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The terminological battle for ‘air’ in modern China

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Introduction

In contemporary science education we take the understanding of ‘air’ as a mixture of gases and the physical and chemical properties of air and its components for granted. Air has in recent years become the object of renewed interest and concern with debates on the climate effects of rising CO_2 concentrations in the atmosphere and on the negative health effects of ambient and indoor airborne pollution. In China recently the most impassioned debates and disturbing information have been related to the rising levels and harmful effects of the small particles of particulate matter in urban air, mostly measured as the smallest particles of particulate matter in air referred to as PM2.5. This focus on and concern about airborne gases and airborne pollution is an effect of increasing scientific knowledge about the climate and the relationship between the quality of ambient air and human health. This now global field of research has developed rapidly over a period of a few decades. In historical terms the field of knowledge related to air, pollution and health has also gone through several stages where the construction of meaning and knowledge to explain the seemingly empty (*kong* 空) space between heaven and earth and between man and his/her environment has developed with the historical development of science.

In the same way that contemporary European understanding of the significance of air quality and health effects of poor air quality is a result of the history of air science in Europe, the same can be said about the Chinese case. Advanced science is today a global field, and so is international research on air, air quality, air pollution and health effects of air pollution. Popular perceptions and interpretations of this field of knowledge are, however, to a much larger degree influenced by specific cultural traits, traditional interpretations, the history of popular science in a specific culture and the language with which these perceptions are conveyed. It is the language of air science in China that is the topic of this article. It may be objected that popular science is today a global field of knowledge that is barely subject to the history of science in a specific cultural context such as China. Some may also argue that ‘air’ in the early scientific translations from the 1850s in China was translated using the term *kongqi* 空氣, ‘oxygen’ was

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translated as *yangqi* 養氣, 'nitrogen' as *danqi* 淡氣, and 'water vapour' as *shuizhengqi* 水蒸氣 or *shiqi* 濕氣 etc. and that there is not much more to be said about the transmission and translation of air science from Western texts into Chinese. My claim is that there is much more to be understood from the Chinese process of translation and adaptation of these terms. We may assume that there is a simple and uniform one-to-one relationship between the terms 'air', 'atmosphere' and 'weather' in English (with parallels in other European languages) and the contemporary Chinese terms *kongqi*, *daqi* 大氣 and *tianqi* 天氣. My aim here is to show that the Chinese terms for air, atmosphere, gases and climate carry cultural traits, brought into the field of popular science through the history of science in China, that have influenced and will necessarily influence popular debates on these issues in China. Simultaneously, a close study of the terminological development of air science in China will also give us a better understanding of one particular aspect of the translation and development of modern science in China. I will in the following show that the process of term translation for central concepts in the modern sciences in China, often through Japan, was far from a unilinear process but in fact a complicated process involving confusing contradictions between different schools of translation and different sets of semantic fields. Simple categorisations of term translations, like semantic loans, roundtrip diffusion via Japan, Chinese neologisms etc., may not be sufficiently precise to describe the often complicated genealogy of specific term translations. I will use terms for 'air' to illustrate this point.

Traditional understanding of 'air' and air-related health issues

In ancient Greek philosophy air (ἀήρ) was regarded as one of the four, and later five, basic elements alongside earth, water, fire and ether. This system for describing the properties of all things influenced European thinking up to the Renaissance. The element of air indicated the properties wet and hot. Aristotle added the fifth element *ether* in order to describe the incorruptible and unchangeable element of heaven and the stars. Air was also included among the elements of medieval European alchemy. In ancient Chinese philosophy we also recognize a system for describing 5 basic elements, or properties, (*wuxing* 五行) but none of these have a parallel in the ancient Greek element referred to as air.

Oxygen, nitrogen and carbon dioxide as components of the atmosphere were discovered during the Enlightenment in the 1750-70s through the work of a number of scientists. Antoine Lavoisier (1743-1794) built his investigations on previous works by his predecessors and contributed to the early modern European scientific quantitative understanding of air as a mixture of several gases rather than just one single substance. Lavoisier studied the oxidation of metals and concluded that air contains several gases of which oxygen is one that supports combustion while nitrogen does not. Lavoisier also found that oxygen was the part of air that contributed to respiration. Through the work of scientists like Lavoisier during the Enlightenment the process of identifying the various substances of air had started, a work that would later lead to the discovery of other gases present in air, such as the isolation of argon gas in 1894.

Miasma theory in Europe claimed that diseases such as cholera and Black Death were caused by rotting air called *miasma*, also referred to as 'night air'. This theory held that these diseases were caused by organic matter that was rotting and emanating bad air. This poisonous vapour called miasma could be caused by bad health, contaminated water or rotting substances and would directly inflict diseases upon the person exposed to this air. Miasma could not be transmitted between individuals. Until the 1850 miasma theory was popular for explaining the spread of infectious diseases, and nurses like Florence Nightingale (1820-1910) supported this theory and worked to clean the air in hospitals to prevent the spread of diseases. The description of 'unhealthy fog' in cities like London in the early 19th century indicated the presence of miasma that would cause the spread of diseases. During the 19th century theories about diseases spreading through physical contact divided the medical community in two, and gradually evidence of germs as the cause of diseases, proven through the work of John Snow (1813-1858), Louis Pasteur (1822-1895), Robert Koch (1843-1910) and others, discredited miasma theory from the 1850s.

In China we also find early theories about the negative health effects of bad air. In early Chinese texts we find descriptions of the hot and humid climate in southern regions being detrimental for human health, such as Jia Yi's 賈誼 (200-168 BC) descriptions of his exile in the south in the 2nd century BC. The idea of *zhangqi* 瘴氣 being a cause of diseases has a long tradition within Chinese folk medicine, often found described in local historical sources. This idea of *zhangqi* as a cause of disease is still prevalent in Chinese folk medicine today.

