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An Analytical Study of Translating Astronomical Technology in the Yuan Dynasty to the West*

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***Abstract*—As an indispensable part of Chinese science and technology, astronomical technology in the Mongol Yuan Dynasty serves as a link between the development of the preceding periods and the following ones. It is a typical representative of splendid Mongolian culture and national history as well. The translation of Chinese science and technology can not only promote the cultural transmission but it is also of academic value. This article discusses the translation problems and strategies in translating astronomical technology in the Yuan Dynasty. Based on the text type of the technological monographs, and combining the two strategies of domestication and foreignization, this article attempts to render a proper way for the translation in the related field, contributing a share to the construction of China's foreign discourse system and dissemination of excellent Chinese culture.**

***Index Terms*—translation strategies, translation methods, astronomy, science and technology**

I. Background Introduction

In Chinese history, the Mongol Yuan Dynasty made great progress in science and technology, especially in astronomy. As one of the first countries to develop astronomy and calendars across the world, China maintained sustainable development in the Yuan Dynasty, during which China not only absorbed astronomical knowledge from Arab and other countries, but also combined the contributions of astronomers from domestic ethnic minorities, thus achieving unprecedented development in the research of Chinese astronomy and reaching the highest standard in the world at that time. Needham (1954) points out in the preface to the first volume of his *Science and Civilisation in China* that the Chinese succeeded in forestalling the scientific and technical discoveries in many important matters and in maintaining a level of scientific knowledge unapproached in the west between the 3rd and the 13th centuries. For example, by employing new astronomical instruments, Guo Shoujing of the Yuan dynasty concluded that the numerical value of the ecliptic obliquity is equivalent to 23 ◦33'5.3", with an error of 1'6.8" compared with the theoretical calculation of the ecliptic obliquity in modern astronomy, which was the most precise figure in the world and a remarkable achievement six or seven hundred years ago. The famous Arab astronomer Al-Battani in the early 10th century measured it as 23 ◦53', and in the 15th century, Central Asian astronomer Ulugh Beg obtained the result as 23 ◦30'20", both of which are not as accurate as the data measured in the Yuan Dynasty of China. Accordingly, the translation of astronomical technology in the Yuan Dynasty can, on the one hand, contribute to the diffusion of the achievements made in science and technology in ancient China so as to improve the communication in this field among countries, and provide important reference value for the understanding and research of Chinese history of science and technology on the other.

By a close study of translation strategies of astronomical technology in the Yuan Dynasty, this article aims to discuss some translation problems arising from the English translation process, the reasons behind the problems, and feasible translation strategies as well as methods, so as to render a reference for future practitioners and spur them to come up with more valuable ideas.

II. Present Situation of English Translation of Astronomical Technology

In many fields of science and technology, ancient China was ahead of other countries and regions of the same historical period, which has promoted the development of civilization of China and the world. A large number of translations for Chinese scientific and technological classics are emerging, covering almost all the fields of human science and technology, such as the *Yellow Emperor's Canon of Internal Medicine*, *The Huainanzi*, *Brush Talks from*

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Dream Brook and so on. The translation and introduction of Chinese science and technology classics has attracted the attention of scholars at home and abroad. However, compared with law, traditional Chinese medicine, martial arts and other fields, works about translation of Chinese ancient astronomy are rare, especially concerning the translation for the astronomy in the Yuan Dynasty. Introduction and dissemination of Chinese ancient astronomy, and authoritative terminology database are relatively fewer. When searching on Amazon, related monographs are very limited. Nevertheless, some monographs can provide valuable reference, of which Volume 3 of *Science and Civilisation in China—Mathematics and the Sciences of the Heavens and the Earth* written by Joseph Needham is considered the most authoritative. Wilkinson (2000, p. 669) comments that "Chinese primary and secondary sources on all aspects of traditional technology and science are quoted and discussed throughout the volumes of Needham (1900-95), *Science and Civilisation in China*, as well as in the various works that grew out of it". Needham's work purports to inspect Chinese science in particular, but also the scientific contribution of Asia, and it aims at doing this in the context of Chinese and Asian civilizations. Therefore, a number of corresponding English astronomical terms can be found in it. Jiang (2015) describes the study of heaven in ancient China, including the astronomical observation and calendars, as well as the exchange and comparison of Chinese and foreign astronomies. Martzloff (2016) also studies the Chinese astronomy in his *Astronomy and Calendars—The Other Chinese Methemetics*. These monographs record the development and accomplishments of Chinese astronomy from different perspectives. Besides, some scholars from home and abroad discuss the topics in this field in a series of papers. As for the astronomical terminology database, the only one can be found is the database of astronomical terminology approved by Astronomical Terms Committee of Chinese Astronomical Society in the year of 2010, which covers a wide range of astronomical terms, and after study and comparison, the terms from it are reasonable, authoritative, and of high reference value. However, it is not quite comprehensive, with some terms excluded. Thus it is unable to meet the needs of current translation practice. With the importance of "telling China's stories" becoming increasingly prominent, construction of a standardized database for the translation of astronomy with Chinese characteristics needs to be put on the agenda.

