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The Frame of Western Learning and the Systematicity of Chinese Translated Technical Terminology

Guowei Shen
Kansai University, Japan

Abstract Modern scientific terminology relies on univocity (clear meaning) and systematicity (organised structure). Strict definitions are key to distinguishing technical terms from everyday language. Yan Fu noted China's tradition of mutual glossing but lack of definitions. Systematicity, as seen in Linnaeus's eighteenth-century classification, organises growing knowledge. China and Japan adopted Western science differently: Chinese actors used new characters, while Japan focused on synthesis. The method employed in Japan proved more effective. This paper explores their linguistic approaches to developing scientific terminology, ensuring univocity and systematicity.

Keywords Neologisms. Newly coined words. Systematicity. Affixation. Translation.

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1 Introduction

What is commonly known in China as the 'Eastward Spread of Western Learning' (*xixue dongjia*n 西學東漸) essentially refers to the historical process of a Western knowledge system being introduced and integrated into the East through the medium of Chinese characters.

Throughout history, Chinese characters always responded to the addition of concepts through a special method of growth. And in the great historical process of the reception of Western learning, Chinese characters also played a decisive role in their distinctive manner. Western learning as a novel scientific system is characterised by the unambiguous nature and systematicity of its terminology. The strictness of definition is an essential means for guaranteeing univocity and distinguishing between common words and technical terms. As Yan Fu 嚴復 (1853-1921) pointed out, the Chinese language only has a tradition of glossing and lacks the practice of defining or delineating objects. From another point of view, systematicity is a necessity for organising the ever-expanding accumulation of knowledge. The biological classification system invented by Carl Linnaeus (1707-1778) in the eighteenth century is the most scientific attempt. In the East, the radicals of the Chinese characters serve as the model for reflecting the classes of the external world in language. But radicals are merely visual symbols that need to acquire sound. Vis-à-vis the scientific conceptual system of the West, John Fryer (1839-1928) and Western missionaries decided to coin new characters as a means to translate terms. Scholars such as Zhang Taiyan 章太炎 (1869-1936) and others advocated to employ traditional philological knowledge of coining new characters to address the increasing number of new concepts. Japan, however, which faced the same terminological problems, used a synthetic method, employing compound words and affixation. In the end, practice corroborated that Japan's synthetic methods were the only feasible way to adopt foreign conceptual systems on a large scale. This article will explore the similarities and differences, as well as the achievements and shortcomings in the history of translatory innovation from the perspective of a scientific narrative characterised by linguistic consistency.

2 Understanding the Characteristics of Terminology: Mill and Yan Fu

The translation of Western scientific books at the outset requires addressing the issue of terminology. Terminology forms the foundation upon which scientific narratives are constructed. Yan Fu, when translating *Evolution and Ethics*, recognised the importance of adhering to scientific standards in dealing with scientific terms by means of

'definitions' and 'explanations'.[1] The second introduction to *Evolution and Ethics* is the section of the original book in which in a broad sense a definition of 'evolution' is provided. However, both in terms of conceptual expression and linguistic form, Yan Fu's translation fails to exhibit the characteristics expected of a scientific definition. On 19 September 1898 (the fourth day of the eighth month by the lunar calendar), Yan Fu in a lecture presented "Five Rules of Definition".[2] At this time, *Tianyanlun* 天演論 (the translation of *Evolution and Ethics*) had just been published, and Yan Fu was in the process of translating Adam Smith's *The Wealth of Nations*.[3] In general, *Evolution and Ethics* is a popular science lecture intended for a general audience, and the issue of terminology is not particularly prominent. However, as the original works which Yan Fu translated became more specialised, the problems related to terminology and its definitions became increasingly prominent. "Five Rules of Definition" reflects Yan Fu's contemplation on definition issues during this period. When Yan was translating Mill's *Logic*, he had to confront the following questions:

1. What meaning do words have, especially which characteristics do science terms have regarding their meaning?
2. What is a definition, and how should it be carried out?
3. What kind of influence did the language behaviour of the Chinese people and the contemporary Chinese language have on definitions?

In the introductory part of his book, John Stuart Mill (1806-1873) provides a detailed and precise definition of logic, in the second part of the first volume he further writes on the problem of using existing words as technical terms:

1 As for example in the introduction of his translation of *Evolution and Ethics* he writes: "[Spencer] defines 'evolution' as 'Evolution is an integration of matter and concomitant dissipation of motion during which the matter passes from an indefinite incoherent homogeneity to a definite coherent heterogenity'" (1981b, ix). Yan Fu's commentary runs: "The principle of evolution is the integration of matter and concomitant dissipation of force. In the process of its practical application things change from simplicity to complexity, from fluidity to coagulation, from chaos to order. The mingling of substance and force, in mutual interaction, gives rise to transformations" (6).

2 The content of "Five Rules of Definition" is as follows: "First, a definition must embody the virtues of the object, any deviation from this results in confusion. Second, a definition must not use the words that are defined, and violation of this leads to circularity. Third, a definition must include all the named things, any failure to do so results in omission. Fourth, a definition must not use semantic glosses or explanations, violating this leads to obscurity. Fifth, a definition must not use words like 'non', 'without', 'not', etc., violating this results in negation" (Yan 1986, 1: 95-6).

3 According to Pi Houfeng (2006, 414-20), *Tianyan lun* was published in June 1898. At this time, already 146 pages of Smith had been translated.

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> Even scientific writers have aided in this perversion of general language from its purpose; sometimes because, like the vulgar, they knew no better; and sometimes in deference to that aversion to admit new words, which induces mankind, on all subjects not considered technical, to attempt to make the original stock of names serve with but little augmentation to express a constantly increasing number of objects and distinctions, and, consequently, to express them in a manner progressively more and more imperfect. (Mill 1882, 40)

Yan Fu, in a note to his translation, writes that over time, the gap between the "name" and the "reality" of things widens to the point where the "name" can no longer represent the "reality" and cannot be used in science. Not only do ordinary people employ nouns thoughtlessly, at times even those "scientific writers" who should be much more cautious in the same way as ordinary people "destroy language". He points out:

> When language is in such a state of confusion, the task of using it for profound and difficult matters of knowledge and principles becomes extremely difficult. (1981a, 35)

General words thus cannot be used as precise scientific terminology. Yan Fu closely related Mill's discussion on the general tendency of semantic change to the narrative of science. In his translated text, Yan Fu rather accurately conveyed Mill's intentions, but at the same time even more stressed the peculiarities of scientific terminologies.

Regarding the influence of language on scientific discourse, Yan Fu employs the words of Alexander Bain in order to point out:

> The definition of meaning is explained by using properties similar to it. However, when things with the same name now have different properties, or when things have similar properties but different names, it becomes impossible to define meaning. (1981a, 35)

Yan Fu stressed that, originally, "the names of things have drifted far from their proper meaning to that extent that there is no clear definition".[4] Science, however, begins with definition and without strict definitions there can be no scientific narrative. Therefore, those engaged in science often abandon common names and create new

4 "Therefore, those who engage in the sciences, quite often refrain from using popular names and create new ones, in order to seek the true essence of language and thought, detached from conventional paths, and indeed in these matters there often is no other choice" (Yan 1981a, 35).

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terminology out of necessity.[5] Considering Yan Fu's extensive use of archaic and less common words in his translation, one can agree with this assertion.

Chapter eight of Mill's original work was titled "Definitions". Here the author of the original work focuses on the issue of defining words. Firstly, regarding what a 'definition' is, Mill states that a definition is a proposition that expresses the meaning of a word. As for how to define, Mill says that listing all the attributes is the most precise and least ambiguous way of defining. However, this method is not very concise, if too many technical terms are involved it is not convenient to use it in everyday contexts. A more common approach is to use one or more other words to explain a word that needs to be defined. However, it is normally assumed that this cannot be considered a definition (this is the technique Yan Fu referred to as 'mutual glossing' *hu xun* 互訓, explained later). Mill states that the definition of a term is the sum of its attributes, which also means that a definition can be broken down into a set of attributes. Mill moreover discusses questions such as the distinction between "complete definition", "incomplete definition" (Mill 1882, 106-7) as well as the difference between complete definition and description.

The term *dingyi* 定義 used today for 'definition' was introduced from Japanese. Yan Fu employed the term *jieshuo* 解說. The earliest appearance of this term in a scientific context is in Matteo Ricci's (1552-1610) and Xu Guangqi's 徐光啟 (1562-1633) translation of Euclid's *Elements* (*Jihe yuanben* 幾何原本, 1607). At the beginning of the first chapter of the book, there is an attached list containing thirty-six definitions, where terms used in the book are defined. Ricci explains:

> Always when you set up a discussion, you first have to separate, distinguish and explain the list of names that is going to be used in the discussion. That is why they are called 'definition'. In all matters pertaining to calendrical methods, geography, music, the crafts and arts, there is Measure and there is Number. This all is subordinated to one of the ten categories, the category of quantity. Generally speaking, Quantity starts with one Point. A Point

5 Yan Fu in his 'translation' writes: "A word with a single meaning should only have one usage, this would achieve the highest reliability. In seeking it through language and written words however, it is not only difficult to attain, but nearly impossible. Even if words only have one meaning, when used by those who do not understand, unfortunately, through widespread usage, diverse meanings proliferate, rendering them insufficient as resources for exhausting knowledge and understanding principles", which actually goes beyond Mill's original text in demanding 'univocal' names in science (Yan 1981a, 42; Mill 1882, 44). Mill also writes: "Scientific definitions, whether they are definitions of scientific terms, or of common terms used in a scientific sense, are almost always of the kind last spoken of: their main purpose is to serve as the landmarks of scientific classification" (1882, 109).

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> is then prolonged to a Line, and a Line is developed into a Surface. A Surface is accumulated into a Solid. Those are called the three Magnitudes.[6]

The first term defined is 'point': "A point: it has no parts" (Engelfriet 1998, 155). Further on at the beginning of every chapter there are definitions of the technical terms used. The first six chapters of Euclid define 80 terms.