Qi 氣 is an ancient term in Chinese traditional medicine that refers to the vital energy, life-giving power, or esoteric substance, that maintains life, and is kept in balance through a life without excesses, a well balanced diet, and through external manipulation of specific acupuncture points (*xuewei* 穴位) on the body. The character for *qi* has its origin in rice or grain presented as gifts, then pronounced *xi* (Qiu 2000: 330), and its ancient semantics are attached to rising damp, gas and vapour. Ancient meanings of *qi* also include other sensory phenomena such as 'cloud', 'damp', 'smoke', 'gas', 'smell', 'breathing', 'temper/mood (of the face)', 'six phenomena of Heaven' (*liuqi* 六氣), 'timespan', and is an important philosophical concept of 'substance' coupled with 'principle' (*li* 理) in Neo-Confucianism. (*Hanyu dacidian*, vol. 6, pp. 1023-1025) Thus *qi* in its traditional sense is semantically related both to health and to vapours. It is therefore not surprising to find that the character *qi* came to be essential when terms were coined in the modern natural sciences for phenomena and substances related to life-giving 'air'. A number of traditional terms derived from *qi* were, as we shall see below, invoked when 'air' and 'atmosphere' were first translated into Chinese. These include *tianqi* 天氣 and *diqi* 地氣, *daqi* 大氣, *shengqi* 生氣 and *kongqi* 空氣. (see e.g. Wright 2000: 5-7) *Tianqi* and *diqi* were used already in

classical Chinese texts as terms referring to climatic changes. *Tianqi* referred then to clear *qi* rising towards the sky, whereas *diqi* referred to murky *qi* of the earth that could inflict illness upon people. (*Hanyu dacidian*, vol. 2, p. 1027, 1430) In the Confucian text *Liji* 禮記, chapter *Yueling* 月令, probably compiled in the 1st century AD, we read for the first month of spring: 是月也。天氣下降。地氣上勝。天地和同。草木萌動。 (*Shisanjing zhushu* 1982, *Liji*, juan 14, p. 1356) "In this month, heavenly *qi* descends upon the earth and earthly *qi* rises towards the sky, there will be harmony between Heaven and Earth, and plants and trees will start to blossom and grow." *Shengqi* is also an ancient Chinese term referring to the vital *qi* that gives and maintains life in all living creatures ands plants. In the same chapter of the *Liji* we find a passage describing the life giving qualities of *shengqi* during the last month of spring: 是月也。生氣方盛。陽氣發泄。句者畢出。萌者盡達。不可以內。 (*Shisanjing* 1982, *Liji*, juan 14, p. 1363) "In this month, life giving *qi* is at its most fullest, and bright *qi* radiates. All crippled [creates] come forward, and all growing [plants] reach out. Nothing can hold back." (See also *Hanyu dacidian*, vol 7, p. 1504) *Kongqi* is originally an early daoist term meaning 'primordial *qi*' (元氣) or 'pure *qi*' (清氣) (*Hanyu dacidian*, vol. 8, p. 417)

The Aristotelian idea of *ether* as the fifth incorruptible element of heaven and the stars was also brought into the debate on Western sciences in China in late imperial times. Inspired by Western physics Tan Sitong 譚嗣同 (1865-1898) developed a theory about ether as the substance behind all the elements in his book *Renxue* 仁學 (Japan, 1899). Tan's theory about ether was inspired by the Chinese notion of *qi* as the prime substance. His theory fused Chinese and Western learning and tried to bridge the gap between the physical and the spiritual realm. Kang Youwei (康有為) (1858-1927) also worked with the idea of ether as a prime substance. John Fryer (傅蘭雅) (1839-1928), a translator of science texts at Jiangnan Arsenal in Shanghai, also associated ether with *qi* in order to make Western physics palatable to Chinese intellectuals. (Elman 2005: 400-403)

Against this backdrop of traditional recognition of *qi* as a sensory substance related to phenomena between heaven and earth and closely related to balance of vital energy in the human body European science was introduced into China after the Opium War. The process of introducing science in China started with the early science translations in the 1850s and continued with more systematic introductions translated into Chinese from the 1870s. Below I will investigate how 'air science' was translated and introduced into China and the terms involved in this process from the 1850s.

The translation of 'air' into Chinese

The translation and introduction of what we may call 'air science' from Western texts into Chinese run parallel with the introduction and translation of Western sciences into Chinese after the Opium war. When we consult relevant dictionaries (e.g. *Jinxiandai Hanyu xinci ciyuan cidian*: 147) on the term 'air'

we find that they refer to the first occurrence of the modern term *kongqi* 空氣 as a Chinese translation of 'air' in an article by William Muirhead (慕維廉) (1822-1900) on geography and the seas in the Chinese language missionary journal *Liuhe congtan* 六合叢談 (*Shanghae Serial*) from July/August 1857: 青色最易返照，故空氣海水，皆見為青色也。 (*Liuhe congtan* no. 7, p. 3a) "The colour green reflects most easily, therefore empty *qi* (*kongqi*) and sea water all appear to be green." I will in this article challenge the idea that Muirhead coined the term *kongqi* for 'air' in 1857 and that all later texts accepted and continued this new term translation. Lydia Liu has suggested that the term *kongqi* meaning 'air' may represent a round-trip diffusion via Japan, indicating that the term is an ancient Chinese term that was imbued with a modern scientific meaning in Japan and then imported back into China with new semantic content - often during the period following the Sino-Japanese war in 1894-95. (Liu 1995: 265) It remains to be investigated how 'air' became translated with *kongqi* and what role Japan may have had in this process, which is the main topic of this article. One of the first Western scientific introductions to air in Chinese is to be found in an article in the 2nd issue of the *Liuhe congtan* from February/March 1857 (*Liuhe congtan* no. 2, pp. 3a-3b). In this article on geography Muirhead introduces air as the gas that surrounds the globe, that is essential for all life, and has the ability to refract light emitted from the sun. Air is unanimously referred to as *qi* in this article, and only in one passage does he make reference to the idea of emptiness/*kong*: 又氣雖空澄亦能阻礙日之光道。 (*Liuhe congtan* no. 2, p. 3a) "Furthermore, even though air is empty and transparent it has the ability to inhibit radiation from the sun". In fact, the sentence from the 7th issue of the *Liuhe congtan*, referred to in the dictionary on modern neologisms in Chinese and in scholarly works on the early translations of 'air', is the only passage where the combination *kong qi* occurs in this magazine. It is therefore my claim that Muirhead did *not* coin the term *kongqi* as a technical translation of 'air' in this text but rather applies emptiness/*kong* as a descriptive characteristic of air/*qi* – 'empty air'. Given that the term *kongqi* was *not* coined by Muirhead as a technical term translation of 'air', we will have to continue our search for Chinese translated term(s) for 'air'. As I shall show below, we will have to wait for another 15 years for the term *kongqi* to appear as a technical term translation for 'air' in China.

