are true and the steps of the deduction follow the rules, one can expect to develop a valid argument in order to reach a true conclusion. Ricci continues:

Preceding the propositions and proofs the definition has been laid down. After that the general principles have been formulated on which the propositions and proofs rest. Next, the propositions follow. They give an explanation of the problem, and a manner of construction or proof. What comes later, is founded upon results that have been obtained before ...Nowhere can the order be reversed; it is one unbroken chain. The undoubtable principles at the beginning are extremely simple and clear (Engelfriet 1998, 458).

Obviously, what Ricci tries to introduce to the Chinese is Aristotelian logic as represented in Euclidean geometry. According to Aristotelian logic, from one proposition to the other, a middle term is required. The key relations with which it is concerned are the opposition between contrary terms and the hierarchy of classification--from genus down to species, sub-species and so on. This is clearly not the pragmatist virtue set up by ancient Chinese sages. The gap between Chinese logic and Aristotelian logic, similar to the cases in translating other Aristotelian logical works, exists in the project of translating Euclid's *Elements* as well. How could this gap be bridged? I think that besides Ricci's deep understanding of Chinese culture and Xu's enthusiasm to Western mathematics, one of the important reasons is that they applied the rule of Pointing Out in their translation, which makes their conversations go on.

III. The possibility of Pointing out “Measures and Numbers” in the Logic of Practice

In Aristotle, “Quantity” is a category abstracted from particulars. By contrast, for the Chinese, “Quantity” as Measures and Numbers cannot be separated from particulars. The crucial difference here is that in the Chinese language game, universal categories have no positions. In Aristotle, there are ten categories which are not predictable. They are universal. Quantity is one of the ten, like Time, Relation, and Quality etc. In solving the problem, the Jesuit and Chinese mathematicians applied a sufficient rule, which both Aristotelian logic and Chinese logic accept—*zhi* 指, Pointing Out in Chinese logic, or Ostensive/Demonstrative Definition in Aristotelian logic. In Chinese logic, the rule, *zhi* 指 was emphasized in the *Later Mohist Canons* and used by many other philosophers in different schools since the pre-Qin and pre-Han periods. The left part of Chinese character 指 *zhi* is a hand radical; the right part of 指 *zhi* is “旨,” means “meaning.” The essence of 指 *zhi* is “pointing out.” *The Later Mohist Canons* says:

有指，於二而不可逃。說在以二參...若智之，則當指之。(經下說，39) Pointing out something is in two things. Explained by: using the two to align. If you know Xs, try to point them out (Graham 1978, 405-406).

A. C. Graham summarizes that the word 指 *zhi* has three main functions: 1) Noun, “finger”; 2) Verb, “point out one form another”; 3) Noun, “meaning,” the direction in which discourse points, its meaning or drift, the main point in contrast with details or side issues (Graham 1978, 458). He says:

We have plenty of evidence as to how pre-Han philosophers used the word *chih* [*zhi*], both as a verb (“point out”) and as a noun (“what is being pointed out”); they applied it not only to the gesture of pointing but to the meaning of discourse and the meanings of word. To ignore the philosophical evidence and start by asking which of the concepts of western philosophy fits the Chinese argument (“universal,” “quality,” “logical class”) is wrong-headed in principle (Graham 1978, 458).

Chinese philosophers used the rule of “Pointing Out” again and again in their dialogues and debates⁸. They used this rule to separate one event from the other and

⁸In my paper, “The Role of Time in the Structure of Chinese Logic” (*Philosophy East and West*, January, 2006), I list the following examples of the discussion about “*zhi*, Pointing Out” among Chinese scholars: “Gong Sunlong in Name School, Zhuang Zi in Daosim and other Chinese philosophers all have discussions on the rule, ‘Pointing Out.’ Gongsun Long says: “且指天下之所兼。天下無指者，物不可謂無指也。Moreover [the pointed out] meanings are collected together by the world. That nothing within the world is the [pointed out] meaning is in the case of things; it being inadmissible to pronounce that nothing is the meaning...” (Graham 1978,

one relation from the other. It is a popular rule in Chinese logical reasoning. Engelfriet points out: “A Chinese term for “demonstration”: The term, *zhilun* 指論, “discussing by pointing out,” was meant in a literal way: arguing something with the help of a model or diagram” (Engelfriet 1998, 150).