The concept of *jieshuo* as a linguistic practice does not have any tradition in China. In a commentary, Yan Fu says that in the West, from the time of Aristotle in ancient Greece on, it has been a common teaching to conduct definitions before engaging in any intellectual endeavour. Therefore, as long as a person was reasonably educated, this tradition would not be violated.

However, China did not have the linguistic habit of defining nouns. Yan Fu specifically points out:

> In the past if one had a term and wanted to explain it, there was no other way than employing the technique of 'semantic glossing' (*xun gu*). If two words were similar or near to each other, then they could be used for 'mutual glossing'. (1981a, 103)

Chinese ancient dictionaries such as the *Erya* 爾雅 or the *Shiming* 釋名 all followed this pattern. For example, the statement 'Large: This means great' (*juzhe da ye* 巨者大也) does not involve describing and defining attributes. Therefore, Yan Fu explained that 'glossing' is not providing 'definitions', it only involves mutual explanations of words, explaining the semantic changes of words from ancient times to the present. Yan Fu added:

> From the perspective of a scientist, this merely constitutes a gloss and cannot be taken as a definition. A definition involves using several words which have a meaning and put them together. Their meaning corresponds to that, what one wishes to define. So, one could say: "A human is a thing that has a body, organs, is filled with life and a spirit and has such an outward appearance". There we have a definition. (124)

A definition should be "exhaustive, covering all attributes". Mill, however, also says that, in everyday contexts, 'mutual glossing' style definitions are unavoidable, such as "A human is a member of the human species" (Wang 1986, 5: 1243).

6 Translation in Engelfriet 1998, 138-9.

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> This is because human cognition of things proceeds gradually. For this reason, the most superficial and most easily understood method is 'mutual glossing'. This is if two terms have the same meaning and if the latter is already known, such as 'a pheasant is a wild chicken', or 'an undercurrent is a stream flowing back' and so on. (Yan 1981a, 124)

Yan Fu apparently was unable to escape the influence of nominalism and he adhered to the Confucian principle of 'proper designation and smooth words'. He criticised China for its scientific backwardness, which resulted in not understanding the essence of things, so that even if a name was clearly incorrect, this was not realised. As for example the 'Five Planets' (*wu wei* 五緯) are still called stars, although they were no stars, or the whale (*jing* 鯨), the mythical fish (*kun* 鯤), the sturgeon (*xun* 鱘) and the Huso sturgeon (*huang* 鰉) all employed the radical for fish although they do not constitute fish. 'Stone charcoal' (*shitan* 石碳) should not be used in order to denote 'coal'. Mercury (*gong* 汞) should not be denoted as being 'sandy', etc. Such examples were extremely numerous. Especially after trade was opened with the West, a large number of Western products was imported, but the translated names were incorrect. Examples include 'Fire-wheelship' (*huolunche* 火輪車) for steamship, 'self-chiming clock' (*zimingzhong* 自鳴鐘) for an automatic clock, 'self-flowing water' (*ziliushui* 自流水) for tap water, 'self-coming fire' (*zilaihuo* 自來火) for gas, 'electric *qi*' (*dianqi* 電器) for electricity, 'elephant skin' (*xiangpi* 象皮) for rubber, 'foreign gun' (*yangqiang* 洋槍) for Western firearms etc. (1981a, 35-6). To address this, scientific knowledge was essential. For this reason, Yan Fu pointed out China's second great weakness: because of a lack of scientific knowledge, the people were unaware of the original principles of things and merely from the appearance created names. It was therefore, that erroneous terms such as 'fire-wheel car' and 'self-chiming clock' could appear.[7] Yan Fu pointed out that, apart from issues related to knowledge, there were certain problems inherent in the Chinese language during that time. The disconnection between names and realities was a common issue in the languages of various countries, but it was particularly pronounced in China, as he stated. When discussing abstract and concrete terms, Yan Fu wrote:

7 'On-the-Spot Naming' is a naming method that captures the surface of things and can be explained in a popular etymological way. Until the mid-nineteenth century, the translated terms of missionaries active in Guangzhou exhibited this characteristic, such as 'light air' (*qingqi* 輕氣, hydrogen), 'nourishing air' (*yangqi* 養氣, oxygen), 'worship period one' (*libaiyi* 禮拜一, Monday), 'protecting against danger' (*baoxian* 保險, insurance), 'accompanying a trial' (*peishen* 陪審, jury). The Shanghai-term 'study of change' (*huaxue* 化學, chemistry) also is a result of on-the-spot naming (cf. Shen 2010).

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> This is so in the case of the 'property of white' (*baide* 白德). Its definition would be: objects, which enable me to perceive whiteness (in this context, the word *bai* 白 in the phrase has a different meaning from the original name *bai* 白, thereby avoiding any offense); as for example, in the case of white objects, their definition can be stated as 'things that evoke a sense of whiteness in people'.[8] (27)

Since Chinese does not have morphological changes, single-syllable forms do not have the means to offer such distinctions.

Yan Fu once again provided a concentrated discussion of terminology in *Zhengzhi jiangyi* 政治講義 (Lectures on Politics, 1906) (Wang 1986, 5: 1241-316). This is the transcript of a series of lectures given by Yan Fu in the early summer of 1905, in response to an invitation from Lu Junwei 駱君維, secretary of the Chinese YMCA. According to research by Qi Xueben 戚學本, *Zhengzhi jiangyi* is a translation of *Introduction to Political Science* of the English historian J.R. Seeley published in 1885[9] (2014). However, unlike general translated works, due to being a transcript of lectures, it inevitably incorporates a large number of colloquial elements, leading to issues of consistency in language. Yan Fu at the outset informs his audience that when discussing scientific issues, it is necessary to have (1) clear and precise terminology (*mingyi liaoxi* 名義了晰) and (2) systematic reasoning (*sili cengzhe* 思理層折), which means establishing rigorous terms and cultivating scientific thinking habits. Especially the former is the foundation of scientific discourse; otherwise,

> Sometimes the meaning is already very clear, yet one may still consider it profound and difficult to comprehend. Or, thinking that one has understood, it turns out that the reality is much farther away. (Wang 1986, 5: 1243)

The viewpoint expressed by Yan Fu here does not exist in the original work; it is specifically added by him for the Chinese audience and consistently runs through the entire lecture.

Regarding the question of scientific terminology, Yan Fu in his lecture repeatedly emphasised:

- "All of you [audience] should understand that the first step in engaging with science is to rectify names". (5, 1247)

8 The original text runs: "Whiteness may be defined, the property or power of exciting the sensation of white. A white object may be defined, an object which excites the sensation of white" (Mill 1882, 133).

9 I used the 1896 edition of Seeley as reference. For a translation of Seeley's work into modern Chinese, cf. Shen, Guo 2016-19.

- "When we discuss politics, we are talking about science. Since it is considered a science, the meanings of the words used in it must be clearly defined without any ambiguity". (1280)
- "A scientific term only has one meaning. If there is a second meaning, we must ask, whether these two meanings are compatible to each other. If they are compatible, it is fine, if they conflict with each other and don't match, then one of them can be employed, the other one needs to be done away with. Only then can the term be used without violating the prohibition of contradicting the principles of language". (1285)
- "This is precisely the crucial task of science; without this, there is no science. Confucius said: 'It most definitely would be to rectify the names'. There has never been a case where names and meanings are vague, and the principles discussed are clear. If you all adhere to this warning, your achievements in science will be considerable". (1285)
- "Scientific terms must have unambiguous meanings and must not allow for ambiguity or contradictions". (1290)

Yan Fu used the example of the term 'freedom' in order to illustrate his points. In general language usage within society, the term 'freedom' roughly encompasses three meanings:

1. "Freedom is the independence and sovereignty of a country, which is not subjected to the restraint and interference of the powerful. This meaning has been transmitted since antiquity, and is most commonly found in historical records and poetry.
2. Freedom is the responsibility of the government towards its citizens. This concept existed in ancient times and remains relevant today. The conflicts between rulers and citizens in Europe often revolve around this idea. Hence, it is said that freedom is like a tree, it must be nurtured with bloodshed before it can grow.
3. Freedom as the limitation of the government's governing power. This can be observed in various aspects of life, such as religious freedom, free trade, freedom of the press, freedom of marriage, freedom of association, which all belong into this category. Often, these types of freedoms coexist with the second category of freedom". (1284)

This is a situation in daily life, but "science cannot not follow it suit because scientific terms cannot tolerate ambiguity, let alone contradiction" (1290).

In his own writing, Yan Fu declared: "To follow the third sort of meaning and simplify government, this then is political freedom" (1290). However, at that time in 1906, the formation of Chinese scientific and technical terminology was still incomplete and

the terminological system in the humanities had just begun to be formed. Yan Fu exclaimed:

> Freedom in the political realm has just this meaning. If we use this term according to the laws of science, then it must not have other uses. Thus, when we use it, then we do it according to the definition. Unfortunately, words in common usage are prone to change. As the examples mentioned before, there may still be ways to grasp other meanings or intentions. Moreover, if there are considerations beyond those mentioned earlier, there may still be ways to understand other intentions or meanings. (Wang Shi 1986, 5: 1284)

Even though the state of the Chinese language at that time did not satisfy Yan Fu, he said: "I can only cope with it". He complained stating:

> The regrettable aspect of the Chinese language lies in the misuse by scholars, resulting in the corruption of language with confusing and elusive words. This is a great obstacle for the development of scholarship. You all will realise this in the long run. Today, I, whom I am not talented, discuss science with you using the language of our country. It is akin to a watchmaker using old Chinese tools like knives, saws, hammers, and chisels, causing only those familiar with them to truly understand the hardships involved. However, we can only deal with what is at hand. Simultaneously, we must strive to refine and improve, while using it with utmost respect. There is no other way. (1247)

3 From Character Components to Radicals. The Classification Tradition of the Culture of Chinese Characters

As described by Yan Fu, scientific terms, or 'terminology', must possess unambiguous meanings; another important characteristic of terminology is its systematicity. Human cognition of the external world, with its myriad phenomena, is chaotic and disorderly but when it becomes the object of human cognition, it is endowed with a certain structure. It is determined by the physiological limitations of the human brain. Due to the scattered nature, handling cognitive objects that lack connections would be more time-consuming and laborious. With the development of human cognitive abilities, there is the need to classify and organise the knowledge that has been accumulated at home and abroad from antiquity to modern times. Linnaeus' system of plant and animal classification was specifically developed to cope with the explosion of knowledge that followed the age of

discovery. The modern Japanese enlightenment thinker Nishi Amane 西周 (1829-1897) has pointed out that human knowledge has evolved from isolated "limited knowledge" to a panoramic "comprehensive knowledge", enabling a broader understanding of the environment. After the nineteenth century, Europe entered a stage characterised by "knowledge with organised structures" (Nishi 1874, n.p.), becoming an academic discipline for both science and governing the state. The medical missionary S.A. Hunter who was working in China said:

> The nomenclature of any science is a true exponent of its condition and progress. Every advance in scientific knowledge has been indicated by a more thorough and accurate terminology, as well as by a higher and more perfect classification. (Hunter 1890, 158)

Classification is the systematisation of knowledge; terminology must reflect this systematic nature to ensure the accuracy and nimbleness of knowledge transmission.

