JAPANESE ENGINEERING AND SCOTLAND

***Ryūgakusei* and *Oyatoi* between 1865 and 1900**

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DECLARATION

I declare that:

(a) I, Mairi Hamilton Arbuckle Araki, have composed this thesis.

(b) The work is entirely my own.

(c) The work has not been submitted for any other degree or professional qualification.

Mairi Hamilton Arbuckle Araki.

ABSTRACT OF THESIS

This study explores Scotland's role in the development of Japanese engineering during the early Meiji period. In particular it looks at the role of Scottish employees of the Meiji central government and Japanese overseas students in the process of technology transfer in the fields of engineering education, lighthouses, shipbuilding, railways, telegraphs and sanitary engineering. The aim is to show that Scottish trained engineers played a significant part in the overall transfer process and that the education and training they received in Scotland was the reason for their prominent role.

I have focused on Scotland rather than on Britain as a whole for two main reasons. Firstly by confining the study to Scotland, greater space can be dedicated to individuals and their contributions rather than to a more general study of a larger number of people. Secondly, although not an independent country, Scotland was sufficiently distinct from other regions of Britain to justify separate treatment of its contribution.

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PREFACE

Methods and Sources

Research for this thesis was carried out both in Scotland and Japan. In Scotland materials were consulted in the libraries of Edinburgh, Glasgow and Strathclyde Universities, in the National Library of Scotland, Edinburgh City Library and Glasgow Mitchell Library. Visits were also made to the Lighthouse Museum in Fraserburgh, and to Glover House in Aberdeen. In Japan, materials were consulted in the prefectural libraries of Saga, Fukuoka, Nagasaki, and Oita, in university libraries in Saga and Fukuoka (Kyushu University), in the National Diet Library, in the Tōkōkai offices, Mitsubishi Archives, UNESCO Archives, and the Yokohama Archives of History. Visits were also made to the Saga Prefectural Museum, the Taku City Museum, Glover Garden in Nagasaki and the Mitsubishi Museum at the Nagasaki Shipyard.

The period with which this thesis deals has been studied extensively and a large number of publications exist in both languages. The general conditions surrounding the employment of foreigners and Japanese overseas students during the nineteenth century has been widely researched by scholars such as Umetani Noboru, Hazel Jones, Ishizuki Minoru, Inuzuka Takaaki, and Watanabe Minoru. The relationship between Britain and Japan during the *bakumatsu* and Meiji periods has also been explored by William Beasley, Grace Fox, Olive Checkland, Kita Masami, Marie Conte-Helm and Andrew Cobbing. In the area with which I have dealt, Scotland and Japan, much groundwork has been laid by Kita Masami and Olive Checkland. Olive Checkland's *Britain's Encounter with Meiji Japan*, Basingstoke: MacMillan, 1989 and Kita

Masami's *Nihon o Hiraita Hitobito: Nippon to Sukottorando no Kizuna,* Tokyo: Dōbunkan, 1984, were the two most influential books in this study. They provided inspiration and a base from which to begin research. However, potential for research is far from exhausted, especially with regard to the activities of individual foreign employees and Japanese overseas students. By identifying and discussing the lives of the Scots who worked in Japan and the Japanese who studied in Scotland I attempt not only to show that Scotland played a significant role in Japanese engineering but also to build a more detailed picture of who these people were.

The general introduction to this thesis relied primarily on the broad range of published material in English which was consulted in the libraries of Scotland, while the majority of information in the main chapters was obtained from both English and Japanese sources. Kita Masami's book, *Nihon o Hiraita Hitobito: Nippon to Sukottorando no Kizuna,* provided valuable background information on Scottish ties with Japan from the mid-nineteenth century through to the end of the Meiji era as well as detailed information on Henry Dyer, the Kōbudaigakkō (Imperial College of Engineering) and the Japanese *ryūgakusei* who studied in Glasgow. Henry Dyer, and more recently, Richard Brunton have been the focus of several studies. One reason for this is because they left written records of their activities in Japan. Henry Dyer wrote detailed reports for the Imperial College of Engineering, published a book, *Dai Nippon; The Britain of the East: A Study in National Evolution*, London: Blackie & Son, 1905 and wrote many articles on engineering education in which he refers to his work in Japan. Brunton also wrote a book detailing his work in Japan which was published posthumous; Brunton, Richard Henry, (with an introduction and notes by Sir Hugh Cortazzi), *Building Japan 1868-1876*, Sandgate, Folkstone, Kent: Japan Library, 1991.[1] In addition to these works, of particular value were Kita Masami's articles about Henry Dyer, and the Yokohama Kaikōshiryōkan's (Yokohama Archives of History) bilingual booklet on Richard Brunton, listed in the bibliography of this thesis. While there are already several studies on these individuals, including some in English, any discussion of Scottish influence on engineering would not be complete without reference to these men and therefore the chapters of this thesis which deal with engineering education and lighthouses discuss their important roles.

I also located biographies in Japanese for Minami Kiyoshi (Murakami Kyōichi, 1904, and Murakami Kyōichi, 1909) and Shida Rinzaburō (Shida Katsunori, 1993), which provided information about these men and their achievements. Murakami Kyōichi's books, *Daitetsudōka Ko Kōgaku Hakushi Minami Kiyoshi Kun no Keireki*, Kinoshita Tateyasu, 1904, and *Minami Kiyoshi Den,* Kinoshita Tateyasu, 1909 record Minami Kiyoshi's personal history and achievements from his childhood until his death in 1904.[2] The book reveals how remarkable a man Minami was through his fifty years. Assistance was required from Japanese friends in order to read the book which was written in the language and style of the Meiji period. Shida Katsunori's book, *Shida Rinzaburō no Seigai*, explores the influence of Shida Rinzaburō's teachers throughout

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[1] This work is also published under the title of *School Master to an Empire.* Brunton, Richard Henry, edited and annotated by Edward R. Beauchamp, *School Master to an Empire,* New York, London: Greenwood Press, 1991.

[2] Murakami Kyōichi was a business associate of Minami Kiyoshi's. In 1896 they established a company together in Osaka, the Tetsudō Kōmusho. Murakami originally wrote *Daitetsudōka Ko Kōgaku Hakushi Minami Kiyoshi Kun no Keireki* as a series of articles in the *Osaka Mainichi Shinbun* in 1904, the same year as Minami Kiyoshi died. The work was reprinted in its original form in Noda Masaho, Harada Katsumasa, Aoki Eiichi, *Meijiki Tetsudōshi Shiryō, Volume 5; Tetsudō Kaden (1) Minami Kiyoshi Den Hoka*, Tokyo: Nihon Keizai Hyōronsha, 1980.

his education, particularly Ishimaru Toragorō at the Keirinsha in Saga, Willliam Ayrton at the Kōbudaigakkō in Tokyo and William Thomson at Glasgow University, then details Shida Rinzaburō's activities on his return to Japan from Glasgow, from the establishment of the Denki Gakkai (Electricity Association) to his pioneering research in the field of Electricity.

Much time was spent browsing through a variety of materials from the nineteenth century including University matriculation records, English newspapers, foreign resident directories and Japanese government reports searching for information relating to Scotland. It was necessary to seek assistance from Japanese friends when reading many of the Japanese documents from this period. The Japanese language and style of the Meiji period was often unfamiliar to me and handwritten documents were extremely difficult to read.

One of the major difficulties experienced in the research of this thesis, besides language, was in the identification of Scottish employees. Official Japanese documents from the period and lists compiled from these (UNESCO, 1975, Takeuchi Hiroshi, 1995) make no distinction between the different regions of Britain when listing nationalities. Occasionally official documents of the time indicate place of birth and home address but only in a small number of cases. It is reasonable to assume that the number of Scottish employees is far higher than the number identified here.

Difficulties were also experienced in tracing the activities of employees before and after their term in Japan. For those employees who followed a career in academia on their return to Britain, papers published in academic journals provide information on their later careers. For those who died in Japan some information is provided on their tombstones. However, for the average engineer, artisan and workman, few records with this kind of information have been found. Further research will be required to uncover details of this kind.

Information on the activities of Japanese overseas students was, in most cases, easier to locate. Published student lists and biographies in Japanese provide a valuable source of information. (Tomita Hitoshi, 1985; Tezuka Akira, 1992) Many of the early overseas students returned to high-level positions in the government, universities or in major companies and in consequence their names appear in various official documents and academic journals. There are a number of students, whose names appear in Scottish university records or in Scottish newspapers, I have not been able to trace in Japan. The majority of information on Japanese students was obtained from Japanese sources.

Lists of British employees in the Lighthouse, Railway and Telegraph Bureau are provided in the Appendices. Information for these tables was compiled from a variety of sources including the following books; Ōkurashō (1888), Stevenson Letterbooks (1868-1876), Tōkōkai (1969), UNESCO (1975), Takeuchi Hiroshi (1995), Teraoka Jūichi (1978), and Tatewaki Kazuo (1996). Many of the names of the British employees remain in katakana because the correct English name is unknown. I was able to identify a number of these people by comparing information in English sources, such as resident directories and English language newspapers, with the information contained in the Japanese name lists and other documents. Compiling the lists and comparing information in each of the existing lists and with other sources was a very time consuming activity but I believe it has been very worthwhile. It is hoped that my lists can be used as reference for further study of British employees and as more is learned about individual employees, information can be added.

A list of Japanese students in Scotland is also provided in Appendix 2. As with the tables of foreign employees, a variety of sources were consulted in compiling the table. These included Scottish University matriculation records, Ōkurashō (1888), Stevenson Letterbooks (1868-1876), Iseki Kurō (1930), Tōkōkai (1969), Tezuka Akira (1992), Tomita Hitoshi (1985), Kita Masami (1984). Unfortunately few company records from Scottish shipyards and factories where the Japanese undertook training now exist. It is therefore possible that many more Japanese were training in Scotland at the time.

Differences in the detail of each chapter were dictated by the availability of material on individuals and in the difficulty in identifying Scots among the British employees. The Letterbooks from the firm of D. & T. Stevenson, Consultants to the Japanese Lighthouse Service between 1868 and 1877 provided a wealth of information, as did the Calenders of the Imperial College of Engineering and for this reason greater emphasis has been placed on the lighthouse and engineering sections.

There is still much to be learned about the Scottish involvement in Japan's modernization, both in the field of engineering where the influence was strong and in other fields such as agriculture where it was less obvious. Some research in this field is being pursued by Japanese scholars such as Inaba Kikuo, Katō Shōji, and Kita Masami. It is hoped that this study will generate greater interest among scholars at home. I intend to continue to search for information on the Scottish *oyatoi* and Japanese *ryūgakusei* mentioned in this study as well as on the many other Scots and Japanese yet to be identified. My interest lies not only with the high-level *oyatoi* and *ryūgakusei*, who tend to attract greatest attention, but also with the lower level engineers, artisans and workmen.

This study has focused on the achievements of the *oyatoi* and *ryūgakusei*, but unfortunately very little has been written about their personal lives. It would be extremely interesting to find out more about the people themselves, about their motives for working or studying abroad, their experiences there, the pressures, hardships and rewards of life at such a crucial period in Japan's history.

One interesting example is James MacIntosh, one of the first lightkeepers to be dispatched to Japan, who was fired two years into his contract for violent and abusive behaviour towards his Japanese trainees. In a letter dated 14th July 1871 Brunton, Chief Engineer to the Japanese Lighthouse Service wrote to the Stevenson brothers, "I am sorry to have to inform you that McIntosh sent out by you has lately given way to drink and other misbehaviors. I enclose you copy of a letter from the Japanese officials complaining of this."[3]

Does the blame lie entirely with him or did the conditions of his employment play a part? It is unlikely that he would have been recommended for the job had he displayed

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[3] The letter gives details of James MacIntosh's wild temper and abusive behaviour towards the workmen and trainees as well as towards the local Japanese. Stevenson Letterbooks, The Japan Lights Incoming letters. Letter of July 14th, 1871 from Richard Brunton.

such behaviour while in the employ of the Commissioners of the Northern Lighthouses. For a single man in his early twenties, being dispatched to remote lighthouses with only Japanese trainees, who had no knowledge of lightkeeping and limited English ability, for company, would undoubtedly be stressful. According to family descendents he never returned to Scotland and his activities afterwards are unknown. Perhaps the shame of his situation forced him to go elsewhere. A lightkeeper by the name of James MacIntosh does appear in the directory of foreign residents in China some time after he was dismissed in Japan.

A second example is the "Sirita" brothers who were already studying in Fife when the Iwakura Mission visited Scotland.[4] Who were these boys, what were they studying and why did they choose Fife?

One personal diary, written by a Japanese trainee lighthouse keeper, was located in the Tōkōkai archives. It was a handwritten document which was extremely difficult to read, even with assistance from native Japanese speakers. Because of the time required to translate and because the content in the first few pages was not very relevant I did not pursue this further.

Personal names, Place names and Romanization

Japanese personal names are given as traditionally used in Japan with the family name

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[4] The *Scotsman*, October 15th 1872, p. 5. No further information has been found about these boys in English or Japanese sources. The modern English romanization of their name is probably Shirita, but as the Japanese character for their name is unknown at this point the romanization cannot be confirmed.

first followed by the given name. The Romanization of Japanese words is that of the Modified Hepburn System. Macrons indicating long vowels are omitted from familiar names and place names (e.g. Tokyo instead of Tōkyō). The recent lists of *ryūgakusei* usually provide both the *kanji* and *hiragana* for Japanese names and therefore the spellings should be correct. The spelling of Japanese names in English language sources of the Meiji period often differs from document to document and also differs from the modern standard of Romanization. If the correct pronunciation is unknown it has been left as it appears in the original source. For example, I have not located any Japanese references to Mr. Yura of the Iwakura Mission, or the "Sirita" brothers, whose names appear in *The Scotsman* newspaper of 1873 and therefore I have left the spelling as it is. The spelling of English names has also caused difficulties. Japanese documents from the Meiji period usually give English names in *katakana* and unless there are English sources to cross reference with I can only guess at the spelling. Occasionally the English spelling was given but it was not always accurate. When the English name cannot be determined it has been left in *katakana*.

INTRODUCTION

"Their handicraftsmen are as expert as any in the world, and, with a freer development of the inventive powers of the people, the Japanese would not remain long behind the most successful manufacturing nations."[1]

Perry's words were prophetic for half a century after he wrote this Japan was indeed one of the "most successful manufacturing nations".[2] The pre-modern country of 1853, which had been unable to resist Perry's gunboat diplomacy in that year, had by the end of the Meiji era in 1912, not only laid the foundations of an industrial state but had accomplished revision of the unequal treaties implemented in the late 1850s, fought and won two major wars with China and Russia, signed an alliance with Great Britain, and was herself recognized as a world power.[3]

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[1] Hawks, Francis L., *Narrative of the Expedition of an American Squadron to the China Seas and Japan Performed in the Years 1852, 3 and 4 Under the Command of Commodore M.C. Perry, U.S. Navy Washington, 1856-8.*, Volume 1, Beverley; Tucker, 1856, p.455.