III. Problems to Be Solved

The purpose of translation is to make the readers understand the original message accurately, for which translators should try to resolve the differences between the two languages in the aspects of style and logic (Liu, 2014). Translation should serve as a bridge between two cultures instead of creating new obstacles. So it is prerequisite to articulate the meaning of the source text, so that the target reader can obtain enough information from the translated text and perceive the culture of the source text. In the process of achieving the goal, idiomatic language and clear phraseology are necessary, with the target culture, the ways of expression, and other different elements taken into account. However, problems of inaccuracy and inconsistency in the aspect of the terminology often occur. Besides, overuse of transliteration for the terminology can also cause trouble to the target reader, producing ambiguous translation. Apart from that, as the astronomical technology of the Yuan Dynasty contains a lot of specialized knowledge in astronomy, literal translation without comprehension of the concepts and the professional descriptions about structures and working principles of astronomical instruments may pose another great challenge for the reader to acquire the desired information from the translated text. In this sense, if the translator is trapped in the mode of Chinese thinking, simply translating the ostensible meaning of the source text in the absence of understanding the implicit information, the translation will fail to serve as a bridge of communication, nor will it strike a responsive chord in the hearts of readers.

IV. Theoretical Basis

A. Text Type Analysis and Translation of Technological Text

The type of the source text is one of the determining factors of the translation methods to be adopted. Newmark (1981) proposes that the translator should adopt different translation methods according to different text types. He divides the texts into three types: expressive texts, informative texts and vocative texts, and points out that scientific and technical reports and textbooks are typical examples of informative texts, the target language of which should be factual, neutral and objective, producing equivalent effect on the target reader, with small loss of meaning during the translation process (Newmark, 1981, pp. 12-16). Reiss (1976, p. 20) also suggests "specific translation methods according to text type". According to her text typology, the technological text pertains to informative text, which is to represent objects and facts in language function, concentrating on delivering information, and logical in language dimension. Since the source text is content-focused, the translated text needs to transmit referential content. In this case, the translation is better to be plain in expression, and explicit as required, trying to implement the informative function.

B. Translation Strategies and Methods

Schleiermarcher, the German philosopher of the nineteenth century, puts forward two translation strategies from translation philosophy: alienating, which means that "the translator leaves the writer alone as much as possible and moves the reader toward the writer"; and naturalizing, which means leaving "the reader alone as much as possible and moves the writer toward the reader" (Schleiermarcher, 1992, p. 42). On the basis of Schleiermarcher, Venuti (1995) puts forward the two translation strategies of domestication and foreignization. He finds that translation projects may either

conform to values currently dominating the target-language culture, taking a conservative and openly assimilationist approach to the foreign text to support domestic canons, publishing trends, and political alignments, or resist and aim to revise the dominant by drawing on the marginal, restoring foreign texts excluded by domestic canons, recovering residual values such as archaic texts and translation methods, and cultivating emergent ones (Venuti, 1998, p. 240). Each strategy has their own advocates, with some domesticating in translation and some adopting foreignization. Domestication finds its strongest and most influential advocates in the French and English translation traditions, particularly during the early modern period, while Schleiermarcher himself much prefers a foreignizing strategy, "an ethnodeviant pressure on those values to register the linguistic and cultural difference of the foreign text, sending the reader abroad" (Venuti, 1998, pp. 241-242).