In ancient China whether nouns, verbs, or adjectives, all adopted monosyllabic forms. In the less-developed morphological structure of the Chinese language, mono-syllables serve as a non-analytical phonetic unit, there is no inherent classification. However, in the process of obtaining a written form through the creation of Chinese characters, Chinese words were influenced by considerations of folk classification, as for example character components such as 'wood' (*mu* 木), 'fish' (*yu* 魚), 'worm' (*chong* 虫), 'water' (*shui* 氵), 'word' (*yan* 讠), 'gold/metal' (*jin* 金), 'stone' (*shi* 石), 'foot' (*zu* 足), 'mouth' (*kou* 口) etc., which already fulfil the function of categorisation.

Character components are of course components for constructing characters belonging to visual imagery and unrelated to spoken language. They reflect the folk understanding and classification of the natural world, especially the plant and animal realms. In the later development of Chinese vocabulary (binominalisation), the markers originally enclosed in the Chinese characters were released and obtained phonetic form such as:

A

松樹	柳樹	榆樹	鯽魚	鯉魚	鯨魚	蝗蟲	駿馬
songshu	*liushu*	*yushu*	*jiyu*	*liyu*	*jingyu*	*huangchong*	*junma*
pine-tree	willow-tree	elm-tree	crucian carp	carp	whale	locust	fine horse

B

樹根	樹葉	樹枝	魚鱗	魚鰭	魚鰓	車輪	車軸	車轅	馬駒
shugen	*shuye*	*shuzhi*	*yulin*	*yuqi*	*yusai*	*chelun*	*chezhou*	*cheyuan*	*maju*
tree roots	leaves	branches	fish scales	fish fins	fish gills	wheel	axle	carriage shaft	colt

The A-form is an inclusive structure, where the posterior component (underscored) serves as an affix to indicate the class of the object written before. The B-form is a segmental structure, where the front part of the compound word represents the whole, and the back part represents the part. In group B, the category component is placed at the front of the compound word, serving a limiting function, thereby ensuring the clarity of metaphorical and extended usage of the posterior component. For example, *gen* 根 originally referred to the roots of a tree, but after the permutation of the limiting components, it can also refer to grassroots (*caogen* 草根), to the heel of a foot (*jiaogen* 腳根), to the base of a wall (*qianggen* 牆根), and so on. The underscored components in the aforementioned A/B classes serve as redundant elements in terms of meaning but carry the function of classifying or distinguishing objects at the colloquial level. The phenomenon of classifying two-character words already existed in oracle-bone inscriptions, and the development of affixes in modern Chinese has further evolved in three-character and four-character words. Oracle bone script is pictorial, and composed by pictograms. Although normally designated as 'single-bodied characters' (*wen* 文) it also contains a large number of 'joint-bodied characters' (i.e. characters that can be dissected into individual parts). The components later came to be referred to as *pian* 偏 or *pang* 旁, among which some have become common components, although their number is small, such as *shou* 手 (hand). The *Shuowen jiezi* 說文解字 (Explaining Simple and Analysing Compound Characters), compiled by Xu Shen 許慎 (58-147) during the Eastern Han Dynasty (23-220 AD), consists of a total of 9,353 characters. Additionally, there are 1,163 *chongwen* 重文 (variant characters). They are classified into 540 different *bu* 部 (compartments) which became the means for retrieving other characters. There are still many facts of this process which need clarification, but the establishment of the classification system certainly is of great significance. But this is not all: The process of character components becoming 'radicals' also was a period of the great proliferation of characters. When sound-components and form components are combined in order to form new characters, the form component at the same time also becomes the classification symbol. After the *Shuowen jiezi* there was a substantial increase in the number of characters. Zhang Taiyan said: "Extending Xu, from the *Yupian*

to the *Jiyun* there were no less than 20,000 characters" (2014, 45). At the time the *Kangxi Dictionary* was compiled, the number of characters included into the dictionary already was more than 40,000. The complexity of such a vast system of linguistic symbols undoubtedly increased the difficulty in its usage.

4 The Temptations of *Cang Jie* 倉頡: Creating New Characters

The Japanese Rangaku scholar Ōtsuki Gentaku 大槻玄澤 (1757-1827) in the chapter five *Meigi kai* 名義解 (The Explanation of Names) of his *Chōtei kaitai shinsho* 重訂解體新書 (Revised New Book on Anatomy) writes:

> When providing specialized translations today it is essential to ensure the appropriateness of the nomenclature in accordance with the original. Translation should not be done by creating new words or using newly devised characters arbitrarily. Terms such as *shun* 肫, *chitsu* 膣 (vagina), *setsugo* 攝護 (prostate) or *kaitai* 解體 (dissection), as well as *shinkei* 神經 (nerves) and *rohō* 濾胞 (follicle) are all examples. (1826, j. 5, 1b)

The newly coined characters mentioned by Otsuki actually refer to two different situations: (1) using obscure and abandoned characters to translate new concepts in Western medicine, in which case these characters are given new meanings; (2) creating new characters to represent Western medical concepts that do not exist in Chinese medicine. In respect to the former, *shun* and *chitsu* mentioned by Otsuki are examples, another character used in the book is *jun* 腱.[10] All three characters can be found in Chinese dictionaries. Regarding the latter practice, *sen* 腺 really is a newly created character, which was used for translating 'gland'. However, newly created characters in the 'Dutch-learning' translations are exceedingly rare. Characters used until today, except the original obscure characters *chitsu* 膣, are only *sen* and *su* 膵 (pancreas). The only character which was integrated into Chinese and is still used is *xian* 腺.

The character *sen* was first used in a book published in 1805, the *Waran naike ihan teikou* 和蘭內景醫範提綱 (Outline of the Dutch Internal Medicine Model). A statement in the first chapter of the book

10 The original meaning of 腱 is a piece of meat, specifically referring to the meat around the elbows and knees that is shaped like a block. Daisuke Ozuki chose this character because on the left side, there is the component 肉 (meat), and on the right side, there is an alternate form of the character 菌 (bacteria or fungi). Together, they convey the idea of an organ formed by the convergence of cellular tissues.

says: "*Sen* is a newly coined character and it is pronounced *sen* 泉". The character *sen* is in its nature similar to affixation and this is of greatest importance. Such characters, which were newly coined in Japan, in linguistic research are called *Kokuji* 國字. In China, they are also referred to as *wozi* 倭字 (Japanese characters), *hesuzi* 和俗字 (ordinary Japanese characters) and *hezhi hanzi* 和制漢字 (Japanese coined Chinese characters). They are Chinese characters newly formed by Japanese on the basis of Chinese methods of character formation. In ancient texts such as the *Kojiki* 古事記 (Account of Ancient Matter, ca 712) and the *Manyoshu* 万葉集 (Collection of ten thousand leaves, after 759) some examples of newly coined characters can already be found, but the majority of newly created characters occurred after the twelfth century. The method of creating characters primarily involves combining meanings, such as in the case of *touge* 峠 (mountain pass), *tsuji* 辻 (crossroad), *shitsuke* 躾 (discipline), *iwashi* 鰯 (pilchard) etc. Most of these characters do not have Chinese-style pronunciations. After the beginning of the Meiji era (1868-1912), combined characters such as *kawat* 瓩 (kilogram), *sun* 糎 (centimeter), *ke* 粁 (kilometer) appeared. These characters were created to represent Western units of measurement using a single piece of movable type. They are not read as individual syllables and should rather be treated as symbols. Those who had received an orthodox Chinese studies education, considered these Japan coined Chinese characters as vulgar and looked down upon them. Regarding, for example, the concept of *sen*, Noro Tennen's 野呂天然 *Seishō shikan* 生象止觀 (Introduction to Anatomy) and others all contain newly created strange characters in order to express it, but in the end none succeeded. Ishizaka Sotetsu 石阪宗珪 (1770-1842) criticised the creation of characters as distorting ancient scriptures, which he considered as a deceptive act (Sasahara 2006, 177-84). This forms a sharp contrast with the practices of Western missionaries who came to China in the nineteenth century, which we will discuss below.

In his *Account of the Department for the Translation of Foreign Books at the Kiangnan Arsenal, Shanghai*, John Fryer pointed out that

> the Chinese language presents extraordinary difficulties both in its acquisition by Europeans and in its use for the expression of the more exalted ideas of Western learning. (Fryer 1880, 79)[11]

11 Translator's note: the author here used the Chinese translations of the account, which was first published under the title "Jiangnan zhizaoju fanyi xishu shilüe" (Brief Account on the Translation of Western Books at the Shanghai Arsenal) in serialised form in the *Gezhi huibian* of 1880, numbers three to five. A reprinted version is in Zhang Jinglu 1953, 9-28. The translation employs the original English version as far as possible. Chinese passages, which are not contained in the original English version, were translated and added.