[2] Commodore M.C. Perry died in 1858 and therefore did not live to see the changes.

[3] The first commercial treaty signed by the United States in July 1858 included "a fixed import and export tariff, mostly at 5 per cent *ad valorem*; extraterritoriality and foreign lawcourts; a resident minister in Edo (Tokyo); consuls at the treaty ports. Five ports were to [be] opened to trade on dates between 1859 and 1863: Hakodate, Nagasaki, Hyōgo (Kobe), Kanagawa (Yokohama), and Niigata. In addition, foreigners were to be admitted to the cities of Osaka and Edo in 1862 and 1863, respectively." The British treaty signed in August also included a most-favoured-nation clause which meant that any right gained by one nation was shared by all others. The 'unequal' treaties in China and Japan became known as such because they were not reciprocal. Chinese or Japanese citizens in Britain, for example would not receive the same rights. Beasley, William Gerald, *Japanese Imperialism 1894-1945*, Oxford: Clarendon Press, 1991, p. 17, 24.

Japan's rapid transformation into an industrial and military power and the role of the West in this process has been the focus of much attention over the years. This thesis looks at one aspect of Japan's modernization during the Meiji period; that of the central government-sponsored technology-transfer from the industrialized West. What makes this study different from others on the subject is that it looks specifically at Scotland's role in this process. I put forward the case that Scotland had a unique and significant part to play in the development of engineering in Japan because of its approach to engineering education, which was distinct from that of England and other industrialized nations.[4] Scotland's universities and colleges placed importance on both theoretical and practical aspects of engineering, a feature of Scotland's education system in general and one which had deep roots in Scotland's past. Scots came to regard their universities not as places of higher learning reserved for the elite but as training centres for all. My argument is that the Scottish system, more than any other, nurtured engineers who were well-versed in engineering theory but who were also practically minded, and this was precisely the kind of engineers a developing nation like Japan required. The legacy of Scottish engineering education was not only that it assisted the Japanese in establishing modern technology in Japan but, by encouraging observation and original thought, helped the Japanese to develop technology by themselves.

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[4] Although there are various publications which look at Britain's role in the technology transfer process there are very few which focus on specific regions of Britain. Important examples include Marie Conte-Helm's *Japan and the North East of England: From 1862 to the Present Day*, London: The Athlone Press, 1989, and Olive Checkland's article "The Scots in Meiji Japan, 1868-1912", in Cage, R. A., *The Scots Abroad: Labour, Capital, Enterprise, 1750-1914*, London Sydney, Dover, New Hampshire: Croom Helm, 1985.

In focusing on the central government-sponsored technology-transfer from the West I do not imply that government-sponsored projects were the most important aspect of modernization nor that foreign technology was the only factor behind Japan's success. Development in the *periphery* played an equally important role and Japan was able to accept, adapt and develop foreign technology because it had already laid the foundations necessary for industrialization.[5] It was simply an area in which I was interested.

Essential to this study is an examination of the process used to adopt knowledge from the West. The concept of using Western technology to modernize emerged long before Japan's encounter with Perry. The threat of foreign invasion and how to prepare for it were topics frequently discussed during the early nineteenth century. Once forced from seclusion in 1853 the Tokugawa Bakufu embraced the idea and, employing old techniques used in earlier centuries to learn from China, began a process of selective borrowing which was continued and expanded by the Meiji government. Foreigners with the desired skills were hired and brought to Japan to initiate modernization policies and transfer their knowledge to their Japanese students. At the same time talented young Japanese were were dispatched abroad to learn as much as possible about modern states.

The opinion of the Meiji government was that no one country provided the perfect

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[5] Tessa Morris- Suzuki wrote, "Emphasis on the role of central government and big business groupings also tends to obscure other parts of the story which may be less readily visible but are just as important." She refers to "the activities of small firms and local communities" as the *periphery.* Morris-Suzuki, Tessa, *The Technological Transformation of Japan: From the Seventeenth to the Twenty-first Century*, Cambridge, New York, Melbourne: Cambridge University Press, 1994, p. 4.

model for every institution and system so they made a point of investigating conditions in different countries with a view to adopting the most appropriate models for Japan. This was one of the objectives of the the Iwakura Mission, a high-level official embassy led by Iwakura Tomomi, which made an extensive tour of the world's industrialized nations from 1871. The details of this Mission will be discussed later in the introduction. Partly as a result of their tour the Meiji government looked primarily, though not exclusively, to Britain for the technical knowledge and skills required for modernization. The highly industrialized central belt of Scotland, often referred to as the *Workshop of the British Empire*, not surprisingly, played a role in supplying technology and skilled personnel to Japan.

The period studied in this thesis is up to 1900 because this was the period during which foreign employees and Japanese overseas students made the greatest impact on Japan's modernization process. The number of foreign employees peaked in the mid 1870s and then declined as the first generation of Japanese trained in Western technology replaced them. Government-sponsored Japanese students returning from study abroad in the 1870s and 1880s generally replaced the highest-level foreign experts. Japan's modern education system was well established by the turn of the century and enabled Japanese professors in several universities and colleges to provide advanced technical education, of a similar standard to that which could be received abroad. The Japanese continued to send students abroad after 1900 but the majority were privately sponsored postgraduate students, who had already received their first degrees in Japan.

An outline of this thesis

Before launching into a discussion of Scotland's role in Japan's modernization during the latter half of the nineteenth century it is first necessary to examine the historical development of both Japan and Scotland before the Meiji period in order to put the study into perspective, to understand why Scotland, on the one hand, developed advanced industrial technology while Japan on the other hand failed to do so and to understand the circumstances behind Japan's decision to modernize, how it was able to transform itself so rapidly, and why Scotland featured in this process.

The section immediately following this introduction briefly discusses Japan's development in the centuries prior to the Meiji era, the factors which influenced it and the consequences for modernization. Similarly, Scotland's development before this period is discussed, with particular emphasis on the development of engineering and technical education during the industrial revolution. This section also highlights the different characteristics of Scotland's development compared to that of the rest of Britain.

The second chapter discusses how foreign employees, who became known as *oyatoi gaikokujin,* and Japanese overseas students, known as *ryūgakusei,* were employed in the transfer of technology and ideas from the West during Japan's rapid modernization in the nineteenth century and how these methods were not unique to the period. It presents statistics on the numbers of foreign employees in government departments, the type of work they performed, their nationalities, and the numbers of Japanese overseas students, their destinations and subjects of study during this period. These statistics show that British employees were in the majority and that, initially, Britain was one of the most favoured destinations for students of engineering. Towards the end of the Meiji period Germany and the USA became the most popular study destinations for Japanese students for reasons discussed in this chapter.

Chapters 2 through 5 form the main core of the thesis dealing with Scottish influence in the fields of lighthouses, engineering education, shipbuilding, railways, telegraphs and sanitary engineering. Each chapter outlines the development of these fields up to the turn of the twentieth century and discusses the employment of *oyatoi* and *ryūgakusei* in the technology transfer during the early Meiji period. The role of Scottish trained engineers is given particular consideration, arguing that their contribution was significant in this modernization process. In each chapter attention is paid to the careers of a number of individuals who have contributed most to these areas.

Factors in Japan's Development up to the Meiji Period

Our perception of Japan during the period prior to the Meiji era (1868-1912) has changed considerably over the last few decades. Japan was neither as secluded nor was its citizens as ignorant of the outside world and foreign technology as once believed. The level of Japanese technical development too has been understated. The Edo or Tokugawa period (1603-1868), as it is also known, saw significant technical innovation and development, be it in a less *visible* form compared to that in the West.[6]

Technological development in Tokugawa Japan was a complex process shaped by many conflicting forces. Progress was on the one hand stimulated by certain aspects of the Tokugawa system and on the other hand restricted by others. Many of the developments stemmed from the social and economic changes which were taking place while others were more directly influenced by Tokugawa policy. It is not within the scope of this thesis to discuss the Tokugawa era in detail but it is important to look at some aspects of the period and its administration which had major implications for Japan's technical development.

For centuries prior to the Meiji period, power in Japan rested with a military government, the Bakufu, which governed the country in the emperor's name. The emperor himself retained a nominal position at the head but had little real political power or influence. Real power rested with the military leader, the shōgun, who ruled over the domain lords, the *daimyō*, who in turn ruled over their samurai retainers and

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[6] Morris-Suzuki, Tessa, *op.cit.*, p. 14.

the general populace below. Society was divided into distinct strata: the samurai at the top followed by peasants, artisans and merchants below. Social status became hereditary and, in theory, unchangeable early in the Tokugawa period.

Civil war in the century leading up to the Edo era (also known as the Tokugawa Era) (1603-1868) was brought to an end by Tokugawa Ieyasu, who led his army to victory in the decisive battle of Sekigahara in 1600. In 1603 he became shōgun, beginning a new era, the Edo era, which was to continue in relative peace for the next two and a half centuries. Ieyasu turned his energies to establishing his authority and strengthening his military and economic position. In the process he laid the foundations of the administration which governed unchallenged until 1868.[7] By the end of the third generation of Tokugawa shōguns, an intricate administrative system had been established, which placed restrictions on all potential rivals. This enabled the Bakufu to supervise their conduct closely and prevent them from becoming powerful enough, either economically or militarily, through alliances or alone, to challenge the Tokugawa's power.

Consequences of Peace and the *Bakuhan* System

As peace prevailed during the Tokugawa era the samurai class were absorbed into the government bureaucracy. They were still regarded as the warrior class and expected as

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[7] Although Ieyasu built the foundations for the Tokugawa system, the "elaborate and rigid system of civil government" associated with the Tokugawa period was developed after Ieyasu's death. He, himself, made little effort to construct a formal administration but instead relied on a few talented and loyal people to tackle these problems. Sansom, George, *A History of Japan: 1334-1615,* Rutland, Vermont & Tokyo: Charles E. Tuttle Company 1993.

such to excel in the traditional warrior arts but were no longer called upon to fight. The rigidity of the social hierarchy prohibited them from participating in agriculture or commerce, pursuits of the lower classes of peasants and merchants. They became permanent residents of the castle towns dependent on merchants and artisans to provide their basic needs. As a consequence of this development urban populations grew steadily.

The influx of people into cities was especially rapid in Edo, the new centre of the Bakufu government, because of the Alternate Attendance System. All lords were subject to the Alternate Attendance system which entailed spending alternate years residing in the capital and during their year's absence leave their wives and family as virtual hostages. This system proved valuable in ensuring their obedience, for not only were lords less likely to rebel when their family were prisoners of the shōgun but the great expense involved in travelling to and from Edo and in maintaining two residences ensured that there was always a drain on their finances.[8]

These changes had major implications for technological development. Greater demands were placed on the surrounding countryside to provide for the ever increasing needs of the growing consumer markets. This stimulated improvements in fields such as agriculture, transport and craft production. Farmers were drawn away

[8] Other regulations imposed on the lords included forced public works projects, which like the AA system placed a drain on domain finances, shōgunal permission for marriages between lords' families, which in addition to the existing rivalry between clans, reduced the possibility of domain alliances. Although the activities of the lords were strictly regulated by the Bakufu, they enjoyed considerable autonomy with regard to the daily running of their domains. Each domain was a semi-independent entity possessing its own army of samurai loyal to their lord.

from subsistence farming to market production and roads were constructed to convey produce from the outlying areas into the city but also from each domain to the capital city. These roads were also necessary to enable *daimyō* and their entourage to travel to and from Edo. Shipping routes were developed to carry larger cargo from further afield. The Alternate Attendence System brought each region into the national market and promoted specialization of agriculture and craft production in different areas. Domestic trade and commercialization thrived, encouraging a move away from the trading of commodities to a money economy, first in the towns, and later in the villages.

The Alternate Attendence system initially caused an outflow of wealth from the domains which induced *daimyō* to seek ways of protecting their local economies. Many hired experts from other regions of Japan to introduce new industries to the domain or new techniques to improve the quality and output of existing agricultural, mining and craft products. One example of such is Yonezawa *han* in the 1780s, which used these techniques to teach farmers how to weave crepe cloth, to establish indigo plantations for the production of dyes and, most importantly, to establish a silk industry. The government set up nurseries for mulberry bushes, gave loans to farmers to establish mulberry plantations, and produced a *Guide to silk Farming* (*Yōsan Tebiki*) for the raising of silk worms. Other domains followed similar policies of introducing silk farming, some hired experts to improve copper and silver mining techniques, while others set up iron foundries.[9] These techniques contributed to a diffusion of technical knowledge from one region to another.

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[9] Morris-Suzuki, Tessa, *op. cit.*, p. 28.

Progress was not restricted to the introduction of techniques from outlying regions. Whether imported or indigenous, technology was improved upon by much experimentation and innovation. An example of native innovations on imported technology can be seen in Arita pottery. The discovery of a rich source of kaolin clay by Korean craftsmen in Arita, Kyushu, led to the establishment of a pottery industry in the area. At first native potters did not possess the know-how to produce the high-quality ceramics of mainland Asia but with much experimentation they succeeded in producing items which rivalled those of China. Despite severe measures to prevent their innovations from being pirated by other regions the determination of others to acquire this knowledge inevitably led to the spread of this information throughout the country.[10]

The economic changes had a major impact on all levels of society. Merchants and farmers were in a position to profit from the changes and the able men of these classes steadily grew richer, providing for the ever-increasing needs of the town dwellers and travellers. The growing economy led to a rise in income and in the living standards of the common people. As an indication of this, peasants in the villages of Okayama could buy only eleven items from peddlers in 1666 but by 1765 the number had risen to thirty-one. By the late eighteenth century demand for products enabled villages to support their own shop.[11]

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[10] Morris-Suzuki, Tessa, *op. cit.*, pp. 30, 31.

[11] Hanley, Susan B., *Everyday Things in Premodern Japan, The Hidden Legacy of Material Culture,* Berkeley, Los Angeles, London; University of California Press, 1997.