As a matter of fact, domestication and foreignization are not opposite concepts, and they can complement each other. Strategies in producing translations inevitably emerge in response to domestic cultural situations (Venuti, 1998, p. 240). There is no accurate translation strategy that can fit all. A certain strategy tends to be selected based on different text types, social context, translation purpose, readers and other factors. Sometimes, two or more strategies will be combined in one translation project.

This article proposes that the translation practice for the astronomical technology in the Yuan Dynasty combine both the domestication and foreignization, with domestication the main strategy and foreignization the secondary. Domesticating translation can consolidate the linguistic norms of the translated text, increase the readability and acceptability, and bridge over the cultural gap between the source text and the target reader. Nida's dynamic equivalence, later functional equivalence, is an expression of domestication, seeking to obtain "the closet natural equivalent to the source-language message" and minimize the "foreignness" of the source text setting (Nida, 1964, p. 166). It is important for the informative text, which stresses the reader's understanding and response and aims to deliver information, to be in accordance with the expression habits of the target language as far as possible, so that the translated text can accurately convey the contextual meaning, ideas and the language form of the source text in a way that can be easily accepted and understood by the target readers. In the translation process, to achieve domestication, translation methods such as amplification, borrowing, division, sentence restructure and other flexible and feasible ways are common to enhance the reader's understanding. However, as Newmark (1988, p. 48) puts it, the equivalent effect is only a desirable result. Since there are a number of culture-loaded words, or culturally vacant vocabularies, in the source text, domestication can not be the only translation strategy during the translation process, and it is when foreignization comes in handy. While foreignizing translation seeks to evoke a sense of the foreign, "it necessarily answers to a social situation, where it may be designed to serve a cultural and political agenda" (Venuti, 1998, p. 242). Foreignization can preserve linguistic and cultural differences of the source text, and fill cultural gaps between different cultures, thus adding cultural characteristics to the TT. Translation methods such as interpretation, transliteration and coinage are usually adopted during the translation process.

V. Strategies of Translation of Astronomical Technology in the Yuan Dynasty

A. Translation of Astronomical Terminology

The description of terminology is widely accepted as "the study of and field of activity concerned with the collection, description, processing and presentation of terms, i.e. lexical items belonging to specialised areas of usage of one or more languages" (Sager, 1990, p. 2). Key notions associated with terminology include concept, definition and term (Bowker, 2020, p. 579). The importance of terminology in the study of various human disciplines is not only reflected in the achievements and contributions of academic research, but also an important symbol of academic discourse power (Wei, 2010, p. 119). The appropriateness of the translation for the terminology has a direct impact on readers' understanding of an ideological system, and misunderstandings caused by improper translation can sometimes lead to serious consequences (Cao, 2006, p. 67). Consequently, successful translation of terminology is of much importance to the translation quality. The English translation and use of terms should meet the three basic principles of conciseness, clarity and consistency.

1. Translation of Astronomical Concepts

A concept is a unit of thought that is used to organize people's knowledge and perception of the world around them. Concepts tend to be understood not in isolation but rather in systematical relation to other concepts, in a sort of structured knowledge system of the domain (Bowker, 2020, p. 579). Thus the translations need to be clear in expression and can reflect the related idea effectively, and the form of the translation should be generally acceptable within the linguistic system.

Example 1:

ST: 古人把黄道附近的星分为二十八宿，每一宿用一星为代表，叫做"距星"，两距星之间的距离叫做"距度"。(Yun, 1994, p. 20)

TT: The ancients divided the stars near the ecliptic into twenty-eight lunar mansions, with each mansion represented by one star called "determinative star". And the distance between two determinative stars was called "distance scale".

In order to observe the movements of the sun, the moon and stars, ancient Chinese astronomers delimited twenty-eight lunar mansions. Being part of the Chinese constellation system, the twenty-eight lunar mansions can be

considered as the equivalents to the zodiacal constellations in the Western astronomy, though the twenty-eight lunar mansions reflect the movement of the moon through a sidereal month rather than the sun in a tropical year. There is a fixed star in each constellation, acting as a relative marker for the measurement of the right ascension, which is called "距星" in Chinese. From this perspective, the translation "determinative star" can show the key role of the star and is accessible in meaning. Besides determinative star, Jiang (2015, p. 83) also uses "the datum star" to denote it, which is acceptable to the target reader as well.