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This is because it is "so ancient, so crude, and so inflexible".

> It is readily granted [...] that such subjects as the doctrines of Christianity, or affairs of a political nature might be expressed easily in the language of a people among whom religion and diplomacy have for ages been carried to a considerable state of advancement. (79)[12]

However, if translating Western science and technology, it could be considered as "almost absurd" (79). Especially with the recent rapid development of science and technology in the West,

> there are numerous fields and a multitude of names, but China lacks both the knowledge and the terminology. How can it be accurately translated? Truly, it is an exceedingly difficult task. (79)

Fryer however, has a solution:

> A little investigation will show that this opinion is without foundation; and that from the time the early Jesuit missionaries commenced their compilations up to the present day no serious difficulties have been experienced by foreign translators. (79)

Fryer also was of the opinion that

> from the almost total absence of native scientific literature and pursuits there is necessarily a paucity of scientific terms, and this appears at first sight to form an almost impassable barrier to the use of Chinese for scientific purposes. (79)

However, Fryer also believed that

> Chinese, like other languages, is capable of growth. The increasing intercourse of China with Western nations is undoubtedly making vast additions to the number of words in current use. (79)
>
> If it were necessary to use only such terms as are to be found in standard Chinese dictionaries, or if it were forbidden to give any

12 The translation department of the Kiangnan-Arsenal did almost no translations of Western humanities. Regarding this kind of translations, Fryer's statement constitutes a misunderstanding. Subsequent translation practices have proven that the differences between China and the West are even greater in the field of humanities. It is also important to note that Fryer is only discussing the translation of Western works by Westerners, as China at this time was still lacking foreign language talents, and translation work could only be carried out in a way dominated by Westerners.

> new shades or meaning to existing characters, the task of translation could never be accomplished. (79)

Therefore, in the creation of translated terms, the translator's task is formidable. Fryer reflects on the coining of new terms by Jesuit missionaries since the late Ming and early Qing dynasties (1600-1720 ca):

> Where it has become necessary to express a new idea, or to give a name to a new object in Chinese, there has always been found a way of managing the matter more or less satisfactorily, and hence some very clumsy specimens of nomenclature are gradually becoming current […]. Of course all such new terms have to stand or fall on their own merits, and if radically wrong or misleading, they are pretty certain, eventually, to be supplanted by better ones. (79)

> It will be remembered that when the English language began to borrow largely from Greek and Latin, many scientific and technical terms were coined which have since fallen into disuse or been supplanted by others. So, it must necessarily be in China in regard to the terms borrowed from the English or other languages. (79)

Regarding the translated names of chemical elements, Fryer proposed two methods:

> 1. Form new terms by using ordinary characters combined with character components, still pronounced with their original sounds. Examples include magnesium 鎂 *mei*, osmium 鉮 *shen*, rhenium 砸 *bu*, and silicon 矽 *xi*; or 2. use less commonly used characters in the dictionary and assign them new meanings to create new names, such as platinum 鉑 *bo*, potassium 鉀 *jia*, cobalt 鈷 *gu*, zinc 鋅 *xin*, and so on. (1880, 79; see fn. 11)

Fryer's examples include platinum, potassium, cobalt, zinc, all of which are found in Chinese dictionaries. The *jia* used in potassium, for example, originally means 'armour', and the *xin* in zinc means 'firm'. The issue discussed here can be considered as pertaining to the levels of character creation and usage. The creation of characters mainly utilises the method of phonosemantics, but the character component employed, to some extent, also made a chemical classification possible: *jin* 金 represents metal, while *shi* 石 represents non-metal.[13]

13 In Fryer's table, the character compound *qi* 氣 for 'gas' does not show up. *Yang* 氧 (oxygen), *qing* 氢 (hydrogen), *dan* 氮 (nydrogen) for the first time appear in the Educational Association of China's *Xieding huaxue mingmu* 協定化學名目 (Agreed on List of Chemical Substances, 1899). Cf. Wang 2000, 15.

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The pioneer of the method to represent chemical elements by creating new characters was the German missionary W. Lobscheid (1822-1893). In his *English-Chinese Dictionary* (1866-69), Lobscheid showed a particular interest in the terminology of chemistry – specifically, the names of elements. In the Preface of Part IV of the dictionary, he specifically discusses the naming issues of chemical elements (Shen 2010, ch. 5). Lobscheid believed that in the Chinese language, the character representing the basic elements constituting the world is *xing* 行 and therefore, the names of the majority of elements can be easily obtained by inserting a certain Chinese character into 行. That is, he divided the character 行 into two parts, placing a Chinese character related to chemical elements in the middle and pronounced it according to that character. Lobscheid provided the following examples:

彳+水+于 (Shwui) = hydrogen	彳+光+于 (Kwang) = phosphorus
彳+炭+于 (Tan) = carbon	彳+绿+于 (Luh) = chlor

Lobscheid hoped that through this simple naming method, Western knowledge of chemistry could be popularised in China. In the preface, he wrote that he believed his method, compared to the explanatory methods commonly used in chemistry books at the time, was more straightforward and practical. He thought that through the use and promotion by experts, people in China could understand Western science, particularly chemistry, more quickly and effectively **[fig. 1]**.

The *English-Chinese Dictionary* includes a total of 49 chemical element names, of which 21 are named using the character creation method. Excluding the four mentioned earlier, the remaining 17 are shown in table 1.

Table 1 Lobscheid, *English-Chinese Dictionary*, terms for chemical elements

Bromine	彳+臭+于 Chau (溴)	Strontium	彳+白+于 Peh (鍶)
Fluorine	彳+黃+于 Hwang (氟)	Tellurium	彳+地+于 ti (碲)
Iodine	彳+藍+于 Lan (碘)	Thorium	彳+灰+于 Hwui (釷)
Nitrogen	彳+硝+于 Siau (氮)[i]	Titanium	彳+紅+于 Hung (鈦)
Oxygen	彳+养+于 Yang (氧)	Uranium	彳+天+于 Tien (鈾)
Potassium (Kalium)	彳+榎+于 Kien (鉀)	Vanadium	彳+皓+于 Hau (釩)
Selenium	彳+紅+于 Hung (硒)	Yttrium	彳+白/金+于 Kin (釔)
Silicon	彳+火/石+于 Shih (硅)	Zirconium	彳+黑+于 Heh(鋯)
Sodium (Natrium)	彳+莎/金+于 So (鈉)		

i Lobscheid also proposed the term *danqi* 淡氣.

Lobscheid did not provide explicit principles for selecting the characters inserted in the middle, but based on examples, they can generally

be categorised into two approaches: characters chosen based on the root of the original word, such as 水 in 氵+水+亍 (water) and 天 in 氵+天+亍 (heaven); and characters selected based on the element's form, properties, colour, etc., such as 養 in 氵+養+亍 (nurture) and 綠 in 氵+綠+亍 (green). It should be noted that the former type of characters is extremely rare. Lobscheid's character creation method mostly falls within the category of phonosemantics, with new characters pronounced based on the character inserted in the middle of the character 行.[14]

The drawback of Lobscheid's 'Five-Elements Method' was that it only could be used to indicate new chemical elements. Moreover, it did not provide any classificatory added value. Fryer's method, on the other hand, could represent the form of substances, and was clearly further advanced. From the point of view of the form of characters, it was more easily accepted by Chinese. Fryer's principle of character formation was formulated in 1869 when he was translating *Well's Principles and Applications of Chemistry* (translated as *Huaxue jianyuan* 化學鑒原). Whether it was influenced by Lobscheid remains unknown, but the significant role played by collaborator Xu Shou 徐壽 (1818-1884) is undeniable. The method of naming they applied was the following:

> In the West, the names of substances often have many syllables 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* 磷) and 'carbon' (*tan* 碳). […] 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

14 Lobscheid provided pronunciations for Cantonese (written in small letters) as well as for the *guanhua* pronunciation (written in large letters). There was no standardised *guanhua* pronunciation for 鈉 and 碲.

> with one Chinese character. If the first sound was unsuitable, we used the second sound. We then added a radical (character compound) to distinguish the classes but retained the original pronunciation. (Wells, Fryer, Xu 1871, j. 1, par. 29, 19b-20a)

The key here is the 'one-character principle based on the name of a single character'. The one-character principle resolves the contradiction between the characteristics of Chinese words and the names of chemical elements. The average length of Chinese words is generally not more than four syllables, while chemical elements need to be used both individually and in compound forms.

If the names of elements are disyllabic, it would be very inconvenient for compound usage. The single-character principle used by Fryer for elements thus is much superior in this aspect to the translated names in *Gewu rumen* 格物入門 (Introduction to Natural Sciences, 1868) by W.A.P. Martin (1827-1916, Ch. Ding Weiliang 丁韙良).[15]

The principles and methods advocated by Fryer for the creation of terminology were embraced by the School and Textbook Series Committee and the China Medical Missionary Association, also known as the *Boyi hui* 博醫會. Particularly noteworthy is the naming system for chemical elements with character creation at its core, which later became a national standard. It needs to be acknowledged that Fryer in respect to his innovation in coining terms for chemical elements was very successful. However, this success also conveyed a misleading message, namely that the creation of new terms was synonymous to the creation of new characters. The character creation method was especially revered by the China Medical Association, which was of the opinion that it was the best method for creating medical terminology embodying their systematicity.

The Medical Missionary Association was established in 1886 with the aim of promoting the introduction and education of Western medical knowledge. The association undertook extensive work in the creation and approval of medical terminology.

P.B. Cousland (1860-1930) documented this period of history in the following manner:

- 1890. The lack of uniformity in the terms used by the various translators was so serious a hindrance to medical education that the Medical Missionary Association of China at its first

15 W.A.P. Martin lists 42 elements in his "Introduction to Chemistry", which was part of his *Introduction to Natural Sciences*. There are Chinese terms for 25 of them. Except for the metallic elements, already known in China's antiquity, such as iron, copper, zinc etc., the names of the other elements are disyllabic. In his scheme, gaseous elements have the character *qi* 氣 (air) at the end (*yangqi* 養氣 'oxygen', *tanqi* 淡氣 'oxygen'), while non-metallic elements mostly have the character *jing* 精 (essence) at the end (*tanjing* 碳精 'carbon', *pengjing* 硼精 'boron'). Cf. Masini 1993, 154-6.