This does not mean, however, that 'air' was not introduced as an essential and life giving substance when missionary translators introduced the discipline of chemistry in China in works on natural science from the late 1840s. Benjamin Hobson (合信) (1816-1873) compiled and edited a book on geography and astronomy entitled *Tianwen lüelun* 天文略論, published in 1849, which contains a chapter on the atmosphere. Air is introduced as atmosphere and systematically termed *diqi* 地氣. (Wang Yangzong 2009: 16) Hobson also compiled and published a general work on modern science entitled *Bowu xinbian* 博物新編 in 1854-55.[2] (Wright 2000, pp. 263-266). The text is not particularly dedicated to chemistry

[2] First published in Guangzhou in 1854 and then in Shanghai in 1855.

and not focussed on air and its gases as such. The entire text opens the discussions on science, however, it includes an introduction to the atmosphere and introduces the term *qi* generally for gases and for the air/atmosphere that surrounds the globe. The text introduces the idea that this gas surrounding us consists of several different kinds of gases which are commonly termed as *shengqi* 生氣.[3] The composition of this air, *shengqi*, is by Hobson explained as consisting mainly of the following elements; oxygen, nitrogen, water vapor and CO_2 and is closely related to the nourishment of life through its vital function for animals and plants. (Hobson 1855, juan 1, pp. 1a-3a) In a later chapter on weather and atmospheric phenomena entitled *On clouds and mist, Yunwulun* 雲霧論, we encounter the term *kongqi* on a few occasions. A close reading of the text shows, however, that *kongqi* in this chapter does not serve as a technical term translation for 'air', which would make it a substitution for *shengqi* for the life giving mixture of gases called 'air' from the first section, but is in fact a short form of what is introduced in the text as a term for 'atmosphere', *tiankongqi* 天空氣. (Hobson 1855, juan 4, pp. 5a-7a) Hobson's dictionary on medical terms in Chinese and English from 1858 confirms that Benjamin Hobson introduced *shengqi* as a translated technical term for 'air' as a composite and life giving gas. In the dictionary he gives the term *diqi* 地氣 for 'atmosphere' indicating that he was not entirely firm on the technical term for 'atmosphere' at this time. (Hobson 1858 in MCST)

Air science was systematically introduced as a field of science for the first time in China in 1868. William A.P. Martin (丁韙良) (1827-1916) wrote a far more comprehensive introduction to the sciences, compared to the *Bowu xinbian*, and published it in Chinese with the title *Gewu rumen* 格物入門 at the Tongwenguan in Beijing. Under the title 'air science' or 'gasology', *qixue* 氣學[4], which comprises one whole volume of the 7 volume *Gewu rumen*, various aspects of the properties and composition of air and gases are introduced in the form of questions and answers. Unlike Hobbes in *Bowu xinbian* Martin endeavoured to introduce a systematic nomenclature in chemistry in this work. (Wright 2000, pp. 266-272, Liu Guangding 2002, p. 204). Martin and his colleagues at Tongwenguan relied on terms with semantics from Chinese tradition to translate elements, substances and phenomena in chemistry, unfortunately often impractical, however, for the systematic introduction of the modern science of chemistry in Chinese. (Reardon-Andersen 1991: 40; Wright 1998: 668) In the second volume of the *Gewu rumen* entitled *Qixue* both 'air', as the mixture of gases, and the 'atmosphere', as the layer of gas surrounding the globe, are translated *tianqi* 天氣, thus imbuing the scientific term for 'air' with semantics from traditional Confucian philosophy about climatic change and nourishment of life, as we have seen above.

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[3] The term *shengqi*/*seiki* 生氣 was applied in early Japanese chemistry translations, such as the *Kagaku kinmo* 化學訓蒙 published in 1873, as a term translation for oxygen (gas).

[4] Some authors use the term 'pneumatics', but I prefer 'air science', 'gasology', or simply *qixue*, as 'pneumatics' is much more specific and semantically narrow than the area of knowledge known as *qixue* in late Qing China.

Until the early 1870s these two incompatible translations of air, *shengqi* and *tianqi*, possibly also including the term *diqi* related to 'air' and 'atmosphere', existed in Chinese scientific literature, *shengqi* with an institutional base in the south (Guangzhou/Shanghai) and *tianqi* with an institutional base in the north (Beijing). A number of monolingual and bilingual dictionaries of the Chinese language were published during this period. An examination of the terms for 'air', 'atmosphere' and 'weather' in dictionaries complied by Robert Morrison (1815-1823 and 1865), S. Wells Williams (1856 and 1874), W. Lobscheid (1871) and Justus Doolittle (1872) confirms the unstable state of affairs for technical translations of terms like 'air' before 1872. In Morrison's dictionary from 1815-1823 we find the terms *qi* and *diqi* as translations of 'air', and that "air of the atmosphere is generally called 風 fung". (Morrison 1815-1823, part 2, 3, vol. 2, p. 20) Williams' dictionaries from 1856 and 1874 do not give us any indication that technical term translations for 'air' have entered the Chinese common language, and Morrison's 1865 reprinted dictionary glosses the terms *tianqi* with "the weather" and "the temperature of the atmosphere" (Morrison 1865, vol. 2, p. 405) and *shengqi* with "to be angry, to fume with rage or passion". (Morrison 1865, vol. 2, p. 206) Still in Lobscheid's dictionary published in 1871 we only find similar common translations related to 'air' and *tianqi*, (Lobscheid 1871, pp. 89, 303; Shen Guowei 2001: 294-300) indicating that until this time editors of bilingual dictionaries in Chinese were not concerned with how technical terms like 'air' and 'atmosphere' were represented in Chinese, and the same is true for the chemical elements and compounds as components of air. This changed with Justus Doolittle's dictionary published in 1872. Doolittle consulted science translations and lists of scientific terms when compiling his own dictionary by synthesising various Chinese "regional standards". In addition, he added lists of technical term translations as appendices to his own dictionary. (Shen Guowei 2001: 301-303) In this dictionary Doolittle attempted to make more systematic sense of all the different terms for 'air' and 'atmosphere'. He translates 'air (of atmosphere)' as *qi* 氣, *diqi* 地氣 and *fengqi* 風氣 (Doolittle 1872, vol. 1, p. 11), while 'atmosphere' is translated *diqi* 地氣, *tianqi* 天氣 and *tiankong zhi qi* 天空之氣 (Doolittle 1872, vol. 1, p. 25). *Shengqi* 生氣 is referred to as 'vital air'. (ibid.) Doolittle's attempt at unifying terms from different text translations into one set of terms for these different aspects of 'air' did not, however, have a lasting effect on the landscape of 'air' translations, as we shall see below.