The ascensional difference between the determinative stars of two adjacent constellations in the twenty-eight lunar mansions is a component of the equatorial coordinates of the former one. The ascensional difference is called "距度" in Chinese, which is the approximate range of distance between celestial bodies as determined by astronomical observations or theoretical models. Accordingly, the translation "distance scale" can express the concept. Domestication is practicable in this case to ensure a quick understanding of the reader.

Example 2:

ST: 黄赤大距是指黄道面与赤道面由于不在同一水平面上而相夹形成的角度，元代叫做"黄赤道内外极度"，现代天文学上则叫"黄赤交角"。(Yun, 1994, p. 19)

TT: The greatest elongation of the ecliptic and equator refers to the angle of intersection formed between the ecliptic and the equatorial planes which are not on the same horizontal plane. In the Yuan Dynasty it was called "north and south inclination of the ecliptic", while in modern astronomy it is called "ecliptic obliquity".

The earth's axis of rotation forms an inclination of 66°34' to its orbital plane of revolution. The relationship between the earth's rotation and its revolution is usually expressed in astronomy and geography by its supplementary angle (23 °26', the angle at which the equatorial plane intersects the orbital plane), while on the geocentric celestial sphere, it is expressed by the crossing angle of the ecliptic and the celestial equator, which is known as the ecliptic obliquity. Ecliptic obliquity is a common concept in modern astronomy, but as the alternative expressions, "黄赤大距" and "黄赤道内外极度" are not that familiar to the target reader. In this case, interpretation can be used to improve the readability of the translation based on the related information like the origin of the appellation and principle. According to *Dictionary of Chinese History* (2000, p. 619), there are two points of intersection of the ecliptic and the celestial equator. In the northern hemisphere, they are the vernal equinox and the autumnal equinox, which are collectively called the equinoxes, or equinoctial points. The two points on the ecliptic farthest from the celestial equator are summer solstice and winter solstice of the northern hemisphere, which are collectively called solstices, or solstitial points. The distance of the solstices from the celestial equator is the greatest distance of the ecliptic from the celestial equator, so the distance is called "黄赤大距". It is not shown by the length unit but the field angle, which is 23 °26'. The angle is called "距角" (elongation) in astronomy. Thus it is not proper to translate "大距" literally into "greatest distance" and "greatest elongation" is more appropriate. There are few materials about the origin of the expression "黄赤道内外极度". A similar expression "黄道内外度" (polar latitude) can be found in *Dictionary of Chinese History* (2000). In view of the explanation of the dictionary, "内度" means that the observed point is to the north of the ecliptic, while "外度" means the observed point is to the south of the ecliptic (p. 340). "黄道内外度" (polar latitude) refers to that the distance from a star to the ecliptic, measured along the right ascension circle containing the equatorial pole. On these grounds, "内外极度" can not be translated into "inner and outside degree" as some online dictionaries present, but refers to the "north and south inclination".

Example 3:

ST: 只要转动赤经双环和窥管，就可以观测空中任何方位的一个天体，并从环面的刻度上读出天体的去极度数。(Yun, 1994, p. 22)

TT: As long as the right ascension double rings and the sighting-tube are rotated, a celestial object in any position of the sky can be observed and the corresponding polar distance degrees can be read through the scale divisions on the surface of the rings.

According to *Dictionary of Chinese History* (2000, p. 180), China's equatorial coordinate system inherits the ancient tradition of recording the position of the fixed star in twenty-eight lunar mansions, and is divided into two quantities: "去极度 (polar distance, or field pitch)" and "入宿度 (determinative star distance, or lunar lodge degrees)". Morgan (2013, p. 34) translates "去极度" into "latitude", but actually "去极度" is the angular distance of the observed celestial body from the north celestial pole, while "入宿度" is the right ascension difference between a celestial body and a determinative star of one of the twenty-eight constellations. "去极度" has the same meaning with "极距 (polar distance, or field pitch)" in the equatorial coordinate system of modern astronomy. The polar distance is equal to the supplementary angle of celestial declination, i.e. : polar distance = 90 °—declination. Adopting the equivalent translation of "极距 (polar distance, or field pitch)" for "去极度" will help the target reader grasp the meaning without any barrier.

Example 4:

ST: 藏历以合朔定月,每月 29.53059 日，小月 29 日，大月 30 日。(Yun, 1994, p. 37)

TT: The Tibetan calendar regarded heshuo[2] as the beginning of a month. There were an average of 29.53059 days in a month, with 29 days in a small month and 30 days in a large month.