Conference held in Shanghai in 1890 appointed a Terminology Committee to draw up a standard medical nomenclature.

- 1901. The first meeting of this committee was not held till 1901, when the subjects considered were Anatomy, Histology, Physiology, Pharmacology and Pharmacy, and a pamphlet containing the chosen terms was issued (Medical Missionary Association of China 1901).
- 1904. The Terminology Committee met for the second time in 1904 and published the terms in Pathology, Pharmacology and Pharmacy, and a pamphlet containing the chosen terms was issued (Medical Missionary Association of China 1904).
- 1905. The third meeting took place in 1905. A Bacteriology and Materia Medica nomenclature and also revised terms in Anatomy, Histology, Physiology, Pharmacology and Pharmacy were issued.
- 1908. The nomenclature devised by the committee was published by Cousland, *An English-Chinese Lexicon of Medical Terms, Compiled for the Terminology Committee*.[16]
- The Terminology Committee of the Medical Association, in the introduction to the terminology collection *First Report* published in 1901, provided the following explanation on the principles of terminology creation:

> It may be of interest to the members of the Association to give some idea of the principles which guided the Committee in its work, especially in regard to fundamental terms. The first subject which claimed attention was the names of the bones. It was thought most desirable that in the case of such a foundation matter there should be, if possible, only one character for each bone, in order to facilitate the naming of arteries, veins, and nerves as well as muscles. After a long and exhaustive search through Williams, Giles, and Kang Hsi for suitable characters, the following list was finally agreed upon on the principle that every long or otherwise important bone should have the bone radical at the side (except those of the head), the bones of the hand should have the hand radical, and the bones of the foot, the foot radical. The

16 On the process, cf. also Wang 1991; Zhang 1994. "However, we should note that, including the Jiangnan Arsenal Translation Bureau, most of the Western books translated into Chinese in the nineteenth century were done by Westerners dictating and Chinese scholars transcribing. The Westerners had limited knowledge of Chinese, and the Chinese scholars had no understanding of foreign languages. Without understanding foreign languages, it was impossible to create translated terms using the morphemic decomposition method. This stands in stark contrast to the Japanese scholars of *Rangaku* 蘭學 (Dutch Learning). In Japanese, 'oxygen' is translated as *sanso* 酸素 (literally 'acid element'), and 'hydrogen' is translated as *suiso* 水素 (literally 'water element') because the Japanese scholars understood the meanings of 'oxy-' and 'hydro-'".

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> bones of the head; it was not thought necessary to specially indicate by the radical, though as a matter of fact most of the cranial bones have the head radical. (Medical Missionary Association of China 1901, iii)

In concrete, this meant using old discarded Chinese characters, or adding character components to existing Chinese characters and giving them a meaning different from the *Kangxi Dictionary*. Such a naming system would be of great help for students and teachers in memorising the location of bones in the body.

The principle for naming each part of the circulatory system is to add the radical for 'blood' (*xue* 血) alongside, and each part is represented by a single Chinese character, as shown in table 2 **[tab. 2; fig. 2]**.

Table 2 Translations of parts of the circulatory system

Original word	Chinese character	Pronunciation	Reason	Modern term
Auricle	窳	*hsüeh*	blood cave	心房
Ventricle	血+賁	*p'en*	blood spirter	心室
Artery	衄	*mo*		動脈
Vein	盂	*huang*	blood going to the heart	靜脈
Capillary	微/血	*wei*	minute blood vessels	毛細管

In the table above, [血+賁] and [微/血] are newly created characters, while the rest are characters listed in the *Kangxi Dictionary* but given new anatomical meanings. Others include:

> For 'canal' and 'duct', the character *wan* 脘 was used.
>
> For 'cell', the character *chu* 胰 was used.[17]

For the translation of 'gland', the terminology committee considered the term 腺 coming from the Japanese and carrying the combined meaning 'flesh spring' as correct, and it should be pronounced as *Chüuan* (this meant that the pronunciation also followed the Japanese model). But at the same time it suggested to employ the character *hu* 糊 for glands without ducts.

The preface also offered explanations regarding the reasons for proposals for the following terms:

17 The compilators refused to use the term *xibao* 細胞 coined by Li Shanlan 李善蘭 (1811-1882) and also were of the opinion that *zhu* 胰 was semantically better fitting than *zhu* 珠, cf. Shen 2000.

pancreas 胰 *I* (胰[腺])
lymph 淋 *Chin* (淋巴)
globulin 球 *Ching* (球蛋白)
tissue [月+罔] *Wang* (组织)
proteins 朊 *Ch'eng* (蛋白质)
serum 盟 *Ming* (血清)
uterus [子+宫] *Kung* (子宫)

The character creation principles established in the *First Report* served as a guideline for the subsequent terminology approval work of the Medical Missionary Association. In the preface of *An English-Chinese Lexicon of Medical Terms* published in 1908, Cousland expressed his own views on the character creation method in the translation term creation principles of the Terminology Committee:

> To utilize the many obsolete or rarely used characters in *K'ang His's dictionary*. – Many were discovered whose composition or meaning enabled us to employ them usefully or appropriately. It is a great advantage to have technical terms, especially those for vessels, nerves, and bones, represented by single ideographs. (Cousland 1908, i)

> To coin new characters. – This is an enticing method, as many characters could be built up from suitable radicals and phonetics, conveying at a glance their meaning and lending themselves to scientific classification. The committee, however, did not feel itself entitled to use this method except in case of dire extremity. (1908, ii)

The second point is precisely the systematic approach that the missionaries diligently pursued. In 1937, with the publication of the revised eight edition of *Cousland's Medical Lexicon*, terms using newly created characters were largely eliminated, and replaced by Japanese medical terminology. It can be said that the efforts of the Medical Missionary Association's Terminology Committee were essentially unsuccessful. Why did the newly created characters of the Medical Missionary Association yield different results compared to Fryer's chemical element names? Firstly, Fryer's newly created characters were primarily phonosemantic, meaning:

> the initial sound is taken from the Roman [Latin] script, translated into a Chinese character. If the initial sound is not suitable, the secondary sound is used, with the addition of character components to differentiate categories, while the pronunciation remains the original sound. (Wells, Fryer, Xu 1871, j. 1, 20a)

On the other hand, the newly created characters by the Medical Missionary Association incorporated more combined semantic

components, pursuing a stronger rationale for the creation of new characters. Secondly, and most importantly, the 'one-character principle' of the Medical Missionary Association ignored the direction of Chinese language development and was deemed unnecessary. If terms such as *zigong* 子宫 (uterus), *danbai* 蛋白 (protein), and *xueqing* 血清 (serum) are replaced with new characters, they create conflicts regarding the shape with characters such as *gong* 宫 (palace) or *ming* 明 (bright, clear), and moreover there is no way to pronounce them. The Medical Missionary Association took Fryer's approach to creating characters for translation to an extreme, ultimately leading medical, especially anatomical, terminology development to a dead end.

In 1904, the chairman of the Educational Society of China, C.W. Mateer (1836-1908) published a terminological dictionary titled *Technical Terms*. This dictionary can be regarded as a summary of a century of missionary terminology creation efforts. In the preface, Mateer stated:

> Suitable technical terms are essential to scientific thought and investigation. The several branches of physical science have added many thousand new terms or words to the English language. To successfully teach Western science in Chinese, a sufficient number of suitable technical terms is absolutely essential. Some of the pioneer writers on physical science in China have avoided as far as possible all new technical terms. The result has been a vague disquisition *about* the science in question rather than the accurate setting forth of the science itself. The many new terms with which the science has enriched the English language must also be made to enrich in like manner the Chinese language. (Mateer 1904; italics in the original)

Mateer was of the following opinion:

> The question whether in general technical terms should be translated, or transferred has often been raised. It seems clear that in case a brief and expressive term can be found, it is the best, and is generally preferred by Chinese scholars. Rather, however, than use a long, or an awkward term, or one that does not strike the essential idea in the case, it is better to transfer the sound of the term used in the West. This method is popular with commercial men. The list contains a considerable number of terms of this kind, though they are but few in the aggregate […].
>
> It will be observed that the list contains a considerable number of *new* characters not found in Chinese dictionaries. All such characters are composed of a radical and a phonetic, and are to be pronounced in accordance with the phonetic part. All the rarer elementary substances, as well as some of the common ones

> are so named, also a number of technical terms for which a single character has been urgently needed, have been so rendered. This method avoids confusion which it enriches the language, and will, we venture to predict, be more resorted to in the future than it has been in the past. (2, 4-5; italics in the original)

The newly coined characters in *Technical Terms* concentrated on the realms of medicine and chemistry. Looking back, the bold predictions of Mateer did not become a reality. In the preface, Mateer pointed out that his wife had greatly contributed to the compilation of the book. However, a decade later, Mrs. Ada H. Mateer (1850-1936), wrote in the preface to her own book *New Terms for New Ideas*:

> Or they have invented new characters for the new ideas, and one is puzzled to know how to pronounce them. Only one is given in his book – for microbe (秒十生[生 at the bottom of 少]). This is given by way of contrast. But such will scarcely become popular. Their own new terms have a distinctly oriental air about them. (1913, 3)

5 Do Translators Need to be Proficient in 'Philology'? The Impact of Zhang Taiyan and His Successors

John Fryer's method of creating characters for the names of chemical elements even became a model for the idea of 'Chinese learning as essence and Western learning for application' (*zhongti xiyong* 中體西用). Zhang Zhidong expressed approval for the practices of "chemists, manufacturers, and all specialists in learning, when there are new things and new methods, in creating new characters", and suggested extending this practice to "all specialized fields of study" (Zhang, Rong, Zhang 1903).

