
Views from England

Technological Conditions of Meiji Japan in The Engineer

Reprint of translation of “Eikoku karano Shisen: Enjinia shi ni miru Meiji Nihon no Gijutsu Jijō,” in Jun Suzuki, ed., *Kōbushō to Sono Jidai* (Tokyo: Yamakawa Shuppansha, 2002): 83–94.

After the Meiji Restoration in 1868, the Japanese government attempted to introduce methodically and massively the technology of Western civilization. The Meiji government invited, in particular, numerous British engineers for the construction and operation of modern factories and railroads as well as for the instruction of young Japanese engineering students at its Imperial College of Engineering. This attempt prompts the following questions for discussion: How was Japan’s introduction of Western technologies viewed by Western engineers? And how were these educational activities for Japanese engineering students viewed by engineers of their own country?

The present chapter would look at such Western visions of Meiji modernization through the pages of an English engineering journal, *The Engineer*. Following articles on events taking place in Japan, I would attempt to see how they viewed Japanese engineering activities. *The Engineer* was a weekly journal established in 1856 addressed to industrial engineers rather than academic scholars. With numerous technical illustrations, it informed its readers about state-of-art of engineering and social conditions surrounding engineering activities, addressing craftsmen, engineers, and industrialists in various industries. The content was not limited to engineering activities in Britain and Western countries, but also covered those in India, China, and other Asian countries, including Japan. News of events in these countries, most probably, interested those British engineers who may have had a chance to get work there. In contrast to the visions of invited engineers employed by the Japanese government, these visions and

opinions expressed in the pages of *The Engineer* reflect the more realistic view of those residing in Britain.

1. Curiosity about Traditional Craftwork

Articles on Japan at the end of its Tokugawa period were mostly concerned with the introduction of the Japanese country and its exoticism, with curiosity towards the unknown, mysterious country. The 1863 article on “Japanese” opened with the statement that “They are bold, courageous, proud, and eager after every kind of knowledge”, and went on to admire the Japanese deftness of a small copper-made working-model of a steamer based only on a Dutch textbook on naval engineering.¹ It also narrated the story of a craftsman who copied precisely a lock made by the famous English lock maker, Bramer, and another man who wove a shirt exactly the same as one given to him. These and other episodes provided readers the impression that the Japanese were deft and skilled at copying.

The article also paid attention to natural resources in Japan, especially its woods and coal, their qualities and potential quantity. It referred to the good quality of coal produced in the Iwanai region of Hokkaido, and mentioned the abundant wood resources found in this unexploited northern island of Japan. On mining methods, it referred to the present method as primitive and “unscientific,” entirely relying on manual labor, but expected the Meiji government to soon realize the effectiveness of the “scientific” method by relying on various machines.²

On ceramics, one of the traditional craft products well-known to Westerners, the article provided an admiring but slightly inaccurate account. Craftsmen in Seto, it reported, had been manufacturing porcelain products with their methods unaltered for over a thousand years, and the kaolin and clay used for their production was of good quality and abundant. The observation of this manufacturing process

1. *The Engineer*, 20 November 1863, vol. 16, p. 299.

2. *The Engineer*, 16 March 1866, vol. 21, p. 203; 20 September 1867, vol. 24, p. 250.

led the reporter to recall an ancient Egyptian illustration of a similar process of making ceramics and the Hebrew proverb “as clay in the hands of ceramic craftsmen.”³

2. *A Proposal for the Nakasendo Railroad Line*

The construction of the railroads in Japan was major news in *The Engineer* after the establishment of the Meiji government. *Kōbushō*, or the Ministry of Public Works, was established on the advice of Edmund Morel who had been invited by the Meiji government to supervise the construction of the railroads in Japan. The primary function of the proposed ministry was to construct a modern infrastructure, largely relying on British engineers and craftsmen, of which the most important and expensive project was the construction of the railroad. A report in 1870 compared the conditions of transportation in China and Japan. Whereas networks of canals and rivers were well developed in China, there was no such well-developed water transportation system in Japan. It took one month to reach a distant place by walking on unpaved routes and two weeks to commute between Tokyo and Kyoto using the most popular and important route.⁴ Here was a country which needed a railroad, it concluded.