The term is explained as follows (Xu Zongze, 279): “If with the hand you point to a thing to exhibit [something] to somebody, he looks at it and gets [the point]: that is called demonstration” (如一手指物示人, 舉目即得, 名為指論) (Engelfriet 1998, 150 footnote). Ostensive/Demonstrative Definition in Aristotelian logic is an acceptable way of defining a term by pointing to its referent. “An ostensive definition refers to the examples by means of pointing, or by some other gesture” (Copi 2002, 119). “Since the object of pure scientific knowledge cannot be other than it is, the truth obtained by demonstrative knowledge will be necessary” (Wittgenstein 1953, 73a, 20). For example, if I want to define what is a *dian* 點 (point), I can make a dot on the paper and then point to the dot and say, “This is a *dian*.” That would be an ostensive definition of *dian*. “Discussing by pointing out” was exactly what the Jesuit and Chinese mathematicians did in *Jihe yuanben*. Starting with the first definition of a *dian* 點 (point), all the way until the end of the book (both six and fifteen books versions), diagrams accompany almost every proposition and problem. In fact, when Li Shanlan authored the fifteen books version, he even added more diagrams in *Jihe yuanben Books I-XV*. With the help of diagrams, *Jihe yuanben* gives definitions to geometrical terms, introduces axioms, proves propositions, adds explanations and discusses problems. The following are the first five definitions among 36 definitions in Ricci and Xu’s first book of *Jihe yuanben Books I-VI*. I use Engelfriet’s translation for the definitions. I italicize the commentaries or explanations, which are clearly not from the original text but which Ricci and Xu add in or quote from other sources, and include the diagrams that they used to illuminate the definitions. My comments are in the parentheses:

1. A point: it has no part.

Commentary: It has no length and breath, nor thickness. As the following diagram shows (This is the alternate definition which Ricci and Xu give to describe “a point”).

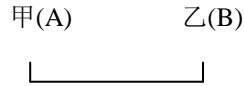
甲 (A)



462). Sun Zi, a pre-Qin philosopher in the field of the philosophy of war, says: “故知者為之分別, 制名以指實。Therefore wise men made divisions and distinctions on behalf of them and instituted names in order to point out objects” (Graham 1978, 458). Zhuang Zi says: “周, 備, 鹹三者, 異名同實, 其指一也。These three, *zhou*, *pian*, and *xian*, are different names for the same object; their pointed out meaning is one.” Yan Shigu (581-645), a linguist of the Sui Dynasty says: “指謂義之所趨, 若人以手指物也。Meaning refers to what the sense runs to words, like a man pointing out a thing with his hand” (Graham 1978, 459).

2. A line has length; it does not have breadth.

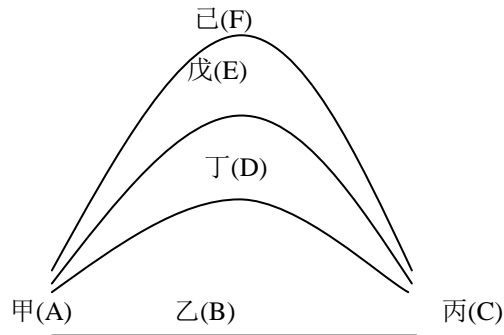
Commentary: The separation between shadow and light on a surface forms a line (This example is not given by Clavius' text).



3. The extremities of a line are points. *Explain:* If a line has boundaries, its boundaries at the two ends must be points (This explanation was written in smaller font after the definition of "line." It is a traditional Chinese way to explain the sentence. Ricci and Xu add their explanation after).