As appendices to Doolittle's lists of terms we find lists of scientific terms deducted from the different individual text translations, from W.A.P Martin's terms in natural philosophy (Doolittle 1872, vol. 2, pp. 308-315), from Hobson's medical vocabulary (Doolittle 1872, vol. 2, pp. 315-318) and from John Glasgow Kerr's scientific terms (Doolittle 1872, vol. 2, pp. 543-549). The list of terms from Hobson confirms that he designated the term *shengqi* for 'air supporting life' while *diqi*, and also the term *qizhi* 氣質 referring to gas as substance, are used as technical term translations for 'air' as substance and 'air' of the atmosphere. (Doolittle 1872, vol. 2, pp. 315-318) This list confirms our reading of Hobson above,

that he has introduced these two terms for 'air' with slightly different, but not entirely distinct, semantic contents. Doolittle's reference to Martin's terms also confirms our initial reading of Martin's introduction to the sciences, as all semantic connotations of 'air' in English, both air as a composite gas and air as atmosphere, are covered by Martin's technical term *tianqi*. (Doolittle 1872, vol. 2, pp. 308-309) Doolittle's dictionary also included a list of terms from John G. Kerr's term translations in chemistry. (Doolittle 1872, vol. 2, pp. 543-549) We find systematic translations of all the essential chemical elements in this list, but 'air' as term is not included. The absence of the term *kongqi* in all parts of Doolittle's dictionary supports my argument that *kongqi* was *not* conceived as a term translation of 'air' or 'atmosphere' in the early 1870s.

An entirely new phase in the introduction of modern chemistry in China commenced in 1870 and 1871 with the publication of two comprehensive volumes on chemistry translated from one and the same original – David Ames Wells' *Principles and Applications of Chemistry* (New York 1862). The first of these is the *Huaxue chujie* 化學初階, translated by John Glasgow Kerr (嘉約翰) (1824-1901) and He Liaoran 何瞭然 and published in Guangzhou in 1870, the second of these is *Huaxue jianyuan* 化學鑑原, translated by John Fryer and Xu Shou 徐壽 (1818-1884) and published at the Jiangnan Arsenal in Shanghai from 1871 (the first volume was published in 1871, the second volume in 1875 and the third volume in 1879). (Wright 2000, pp. 273-278, Liu Guangding 2002: 204, 205, 206) When working out systematic nomenclatures in chemistry for their publications, Kerr and He based parts of their term translations on lists they had obtained from Fryer and Xu. James Reardon-Anderson concludes that "Fryer and Hsü deserve credit as founders of the modern Chinese chemical nomenclature". (Reardon-Anderson 1991, p. 41) Fryer and Xu published an extensive glossary of terms and substances in 1885, *Huaxue cailiao Zhong-Xi mingmubiao* 化學材料中西名目表. The foundation for this set was, however, set already in the early 1870s. Reardon-Anderson has found that when assigning characters and defining terms for chemical elements and compounds Fryer/Xu and Kerr/Liao established principles that went contrary to Martin's translations. (Reardon-Anderson 1991, p. 42) Reardon-Anderson is clearly right in this assumption for the chemical elements, but his conclusion is not valid for the terms for 'air'. For 'air' Kerr/Liao followed Martin and systematically employed the term *tianqi*, whereas Fryer/Xu assigned the neologism *kongqi* for 'air'. (Zhang Zigao & Yang Gen 1986: 118) Thus, by 1871 China had a set of no less than (at least) four different technical translations for 'air'; *shengqi*, *diqi*, *tianqi* and now also *kongqi*. Hobson's terms *shengqi* and *diqi* as technical term translations for 'air' and 'atmosphere' were relatively soon made obsolete by the influence of these new texts.[5]

[5] Not entirely obsolete, however, as we find the term *shengqi* for 'life-giving air' in journal articles in the 1870s and 1880s and still in use in an anonymous article entitled *Shengqi yangti* 生氣養體 in *Zhixinbao* 知新報 in 1897. (*Zhixinbao* 1897, no. 26, pp. 24a-24b) Also the term *diqi* is occasionally found meaning 'atmosphere' in journal articles in the 1880s and 1890s.

The systematic translation of texts on chemistry that started with Kerr/He and Fryer/Xu in the early 1870s continued with increasing speed into the 1870s and 1880s when Jiangnan Arsenal and Yizhi shuhui in Shanghai, and Tongwenguan in Beijing played the major institutional roles. All three institutions engaged in the translation and publication of books in the natural sciences, including chemistry. John Fryer and Xu Shou, together with Xu Jianyin 徐建寅, took on leading roles in this respect at the Jiangnan Arsenal, whereas William A.P. Martin and Anatole Adrien Billequin (畢利幹) (1837-1894), together with Cheng Lin (承霖) and Wang Zhongxiang (王鐘祥), took on similar roles at the Tongwenguan. Texts translated by Fryer and colleagues and published in Shanghai with introductions to air in the 1870s, 1880s and 1890s include:

1871: *Huaxue fenyuan* 化學分原 translated by Fryer and Xu Jianyin, published by Jiangnan Arsenal[6]
1881: *Huaxue yizhi* 化學易知 written by Fryer, published by Yizhi shuhui 益智書會[7]
1883: *Huaxue kaozhi* 化學考質 translated by Fryer and Xu Shou, published by Jiangnan Arsenal[8]
1883/1888: *Huaxue qiushu* 化學求數 translated by Fryer and Xu Shou, published by Jiangnan Arsenal[9]
1886: *Huaxue xuzhi* 化學須知 and *Qixue xuzhi* 氣學須知 edited by Fryer, published by Yizhi shuhui/Jiangnan Arsenal[10]
1890: *Huaxue weishenglun* 化學衛生論 translated by Fryer, published at the Gezhi shushi 格致書室[11]
1898: *Huaxue gongyi* 化學工藝 translated by Fryer and Wang Zhensheng, published by Jiangnan Arsenal

