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## 科学 /Kagaku / 究理 /Kyūri: Science

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What sort of intellectual apparatus was necessary to incorporate and develop science and technology from the Meiji era onward, both as a national policy and as something inherently foreign? The ideology accompanying the introduction of science and technology was one of consummate Enlightenment faith (*keimōshugi*). This trait is evident in the case of the “*Kyūri* Fever” that arose in early Meiji Japan.

In the narrowest terms, *kyūri* was the word for physics in the Dutch Studies tradition. In Japan, the study of physics or *kyūri* had always been an inquiry into the concept of “reason” (or order) conceived on the basis of the Neo-Confucian notion of the unity of reason (*ri*) and spirit (*ki*). The word *kyūri* was used in Dutch Studies as the translated term for Dutch words related to the study of nature (*natuurkunde*) or natural philosophy. Incidentally, in Dutch Studies the word for chemistry was *seimi* (舍密)—a transliteration of the Dutch *chemie*—and the biological disciplines became the “natural sciences” (博物学; *hakubutsugaku*), replacing the traditional pharmacology (本草学; *honzōgaku*). Along these disciplinary lines, *kyūri* was the general term for the study of nature, and loosely corresponds to our contemporary concept of “science” (科学; *kagaku*).

The word that came to be used for “science” in the early Meiji period—*kagaku* (科学)—is actually short for *bunka no gaku* (分科の学), or “taxonomical studies.”

Both the “ka” (科) of *kagaku* and the “ri” (理) of *rigaku* originally come from Taoist concepts, and are thought to have referred to ceremonial lattices and wooden frames. “Ri” and “ka” subsequently came to mean to separate and categorize things, to arrange and classify things—basically thinking about things in terms of taxonomies of differences and similarities. The use of these words to describe the sciences is intimately related to the specialization of the sciences in Europe.

A large-scale campaign to promote the sciences had to be pursued before the word *kagaku* could find currency in Japan. This happened in the form of a series of publications on *kyūri* begun in 1872. Masses of “Scientific Enlightenment” books were published in order to spread scientific education. The person behind this campaign was none other than Fukuzawa Yukichi. All of his allies at Keiō University worked hard to make the campaign effective.

Fukuzawa’s brainchild was a huge success. The campaign set off a boom for *kyūri* tracts. This boom went down in history as the *Kyūri* Fever (*kyūrinetsu*). It spread like a contagion, as the name suggests. It is ironic to think that science, which should be dispassionate, objective, and universal, would spread like a fever. That it would become a “fad” infecting the masses, seems a social phenomenon in complete opposition to the certainty and solidity presumed to be characteristic of scientific knowledge. Focusing on this phenomenon, I would like to take a look at the characteristics of the Japanese Enlightenment that developed at this time.

*Kyūri* Fever was spread by books known as *kyūri* tracts (*kyūrisho*), which were published with the aim of promoting European scientific ideas. Examples of these tracts include Fukuzawa Yukichi’s *Illustrated Kyūri* (*Kyūri zukai*; 1872), Nagasawa

Katsuhisa's *New Kyūri* (*Kyūri shinpen*; 1872), and Mochizuki Makoto's *Elementary Kyūri Explained* (*Kunmō kyūri benkai*; 1872). These all became classic science primers. Basic science primers from America, England, and France were also prolifically translated. With the promulgation of the new Meiji education system in 1872, Fukuzawa's translation and publication efforts led to a series of textbooks of similar levels and styles to those adopted as school texts. Fukuzawa's famous *An Encouragement of Learning* was serialized during the years 1872-76, and his *Outline of a Theory of Civilization* was published in 1875.

Yet it is important to note that the Fukuzawa group's *kyūri* tracts are not found in the line-up of textbooks adopted under the new school system. The textbooks approved by the Ministry of Education were almost all translations of American and British materials—for example, *Elementary Chemistry* (*Shōgaku kagakusho*) and *Elementary Physics* (*Shōgaku buturisho*), which were adapted from the British *Science Primer* series—or of French works on physics. One can see here the complicated relationship between officials at the Department of Education and Fukuzawa, whose Keiō group was outside government circles.

It is not difficult to imagine that the formal and systematic character of Anglo-American scientific publications and French school textbooks, together with the fancy packaging and the stylish appeal of what was, after all, a type of imported luxury item, were well suited to the tastes of proponents of the new authoritarian national education. At the same time, the *kyūri* books may well have seemed suspect to education authorities since they were woodblock-printed and thread-bound in Japanese style and thus similar looking to popular reading material of the Edo period like the yellow-covered comic

books called *kibyōshi*. And prior to these possible aesthetic reservations, there was the twisted structure of relations between the powerful persona of Fukuzawa and his private academy, Keiō gijuku. The fact that the intellectual products of Fukuzawa and his fellow popular campaigners could not flow directly into public education was probably the main reason that the so-called *kyūri* books ultimately lost out to *kagaku* primers.