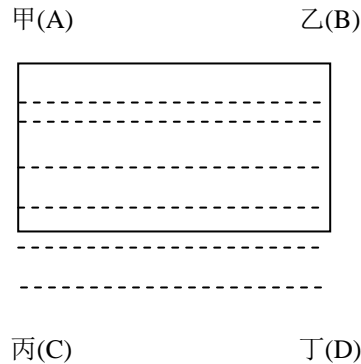
4. A straight line has only two ends [?]; above and below those ends there are no other points.

Commentary: The shortest way between two points is a straight line; if it is slightly curved it is already a deviation and a longer way. (This is an Archimedean definition)



5. A surface has length and breadth only.

Commentary: the shadow of a body resembles a surface in the extreme. If you imagine a line that moves transversely, the trace that remains forms a surface. (This is added by Ricci and Xu)



(Ricci and Xu, *Jihe yuanben Books I-VI*)⁹

With the comments and diagrams, one can see that the abstract concepts, such as “point,” “line,” “surface” are brought down to the concrete figures or particular things. The Chinese character “*dian* 點, point,” which means “a dot” literally, is pointed to a diagram of a “dot.” It becomes a physical mark or an objective dot, but no longer a dimensionless and immaterial “point” in the Euclidean sense. The Chinese character “*xian* 線(line),” which means “a thread made of silk” literally, points to a diagram of a piece of “thread” with two ends. It becomes a particular line or a piece of thread, but no longer a line which is breadthless in length, being in the same plane and being produced without limit in both directions, and does not meet in either direction. The Chinese character *mian* 面 (surface), which means “a [flat] face/side” literally, points to a diagram of a rectangle with six break lines, which represent the image of the moving lines on a surface. It is no longer a surface which has no thickness and spreads in all directions. By doing so, each of these Euclidean geometry terms points to a particular figure, and becomes a term that can be understood in Chinese mathematics—the field of a “sold practice.”

⁹The English translation is based on Engelfriet’s discussion in pp. 155-159 (1998). The original Chinese is the following (diagrams are not included in the footnote):

第一界：點者無分。

無長短廣狹厚薄。

第二界：線有長無廣。

試如一平面，光照之。有光無光之間，不容一物，是線也。...

第三界：凡線之界是點。[凡線有界者，兩界比是點。]

第四界：凡直線止有兩端。兩端之間上下更無點。

兩點之間至徑者直線也。稍曲則繞而長矣。...

第五界：面者，止有長有寬。

...凡體之影極似與面，[無厚之極]

想一線橫行所留之迹即成面也。

IV. A “Chinese-Aristotelian” Logic after Applying the Rule Pointing Out

The questions are raised. Why did Jesuit mathematicians accept these diagrams or changes? Can Aristotelian deductive rules still function?

For the first question, I think that one has to pay attention to the inconsistency of Aristotle’s work. When Aristotle discussed the problems in the real world, he himself did not always use his logic, the hierarchical system of classifications, as guidance. Jesuit philosophy, mainly Aristotelian philosophy, was fundamentally realistic. Basic mathematical concepts for them were derived from and secondary to natural bodies.¹⁰ This means that to represent an abstract/universal term “X” by a particular member “a” in the set “X” is not a terrible way of thinking for Jesuit mathematicians to accept.¹¹ It is true that Greek mathematics tends to separate abstractness from objects. But if speaking fairly, as Engelfriet says, “Although, undoubtedly, the Greek made exactness and logical rigor into a very important requirement, those concepts are not identical with “abstractness” [...] in Aristotelian context geometrical objects were at most idealizations of real sensible objects, in which they were taken to be present in ‘potency’” (Engelfriet 1998, 108). Therefore, even though Euclid wants to use as few as possible diagrams because few diagrams might easily refer to particular objects/figures in the world of experience, which can never be accurate or perfect, Euclid’s *Element* still involves diagrams. More specifically, Euclid’s *Elements* used the diagrams to demonstrate the steps of solving problems. These facts opened up the possibility for Jesuit and Chinese mathematicians to employ diagrams to point out what a definition meant.