"合朔" in the sentence refers to that the difference of geocentric apparent longitude of the sun and the moon is zero, and the sun and moon are in the same plane perpendicular to the ecliptic. At this time, the moon is between the sun and the earth, with the unlit half facing the earth, so it can not be seen on the earth. In most cases, "合朔" can be simply translated into "the first day of the lunar month". However, in this context, it will cause confusing translation like "regarding the first day as the first day". So domesticating translation is not fit for the situation and specific explanation is needed. Transliteration can be adopted with annotation added to guarantee that the target reader can receive enough information.

It should be noted that though transliteration can be used together with annotation to help with the understanding, overuse of such method will spoil the smooth reading of target readers as it will cause too many pauses for them to look for the annotations. So foreignization can only act as a supplementary strategy in technological texts.

2. Translation of Astronomical Instruments

Example 5:

ST: 仰仪是铜制的中间空的半球面仪器，像一口朝天的大锅。 (Yun, 1994, p. 22)

TT: The Scaphe is a copper hollow hemispherical instrument like an upward cauldron.

"仰仪" is an observation instrument which follows the principle of direct projection. The lip of it is inscribed with directions and twelve double-hour periods, while the inner side is inscribed with the equatorial coordinates. The replica of the instrument "仰仪" is now situated in the north observatory in Gaocheng Town, Dengfeng City of Henan Province, where the explanatory placard of it shows the transliteration "Yangyi" in the English introduction of the instrument. In this scene, it may be understandable for foreign visitors as they can refer to the entity and there is a detailed English explanation following it. However, when it comes to translation of the text, it is obvious that direct transliteration cannot be accepted by target readers who do not possess the background knowledge of Chinese astronomy. Youdao online dictionary presents two versions: "upward looking bowl sundial" and "Scaphe". It is obvious that the translation "upward looking bowl sundial" adopts the translation method of interpretation. Xi (1981) also uses the version to denote the instrument. Though it is understandable, there is an equivalent term in the target language—"Scaphe". According to the online Wikipedia Encyclopedia (https://encyclopedia.thefreedictionary.com/Scaphe), Scaphe is a sundial said to have been invented by Aristarchus of Samos (3rd century BC). It consists of a hemispherical bowl with a vertical gnomon placed inside it and the top of the gnomon leveling with the edge of the bowl. Twelve gradations are inscribed perpendicular to the hemisphere, indicating the hours of the day. According to these descriptions, the instrument is of similar function and structure to the one created in the Yuan Dynasty. And Needham (1959) presents Korean and Japanese scaphes with his figure 123 (a) and figure 123 (b) in PLATE XXXVI of his monograph, which fall into the same kind of instrument. Thus the translation can be well received by the target reader with the corresponding image in mind and it additionally conforms to the the principle of conciseness.

Example 6:

ST: 景符、闚几都是圭表的专用附件。 (Yun, 1994, p. 23)

TT: Shadow Definer and Observing Table are special accessories of the Gnomon.

"景"in "景符" is a false character borrowed to replace "影", which refers to the shadow of the sun. According to Yun (1994, pp. 23-24), "景符" is an accessory assisting in measuring the shadow of the sun, the creation of which is to solve the problem of capturing a solid sun shadow, making sure that the shadow is not vague and light. It is a thin copper piece with a small hole in the center, which is installed on a small frame and can move on the surface of the Gnomon shadow template. The sunlight can go through the hole, forming a clear shadow based on the pinhole camera model. The method can realize high accuracy in measurement. There is no equivalent item found in the target language, and compared with transliteration "Shadow Definer" can not only show its function, but it is short and concise in form.

"闚" in "闚几" is the ancient writing of "窥", meaning to look through a hole or a slit. "几" refers to a table. In the light of Yun (1994, p. 24), the instrument is shaped like a rectangular table with a long slit in the middle, both sides of which are inscribed with numbers of degrees. Putting the table on the surface of the Gnomon shadow template with the slit facing south, astronomers under the table can directly observe the stars and the moon through the slit and get the needed data of the sun's shadow. It is an instrument to assist in the measurement of length of stars and moon shadow. In this sense, the translation "Observing Table" combines the function and shape of the instrument and can be well perceived by the target reader.