Education was another area of enormous importance in Japan's technological development. The importance of learning to the Tokugawa can be seen from the beginning of the period. The first article of the Buke Sho-Hatto, a code of behaviour for the military class issued by Tokugawa Ieyasu in 1615, instructs samurai to practice military arts in combination with the pursuit of learning.[12] This became the accepted code of behaviour throughout the period. For the underemployed samurai, who could not be accommodated in the government bureaucracy usually lower ranking samurai (the number of samurai usually exceeded that of official positions), the pursuit of learning was the most respectable vocation.[13] It was common for these men of learning to establish themselves as independent scholars, some following a similar course to that of the domain schools, which generally focussed on Chinese classics, while others pursued fields outwith this orthodoxy.[14] One such example of the latter was *rangaku*, or Dutch learning, a form of learning based on Western science. Because this knowledge was acquired through the Dutch settlement in Nagasaki it became known as Dutch learning.

The reputation of some of these private schools became such that they attracted students from distant regions of Japan. This custom of travelling out of the *han* to study at a particular school was known as *yūgaku* and became more common as the era

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[12] Sansom, George, *A History of Japan: 1334-1615,* Rutland, Vermont & Tokyo: Charles E. Tuttle Company 1993, p. 405.

[13] Morris-Suzuki, Tessa, *op. cit.*, p. 23.

[14] At the beginning of the Edo period education for the samurai usually focused on Chinese classics, military skills and etiquette but as the era progressed, the type of schools and their curricula became more diverse. In addition to local domain schools, many private schools were established by independent scholars through the period.

progressed. The exchange of ideas, which *yūgaku* encouraged, led to the diffusion of these ideas throughout the country.

Education was not restricted to the samurai class. Peasants, artisans and merchants could attend *terakoya* schools run by local temples, which taught courses focusing on literacy, numeracy and vocational skills. The development of education among this group was fostered by Tokugawa policy, though in a less direct way than that of the samurai. One of the greatest stimuli came from the economic changes which occurred during the period. Samurai had become urban dwellers without land to provide for themselves and were paid in stipends of rice. Naturally they came to rely on middlemen, the merchants, to supply their daily needs. The demands of the urban consumers also had the effect of drawing farmers away from subsistence farming to market production. Arithmetic became a necessity for the general population, but particularly for the merchant class and as their businesses grew they required greater managerial and accounting skills.[15] Later in the era wealthy merchants and peasants often sought respectability by turning to a more classical education similar to that of the samurai. By the end of the Edo era Japan had a highly literate population comparable to many of the industrial nations of Europe.

High literacy rates among the Japanese, including the lower classes of farmers and merchants, combined with their newly acquired wealth created a growing demand for reading material and a desire to share knowledge with others. Educated people, regardless of class, were now capable of publishing and buying material. This led to

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[15] Morris-Suzuki, Tessa, *op. cit.*, p. 20.

the emergence of a diverse range of publications, from novels to enyclopedias. Commercial libraries and mobile libraries began to appear and contributed to the diffusion of knowledge and ideas from class to class and also from region to region.[16] Gradually it became easier for the general population to acquire knowledge of technology being developed in other regions and in other countries. For example, at least one hundred texts on silk farming were published during the period, some written by silk producers and merchants themselves.

Technological development in Japan took on a different form compared to that of Britain and the other industrializing countries in Europe. Japan had a stable population, restricted foreign trade and limited resources of materials such as coal and iron. This meant that there was little room for growth in Japan's markets. There were few incentives to develop the kind of labour-saving mechanization being developed in Britain which had abundant raw materials and an extensive overseas market. Such developments, which would have caused major changes to the social order, were also discouraged by the Tokugawa Bakufu. Tokugawa policies which placed restrictions on the size of ships and on the size and type of roads and bridges had a direct and detrimental effect on the development of naval architecture and civil engineering.[17]

Innovation in Japan tended to be focussed on improving the quality rather than increasing the quantity of products. Greater profits could be made in Japan by

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[16] Morris-Suzuki, Tessa, *op. cit.*, pp. 33, 34.

[17] Restrictions were enforced in these fields for military and strategic reasons. Ships above a certain size, wide roads and bridges were prohibited because they might allow large-scale movement of armies against the Bakufu. Large ships could also be used to trade overseas where huge profits could be made. If lords became economically powerful enough they could threaten the Bakufu's position.

developing a wide range of products to specialized standards. A good example of this kind of innovation was silk production. In Europe innovation tended to be concentrated on increasing the production by improving the later stages of silk production and reducing the labour requirements. Water-powered throwing machines, automatic looms and reeling machines improved the speed and efficiency of production and their use spread quickly from the eighteenth century. These techniques were also known to have been introduced in Japan but they were not adopted widely. Japan's markets did not require vastly increased production or a reduction in labour requirements. In addition the reduction in the quality of the silk as a result of using these machines probably discouraged the Japanese from using them. Instead, silk producers in Japan concentrated on improving the quality of the silk by innovations at the early stages of production. Selective breeding and careful control of the rearing conditions of the silkworms during the Edo period produced a diversity of quality silks and reduced the length of time required for rearing.[18] Instead of reducing labour requirements, this process actually became more labour intensive. This was often a feature of Japanese innovations during this period.

The increased use of iron in agricultural and kitchen equipment stimulated innovations in iron production, which, while less spectacular than those in the West, were nevertheless significant. The efficiency of the whole process was gradually improved by new selection techniques of alluvial iron sands, by a progression from open-air hearths to enclosed furnaces and by the changes in the bellows which enhanced temperature control. As in other areas of Japanese technological development the most

[18] Morris-Suzuki, Tessa, *op. cit.*, pp. 36-43.

remarkable aspect of this innovation was not so much the increased quantity but the quality and diversity of the end product.[19]

Japan's foundries were not suited to the large-scale production of iron required for making iron ships or cannon but the knowledge they had of iron production undoubtedly aided in the transition. Before Japan emerged from seclusion Saga *han* made the decision to develop western-style weaponry, and, armed with a translation of a Dutch ironworks manual and a team of traditional iron workers, scholars, and artisans they succeeded in building the first Japanese reverberatory furnace in 1850. Soon after its completion they began producing cast iron cannons. By 1854 Satsuma *han* had also established its own reverberatory furnace and other *han* were experimenting with the process. While the reverberatory furnace was not very complicated, the process involved new and unfamiliar techniques to the Japanese. The adaption and development of iron production to Western standards involved much experimentation and innovation, which, in itself, is remarkable.

These are only two examples, among many, of Japanese innovation during the Edo era but they demonstrate that technological development was far from stagnant in Tokugawa Japan, and while it did not produce the same result as it did in the West it cannot be dismissed as insignificant. Technological innovations increased agricultural yields, improved energy efficiency, sanitation, health and comfort for the Japanese.

[19] Morris-Suzuki, Tessa, *op. cit.*, pp. 46, 47.

Contact with the West

Europeans first set foot in Japan during a period of civil war in the sixteenth century. Portuguese traders on their way to Macao were blown off course and landed at Tanegashima in Kyushu in 1543. This first encounter led to the establishment of a Portuguese trading route from Hirado in Kyushu to Macao. These traders were soon followed by Spanish merchants, Jesuit, Dominican and Franciscan missionaries and, half a century later, by Dutch and English merchants.[20]

Westerners were greeted with curiosity and interest when they first arrived in Japan. The Japanese were intrigued by their novel customs and ideas, new religion and interesting technology, and welcomed the trade they brought. Tokugawa Ieyasu, shōgun from 1603, encouraged foreign trade with the Europeans and also granted Japanese licenses to trade abroad with the result that Japanese settlements emerged in several regions of East Asia. Friendly relations with the newcomers were short-lived, however, and the initial curiosity turned to suspicion as Christianity gained influence among several domain lords of Kyushu. Several anti-Christian edicts were introduced; the first in 1611, and books relating to Christianity were banned. Within a century of their arrival a policy of isolation, the *sakoku* policy, was introduced in 1639 expelling Europeans, with the exception of the Dutch, from Japan and prohibiting Japanese from travelling abroad.[21]

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[20] The first missionary known to have reached Japan was the Spanish Jesuit, Francis Xavier in 1549. Tomita Hitoshi, *Umi o koeta Nihonjin meijiten,* Tokyo: Nichigai Associates, 1985, p. 3.

[21] The English had already left Japan voluntarily in 1623 after only ten years (1613-23), having failed to make a profit from their factory in Hirado. For further details on the English factory refer to Milton Giles, *Samurai William: The Adventurer Who Unlocked Japan*, London: Hodder and Stoughton, 2002.

This early contact, however brief, did leave its mark on Japan. The Europeans introduced a range of products and techniques to the Japanese, from everyday foods such as *tenpura* and *castella* to more technical products such as clocks, telescopes and guns.[22] It is also possible that mining, metal-refining and water-filtering techniques were introduced at this time.[23] The smoothbore musket, introduced by Portuguese merchants, generated such interest that the Japanese soon learned to produce and use this new weapon. Oda Nobunaga (1534-1582) is said to have made good use of the muskets in his campaign of military expansion which ultimately ended the civil war and led to the reunification of Japan.[24] While Europeans disappeared from general view, the knowledge they introduced did not. In some cases this knowledge spread throughout Japan where it continued to develop.[25]

Japan's ties with the outside world during the seclusion period, although restricted, were not completely severed as illustrated by the existence of several international trading routes which were maintained throughout the period. The Dutch were

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[22] *Tenpura* (usually spelled Tempura in English) is a method of food preparation in which ingredients are coated in batter and deep fried. Modern-day *tenpura* uses ingredients such as seafood and vegetables. *Castella*, a speciality in Nagasaki, is a sweet sponge cake.

[23] Morris-Suzuki, Tessa, *op. cit.*, p. 16. and Nihon Suidō Kyōkai, *Nihon Suidōshi*, Tokyo: Nihon Suidōshi Hensan Iinkai, 1967, P. 7.

[24] Civil war in the century leading up to the Edo era had weakened and divided the country but the efforts of three powerful leaders who ruled in succession in the sixteenth century, Oda Nobunaga (1534-1582), Toyotomi Hideyoshi (1537-1598), and Tokugawa Ieyasu (1543-1616)) brought the civil war to an end and reunited Japan under one leader. Tokugawa Ieyasu led his army to victory in the decisive battle of Sekigahara in 1600, and in 1603 he became shōgun, beginning a new era, the Edo era, which was to continue in relative peace for the next two and a half centuries.

[25] Morris-Suzuki, Tessa, *op. cit.*, p. 16.

permitted to continue trading because, unlike the Spanish and Portuguese, they had made no effort to spread their religion. Despite this they were still regarded with suspicion and were confined to the small island of Dejima where the Bakufu could supervise and control their activities. The Tokugawa also authorized several other foreign trading ventures. These included trade between Nagasaki and China, between Satsuma *han,* one of the large domains in south Kyushu and the Ryūkyū Island kingdom; now known as Okinawa, between Tsushima *han*; an island domain between Kyushu and Korea, and Pusan in Korea and between Matsumae *han*; a domain in south Hokkaido, and the islands to the north.[26]

Dutch trade in Japan was not hugely profitable for either side but the Dutch East India Company maintained its factory in Dejima throughout the Edo era. Only a handful of Dutchmen were resident in Dejima at any time and only two shipments of goods were made each year. In consequence the economic impact was minimal. A greater impact of the Dutch presence on Japanese society was the development of *rangaku*, or Dutch learning. The gradual change from militarism to intellectualism during the Edo era was accompanied by the emergence of different schools of thought, including ancient learning, (*kogaku*), national learning (*kokugaku*) and Dutch learning (*rangaku*). *Rangaku* differed from the other schools in that it was Western in origin and its focus was on the sciences rather than more philosophical matters.

The original *rangaku* scholars were translators assigned to the Dutch factory. The job of the translator included vetting imported books for unsuitable material and keeping

[26] Mason, R. H. P., Caiger J. G., *A History of Japan*, Rutland, Vermont & Tokyo: Charles E. Tuttle, 1997, pp. 205-7.

the Bakufu informed of European affairs and as such they had access to the Dutch in Dejima and a variety of written material about Europe. Some of these men published works in Japanese on European topics providing non-Dutch speakers with the opportunity to read about the West. One example is Yoshio Kōsaku, head mediator in Nagasaki from 1778 who wrote over thirty works on subjects relating to Europe. In addition to his writings he ran a Western-style medical school which taught six hundred students.[27] Because of such men *rangaku* spread beyond this small group and beyond Nagasaki and the scope widened from Western medicine to include other scientific disiplines such as astronomy and military sciences.

Rangaku's development was aided by the eighth Tokugawa shōgun, Yoshimune, whose interest in the practical sciences led him to encourage his advisers to study *rangaku* and relax the ban on the importation of foreign books.[28] It was also helped by numbers of samurai scholars like Katsuragawa Hoshū and his brother Morishima Chūryō, who wrote prolifically on subjects relating to the West.[29] One of Chūryō's best known works was a best-selling account of Europe, *Kōmō zatsuwa*, the Red-fur Miscellany, written in 1787.

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[27] Screech, Timon, *The Lens Within the Heart, The Western Scientific Gaze and Popular Imagery in Later Edo Japan,* University of Hawaii Press, Honolulu, 2002, p. 15.

[28] Yoshimune (who ruled from 1716 until 1745) took an interest in aspects of Dutch studies which offered practical solutions to the economic troubles the country was experiencing. His purpose in encouraging *rangaku* is said to have been to facilitate Bakufu sponsored practical undertakings rather than to enlighten the people. Goodman, Grant K., *Japan: The Dutch Experience*, London and Dover, New Hamshire: The Athlone Press, 1985, Chapter 7.

[29] Katsuragawa Hoshū's interests were diverse and his works covered a range of different topics. Before his appointment as private physician to the shōgun he befriended the Swedish physician to the Dutch settlement, Carl Thunberg. Morishima Chūryō published the first Japanese-Dutch dictionary in 1788 and many other works besides. Screech, Timon, *op. cit.*, pp. 17,18.

Rangaku was restricted by the availability of materials, the lack of qualified instructors and the absence of a systematic method of acquiring Western knowledge but despite the many limitations it gradually attracted more disciples. While much of the information tended to be fragmented it is clear that knowledge of some of the latest technological advances did reach the *rangaku* scholars early in their development. Electricity is a case in point. Hiraga Gennai (1728-80), the son of a low ranking samurai, who became a *rangaku* enthusiast, obtained a broken electric generator from a Dutch interpreter in Nagasaki. With much experimentation and some help from other Dutch learning scholars he restored the machine and later was able to replicate it.[30] He established a salon where people could come to receive medical treatment or just to view the electric machine. Other Japanese are known to have constructed similar machines after Gennai.[31]

Hiraga Gennai experimented widely with foreign ideas and set up many different ventures with varying degrees of success. He experimented with sheepfarming, fire-resistant asbestos fabric, iron ore mining, large-scale charcoal production for use in smelting iron, ceramic making and mine surveys. He also made a name for himself as a scholar of botany and geology. In addition he organized popular exhibitions of various natural resources including mineral ores and medicinal plants. Other *rangaku* enthusiasts like Hiraga similarly experimented with Western technology.[32]

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[30] Morris-Suzuki, Tessa, *op. cit.*, p. 25.

