

Translating Words, Building Worlds: Meteorology in Japanese, Dutch, and Chinese

The act of translation requires not only the generation of adequate language for foreign ideas, but also the situating of those ideas in a different conceptual world. This fact may go unnoticed when the translation in question is between languages of the same family, and that share material environments, practices, and intellectual legacies that constitute the cognitive bases for their conceptual schema. In such cases, a translator often relies on the fact that an adequate foreign term occupies a similar semantic field; that it is likely to evoke associations with similar practices, and to rely on a similar set of cultural assumptions. Taking for granted a shared cultural basis, we may conclude that rendering a text from one language into another marks the beginning of the process of knowledge transfer, in which information previously restricted to one language is made available to speakers of another.

Scientific translations between languages rooted in conceptually different worldviews reveal the fact that written translations are not the source, but rather the result, of an already ongoing process of learning. When a translator cannot assume the existence of similar assumptions in the target language, simply designating a new term is not enough to render foreign ideas meaningful. Instead, one must situate foreign terms in familiar practices, objects, and theories. When meanings associated with a foreign term lie completely outside of the conceptual world of the target language, the task of the translator is to articulate a conceptual world that has a place for the new meanings.

This point is difficult to make without an example. After all, if we attach meanings to statements by abstracting previous experience, we must acquire new experiences in order to

make space for new interpretations. The example I will discuss is scientific translation of texts on thermometers and barometers from Dutch to Japanese during the late eighteenth and early nineteenth century. At the time, the Dutch were the only Europeans allowed to Japan, and even they were restricted to the tiny V.O.C trading post on the artificial island of Dejima, off Nagasaki coast. The Dutch were buying Japanese copper, and in return brought goods from Southeast Asia, as well as instruments and books from Europe—oftentimes at the request of the Japanese authorities. Nevertheless, due to the minimal contact with the Dutch, the Dutch language ability among the Japanese people was rather limited, especially prior to the nineteenth century. Furthermore, the scientific worldview in Japan, at the time, differed significantly from the European one. It was in such circumstances that Japanese translators resorted to a series of strategies that allowed them to build a new conceptual world—a world in which Dutch texts, and the instruments they described, made sense.

Translating treatises on barometers and thermometers required comprehension of terms like “air pressure” and “vacuum”—terms laden with assumptions stemming from hundreds of years of debates within natural philosophy. Not that these terms were necessarily clearly understood by all European readers, but Europeans were immersed in a conceptual universe saturated with the same assumptions that had fed Torricelli’s experiments and others that followed. Consequently, even if European readers did not fully understand the practical and philosophical implications of thermometry-related terms, they had *some* associations to which to attach these terms—such as, for example, the concept of air as one of the four elements.

Translating such terms into Japanese, however, proved to be extremely difficult.

Japanese has no familiar relationship to any European language or to any other language Europeans had previously encountered. Prior to the nineteenth century there were no Dutch-to-Japanese dictionaries or grammar manuals; only a handful of people had exposure to spoken Dutch; and there were no native Dutch speakers fluent enough in Japanese to resolve linguistic difficulties. Consequently, even professional Japanese interpreters of Dutch were extremely limited in their ability to comprehend Dutch texts.¹ Yet insufficient linguistic capabilities only masked the fact that at the core of translation difficulties lay differences between Japanese and Dutch conceptual worlds. It is not that eighteenth-century Japanese people lacked the language skills necessary to resolve conceptual differences; rather, some concepts were so alien to Japanese translators that they could not even identify them. By improving their Dutch language skills, Japanese translators could learn more about Torricelli and other historical sources on barometers and thermometers. However, in order to render foreign terms into concepts meaningful to Japanese readers, translators had to first answer certain questions: What was it about the structure of a barometer that allowed it to “foresee” the weather? What was “air,” and what was it about air that made weather prediction possible? How could this “air” have pressure and how was this invisible “air” different from another foreign concept of “void,” which was similarly empty? Moreover, how could “nothingness” or “emptiness” have any effect at all? By answering these questions Japanese translators built a new world of metaphors, associations, and

¹ I provide a lengthier discussion of the difficulties facing Japanese translator in “Before Words: Reading Western Astronomical Texts in Early 19th Century Japan,” *Annals of Science*, Vol. 73 (2016), 2: 170-194.

implications— a world that had space not only for “barometers” and “thermometers,” but also for the concepts necessary to understand them.