B. Translation of Segments

Xu (2018, pp. 152-154) points out that as a formal style of writing, English for science and technology tends to use long and complicated sentences, more noun phrases, passive voice, non-finite forms of verbs, different tenses, and

[2] Hesuo refers to that the difference of geocentric apparent longitude of the sun and the moon is zero, and the sun and moon are in the same plane perpendicular to the ecliptic. At this time, the moon is between the sun and the earth, with the unlit half facing the earth, so it can not be seen on the earth. Heshuo happens on the first day of the lunar month.

post-position of attributives. Thus the practitioner needs to attach greater importance to the characteristic syntax of English for science and technology so as to make the translation more idiomatic.

Example 7:

ST: 大圆面上用竿架着一块板，板上有小孔，小孔正好对着半球面的球心上，太阳光通过小孔在半球面上投下一个圆形的倒象映在坐标上，即可读出太阳在天空上的位置。(Yun, 1994, pp. 22-23)

TT: There is a cross on the hemisphere, which supports a small piece of board with a small hole in the center. The hole is directly opposite to the center of the hemispherical surface. When the sun's rays pass through the small hole, casting on the hemispherical surface a circular reflection that falls on the coordinates, the position of the sun on the sky can be read accordingly.

Chinese is a language that emphasizes parataxis and the sentences are relatively short. It depends much on the semantic relation of sentences, free of functional words like conjunctions, pronouns, etc. There is no classification of clauses in Chinese. Complex sentences are mainly divided into two categories: associate sentences and subordinate sentences (Xu, 2018, p. 122). On the contrary, English puts much emphasis on hypotaxis, and sentences are prone to be either subordinate or paratactic, combined by connectives or prepositions. The disparity of the two languages in structure may hinder the thinking mode of translators and thus interfere with the translation. As Example 9 shows, there are five clauses in the sentence, combined mainly by the relevance of meaning. Although long and complex sentences tend to be used in English, the translation should be tackled discriminatingly. If the sentence is translated into one English sentence, it is bound to be too long and complicated, impeding the understanding of the reader. The usual method of translating Chinese long sentence into English is division at syntactical level, cutting certain meaning groups into independent sentences, and the key to guarantee a good translation is to discern the main idea and the subordinate ones, taking the structure of the whole sentence into consideration (Xu, 2018, p. 141). The layers of meaning can be sorted out from the overlapped structure and then cut into some segments.

Example 8:

ST: 其（景符）为一中间有小孔的薄铜片，在太阳过子午线时将其装在一个小架上在圭面来回移动，使太阳光通过小孔，利用几何光学中的微孔成像原理，在圭面上形成一米粒大的、中间带有一条细而清晰的横梁影子的太阳像，克服了由于日光在空气中的散射，造成表顶影子落在圭面上不清晰的弱点。(Yun, 1994, pp. 23-24)

TT 1: Shadow Definer is a thin copper piece with a small hole in the middle, and when the sun passes the meridian, it is installed on a small frame that can be moved back and forth on the surface of the Gnomon shadow template so that the sunlight can go through the hole to form on the surface of the Gnomon shadow template a sun's shadow as large as one grain of rice and with a thin and clear beam shadow in the middle based on the principle of microhole imaging in geometric optics, which overcomes the weakness that light scattering will cause a faint shadow falling on the surface of the Gnomon shadow template.

TT 2: Shadow Definer, a thin copper piece with a small hole in the middle, is installed on a small frame which can be moved back and forth on the surface of the Gnomon shadow template. When the sun passes the meridian, the Shadow Definer is moved so that the sunlight can go through the hole to form on the surface of the Gnomon shadow template a sun's shadow as large as one grain of rice and with a thin and clear beam shadow in the middle. This is based on the principle of microhole imaging in geometric optics, which overcomes the weakness that light scattering will cause a faint shadow falling on the surface of the Gnomon shadow template.

Tytler (1978, pp. 15-16) describes a good translation to be one that transfuses the merit of the original work completely into another language so that it can be understood as clearly and fully by the target reader as by those who speak the language of the original work. The communication of different languages and cultures is realized through translation, but since the forms of different languages vary, sentences will sometimes need to be restructured during the translation process in order to reproduce the meaning of the original text and make the target text as smooth as possible. Compared with TT 1 which follows the order of the source text, TT 2 is clearer in meaning and less rigid in language form with the orders of segments—"在太阳过子午线时" and "利用几何光学中的微孔成像原理"—adjusted in the translation process.

