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A NEW INQUIRY INTO THE TRANSLATION OF CHEMICAL TERMS BY JOHN FRYER AND XU SHOU

In the transmission of modern scientific knowledge from the West to China, the problem of the translation of scientific terms deserves serious consideration. Inquiring into the development and evolution of scientific terminology not only helps us to elucidate the process of the transmission of scientific knowledge, but it also enables us to understand instances of successful communication and misunderstanding, which inevitably accompany the transmission of scientific knowledge across cultures. In this paper, I will analyze the scientific terminology used by John Fryer (Fu Lanya 傅蘭雅 , 1839–1928) and Xu Shou 徐壽 (1818–1884) in their translations of chemical works and discuss the influence of these translations on the formation of modern Chinese chemical terminology.

It is well known that the *Bowu xinbian* 博物新編 (Natural philosophy), compiled by the medical missionary Benjamin Hobson (Hexin 合信, 1816–1873) and published in 1855, was the starting point for the transmission of modern Western chemistry into China. The *Bowu xinbian,* however, was by no means a specialized chemical textbook. In the first part of the work, the chapter "On the earth and the atmosphere" (*Diqi lun* 地氣論) introduces oxygen (*yangqi* 氧氣) and hydrogen (*qingqi* 氫氣) as well as hydrochloric acid (*yanqiangshui* 鹽強水), sulphuric acid (*huangqiangshui* 磺強水) and other substances. The chapter "On the nature of water" (*Shuizhi lun* 水質論) mentions that all things are composed of fifty-six 'elements' (translated as *yuanzhi* 元質) and thus constitutes the earliest introduction of the theory of the elements into China.[1] More than a decade later, in 1868, W. A. P. Martin (Ding Weiliang 丁韙良 , 1827–1916), who served as instructor of 'Western studies' at the Tongwenguan, published his *Gewu rumen* 格物入門 (Introduction to the sciences). This collection contained one volume entitled *Huaxue rumen* 化學入門 (Introduction to chemistry) which introduced thirty-one elements and compounds formed with them.[2]

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[1] Benjamin Hobson (Hexin 合信). 1855. *Bowu xinbian* 博物新編 (Natural philosophy). Shanghai: Mohai shuguan, pp. 10a–12a.

[2] W. A. P. Martin (Ding Weiliang 丁韙良). 1868. *Gewu rumen* 格物入門 (Introduction to the sciences). 7 vols. Beijing: Tongwenguan.

Michael Lackner, Iwo Amelung and Joachim Kurtz (eds.). *New Terms for New Ideas. Western Knowledge and Lexical Change in Late Imperial China*. Leiden et al. 2001, pp. 271–284.

However, the contents of this book was still very sketchy and the translations of technical terms far from ideal. For example, Martin translated 'potassium' as *huijing* 灰精 and 'silicon' as *bojing* 玻精 , and even employed phonemic loans to render the Western symbols for the elements, e.g. *biai* 避愛 for 'Bi' (bismuth), *bier* 避而 for 'Br' (bromium), *mizhi* 米治 for 'Mg' (magnesium) and *niai* 尼愛 for 'Ni' (nickel), so that readers had no way of understanding what was meant. On the whole, there were no specialized translations of chemical books into Chinese[3] and no translated terminology had been coined when Fryer and Xu Shou began their translation work in 1869.

At this time, China lacked scholars with sufficient knowledge of Western languages. Although the Westerners who came to China had a relatively good grasp of the Chinese language, it was difficult for them to translate Western books into Chinese on their own. For this reason, the prevalent way of rendering Western works on sciences and technology was collaboration between a Westerner with some knowledge of the Chinese language and a Chinese scholar.[4] This practice

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[3] The *Huaxue chujie* 化學初階 (First steps in chemistry), translated by John Glasgow Kerr (Jia Yuehan 嘉約翰) and He Liaoran 何瞭然 , was published some months earlier than *Huaxue jianyuan* but Kerr and He employed the names for the elements coined in *Huaxue jianyuan*. The translation of *Huaxue jianyuan* was begun and completed prior to that of *Huaxue chujie*. See Wang Yangzong. 1990. "Guanyu *Huaxue jianyuan* he *Huaxue chujie*" 關於《化學鑑原》和《化學初階》(On *Huaxue jianyuan* and *Huaxue chujie*), *Zhongguo keji shiliao* 11.1, pp. 84–8; and id. 1994. "Wan Qing kexue yizhu zakao" 晚清科學譯著雜考 , *Zhongguo keji shiliao* 15.4, pp. 32–40.