The route from Tokyo to Kyoto first suggested by a British engineer was a line along the Nakasendo route. (Fig. 4.1) The Nakasendo was one of the five major roads connecting major cities in Edo Japan. The Tokaido as well as the Nakasendo connected Tokyo and Kyoto. While the Tokaido went along the Pacific Ocean, the Nakasendo went across the middle of Honshu island. Modern Japanese readers would wonder why the Nakasendo going across mountainous areas, rather than the Tokaido, was conceived by British railroad experts as the first candidate for the route. R. Vickers Boyle who was engaged in the design and construction of the Japanese railroad explained in his article in *The Engineer* that this choice was mainly due to consider-

3. *The Engineer*, 22 September 1876, vol. 42, p. 216.

4. *The Engineer*, 27 August 1870, vol. 29, p. 397.

ation of the development of domestic industries inside the Japanese island and the transporting communication between the well-opened cities on the Pacific side and ports of the Japanese Sea. As he stated:

The main trunk line from Tokio to Kioto would pass through the silk districts of the S[outh] part of Kodzuke and the N[orth] portions of Shinano. The line to Niigata would traverse the rice districts of Yechigo, and therefore, with increased facilities of transport, the production and export of those articles and of tea might be expected to increase from many parts of the interior. As main arteries through the heart of Japan, to and from which numerous feeders and branches by improved roads would bring the outlying districts within easy communication of the chief seaports, these lines, if gradually constructed, could not fail to aid in developing the agricultural and mineral wealth of the country, to benefit trade generally, and to advance alike the convenience and interests of the Government and of the people.⁵

British readers of *The Engineer*, having seen the map with the planned Nakasendo rail route without contour lines to designate geographical altitudes on the area where it was crossing, would have taken Boyle's planning of the route and his explanation as natural and reasonable. They would have thought that the southern route along the Pacific Ocean was entirely unattractive from the viewpoint of transportation of inland goods and produce. Takasaki, on the route about a hundred kilometres north of Tokyo, was a regional center of transportation, connecting the routes of Nakasendo and Joetsudo, crossing a mountain and leading to Niigata, as well as being located near Maebashi and Kiryu, the areas that produced silk. The route would be able to carry products like rice, tea, and silk from inland farmlands to ports on the coasts of the Pacific or possibly the Japanese Sea in the future. After all, the plan to construct the Nakasendo line was given up and was only realized long after the publication of

5. *The Engineer*, 25 May 1877, vol. 43, pp. 362–363, on p. 363. The career of Boyle is briefly explained in Naomasa Yamada, *Oyatoi Gaikokujin (Employed Foreigners)*, vol. 4 “Kōtsū (Transportation)” (Tokyo: Kashima Shuppankai, 1968), pp. 172–174.