All these texts translate all aspects of 'air', as gas and as atmosphere, with the term *kongqi*, following the vocabulary that the Jiangnan Arsenal translators introduced in 1871. In the 1886 publication on 'air science', *Qixue xuzhi*, Fryer also explains his choice of term and explicitly imbues the modern scientific understanding of 'air' with connotation from the ancient European idea of air as one of the four elements: 空氣為流行縹緲之物，古人列為四行之一，謂能長養萬物者也，其彌漫於地球周圍，猶如氣海，高厚約一百三十餘里，故地面一切人物，皆得受其包涵，凡各孔各隙，亦能無微不入，因其目不能見，手不能捫，故曰空氣，然實非空，確有質性可驗， (*Qixue xuzhi* 1886, p. 6a) "*Kongqi* is a flowing and invisible substance. People in ancient times listed it as one of the four elements and referred to it as the substance that has the ability to maintain life. Its concentration around the earth resembles a sea of *qi* with a thickness of more than 130 *li*. Therefore all people and things on the surface of the earth are

[6] Wright 2000: 57, 471; Liu Guangding 2002: 205
[7] Wright 2000: 293, 472; Liu Guangding 2002: 207
[8] Wright 2000:472; Liu Guangding 2002:207
[9] Wright 2000: 472; Liu Guangding 2002: 207
[10] Wright 2000: 472; Liu Guangding 2002: 209
[11] May have been published by the Guangxuehui 廣學會 in Shanghai already in 1879 (Liu Guangding 2002: 206; Wright 2000: 472)

wrapped up in it, it even fills all small holes and cracks. Since we cannot see it with our eyes and cannot grasp it with our hands we call it empty (*kong*) *qi*. It is in reality not empty, it is a substance that can be made evident." It is significant for our analysis here that Fryer does not make any attempts to attach semantic relevance to the term *kongqi* as an ancient idea taken from the daoist tradition.

Parallel in time with endeavours by Fryer and his colleagues in Shanghai to introduce *kongqi* as a modern scientific term for air by drawing on Western tradition Martin and his colleagues in Beijing had a different strategy. They continued to rely on the Chinese term *tianqi* as a technical term translation for 'air' introduced in the 1868 publication of *Gewu rumen*. Anatole Adrien Billequin at Tongwenguan published his chemistry translation *Huaxue zhinan* 化學指南 at Tongwenguan in 1873. A major part of the first volume is dedicated to an introduction to oxygen and other gases of the atmosphere.[12] Air as gas and as atmosphere is unanimously translated as *tianqi*. This terminological tradition is continued when Billequin, Cheng Lin and Wang Zhongxiang published the *Huaxue chanyuan* 化學闡原 at Tongwenguan in 1882.[13]

David Wright concludes that these chemistry translations were not widely applied outside of the Tongwenguan, whereas the translations from Fryer and his colleagues in Shanghai gained much greater influence. (Wright 2000: 284-285) It is therefore to be expected that Fryer's term *kongqi* exerted greater influence upon the growing interest in chemistry and 'gasology' in China than Martin and Billequin's term *tianqi*. That is a correct observation when we consider the rather narrow circle of Chinese intellectuals and foreigners engaged in the promotion and translation of chemistry and natural science in China at this time. A browse through a number of translations on chemistry in the 1880s, 1890s and the early 20th century shows that these texts all employ Fryer's term *kongqi* for 'air':

1875-80: *Gewu tanyuan* 格物探原 written by Alexander Williamson, published in Shanghai[14]
1896: *Gezhi qimeng* 格致啟蒙 translated by Young Allen and Zheng Changyan, published by Jiangnan Arsenal
1896: *Huaxue xinbian* 化學新編 translated by John C. Ferguson and Li Tianxiang, published by Nanking University[15]
1898: *Huaxue bianzhi* 化學辨質 translated by James Boyd Neal and Shang Baochen, published in Shanghai by the Meihua shuguan[16]

[12] The most remarkable feature of the *Huaxue zhinan* is Billequin's attempt at introducing a new system for the chemical elements. (Wright 2000: 284; see also Liu Guangding 2002: 205; Wright 2000: 281-285)
[13] Liu Guangding 2002: 207; Wright 2000: 281-285
[14] Wright 2000: 93-97, 470
[15] Liu Guangding 2002: 209
[16] Liu Guangding 2002: 210

1900: *Huaxue yuanliulun* 化學源流論, published by Jiangnan Arsenal[17]
1903: *Huaxue daoyuan* 化學導原 translated by Sun Yunxin, published in Jiangning by Jiangchu shuju[18]
1903: *(Zuixin zhongxue jiaokeshu) Huaxue* (最新中學教科書)化學 translated by Xie Honglai and Zhong-Xi yishe, published by Shangwu yinshuguan in Shanghai[19]
1904: *(Zuijin) Putong huaxue jiaokeshu* (最近)普通化學教科書 translated and published by Sanyishe in Changsha[20]

Yet another term translation for 'air' was introduced in 1886 with Joseph Edkins' publication of *Huaxue qimeng* 化學啟蒙.[21] Three whole chapters are dedicated to the chemistry of 'air', which he translates *fengqi* 風氣 covering all aspects of air and atmosphere. The first passage in chapter 3 gives an interesting introduction to his choice of term: 在此室內，爾我之間，有無形之物，何由能知乎，諸生謂門外有風，試還問之諸生，所謂風者為何，將手與臂迅速動搖，必覺指尖處有風，以扇向面撲搧，即覺有風吹噓，風為行動之氣，可名其氣曰風氣，便與他氣有別， (Edkins (ed. and tr.) 1886: 8a-8b) "In this room, between you and me, there is a formless substance. How can we know this? Everyone would say that there is wind outside the door. But what if we ask them what this wind really is? If we take the hand and the arm and rapidly move them, we will sense a wind at the fingertips, and if we wave a fan towards the face we can feel a wind blowing. Wind is moving *qi*, and we can call this *qi* '*fengqi'* in order to distinguish it from other kinds of *qi*." In 1886 Edkins attempted to introduce a new technical term translation for 'air' presumably because he was less than satisfied with existing terms and found the term *fengqi* and its terminological relationship to wind and *qi* more compelling than terms like *tianqi* and *kongqi*. Unfortunately for Edkins his innovative term translation for 'air' was not used in other texts[22] and did not gain general recognition.