Questions about the weather were answered in Japan following another translation project—albeit from Chinese. In the seventh century, Japan had adopted Chinese governmental structures, religions, and system of writing, as well as moral and natural philosophical canons. From that point onwards, Japan imported books written in Classical Chinese that detailed, among other things, the developing discourse surrounding meteorological phenomena. Translation from Chinese, however, had its own challenges. Although Japan adopted Chinese characters, the grammatically distinct Japanese language could not be written with characters alone, and had to be supplemented by two alphabets — *katakana* and *hiragana*. Moreover, the order of words in Japanese sentences differs from Chinese. To read Classical Chinese texts, Japanese readers had to mentally rearrange the order of the characters in the sentence, and add grammar that didn't exist in Chinese. Not everybody could do so, and the preparation of Chinese texts for Japanese readership — a translation, in a sense—was delegated to experts fluent in Classical Chinese. The experts not only marked the text to indicate *how* to rearrange Chinese sentences and what grammar to add, but also used their knowledge of Classical Chinese literature to add clarifications, in Japanese, alongside the Chinese words.

Dutch meteorological terms were therefore initially interpreted according to a natural philosophical system heavily reliant on the Chinese conceptual world. Before the arrival of thermometers, meteorological phenomena were explained in Japan in terms of *qi* (氣, *ki* in Japanese pronunciation), as well as the theory of *yin* and *yang* (陰, *in* and 陽, *yō* in Japanese). In this scheme, rain, wind, thunderstorms, etc., were all explained in terms of the movement of *qi*.

Temperature was perceived as the battle between opposing entities of heat and cold, which reflected the seasonal interplay of *yin* and *yang*. Given this perceived inherent seasonality, weather was considered to be part of calendrical science, and hence subject to pre-calculation rather than measurement. Given the fact that warmth and cold were conceived of in terms of opposing entities, it did not make sense to describe the sensation of warmth or cold in terms of numbers arranged on a scale. Even when certain practices, such as brewing, required gauging temperature, doing so was not perceived as an act of measurement, but as a tacit knowledge of the “right” state of material for a particular stage in the process. For seventeenth century Japanese philosophers, such as Yamaga Sokō, for example, natural phenomena were beyond man-made numerical scales and hence immeasurable.²

In order to make sense of foreign devices, Japanese scholars attempted to situate them within familiar conceptual landscapes. The author of the 1765 *Dutch Stories* described a thermometer as ‘a long glass pipe with water inside...this water gradually rises up on itself, from the one *yang* of the winter solstice to the summer solstice. On its gradation there are markers of the *sekki*, so this is a device to measure seasons.’³ The expression “one yang of the winter solstice” refers to a *Classic of Changes* (also known as the *I-Ching*) hexagram “return,” in which there is only one *yang* line, and which was associated with the winter solstice. The *sekki* (節氣) were the twenty-four solar seasons dividing the solar year, each equal to about fifteen days, which, according to ancient Chinese calendrical thinking, were supposedly reflective of the

² Yamaga Sokō, *Seikyō yōroku* 聖教要録, middle volume on *Yin and Yang*. See Tamura, Sennosuke. *Nihon kishōgakushi kenkyū*. 3 Mishima: Mishimakagakushikenkyūjo, 1981. p. 329.

³ Gotō Godōan, *Oranda banashi* 紅毛談, 1765. Waseda University Sogo Kotenseki Database of Old Chinese and Japanese Classics.

particular state of *qi* of any given season. The assumption that the device in question had something to do with the *sekki* was easy to make, and not only because of the correlation between seasons and warmth, but also because the vertical measurement device was visually similar to another device familiar to the mid-18th century Japanese public — the vertical clock. In Japan, time was measured in hours of variable length. The exact duration of an hour changed with the annual cycle of twenty-four *sekki*. The vertical clock—a fashionable novelty in the 1760s— had an index hand that made a daily move downward on the dial, and the dial itself was adjusted every *sekki* to reflect seasonal changes in the length of hours. Seeing a similarly vertical scale, against which an index moved up and down, and which had something to do with heat and cold, suggested that the European device operated on a similar principle. So it may not have been entirely clear how the European devices worked, but interpreting them through the lens of familiar practices, Japanese translators could conclude that such devices had a scale that was rising or falling, and that this scale had something to do with the dual entities of heat and cold. In 1768 an official interpreter from Dutch, Yoshio Kōsaku, coined a term for this instrument — “A Device for the Rising and Falling of Heat and Cold (寒熱昇降器).”⁴