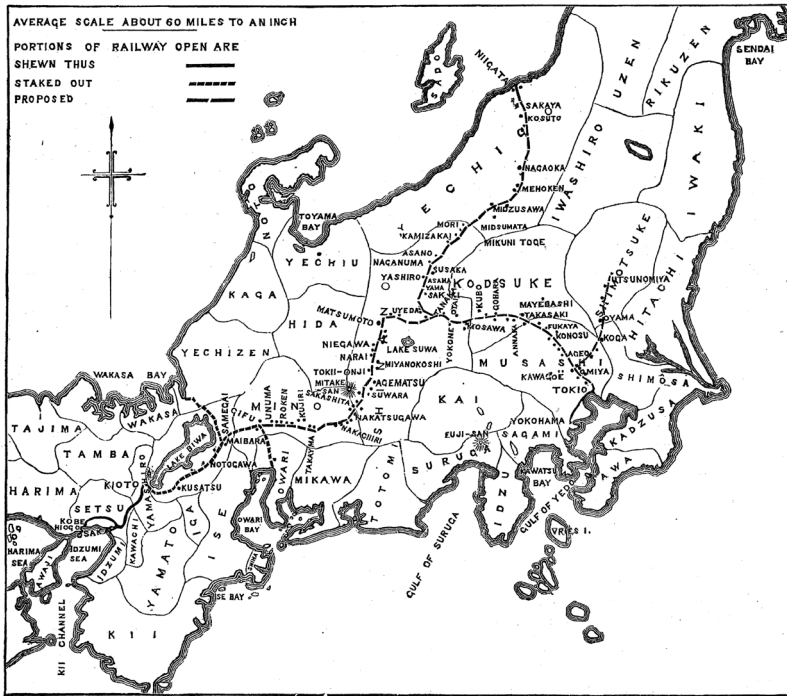


Figure 4.1

The map of central Japan and planned railroad lines. Nakasendo, Echigo, and other railroad lines were shown and explained in Boyle's article in *The Engineer*. (From *The Engineer*, 25 May 1877, vol. 43, p. 362)

Boyle's report.⁶ The publication of his long explanatory report with a large map of the planned route of the Nakasendo Line would, however, indicate that readers of *The Engineer* may have had a good interest

6. For the plan and halt of the Nakasendo railroad line, see Nihon Kokuyū Tetsudō (Japanese National Railways), ed., *Nihon Kokuyū Tetsudō Hyakunenshi (The Centennial History of Japanese National Railways)* (Tokyo: Japanese National Railways, 1969), pp. 45–55. The details of the plan for the Nakasendo Line is discussed in Naofumi Nakamura, *Nihon Tetsudōgyō no Keisei, 1869–1894 (The Formation of Japanese Railroad Industry, 1869–1894)* (Tokyo: Nihon Keizai Hyoronsha, 1998), pp. 92–103; the plan and completion of the construction of the railroad across the Usui Pass, the geographical bottleneck of this route, are described in Katsumasa Harada, *Nihon Tetsudōshi: Gijutsu to Ningen (A History of Railroads in Japan: Technologies and People)* (Tokyo: Tōsui Shobō, 2001), pp. 48–81.

and some excitement in the national initiation of large engineering activities in a Far Eastern country.

3. The Evaluation of the Japanese Engineering Education

The 1880 issue of *The Engineer* reviewed two books authored by engineers residing in Japan: Henry Dyer's *The Education of Engineers* and Curt Adolphe Netto's book on Japanese mining.⁷ Dyer was a Scottish engineer who was invited as principal of the Imperial College of Engineering, established in 1872. In the book, he explained his pedagogical design for the college as a synthesis of the Continental theory-oriented and the English practice-oriented engineering education. The editor of *The Engineer* who reviewed the book, however, pointed out that Dyer certainly would not know about the conditions of engineering education in France. *École Centrale des Arts and Manufactures* in Paris, where Kōi Furuichi (Kauy Fourouitsi in his own French-style spelling) had studied civil engineering, did place emphasis on learning engineering in practice. Besides such reservations, the reviewer agreed with Dyer that the training of engineering judgment was important, and that a new type of engineering education was being attempted in Japan.⁸

Before reviewing the Netto book, its reviewer first gave his own view that the cultural growth of the country depended on the accumulation of wealth, inferring from Netto's description of Japanese mining a limitation of natural resources in Japan. He then turned to the fact that many foreign teachers were forced to return to their own country without any reason, and speculated:

Perhaps the true cause may be sought in the suggestion that neither

7. *The Engineer*, 20 August 1880, vol. 50, p. 143.

8. The pedagogical vision of Henry Dyer on engineering education is discussed in Nobuhiro Miyoshi, *Meiji no Enjinia Kyōiku: Nihon to Igrisu no Chigai (Engineering Education in Meiji Japan: The Difference between Japan and Britain)* (Tokyo: Chuo Koronsha, 1983); and idem, *Daiā no Nippon (Japan [Viewed] by Dyer)* (Tokyo: Fukumura Shuppan, 1989).

the wealth nor other environments of Japan as yet fit it for University education, and that the experiment promoted largely by external interests may not improbably in the end collapse.⁹

The review is more the personal expression of a cool and pessimistic view on the endeavor of Japanese modernization than an objective review of a book describing its process.