For the second question, I think that one can look at *Aristotelian Square of Oppositions* with a singular predicate. Aristotelian syllogisms are composed of four types of propositions. As I mentioned before, the key relations with which syllogisms are the opposition between contrary terms and the hierarchy of classification—from genus down to species, sub-species and so on. The four types of propositions are:

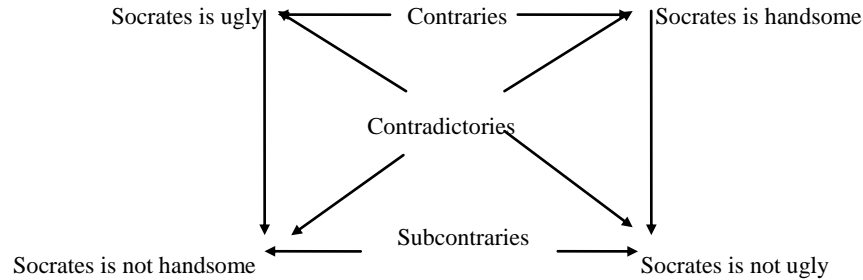
- All S is P (A)--Universal affirmative
- No S is P (E)--Universal negative (denial)
- Some S is P (I)--Particular affirmative
- Some S is not P (O)--Particular negative

In Aristotelian logic, a proposition with a singular predicate, such as “Socrates is beautiful”(A) is treated as a universal affirmative and “Socrates is ugly”(E), a universal negative, for “Socrates” is a single subject, if “Socrates is beautiful,” it would mean that “(All) Socrates is (are) beautiful.” Therefore, the traditional *Square*

¹⁰See Engelfriet 1998, 40, footnote 127: Baldin, *Legem imone subactis*, p. 10.

¹¹In the proposition logic, the rule UI (Universal Instantiation) allows this shift. For example, $(x)(Dx \supset Px)$ can move to the proposition, $Da \supset Pa$ by UI. The propositions in the example read: “Given any x, if x is a *dian* x then it is a *point* x.” By the rule UI, it is valid, “if it is a *dian* a, then it is a *point* a.” But, when a deductive proof ends, by the rule UG (Universal Generalization), one has to change the “a” back to “x.”

of *Oppositions* has two kinds¹². One is the *Square of Oppositions* made by the above four types of propositions; the other is the *Square of Opposition* with singular predicates. The latter is the following:



In the above the *Square of Oppositions* with singular predicates, though Socrates is a particular man, the contrary relations of the four types of propositions, which the syllogism involves still exist. Therefore, when a particular dot was pointed out to be the replacement of an abstract/universal point, the sentence, “this is ‘*dian* (point)’” becomes a singular predicate proposition. It can be treated as a universal affirmative in the Aristotelian sense, like “Socrates is beautiful.” It is because if “this (the dot that I point out) is ‘*dian* (point),’” then “(All) this (the dot that I point out) is/are ‘*dian* (point).” If the relations among the four types of propositions are similarly represented by the *Square of Oppositions* with singular predicates, it follows that Aristotelian deductive rules can be performed among the four types of propositions with singular predicates as well. Therefore, after Jesuit and Chinese mathematicians refer a definition of a term to a particular diagram, what they discussed in *Jihe yuanben* becomes either the relations of particular propositions (*I* and *O* types) or the relations in the *Square of Oppositions* with singular predicates. In this way, Aristotelian deductive proofs turn into “Chinese-Aristotelian” deductive proofs. The problems caused by the lack of “universal concepts” and the understanding of the classification of genus and species in the Chinese language game are covered at the natural language level, though they still exist at the logical level. It is the method by which assisted by the rule, Pointing Out, Chinese logic was bridged with Aristotelian logic. While Aristotelian readings of “point,” “line” or “surface” are idealistic

