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# Science and Technology in Modern China, 1880s-1940s

*Edited by*

Jing Tsu and Benjamin A. Elman


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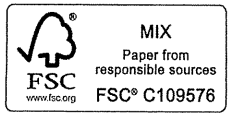


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# Science in Translation

## *Yan Fu's Role*

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### Abstract

Chinese characters are considered an adaptable system, open to expansion and revision. Throughout history, the creation of new characters was one of the most important solutions to enlargements of the conceptual repertoire. Both scholars of "Dutch Learning" in Japan and missionaries active in nineteenth-century China used Chinese characters in their translations of Western concepts. From a methodological point of view, Japanese scholars mostly coined compound words rendering the literal meanings of the Western terms, while translators in China, invigorated by the success of the new characters devised for chemical elements, believed that drafting new characters was more in line with the characteristics of the Chinese language. However, notwithstanding the painstaking efforts with which they were created, the new characters proposed by missionaries were eventually replaced by compound terms first used in Japanese adaptations. This essay examines the different practices and attitudes of Yan Fu toward the Japanese creation of new characters for kexue 科学 to translate "science."

## I Introduction: From Concepts to Words

Yan Fu 严复 (1854–1921), the famous Chinese translator, spent considerable energy inventing new words to translate foreign concepts. For everyday concepts, Yan Fu believed that it was sufficient if a translation could be understood by society;[1] for the key words of the era, however, Yan Fu held that it was necessary to search the Chinese Classics in order to ensure accuracy.[2] For words in the latter category, such as "liberty" (自由), "authority" (权利), or "economics" (经济), Yan Fu carefully considered the deeper meanings. When translating another of the era's most important buzzwords, "science," however, Yan Fu appears to have made only a cursory effort. "Science" (*kexue* 科学) is one of the core concepts of the modern age. How, then, did Yan Fu, living as he did at the close of the nineteenth century and the dawning of the twentieth, understand SCIENCE, and what did he intend when he chose 科学 to represent

1 Yan 1986, vol. 3, 518.

2 Yan 1986, vol. 3, 519.

it?[3] I believe this is a fascinating question, and in this essay I will examine *The Collected Writings of Yan Fu* (严复集) and some of his early translations, in particular his thought process when analyzing "science" and related concepts.[4] This kind of analysis should shed some new light on Yan Fu's conception of science.

## II Origin of *Kexue* 科学 as a Word: Its Creation and Spread

The first knowledge from Europe to be incorporated into the body of Japanese scholarship was Dutch Learning (Rangaku 蘭学), which was introduced to Japan in the middle of the eighteenth century. In translating the new concepts from Europe, the Rangaku scholars used traditional Chinese vocabulary, such as *qiongli* 穷理 (searching for governing principles), whenever possible. They were deeply aware, however, of the chasm between the Chinese and European systems of knowledge and methodology.[5] In the Meiji era (1868–1912), Japan began its campaign of full-scale absorption of the new learning from Europe. At the close of 1870, Nishi Amane 西周 (1829–1897) noted in the conclusion of his encyclopedia, the *Hyakugaku renkan* 百学連環, that Western learning encompassed a myriad of disciplines, each with its own array of fields, and that detailed academic inquiry was the pursuit only of scholars, who were each experts in their own fields, and who never strayed into other disciplines. Although traditional Chinese classical studies (*kangaku* 漢学) also distinguished between the Five Classics and the official histories of each era, there was no equivalent in Japan of the Western concept of academic fields. Nishi also published material from the introduction to his encyclopedia in an article entitled "Theories of Knowledge" (Chisetsu 知説) in the *Meiroku zasshi* (*Journal of the Meiji Six Society*). In his treatise Nishi expounded upon the word *gakujutsu* 学術 (academics): the first character, 学, represented the seed germ

3 English words written in capital letters denote concepts, while words in lowercase letters denote the lexemes themselves.

4 Yan 1986. The most famous of Yan Fu's translations are Huxley 1981; Smith 1981; and Mill 1981.

5 See, e.g., Utagawa 1980. It is also important to keep in mind that at the beginning of the Meiji period, the lexeme *kagaku* also meant "studying for the [Chinese] civil service examination" (科挙之学). For example, in the April 1869 issue of *Kōgisho nisshi* 公議所日誌, there is the following passage: "Even so, since studying for the civil service examination (*kagaku*) has become a useless exercise in empty rhetoric, proctors must scrutinize the candidates for their virtue or wickedness and their actions" (然レドモ科学ハ空文無益ニ成行モノ故試官ヨク其人ノ正邪ト実行トニ注意スベシ。). See Sōgō 1986.



of knowledge, the observation of objective truth, and consideration of its meaning; the second character, 術, described adherence to known methodologies and experimentation. The proper order for conducting research was first to gather facts and ponder their meaning (学), and then to conduct experiments (術). Nishi further pointed out that the basis for 学 was investigation, of which there were several valid methods. The three methods current in Europe at the time were observation, experimentation, and proof. None of these steps could be omitted.[6] Nishi Amane impressed upon his readers that the most important research methods were deduction and induction. Nishi laid out his argument as follows:

> "Science" consists of the induction of a general truth from the observed facts, stating this truth as a hypothesis, expounding the conclusions that follow, and recording the result as a monograph, to serve as an example. Once the facts have become clear from investigation, the art of science lies in making this truth useful to mankind. Thus, the aim of the inquiry must not ignore the benefit or harm the discovered truth might have in a narrow quest for truth for its own sake. The art of science consists of making use of discovered truth in order to eliminate evils and loss, and promote benefit and gain for mankind, etc. In this way, inquiry serves to open up new frontiers of learning, while the art of science aids in the progress of technology.
>
> Though the aim of inquiry and the art of science differ, when united as the study of science, they are difficult to separate. Chemistry is a good example. Although analytical chemistry may be classed as inquiry and synthetic [organic] chemistry as the art of science, the two are all but inseparable.[7]

Nishi added that, while European scholarship was enjoying an unprecedented flowering, it had never had an overarching, unifying principle. Isidore Auguste Marie François Xavier Comte (1798–1857) ordered the five disciplines from simplest to most complex: astronomy, physics, chemistry, biology, and sociology; thus, the various disciplines and fields discussed in Nishi Amane's encyclope-

6 Yamamuro and Nakanome 2009, middle vol., 202. I have translated all citations from this work from the Japanese. English words within the citations are the editors' (Yamamuro and Nakanome) reconstruction from transliterations in the original work.