[4] John Fryer described the translation practice at the Jiangnan Arsenal as follows: "The foreign translator, having first mastered his subject, sits down with the Chinese writer and dictates to him sentence by sentence, consulting with him whenever a difficulty arises as to the way the ideas ought to be expressed in Chinese, or explaining to him any point that happens to be beyond his comprehension. The manuscript is then revised by the Chinese writer, and any errors in style, &c., are corrected by him. In a few cases the translations have been carefully gone over again with the foreign translator, but in most instances such an amount of trouble has been avoided by the native writers, who, as a rule, are able to detect errors of any importance themselves, and who, it must be acknowledged, take great pains to make the style as clear and the information as accurate as possible." John Fryer. 1880. "An Account of the Department for the Translation of Foreign Books at the Kiangnan Arsenal, Shanghai", *North China Herald*, January 29, 1880, pp. 77–81; 80. The text was published again as id. 1881. "Science in China", *Nature*, May 5, 1881, pp. 9–11; May 19, 1881, pp. 54–7. A revised Chinese version under the title "Jiangnan zhizao zongju fanyi xishu shilüe" 江南製造總局翻譯西書事略 (A brief report on translating Western works at the Kiangnan Arsenal) can be found in: Zhang Jinglu 張靜廬 (ed.). 1953. *Zhongguo jindai chuban shiliao chubian* 中國近代出版史料初編 (First collection of materials on the history of publishing in modern China). Shanghai: Shanghai chubanshe, pp. 1–23.

was commonly referred to as 'oral translation [by a Westerner], recorded with the brush [by a Chinese scribe]' (*kouyi bishu* 口譯筆述). Xu Shou was one of the founders of the most important official organization for translation—the Translation Department at the Jiangnan Arsenal; John Fryer was Xu's main collaborator and the most productive 'oral translator' of the Translation Department. Together, the two rendered five specialized works on chemistry into Chinese:

(1) *Huaxue jianyuan* 化學鑑原 (Mirroring the origins of chemistry), 1871[5];
(2) *Huaxue jianyuan xubian* 化學鑑原續編 (A sequel to *Mirroring the origins of chemistry*), 1875[6];
(3) *Huaxue jianyuan bubian* 化學鑑原補編 (A supplement to *Mirroring the origins of chemistry*), 1882[7];
(4) *Huaxue kaozhi* 化學考質 (Chemical analysis), 1883[8] ;
(5) *Huaxue qiushu* 化學求數 (Seeking numerical patterns in chemistry), 1883.[9]

Huaxue jianyuan, as the first work on chemistry in the Chinese language, exerted considerable influence during the later half of the nineteenth century. I will therefore focus my analysis in this paper on the *Huaxue jianyuan*, including its "Sequel" (*xubian*) and "Supplement" (*bubian*). Zhang Zigao and Yang Gen[10] have published an article on the question of the terminology used in these works and David Wright has subjected it to a more complete and thorough scrutiny.[11] On the basis of their work, I will make some additional comments.

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[5] Xu Shou 徐壽 and John Fryer (trs.). 1871. *Huaxue jianyuan* 化學鑑原 (Mirroring the origins of chemistry). Shanghai: Jiangnan zhizaoju.

[6] Xu Shou 徐壽 and John Fryer. 1875. *Huaxue jianyuan xubian* 化學鑑原續編 (A sequel to *Mirroring the origins of chemistry*). Shanghai: Jiangnan zhizaoju.

[7] Xu Shou 徐壽 and John Fryer. 1882. *Huaxue jianyuan bubian* 化學鑑原補編 (A supplement to *Mirroring the origins of chemistry*). Shanghai: Jiangnan zhizaoju.

[8] Xu Shou 徐壽 and John Fryer. 1883a. *Huaxue kaozhi* 化學考質 (Chemical analysis). Shanghai: Jiangnan zhizaoju.