An essential part of making conceptual space for a foreign instrument and the notions associated with it was attempting to relate to in on an experiential, rather than purely theoretical, level. Such experiential learning was carried out by Shiba Kōkan—a painter, who, through his interest in Western styles of depiction, developed a taste for Western sciences and technologies. Kōkan’s initial response to the thermometer was to try to interpret it within the framework of the duality of *yin* and *yang* and the movement of *qi*: “recently there is a device called *terumomeeteru*

⁴ Tamura. *Nihon kishōgakushi kenkyū*. 3. p. 611.

that arrived from the West. It is a tool that measures the state of *qi* of the heat and cold of heavens and earth.”⁵ Later, however, he began experimenting with the device, which made him reevaluate not only the notion of heat and cold, but also his own sensations. First he took a thermometer with him while traveling from Kyoto to Osaka, and discovered that although it felt hotter in Kyoto, the thermometer showed the same value. Then, he recorded measurements of water, and his impression was that “the well water is chill in summer months and warm in the winter. But water in itself does not have chill or warmth, it is just that the human body itself has the heavenly *qi* and thus feels the warmth.”⁶

Association with familiar material culture and practices, however, was only so helpful. In order to understand how the devices worked, Japanese scholars needed to engage with thermometers on a linguistic level, and grapple with concepts such as ‘air’ and ‘vacuum,’ which were foreign to the natural philosophical discourse in Japan.

Here, again, the grammatically different yet culturally related Chinese language served as a mediating agent. Jesuits, who were expelled from Japan in the early 17th century, sought to gain access to Chinese scholarly elites and worked with Chinese converts to translate European religious and metaphysical world into Chinese. Many of the texts were purportedly translations of Western scientific works, such as Euclid’s *Elements of Geometry*,⁷ or astronomical or natural philosophical treatises written in China. Working with Chinese scholars, the Jesuits had found Classical Chinese terms that occupied the closest semantic field to the Western concept, often

⁵ Shiba Kōkan. *Shunparō tenmon no sho sōkō* 春波楼天文之書草稿, date unknown, Waseda University Sogo Kotenseki Database of Old Chinese and Japanese Classics (hereafter Waseda).

⁶ Ibid.

⁷ See Peter Engelfriet. *Euclid In China: The Genesis of the First Chinese Translation of Euclid's Elements, Books I-VI (jihe Yuanben, Beijing, 1607) and Its Reception Up to 1723*. Leiden: Brill, 1998.

resorting to lengthy explanations clarifying the numerous ways in which a given Western concept differed. One such term was “air.” The Jesuits wanted to explain that air was one of the four basic elements, and sought to use the Chinese notion of the five phases to clarify the place of air in the general natural philosophical order. Yet they were appalled by the fact that Chinese “elements” included wood and metal, but not air. At the same time, they were struggling with the Chinese concept of *qi* that was completely alien to European natural philosophy yet omnipresent in China. Their solution was to equate the two concepts, insisting that *qi* was nothing but the element of air, and that *air* was nothing but *qi* of empty space.⁸

Imported from China to Japan, Jesuit texts had, therefore, already done significant work embedding foreign concepts into the existing natural philosophical discourse. Not all texts written by the Jesuits or their students were imported, and those that were imported did not necessarily discuss the properties of “air,” but the imported texts still served to mediate between Western and Japanese scientific worldviews. They introduced a variety of related concepts and practices, explaining how instruments worked and how calculations made sense in the conceptual world of Western natural philosophy. In so doing, Jesuit texts offered Japanese translators conceptual tools to grapple with scientific notions in their Dutch source texts.

The first attempt to grapple with a Dutch text on weather-related instruments, therefore, relied on previously established ties between foreign devices and local natural philosophical discourses, on experiential reports that correlated subjective sensation with measurements taken using thermometers, as well as on the mediation of Jesuit texts. The person to make this attempt

⁸ See Qiong Zhang, “Demystifying Qi: The Politics of Cultural Translation and Interpretation in the Early Jesuit Mission to China,” in Lydia Liu ed. *Tokens of Exchange*. Durham: Duke University Press, 1999, 74-106.