7 *Meiroku zasshi* 明六雑誌 22 (December 19, 1874), in Yamamuro and Nakanome 2009, middle vol., 236.

dia, *Hyakugaku renkan*, were much more complicated.[8] It was in this context that the compound *kagaku/kexue* 科学 first appeared. This use of the word *kagaku/kexue* has been touted as the first known instance of a translation for "science," making Nishi the first person to coin the Japanese term. More recently, however, the consensus within the Japanese academic community has been that *kagaku* did not mean "science" but rather "subject" or "discipline."[9] In other words, the lexeme *kagaku* may well be a mistake for *gakka* 学科, which appears frequently in the *Hyakugaku renkan*. There is another basis for this conclusion besides the context for each usage of *kagaku*. That is, Nishi Amane did not use this term in his other original works until a much later point in his career. Another plausible explanation is that Nishi originally intended *gaku* 学 as a translation for "science," *jutsu* 術 for "art," and *kagaku* as a variant of *gakka*, which would mean "subject" or "discipline." Nishi explained the latter as the study of specialized subjects.

During the same period, Nakamura Masanao 中村正直 (1832–1891) was also using the term *gakujutsu* 学術 to render the term "science."[10] Nakamura pointed out that, according to Western theories, Western academics could be divided into two categories: metaphysics and physics. The former category included literature, logic, theology, ethics, law, and politics; the latter category contained physics, craftsmanship, chemistry, medicine, and agriculture. Nishi Amane's list of disciplines and their hierarchy were adapted by Nakamura as the two categories "metaphysics" and "physics." These terms also contain the implication of hierarchy.[11]

In 1877, three years after publication of "Theories of Knowledge," Nishi gave a lecture entitled "Science Lies in Deepening Understanding of the Source" (学問ハ淵源ヲ深クスルニ在ルノ論) at Tokyo University, in which he state the following:

> First, when deepening understanding of science (as stated in the title), it is necessary to meet the urgent needs of the era, and although one should not neglect to choose the quickest, most efficient approaches, nevertheless when studying science, effort should be made to grasp the deeper workings of each discipline, even when it does not seem to have immediate application; though such pains may seem profitless, being able to expound on the theories of science requires a thorough understanding.

8 Yamamuro and Nakanome 2009, middle vol., 237. Also see Fan 1988.

9 Hida 2002, 205.

10 Nakamura 1874, in Yamamuro and Nakanome 2009, first vol., 341.

11 *Meiroku zasshi* 6 (September 22, 1874), in Yamamuro and Nakanome 2009, middle vol., 87.



> As with the proverbial bounty of enriching water flowing from river to sea, so it is with gathering all the varied truths and assembling them into one, unified truth, where left meets right on common ground.[12]

The word *gakumon* in the title is clearly meant as "science," and since the term *kagaku* is modified by the adjective "each," it refers to the various disciplines that make up "science." This lecture reflects the thought of Nishi Amane on the subject of the relationship between the "myriad subjects" (百科諸学) and philosophy. Two years later, Nakamura Masanao used *kagaku* and *gakumon* to render "science" in one of his translations. This is the first undoubtedly deliberate use of *kagaku* as a translation[13] for "science," and there are even sample sentences demonstrating how to use the word, some of them with a phonetic rendering of "science" printed in small characters above them.[14] In fact, the word *kagaku* was never again limited to academic disciplines but was extended to mean the scientific method as well.[15] The 1881 *Dictionary of Philosophy* (哲学字彙) firmly established *kagaku* as the standard translation of "science," and this became the accepted term throughout Japanese society.

From the second decade of the Meiji era (1887–), *kagaku* became a buzzword in Japan.[16] Judging from the definitions in Japanese reference works, the word *kagaku* was more strongly associated with the natural sciences, as it is in the 1893 *Japan Great Dictionary* (日本大辞書), "*kagaku*—another name for physical science" (*rigaku* 理学); in the 1896 *Great Imperial Dictionary* (帝国大辞典), "There are set principles that govern everything, and academic inquiry into these principles is called 'science' (*kagaku*). Science is physics, as opposed to philosophy, which is metaphysics"; and in the 1897 *Japan New Dictionary* (日本新辞林), "Science and philosophy complement each other." These dictionary definitions point to a tendency in Japan to see science and philosophy as a pair, in a dualistic paradigm. Regarding the relationship between science and philosophy in nineteenth-century Japan, Tsuji Tetsuo commented:

12 Nishi 1960, 572. Also see Tsuji 1973, 178.

13 Nakamura 1879. The original work was *The Science of History*, by G. G. Zerffi, which was written in response to Japanese demand. This work had an important role in the establishment of the positivist school of history in Japan. See Katō 1991, 260. The passage quoted is from Hida 2002 (my translation).

14 The Japanese lexeme *kagakuteki* 科学的 corresponds to "scientific."

15 "Scientific" (*kagakuteki* 科学的) refers not only to an empirical methodology but also to logical reasoning.