[9] Xu Shou 徐壽and John Fryer. 1883b. *Huaxue qiushu* 化學求數 (Seeking numerical patterns in chemistry). Shanghai: Jiangnan zhizaoju.

[10] Zhang Zigao 張子高 and Yang Gen 楊根. 1986. "Cong *Huaxue chujie* he *Huaxue jianyuan* kan Woguo zaoqi fanyi de huaxue shuji he huaxue mingci" 從《化學初階》和《化學鑑原》看我國早期翻譯的化學書籍和化學名詞 (Early Chinese translations of chemical works and chemical terms as seen from *Huaxue chujie* and *Huaxue jianyuan*), in: Yang Gen (ed.). *Xu Shou he Zhongguo jindai huaxue shi* 徐壽和中國近代化學史 (Xu Shou and the history of chemistry in modern China). Beijing: Kexue jishu wenxian chubanshe, pp. 119–41.

[11] David Wright. 2000. *Translating Science: The Transmission of Western Chemistry into Late Imperial China, 1840–1900*. Leiden, Boston, Köln: Brill.

1. THE TRANSLATION OF CHEMICAL ELEMENTS IN *HUAXUE JIANYUAN*

The technical terminology employed in the *Huaxue jianyuan* can be divided into one part concerned with chemical substances (mainly elements and chemical compounds) and another dealing with chemical concepts. The efforts by Xu Shou and John Fryer to coin translated terms for the chemical elements were particularly successful. Xu and Fryer were the first to propose a consistent program for the translation of chemical elements into Chinese:

> In the West, the names of substances often have many 'characters' and are difficult to pronounce. If one translates them into Chinese, it is impossible that they fully correspond [to the original]. Here we use one character for each term designating a chemical element. …With respect to the names of compounds we combine the terms of the elements. Many of the elements were known in ancient China. Their names we retained, for instance, 'gold' (*jin* 金), 'silver' (*yin* 銀), 'copper' (*tong* 銅), 'iron' (*tie* 鐵), 'lead' (*qian* 鉛), 'tin' (*xi* 錫), 'mercury' (*gong* 汞), 'sulphur' (*liu* 硫), 'phosphorus' (*lin* 燐) and 'carbon' (*tan* 炭). … We also retained names that had already been translated appropriately, such as *yangqi* 養氣 'oxygen', *danqi* 淡氣 'nitrogen' and *qingqi* 輕氣 'hydrogen'. In addition, there are several dozen [elements]—which were either unknown to the ancients or which they knew of but designated with a name that was deficient in some respect—and which are covered more completely in Western books. Were one to translate their meanings, it would be extraordinarily difficult to be concise. Transliterating the whole name would be excessively complicated. We therefore used the first sound of the Western term and transliterated it with one Chinese character. If the first sound was unsuitable, we used the second sound. We then added a radical to distinguish the classes but retained the original pronunciation.[12]

The method of employing one character to translate the name of an element and add a radical in order to indicate a rough classification was certainly not invented by Fryer and Xu Shou. Rather, they followed an established practice for coining Chinese characters. Their contribution lies in proposing the principle of employing the first or second sound of the Western term for the translation of the element. This translation principle respected Chinese practices, while avoiding at the same time the unnecessary complexity of complete translitera-

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[12] Xu and Fryer 1871, ch. 1, paragraph 29: "Huazi mingming" 華字命名 (Chinese designations).

tions. Moreover, Xu Shou and Fryer proposed the principle to use *guanhua* 官話 or Mandarin as the basis for transliterations. Overall, these principles were comprehensive, simple and easy to understand. Not only did they make it possible to coin appropriate names for known elements but they set a standard for naming elements that were to be discovered in the future. In contrast, John G. Kerr (1824–1901) and He Liaoran applied no fixed principles in the translation of the elements in their *Huaxue chujie*, sometimes using semantic renderings and sometimes transliterations. Some of the characters they devised for the chemical elements had a very large number of strokes.[13] If one compares the two systems, the advantages of Xu Shou and John Fryer's approach are obvious (see Table 1):

Table 1: Comparison of the names for chemical elements in Huaxue jianyuan *and* Huaxue chujie