was Baba Sajūrō—a young interpreter trained to translate the astronomical treatises that had arrived in Japan in Dutch translations. To prepare, Sajūrō’s studied astronomy, including the Jesuit astronomical books written in China, and learned glass-blowing, drawing, and clock-making, practical skills essential to understanding how instruments worked. In the course of his studies he read a treatise on the behavior of pendulums, written by one of his teachers, the astronomer Hazama Shigetomi, who had been educated using Jesuit astronomical treatises written in Classical Chinese. In his treatise, Shigetomi attempted to extrapolate from his experiments with pendulums how to calculate the mass of the planets. Claiming that planets in the solar system behaved in a similar manner to a set of pendulums, he wrote:

When we look at the proportional relation of the heavenly *qi* (*tenki* 天氣), the closer a heavenly layer is to the fire of the sun, the lighter its *qi* is. Therefore, the planet on this layer will be light as well (there is no relation to the size [of the planet], only to its weight). The *qi* of a layer that is far from the sun is heavy, and hence a planet in this layer will be heavy too. For this reason, the rotation of a planet close to the sun, such as Mercury, is quick, whereas the rotation of planets distant from the sun, like Saturn, is slow.⁹

Sajūrō’s astronomical training provided a basis for his translation practice. In 1810 he took up the translation of the entry on barometers in Egbert Buys’ *A New and Complete Dictionary of Terms of Art*—a multi-volume encyclopedic dictionary of scientific terms. Titling his work *Explanation of the Device that Calculates the Heavenly Qi* (*Tenki* 天氣), Sajūrō extended his teacher’s understanding of the notion of *heavenly qi*.¹⁰

Sajūrō annotated his translation with much needed clarifications. The very first Dutch sentence in the entry already posed a conceptual difficulty. He translated it as “a device that

⁹ Hazama Shigetomi, *Suikyūseigi* 垂球精義. 1804. Japanese Academy of Science Archive (Gakushiin).

¹⁰ Baba Sajūrō, *Tenkikeigi yakusetsu* 天氣計儀訳説, alternatively titled ‘Explanation of Qi-Prognosticating Tube’ *Uranai kikan yakusetsu* 占気筒訳説. 1810. Gakushiin.

measures the differences in the lightness and heaviness of the air, and enables one to know those changes.” Sajūrō did not yet tackle the question of how “air” could be light or heavy; rather, he chose to situate the device in a world of familiar meteorological terms, adding a note that stated that by “changes” he meant “clear weather, rain, wind, snow, lightening, and thunder.”

In order to explain the “lightness and heaviness of air,” Sajūrō had to explain an even more loaded term—gravitation, for which he coined a new Japanese word that literally means “force of heaviness” (重力 *jūryoku*). To do so, Sajūrō relied on the Dutch “zwaartekracht,” comprised of the self-explanatory particles “zwaarte” (heaviness) and “kracht” (force). However, the term by itself did not make much sense, so Sajūrō continued his explanation of “the force that is born out of the heaviness of the air” by invoking the everyday experience of gravity (the “force of heaviness,” he wrote, was the force with which objects fall down) and by equating between “air” and “*qi*.” Thus, he proceeded, “the heaviness of air is this—when the *qi* becomes full, it has a force of falling down.”¹¹

Discussing the “heaviness of air” allowed Sajūrō to approach the question of “air pressure.” Referencing the words of his teacher, Hazama Shigetomi, he explained “air pressure” by stating that “the air wraps the earth—the closer you are to the ground the thicker it is, and the higher you go the thinner it gets. The thicker the air is, the more severely it presses on the mercury inside the tube, causing the level of the mercury in the tube to drop.”¹² Only after explaining this could Sajūrō finally return to the key question: how does the barometer reveal the correlation between the state of the air and the weather?

¹¹ Ibid.

¹² Ibid.

Sajūrō’s work is notable not for the sentences he was able to translate literally and “get right,” but for the commentary with which he annotated the text. It was with this commentary that Sajūrō articulated a conceptual world in which barometers, thermometers, “air pressure” and “void” made sense. Only then could more literal translations—such as Aochi Rinsō’s 1825 translation of Johannes Buijs’ *Schoolbook for Natural Philosophy*—be carried out.¹³ With such literal translations came further conceptual transformations in the understanding of weather and temperature. Revising *Schoolbook for Natural Philosophy* several decades later, another scholar, Kawamoto Kōmin, concluded that ‘there is no such thing as “cold”—what we call “cold” is just a very low heat,’ a claim that overturned the traditional dualism of opposing entities and promoted the idea of temperature as measurable using a graduated scale.¹⁴

By the 1820s the linguistic abilities of Japanese translators had markedly improved over the previous half century, but rather than seeing this alone as enabling the mass uptick in translation that would follow we should see it as abetting the long, arduous process of building conceptual worlds that began at a time when simply coining new words was inadequate. It is not that translators were able to overcome conceptual challenges once they mastered the language. The reverse is true—mastery of the language was made possibly by resolving many of the challenging conceptual questions associated with Western terms.