A committee for the standardization of medical terms was established by the Medical Missionary Association of China, and under the leadership of Philip B. Cousland they published the first modern dictionary of Chinese medical terms in Chinese in 1908. Here we find systematic use of *kongqi* for 'air'. (Cousland et.al. (eds.) 1908: 8) We also find the same tendency in the many scientific journal articles discussing air-related phenomena from this same period; *Tianqi* is obscure in these publications as term translation for 'air', whereas *kongqi* is common in journal articles for 'air' from 1873.[23] China's first

[17] Liu Guangding 2002: 210
[18] Liu Guangding 2002: 212
[19] Liu Guangding 2002: 212
[20] Liu Guangding 2002: 209 (Liu gives the wrong year of publication)
[21] Wright 2000: 473; Liu Guangding 2002: 208-209
[22] Except for the mention of this term in Doolittle's dictionary from 1872 and in Edkins' own edited texts in the same *Gezhi qimeng* 格致啟蒙 series published in 1886, like *Gezhi zongxue qimeng* 格致總學啟蒙 and *Gezhi zhixue qimeng* 格致質學啟蒙.
[23] Starting in the *Jiaohui xinbao* 教會新報 in 1873 (issue 224) and the *Gezhi huibian* 格致彙編 in the autumn issue 1876.

chemistry journal, the *Yaquan zazhi* 亞泉雜誌, was published in Shanghai between October 1900 and April 1901. In articles in the *Yaquan zazhi* we find systematic use of *kongqi* for ‘air’ and *tianqi* only for ‘weather/climate’, thus following the Fryer/Xu-tradition.

This is, however, contrary to the general picture we get from examining bilingual dictionaries published during this period, such as Eifel 1877, Kwong 1887, Giles 1892, Yan 1908, Williams 1909, MacGillivray 1918, Mathews 1931. We find the term *tianqi* frequently occurring in the common meaning related to weather, climate, temperature and vapour (Eifel 1877: 721; Giles 1892: 125, 1390; Williams 1909: 77, 790; MacGillivray 1918; Mathews 1931: 921), and we find the term *shengqi* in its common meaning of “to get/be angry” (Giles 1892: 126; Williams 1909: 77, 694; MacGilivray 1918: 771; Mathews 1931: 796). In addition, we also frequently come across translations of the common semantics of the terms *qi* 氣, *feng* 風, *diqi* 地氣, *daqi* 大氣, *fengqi* 風氣, *tuqi* 土氣 and *tiankong zhi qi* 天空之氣 related to ‘air’ and ‘atmosphere’ (Kwong 1887: 11, 23, 458, 459; Giles 1892: 125; Yan 1908: 44-45, 127; Williams 1909: 77; MacGillivrany 1918: 882; Mathews 1931: 897). These are, however, to be understood primarily with semantics from the common language and are not presented as technical term translations of ‘air’ and ‘atmosphere’. When we search for technical term translations in these dictionaries we find that *only* the term *tianqi* appears in this sense in these dictionaries before 1908, and the term *kongqi* does not occur in this sense. In Yan 1908 *tianqi* also appears as the technical term translation for ‘air’ and for ‘atmosphere’ (Yan 1908: 44-45, 127). Under the term ‘atmospheric’ in Yan 1908, however, we encounter the term *kongqi* in a number of combinations. (Yan 1908: 127) In Mathews 1931 *kongqi* is clearly presented as a technical term translation of ‘air’. (Mathews 1931: 547)

We can at this stage conclude that Fryer’s term *kongqi* gained rapid influence in intellectual circles, among those involved in translation and promulgation of science in China, but Martin/Billequin’s term *tianqi* sustained the influence from Fryer’s term much longer in common dictionaries presumably representing more common language usage.

‘Air’ via Japan

The trajectory of term translations for the chemical elements in Chinese have been thoroughly studied and described in research literature. The process of term translations for the elements can be traced back to the early term translations in Hobson’s *Bowu xinbian* and the magazine *Liuhe congtan* in the 1850s. Initially, we find a number of competing systems for the chemical elements in Chinese, such as the rather obscure system for naming the elements introduced in Lobscheid’s dictionary, the terms in Martin’s translations, in Kerr’s translations and in Fryer’s translations. (Shen Guowei 2001: 294-301; Wright 1998: 667-671; Wright 2000: 201-228, 449-460; Reardon-Anderson 1991: 40-45; Zhang Zigao and Yang Gen 1986: 111-116; He Juan 2005) Already before the burgeoning Japanese influence on text and term

translations in the sciences from the late 19th and early 20th centuries the system designed by Fryer/Xu at Jiangnan Arsenal had gained general recognition in China. These term translations created at the Jiangnan Arsenal have, through a protracted process of standardization that ended with the publication of the *Huaxue mingming yuanze* 化學命名原則 in 1932 generally also continued into Modern Standard Chinese. (He Juan 2005) If we look specifically at the chemical elements involved in 'air' we find that oxygen was translated *yangqi* 養氣 from *yang* 養, 'to nourish' and *qi* 氣 for 'gas, vapour' already by Hobson in 1849 and 1855. In Hobson's works we also find *danqi* 淡氣 for nitrogen (*dan* 淡 for 'bland') and *qingqi* 輕氣 for hydrogen (*qing* 輕 for 'light') (Hobson 1855, vol. 1, pp. 1a-2b; Shen Guowei 2001: 297-298; Wright 1998: 669; Wright 2000: 221-227, 449-460; Nakayama 1991: 303-304). In later texts these *single* characters *yang*, *dan* and *qing* were applied for the elements. These term translations were generally followed in texts and lists of scientific terms in the late 19th and early 20th century.[24] Through a systematic study of teaching material published between 1903 and 1932 He Juan has concluded that these chemical elements were assigned distinct Chinese characters to distinguish them from the original characters meaning 'to nourish', 'light' and 'bland'. Through this process we got *yang* 氧 for oxygen, *dan* 氮 for nitrogen and *qing* 氫 for hydrogen, a system that to a large extent was first introduced through Calvin Wilson Mateer's dictionaries on chemical terms from 1901 and on technical terms from 1904 (Wright 2000: 449-460) and taken up in teaching material from 1920. (He Juan 2005) These new characters also entered scholarly works on chemistry in the early 1920s[25] and more popular texts on chemistry only in the 1930s. The Japanese influence on scientific term translations in many scientific disciplines was prominent after 1895 and often made indigenous Chinese term translations obsolete. Japan had already from 1825 started to develop a system of term translations for some of the most common chemical elements but these had little influence on the term translation process in China, presumably because the Chinese term translations for chemical elements were firm and stable by the 1890s. (Wright 2000: 227, Nakayama 1991: 302-205) The Japanese influence is, however, not *entirely* obsolete when investigating the translation history of the elements of air, as I will show below.