No.	*English*	Huaxue jianyuan	Huaxue chujie	*Modern Chinese*
1.	calcium	鈣	鈣	鈣
2.	potassium	鉀	鈇	鉀
3.	silicon	矽	玻	硅
4.	sodium	鈉	鎝	鈉
5.	arsenic	鉮	𬬭	砷
6.	cadmium	鎘	鍥	鎘
7.	cobalt	鈷	鎬	鈷
8.	uranium	鈾	鈊	鈾
9.	zinc	鋅	鍠	鋅

The main reason why Xu Shou and John Fryer's translated names for the elements are still in use is that their method of translation was quite rational, and not simply, as has been suggested, that the books translated at the Jiangnan Arsenal enjoyed considerable circulation. In striking contrast, the overwhelming majority of the terms for organic and inorganic compounds and chemical concepts which Xu and Fryer proposed in the same works were not adopted by later generations and soon fell into oblivion.

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[13] *Huaxue chujie* includes twenty-two newly created terms for chemical elements which are similar to those in *Huaxue jianyuan*. In Wang 1990, pp. 84–8, I have argued that these terms were systematically borrowed from *Huaxue jianyuan*.

2. Terms for chemical compounds

With respect to the translation of names for inorganic chemical compounds, Xu Shou and Fryer adopted the method of "combining the names of the elements" (*lianshu yuanzhi zhi ming* 連書原質之名).[14] Translating the names of chemical compounds in this way was equivalent to indicating their chemical or molecular formulae (see Table 2). Merely re-writing these formulae however, led Xu and Fryer to produce terms that were clearly different from the original English names which were capable of mirroring the specific chemical properties. In a sense, one could therefore say that their renderings were no translations at all.

Table 2: Translations for inorganic compounds in Huaxue jianyuan

No.	*English*	Huaxue jianyuan	*Modern Chinese*
1.	cadmium oxide	鎘養	氧化鎘
2.	calcium fluoride	鈣弗	氟化鈣
3.	chloric acid	綠養五	氯酸
4.	chlorides	以綠為本之質	氯化物
5.	chlorous acid	綠養三	亞氯酸
6.	nickel oxide	鎳氧	鎳化氧
7.	nitric acid	淡氧五	硝酸
8.	nitrous acid	淡氧三	亞硝酸
9.	potash nitrate	鉀氧淡氧五	硝酸鉀
10.	sodium chloride	鈉綠	氯化鈉
11.	sulphates	含硫氧三質	硫酸鹽
12.	sulphides	含硫質	硫化物
13.	sulphuric acid	硫氧三	硫酸
14.	zinc sulphate	鋅氧硫氧三	硫酸鋅

For the names of organic compounds Xu Shou and Fryer employed phonetic renderings. They explained their translation strategy in this respect as follows:

> Since the sixty-four elements which we mentioned in our previous compilation have compounds which can be arranged by type [of the element from which they are made], they can be presented without any

[14] Cf. Xu and Fryer 1871, ch. 1, § 29.

> confusion. In the present work, there are only four elements [in organic substances] but their compounds are much more complicated. When the Westerners named them they created terms with meanings derived from the sounds of places, people, the properties of the compounds, or their taste and colour. These terms were then gathered into connected prose. To truncate the current translation for the sake of simplicity would result in many lacunae. Therefore, merely following the example of our previous compilation and arranging the compounds according to [their chemical formulae], i.e. as made up of a few parts of carbon, hydrogen, oxygen, or nitrogen, would be unsatisfactory since there would be innumerable difficult cases of compounds which could not be distinguished due to their equivalent formulae. Therefore, we transcribed the entire sounds of their names and added details of their properties. If the compounds were known in China, we indicated it. When they were not known, we left a gap. Scholars may thus investigate their properties and imagine what they are like. If they do have these substances at hand, they can test the principle. Thus, even if they deeply dislike the confusion and complexity of the Western terms, they will [be able to] seek out the Chinese substances.[15]

Although at this time there were already fairly good proposals for the naming of organic substances, Charles L. Bloxam, the author of the original text on which *Huaxue jianyuan xubian* was based, had not employed them.[16] For this reason, the terms for organic compounds were not standardized in the text which Xu Shou and Fryer used for their translation. In such a situation it was naturally very difficult for them to come up with appropriate Chinese renderings and consequently they saw no other way than transliterating the names. Yet, they tried their best to elucidate the origins of the various organic substances in order to make it easier for their Chinese readers to link the

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[15] Xu and Fryer. 1897 [1882]. *Huaxue jianyuan bubian* 化學鑑原補編 (A supplement to Mirroring the origins of chemistry), in: Zhao Yuanyi 趙元益 (ed.). *Xixue fuqiang congshu* 西學富強叢書 (Anthology of monographs on Western knowledge, wealth and power). Shanghai: Xiaocang shanfang 1.2.