The process of articulating new conceptual worlds that enabled translation is representative of a larger phenomenon characteristic of 19th century Japanese science. “Air pressure,” “vacuum,” and “gravitation” were representative of a large number of concepts newly

¹³ Aochi Rinsō, *Kikai kairan* 気海観瀾, Preface from 1825. Waseda.

¹⁴ Kawamoto Kōmin, *Kikai kairan kōgi* 気海観瀾広義. Between 1851-1858. Waseda.

employed by Japanese scholars. Some terms—like “air” (空気 *kūki*), “geography” (地理 *chiri*), or “hygiene” (衛生 *eisei*)—were borrowed from ancient Chinese natural philosophy yet infused with new meanings.¹⁵ The term for “air” was no longer associated with Chinese metaphysics, nor with the Jesuit equation of *qi* with air. Losing previous associations, the Japanese word for “air” took on all the meanings and implications embedded in the modern notion of air as it plays in chemistry, physics, and biology. Today, despite its etymology, the combination of characters that reads “empty *qi*” occupies a similar semantic field to the English word “air.” Similarly, the term “heavenly *qi*” now simply means “weather.”

Other terms—like the word for “science” (*kagaku* 科学)—were true neologisms, formed by creating a combination of characters that did not previously exist in Japanese language. Yet the fact that the word itself was new conceals a similar process of comprehending foreign notions through the lens of familiar concepts, and making the foreign familiar by conceptually tying it to familiar practices, lived experiences, and existing conceptual schemes.

The next—albeit not final—stage in the dynamic process of building new conceptual worlds that took place in the multifaceted translations between Japanese, Chinese, and Western languages, was the exportation of new scientific terms to China. During the late nineteenth century numerous Chinese students came to Japan to study Western science. When they returned to China they brought with them Japanese translations of Western scientific and philosophical works. This time, it was the Japanese language that served as a mediator for Chinese readers and translators. Many notions essential to Chinese culture in the twentieth century—such as

¹⁵ For discussion of the evolution of the term “hygiene” in Japanese see Ruth Rogaski, *Hygienic Modernity*. Berkeley: University of California Press, 2004.

“revolution” (革命 Japanese *kakumei*, Chinese *geming*) for example—were in fact words coined in Japan to express meanings found in European philosophy. Together with neologisms, late nineteenth century Chinese imported from Japan terms that had originally been written in Chinese but had gone through conceptual transformations in Japan. These terms—particular combinations of Chinese characters—had appeared originally in ancient Chinese classics, yet they now bore new, transformed meanings. It was this new set of meanings with which the ancient terms came to be associated during the twentieth century. Today, when Chinese speakers intend to communicate the same array of meanings implied by the English word “air,” they use the term *kongqi* (traditional 空氣 ;simplified 空气), which is a *concept* imported from Japan superimposed on a *word* that had existed in Chinese for centuries.

Looking at translations between distant languages and cultures exposes the complexities of the cognitive processes that often go unnoticed when translating between languages that have grammatical and semantic commonalities. Japanese translators who attempted to translate treatises on barometers and thermometers from Dutch first had to make sense of the foreign devices in terms of familiar practices and concepts. They then had to experiment with those devices and *experience* the processes using them to take measurements; translators had to rely on mediation by culturally closer Classical Chinese texts that offered some explanations of Western concepts, themselves already mediated by Jesuits active in China; and translators had to learn Western sciences to situate foreign concepts among the metaphors and assumptions embedded in those concepts in Dutch. In so doing, translators gradually but substantively altered their own associations with weather-related practices, building a whole new world of interlinked concepts

that together expressed the added value of foreign texts. Far from marking the beginning of the process of knowledge transfer, formal translations, therefore, captured the already ongoing processes by means of which foreign concepts were integrated into the existing conceptual fabric, impregnated with linguistic and cultural associations, and made intelligible to the local reader.