16 Hida 2002, 206–210.

> In Japan, when modern science was adopted, the academic methodologies of science and the nature of logical inquiry were not understood as being an integral part of modern science. Science was imported to provide immediate practical benefits through specialized expertise; this was because the methodologies and system of knowledge of science could not be readily understood, and the situation at the time was too desperate to prioritize attempts to grasp the deeper significance of Western scientific thought. The uniquely Japanese adaptation of modern philosophy came to (unexpectedly) fill this gap.[17]

Next, let us turn our attention to China. As Fan Hongye 樊洪业 pointed out, the traditional method for Chinese gentlemen to cultivate cultured manners was to "examine the phenomena and ponder the truth" (*gewuzhizhi* 格物致知).[18] Jesuit missionaries arrived in China at the close of the Ming dynasty (1368–1644). Regarding the scholarship they brought with them, Xu Guangqi 徐光启 (1562–1633) wrote: "Roughly speaking, there are three kinds: the greatest is to develop morality and serve heaven; the least is to examine the phenomena and discover the truth."[19] He treated the latter as an appendix to theology.[20]

In the nineteenth century, the latest European science once again flowed into China, this time brought by Protestant missionaries. The traditional terms *gewu* 格物 or *gezhi* 格致 came to denote the natural sciences, although these terms were also used for physics and chemistry or simply physics.[21] The modern Chinese word *kexue* 科学 was borrowed from Japanese. Who adopted this word, and when? How was it used?[22] The answers to these questions are the subject of many studies on the history of modern academics.[23] In the article quoted above, Fan Hongye conjectures that the honor belongs to Kang Youwei

17 Tsuji 1973, 179–180.

18 Fan 1988, 40.

19 Xu 1965a.

20 Xu 1965b.

21 Fan 1988, 44–45.

22 The definition of *kexue* in the *Xin erya* 新尔雅, a 1903 collection of technical terms compiled by Chinese students in Japan, is "In research of the phenomena of the world, a systematic ordering of knowledge is called *kexue*."

23 Early research includes Yuan 1985; and Fan 1988. The greater part of Fan's work discusses in depth the shift from *gezhi* to *kexue*. More recent works include Jin and Liu 2008. Chapter 12 of this book utilizes new methodologies such as statistical analysis to examine the prevalence of *gezhi* and *kexue* in the Chinese-speaking world during the early modern era, as well as other issues in the history of thought. Both works have served as inspiration for my own work. Besides these, academic works that explore *kexue* include Elman 2000; Zhu Jianfa 2005; Zhou 2009; Zhang 2009.



康有为 (1858–1927), but Zhu Fajian 朱发建 disagrees, stating that Taiwanese scholarship has found evidence that the memorial in which *kexue* appears is a later forgery and thus cannot be taken as conclusive. Kang Youwei's *Annotated Bibliography of Japanese Books* (*Riben shumu zhi*) (日本书目志) does contain the lexeme *kexue*, but only as part of a book title. This can hardly be said to be the first known Chinese usage of the word.[24] Zhu Fajian believes that the first person to adopt *kagaku/kexue* was Wang Guowei 王国维 (1877–1927).[25] In his introduction to the *Essentials of Oriental History* (东洋史要), published in December 1899 as the Chinese translation of Kuwabara Jitsuzō's 桑原隲蔵 (1871–1931) *Intermediate History of the Orient* (中等東洋史), he wrote:

> My schoolmate Fan Bingqing (樊炳清), of Shanying [present-day Zhejiang Province], translated Kuwabara Jitsuzō's *Essentials of Oriental History*. It has just been published. My teacher Professor Fujita then discussed the main points of the book and had Wang Guowei write in the foreword that modern history is a science. Therefore, it is not permissible for there to be no order among facts; no matter what the discipline, if there is any scholar who lacks order in his inquiries, his work cannot be considered science.[26]

Although there is no way to know today what kinds of discussions took place between Fujita Toyohachi 藤田豊八 (1869/70–1929) and Wang Guowei, it is very clear that Fujita taught his students that the essence of science was the relationship between the myriad phenomena and our knowledge, and that history was no exception to this principle. This assertion coincides with the tenets of Japanese positivist history as pioneered by Nakamura Masanao. Even so, the following excerpt, written by Liang Qichao 梁启超 (1873–1929), is older:

> This then is the future of the Pacific. As all the races of men advance in politics, commerce, religion, and academics, there are disputes and wars

24 Also see Shen 2003.

25 See Zhu Fajian 1899. Zhou Cheng (2009) believes that Tang Tingshu 唐廷枢 "was the first person in China to use *kexue*," but the examples cited are all compound words such as *jiaokexue* 教科学 (theory of education) or *jiaokeshu* 教科书 (textbook), which should be analyzed as *jiaoke+xue*.

26 Zhu Fajian 1899. For an analysis of the circumstances behind publication of this book and the translation challenges involved, see Sanetō 1970, 216; Shen 1994, 222–268 (223–272 in the 2008 ed.).

> of aggression. The relationship is significant, and there is no doubt that progress leads to world war. When this happens, there must be a direct cause. In fact, there are two such phenomena: the advance of science and the balance of power among the great powers.[27]

We must remember, however, that this piece by Liang Qichao is merely a translation of a Japanese publication. It would have been extremely difficult for Liang to have as deep an understanding of *kexue/kagaku* as did Wang Guowei, since he did not study under Fujita Toyohachi.

After the turn of the twentieth century, large numbers of translated Japanese books and magazines flooded into China, and educational reforms within China contributed to the surge in the number of instances of *kexue* appearing in Chinese publications, including government documents. For example, Zhang Zhidong 张之洞 (1837–1909) wrote in his *Guidelines for Educational Affairs* (*Xuewu gangyao* 学务纲要): "All teachers should lecture scientifically, and students respond scientifically, and the language used must not veer into the vulgar and crude."[28] At this time, *kexue* still meant "academics divided into disciplines." As a proponent of "Chinese content, Western practicality" (中体西用), however, Zhang Zhidong failed to understand that introducing Western academic structures and systems of knowledge, as exemplified by SCIENCE, would also require the adoption of the underlying methodologies that were completely foreign to China's academic tradition, not to mention the specialized terminology that he had characterized as "vulgar and crude." It was in such an awkward milieu that Yan Fu found himself confronted with the problem of translating "science."