[16] Cf. *Huaxue jianyuan xubian*, 1.1: "There is a multitude of ways to fix the names for known organic substances. In many cases their properties are used to order them. While this is an old method, it is extremely simple and clear. If they are arranged according to their numbers of atoms, the result will be that compounds with similar properties will be very far from another in the sequence and it will be very difficult to distinguish them. For this reason, we do not employ the new method of ordering them according to the number of atoms in this book but order them classified according to the changing chemical properties that we commonly observe". Bloxam was not interested in organic chemistry and therefore the part on organic chemistry in his book was of inferior quality. Cf. D. I. Davies et. al. 1986. "Charles Loudon Bloxam—A Victorian University and Military Academy Chemistry Teacher", *Ambix* 33, pp. 25–9.

transliterations to well known substances so that the text could be understood more easily (see Table 3).

Table 3: Translations for organic compounds in Huaxue jianyuan

No.	*English*	Huaxue jianyuan	*Modern Chinese*
1.	acetone	阿西多尼	丙酮
2.	benzine	偏西尼	石油精 汽油
3.	benzoic acid	偏蘇以克	苯鉀酸
4.	chlorophyll	格羅路非勒 葉綠	葉綠素
5.	citric acid	檸檬酸	檸檬酸
6.	ether	以脫	乙醚
7.	ethylene	以脫里尼	乙烯
8.	hydrocyanic acid	輕衰	輕氰酸
9.	ketone	幾朵尼	酮
10.	malic acid	瑪里克酸 蘋果酸	蘋果酸
11.	oxalic acid	草酸	草酸
12.	quinine	雞那以尼	奎寧

Terms translated in this way were also used by later Chinese chemists. Some of these terms, such as *ningmeng suan* 檸檬酸 for 'citric acid', *caosuan* 草酸 for 'oxalic acid' and *yelü* 葉綠 for 'chlorophyll' are still used today. These few translated terms, however, are not related to any system of the organic substances. Such a system was only tentatively put into practice in the *Youji huaxue mingming cao* 有機化學命名草 (Draft vocabulary for organic chemistry) published by Yu Heqin 虞和欽 in 1908.

3. Translated terms for chemical concepts

Xu Shou and John Fryer paid special attention to the translation of the names for chemical substances. The chemical terms coined by Xu Shou and Fryer in their translations of *Huaxue jianyuan*, *Huaxue jianyuan xubian* and *Huaxue jianyuan bubian* were later put in order and compiled into the *Huaxue cailiao Zhong-Xi mingmubiao* 化學材料中西名目表 (Vocabulary of names of chemical substances) published by

the Jiangnan Arsenal in 1884.[17] Names for organic and inorganic substances make up the largest part of this compilation. In addition, there is a limited number of terms for minerals and biological substances. In contrast, Xu and Fryer were much less careful in their translations of chemical concepts. The *Huaxue cailiao Zhong-Xi mingmubiao* included terms for only very few chemical concepts, such as 'atom' (translated as *zadian* 雜點) and 'element' (*yuanzhi* 原質). Their translations of chemical concepts were in most cases far from ideal (see Table 4).