Example 9:

ST: 元简仪不但取消了原浑仪的白道环（月球视运动轨道），而且又取消了黄道环（太阳视运动轨道），并且把地平坐标（由地平圈和地平经圈组成）和赤道坐标（由赤道圈和赤经圈组成）分成了两个独立装置。(Yun, 1994, p. 21)

TT: Not only has the Abridged Armilla of the Yuan Dynasty been removed of the moon's path ring (lunar apparent motion orbit) and the ecliptic ring (solar apparent motion orbit), but its horizontal coordinates (composed of horizontal circle and azimuth circle) and equatorial coordinates (composed of equatorial circle and right ascension circle) have also been separated as two autonomous devices.

As Xu (2018, p. 153) points out that passive voice is extensively used in English for science and technology to achieve objectivity. But passive voice is not that pervasive in Chinese. Instead, active voice is the dominant voice in whether spoken language or written language. As shown in Example 8, the Abridged Armilla of the Yuan Dynasty functions as the subject to make movements. When translated into English, the sentence is converted into passive voice to conform to the tradition of the target language. Catford (1965) considers the conversion as a structural shift, one kind

of category shifts, which is a departure "from formal correspondence in the process of going from the SL to the TL" (Catford, 1965, p. 73). It is a common practice during the C-E translation process.

Example 10:

ST: （仰仪）半球的大圆面上刻着东、南、西、北和十二时辰，半球面上刻有与观测地纬度相应的赤道坐标。(Yun, 1994, p. 22)

TT: The lip of the large hemisphere is inscribed with the east, south, west, north and twelve double-hour periods, while the inside hemispherical surface is inscribed with equatorial coordinates in accordance with the latitude of the observed site.

Example 11:

ST: 藏历以合朔定月,每月 29.53059 日，小月 29 日，大月 30 日。(Yun, 1994, p. 37)

TT: The Tibetan calendar regarded heshuo[3] as the beginning of a month. There were an average of 29.53059 days in a month, with 29 days in a small month and 30 days in a large month.

Xiong (2014) points out that the addition of some words, sentences or paragraphs is advisable in the translation process according to the needs of the target language's lexicon, syntax, semantics, rhetoric or style so as to better express the ideological content of the original text or better accomplish the aim of specific translation.

In Example 10, "半球的大圆面" and "半球面" in the source text refer to different parts of the instrument with the former denoting the edge of the hemisphere, which is also figuratively called Instrument Lip, and "半球面" meaning the inside hemispherical surface. The translation of the two parts should be distinguished. Adding the word "inside" in front of "半球面 (hemispherical surface)" will help the reader to distinguish similar expressions.

In Example 11, if literally translated, "每月 29.53059 日" should be translated into "there were 29.53059 days in each month". But according to the context, there were 29 days in a small month and 30 days in a large month, which shows that "29.53059" is a mean number. Adding the phrase "an average of" before "29.53059 days" will make the translation more rigorous.

It is viable to adopt amplification when translating technological texts, as the accuracy of the information communicated is attached great importance to.

VI. Conclusion

In order to spread the excellent culture in science and technology of China's Yuan Dynasty and facilitate the technological exchange between China and foreign countries, it is of great importance to study the translation strategies of Chinese scientific and technological texts. It is also beneficial to clarify the strategies and methods of English translation of Chinese astronomical science and technology, which will help to solve randomness and inaccuracy in the translation process, and help to establish standards for the implementation and evaluation of related translation practice. This article, aiming to enable readers to get a deeper understanding of the unique Chinese wisdom and Chinese charm in ancient Chinese astronomy, advocates the translation strategy of "domestication as the main strategy and foreignization as a supplement", hoping to provide solutions and enlightenment to the normative problems of the translation in astronomical science and technology of the Yuan Dynasty, and thus making a useful attempt to tell Chinese stories well and enhance China's cultural soft power.

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[3] Hesuo refers to that the difference of geocentric apparent longitude of the sun and the moon is zero, and the sun and moon are in the same plane perpendicular to the ecliptic. At this time, the moon is between the sun and the earth, with the unlit half facing the earth, so it can not be seen on the earth. Heshuo happens on the first day of the lunar month.

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