## III Yan Fu's Relationship with SCIENCE

On February 4, 1895, Yan Fu published "On the Speed of World Change" (Lun shibian zhiji 论世变之亟) in the *Zhibao* newspaper (直报), outlining his beliefs regarding the reasons for the strength of the Western nations.[29] A month later, he published "On the Origin of Strength" (Yuanqiang 原强), in which he introduced Chinese readers to sociology for the first time.[30]

27 Liang 1899.

28 Zhang Zhidong, *Xuewu gangyao* 学务纲要, September 1903. Cited from *Jindai Zhongguo jiaoyu shiliao* 1928, 8–30.

29 Yan 1986, vol. 1, 1–5.

30 Yan 1986, vol. 1, 5–15.



Describing it as a field that "greatly explains matters of ethics," he also stated that the study of mathematics, logic, physics, and chemistry was a prerequisite for sociology. In this way, Yan considered the "physics" subjects, such as mathematics and the practical sciences, to be the foundation for metaphysical disciplines that "greatly explain matters of ethics." He proceeded to divide knowledge into the three categories of heaven, earth, and man, commenting that the study of man was the most urgent because it included physiology and psychology, which constituted the foundations of sociology. These remarks illustrate Yan's view of SCIENCE at this time, which was clearly influenced by the theories of Comte.[31]

From May 1 to May 8, 1895, Yan Fu serially published his "On Our Salvation" (Jiuwang juelun 救亡决论) in *Zhibao*.[32] He asserted that China must reform by "losing no time in abolishing the eight-legged essay [the writing portion of the civil service examination]." Regarding reforms in the academic establishment, Yan believed it imperative to "excise the eight-legged essay and to lecture on Western learning." After painstakingly outlining the various grievous ills caused to man and nation by eight-legged essays, Yan discussed how Western physics and chemistry, or *gezhi* 格致, were completely different from Chinese learning, because with their proviso that "the proof of every theorem or law, every phenomenon, must be tested and only then accepted cautiously," all theories had to be tested through experimentation. "Western *gezhi*" in this context refers especially to the Western natural sciences. Yan was careful to mention that "Western scholars say, however, that all study seeks not only to know the unknown but also to probe what is possible and impossible. Astronomers do not spend their lives merely examining the heavens; chemists are not limited to experimenting with substances; as for botanists, they do not farm; zoologists do not need to practice animal husbandry. The great, exquisite effect lies in training the mind and practicing the manipulation of the heart, so that those who learn to sink and float with the times or those who learn sincerity cannot indulge in preposterousness." Emphasizing the nonutilitarian nature of science and its character-building effects on people, Yan pointed out that science was equivalent to the Chinese concept of the study of governing principles (*lixue* 理学) and that it would make an adequate substitute for the traditional method that Chinese gentlemen used to cultivate cultured manners, namely, to "examine phenomena and ponder the truth" (*gewuzhizhi* 格物致知). In this way Yan distinguished his stance from that of Zhang Zhidong, who simply wanted to borrow the trappings of Western science.

31 Fan 1988, 45–46.

32 Yan 1986, vol. 1, 40–54.

Regarding how the Western concept of scientific investigation, which Yan Fu translated as *xue* 学, qualified as scholarship in the traditional Chinese sense, which was also denoted by the lexeme *xue* 学, Yan stated that in order for knowledge of any kind to be elevated to the status of scholarship, it must have organization, be systematic and provable, and have strictly defined terminology. This kind of scholarship (学) could then be investigated according to logic and be applied to human society.

In his preface to *Tianyanlun*, his 1898 translation of Thomas Huxley's *Evolution and Ethics*, Yan Fu wrote that, while the ancients had divided learning into physics and metaphysics, the two were now united into one as a result of the acknowledgment that metaphysics also follows the three principles of physics. The three principles were measurement, broad applicability of universal truths, and experimentation. All three were necessary elements in science, but "experimentation in particular is vital."[33] The following passage is likely the original English source for these statements: "And the business of the moral and political philosopher appears to me to be the ascertainment, by the same method of observation, experiment, and ratiocination, as is practised in other kinds of scientific work, of the course of conduct which will best conduce to that end."[34]

In his "The Effects of Western Learning" (Xixuemenjing gongyong 西学門径功用), which he published in the periodical *Guowenbao* 国闻报 on September 22 and 23, 1898, Yan Fu remarked that, in order to probe truth through investigation (学), it was first necessary to observe the objective facts and then to organize the findings according to the properties of each fact.[35] Only then would the proper foundations be laid for an analysis of the phenomena, which was always conducted in a strictly methodical, logical manner. The scholars of ancient Europe and China, no matter how great their accomplishments, had many errors in their conclusions because they had followed only two of the three necessary procedures. This was why modern science came about, with its emphasis on experimentation.

It is possible to observe the influence of Nishi Amane's thought (as quoted above) in Yan Fu's statements regarding science; in fact, the two are largely in agreement. In this way these two men had a great impact on their countrymen, although there was nearly a thirty-year gap between when they introduced science to their respective societies. Both men were writing under circumstances in which there was as yet no set translation for the new science vocabulary. As

33 Huxley 1981, 44.

34 Huxley 1902, 43.

35 Yan 1986, vol. 1, 92–95.



explained in the next section, Yan's understanding of science was based on *An Inquiry into the Nature and Causes of the Wealth of Nations* by Adam Smith (1776) and *A System of Logic* by John Stuart Mill (1843).

## IV Yan Fu and "Science"

As outlined above, Yan Fu used such expressions as "examine the phenomena and search for governing principles" (格物穷理), "investigation" (学), "academics" (学问), "scholarship" (学术), and "physics and chemistry" (格致) in his early works in order to convey the concepts contained in "science." In other words, although he had a deep understanding of the meaning of science itself, he had not yet adopted a single term to encompass all of the above aspects. Yan first used the word *kexue* 科学 in his translations of Adam Smith's *An Inquiry into the Nature and Causes of the Wealth of Nations* and John Stuart Mill's *A System of Logic*, which were published after 1895. There are about a dozen instances of this word in the latter work. Around 1900, perhaps influenced by his experiences translating, Yan began to use the term in his own writings. There are 143 instances of *kexue* in *The Collected Writings of Yan Fu* (严复集).