¹²In their paper, “Could Aristotelian *Square of Opposition* be Translated into Chinese,” Mary Tiles and Jinmei Yuan says, in footnote, “Classical logic did not distinguish these two kinds of universals until Frege. Frege is the first person who distinguishes these two kinds of universals. He thinks that in the proposition ‘All A is B,’ ‘A’ and ‘B’ both are classes. A is included in B ($A \leq B$); but in the proposition ‘a (singular subject) is B’ ‘a’ is a member of ‘B,’ where ‘A’ is an individual but ‘B’ is a class. The second kind of proposition says that ‘a’ belongs to B ($a \in B$). The relation of inclusion is transitive. But the relation of belonging is not transitive. If $A \leq B$ and $B \leq C$, then $A \leq C$. But in $a \in A$, one can treat A class as belonging to some other kind of class. It does not follow that ‘a’ belongs to the other class” (June 2006, *Dao, A Journal of Comparative Philosophy*).

abstract and immaterial, the Chinese understand them as “*dian*,” “*xian*,” or “*mian*” which are particular objects in their logic of practice. This is the situation that Wittgenstein points out:

Doubtless the ostensive teaching helped to bring this about; but only together with a particular training. With different training the same ostensive teaching of these words would have affected a quite different understanding (Wittgenstein 1953, 6. 4e-5e).

The above problem of changing Aristotelian logic to “Chinese-Aristotelian” logic shows that the rule of Pointing Out or Ostensive Definition has serious limitations. For example, one can indicate only what is visible. When the discussion turns to some other “categories,” such as “quality,” “relation” and so on, one can hardly find any ostensive way to define them. That is why Li Zhizao had a difficult time in translating Aristotle’s *Categories*, and his translation of *Categories*, *Mingli tan* did not receive a warm response in China. Four hundred years have passed since Ricci and Xu’s *Jihe yuanben Book I-VI* was published. Chinese people’s understanding of the way of traditional Western thinking has become much deeper now. The limitations of Pointing Out or Ostensive Definition in translating *Jihe yuanben*, both the six volume and the fifteen volume editions are being discovered by contemporary mathematicians. In the preface of Lan and Zhu’s 2003 edition of *Jihe yuanben*, they point out, “The two older versions of *Jihe yuanben* have huge differences from Euclidean original *Elements*”(Lan and Zhu 2003, 1). They also say, “In fact, during the Ming and Qing dynasties [17th-18th centuries], almost no scholar studied the approaches of derive propositions from the ‘first principles’ and systems of deductions” (Lan and Zhu 2003, 14). That is why they decided to re-translate Euclid’s *Elements* according to diagrams that were used to illuminate definitions in the beginning of the older *Jihe yuanben*. In other words, they tried to get rid of the inaccurate resulting from the influence of Chinese logic. This is a good example of Chinese scholars starting to discover the real Aristotelian logic in *Elements*.

Conclusion

For the Chinese, Aristotelian logic is like a foreign language. From its presupposition to its system of deduction, Aristotelian logic is represented as a different co-ordinate system to Chinese. When Aristotelian logic met traditional Chinese logic in 17 century, there were three options involved: 1) Using Aristotelian logic to replace Chinese logic. The unsuccessful consequence of introducing *Mingli tan* proved that it is almost impossible. 2) Using Chinese logic to reject Aristotelian logic. Some Chinese scholars tried to do so; they paid attention only to the methods of solving geometry problems instead of the logic in *Jihe yuanben*¹³. By doing so, neither did

¹³Even Mei Wending 梅文鼎, a famous Chinese mathematician in Ming dynasty, did not paid enough attention to the logic system in *Jihe yuanben*.

Chinese logic make progress, nor did Aristotelian logic disappear. 3) Finding a way to continue the discourse between these two language-games. This was the way opened by Ricci and Xu by applying the rule Pointing Out. The success of introducing *Jihe yuanben* proved that it was an effective way to develop a mutual understanding between these two different language-games. The path of studying *Jihe yuanben* indicates that as long as the discourse continues, the hope of a mutual understanding exists. This hope will sooner or later lead to a deeper inquiry, which could make Aristotelian logic be fully understood by the Chinese, as well as enrich the Chinese understanding of their logic in the practice. Therefore, option three could be a model of how two different language games communicate.

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