[31] Screech, Timon, *op. cit.*, p. 46.

[32] Tessa Morris-Suzuki gives examples of two other enthusiasts, Takamori Kankō and Hosokawa Yorinao whose interest lay in electricity, clocks and automata. Morris-Suzuki, Tessa, *op. cit.*, p. 26.

Interest in European things extended beyond academia into the lower classes. In addition to academic works relating to the West, which were generally written in *kanbun*, the pseudo-Chinese writing style adopted by scholars, there also appeared works written in a form closer to spoken vernacular Japanese. These works were also written by scholars like Hiraga Gennai, often under pseudonyms, but were directed at a class of people who were educated but who could not readily understand the *kanbun* style of writing. Literature on Western themes and fiction permeated by *Ran* written by educated men was commonly found circulating around the Floating World (*ukiyo*).[33] These pleasure districts were places of escape from the usual restraits of society where samurai could socialize with members of the merchant class. Western novelties imported through the Dutch, including glasses, ceramics, lenses and cloth were also available in these districts.[34] The conditions in which *rangaku* developed often led to a perception of the West which did not exactly match the reality but it clear that, contrary to popular belief, information about the West was not restricted to the samurai elite, and was in fact accessible, to a certain degree, to the common people.[35]

From the nineteenth century *rangaku's* popularity grew steadily. Much of the new interest was directed at military science and was stimulated by a fear of Western

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[33]The Floating World was associated with the pleasure districts of the larges cities, such as the Yoshiwara in Edo, Shinmachi in Osaka, Shimabara in Kyoto and Maruyama in Nagasaki. Screech, Timon, *op. cit.*, pp. 22, 23.

[34] A wood block print of 1796 featuring Hikida's foreign goods shop in Osaka can be seen in Timon Screech *op. cit.*, pp. 26, 27.

[35] Screech, Timon, *op. cit.*, pp. 20, 21.

advances into the East.[36] The Japanese were aware of a rise in Western activity in East Asia both through the up-to-date reports on foreign affairs obtained through the Dutch and Chinese traders and through first-hand experience of encounters with Western ships in Japanese waters, which were occurring more frequently.[37] They were also aware of how powerful some of these nations had become and recognised that they could pose a threat not only to seclusion but also to Japanese independence. The opinion that Japan could best protect itself from these powerful nations by using Western knowledge and technology to strengthen its own nation emerged. For this knowledge the Japanese turned to *rangaku.* The trend is reflected in the establishment of a Bakufu official translation bureau, known as the Banshoshirabesho, in 1811.

The signing of the treaty of friendship with the USA in 1854 marked the beginning of the end of seclusion. As soon as news of Commodore Mathew Perry's success in signing a treaty of friendship reached the European powers, they arrived with similar demands. The possibility of a return to seclusion became more remote in 1858 with the conclusion of commercial treaties which opened up treaty ports to foreigner merchants. Despite resentment at having been forced to open their country and enter into unequal

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[36] Takashima Shirōtayū a former local official of Nagasaki, was one of the first to establish a school teaching Western military arts. He had received instruction in up-to-date military techniques and gunnery from Reserve Colonel Jon Willen De Sturler, chief of the Dutch factory in Dejima from 1823 to 1827 and had imported both weapons and books on the subject. Arima Seiho, "The Western influence on Japanese military science, shipbuilding, and navigation", *Monumenta Nipponica* 14 (1964), pp. 352-79.

[37] Russian expeditions to the Kurile Islands and Hokkaido often resulted in armed conflict with the Japanese and when the British warship *Phaeton* entered Nagasaki bay in 1808 looking for Dutch ships, they forced the Japanese to supply them with stores by seizing hostages. Beasley, William Gerald, *Great Britain and the Opening of Japan*, London: Luzac 1951, pp. 8 and 32.

commercial treaties by the Western powers, the new situation presented opportunities to learn more about the West and the technology behind its power. Despite internal tensions the Japanese embarked on a period of learning from the West and used this knowledge to modernize in a process which began slowly during the *bakumatsu* years and accelerated during Meiji.

When Westerners gained access to Japan in the mid-nineteenth century there were few visible signs of what was expected in an advanced nation; no large-scale industry, no steamships, railways, telegraphs, paved roads, or bridges and few signs of luxury in the daily life of the Japanese. The absence of these things may have given the impression that Japan was far behind the West in terms of development. However, Japan had a highly developed infrastructure and already possessed the foundations necessary for modernization.

Each region in the country, however remote, was linked through an extensive (though primitive by Western standards) domestic transportation network, to a nationwide commercial market working on a money economy. The general public had access to education and the literacy rate was high among all classes, from the samurai elite down to the merchant class, and comparable to levels in the most developed nations of the West. The volume and variety of published material accessible to the general population through commercial libraries and booksellers was great and knowledge was able to diffuse rapidly through the nationwide network. The custom of *yūgaku* also contributed to a diffusion of knowledge at a higher level of scholarship.

Information about Western affairs, including modern technology, though restricted to a certain degree, was available to scholars through the study of *rangaku* and to the general public through the many works published by scholars in colloquial Japanese. Foreign items also became widely available to the public. Experimentation with different aspects of Western technology was widely undertaken and many successfully reproduced machinery and techniques.

Technological innovation was also alive and well in Tokugawa society but took on a different form compared to that in the West. Innovations tended to focus on improving the quality of products rather than increasing the level of production through large-scale labour saving machinery as developed in the West. All of these developments helped prepare Tokugawa Japan for industrialization.

The Transition to Meiji

The events of early 1868, which resulted in the return of administrative power to the emperor, became known as the Meiji Restoration, *meiji ishin*, and the era which it began, the Meiji era. The Restoration was not a revolution since power remained in the hands of the samurai elite and the political and social structure was initially retained, but the era into which it moved was to be one of transition and marked a break from many of the traditions of the past.

When the new political leaders took over they had no definite political programme but they shared some solid basic principles and long-term aims which set the country in good stead. One of their immediate goals was to establish, then strengthen central control over the whole country and present a united front to the outside world. A weak and divided country was easy prey for the colonial powers. A second but equally important goal was to create wealth through international trade, for wealth was the key to military strength. This goal was summed up in the popular slogan *fukoku kyōhei*, enrich the country, strengthen the army. They also determined to revise the unequal treaties with the Western powers and to stand alongside the most advanced nations of the world as equals. The key to these goals was modernization and in order to obtain the necessary knowledge, technology and skills they turned to the West. This idea was embodied in the Charter Oath of April 1868, one of the first Meiji government documents issued in the name of the emperor, which stated that Japan would seek knowledge throughout the world to strengthen the foundation of the Imperial polity.[38]

In the first move towards centralized government the emperor was moved to Edo to take his place at the head of the administration and the city was renamed Tokyo, eastern capital. The old feudal system was gradually dismantled, beginning with the abolition of the domains and the withdrawal of samurai privileges. Prefectures replaced domains in a process known as *haihanchiken*, and governors elected by Tokyo gradually replaced the domain lords. Tensions initiated major uprisings in Saga and Satsuma but were quelled by the government. Despite the loss of their privileges, the samurai class, who were highly educated and possessed a strong sense of loyalty, amongst other qualities, were the most important group in the modernization process.

The improvement of communications was extremely important for centralization and later for the development of industry. Japan already had an extensive road and sea

[38] Details of the Charter Oath can be seen in Beasley, William Gerald, *The Meiji Restoration,* Stanford: Stanford University Press, 1991, pp. 322-24.

network although this was primitive by Western standards. During the early Meiji period, the government invested heavily in railways, roads, bridges, and telegraphs. Also high on the government's agenda was the promotion of trade, industry and a modern economy in order to create wealth. Japan had no significant industries of its own at the beginning of the period and the new industries established were at a great disadvantage because cheap, high quality imports began to flood the market from abroad and Japan was neither able to provide the same quality nor quantity to compete. Furthermore tariff stipulations in the treaties prevented them from regulating imports by the use of import duties. Technological skill and private capital were insufficient to fuel the development in these fields so the responsibility of obtaining the necessary skills, setting up and running new industries fell to the government. Large sums of money were invested in the purchase of modern equipment from abroad, the hiring of foreign experts and sending of Japanese abroad to aid in the technology transfer and promote industrial development.

These developments necessitated a reform in the educational system. The Japanese were fortunate in having a highly literate population due to the emphasis which had been placed on scholarship during the previous era. The education code of 1872 set out the aims of the government stating that education would be of Western style and, with the provision of schools in all towns and villages, would be made available to all citizens. Western teachers and advisers were brought into the system and texts were modelled on, or translated from, Western ones.

The burden of paying for modernization fell heavily on the government. Tax reform, in the form of a new centrally administered land tax was introduced to create revenue with which to pay for the enormous initial investment. Industries, once established and running were expected to create revenue later in the process. Fiscal reform and development of a modern banking system were also vital to development and urgently required. National banks were set up, the currency unified and sole rights to print notes were given to the Bank of Japan. By the end of the century Japan had been fully converted to the gold standard and the currency stabilized.

Meiji modernization was extensive and touched almost all aspects of Japanese life. The process was plagued with difficulties but remarkable progress was made. By the end of the Meiji period in 1912, the country was run by a centralized bureaucracy and had a modern judicial system. Light manufacturing industries were flourishing and exports of manufactured goods were significant. The foundations of heavy industries had been laid. There were extensive road, rail, telegraph and shipping networks, and a modern education system in which 90% of primary school age children of both sexes were attending school.

Scotland's Development up to the Nineteenth Century

In 1603 the Union of the Crowns brought Scotland and England together under one monarch and a century later in 1707 the Treaty of Union united their parliaments, creating one kingdom which became known as Great Britain. The union did not arise from popular support yet it was sought by the English Whig government and passed by a clear majority in the Scottish Parliament. Despite the uneasy relationship over the following decades the Union lasted and Scotland's development became closely tied to its neighbour's.[39] The Treaty of Union had granted Scotland the right to retain some of her institutions such as the legal system, the Royal Burghs, the Church of Scotland, and her education system and this gave her the right to make many of her own decisions and therefore hold a semi-independent status.

By the mid eighteenth century the Scots began to feel the economic benefits of free trade and became more involved in British affairs. For well-connected Scottish nobility and successful merchant companies career opportunities arose in London. For the majority of Scots, however, the greatest prospects were offered by the colonies. Ordinary Scots, who were comparatively well educated compared to their southern neighbours, were well placed to take advantage of career opportunities abroad. The remarkable success of the Scots in British politics, in leading merchant firms, in the army and navy as well as in administration and the professions in the colonies, triggered some resentment in London during the mid eighteenth century leading to

[39] For details of the motives behind the Union refer to Whatley, Christopher A., *Bought and Sold for English Gold? Explaining the Union of 1707*, East Linton: Tuckwell Press, 2001.

some 'Scottophobia'.[40] The Scots, however, were slowly becoming more comfortable with union.

In the more stable and prosperous environment of the mid to late eighteenth century the Scots turned their thoughts to matters of a more universal nature. It was a time when new ideas emerged to challenge accepted values and these ideas were debated openly in the public arena. This movement, which was part of a wider European phenomenon, became known as the Scottish Enlightenment. Scotland, though a small and impoverished country on the edge of Europe, made a remarkable contribution to this European Enlightenment.

Scottish universities played a major role in the Scottish Enlightenment due to their readiness to accept new ideas in areas such as philosophy, theology, law, medicine, mathematics and science. Many of those who contributed were university professors, ministers and lawyers who diffused their ideas through the universities, through journals such as the Scots Magazine and clubs such as the Literary Society in Glasgow, the Rankenian Club in Edinburgh and the Edinburgh Philosophical Society which became the Royal Society of Edinburgh in 1783.

According to Sir Henry Craik, the transition from the old Regenting system in universities to a Professoriate system was crucial in the Scottish Enlightenment.

[40] Devine, T. M., *The Scottish Nation, 1700-2000*, Harmondsworth, Allen Lane: The Penguin Press, 1999, pp. 27-8, "one confirmation of the growing Scottish success within the union was the Scottophobia that was generated in the capital in the 1750s and 1760s. This was especially so during the term of office of John, Earl of Bute, the first ever Scottish Prime Minister, when many of his countrymen were rising to positions of public prominence in the government."

"Under that system [The Regenting system] all the subjects of the curriculum were taught by one or another Regent to a certain number of the *alumni*; but the instruction was carried on by means of prescribed compendiums, in which the pupils were duly exercised, but from which no discursion was permitted." In the new system, professors were appointed to different subjects and had a certain degree of freedom in what they taught. "It was in their interest to attract and stimulate pupils, to extend the range of his science, and open up new fields of speculation, bringing his own personal influence to bear in the enforcement of his views." [41]

Scotland had always held education in high regard. By the end of the sixteenth century there were five universities in St. Andrews (established 1413), Glasgow (1451), Aberdeen (Kings College established 1495, Marischal College, 1593) and Edinburgh (1583), grammar schools in most large towns as well as numerous schools attached to collegiate churches, abbeys and cathedrals. Following the reformation of 1560 the protestant church placed greater emphasis on a universal education. Church pressure led to a series of Acts of the Scottish Privy Council and Parliament which introduced taxes on local landowners to pay for a local school and master. The system aimed to provide a public school in each Parish at affordable rates for as many people as possible. The taxpayers provided funds for establishing schools and hiring masters, student fees provided running costs and the church, the Kirk, ensured that teaching was of a suitable nature and standard. The aim was to link these parish schools to the town grammar schools and universities. This type of public education system differed

[41] Craik, Sir Henry, *A Century of Scottish History*, Edinburgh and London: William Blackwood and Sons, 1911, pp. 431-2.

significantly from England and most of Europe, where elementary education continued to be "based on fee paying schools, charities and endowments."[42]

By the beginning of the eighteenth century the education system was one of the best developed in Europe. Most parishes in Scotland, even in the remote highlands had a local school paid for by public funds. An increasing population and growing demand for education placed pressure on the public system and as a result private schools and charity schools began to emerge alongside these parish schools creating a varied and widespread elementary education system. The Universities offered a standard of education comparable to the great universities in Europe. "Overall, Scotland had a higher ratio of university places to population size than other European nations, an achievement which was in large part due to the function of the parish and burgh schools as feeders for higher education".[43] In comparison England had only two Universities at Oxford and Cambridge. From the 1760s vocational schools, known as town academies, emerged as alternatives to universities to teach practical subjects for those intending to become merchants or manufacturers. These schools were supported by subscription funds and usually managed by the local council and were crucial in Scotland's rapid economic development from the late eighteenth century.