The term used was not actually *kagaku* either. The field of study as a whole became known from this time as *rika*. This is deeply related to the fact that *rika* was chosen as the course name for natural science education in the primary school curriculum. *Kyūri* did not become a curricular term. The designation that the Ministry of Education under the Meiji government established in the schools was “*rika*.” For a period of time, one finds use of the terms *hakubutsu* and *kyūri* in parts of some of the regional curricula, but science education in Japan came to be understood fundamentally as *rika* education. The framework of *kokugo* (national language), *sansū* (arithmetic), *rika* (science) and *shakai* (social studies) became essentially fixed from the Meiji period. Even today, curricular language broadly expresses the divide between the “two cultures” that C.P. Snow lamented, with subjects in science and technology, engineering, medicine, and agriculture grouped as the *rika* track (“*rikakei*” or “*rikei*”), while social sciences, humanities, and art are grouped as arts and letters (文科系、“*bunkakei*” or 文系、“*bunkei*”; sometimes written as 文化系 *bunkakei*, meaning “culture curriculum,” which include art clubs and other extracurricular activities).

*Rika* must have sounded fresher at the time than *kyūri*, which retained echoes of the older Confucian conception of *kakubutsu kyūri*, the “investigation of things.” Fukuzawa’s *kyūri* science also frequently designated a field of study equivalent to

*hakubutsu* (nature studies) and *seimi* (chemistry), and thus meant something like physics, not the natural sciences in general. *Butsuri*, the translation term for physics, was, incidentally, a term derived from the Confucian *kakubutsu kyūri*.

The suffix *ka* (科) generally expresses a coherent whole made of like things, and it is used particularly for classification of groups or species. To take a familiar example, medical practice is divided into *naika* (internal medicine), *geka* (surgery), *shōnika* (pediatrics), *ganka* (ophthalmology), and so forth. Classifying the conceptual pair represented by *bunri* (文理) into two distinct fields, *bunka* and *rika*, facilitated setting them in opposition to one another. And the respective terms based on this dichotomy, *bungaku* and *rigaku*, agree readily with everyday language and thus have a more familiar sound in Japanese than the abstract *kagaku*. Of the two contemporary terms that form a triad with “natural science” (*shizen kagaku*)—“human science” (*jinbun kagaku*) and “social science” (*shakai kagaku*)—the latter in particular draws with it the baggage of the Marxist concept of scientific socialism. The question of what Fukuzawa’s *kyūri* campaign left us is one we must return to, but what got systematized and preserved in the area of public science education was *rika*.

The thing to note is that parallel to the Ministry of Education’s efforts in elementary school *rika* instruction, these non-state science campaigns spread throughout the country. They had several conspicuous historical characteristics. The *kyūri* tracts of Fukuzawa’s campaign sold extraordinarily well, although they lacked the systematic organization for pedagogical purposes evident in the textbook translations from English and French. Their popular language and journalistic style merits consideration on its own

terms. What can we tell about the promotion of science and technology in Japan from looking at these *kyūri* tracts?

First and foremost, these books posit that *kyūri* (which we might here call physics) is the most vital and influential factor in making the world work. But we need to give particular attention to the Fukuzawa group's ideas of physics. They do not necessarily suggest that the laws of nature or the scientific method that allows one to comprehend the laws of nature are important in and of themselves. Of course, these books attempt to explain various natural phenomena, but this is largely as a means of understanding and dealing with catastrophic natural events. Among the natural phenomena they introduce, for example, particular attention is devoted to explaining comets and thunder, both of which had traditionally been feared as the work of the gods in Japan, stressing that these "convulsions of nature" were not to be feared. The traditional Japanese understanding of nature is treated as superstitious and unenlightened, and the books emphasize the importance of understanding natural phenomena as manifestations of physics. It should be noted that these tracts were written shortly after the change of regime brought by the Meiji Restoration. Dealing with natural disasters also meant dealing with social disasters. These books imply that one could understand and ultimately control disasters through *kyūri* rather than harboring unenlightened and ignorant fear of them.