Robert H. Smith, once an instructor of engineering at the Science School of Tokyo University, sent a letter to the editor of the journal criticizing this review.¹⁰ He first complained that the review neither introduced Netto, the author, nor the content of his book itself. He stated that he had returned to England because he had hoped to do so, and conjectured that that would also apply to other cases as well. He further added that the engineering education in Japan was promoted by the consistent planning and effort of politician Takayoshi Kido and the educator, Arinori Mori, and that the quality of students was high; the concern about the failure of this national experiment as expressed by this reviewer was therefore unnecessary, Smith stated. Neither the reviewer nor Smith referred to the financial burden of the Meiji government to keep hiring these foreign teachers.

4. *The Adaptation to Competition and Markets*

For several years after the review, there were no articles concerning Japan in *The Engineer*. In 1887, it carried a report on the Industrial Exhibition held in Ueno, Tokyo, in which the anonymous author pointed out that Britain was competing with other European and American countries over the Japanese market.¹¹ Until then, he point-

9. *The Engineer*, 20 August 1880, vol. 50, p. 143.

10. *The Engineer*, 27 August 1880, vol. 50, p. 164. Before the merger with the Imperial College of Engineering, Tokyo University had a department of engineering in the School of Science, where Smith taught mechanics, thermodynamics, and mechanics of materials. See Tokyo Daigaku Hyakunenshi Henshū linkai, ed., *Tokyo Daigaku Hyakunenshi (The Centennial History of the University of Tokyo)*, *Bukyokushi*, vol. 2 (Tokyo: University of Tokyo Press, 1987), p. 232.

11. *The Engineer*, 7 June 1887, vol. 63, pp. 443–44.

ed out, Japan had been a market dominated by Britain, but it no longer was. British exporters had to compete with Japanese domestic manufacturers, and he advised that British manufacturers like those in Sheffield should take into account the conditions in Japan and make commodities adaptable to the Japanese social and economic conditions. As an example, the editor remarked that Japanese carpenters drew lines on floors and cut wood by pulling rather than pushing a saw on it. The shape of the teeth of Japanese saws all conformed to this carpentry custom, which British tool makers should be aware of if they attempted to export their saws to Japan. To be competitive in the Japanese market, British manufacturers thus had to make goods which were not only of good quality but also adaptable to the customs of Japanese users. Taking another example, the editor also mentioned the steam locomotives for railroads. Since Japan had adopted the metric system, he pointed out that it tended to purchase locomotives from the United States or from Germany.¹² The editorial report reflected the view of British industrialists who competed in the Far Eastern market, with the United States having a geographical advantage and with Germany producing cheaper products.

5. Increasing Interest after the Sino-Japanese War

After Japan won over its war against China, Britain came to have a closer relationship with Japan, and the editors of *The Engineer* planned to report in detail on industrial and technological conditions in Japan. To do so, they sent a special reporter to Japan and asked him to contribute a series of reports on the present Japanese situation. The current information from the reporter stationed in Japan was considered profitable for readers of the journal.

Though the reports were not signed by their author, the contracted journalist for these Japanese reports was Stafford Ransome, who had

12. *The Engineer*, 21 August 1891, vol. 72, p. 161. On the production of steam locomotives in Britain and the United States and the comparison of their exports to Japan, see Steven J. Ericson, "Importing Locomotives in Meiji Japan: International Business and Technology Transfer in the Railroad Industry," *Osiris*, 13(1998): 129–153.

experience in and knowledge of engineering and business.¹³ The mission assigned by the editor, according to the reporter, was the investigation of the following three points: first, the present technological conditions of Japan; second, the Japanese market for British engineering products; and third, the possibility for British engineers to advance in Japan. These three investigative tasks assigned to the reporter were a frank expression of interest from the side of British engineers, manufacturers, and industrialists in Japan as a potential market for their products and engineering knowledge and skills. Having announced this planned series, the editor called it to readers' attention, informing them that the first several reports would be on the latter two topics.