Table 4: Some chemical terms as translated by Xu Shou and Fryer

No.	*English*	*Xu Shou and Fryer*	*Modern Chinese*
1.	affinity	愛攝里	親和力
2.	alkali	鹹類	鹼
3.	alloy	雜金	合金
4.	atom	質點	原子
5.	atomic weight	質點之重數	原子量
6.	compound	雜質	化合物
7.	inorganic compound	死物質	無機化合物
8.	organic compound	生物質	有機化合物
9.	element	原質	元素
10.	equivalent	分劑	當量
11.	mineral colouring matter	死物顏料	礦物顏料
12.	mineral water	地產之水	礦泉水
13.	molecule	雜點	分子
14.	organic chemistry	生物化學	有機化學
15.	particle	微點	粒子
16.	properties, chemical	性情	化學性質
17.	qualitative analysis	考質	定性分析
18.	quantitative analysis	求數	定量分析

Xu Shou and John Fryer's translations of chemical concepts mainly suffer from two related problems. The first is the lack of accuracy. For example, when 'compound' is translated as *zazhi* 雜質 and 'molecule' as *zadian* 雜點 , it is impossible to express the meaning underlying the concepts of 'compound' and 'molecule' because the semantic differ-

[17] John Fryer (ed.). 1884. *Huaxue cailiao Zhong-Xi mingmubiao* 化學材料中西名目表 (Vocabulary of names of chemical substances). Shanghai: Jiangnan zhizaoju.

ence between the translation and the original meaning is simply too big. If one tried to understand the concepts of 'compound' (*zazhi* 雜質), 'molecule' (*zadian* 雜點) and 'alloy' (*zajin* 雜金) only from the appearance of the Chinese words employed, one could easily assume that an alloy is also a chemical compound, which is of course not the case. Likewise, Xu Shou and Fryer were apparently aware that 'living compound' (*sheng zazhi* 生雜質) and 'dead compound' (*si zazhi* 死雜質) were inappropriate renderings of 'organic' and 'inorganic compound' and therefore proposed *sheng wuzhi* 生物質 and *si wuzhi* 死物質 instead. But even these translations differ considerably from the meaning of the English original. The second problem was that the extent of specialization in their translation of chemical terminology was insufficient. This is obvious in translations such as *xingqing* 性情 for 'chemical properties' and the above mentioned renderings of 'inorganic' and 'organic compound'.

One reason for these weaknesses may be that Xu Shou and John Fryer hoped their strategy would facilitate the Chinese readers' comprehension of the texts. Another reason might be misunderstandings in the transmission from the oral translator to the person writing down the translated text. We know that Fryer, whose command of Chinese was outstanding among Westerners in China at the time, had received only a very basic education in the sciences.[18] He had not experienced any special training but had only completed basic science education at Highbury Training School. For this reason he was simultaneously studying and translating when he rendered texts on mathematics, chemistry, acoustics, electricity, medicine, scientific measuring, machinery and mining at the Jiangnan Arsenal. It is almost impossible to imagine that he understood without error the contents of all the texts he translated.[19] In addition, the process of coordination and deliberation between the oral translator and the scribe responsible for recording the text could easily lead to misunderstandings. Translated terms like *zazhi* for 'compound' or *siwu yanliao* 死物顏料 for 'mineral colouring matter', if they were not coined due to mistakes of the oral translator Fryer, were most likely misunderstandings on the part of the scribe Xu Shou. It seems that the collaborative method of 'oral translation recorded

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[18] Cf. Adrian Arthur Bennett. 1967. *John Fryer: The Introduction of Western Science and Technology into Nineteenth-Century China*. Cambridge, Mass: Harvard University Press, p. 22; Wright 2000, pp. 100–19.

[19] Cf. Bennett 1967, pp. 23–5.

with the brush', which was employed at that time, did not represent a perfect solution to the problem of translating technical terminology. Moreover, the original books on which Fryer and Xu Shou based their translations, like David Wells' *Principles and Applications of Chemistry* (1858) and Bloxam's *Inorganic and Organic Chemistry* (1867), were rather simple and sketchy in describing basic chemical concepts. They did not even contain a specialized introduction to molecular theory. Naturally, this placed restrictions on the understanding of the translators and in consequence influenced the ability of the reader to master these concepts. In addition, the translations of technical concepts could in turn influence the rendering of the names for chemical compounds. When Xu Shou and Fryer translated 'bismuth oxide' as *biyang* 鉍養, 'chloric peroxide' as *lüyang-si* 綠養四 and 'chlorine oxide' as *lüyang* 綠養 this was because they had an inadequate understanding of the concept of oxidization. On the other hand, the success of their proposal for translating the elements can partly be referred to the fact that the Western theory of elements was already in a mature state and was outlined very clearly in the original English works on which the Chinese translations were based.