Yan Fu used the word mostly in the following three groups of works:

1. His translations of *An Inquiry into the Nature and Causes of the Wealth of Nations* and *A System of Logic* contain eighteen instances of *kexue*. These examples reflect Yan Fu's understanding of SCIENCE and his choice of Chinese words during the translation process.
2. His "Letter to the Editor of the *Waijiaobao* on Education" (与外交报主人书) and "On the Burning Issue of Physical Science and Education" (論今日教育応以物理科学為当務之急) together contain forty instances of *kexue*. Both were published around 1903.
3. There are thirty-seven instances of *kexue* in "Lectures on Politics" (政治讲义).[36] The period around 1906 was also marked by frequent use of this word.

The use of *kexue* in these works will be analyzed in the next sections.

36 Yan 1986, vol. 5, 1241–1316.

### *"Science" in Yan's Translations of* An Inquiry into the Nature and Causes of the Wealth of Nations and A System of Logic

*An Inquiry into the Nature and Causes of the Wealth of Nations* is a book about economics written in 1776 by Adam Smith. In book 5, chapter 1, part 3, article 2, "Of the Expense of the Institution for the Education of Youth," Smith discusses the origins of the cost of primary, middle, and higher education, the organization of the faculties, and issues regarding the educational environment from the viewpoints of both teachers and students.[37] In this passage, which is more or less distant from the topic of economics, there are twenty-seven instances of the word "science."[38] There are also other expressions, some of them contrasting "science" with "art." For example:

> (1) In its nature, it is arbitrary and discretionary; and the persons who exercise it, neither attending upon the lectures of the teacher themselves, nor perhaps understanding the sciences which it is his business to teach, are seldom capable of exercising it with judgment.[39]

Yan Fu simply rendered the general meaning and did not provide a translation for the individual lexeme "science" (621).

> (2) If in each college, the tutor or teacher, who was to instruct each student in all arts and sciences, should not be voluntarily chosen by the student, but appointed by the head of the college ...[40]

Yan's translation of the above-mentioned passage contains the first use of *kexue*. Here, however, it is used to denote "arts and sciences" (622).

> (3) In the universities, the youth neither are taught, nor always can find any proper means of being taught the sciences, which it is the business of those incorporated bodies to teach.[41]

The "sciences" in the above-mentioned passage appear as "specialized sciences" in Yan Fu's translation (624).

37 For Smith's original, I used Smith 1995. Pages numbers for citations from this work are given in parentheses in the text. I also used Smith 1981, 2008.

38 The work as a whole features forty-three instances of "science."

39 Smith 1904, vol. 2, 251.

40 Smith 1904, vol. 2, 252.

41 Smith 1904, vol. 2, 254.



> (4) The parts of education which are commonly taught in universities, it may perhaps be said, are not very well taught. But had it not been for those institutions, they would not have been commonly taught at all; and both the individual and the public would have suffered a good deal from the want of those important parts of education.[42]

In this example Yan Fu has used *kexue* for "education" (624).

In the 1770s, when Adam Smith was writing, the core meaning of "science" was "a particular branch of knowledge or study; a recognized department of learning.[43] While Yan Fu's *kexue* cannot be considered a perfect match, it does convey the implication of there being many disciplines, and this was the standard usage in Chinese at the time.

Thus, it seems plausible that Yan Fu's notion of "science" is derived from Adam Smith—or perhaps even more plausibly from Mill. Yan Fu started translating *An Inquiry into the Nature and Causes of the Wealth of Nations* and *A System of Logic* at around the same time, and the latter had a large influence on Yan.[44] In Mill's original work, "art" (*shu* 术) and "science" (*xue* 学) seem to form a contrast, with science superior to art; science is the basis of art; and without science art is shallow. In that case, what are the factors that distinguish science from art? Can art be elevated to science and, if so, how? The process of drawing up a systematic theory based on observed phenomena is indispensable. Several of the "arts" cannot be called "sciences" because they consist of the combination of multiple sciences. Logic is considered a unifying discipline that provides the methodology for all other disciplines, which is why Yan saw fit to introduce it to his Chinese readers. Yan believed that "science" included "examining the phenomena and pondering the truth, leading to medicine, which is the sum of logic, mathematics, chemistry, and physics." He also pointed out that logic governs its own relationship with the other disciplines: "Though logic is the unifying principle underlying all subjects, it is itself an independent discipline." Yan ended his remarks with a discussion on the problems of specialized science terminology: "The ideas of science are sparkling jewels and the terminology is accurate, which is why its rules are the strictest of all."[45]

Where did Yan Fu get the word *kexue*? In Chinese-language works written in China around the year 1900, there are almost no examples of *kexue*. In Japanese-

42 Smith 1904, vol. 2, 254.

43 *Oxford English Dictionary* 2nd ed. (1989).

44 For Mill's original, I used Mill 1848. I also used Mill 1981; and a Japanese translation, Mill 1949.

45 Mill 1981, 3.

influenced journals that published translations from Japanese, such as *Dissenting News* (*Qingyibao* 清议报) or *A Collection of Translated Books* (*Yishuhuibian* 译书汇编), however, there are already instances of *kexue*. It is possible that Yan Fu had encountered new Japanese words in publications such as these, including "philosophy" (*zhexue* 哲学), which he used numerous times in his translations of *An Inquiry into the Nature and Causes of the Wealth of Nations* and *A System of Logic*.[46] On the other hand, although Japanese undeniably had an influence on the form of the new words, Yan's *kexue* does not draw its meaning from Japanese. "Science" may be either singular or plural in English, but Chinese nouns do not decline according to gender, number, or case. Yan tried to distinguish between science as a whole and the various sciences by using *xue* 学 and *kexue*, respectively. In other words, for Yan, "science" was not a collective noun.[47]

### Kexue *in "Letter to the Editor of the* Waijiaobao *on Education"*

The "Letter to the Editor of the *Waijiaobao* on Education" (与外交报主人书) and the March 4, 1902, issue of the *Waijiaobao* that prompted it belong to the second group of writings. There are sixteen uses of *kexue*, the meaning and usage of which are in the same vein as in *An Inquiry into the Nature and Causes of the Wealth of Nations* and *A System of Logic*.