The earliest clear and unequivocal response to the missionaries' character creation method came from Liang Qichao 梁啟超 (1873-1929). Liang Qichao stated:

> The ancients created characters in order to name things, but when those things no longer exist, the characters become useless. For the things existing today without corresponding characters, it becomes necessary to borrow characters from the past to name them by force. This borrowing is a practice that leads to the multiplication of words […] With the increasing emergence of new things, it is impossible to exclusively borrow ancient characters. Therefore, in today's context, the foremost priority is to create new characters. In translating names, for example, characters like *qi* 汽 are borrowed, and for names like the sixty-four elements zinc, platinum, potassium, etc., new characters are created. In John Fryer's

> translation of chemistry books, he took the original names of the various elements, selected the first sound, translated it into Chinese characters and added character components. He added the character for metal to those belonging into the metal category, and the radical for stone to those belonging to the stone category. This method is most effective. In future translations of names, it is advisable to universally follow this example, even adding the character component for fish to those belonging to the fish category, the character component for bird to those belonging to the bird category, the character component for wood to those belonging to the wood category, and the character component for container to those belonging to the container category. For all other things, they should follow the same approach. This not only alleviates the burden of excessive naming but also provides the benefit of observing similarities and distinguishing differences of categories. After the names have been established, still a glossary should be used and the terms in both languages should be printed side by side in order to provide reference. This is the grand track of translators in giving proper names. (Liang 1897, 3-4)

In addition to praising John Fryer, there thus was the desire to expand the method of character creation to the creation of all translated terms. Huang Zunxian 黃遵憲 (1848-1905) holds a similar opinion on this matter. In a letter to Yan Fu in 1902, he discussed the creation of translated names and the reform of writing forms, expressing his agreement by saying: the Chinese characters that originated four thousand years ago

> used to document the knowledge of things and events in China since ancient times, are no longer suitable, let alone for the various sciences of the West. (Wang 1986, 1572)

The meanings of ancient characters and the contemporary significance of things are "no longer comparable", not to mention comparing them with Western languages. Huang Zunxian pointed out:

> Today, we are already in the world of the twentieth century in which Eastern and Western civilisations have converged. The task of translating books, to bridge the understanding between us and them, elucidating the knowledge of both the new and the old, is indeed an essential duty. (1572)

Regarding the creation of translated names, Huang Zunxian specifically proposed the following methods: creating new characters, borrowing, analogies, creating compound words, phonetic translation and hybridity. Huang mentioned the creation of new characters at

the top of his list, apparently because he considered it as the most practical method. Huang said that "Chinese scholars consider this as the authoritative and independent acts, which the ancient sages and worthies carried out" (1572). In fact, the *Cang Jie* only contained a little more than 3000 characters. However, the character count expanded to around forty to fifty-thousand in later works like *Jiyun* 集韻 (Collected Rimes) and *Guangyun* 廣韻 (Broad Rimes). These additional characters were created in response to specific needs and circumstances that arose later on. Characters like *seng* 僧 (monk) and *ta* 塔 (pagoda), often considered as part of the classical language in the Thirteen Classics by traditional prose writers, were actually created for translating Buddhist scriptures. Huang emphasises that such a practice of creating characters for religious texts did not exist before the Jin and Wei dynasties (220-420). Huang went so far to state that, as Xunzi 荀子 (300-236 BC ca) had said, new words need time for being accepted by the society and that for those words which are not understood by the society an explanation of the meaning and a discriminatory analysis of the word is necessary. He was of the opinion that only new words created by the "character creation method" would be quickly accepted by society (Wang 1986, 5: 1571-3).

In the chapter *Ding wen* 訂文 (A Critical Discussion of Literature), Zhang Taiyan (2014) had a detailed discussion regarding the method of creating new characters or utilising abandoned and obscures characters for translated terms.

Zhang Taiyan quotes the words of Xunzi, stating that in the reign of later kings, "they will certainly adhere to old names and create new names" (2014, 208). The term "new names" in the context of Zhang refers to the creation of new characters. Zhang Taiyan was of the opinion that for a number of concepts originally no names existed. For example, there was a name for 'older brother' (*xiong* 兄) but there was no word for 'younger brother'. The same was true for opposite concepts. Quite often there only was a word for one side of the concept, as in the case of the term for 'younger brother', the word for the opposite concept was coined later. For this reason, Zhang hold that for newly discovered concepts new words – and this, in his case, means characters[18] – should be created, just as the ancients did.

Moreover, in China, now

18 Translator's explanation: Zhang Taiyan distinguished between *wen* 文and *zi* 字. For him, *wen* were indicative or self-explanatory characters (*zhishi* 指事, 'pointing at situations') and pictographic characters (*xiangxing* 象形, 'depicting the shape'), while *zi* were semantic-phonetic compounds (*xingsheng* 形聲, 'shape and sound') and suggestive compounds (*huiyi* 會意, 'combining meanings', ideographs) developed only later. The compound characters (*zi* 字) increased following the propagation (*ziru* 孳乳, 'extension') of expressions (*yan* 言). Cf. Kaske 2008, 145.

> there is mutual trade with foreign lands, constant advancements in technology and machinery, and a daily increase in the pursuit of new aspirations and ideas. (210)

Zhang specifically pointed out that:

> [there] are colloquial expressions and there are scientific expressions, this is the reason that academic and colloquial language needs to be distinguished. (217)

For this reason, there is the need for many more terms. How to deal with that?

> When the common affairs flourish, then the proper words and the compound characters need to multiply every day. However, if there are no newly created characters, the names of newly introduced tools will inevitably borrow from one another. (209)

This inevitably will result in confusion. But Zhang did not propose to create new words for all new concepts. "Pick out the important ones and this will be practicable" (209). However, both Zhang Taiyan and Huang Zunxian never explicitly explained how to create characters.

Zhang Taiyan also mentioned another method, which is to revive obsolete characters. Zhang stated:

> There are ancient meanings that are profound and vivid, yet are no longer in use today. To lift them up and apply them is akin to restoring disused official positions. (218)

This clearly indicates an awareness of Fryer's attempt to name chemical elements using archaic and uncommon characters. However, Zhang expressed a strong dissatisfaction with Fryer's approach, saying:

> There are certain old characters, which now are forcefully used to denote other things. They need to be pruned in order to serve as re-definition. As for example it is the case of *dang* 鎕 and *ti* 銻, which originally referred to a kind of fiery bead, and today *ti* is used to denote a chemical element in the class of metals. Steam originates from the evaporation of water, and it is written as 氿 in ancient scripts. Nowadays, 汽 is used to represent steam. The discrepancy between the name and reality is like throwing dice in a bowl, making it easy to cause confusion and bewilderment. (218)

In ancient times, there may have been similar instances,

> however, when closely examined, there is no fitting comparison. Therefore, writings on antimony, steam, and the like must be more precisely defined. (218)

Regarding the utilisation of obsolete characters, Zhang Taiyan did not object. He stated:

> In recent years, there may be a need for newly created characters. Upon examining the *Cangjie pian* and the *Erya* dictionaries, many discarded words can be employed as new language, such as *ruan* 耎, *bi* 匕, *chuo* 輟, *ji* 暨, and others. (230)

The prerequisite however was to have a complete understanding of philological issues and only then it would be possible to transform the decayed into something miraculous. The Japanese scholar Matajiro Takeshima 武島又次郎 (1872-1976) authored a book titled *Shūjigaku* 修辭學 (Rhetorics) (1898), in which he advocated for the exclusion of obsolete language in writing. About this Zhang said:

> People from the East are not well versed in philology, they do not know that a word can be replaced by another. This almost is as closing the eyes once and never re-opening them. (230)

Zhang Taiyan's principle was:

> Using obsolete language is not different from foreign words or newly created characters: it is necessary to carefully consider and guard against excess. (232)

On 29-30 July 1905, the *Shenbao* 申報 newspaper serialised an article titled "Translators Should Take Philologyinto Account" (*Lun yixue dang zhuzhong xiaoxue* 1905). The author asserted that knowledge of philology (linguistics) is indispensable for translation; the translator's crucial task is to verify translated names based on the original work's meaning, and this presupposes to understand the true meaning of words. Therefore, an era which emphasises translation also is an era that values philology. This argument aligns with the advocacy of Zhang Taiyan.[19]

Yan Fu, however, was reserved in his approach towards the methods of missionaries. Although he extensively used archaic characters in his early translations, during the period of 1909-10, when he was in charge of reviewing and approving scientific and technical

19 The author of this article is unclear. Rao Jiarong thinks that the author might have been Liu Shipei 劉師培 (1884-1919).

vocabulary at the Nomenclature Bureau of the Ministry of Education, there were certain limitations imposed on the use of archaic characters. For instance, in the approved terms, only a few examples, such as the translation of 'lymph' with the archaic character 盡 derived from the *Kangxi Dictionary*, were permitted (Shen 2010; 2018, ch. 2). As for the creation of new characters, Yan Fu and other native translators seemed unwilling to risk attempting it, possibly fearing the "crime of creating characters without the sanction of the sage" (in the words of Huang Zunxian) (Wang 1986, 1572).