It is difficult to determine the literacy rate in Scotland at this time. The duration of full-time education varied greatly across the social scale. Although most families were in favour of educating their children, wealthier families could afford to send their children to school for several years, while the less well off could only afford one or

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[42] Devine, T. M., *op. cit.*, p. 92.

[43] *ibid.*, p. 78.

two years' education. Among the latter group, priority was given to reading, with writing of secondary importance. Despite the difficulty in determining the literacy rate it is estimated that it was much higher than in England generally.[44]

Education continued to hold an important place in Scotland during the nineteenth century and student enrolment continued to rise. The Argyll Commission reported in the 1860s that one in 140 people in Scotland were receiving secondary education as opposed to one in 1300 in England. In 1865 one in 1000 Scots attended higher College or University education while the number was one in 5800 in England.[45] The high level of education provided at Scottish universities attracted students both from within Scotland and from abroad, particularly from Ireland and England.

Scottish universities were relatively poor in comparison to those in England, and heavily dependent on government for financial support. The lack of funding made it necessary to attract as many students as possible. Fees were kept low, requirements for university residence were dropped, entrance qualifications were relaxed and curricula were adapted and expanded, making the Scottish universities more accessible and attractive to a broad social range of students, even from modest backgrounds.[46] Oxford and Cambridge, in comparison, were expensive and elitist institutions attracting

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[44] *ibid.*, p. 97.

[45] Kita Masami, "Nisso hikaku keizaishino ichi kōsatsu: Henry Dyer. Dyer Kenkyū" (A view on the comparative socio-economic history between Scotland and Japan, A study on the foreign employee, Henry Dyer), *Sōka Keizai Ronshū,* 9/2, (1979), pp. 71-93; Smout, T.C., *A Century of the Scottish People, 1830-1950*, London: Fontana Press, 1997, p. 216.

[46] At Glasgow University in the early nineteenth century fees were £5 a year, one-tenth of those at Oxford or Cambridge. Devine, T. M., *op. cit.*, p. 98.

students from the wealthy landed class, or the church. The Scottish education system placed less emphasis on position and more on ability.

Scottish universities were considered as training centres for all the professions; for ministers, teachers, lawyers and doctors, and later for merchants and farmers, with the result that the curriculum was broad and included much practical science teaching. By 1800 there were twelve chairs in mathematics, science and medicine at Edinburgh University, five chairs in the sciences and medicine and two untenured lectureships in chemistry and in material medica at Glasgow University. These subjects were "more peripheral" at Oxford and Cambridge where the classics and theology were given greater emphasis.[47] The need to attract students and compete with the vocational schools also made the Scottish universities more open to new ideas and innovation which were important in Scotland's industrial development. Newtonian theory was introduced to Scottish universities very early, agriculture was first introduced as a university subject in Scotland, and Glasgow University was the first university in the world to establish a chair of engineering in 1840. In contrast, "the English universities were closed to non-conformists, and it was among the intellectual dissenters that much industrial enterprise was to originate".[48]

The emphasis on practical teaching and the links with industry were features of the Scottish education system which enabled them to contribute to industrial development.

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[47] Anderson, R. G. W., "Industrial Enterprise and the Scottish Universities in the Eighteenth Century", in Calder, Jenni, *The Enterprising Scot: Scottish Adventure and Achievement,* Edinburgh: Royal Museum of Scotland, 1986, p. 59.

[48] *ibid*, p. 59.

The first professors of Edinburgh's Medical school, John Innes, Andrew Plummer, Andrew St Clair and John Rutherford, appointed in 1726 were unsalaried and were expected to generate their own income. Student fees provided part of their income but the bulk came from a drug preparation and wholesaling business which they established and ran successfully alongside their teaching positions. "The professors were pursuing dual careers, as academics and industrialists." [49]

Circumstances such as these led several Scottish professors to turn their attention to practical uses of science and in doing so forge close associations with industry, particularly in Glasgow. One of the early students of Edinburgh's Medical school, William Cullen, became a lecturer in chemistry at Glasgow University from 1747. His interests lay in the improvement of the bleaching process for cloths and also in chemical uses for agriculture. When Cullen was appointed to Plummer's Chair in Edinburgh in 1756, one of his students, Joseph Black (1728-99), took over his position and carried on the tradition of practical research. Black's research interests ranged from the use of alkalis in bleaching to the properties of latent and specific heat and he was often consulted on a range of issues by local industries.

Two of Black's students, Charles MacIntosh and Charles Tennant improved the bleaching process using chlorine and lime and in 1800, established the St Rollox Chemical Works in Glasgow which became one of the major chemical plants in the country. Black also entered a business partnership with James Watt, mathematical instrument maker to Glasgow University, and Alexander Wilson, type founder. Watt

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[49] Anderson, R. G. W., *op. cit.*, p. 60.

made a name for himself with his improvements to the steam engine and he later joined with Matthew Boulton of Birmingham to build Watt's improved engines. He also had varied research interests.

Scottish universities extended their practical teaching to non-matriculated students by offering classes to occasional students and the general public. This system became common in the nineteenth century but was already in use during the previous century. Francis Hutcheson, Professor of Moral Philosophy at Glasgow University from 1729 gave lectures on Sunday evenings to "crowded audiences composed of citizens as well as students".[50] Cullen and Black both offered such classes, as did professors such as Robert Dick, Professor of Natural Philosophy at Glasgow University and his successor, John Anderson. The latter two both taught public courses in experimental physics and astronomy.[51]

The emphasis on practical teaching was continued into the nineteenth century by professors such as John Anderson, Lewis Gordon, William Thomson (later Lord Kelvin) (1824-1907) and William Rankine. [52]

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[50] Craik, Sir Henry, *op. cit.*, p. 436.

[51] Devine, T. M., *op. cit.*, p. 79.

[52] Information on Scottish Universities can be found in Carter, Jennifer J. and Withrington, Donald J., *Scottish Universities: Distinctiveness and Diversity*, Edinburgh: John Donald Publishers, Ltd., 1992.

Scotland's Industrial Revolution

From the mid eighteenth century, Scotland's economy began to show modest improvement as trade and small-scale manufacturing grew. This growth accelerated from the late century and it is from this point that Scotland experienced an agricultural and industrial revolution. Although part of a wider British and European phenomenon, the Scottish revolution differed in many respects. It is generally accepted that Scotland's revolution came later and was 'more compressed than its English counterpart'.[53] There were two distinct stages in Scotland's industrial revolution; the first roughly between 1780 and 1830, in which general products such as textiles, coal and iron played a major role, and the second from the 1830s to the 1880s as metal industries, particularly heavy engineering and shipbuilding took on the leading role. While the first stage relied on relatively unskilled production, the second required highly skilled production. By 1850, it is said that Scotland was more industrialized than the rest of Britain with employment in manufacturing higher than in England.[54]

During the initial stages of Scotland's industrial revolution, the major industries were textiles, particularly cotton, linen and wool. In the early stages of development, new technology, knowledge and experience was borrowed from south of the border and used to develop the industry in Scotland. Hand spinning gradually declined as spinning mills took over production. The cotton industry took the lead in the textile industries. Raw cotton imports increased five-fold between the 1780s and 1800 and

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[53] Whatley, Christopher, A., *The Industrial Revolution in Scotland, op. cit.*, p. 6.

[54] R.A. Cage gives an explanation of Scotland's contribution to England's development in Cage, R. A., *The Scots Abroad: Labour, Capital, Enterprise, 1750-1914*, London Sydney, Dover, New Hampshire: Croom Helm, 1985, p. 35.

the number of mills from one in 1778 to thirty-nine in 1795.[55] Because cotton spinning initially relied on waterpower, mills were located primarily in the countryside. James Watt's improvements to the steam engine soon led to the introduction of steam power in many spinning mills and other manufacturing industries, leading to greater mechanization and lifting restrictions on the geographical location of factories. Cotton mills became more concentrated in the Glasgow and Paisley areas. Less important but also expanding was the linen industry which became concentrated on the east coast around Dundee. Woollen industries also grew and concentrated in the border region of Scotland. In 1826 Sir John Sinclair estimated that over a quarter of a million Scots worked in the cotton, linen and, to a lesser extent, wool and silk spinning industries, accounting for approximately ninety per cent of manufacturing employment in Scotland.[56]

The development of a metallurgy industry in lowland Scotland over the first three decades of the nineteenth century prepared the country for the second phase of industrialization in which metal and heavy engineering played a major role. The metallurgy industry was encouraged by the increased mechanization in textiles. Although progress was initially slow, there were several factors which contributed to the industry's development. Central Scotland had an abundant supply of local raw material and fuel; iron and coal, which could support the nearby iron foundries and engine shops manufacturing machinery. Furthermore capital made available by the decline in the cotton trade was diverted into the industry and local innovators

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[55] Whatley, Christopher, A., *The Industrial Revolution in Scotland, op. cit.*, p. 25.

[56] Devine, T. M., *op. cit.*, p. 109 and Whatley, Christopher A., *The Industrial Revolution in Scotland, op. cit.*, p. 26.

contributed to development with various discoveries, inventions, and innovations. As a consequence of the early development of a metallurgy industry, Scotland had a substantial labour force of skilled engineers who could be easily directed into heavy industry and iron shipbuilding. Robert Napier established an iron foundry in Glasgow and progressed from making pipes for water and gas, to making components for marine engines, to building the engines themselves and finally to building ships.

The advent of new building materials, and advances in engine and fuel efficiency, steam power and ship construction, many of which originated in the west of Scotland, were crucial in the promotion of the Clydeside heavy engineering and shipbuilding industry. James Watt revolutionized steam power by improving the efficiency of the Newcomen steam engine.[57] This in turn led to experimentation in ship propulsion and in 1812 Henry Bell (1767-1830) launched Europe's first passenger steamboat, *The Comet*, from the Clyde. James Neilson (1792-1865), Manager of the Glasgow Gasworks, invented the hot-blast furnace in 1828 which increased fuel efficiency in iron production significantly. The hot-blast furnace could be run on raw coal instead of coked coal which led to significantly increased fuel efficiency and reduced costs. This gave Scottish iron manufactures an advantage over rivals and led to a dramatic rise in production from 23,000 tons in 1800 to 241,000 tons in 1840, accounting for 25 percent of total British output.[58] James Napier's horizontal tubular boiler, Robert Wilson's screw propeller which replaced the slower paddle, William Fairbairn's riveting machine for metal which led to his building the first iron steamship, John

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[57] James Watt (1736-1819) was born in Greenock and after learning basic engineering skills at his father's workshop, trained as a mathematical instrument maker in Glasgow.

[58] McCaffrey, John F., *Scotland in the Nineteenth Century,* Basingstoke: MacMillan Press, 1998, p. 30.

Elder's (1824-69) compound engine which expanded power, and Alexander Kirk's (1830-92) triple expansion engine all contributed to the Clyde's success.

On the eve of the First World War, Glasgow and the surrounding area had earned a name for innovation and was producing one half of the British marine engines, one third of the British ship tonnage and one fifth of the world's, one third of the railway locomotives and rolling stock, and one fifth of Britain's steel.[59] The heavy industries which concentrated in and around the city of Glasgow and along the Clyde earned Scotland the title of Workshop to the Empire.

Scotland's success was not confined to the West of Scotland nor the heavy engineering field, for the cities of Edinburgh, Dundee and Aberdeen also prospered and the textile industry continued to grow. Although cotton manufacture declined from the mid nineteenth century, production of thread, linen, tweeds and woollen goods continued to contribute significantly to Scotland's economy. Other growing industries were that of shale oil, and whisky distillation

Trade was crucial in the development of Scotland's economy and industry. Scotland was geographically well placed for trade on the border with England and between America and the European continent. As the Atlantic trade grew in importance during the eighteenth century ports along the western coast of Europe thrived. The ports along the Clyde expanded and became leading centres of importation of tobacco, sugar and cotton. Scots became heavily involved in the tobacco trade with North America and by

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[59] Devine, T.M., *op. cit.*, pp. 249-50.

1765, controlled 40 per cent of the UK trade.[60] The majority of tobacco imported into Britain was then re-exported to Europe. North America was also an important export market for Scottish manufactures although its importance declined with American independence and Scottish industries began to expand into South America, Asia and Australia.

Scottish industry prospered over the nineteenth century and became more heavily dependent on the export market. This prosperity led to greater capital investment in transportation and communications; in the development of canals, railways, and shipping, and fuelled further development and expansion of export markets. The rapidly developing economies in America, Australasia, and Asia created a demand for ships, locomotives and heavy machinery and Scotland's pre-eminence in these fields placed her in a good position to supply these products. Scotland, and the rest of Great Britain, had the advantage of being first in industrialization and therefore had no significant competition. Between 1860 and 1885 metallurgical industries became Scotland's chief economic activity.

Scots Abroad

Scots have always displayed an interest in foreign lands and a tendency to migrate, whether to fight, study or trade. This tendency continued and indeed increased after the Union of the Parliaments and throughout the industrial revolution. As a consequence, the Scots were active in many regions of the world during this period,

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[60] *ibid.*, p. 105.

particularly in the countries which made up the British Empire. The reasons why so many Scots were attracted to foreign shores at this time are varied. Some went in search of adventure, some to spread God's word, while others saw better opportunities to make money or to climb the social ladder. Whatever their reasons, many of them made an impact on the countries they travelled to.

Scots showed an interest in foreign settlement and trade from early times. They crossed over to Ireland in the early fourteenth century with Edward Bruce, Robert Bruce's brother, to fight against the English in an attempt to rid the country of its English occupiers and many of them stayed. Much later James VI encouraged settlement in Ireland by granting areas of land in Ulster to interested Scots. They were also commercially active in England and Western Europe and, as time progressed, further a field. From as early as the fifteenth century, Scots were actively fishing and whaling off Iceland and Greenland and by 1600 a Dundonian merchant is known to have been trading with Newfoundland.[61] Due to the scarcity of records before the seventeenth century it is difficult to determine the scale of Scottish trade with such regions but the few examples that are known indicate that the Scots had begun to look beyond their traditional commercial partners in Europe before Union with England.