During this period, there was a profusion of arguments regarding reform of the educational system. Some of the most representative were: (1) retain Chinese learning as the foundation, with pragmatic borrowings from Western technology, and (2) adopt Western politics as the foundation and embellish with Western arts. The stance in the *Waijiaobao* was that education should be conducted in Chinese and not in foreign languages.[48] Yan Fu's rebuttal included

46 Yan Fu was not satisfied with *zhexue* (哲学) because "the Western name for governing principles (*lixue* 理学) reveals its origins in the study of temperaments, with observation of phenomena as its opposing concept. Japanese have rendered theology, anthroposophy (*zhixue* 智学), and philosophy (*aizhixue* 爱智学) all alike, as *zhexue*. I hope that the most recent studies on this subject will all be called *aizhixue*, with all subjects pertaining to the spirit classed as *xinxue* (心学), since the term *zhexue* has not yet become standard" (理学其西文本名谓之出形气学，与格物诸形气学之对，故亦翻神学，智学，爱智学，日本人谓之哲学。顾晚近科学独有爱智以名其全，而一切性灵之学归于心学，哲学之名似尚未安也。) (Mill 1981, 12).

47 The usage "one science, two sciences" (一科学，二科学) in Smith 1981 and Mill 1981 reflects this circumstance. The elements that make up true compound nouns cannot be modified by external adjectives or other modifiers. Thus, "very big sea" (很大海) and "very long residence" (很旧居) are incorrect expressions in contemporary Chinese.

48 I will discuss Yan Fu's ideas on a national language (*guoyu* 国语) in depth elsewhere.



a discussion of *kexue*, especially in his refutation of the idea of adopting Western politics and a little art. He says of this approach that it has "everything backward." What, after all, is meant by "art"? Isn't it in fact "science"? Logic, mathematics, chemistry, and physics are all "sciences." All these sciences are based on principles and laws, which are also the foundation of the best aspects of Western politics. As Huxley pointed out, since Western politics did not yet completely conform to the principles of "science," it would not remain at its current level. Chinese politics would be left further and further behind, rendering China unable to take its place among the great nations, because Chinese governance was not in accordance with the principles of science and was, in fact, in violation of them. In Yan's eyes, the "Western arts" as commonly perceived actually embodied the modern scientific spirit, with its emphasis on "observe, generalize, experiment," so that, if "science" and "Western arts" are equivalent, then the notion that "the basis of Western politics is Western arts" would be true but not the reverse. Some may argue that "Western arts" and "science" are not synonymous, but even if that is the case, surely science is the foundation of both Western arts and Western politics—in other words, they would be component concepts included in "science"—and are thus inseparable, like the left and right hands of the same person. In the context of the letter, Yan uses *kexue* in both its narrow and its wide senses: the former as the "physics" corollary to logic; and the latter as a system of knowledge encompassing both "physics" and metaphysics. It is clear that Yan was using the word here primarily in its narrow sense.

Included in the same group of manuscripts is "On the Burning Issue of Physical Science and Education" (論今日教育応以物理科学為当務之急), the script for a lecture (unfinished).[49] The word *kexue* appears twenty-one times in this document (including in the title). Yan Fu pointed out that human thought can be divided into two types, rational thought and emotion, and that there is a difference between cerebral, rational thought and intuitive, emotional thought. He stated that moral education shapes the latter, and intellectual education the former, with science as its main instrument. Here Yan's "science" refers to the natural sciences, whose object is to discover the laws of nature. Thus, Yan agreed with Huxley that the purpose of education is to "clear the channels of the intellect, and broaden and deepen knowledge," and that the method of education should "broaden and deepen knowledge" through "clearing the channels of the intellect."[50]

49 The date must have been sometime before Yan Fu, "Jingshi Daxuetang yishuju zhangcheng" 京师大学堂译书局章程, *Ta Kung Pao* 大公报, August 29–31, 1903.

50 Yan 1986, vol. 2, 278–280.

Yan Fu pondered which of the sciences would be most effective to study to achieve this goal, given that time to study is usually limited. He asserted that the deductive sciences of mathematics and geometry and the inductive sciences of physics, chemistry, zoology, and botany would not only increase knowledge but even discipline the emotions and train the mind. He believed that the problem with Chinese education was that it "disproportionally stressed moral education at the expense of physical and intellectual education"—that is, that there was too much art and not enough physics, with an almost exclusively deductive approach that neglected inductive reasoning. In order to put forth arguments in the traditional manner, it was necessary only to think about an issue, not to gather facts. Thus, "mastering scholarship only leads to a slavishly dogmatic intellectualism." According to Yan, the antidote to this state of affairs was to increase the share of the physical sciences in the curriculum. He included physics, chemistry, zoology, botany, astronomy, geology, biology, and psychology in his "physical sciences." Most of these subjects are considered natural sciences today, but some of them are now considered human sciences. From the above analysis, it is clear that in 1903, Yan's understanding of science encompassed not only the concepts of dividing academic pursuit into separate fields, specialized inquiry, and academic fields but also those of the natural and human sciences, with a particular emphasis on induction.