Fan Diji 范迪吉 heading an editorial group of 6 co-editors published a large encyclopaedia of modern knowledge entitled *Baike quanshu* 百科全書 at the Huiwen shushe 會文書社 in Shanghai in 1903. The encyclopaedia contains modern knowledge in both the human, the social and the natural sciences in 100 volumes, some of which are direct translations from Japanese texts, others formulated as questions and answers (*wenda* 問答) presenting scientific knowledge in popular form. Several of these 100 volumes deal with knowledge related to air and gases, in particular the volumes 7, 13, 20, 76, 85 and 88. 'Air' is unanimously translated *kongqi* in all these volumes. When these volumes represent texts on

[24] Lobscheid's dictionary from 1871 is the most prominent exception. In addition Martin/Billequin introduced the term *danqi* 淡氣 for hydrogen and used *xiaoqi* 硝氣 for nitrogen.
[25] When the two systems often were listed in parallel in order to avoid confusion.

chemistry translated from Japanese we find that the gases and elements related to air have taken the term translations from Japanese in spite of the relatively firm Chinese vocabulary by this time. Oxygen is translated as *suansu* (Jap. *sanso*) 酸素, nitrogen as *zhisu* (Jap. *sasso*) 窒素[26], and hydrogen is translated as *shuisu* (Jap. *suiso*) 水素. Gases in general are translated *wasi* 瓦斯 and not *qi* 氣 or *qiti* 氣體. (Fan Diji (ed.) 1903: vol. 7, p. 39a; vol. 76, pp. 3a-3b; vol. 77, pp. 2a-3b; Wang Lida 1958: 90) These terms date back to the early Japanese texts on chemistry and physics presenting Antoine Lavoisier's *Traité élémentaire de chimie* (Paris 1789) in Japanese in the text *Kikai kanran* 氣海觀瀾 translated/edited by Rinsō Aochi 青地林宗 and published in 1827. The semantics of these term translations have their affiliations in the German and Dutch languages. (Shimao 1972: 310-313, Tsukuhara 1993: 100-106, 154) In other volumes of the *Baike quanshu*, in particular in the question and answer texts, we find the use of the common Chinese term translations *yang*, *qing*, *dan* etc., and sometimes these two systems are used in tandem in one and the same text. (Fan Diji et.al. (eds.) 1903: vol. 13, pp. 3a-4b; vol. 20, p. 2b; vol. 76, pp. 5a-6a) Other teaching material translated from Japanese originals, such as *(Zuijin) Putong huaxue jiaokeshu* (最近)普通化學教科書 and *Zuixin huaxue jiangyi* 最新化學講義 published in Chinese in 1904 and 1905 have also applied the Japanese terminology for the elements. He Juan has found this tendency in some more of the school textbooks published between 1901 and 1920. (He Juan 2005) This tendency did not, however, last long and later texts continued the established Chinese set of technical term translations for these elements.

If we turn our attention from chemical elements and again back to our primary interest in term translations for 'air' we find a slightly different trajectory of influence between China and Japan. Benjamin Hobson's *Bowu xinbian* published in China in 1854/1855 was reprinted in Japan already in 1858. (Amelung 2004: 386) Thus we know that Hobson's term *shengqi/seiki* 生氣 for 'air' was available in Japan in 1858. William A.P. Martin's *Gewu rumen* was reprinted in Japan in 1869, (http://kindai.ndl.go.jp; see also Tan Ruqian 1981: 210) thus introducing Martin's term *tianqi/tenki* 天氣 for 'air' in Japan. Kerr and He's *Huaxue chujie* was reprinted in Japan (Tokyo and Osaka) in 1873, confirming the introduction of the term *tianqi* for 'air' in Japan. (http://kindai.ndl.go.jp) None of these terms for 'air' gained any influence or made their way into current Japanese texts or bilingual dictionaries, such as James Curtis Hepburn's (1815-1911) *A Japanese and English Dictionary* (和英語林集成) from 1867 and 1872, indicating that they did not become alternative term translations for 'air' in Japan. Nakayama Shigero 中山茂 has suggested that the term *kongqi*/*kūki* was used in the meaning of 'air' in Japan already in 1823-28, (Masini 1993: 185) most probably pointing to the *Kikai kanran* published in 1827. This information cannot be confirmed when checking the *Kikai kanran*. Elsewhere Nakayama Shigero points to the entry in *Liuhe congtan* from 1857 as the first occurrence of the term *kongqi*