Ransome's reports were published from 1896 to 1898 as a series of twenty articles titled "Modern Japan, Industrial and Scientific." They were intended to inform British engineers about the present engineering and industrial conditions and activities in Japan, covering such topics as railroads, ship construction, electricity, patents, engineering education, and business. He narrated the newest information and future prospects of Japan, citing in some cases reports of other experts in the relevant areas and recounting in others his own experiences. The Japan portrayed by Ransome through his twenty reports was a country acquiring growing competitiveness in technology and offering business chances to foreign engineers and businessmen.

6. *Technical Capacity through Dead-copying*

In his first report, Ransome referred to the issue of making copies of foreign-made products without permission. Some British companies were reluctant to export to Japan because of this copying custom of Japan. Soon after they exported products to Japan, they were copied and sold as cheaply as half of the original price. The steam

13. The reports were later compiled and published as Stafford Ransome, *Japan in Transition: A Comparative Study of the Progress, Policy, and Methods of the Japanese since Their War with China* (London: Harper, 1899). It was cited in Henry Dyer, *Dai Nippon, the Britain of the East: A Study of a National Evolution* (London: Blackie, 1904).

locomotives would also be sooner or later copied and manufactured in Japan. He considered it to be inevitable.¹⁴

Before Ransome's report on this issue, *The Engineer* had an article of caution on this problem of the production of dead-copied products.¹⁵ Its author expected that the amount of British exports to Japan, China, and Russia would increase, but pointed out that their export to Japan posed a problem. For when machines with foreign patents were brought to Japan, they disassembled the machines, immediately initiated copying and making their duplicate models, and sold them at half the price. British industrialists had to be cautious about providing information to them. The Japanese were skilled at mechanical techniques, and, he continued, they were good at duplication, though not good at invention and innovation. It was expected that the demand for spinning machines would increase, and therefore the editor warned that engineers in Lancashire should be careful and do nothing more than helping the Japanese.

As for patenting in Japan, a newly established patent law was expected to protect patents, trademarks, designs.¹⁶ The patent law would become effective in 1899, when Japan joined the Paris Convention of International Agreement of Industrial Property Rights and began to follow the international rule on this matter.¹⁷

7. *Strict Testing*

Ransome picked up the issue of strict testing at the government office responsible for the inspection of imported materials.¹⁸ He even called the level of strict testing "hypercritical" and considered it to be working as one of the trade barriers for exports to Japan. For import-

14. *The Engineer*, 27 November 1896, vol. 82, p. 533.

15. *The Engineer*, 17 August 1894, vol. 78, p. 150.

16. *The Engineer*, 21 December 1894, vol. 78, p. 554.

17. On the history of the Japanese patent system, see Japan Patent Bureau, ed., *Kōgyō Shōyūken Seido Hyakunenshi (One Hundred Year History of Industrial Property Rights)* (Tokyo: Hatsumei Kyokai, 1984–85).

18. *The Engineer*, 11 December 1896, vol. 82, p. 581.

ing goods to be used by the government, in particular, Japanese tended to prefer French products to British, since French goods were more meticulously made and strictly tested.¹⁹ To ameliorate the situation, he suggested that Britain should invite Japanese students to British schools and factories, since those students who learned in British institutions would introduce British technical methods and manufacturing processes after their return to Japan.

One of the reasons behind such strict testing for imported materials, Ransome conjectured, would be the existence of a defect in engineering training and education. Although young Japanese engineers were receiving an excellent education, it emphasized theory or theoretical learning. And almost all engineers working on site were young engineers who had graduated from school. They lacked the practical skills and knowledge acquired through long-time experience. The accurate and swift testing of technological products was only possible through such engineering experience. As a consequence, he argued, Japanese officials blocked the import of products with enough quality, although the lack of testing capability usually would lead to importing sub-quality products.