Among the canonized *kyūri* tomes is the aptly titled *Convulsions of Nature* (Obata Atsujirō, 1872; first printing 1868). In it, the "old Japanese understanding" is juxtaposed with "the European understanding." For example, the image of lightning as a god on a rampage is condemned as a superstition, and the lightning rods atop churches and

Benjamin Franklin's kite are given as examples of how, with the new knowledge of physics (*kyūri*), one no longer had to fear lightning. There are also illustrated explanations of astronomical phenomena such as solar and lunar eclipses, as well as comets. Shortly after the publication of *Convulsions of Nature*, a supplemental volume was published in Osaka entitled *On Convulsions; or Reconsidering Convulsions of Nature* (Toriyama Kei of Kishū Wakayama), which discusses tornadoes, whirlwinds, and mirages. The fact that this volume was written by a man from Wakayama and published in Osaka attests to the widespread geographical influence of *kyūri*.

The actual explanations in these *kyūri* tracts are extremely simplistic, even as a treatments of elementary physics. And while this simplicity is due in part to the fact that they were written for the sole purpose of spreading scientific knowledge to novices, the fact that almost all of the examples come from ordinary daily experience also directly expressed Fukuzawa's vision of *kyūri*. For example, the explanation of the existence of air and vacuums includes diagrams of an inverted teacup stuck to the palm of a hand, a discussion of mercury, and a description of the workings of a well pump. The point was to appeal to experiential and visual learning, and to emphasize utility, such as how a pump can actually be used in real life. In other words, physics is presented as just an amplified version of the mundane, obvious from experience as well as intuition—knowledge that is basically a handy extension of common sense.

I'd like to take a moment to refer to one of the classics of science and technology studies, Shapin and Schaffer's *Leviathan and the Air Pump*. A leviathan, aside from being the titular creature of Hobbes' 1651 classic, is an evil creature that lives underwater. The premise of Hobbes' book is that self-preservation is a natural right, but



that this leads to infighting among people and to “the war of all against all,” which works contrary to self-preservation. In order to avoid this, people must create a social contract in accordance with natural law and form a national body that is given absolute power: a leviathan. In reading Hobbes’ classic, Shapin and Schaffer undertake a careful analysis of British political history within the context of British scientific history. They analyze how Baconian scientific discourse was used, as in the air pump’s production of knowledge as a confession extracted through the “torture of nature.” They show how the natural sciences were constructed as an ideology in mutual reference with social theories of the time. This sort of tandem ideology can be found in Fukuzawa as well. Scientific discourse was developed as a discourse in response to early Meiji political and social crises. Thus, in Japan too one can point to the strong mutual reference between scientific and social discourse. But scientific knowledge, in Japan’s case, was not something exhaustively, forcefully intervening in nature—it did not “torture” a “confession” out of nature with an air pump that created a state that does not exist in nature. Fukuzawa’s Enlightenment hasn’t a trace of the concept of elucidating natural laws by artificially intervening in nature or forcing it to speak. The laws of nature appear as common sense, simplified and on a larger scale—and most of all, as something useful.

The “ignorance” that the *kyūri* tracts programatically condemn is the tendency of Japanese to pursue an understanding of nature through Buddhist and Taoist mysticism, and their larger project over the long term can be seen as the debunking of any school of thought that analyzed nature from a transcendental perspective and the championing of realist utilitarianism. A great deal of the superstitious and unenlightened thought that is attacked in these *kyūri* works is rooted in Buddhist or Indian philosophy. This could be

seen as Fukuzawa's attempt to take the last bit of intellectual clout from the Buddhist worldview, which had been formalized during the Edo era as so-called "funeral Buddhism" and granted political authority through the shogunate's policies toward shrines and temples and the national hierarchy of parishes. It can also be seen as Fukuzawa beating a dead horse, as Buddhism had already been dealt a fatal blow by the Meiji policy of abolishing Buddhism and destroying Buddhist icons (*haibutsu kishaku*) and had been intellectually bankrupted by ill-advised disputes with Dutch Studies. In contrast to Buddhism, Confucianism was able to preserve its intellectual currency by pursuing the tenuous position of playing a supplemental role, in a sense, to Dutch Studies and the sciences being imported from Europe. By smoothly latching on to the Confucian mentality of "A wise man relies not on supernatural forces" (*kairyoku ranshin o tanomanai* 怪力乱神を恃まない), the *kyūri* campaign was also carried out as a program of realism and scientific utility. Fukuzawa is thought of as someone who rebelled against the authority of tradition, but he was also sensitive to opportunity, and cleverly chose the times and places to rebel. Rather than blindly despising everything Confucian, he opted for the more refined battle tactic of doing what he could with the materials available to him for his social campaign to advance the status of Western sciences—a status that he himself had established for them. In either case, Western knowledge was completely and meticulously stripped, with Fukuzawa-esque ferocity and speed, of any hint of mythological, mystical, and transcendental interpretation. Alternately fighting the authority of the Church and dependent upon it, European science had formed a finely woven, even sacred, fabric that fused within it ontological mysticism and teleological profundity. Taking this fabric, without regard for its subtleties, as mere cloth, the

publishing strategy of Fukuzawa and his group interpreted science as a practical extension of common sense, to be spread about in a popular campaign.