Regarding the creation of new characters and the use of obsolete characters, Hu Yilu 胡以魯(1895-1968) and his teacher Zhang Taiyan had differing views. Firstly, in chapter 9 of *Guoyuxue caochuang* 國語學草創 (Drafts on National Language Studies), when discussing how to transform the Chinese language into a 'substantial language' (*zhiwen* 質文) (a form of written language closely resembling spoken language, as discussed in chapter 3, "Yingyong zhi wen" 應用之文 'Applied Language'), Hu Yilu pointed out:

> For the names of new things and the expression of novel ideas, it is recommended to employ compound words rather than creating new characters. Foreign words should also be translated in meaning (however, for names lacking inherent meanings, such as personal names, place names, or newly invented items designated with proper nouns, one may adopt the phonetic sound directly). When terms translated into Chinese characters by the Japanese are interchangeable, they should be used. Otherwise, they need to be changed. (2014, 124)

In respect to obsolete terms, Hu Yilu did not endorse John Fryer's practice of using them for chemical elements. His reasons were:

> If an ancient name exists, and it is mistakenly used by the Chinese people or translators, it is advisable to remove it for greater accuracy. Even if the mistakenly used character is an obsolete character, after clarification of the written materials, the term reappears and is used again, it will lead to further confusion. In such cases, a correction needs to be done. For example, 鎕 originally referred to the brilliance of a burning bead of fire, and 銻 meant a bead of fire reaching its peak. Now, borrowing 銻 to translate the name of metallic elements in the gold group is inappropriate. Similarly, 汽 originally denoted the drying up of water. Using 汽 to translate the name of water vapour is not suitable. In essence, it is stating that these characters, while now considered obsolete, originally had specific meanings related to fire or water, and using them to translate the names of metallic elements or water vapour is inappropriate. (1914, 9-10)

This is because, even though these characters are currently obsolete, they might be misunderstood when revived after clarification of written materials.[20]

The impact of the issue of newly creating terms was long-lasting, especially in the fields of medicine and chemistry.

In 1916, the second volume, issues 1 and 3, of *Zhonghua yixue zazhi* 中華醫學雜誌 (Chinese Medical Journal) published Yu Fengbin's 俞鳳賓 (Yui Voonping 1885-1930) "Yixue mingci yijian shu" 醫學名詞意見書 (Opinions on Medical Terminology). In part 1, Yu Fengbin emphasised:

> Composing single-bodied characters is not difficult, but creating joint-bodied characters is challenging, and for foreigners to create Chinese characters is particularly difficult. It is no wonder there are inappropriate terms. It's like trying to fit a square peg into a round hole. In our national language, occasional use of new terms is acceptable, but the creation of new characters is a challenging task. If scholars attempt to do so in isolation, not only will they be ridiculed, but ordinary society will also criticize it. Therefore, it is not something knowledgeable people should pursue. (1916, 1: 14)

He thus expressed a negative attitude towards the creation of new characters, especially if it was done by foreigners. In part 2 of "Yixue mingci yijian shu", Yu Fengbin continues to express his views on character creation, stating:

> In the past, Wu Zetian attempted to create new characters, but they were constructed with forced and fragmented strokes, deviating from ancient meanings, making them difficult to use appropriately. They were soon abandoned. This shows that creating new characters is not an easy task. It requires to make reference to the 'Six Categories' (*liushu*) and to recognise the standards, this is indicatives, pictographs, phonosemantic compounds, associative compounds, derivative cognates and loangraphs as well as numerals. Examining what principles to follow and which methods to adhere to, having a well-defined plan, is essential. After creating characters that are clear and concise, collaboration with experts in philology is necessary for their evaluation and approval. Only then they should spread widely. In the past, when translating chemical terms at the Jiangnan Arsenal, the creation of new characters that are still in use today has been successful, as they align with the essence of the *Shuowen Jiezi*. This is the best proof. (Yu Fenbing 1916, 3: 16-17)

20 On Hu Yilu, cf. also Shen 2005.

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Yu believes that although the *Shuowen Jiezi* contains over nine thousand characters, less than one-third of them are commonly used. In the case of Western medical terminology, which exceeds fifty thousand terms, a one-to-one correspondence is not feasible. However, he points out that Chinese is not structured in such a way that each character necessarily represents a word. There are many compound words consisting of two characters. There is absolutely no need to forcefully create a single character to replace terms like *tianwen* 天文 (astronomy) or *dili* 地理 (geography), or established translations for terms like *xijun* 細菌 (bacteria) or *yuanchong* 原虫 (protozoa). Why introduce new characters when these translated terms have been in use for a long time? When there is no existing translated term, it is advisable to combine characters to create new words.

> The top priority is to avoid creating new characters whenever possible. However, in cases where it is necessary to do so, it should be a limited and well-considered approach. For nouns that cannot be translated, it is recommended to compile a list, clarify their meanings, and then discuss whether new characters should be created. If there is a desire to create new characters, one should strive to align with the intention of the six principles, thus avoiding the drawbacks of confusion and stagnation. (Yu 1916, 2(3), 17)

> When there is a thing or concept for which there is no existing noun, it is appropriate to create new terms to express them. Moreover, if there are things or concepts that China does not have, and new terms are insufficient to convey them adequately, then it is even more appropriate to create new characters to address this inevitable need, this is a necessary tendency. (16)

Yu Fengbin believed that the creation of new characters was inevitable, but their quantity should be controlled, and the methods of philology should be followed. This perspective is shaped by Yu's observation of the drawbacks in the medical terminology used by the Medical Missionary Association as "frequently using Japanese translations and excessively creating new characters" (1916, 2(1), 14) **[fig. 3]** [旅華醫士 refers to the Medical Missionary Association].

In August 1918, during the fourth meeting of the Medical Terminology Committee, it was renamed the Scientific Terminology Review Committee. The committee aimed to integrate medical terminology into the broader context of scientific and technological terminology.

In 1921, the seventh volume, issue 3 of the *Zhonghua yixue zazhi* published the "Opinions on the Criteria for Verifying Scientific Terms" by the Physics Terminology Review Group. This document outlined seven principles, including:

1. It is advisable to use terms consisting of two or more characters, and avoid using single characters.
2. However, when creating new terms, refrain from inventing new characters.

Subsequently, not only in physics but also in medical terminology, the creation of characters was restrained. This can be understood as the terminologists giving up efforts to demonstrate systematic structures through radicals and character components.

In 1919, Zhu Ziqing 朱自清 (i.e. Zhu Peixian 朱佩弦 1898-1948) published *Yi ming* 譯名 (On the Translation of Names) and discussed the creation of new characters from the point of view of a nonnatural science scholar. Zhu Ziqing believed that the creation of new characters as a method for translating terms could be divided into the following two types:

1. Take a Chinese character containing a part of the original meaning and add a character component, or replace the original character component. The added or replaced character component should be related in nature to the original term. For example, Zhang Zhenming 張振名 uses 亻+財 (Ewnomy) [*sic*].
2. Take a Chinese character with the same pronunciation as the original term, add or replace a character component related in nature to the original term, while still maintaining the original pronunciation. For example, as presented by Geng Yijun 耿毅君, 忄+羅忄+輯 (pronounced as 'logic') (Zhu 1919, 99).

The method mentioned by Zhu Ziqing was only intended to evoke a certain association and unrelated to systematic classification. John Fryer once quipped:

> Why should 'coffee' be written 加非? […] Why should not such old long forgotten characters with the appropriate tree radical, as 槟榔, have been selected? The only danger if it may be called danger, is that some future Chinese philologist will look up their original meaning in some antiquated volume and declare they are correctly used; or else that some conservative patriot of the future will write an elaborate essay to prove that coffee was known to the ancient Chinese and introduced from China to Western countries in the same way that steam engines and telegraphs were! (1890, 542)

In 1920, Liang Guochang 梁國常(1891-1956) stressed the importance of focusing on the scientific meaning in the creation of new characters while also considering explanations from the *Shuowen Jiezi*: "Clarity and simplicity should be emphasised, as it is the virtuous way". His rationale was that:

> the creation of a character is a means to publish a type of knowledge; when such knowledge is instilled and widely disseminated, the character will naturally become accepted. (1920, 999)

He believed that addressing the confusion in the nomenclature of organic chemistry is "even more challenging without creating new characters, and success is hard to achieve" (999).

In 1925, the journal *Kexue* published three issues featuring "Youji huaxue mingmingfa pingyi" 有機化學命名法評議 (A Review of Nomenclature in Organic Chemistry) by the chemist Wu Chengluo 吳承洛 (1892-1955). In the article, Wu advocated for a chemical nomenclature that

> takes existing commonly used terms as the foundation and facilitates ease of use; prioritises the avoidance of creating new characters, with the creation of new characters being supplementary, and does not solely focus on systematic terminology. (Wu 1925, 346)

In 2017, the media announced the Chinese names for the four newly discovered elements in the seventh row of the periodic table. The radicals 钅 and 石 were used to represent the properties of the substances, while the phonetic part indicated the country where they were first discovered, following the internationally accepted naming principles. With this, the gaps in the periodic table were filled, and it seems that there is no longer a need for creating new characters **[fig. 4]**.

6 Conclusion: Insights from *Rangaku* and the Birth of New Affixes

As mentioned above, the history of Chinese characters is a history of proliferation and evolution. Apparently the 'Six Principles' in the first place were attractive to Westerners. However, as Huang Zunxian pointed out, for Chinese scholars, creating characters is an endeavour reserved for ancient sages and wise men, not something that ordinary individuals can casually engage in. This sense of reverence for Chinese characters was shared by Japanese *Rangaku* scholars. Additionally, the characteristics of the translated language greatly inhibit the impulse to create characters. The books of the *Rangaku* scholars were mainly written in Dutch, medical terminology extensively employs Latin and Greek, both of which have excellent decomposability. The morphemes of Latin interact with Chinese characters, generating affixes in the process. As we can see below, the *Rangaku* dictionary *Yakken* 譯鍵 (A Key to Translation) by Fujibayashi Fusen (1810) already confirms the corresponding relationships of the following affixes:

臼齿-tand (tooth); 骨膜-vlies (membrane); 血石-steen (stone); 饮器-bak (bin/container); 肺脉-ader (vein); 胃病-ziegte (disease)

In the 1873 publication *Igo-rui-kai* 醫語類聚 (A Medical Vocabulary in English and Japanese) by Okuyama Torasho 奥山虎章, the following morphemes have completed the process of affixation.