During the early seventeenth century the Scots made several colonizing ventures to America. Spain and Portugal had already established themselves in Central and South America, England in Virginia, France at Port Royal and Quebec and Scotland attempted to do so in Nova Scotia. The venture failed to attract large numbers of Scots

[61] Fry Michael, *The Scottish Empire,* East Lothian and Edinburgh; Tuckwell Press and Birlinn, 2001, p. 20.

and the few who did take up residency in the area did not remain there for long. Unsuccessful as these attempts were they do show that the Scots possessed an adventurous spirit.

Later in the century a plan was made to establish a Scottish colony on Darien on the Isthmus of Panama. However, bad organization, corruption, attacks by Spanish colonists, obstruction by the English and tropical disease all combined to force the colonists to abandon the colony only three years after its establishment. Two thousand colonists had made their way to Darien but only a small number survived and over £200,000, estimated at one-quarter of Scotland's liquid capital, was lost. The failure of the venture was disastrous for Scotland's economy as well as her morale and is said to have been one of the major reasons behind Scotland's decision to abandon independence and accept Union with England.

After Union with England the Scots continued to take an interest in foreign ventures, but from this point they did so alongside their union partners. They gradually established themselves as traders, administrators, and military leaders in English territories such as North America and India. Foreign Service offered adventure and an opportunity to climb the social ladder. The Scots willingly took up such posts and were well represented among the British staff. For example, Scots took up to 30 per cent of administrative posts in Bengal in 1750.[62] They proved themselves hardworking and loyal servants to the British Empire and many rose to prominent positions. Those who profited from trade were often able to buy their way into respectability by acquiring

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[62] Fry, Michael, *op. cit.*, p. 85.

large estates at home and marrying into the nobility.

This tobacco trade brought considerable wealth to Scotland but it was soon disrupted by the American war of independence and never fully recovered. Fortunately much of the profit generated was reinvested into other products and into other regions. Sugar and cotton plantations in the West Indies attracted much of this investment and Scots flocked to the region. Up until the abolition of slavery in the 1830s, Scots "numbered one in three of the whites on Jamaica" and the majority in Tobago.[63]

The Scots also made their way east, most often as employees of foreign governments or companies. For example a Scot by the name of William Carmichael worked for the government of Portuguese India in the early 1600s and a William Campbell was in Dutch employ in the East in 1832.[64] Scots were found in many of the English East India Company's European rival companies and after the Union, they began to infiltrate the English company which held a monopoly of trade between Britain and the East. When the company's monopoly was broken; 1813 in India and 1833 elsewhere, Scottish trading firms began to spring up across the East. One feature of these Scottish firms was their clannishness; they preferred to hire Scots, often relatives or friends, above other nationalities. These firms traded in such commodities as tea, rice, cotton, silk and jute. Several, notably the firm of Jardine and Matheson, one of the largest and most successful merchant companies to grow in the East also made large fortunes in the trade of opium and weapons and played no small part in promoting the opium wars with China.

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[63] Fry, Michael, *op. cit.*, p. 72.

[64] Fry, Michael, *op. cit.*, p. 304.

During early adventures many of the Scots who travelled abroad did so with the intention of returning to Scotland once they had established a name for themselves or had made their fortune. Even after the Union this mentality remained and levels of emigration were relatively low. Towards the end of the eighteenth century, however, emigration to regions such as Canada became much more common. The development of new regions of the world attracted immigrant farmers first, but as these populations rose it also created a demand for professionals such as doctors, teachers and ministers. Scots valued their education and religion and took many of their own educators and ministers with them. As the industrial revolution spread out from Britain in the nineteenth century, Scotland also contributed many skilled engineers and artisans to the New World. Having been the first country to experience such industrial development, Britain had a large population of skilled labour and a well-established training system.

Scots, who pursued careers abroad, whether as permanent emigrants or temporary residents, were generally well educated and highly skilled and their success in the professions, in trade and administration abroad was due in great part to the education and training which they had received at home. While it cannot be said that their activities were always beneficial to local communities, in many cases they did invest in schools, railways and banks for the benefit of both themselves and the local residents.

Scottish Identity

Scottish society was transformed by the rapid industrialization and urbanization of the nineteenth century and many say, became increasingly Anglicized during this period of economic development. Scottish politicians and businessmen favoured closer integration with England in their commitment to Empire and many of the Scottish aristocracy chose to be educated in England to increase employment opportunities. The Disruption of 1843 which led to the disintegration of the national church removed one of the strongest influences on Scottish life which distinguished it from England.

However, the degree of Anglicization has been exaggerated, for Scottish society retained much of its distinctiveness. Sir Henry Craik wrote in 1911,

> While the epoch during which Scotland had maintained her independence by the sword had now closed, and while the sword was growing rusty in the scabbard by disuse, it must not be assumed that the two nations were brought more close in sympathy. In everything that constitutes national life the Scotsman stood in sharp contrast to the Englishman. His language was then, and continued for long to be, marked by such strong dialectical peculiarities that it was to the Englishman, to all intents and purposes, a foreign tongue. His notions as to religion and church government entered very deeply into his mind and character; and they were notions which the Englishman neither understood nor cared to understand.[65]

This was due, in a large degree, to the fact that daily life in Scotland continued to be governed by the Scottish institutions which had been retained from before 1707, allowing Scotland to be governed with considerable autonomy within the union.

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[65] Craik, Sir Henry, *op. cit.*, chapter 1.

Graeme Morton wrote, "Scotland's distinct civil society within the British state was labelled by John P. Macintosh as producing a 'dual nationality' where the Scots can be British if they wish, or, if not, they can 'opt out' and their identity can return to being a Scottish one."[66]

Instead of diminishing as might be expected, Scottish identity did in fact strengthen. Sir Henry Craik wrote, "All that threatened to obscure and obliterate the traditions of Scotland, all that weakened the sense of her nationality, all that portended her subjection to the moods of her more powerful neighbour, stirred a sense of patriotism that was not altogether unpleasing.... Such an atmosphere was eminently fitted to encourage the literary side of Scottish national life, and the exasperation of offended patriotism found in that sphere a safer and a more congenial occupation"[67] There was a revival of Scottish vernacular literature by Allan Ramsay and Burns and poems by John Barbour and Blind Harry, portraying the heroic actions of Bruce and Wallace, and novels by Sir Walter Scott became hugely popular. The formation of the National Association for the Vindication of Scottish Rights in 1853, the construction of the Wallace Monument in 1869 and the adoption of the kilt and highland dress as the national costume indicate that patriotism was alive among the people.

The Scots were proud of the role they played in Britain's achievements during the eighteenth and nineteenth centuries. They were comfortable with their distinctiveness for they felt themselves equal to their English neighbours. They contributed greatly to

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[66] Morton, Graeme, *Unionist Nationalism; Governing Urban Scotland, 1830-1860,* East Linton: Tuckwell Press, 1999, chapter 1.

[67] Craik, Sir Henry, *op. cit.*, p. 339.

Britain's industrial revolution and to the development of the British Empire. In the 1860s Charles Dilke wrote of the Scots in India, "For every Englishman who has worked himself up to wealth from small beginnings without external aid, you find ten Scotsmen. It is strange, indeed, that Scotland has not become the popular name for the United Kingdom." [68] In 1888, John Nichol, Professor of English Language and Literature in the University of Glasgow wrote, "The Scotch are, in some respects, the most reticent, the most long-suffering, as well as the most stubbornly strong race in Europe; but they are self-sufficient, if not vainglorious, their patriotism is aggressive, and their love of approbation is intense."[69] In addition, despite the fall of the national church, religion did continue to influence the daily lives of the Scots. The nationalism displayed by the Scots was not hostile to the British State and not of a kind seeking parliamentary independence but a type described by Graeme Morton as "Unionist Nationalism".[70] Scotland's economic success and the considerable autonomy of her institutions did not compel her to seek national independence.

Britain, Japan and Scotland

The first Englishman known to have set foot on Japanese soil was William Adams who arrived in Japan aboard a Dutch ship in 1600. Thirteen years later, John Saris in the employ of the English East India Company sailed to Japan to establish a factory there. According to Miyanaga Takashi, a report by Murai Masahiro (1693-1759) suggests

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[68] Quote taken from Fry, Michael, *op. cit.*, p. 319.

[69] Nichol, John, "Scotch University Reform" *Glasgow University Pamphlets, University and Educational, Chapter 9*, James Maclehose & Sons publishers to the University 1888.

[70] Graeme Morton gives his interpretation of Scottish national identity between 1830 and 1860 in *Unionist Nationalism, op. cit.*

that the English actually arrived in present day Fukuoka prefecture half a century earlier in 1548, just five years later than the Portuguese.[71] However, Murai's sources are unknown and therefore cannot be corroborated. Miyanaga also writes that a Spanish source (which he does not specify) describes a visit to Nagasaki by the British in the late sixteenth century. It is possible that there were British crewmembers aboard some of the Spanish ships.

It would appear that the Scots also made their way to Japan in the seventeenth century. Scotland was an independent country at this time but shared one monarch with England from the time of the Union of the Crowns in 1603. An English ship which visited Hirado in 1671 reported that there were Scots and Irish in Hirado but could not explain why they were there.[72] It is possible that they were the offspring of traders who had arrived in Japan with the English East India Company between 1613 and 1623, or that they arrived aboard Dutch ships, for it was common for Scots to be employed on European ships at the time. However, their reasons for being in Hirado can only be speculated at this point.

After the closure of the Hirado factory several attempts were made by the English during the seventeenth century to re-establish trading links but with no success. For almost one hundred and twenty years after the last attempt in 1673, English ships (British after the Treaty of Union in 1707) made no visits to Japan. From the 1790s there were a few renewed attempts but they too ended in failure and it was not until

[71] Miyanaga Takashi, *Nihon to Igirisu Nichiei Kōryū no Yonhyaku Nen*, Tokyo: Yamakawa Shuppansha, 2000, p. 5.

[72] *ibid.*, p. 33.

1854 that the British were able to resume formal contact with Japan and not until 1858 that trading links were resumed.

Scottish links

The conclusion of friendship treaties in 1854 and commercial treaties in 1858 with America, Britain, France, Russia and Holland, saw the return of Westerners to Japan. Merchants operating in the Far East welcomed news of the treaty and began to arrive in the agreed treaty ports of Nagasaki, Yokohama and Hakodate, some even before the treaties had been finalized. British merchants came to dominate the treaty ports as they did in other parts of Asia. This is illustrated by the fact that of fifty-seven foreign merchants renting land in Nagasaki in 1861, thirty-seven were British.[73] Merchants were not alone among the Westerners who arrived in Japan. Diplomats took up official positions and a variety of tradesmen settled in the treaty ports. The increasing demand for knowledge of the West among the Japanese led to the hiring of many Western teachers, doctors and later technology experts.

Scots were among the first Westerners to arrive in Japan. In 1858, shortly after the conclusion of the commercial treaty between Japan and the United States of America, the Earl of Elgin arrived as the British diplomatic plenipotentiary to obtain a similar treaty for Britain.[74] He was the first British representative to be sent to Japan since Stirling's visit in 1854 when the treaty of Amity was signed, and he was a Scot. The

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[73] Fox, Grace, *Britain and Japan, 1858-1883*, Oxford: Clarendon Press, 1969, p. 327.

[74] The first treaty with America was concluded by Townsend Harris who also aided Elgin in his negotiations.

Scots were well represented in the British diplomatic service and the Earl of Elgin was the first of several Scots to serve in Japan.[75]

The leading British merchant company in Asia and one of the first to establish offices in Japan was the highly successful Scottish firm of Jardine, Matheson & Company.[76] This company was one of several Scottish enterprises which had emerged after the collapse of the English East India Company's monopoly in Far Eastern trade. Like many Scottish companies it hired large numbers of Scots for its ventures abroad. This clannishness was very common among Scots companies at the time. The firm, which had already been trading indirectly with Satsuma through the Ryūkyū Islands for almost a decade, sent two Scotsmen, William Keswick and Kenneth Ross Mackenzie to Nagasaki in January 1859, several months before the official opening of the port, to investigate trading possibilities. Later that year the company established offices in Nagasaki and Yokohama with Mackenzie and Keswick as representatives.

In addition to his duties with Jardine, Matheson & Company, Mackenzie acted as an agent for another Scottish concern, the Peninsular and Oriental Steam Navigation Company. P. & O. had sent another Scot, Thomas Sutherland, to Nagasaki in 1859 to investigate commercial possibilities and as a result of his investigations established an office in Yokohama and Nagasaki.

[75] According to Devine, T., *op. cit.*, p. 290 one third of the colonial governor-generals between 1850-1935 were Scots.

[76] Jardine Matheson and Company was established by two Scots, Huge Matheson and William Jardine, in 1832. Jardine Matheson & Co., *Jardine, Matheson & Company; An Historical Sketch*, Hong Kong: Jardine Matheson & Co., 1960.

Thomas Glover and the Nagasaki Scots

In September 1859 another young Scot by the name of Thomas Blake Glover arrived in Nagasaki from Shanghai to work alongside Mackenzie. He became one of the best known foreigners of the *bakumatsu* and Meiji periods and probably the best known Scot. He established his own company of Glover and Co., and with Mackenzie's departure in 1861, became Jardine, Matheson & Company's representative in Nagasaki. By 1865 his company was one of the leading merchant firms in Nagasaki, having sixteen employees, being an agent for six insurance companies and having representatives in Yokohama and Shanghai.[77] Mackenzie had moved back to Shanghai in 1861 but he returned to Japan in 1867 to join Glover's company as a partner. He worked in the company's Osaka branch then, when his health deteriorated, he moved back to Nagasaki where he died in 1873.[78]

Foreign merchants were generally restricted to the treaty ports and had minimal contact with ordinary Japanese. Consequently their knowledge of the conditions within Japan and her people was also very limited. Glover stands out among the foreign merchants because he took an interest in Japan and its politics and his activities extended beyond trade. He was a prominent member of the foreign community but he married a Japanese woman, learned to speak Japanese and made friends among the locals. He is well known for having made his fortune by selling arms and ships to the anti-Bakufu samurai of the western clans but his relationship with them extended

[77] Fox, Grace, *op. cit.*, p. 330.

[78] Earns, Lane R. and Burke-Gaffney, Brian, *Across the Gulf of Time: The International Cemeteries of Nagasaki*, Nagasaki, Nagasaki Bunkensha, 1991, pp. 32-3.

beyond trade. He aided several groups of travellers from these clans to study in Britain while the Bakufu ban on travel was still in place, among them several men who became senior officials in the Meiji government.