Conclusion

The coining of Xu Shou and John Fryer's chemical terminology was largely completed by the end of the 1860s. No matter whether their terms were successful or not, their efforts were without doubt a pioneering enterprise. Their experience in coining translated terms in the realm of chemistry served as a model for their translation of other technical terminologies. In his "Brief Report on Translating Western Works at the Kiangnan Arsenal" (1880) Fryer described his principles for coining new technical terms in the following way:

> Coining of new terms: When there is no term in Chinese, it is necessary to coin a new term. There are three methods for this:–
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> a. Take a frequently used character, add a radical and use it as a new term. Continue to read it according to its old pronunciation, e.g., *mei* 鎂 for 'magnesium', *shen* 鉮 for 'arsenic', *bu* 砩 for 'boron', *xi* 矽 for 'silicon' etc. Or: employ a rarely used character, explain it and use it as a new term, e.g., *bo* 鉑 for 'platinum', *jia* 鉀 for 'potassium', *gu* 鈷 for 'cobalt' or *xin* 鋅 for 'zinc'.
>
> b. Use several characters to explain the subject and use this explanation as a new term; use as few characters as possible, e.g., *yangqi* 氧氣

> for 'oxygen', *qingqi* 輕氣 for 'hydrogen', *huolunchuan* 火輪船 for 'steamship' or *fengyubiao* 風雨表 for 'barometer'.
>
> c. Use Chinese characters to transliterate the Western name. Use *guanhua*-pronunciation and always employ the same characters to transliterate the same Chinese sounds. Use characters which have been employed in earlier translations and the Chinese will at once be able to see that it is a [transliterated] Western name.
>
> Consider all terms that you coin yourself as temporary. If it turns out that there has been a name for a certain thing in the past or if you realize that the newly coined term is inappropriate, it can still be changed.[20]

This set of rules for translating terms was very good in principle, and yet it proved to be no more than a tentative outline. Applied in practical work it could be successful, as in the case of the names for the chemical elements, but it could also fail, as in the case of the terms for chemical compounds and concepts. Nevertheless, in the final analysis, Fryer and Xu Shou's work was a very important step in the formation of Chinese technical terminologies.

The nineteenth century saw rapid and constant changes in the development of chemistry. The books Fryer and Xu Shou translated were popular British or American textbooks from the 1850s and 60s. When these books were published, they already lagged to a considerable extent behind more recent developments in chemistry. By the time the Chinese translations were completed, revised editions had appeared or they had been replaced by new textbooks. Since the originals were in many respects inadequate, it is not surprising that the translated terms of Fryer and Xu Shou displayed similar shortcomings. It is regrettable that the new terms they coined for 'temporary usage' were employed for almost thirty years. In this period no new Chinese translations on chemistry were published that could have substituted their

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[20] Quoted from the Chinese version in Zhang Jinglu 1953, p. 17. The original English text on which Fryer based his revisions read as follows:

"Coining of New Terms:–Where it becomes necessary to invent a new term, there is a choice of three methods:

a. Make a new character, the sound of which can easily be known from the phonetic portion, or use an existing but uncommon character giving it a new meaning.

b. Invent a descriptive term, using as few characters as possible.

c. Phoneticise the foreign term, using the sounds of the Mandarin dialect, and always endeavouring to employ the same character for the same sound as far as possible, giving preference to characters most used by previous translators or compilers.

All such invented terms are to be regarded merely as provisional and to be discarded if previously existing ones are discovered or better ones can be obtained before the works are published." See John Fryer 1880, p. 80.

work. The situation changed only after the turn of the century when Japanese books on chemistry began to be translated into Chinese. Except for the elements and chemical compounds where no great changes had occurred, the contents of the Japanese books was completely different from the works of Wells and Bloxam, in particular with regard to chemical theory. The periodic table of elements, molecular theory and the theory of oxygen reduction were described very clearly. Thus a large number of technical terms of chemistry were directly taken over by Chinese scholars from the Japanese and many terms coined by Xu Shou and Fryer eventually proved inferior and fell into disuse. In fact, not only the terminology of chemistry but also that of physics, biology, geology and other disciplines experienced a similar fate in China.

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