8. Theory-biased Education

Ransome provided a detailed explanation of engineering education in Japan in his thirteenth and fourteenth reports.²⁰ He introduced the educational curriculum, engineering teachers, and employment of graduates of the Imperial College of Engineering, which became the Engineering School of Tokyo Imperial University. He evaluated the high level of engineering education, and admitted that they could absorb technical knowledge not only through school education, but also through their training at engineering sites such as factories. But he also pointed out that the Japanese were not good at applying the knowledge acquired through education into their own engineering

19. *The Engineer*, 19 June 1891, vol. 71, p. 487.

20. *The Engineer*, 3 December 1897, 10 December 1897, vol. 84, pp. 544–45, 567–69.

practice. The reason for this, he assumed, was that even when they received instruction on site as at ironworks, the number and kinds of practical learning were much more limited than the years-long learning through actual practice. They also could not learn from parents or relatives, even if they had been sons of craftsmen. They were, he quipped, “handling things while wearing gloves,” insinuating that they could not reach the engineering level of foreign engineers unless they took off their gloves and directly touched real things.

Ransome also quoted the following episode. Even when the Japanese purchased a machine designed and made by British engineers, they would ask a graduate from the engineering college to see if it were necessary to modify the machine to work in Japan. But the modification of a part of the well-designed machine would lead to destroying its harmonious system, and the inexperienced engineer would never attempt such a modification. Japanese engineers checked if the machine were the same or different from what they had learned from their teachers, and if they found it to be different, they would exercise the spirit of “dead-copying” and correct precisely as they were instructed. The manufacturer who purchased the machine could only follow the instructions of the young engineer who knew engineering only on paper.²¹

To meet the demand of more practical engineers, other engineering colleges were established in Tokyo and other cities. Tokyo Vocational School, the precursor of the present Tokyo Institute of Technology, was established in 1881. It was renamed as Tokyo Technical School in 1890. Students of the Imperial College of Engineering had been trained in the factory at Akabane, but the factory was turned into an arsenal for the army and no longer served for educational training. The machine factory at Tokyo University, Ransome observed, had more the character of a museum than of a practical training place. On the other hand, Tokyo Technical School emphasized more practical education, and produced able graduates. They were, he observed, ranked second to graduates from Tokyo Imperial University.

After the publication of the article about engineering education, the

21. *The Engineer*, 25 February 1898, vol. 85, p. 178.

editors received letters from the above-mentioned Smith and also from Divers, who instructed chemistry at the Imperial College of Engineering. Smith corrected the factual errors in Ransome's description of the history of engineering education, and Divers further corrected Smith's description. They were all concerned with the historical and institutional relationship between the Imperial College of Engineering and Tokyo University as well as the Engineering School of Tokyo Imperial University. However, neither was opposed to Ransome's evaluative and critical observation about the theory-biased engineering education at this university. Ransome pointed out the lack of university graduates in practical training and experience, and both Smith and Divers seemed to agree with this evaluation implicitly.

9. Concluding Remarks

Articles in *The Engineer* in the latter half of the nineteenth century disclose a consistent interest on the part of British engineers in the technological and industrial conditions in modernizing Japan. Their particular interest lay in the potentiality of the Japanese market for British manufacturers and in the new cadre of Japanese engineers who had started to control the industrial conditions in the country. From this viewpoint, they expressed frustration with the Japanese inspection standard for imported goods and patent protection system, and criticized the engineering education initiated by young British engineers, which had been usually evaluated highly as an early successful attempt at engineering education of university level. To the authors of these articles which were largely addressed to British industrial engineers, the educational curriculum at the Imperial College of Engineering, in which Henry Dyer intended to harmonize the theoretical and practical aspects of instruction, was viewed as more theory-biased and as a source of various problems in the Japanese industrial and technological situation. Young engineers with little practical experience were sent to factories without foreign engineers and committed large and small engineering errors, through which, we could say, they experienced their real postgraduate training in engineering practice.