Over and above these activities, he is also known for introducing modern technology to Japan. He built the first dry dock in Japan for ship repairs; the Kosuge dock, demonstrated the first full-sized steam locomotive, introduced steam pumps for the first time in mines at Takashima and ran one of the first private telegraph lines.[79] These activities may have been designed to boost his business in Japan but it is clear that the Japanese regarded him as more than just another foreign merchant. He maintained contact with many leading Meiji officials and business men throughout his life, acted as a consultant to Mitsubishi in his later years and was awarded the Second Order of the Rising Sun in 1908 for his many contributions to Japan. These all suggest that Glover was held in high regard by the Japanese.

The decline in Nagasaki as a trading centre as well as a drop in demand for arms after the Restoration and the difficulty in collecting on domain debts led to the liquidation of Glover's company in 1870. His situation was not unique for other prominent foreign firms in Nagasaki's treaty port, such as Ryle, Holme and Alt & Co., went into liquidation around the same time.[80] *The Nagasaki Express*, the local English

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[79] There is some uncertainty about whether Glover actually did demonstrate a full sized locomotive because no mention seems to have been made in the local English language newspapers.

[80] Announcements of these and other firm's liquidations were made in the local English newspapers. Glover's bankruptcy was announced in the August 27th 1870 edition of *The Nagasaki Express*, Alt & Co.'s liquidation in the January 21st 1871 edition and Ryle & Holme in the February 3rd 1872 edition.

Newspaper, often reported on the decline of trade in Nagasaki.[81] Despite his bankruptcy, Glover remained in Nagasaki and continued to hold a prominent position in the Nagasaki settlement.

Several members of Glover's family and friends also joined him in Nagasaki over the years. John S. Massie, a childhood friend of Glover's, travelled to Nagasaki in 1864 aboard the *Satsuma,* one of the ships ordered through Glover & Co. from an Aberdeen shipyard for the Satsuma clan. He worked at Glover & Co. until its bankruptcy in 1870 then moved to the firm of Gribble & Co., also in Nagasaki. In 1872 he established the International Hotel in Nagasaki which proved a great success. He married a Japanese woman and lived in Nagasaki until his death in 1917.[82]

Thomas's oldest brother James joined him in Nagasaki in 1861 and became a partner in Glover & Co. on its establishment in 1862. His youngest brother Alfred Berry Glover arrived in Nagasaki in 1867 and also joined the company. After the company's bankruptcy he worked for Takashima mine, Gribble & Co. then Holme, Ringer & Co. He remained with the latter firm until 1904. When his health failed he decided to return to Scotland but died on board the ship which was to take him home. His body was returned to Nagasaki and buried at Sakamoto International Cemetery. Thomas's sister Martha Anne Glover moved to Nagasaki in 1895 after the death of her husband

[81] The following report appeared in the Saturday July 22nd 1871 edition of *The Nagasaki Express*. "The condition trade is in at this port has for some time past been a question of very serious importance to those interested in it....Beyond having a trade in coal and tea, both of which articles are likely to cause a few firms to remain, Nagasaki has but little business of any other description worth speaking of, so that literally the port, year by year continues on its downward course."

[82] Earns, Lane R. and Burke-Gaffney, Brian, *op. cit.*, p. 119.

and son to tutor Thomas's daughter, Hana.

As well as merchants, there were many other Scots who lived and worked in the treaty ports of Japan. Another early Scottish resident of Nagasaki, also an Aberdonian, was James Mitchell who arrived in 1859. He established a shipyard in Nagasaki which he named *The Aberdeen Yard*. He was a ship carpenter who had formerly worked for the famous Alexander Hall & Co. shipyards in Aberdeen.[83] His yard advertised "vessels of every description to order" in the local English newspaper, *The Nagasaki Shipping list and Advertiser*.[84] He built a schooner yacht in 1861, the *Phantom,* for William Alt, which was reported as being the first European ship constructed in Japan.[85] He was also involved in the construction of the Kosuge ship repair dock with Thomas Glover. He moved to Shanghai in 1880 and opened a shipyard there but later returned to Japan, moving to Kobe where he worked as a house builder until his death in 1903.[86]

John Stoddart, a mining engineer, was employed by Thomas Glover to supervise Glover's operations at Takashima coalmine. Stoddart was born and educated in Scotland and after graduating from Edinburgh University entered an apprenticeship in the firm of Rankin & Co. in Glasgow. He moved to Nagasaki in 1878 at the request of Thomas Glover and became an employee of Mitsubishi in 1881 when Takashima mine was taken over by that company. He continued to work for Mitsubishi on several other

[83] McKay, Alexander, *Scottish Samurai; Thomas Blake Glover 1838-1911*, Cannongate Press, 1997, pp. 30, 31.

[84] This newspaper was only in existence for a few months from July 1861 until November 1861.

[85] *The Nagasaki Shipping list and Advertiser*, July 6th, 1861.

[86] Earns, Lane R. and Burke-Gaffney, Brian, *op. cit.*, pp. 27, 28.

mining projects in Kyushu until his death in 1892.[87]

The Iwakura Mission in Scotland

On December 23rd 1871 a special embassy, known as the Iwakura Mission, departed from Yokohama to begin a tour of all of the major industrial nations including the USA, Britain, France, Germany, and Holland. The Embassy was composed of forty-six officials and approximately fifty to sixty students. Among the members were some of the highest-level government officials including Iwakura Tomomi (Ambassador Plenipotentiary and Deputy Prime Minister), Ōkubo Toshimichi (Minister of Finance), Kido Koin (Takayoshi) (Privy Counsellor), Itō Hirobumi (Minister of Public Works) and Yamaguchi Masuka.[88] Although the Bakufu had dispatched three missions abroad in the previous half decade none had been on such a scale or attended by such distinguished men. The tour was scheduled to last one year but in reality it lasted almost two years and the main party returned to Japan on September 13th 1873.

The Embassy had three major objectives; to seek recognition from the Western powers of the new Meiji regime, to investigate Western progress with a view to adopting those aspects appropriate for Japan and to renegotiate the unequal treaties. The first two objectives were, on the whole, successfully accomplished but the last proved impossible. Treaty negotiations were pursued during the seven months spent in the

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[87] Earns, Lane R. and Burke-Gaffney, Brian, *op. cit.*, pp. 59, 60.

[88] Yamaguchi's given name has often been mistakenly pronounced as Naoyoshi. In the guest book of a porcelain factory visited in Florence during the tour he signed his name Yamaguchi Maska. Takeoshi Toshokan Rekishi Shiryōkan, *Iwakura Shisetsudan Hyakusanjū Nen: Umi ni Karin o Yamaguchi Masuka no Beiō Kairan,* Takeo: Takeoshi Toshokan Rekishi Shiryōkan, 2002.

United States and the Embassy's stay was extended because of them. However, by the time they departed for Britain it was clear that the United States regarded renegotiation of the treaties as premature and the European powers were sure to feel the same way. The Japanese resigned themselves to the situation and concentrated on the first two objectives during the remainder of the tour.

The members of the Mission spent most of the time travelling in smaller groups, each with their own itinerary, investigating different aspects of Western civilization, from the country's laws, government, industry, transportation, to their education system. Generally the higher-ranking ambassadors including Iwakura Tomomi, Ōkubo Toshimichi, Kido Koin, Itō Hirobumi and Yamaguchi Masuka travelled together but occasionally they too split into smaller groups.

Throughout the whole trip, Iwakura's secretary, Kume Kunitake kept a detailed record of Iwakura's movements and the group's observations and this record was published in 1878 as the five-volume *Ōbei kairan jikki.* The diary is divided into sections according to the country visited and records observations on each region's politics, economics, military, industry, education systems, medical systems and customs. In the published diary there are also sections which are taken from guidebooks, scientific journals, commissioner's reports and various other documents collected during the journey. The itinerary followed in the diary was that of Iwakura's travels and many of the places visited by other members of the mission are not included in it. Information on the other travellers can often be obtained through local newspapers.

The Iwakura Mission arrived in Britain on July 14th 1872 and spent four months on an extensive investigative tour of the country. During their stay in Britain a number of the members, including the main ambassadors, spent almost two weeks in Scotland investigating industrial and agricultural sites. The Embassy travelled to many regions of the country, from the very south of England to the Highlands of Scotland. In each region they observed various aspects of British life and work. In the south of England diplomatic duties and inspections of naval and military facilities took up the majority of their time. In the north of England and in Scotland the main focus was on industrial processes. During the two weeks spent in Scotland iron foundries, shipyards, paper making facilities, rubber works, paraffin works, sheep and cattle farms were among the many facilities inspected.

The main party of the Mission, including Iwakura Tomomi, Ōkubo Toshimichi, Kido Koin, Itō Hirobumi and Yamaguchi Masuka arrived in Glasgow by train on the evening of October 9th 1872. They were taken to Erskine House in Blantyre where they spent their first few nights as the guests of Lord Blantyre. Two other parties, referred to by the *Scotsman* newspaper as the Agricultural Commissioners and the Scientific Staff were already in Scotland when they arrived. The Agricultural Commissioners were based at Burntisland in Fife and the scientific staff in Edinburgh.

On the morning of October 10th the main party of ambassadors were greeted at the station in Glasgow by the city's Lord Provost and other local dignitaries. Their arrival had also attracted a large crowd, "among whom were several natives of Japan."[89] They were taken to various places of interest in the city including two locomotive works; Mr

[89] *Scotsman*, October 11th 1872, p. 5.

Higginbotham's Works and Mr Dub's Locomotive Works in Rutherglen Road, the Royal Exchange and the Chamber of Commerce. After attending a reception in their honour at the Chamber of Commerce the party continued their tour around central Glasgow in carriages provided by the Lord Provost before boarding the five o'clock train back to Blantyre

On the following day the group, consisting of about twenty, visited the engineering works and shipbuilding yards of Messrs. Caird & Co. in Greenock and the sugar refinery of Messrs John Walker & Co. At Caird's shipyards they were able to observe work on the steamship the *City of Chester*, the largest merchant vessel in the world at the time, which was under construction.

On the afternoon of October 12th the ambassadors left Blantyre for Edinburgh where they continued their tour. On their first full day in Edinburgh they visited the Signet Library, the Parliament House and Courts, the Museum of Science and Art, the Edinburgh University Library, Holyrood Palace, Messrs. Umpherston & Co. Engineering Works, Leith Oil Mills owned by Messrs. Tod and Thomson, flour mills owned by Messrs. A. & R. Tod, a printing ink factory owned by Messrs. Fleming and Co. and a rope and sailcloth manufactory of the Edinburgh Roperie Company. "In all of these establishments the gentlemen forming the Embassy seemed very much interested and took away with them samples of the various manufactures."[90] Despite their busy schedule they were also able to take time out to climb Arthur's Seat for a view over the city.

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[90] *Scotsman*, October 15th 1872, p. 5.

On the 16th, the group sailed to the Bell Rock and the Isle of May to view the lighthouses there. According to the *Scotsman* newspaper "one of the chief objects" of the Mission's visit to Edinburgh was "to make further arrangements for the construction of lighthouses along the Japanese coast."[91] The company of D. & T. Stevenson in Edinburgh had been consultants to the Japanese Lighthouse Service from 1868. Their role will be discussed in a later chapter. They were responsible for designing and supplying equipment as well as selecting personnel to send to Japan. Henry Brunton, who was sent out by the Stevenson Company as Chief Engineer to the Japanese Lighthouse Service, was on home leave and accompanied the Mission in Scotland. Also accompanying the group was Mr Cunningham of the Northern Lighthouse Commissioners and the Messrs. Stevenson. The *Pharos* lighthouse ship belonging to the Commissioner of the Northern Lights was placed at the Mission's disposal on the day. Weather conditions prevented them from landing at the Bell Rock but they were able to land at the Isle of May where they inspected lighthouse apparatus and toured the light keepers' dwellings.

Iwakura, Kume and several other officials, accompanied by Sir Harry Parkes, took a trip north into the Scottish Highlands from October 17th to 19th. They travelled to Blair Atholl, Aberfeldy, Killin, the Trossachs, Callander, Loch Katrine and Loch Lomond before returning to Edinburgh. At Loch Katrine they inspected the Water Works which had been built to supply the city of Glasgow. On the evening of the 19th they returned to the Royal Hotel in Edinburgh.

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[91] *Scotsman*, October 15th 1872, p. 5. Unfortunately I found no record in the Stevenson company record books of the meeting between the Stevenson brothers and the Iwakura Mission.

While Iwakura was touring the highlands, the other ambassadors remained in central Scotland and continued their tour. Itō Hirobumi, Kido Takayoshi, Ōkubo Toshimichi, Yamaguchi Masuka and three Public Works officials, Mr Hayashi, Mr Otori and Mr Utsunomia, visited Young's Paraffin Oil works at Bathgate with Henry Brunton. After the visit, Itō and the Public Works officials continued by train to Glasgow where they checked into the Queen's Hotel. Kido, Ōkubo, and Yamaguchi returned to Edinburgh.

The three ambassadors in Edinburgh spent the 18th visiting the Merchant Company's Ladies School and the *Scotsman* newspaper office. At the school they were given a tour and observed several classes and at the *Scotsman* office they observed the printing presses at work. In the evening they joined Mr Yura of the Agricultural Commissioners in Burntisland for a banquet which was held in honour of their host Mr Scott. [92] The next day on Mr Yura's recommendation they visited agricultural implement works and farms in Leven and Kirkcaldy.

While in Glasgow the Public Works officials, lead by Itō, toured various manufacturing works in the area. These included the cabinet works and warehouses of Messrs. Wyllie and Lochead, Templeton's carpet factory, Messrs. Elder & Co.'s shipyards, Elder's engineering works, the paper-hanging factory of Messrs Wyllie and Lochead, Messrs. Smith & Sons foundry, where artistic iron castings were made, and

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[92] The spelling of the name Yura, which appears in the *Scotsman* newspaper, is probably incorrect. The only name similar to Yura among the Iwakura Mission's attendees is Yuri. This name appears in Tanaka Akira's list but none of the other lists consulted. Few details are given about this man or his position in Tanaka's list so it is impossible to determine whether it is the same man. Tanaka Akira, *Iwakura Shisetsudan* [Beiō Kairan Jikki], Tokyo: Iwanami Shoten, 2002, p. 245.

Messrs. Hannay & Sons' Blochairn Iron Works.