The chief characteristic of these *kyūri* tracts is that all of the natural phenomena explained through *kyūri* concepts are immediately linked to “utility” and usefulness. For example, Nagasawa’s *New Kyūri* ties natural phenomena to mechanical power, to steam-powered boats and trains. The *Articles on Kyūri Discoveries and Progress* (*Kyūri nisshin hatsumei kiji*; Osaka, Azumai Ketsuzen), predictably begun in 1872, resulted in at least five volumes, which we may assume were widely distributed; and the books in this series, as we can infer from the title, contain illustrated explanations of European and American discoveries and inventions, directly linking each to the concept of *kyūri*. They suggest, though not in so many words, that *kyūri* is the form of knowledge that leads to these discoveries.

In contemporary terms, all of these books would be considered exemplary works of “popular science.” Indeed, all of the Fukuzawa-influenced journalistic introductions to Western texts since *Conditions in the West* (*Seiyō jijō*; 1866) were part of the campaign to spark public interest in the sciences. *An Encouragement of Learning* and *Outline of a Theory of Civilization* are often acclaimed as active agents of modernization—as establishing conceptions of human rights or liberalism in Japan, as a blow to the old authorities and a rejection of the feudal system—but these books are more than works of theory. It is important to recognize the role of these books as part of the strain of Fukuzawa’s Enlightenment propaganda that ran easily through the whole era, together with the popular science awareness campaign under the rubric of *kyūri* and the movement to speed up the introduction of foreign technologies. In this way, they are in complete

continuity with the unabashed envy of Great Britain for its defeat of China and its condescending attitude toward all of Asia found in Fukuzawa's "The Joys of Oppressive Government" (*Assei mo mata yukai naru ya*; 1882), as well as this text's shameless promotion of Japanese aggression in Asia. We must pay attention to how these campaigns, informed by Fukuzawa's Enlightenment faith, were easily transformed into campaigns for social Darwinism, and in a broader sense were fundamental in establishing the philosophical and technological infrastructure for the latter-day growth of Japanese imperialism.

This Japanese variety of Enlightenment remains a powerful and active cultural device to this very day. This is obviously a very different Enlightenment from the original one that established itself as the greatest potential opponent to the dominant Christian paradigm in Europe. If one focuses on the moment of *Kyūri* Fever, the hypothetical enemy for science in Japan appears as mysticism and abstract philosophies of nature. It was no secret that Fukuzawa—who was often dismissed as too frivolous by his contemporaries—harbored a great loathing for the heavy, metaphysical pedantry of the old regime.

As noted above, the Enlightenment of Fukuzawa and his colleagues was strongly colored by a utilitarian understanding of science and technology. The "scientific understanding" advanced by *kyūri* tracts likewise meant a larger-scale version of common sense, an extension of a radically simplified worldview. They chose to believe that there was no particular need in Meiji Japan to press for a Copernican inversion of common sense that used knowledge to move an immovable earth.

In this way, the deep-seated belief in Western superiority that lay at the heart of the Japanese Enlightenment caused a great deal of value to be placed on a version of “modernization” that was essentially a process of catching up with Western societies. The darkness of ignorance that had to be enlightened in Japan was basically Japan itself—or “Asian backwardness.” Although it is an unappealing concept often used in objectionable contexts and manners today, the phrase “Masochistic Historiography” (*jigyakyu shikan*) does capture a major characteristic of the Japanese Enlightenment.

Marxists and socialists adopted Japanese Enlightenment thinking with the greatest vigor. Even now, the groups who speak the most openly for promoting scientific enlightenment are Marxists or self-professed leftists, together with other groups working for the advancement of scientific education—groups that now stand on the side of cultural conservatism.

And yet in all, Enlightenment faith has permeated deeply and broadly in Japan as a whole. For example, whenever talk of new policies for promoting science and technology or new theories of science education are in the air, the linear Enlightenment views of science that one invariably hears unquestionably continue in the tracks first laid by Fukuzawa. Even now, Fukuzawa’s face still graces the bill that represents Japan’s currency in the world. The seeds he planted have grown tall, but the fruit of these plants of Enlightenment, in the form of the “yen,” seems to have grown out of control, thus persisting in the present as a large question when considering science and technology in Japanese society.