[26] We do also at this time find nitrogen translated *yu* (育). (Xie Honglai & Zhong-Xi yishe (trs.) 1903)

referring to ‘air’. (Nakayama 1991, p. 304) In Japanese science texts published before the 1870s we find both *kūki* 空氣 and *taiki* 大氣 for ‘air’ and ‘atmosphere’, the latter being the most frequent of the two; In the *Kikai kanran* 氣海觀瀾 from 1827 we find only the term *fun’iki* 氛圍氣 used for air both as gas and as the atmosphere. (Aochi Rinsō 1827: 11a-11b) In the *Seimi kaisō* 舍密開宗 published in 1837-47 ‘air’ in all forms is translated *taiki*. (Udagawa Yōan 1837-47: book 2, p. 8a) In the *Kikai kanran kōgi* 氣海觀瀾廣義 from 1856 we find both *kūki* and *taiki* used for ‘air’, *kūki* indicating air as gas and *taiki* air as atmosphere. (Kōmin Kawamoto 1956: book 2, 3a, 5b, 6a) In the *Seimi binran* 舍密便覽 published in 1859 only *taiki* is used for ‘air’. (Kawano Teizo 1859: chart 6) Also in the *Kagaku kinmo* 化學訓蒙 published in 1873 we only find the term *taiki* for ‘air’. (Ishiguro Tadanori 1873: book 2, pp. 1a-3a) Hepburn’s dictionary published in Japan in the first edition in 1867 gives the following translation for *kūki*/空氣: “The atmosphere, air”. Precisely the same translation is given for the term *taiki*/大氣 (Hepburn 1867: 278, 516) From 1873 onwards *kūki* as well as *taiki* became frequently used terms for ‘air’ and ‘atmosphere’ in Japanese science texts, *kūki* mainly referring to air as gas and *taiki* to air as atmosphere, *taiki* being the most frequent of the two. (http://kindai.ndl.go.jp)

We can conclude that *kongqi*/*kūki* appears as a term used for ‘air’ in Japan already before Fryer/Xu published *Huaxue jianyuan* in 1871 but was not the most frequent technical term translation for ‘air’ and ‘atmosphere’ in Japanese science texts before the 1870s. *Taiki* was the standard Japanese technical term for all aspects and qualities of ‘air’ at this time. Chinese translators and scholars of this time made very little effort to learn from early Japanese scientific translations, whereas Japanese translators made visits to Jiangnan Arsenal to buy Chinese translated books on the sciences. (Reardon-Anderson 1991: 51) Fryer most probably coined and introduced the term *kongqi* without reference to the earlier occasional Japanese use of the term *kūki* for ‘air’. Because of the influence in Japan of books from the Jiangnan Arsenal the term *kūki* rapidly gained influence in Japan after the early 1870s alongside the established term *taiki*.

Conclusion

In this article I have endeavoured to describe the genealogy of term translations for ‘air’ and air-related terms in late Qing China. I have argued against the commonly recognized origin of the term *kongqi* 空氣 in Chinese dated to an article in *Liuhe congtan* from July/August 1857. The term *kūki*/*kongqi* appeared as a translation of ‘air’ in some texts in Japan before the 1870s but *kūki* was not the most commonly used technical term translation for ‘air’ in Japan. The standard technical term for ‘air’ and atmosphere’ in Japan before the 1870s was *taiki* 大氣. Textual evidence in this study shows that the Chinese term *kongqi* was coined by John Fryer and Xu Shou at the Jiangnan Arsenal when translating the chemical text *Huaxue jianyuan*, published in 1871. Fryer, Xu and other translators at the Jiangnan Arsenal applied the term *kongqi* for all physical and chemical aspects of ‘air’, including air as atmosphere, and these translators of the Arsenal continued this term translation throughout late Qing times. These translated

texts influenced the translation of 'air' in Japan and *kūki* soon replaced the term *taiki* for 'air' in Japan from the early 1870s. This relatively late evidence for the etymological history of *kongqi* as a technical term translation for 'air' in China opens up for the possibility that other term translations for 'air' and 'atmosphere' were current before the early 1870s.

The history of term translations for 'air' in late Qing China is far more complex than what is commonly suggested and involves several classical terms imbued with modern scientific semantics. Before *kongqi* was introduced by Fryer and Xu a number of alternative translations were in current use in translated texts, in dictionaries and in popular science journals. In 1849 and 1855 Benjamin Hobson introduced the term *shengqi* for 'air' as a life-nourishing gas and *diqi*, and occasionally also *tiankongqi*, as term translations for air of the atmosphere. The first more systematic introduction of what we may call 'air science' in China was published in 1868 with Martin's science primer *Gewu rumen*. In this book he systematically translated 'air', both as a mixed gas and as the atmosphere surrounding the globe, with the term *tianqi*. This term translation for 'air' was continued by Martin, Billequin and Chinese colleagues at the Tongwenguan also in later texts on air and gases in late Qing. John Glasgow Kerr and He Liaoran translated the same text that was the basis for Fryer and Xu Shou's *Huaxue jianyuan* and published this with the title *Huaxue chujie* in 1870. There are similarities between Kerr and Fryer's two translations in the early 1870s but when it comes to the term translation for 'air' Kerr and He continued Martin's term *tianqi*. Bilingual dictionaries from the period before 1870 confirm that only these terms, *shengqi*, *diqi* and *tianqi*, were current for the various aspects of 'air', *kongqi* was not. Joseph Edkins attempted to introduce a new term translation for 'air' with the term *fengqi* in his 1886 publication, but that term never gained further recognition.

When we compare the two main traditions, the Tongwenguan and the Jiangnan Arsenal traditions, and the two main terms for 'air' *tianqi* and *kongqi*, we find that Martin and Billequin's *tianqi* was established upon the semantics of the term taken from ancient Chinese Confucian philosophy while Fryer and Xu Shou's *kongqi* was coined as a 'modern' technical term for the scientific features of 'air'. From other studies on the influence of texts and term translations from these two institutions we know that Jiangnan Arsenal exerted greater influence on late Qing science text translations and early science education compared to that of Tongwenguan. The same is the case for these two term translations, *kongqi* gained the upper hand compared to *tianqi* in the growing volume of text translations concerned with air in late Qing. In the popularisation of science and in general dictionaries in late Qing China, however, *tianqi* was current well into the 20th century.

We are familiar with the profound effect the translation efforts of Chinese students and intellectuals in Japan after 1895 had on the Chinese lexicon in many branches of the sciences. If we investigate the

Chinese term translations for the chemical elements involved in air, such as oxygen, nitrogen, and hydrogen, we find that the Chinese tradition from the Jiangnan Arsenal endured the influence from a different set of terms from Japan that made itself evident for a short period in Chinese publications around 1903-05. Regarding the terms for ‘air’ the influence from Japan after 1895 simply reinforced the influence of the term *kongqi*, contributing to the gradual demise of the term *tianqi* from Tongwenguan. During the first decades of the 20th century *kongqi* substituted *tianqi* for ‘air’ as gas and the atmosphere in both science texts and in popular literature, and the term *tianqi* was confined to the semantics of ‘weather’ and ‘climate’.

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