### Kexue *in "Lectures on Politics"*

The other major work by Yan Fu that contains the word *kexue* is "Lectures on Politics" (政治讲义).[51] This work was divided into eight lectures, and *kexue* appears thirty-seven times. The most significant instance occurs in the introduction of the first lecture, where he claimed that in the West, politics had already become a science. Politics that has "already become a science" must necessarily have adopted the fundamental principles underlying the practical physical sciences, in particular the division of subjects. After analyzing the contrast between observation (学) and experimentation (术), Yan remarked that when the scholars of old discussed politics, their arguments could not be considered "observation" when judged according to the standard of modern science. This was because "scholars, even if they seek the principles of physical things, examine only what is already known, while artisans know the path to morality when they have no work, but first ask what is appropriate." Yan further pointed out that "in order to learn science, it is necessary to start with correct names"; "what my generation calls politics is actually a science. If one

51 Ibid. (in Yan 1986, vol. 5, 1241–1316).



calls it a science, then whatever characters one uses must clearly distinguish fields, for if these standards are not properly observed, confusion will creep in." "In the vocabulary of science, whether a word has one meaning or two, it is necessary to ask whether the meanings are compatible," "because the vocabulary of science does not allow two separate meanings, and contradictions are even less acceptable." At the time, in 1906, specialized science terminology in Chinese was incomplete, so "in speaking of science, if my meaning and arguments differ from what is customary in our country, that creates difficulties; one problem is the seeking of clarity in names and meanings so as to avoid ambiguity, and another is the logical ordering of thought, since we are not used to it." Yan continued with great emotion: "Today we talk of science unabashedly with the nobility, but when we use our literary language to do so, it is just like a watchmaker using old-fashioned Chinese knives, saws, weights, and awls—I think such a watchmaker's difficulties are obvious to anyone. He can only make do with such tools: on the one hand, tinkering to make slight improvements and, on the other, shying away from using them at all, for he has no other art." Though Yan was very vocal in his belief that using Chinese to teach science was not a mistake,[52] at the same time he lamented that it would take twenty years before China reached that high level.[53]

## V Conclusion

To conclude, Yan Fu's view of SCIENCE can be summarized as follows: "science" (*xue*) and "art" (*shu*) are two opposing concepts, with the purpose of science being to pursue truth (in Yan's words, "the laws of nature"); "art" (*shu*) tends toward practicality, or what was described as "knowing the path to morality." "Art," however, can be elevated to science, the necessary requirement being to submit all observed phenomena to "systemization" (*tixihua* 体系化). As for science, in the past "academics" (*xue*) were classified as either "ethics of form or spirit" (形行气道德), which were metaphysics and "physics," respectively. Logic was one of the "physics," as a subcomponent of philosophy; since the modern era, however, the principles of "physics" (observation, generalization,

52 "Recently European theories have been flowing east, from statecraft to catching insects and fish, and they teach that it is not a mistake to conduct education in one's own national language" (方近欧说东渐，上自政法，下逮虫鱼，言教育者皆以必用国文为不刊之宗旨。). See Yan Fu, "Yan Fu zhi Wu Guangjian han" 严复致伍光建函 (Letter to Wu Guangjian), in Yan 1986, vol. 3, 586.

53 Yan 1986, vol. 2, 562.

experimentation) have been better appreciated, leading to the transformation of the old "ethics of form or spirit" into science (*kexue*), which was also a division of inquiry into separate fields. In particular, logic became a science par excellence, since it utilized both inductive and deductive reasoning. In Yan Fu's opinion, traditional Chinese scholarship "simply did not have the art of observation" "nor any appreciation for the necessity of proofs,"[54] so that "the knowledge of the people is underdeveloped, and the nation is poor and weak."[55] China needed to quickly adopt physics, chemistry, zoology, botany, astronomy, geology, biology, psychology, and other sciences. These "physical sciences," based on inductive reasoning, would raise the living standards and knowledge level of the people. The brand-new, highly systematized sciences would inevitably transform the old world, and they were also China's only route to salvation. This is the reason for Yan Fu's praise of "science," "logic," and the "physical sciences."

As for Chinese translations of scientific terminology, Yan Fu first used *kexue* in his translation of Smith's *An Inquiry into the Nature and Causes of the Wealth of Nations*. His decision to focus on the "study of a specialized field" portion of the meaning of "science" reflects the most common understanding in China at the time. What is original is that Yan infused the new Chinese word with a sense of the essence of what makes science scientific. An important caveat, however, is that he never abandoned the use of *xue* to mean the sum total of human knowledge and the systemization of scholarship. For example, starting in 1909 Yan Fu was chief editor at the Qing government's Bureau of Terminology (审定名词馆) in the new Ministry of Education (学部), where he was responsible for evaluating nearly thirty thousand new technical terms. The Chinese term for "science" adopted by this bureau as the national standard for use in education was *xue*. The entry for *kexue*, which had also been a strong contender, was simply defined as a neologism in wide use, showing that Yan Fu and his colleagues still had an ambivalent attitude toward it.[56]

From the above analysis, it is clear that Yan Fu himself thought deeply about the full meaning of SCIENCE, the necessity of adhering to the SCIENTIFIC method, the nature of SCIENTIFIC terminology, the fundamental chasm between Chinese and Western scholarship, and the attitudes of traditional society toward "science" and "art." How many people in Yan Fu's day truly, intimately understood science as presented in Yan's abstruse (by necessity)

54 Yan 1986, vol. 2, 281.

55 Yan 1986, vol. 2, 285.

56 Shen 2008.



writings?[57] Later, the leaders of the May Fourth Movement, who had included "Mr. Sai [Mr. Science]" (赛先生) among their slogans, spread scientific thought and even became intoxicated with the notion of the omnipotence of science. Thus, *kexue* developed along somewhat different lines than what Yan Fu had in mind when he wrote that science was "most effective in national enlightenment." As for what was gained and lost during the crucible years of modern China, that is not within the bounds of the study of the history of translation or of the history of individual words.

## Bibliography

*Dongyangshi yao* 东洋史要 1899. Translated by Gezhi Xuetang 格致学堂. Shanghai: Dongwen Xueshe 东文学社.

Elman, Benjamin 2000. "Transition from the Pre-modern 'Chinese Sciences' to 'Modern Science' in China," *China Scholarship* 2: 1–43.

Fan Hongye 樊洪业 1988. "Cong 'gezhi' dao 'kexue'" 从 '格致' 到 '科学,' *Ziran bianzhengfa tongxun* 自然辩证法通讯 10, 3: 39–50.

Hida Yoshifumi 飛田良文 2002. *Meiji umare no Nihongo* 明治生まれの日本語. Kyoto: Tankōsha 談交社.

Thomas Henry Huxley 1902. *Evolution and Ethics and Other Essays.* New York: D. Appleton.