Affix	Frequency	Examples					
-炎[1]	163	生殖器炎	網膜炎	扁桃核炎	脈管炎	動脈炎	
		genitis	retinotis	tonsillitis	vasculitis	arteritis	
-學	37	藥劑學	病因學	解剖學	運動學	修身學	健康學
		pharma-ceutics	Patho-genesis	anatomy	kinematics	ethics?	health studies
-管	38	輸水管	泌尿管	毛細管	導尿管	乳糜管	圓錐管
		pipeline	urinary canal	capillary	catheter	chyle duct	?
-器	31	生殖器	驗液器	聽胸器	分泌器	放血器	哺乳器
		reproductive organ	test tube	stethoscope	secretory organ	bloodletting device	breast pump
-機	19	愈合機	滲入機	成形機	滲出機	生殖機	循環機
		mixing machine	exuding machine	forming machine	exuding machine	reproductive machine	circulatory machine
筋[1]	26	內直筋	異常筋	舉耳筋	二頭筋	角舌筋	毛樣輪筋
		rectus muscle	abnormal muscle	auricus muscle	biceps	angular tongue muscle	trinarius muscle
-骨	15	尾骶骨	上舌骨	上膊骨	無名骨	腕前骨	跗前骨
		coccygeal bone	epihyoid bone	superior hyoid bone	nameless bone	brachial bone	anterior rib
-質	14	白堊質	象牙質	琺瑯質	灰白質	特異質	蜂巢質
		cement	dentin	enamel	gray matter	ectoplasm	honeycomb structure
-術	59	外科術	動脈切開術	造鼻術	割去術	導尿管插入術	
		surgery	arteriotomy	rhinoplasty	excision surgery	urinary catheterisation	
-症	18	膽汁變質症	乏血症	恐血症	腸蟲症	膿毒症	
		cholelithiasis	anemia	hemophobia	tapeworm infection	sepsis	
-腺	37	甲狀腺	松子腺	攝護腺	粘液腺	會厭腺	列印巴腺
		thyrothy gland	matsuko gland	prostate gland	mucous gland	tonsil	Lymph gland
-素	17	膽液素	軟骨素	消化素	血紅素	纖維素	血球素
		lycosinophytes	cartilage	digestive elements	hematocytes	fibrins	hemocytosis
-體	38	四疊體	硝子體	乳嘴體	細胞體	腦索狀體	圓錐體
		quadrigeminal vein	vitreous body	mammillary body	cyton	cerebellum	cone

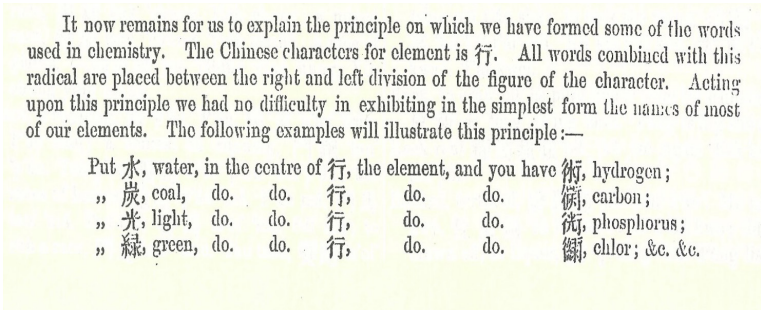
Affix	Frequency	Examples					
-痛	41	咽喉痛 sore throat	神經痛 neuropathic pain	鼠蹊痛 inguinal pain	胃脘痛 epigastric pain	心臟痛 angina cordis	膀胱痛 cystalgia
-熱	24	粘液熱	膽液熱 bilious fever	稽留熱 retained fever	泥沼熱	發汗熱 sweat-induced fever	
-病	107	副腎病 adrenal gland disease	乏血病 oligocymia	脈管病 vascular disease	關節病 knots	異膽液病 heterogeneous fluid disease	結膜病 conjunctival disease
-法	63	撥下法	斷食法 fasting	止血法 hemostatis	砂浴法	聽胸法	湯治法 balneotherapy
-膜	44	基底膜 basement membrane	脫落膜	處女膜 hymen	細胞膜 Cell membrane	脈絡膜 choroid	胃粘膜 gastric mucosa
-藥	143	清滌藥 purifier	解毒藥 antidote	變質藥	祛痰藥 expectorant	鎮痛藥 analgesic	防腐藥 anti-corrosive agent
-論	65	生殖器論 genital theory	空氣論 aerology	脈管論 vascular theory	人身論 anthropology	關節論 joint theory	動脈論 arteriology

1 The character *yan* 炎 (inflammation) in its function as suffix has been created by B. Hobson, but in his *Medical Vocabulary in English and Chinese* (1858) are 45 examples, 13 of the 1 + 1 style, 9 of the 2+1 three-character style. The rest is of the form phrase+*yan*.

2 The Japanese *sin* 筋 is equivalent to the Chinese *ji* 肌.

This affix-like component is referred to as 'new affix' (*xin cilei* 新詞綴) because, compared to affixes in European languages such as English, it is only 'similar' to affixes, hence also known as 'pseudo-affix' (*lei cilei* 類詞綴). I am of the opinion, however, that the primary function of these affix components is classification, organising the increasing number of concepts into distinct categories. They can be referred to as *leibie cilei* 類別詞綴 (category affix). The division between word-forming elements and category affixes lies in the distinction between two-character words and three-character words.

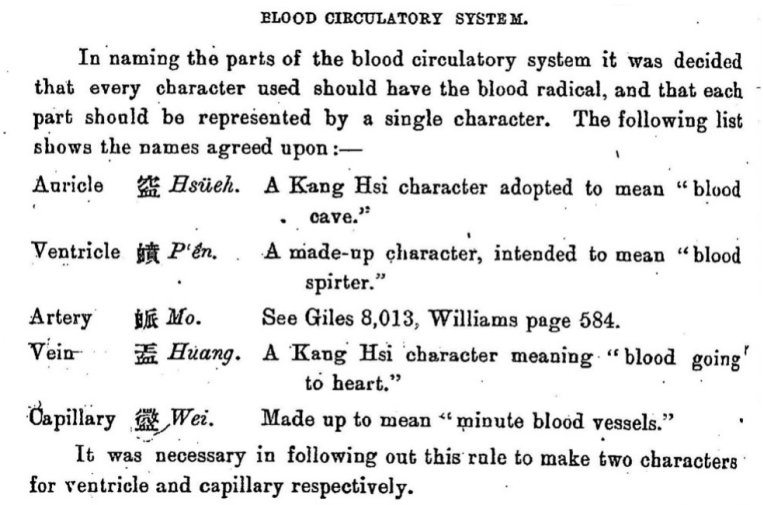
Wang Lida 王立達 has suggested that the new affixes in the Chinese language have been formed under Japanese influence. Japan systematically translated scientific books earlier than China, and Wang Lida's judgment aligns with historical facts (Wang 1958). At the same time, it is important to recognise that Chinese characters possess a powerful classification function. As Benjamin Hobson's *A Medical Vocabulary in English and Chinese. Yixue Ying Hua zishi* 醫學英華字釋 has demonstrated, in the process of the translation of Western scientific knowledge, the classification function of Chinese characters has gained new vitality (1858). The widespread use of category affixes indicates that modern Chinese was undergoing a transition from two-character to three-character words.



It now remains for us to explain the principle on which we have formed some of the words used in chemistry. The Chinese characters for element is 行. All words combined with this radical are placed between the right and left division of the figure of the character. Acting upon this principle we had no difficulty in exhibiting in the simplest form the names of most of our elements. The following examples will illustrate this principle:—

Put 水, water, in the centre of 行, the element, and you have 衜, hydrogen;
„ 炭, coal, do. do. 行, do. do. 衒, carbon;
„ 光, light, do. do. 行, do. do. 衖, phosphorus;
„ 綠, green, do. do. 行, do. do. 衋, chlor; &c. &c.

Figure 1 Lobscheid, *English-Chinese Dictionary*, Part IV, Preface



BLOOD CIRCULATORY SYSTEM.

In naming the parts of the blood circulatory system it was decided that every character used should have the blood radical, and that each part should be represented by a single character. The following list shows the names agreed upon:—

Auricle	盩 *Hsüeh.*	A Kang Hsi character adopted to mean "blood cave."
Ventricle	衋 *P'ên.*	A made-up character, intended to mean "blood spirter."
Artery	衇 *Mo.*	See Giles 8,013, Williams page 584.
Vein	盲 *Huang.*	A Kang Hsi character meaning "blood going to heart."
Capillary	衛 *Wei.*	Made up to mean "minute blood vessels."

It was necessary in following out this rule to make two characters for ventricle and capillary respectively.

Figure 2 Terms of the different parts of the circulatory system.

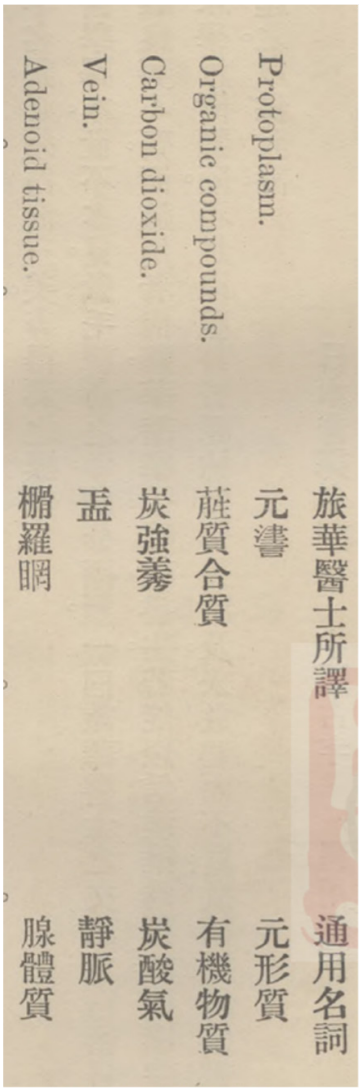


Figure 3
Terminology used by the Medical Missionary Association. © Yu 1916, 14

原子序数	英文名	符号	中文名	汉语拼音
113	nihonium	Nh	钅尼	nǐ
115	moscovium	Mc	镆	mò
117	tennessine	Ts	砿	tián
118	oganesson	Og	氪	ào

Figure 4
Characters for new elements proclaimed in 2017. © Xinhua news agency, May 9, 2017

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