___ 1981. *Tianyanlun* 天演论 [Evolution and ethics], translated by Yan Fu 严复. Beijing: Shangwu yinshuguan, Xinhua shudian Beijing faxingsuo. [Originally published 1898.]

Jin Guantao 金观涛 and Liu Qingfeng 刘青峰, 2008. *Guannianshi yanjiu: Zhongguo xiandai zhongyao zhengzhi shuyu de xingcheng* 观念史研究：中国现代重要政治术语的形成. Hong Kong: Chinese University Press.

*Jindai Zhongguo jiaoyu shiliao* 近代中国教育史料 1928. Beijing: Zhonghua shuju.

Katō Shūichi et al., eds. 1991. *Nihon kindai shisō taikei 13 rekishi ninshiki* 日本近代思想大系13歴史認識. Tokyo: Iwanami shoten.

Liang Qichao 1899. "Lun Taipingyang zhi weilai yu Riben guoce" 论太平洋之未来与日本国策, *Qingyibao* 清议报 13 (March): 793.

Mill, John Stuart 1848. *A System of Logic.* New York: Harper and Brothers (http://www.archive.org).

___ 1949. *Ronrigaku taikei* 論理学大系, translated by Ōzeki Masakazu 大関将一. Tokyo: Shunjūsha.

57 For the linguistic constraints Yan Fu faced, see Shen 1994, pt. 2, chap. 3.

___ 1981. *Mulu mingxue* 穆勒名学, translated by Yan Fu. Beijing: Shangwu yinshuguan, Xinhua shudian Beijing faxingsuo.

Nakamura Masanao 中村正直, trans. 1874. "Seigaku ippan" 西学一斑, *Meiroku zasshi* 明六雑誌 10 (June 28): 341.

___, trans. 1879. *Shigaku* 史学1, pt. 1.

Nishi Amane 西周 1960. *Nishi Amane zenshū* 西周全集, edited by Ōkubo Toshiaki 大久保利謙, vol. 1. Tokyo: Nishi amane kinenkai.

Sanetō Keishū 実藤恵秀 1970. *Chūgokujin ryūgaku Nihonshi* 中国人留学日本史, translated by Tan Ruqian 谭汝谦 and Lin Qiyan 林启彦. Hong Kong: Sanlien shudian.

Shen Guowei 沈国威 1994. *Jindai RiZhong yuhui jiaoliushi* 近代日中语汇交流史. Tokyo: Kasama shoin.

___ 2003. "Kang Youwei yu Riben shumuzhi" 康有为与日本书目志, *Wakumon* 或问 5: 51–69.

___ 2008. "Guanhua (1916) ji qi yici—'xinci' 'budingci' wei zhongxin" 官话 (1916) 及其译词－ '新词' '部定词' 为中心, *Ajia bunka kōryū kenkyū* アジア文化交流研究 3: 113–129.

Smith, Adam 1904. *An Inquiry into the Nature and Causes of the Wealth of Nations.* New York: G. P. Putnam's Sons.

___ 1981. *Yuanfu* 原富, translated by Yan Fu. Beijing: Commercial Press

___ 1995. *An Inquiry into the Nature and Causes of the Wealth of Nations.* London: William Pickering (http://www.archive.org).

___ 2008. *Guofulun* 国富论, translated by Xie Zujun 谢祖均. Beijing: Xinshijie chubanshe.

Sōgō Masaaki 惣郷正明, ed. 1986. *Meiji no kotoba jiten* 明治のことば辞典. Tokyo: Tokyodō Shuppan 東京堂出版.

Tsuji Tetsuo 辻哲夫 1973. *Nihon no kagaku shisō* 日本の科学思想. Tokyo: Chūkō shinsho.

Utagawa Yōan 宇田川榕庵 1980. *Shokugaku keigen/shokubutsugaku* 植学啓原／植物学. Tokyo: Kowa shuppan. [Originally published 1834.]

Xu Guangqi 徐光启 1965a. *Ke "Jihe yuanben" xu* 刻<幾何原本>序, *Jihe yuanben* 幾何原本 (1607), in *Tianxue chuhan* 天學初函, bk. 4. Taipei: Xuesheng shuju.

___ 1965b. *"Taixi shuifa" xu* <泰西水法>序, *Taixi shuifa* 泰西水法 (1612), in *Tianxue chuhan* 天學初函, bk. 3. Taipei: Xuesheng shuju.

Yamamuro Shinichi 山室信一and Nakanome Tōru 中野目徹, eds. 2009. *Meiroku zasshi* 明六雑誌. 3 vols. Tokyo: Iwanami shoten.

Yan Fu 严复1986. *The Collected Writings of Yan Fu* 严复集, edited by Wang Shi 王栻. 5 vols. Beijing: Zhonghua shuju.

Yuan Hanqing 袁翰青 1985. "Kexue, jishu liang ci suyuan" 科学，技术两词溯源, *Beijing Wanbao* 北京晚报, September 19.



Zhang Fan 张帆 2009. "Cong 'gezhi' dao 'kexue': Wan Qing xueshu tixi de duguo yu bieyi (1895–1905)" 从 '格致' 到 '科学' ：晚清学术体系的度过与别译(1895–1905), *Xueshu yanjiu* 学术研究 12: 102–114.

Zhou Cheng 周程 2009. "Jiujing shei shi zhongguo zuixian shiyongle 'kexue' yici?" 究竟谁是最先使用了 '科学' 一词?, *Ziran bianzhengfa tongxun* 自然辩证法通讯 4: 93–98.

Zhu Fajian 1899. *Dongyangshi yao* 东洋史要, translated by Gezhi Xuetang 格致学堂. Shanghai: Dongwen xueshe.

Zhu Jianfa 朱建发 2005. "Zao yinjin 'kexue' yici de Zhongguoren bianxi" 最早引进 '科学' 一词的中国人辨析, *Jishou Daxue xuebao (shehui kexue ban)* 吉首大学学报(社会科学版) 2: 59–61.