The Agricultural Commissioners, led by Mr Yura and Dr Fukui, were the guests of Mr Scott of Lochie House in Burntisland from October 9th. From their base in Burntisland they visited several farms, including the farm of cattle breeder Mr Drysdale at Kilrie, and a sheep farm at Glassmount. According to the *Scotsman* newspaper it was the rearing and feeding cattle to which their attention was to be "principally devoted in Scotland" although they also visited several arable farms.[93] From October 10th they visited industrial works including floor cloth and linen factories in Pathhead, damask factories in Kirkcaldy, and Messrs. Henry Balfour & Co.'s iron foundry in Leven. Balfour's company manufactured a variety of implements, mainly agricultural, but they were also constructing "tanks and other apparatus for the mint in Japan" at the time of the visit. Mr Yura "commissioned Mr Anderson, of H. Balfour & Co., to furnish him with the cost of various agricultural implements, steam engines and farm gearing."[94] Afterwards they inspected the process of manufacturing artificial food for cattle. On the Sunday they attended a local Free Church service.

While in Burntisland Mr Yura's group visited two young Japanese brothers, Messrs. "Sirita" who, "have been studying here for some time" at Lochies Academy.[95] According to the *Scotsman*, Mr Yura "has engaged to place his own son under Mr. Scott's care."[96]

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[93] *Scotsman*, October 11th 1872, p. 5.

[94] *Scotsman*, October 14th 1872, p. 4.

[95] No further information on these two brothers has been found at this point.

[96] *Scotsman*, October 15th 1872, p. 5.

The third party, initially accompanied by Henry Brunton, visited paper mills of Messrs Cowan at Penicuik, the Bonnington Chemical Works and the North British Rubber Company's works. Three of the scientific staff left Edinburgh for Newcastle on 17th October.

Iwakura, Ōkubo, Yamaguchi and several other officials, accompanied by Sir Harry Parkes, left Edinburgh on October 21st calling at Galashiels to inspect the woollen and tweed mills there before moving on to Newcastle. Itō's group departed from Glasgow for Newcastle on Tuesday 22nd October and Mr Yura remained for several more days.

The Mission was warmly welcomed in Scotland and their presence at times attracted "a good deal of sensation."[97] According to the *Scotsman* newspaper "Before leaving, several members of the Embassy expressed their thanks to Mr McGregor, (Royal Hotel) and stated that they were sorry to go away, as in Scotland they had been more hospitably received by all classes than in any other country they had visited.[98] They also impressed their hosts with their "high breeding and true gentleness of manners which our visitors have exhibited on all occasions."[99] The distinguished members of the Mission and their conduct during the tour succeeded in convincing their hosts that the new Japanese government was serious about modernization. This was a welcome development for Scottish firms, some of which were already manufacturing goods for Japan. The presence of such a mission gave these and other firms a rare opportunity to

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[97] This remark was made about the group visiting Fife. *Scotsman*, October 12th 1872, p. 4.

[98] *Scotsman*, October 22nd 1872, p. 4.

[99] *Scotsman*, October 21st 1872, p. 6.

promote their products at the highest level.

CHAPTER ONE
THE ROLE OF *OYATOI GAIKOKUJIN* AND *RYŪGAKUSEI* IN INDUSTRIALIZATION

In the mid nineteenth century, Japan embarked on a period of borrowing from the West. Although cultural borrowing was not a new concept, for Japan's early development had been greatly influenced by the outside world, the circumstances behind the transfer in the nineteenth century differed from earlier periods in many respects. The focus of study was the West and not China, the borrowing was more selective and concentrated into only a few decades. Despite the differences, the Japanese turned to their past for guidance on how to proceed with the absorption of knowledge. Employing people as mediums in the transfer of knowledge was an old concept, but it proved to be a most efficient and reliable method in the nineteenth century. Japanese were sent abroad to study and observe and foreign nationals were hired in Japan to perform specific duties. These Japanese students were known as *ryūgakusei,* and the foreigners hired in Japan became known as *oyatoi gaikokujin* in the Meiji period.[100]

The Tokugawa Bakufu and local domain lords reintroduced these techniques on a modest scale during the late *bakumatsu* period and the Meiji government continued to

[100] According to the *Nihon Kokugo Daijiten* the word *ryūgaku,* meaning to travel for the purpose of study, appears in one of the earliest Japanese chronicles, the *Nihongi*, compiled around A.D. 700. *Oyatoi gaikokujin; Yatoi* means hired person and was usually prefixed by the honorific 'o'. *Gaikokujin* is the Japanese word for foreigner. *Oyatoi gaikokujin* was used to describe Westerners employed by the Meiji central government but its use was often extended to Westerners employed by local governments, private companies and individuals. Nihon Kokugo Daijiten Dai Ni Han Henshū Iinkai, *Nihon Kokugo Daijiten*, Shogakkan, 2002, p. 895.

use them on a much larger scale after 1868. Both policies were pursued simultaneously by the Meiji government so that while Japanese *ryūgakusei* were studying abroad, foreign employees were hired to begin work on projects in Japan and at the same time to pass on their knowledge and expertise to ordinary Japanese both through formal teaching in the classroom and through practical training at worksites. Japanese *ryūgakusei* returning from several years of study and training in the West and Japanese trained by foreign employees in Japan replaced the foreigners, taking over their role as teachers, advisers and directors. These two methods were crucial in the speedy transfer of knowledge which helped Japan modernize successfully within a matter of decades.

On the whole, Western influence during the Meiji period was dominated by the British. Britain was a small island nation, not unlike Japan in terms of size and population, but it was the world's leading industrial nation and the ruler of a great empire. It was the first country in the world to have undergone an industrial revolution and continued, throughout the nineteenth century, to lead the industrial world. As such it could provide Japan with the knowledge, practical skills and most up to date modern technology with which to modernize.

British dominance in Japan during the Meiji period is illustrated by the high number of British nationals in the country compared with other Western nationals during that time. Of the four thousand or so Westerners in Japan each year during the period, it is estimated that half of these were British.[101] More significantly in terms of Britain's

[101] This number may be slightly misleading as Australians and New Zealanders were often considered as British. Jones, H. J., *Live Machines: Hired Foreigners and Meiji Japan*, Vancouver: University of British Columbia Press, 1980, p. 168.

influence, of the calculated three thousand Westerners hired by the Meiji government between 1868 and 1900, representing twenty-five national groups, the British accounted for over half.[102] In the Ministry of Public Works, which sponsored major technological projects and model industries, two thirds were British.[103]

Within the sphere of British influence on Meiji Japan, Scotland featured prominently. Some of the most notable Westerners in Japan were Scots, including many of the engineering experts hired by the Meiji government. In addition, many of the young Japanese students who studied in Scotland or under Scots rose to high positions in government and industry.

Cultural Borrowing Prior to the Nineteenth Century

Throughout history, Japan's development has been greatly influenced by foreign technology, ideas, religious doctrines and practical skills. Whether by a process of passive or active transfer foreign elements reached Japan and were incorporated to varying degrees into Japanese culture. Early migrants from the Asian mainland passively introduced such technology as that of rice cultivation, ceramic, bronze and iron making. By the first century A.D. the transfer became more active as Japan's intercourse with her more advanced neighbours increased. An entry in the official dynastic chronicle of China in A.D. 57, records the visit of a Japanese envoy from Kyushu to China, suggesting that clans from the West of Japan were engaged in

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[102] This is only an approximate estimate, for records are scarce and sometimes misleading. The fact that names are written in Katakana also makes tracing these people very difficult.

[103] Statistics for the numbers of hired Westerners in Meiji Japan can be found in H. J. Jones, *op. cit.*

regular intercourse with China by this time. Over the following centuries Japanese, Koreans and Chinese from various walks of life, including teachers, monks, students, artists and craftsmen, travelled to and from the Asian mainland carrying with them valuable knowledge and skills which were to have a major impact on Japan's development. They may be considered as the early *ryūgakusei* and *oyatoi*. The legacy of the early Chinese contact is clearly evident in Japan today. One needs look no further than the Japanese writing system and the Buddhist religion to see the significance of this early exchange.[104]

Experience over many years taught the Japanese to be selective in their absorption of foreign ideas and systems which were not always compatible with those in Japan.[105] They began to adapt and blend suitable elements with native systems rather than import whole systems at once. When Westerners arrived in the seventeenth century

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[104] Until the introduction of the Chinese script the Japanese had no writing system. The script made a significant impact on Japan for it became possible to record events and to read Chinese books. Although introduced in the fifth century, it was some time before its influence spread throughout the whole country. The same can be said of the Buddhist faith, introduced in the sixth century. It was initially practised only by the court and among nobility.

[105] Chinese systems and ideas, which had often taken many years to develop in China, were not always compatible with those in Japan. The complex administrative reforms carried out in the seventh century are an example of such incompatibility. The elaborate system of the great Tang dynasty, when implemented in Japan, was found to be unsuitable and as a result was greatly altered over the next few centuries. Although the system was almost an exact copy of the Tang system, there were a few notable changes made from the start, such as the precedence of the Department of Worship over the Council of State. "The fact that special recognition was accorded to the priestly functions of the sovereign shows that, despite an almost slavish adherence to the Chinese pattern in other respects, the Japanese reformers were not willing to abandon their national tradition of kingship, according to which the sovereign is in theory sacred and inviolable." Sansom, George, *A History of Japan to 1334,* Rutland, Vermont & Tokyo: Charles E. Tuttle Company 1993, p. 69.

there was a short period of very selective borrowing in which *ryūgaku* and the hiring of foreign nationals played a very small role. The first Japanese *ryūgakusei* known to have visited Europe was Kagoshima no Bernard in 1551. He was one of four Japanese Christian converts who left Japan with the Spanish Jesuit Francisco Xavier to travel to Portugal. Bernard was the only one of the five who survived the journey.[106] Several more Japanese travelled to Europe in the following decades. One of the first Westerners who may be considered as an employee of the Japanese government was the Englishman, William Adams. In 1600 William Adams was shipwrecked off the coast of Kyushu. After being summoned to the shōgun's court to be questioned about his motives for travelling to Japan and for details of his trip from Europe, he was ordered to remain at court as adviser to the shōgun, Tokugawa Ieyasu. Adams, who was an experienced seaman, had greatly impressed Ieyasu with his knowledge of sea navigation and shipping and was regarded as a valuable asset. In return for his services he was rewarded with gifts of land and status and as such can be regarded as an employee of the Japanese government. He was neither the first Westerner to set foot in Japan nor the only one to advise the government but he was certainly one of the most prominent at the time.[107]

Freedom to travel to and from Japan came to an abrupt end with the implementation of a seclusion policy in 1636, which prohibited foreigners from entering Japan and Japanese from leaving the country. As a consequence the flow of ideas into Japan was restricted at a crucial time in world development, preventing knowledge of many of

[106] Tomita Hitoshi, *Umi o Koeta Nihonjin Meijiten,* Tokyo: Nichigai Associates, 1985, p. 184.

[107] Other survivors of the same shipwreck were hired as lesser advisers. Milton Giles, *op.cit.,* p. 120, 129.

the revolutionary changes which were occurring in the West, from reaching Japan. There was one major exception to the policy, however, which permitted a small number of Dutch and Chinese to continue to trade in Nagasaki, and through this window, limited information was able to seep through. According to Hazel Jones, a few Western teachers were employed to teach Japanese after 1673 although their numbers were small.[108] However, *ryūgaku* was almost unheard of. Shipwrecked Japanese sailors did occasionally find themselves washed ashore in Russia by accident, but there is also one known example of a *ryūgakusei* in Europe during the seclusion period. Nakajima Chōjirō escaped from Japan on a Dutch ship and spent two years studying Medicine at Leiden University before returning to Japan.[109]

These cases were rare and for the majority of Japanese, the opportunity to study under foreign instructors at home or abroad did not come until the middle of the nineteenth century. Concerned by the spread of European Imperialism in Asia the Japanese took a greater interest in world affairs at this time. Knowledge of Western developments highlighted Japan's military weakness and gave rise to the idea that Japan's deficiencies in defence could be supplemented by knowledge and skill adopted from the West. The Japanese began to appreciate the value of Western technology but were frustrated by the limitations of the contemporary system of learning created by the *sakoku* policy. They began to question the advantages of isolation and showed a renewed interest in the concept of sending Japanese abroad to study.

Sakuma Shōzan, a well-known scholar of the *bakumatsu* period, wrote in 1854 that

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[108] Jones, H. J., "Bakumatsu foreign employees", *Monumenta Nipponica*, 29/3 (1974), pp. 305-27.

[109] Cobbings, Andrew, *op. cit.*, p. 3.

there was no better way to learn how to defend Japan's coasts than to select men of talent and send them abroad.[110] There they would experience and observe the conditions of the West, learn military and naval strategy, and coastal fortifications. Learning from books and lectures was not sufficient; only by setting foot in the land could they really learn these things.[111] Sugi Ryōji wrote in 1856, in a proposal to Abe Masahirō, head of the council of rōjū, of the inadequacy of Japanese defence against Britain; the wealthy and strong nation of the West, which was aggressively expanding into Asia. He suggested Japan concentrate on building a rich country, using its newfound wealth to strengthen defences with military skills adopted from the West. He proposed sending twenty or thirty good men abroad for training in these skills.[112] Hotta Masayoshi, head of the Bakufu council at the time of commercial treaty negotiations wrote, in 1857, that "military power always springs from national wealth", and wealth is "principally to be found in trade and commerce." Japan should therefore "conclude friendly alliances, to send ships to foreign countries everywhere and conduct trade, to copy the foreigners where they are at their best and so repair our own shortcomings, to foster our national strength and complete our armaments."[113] The *daimyō* of Satsuma, Shimazu Nariakira, wrote in 1857 of a plan to send young men from Satsuma and the Ryūkyū islands to Britain, France and America, to study

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[110] Sakuma taught at a European style military science school in his native Matsushiro Han. His concern about Japan's security is reflected in his *Kaibō hassaku* [Eight policies for maritime defence]; Goodman, Grant K., *Japan: The Dutch Experience*, London and Dover, New Hampshire: The Athlone Press, 1985, pp. 149-150.

[111] Letter dated 27th day of the 4th month, Ansei 1, from Sakuma Shōzan to Yamadera Gendayu and Mimura Seizan. Ishizuki Minoru, *Kindai Nihon no Kaigai Ryūgakushi*, Tokyo: Mineruva Shobō, 1972, p. 6.

[112] Ishizuki Minoru, *op. cit.*, 1972, p. 4.

[113] Beasley, William Gerald, *Japanese Imperialism 1894-1945*, Oxford: Clarendon Press, 1991, p. 28.

language, medicine, manufacture, shipbuilding, gunnery and to investigate the situation of these countries.[114]

The biggest obstacle to learning from the West was the seclusion policy. Although many shared the opinions of enlightened men like Sakuma, Sugi and Shimazu, ending seclusion was very much controversial. The Bakufu dared not abolish the seclusion policy for fear of disturbing their already precarious position. However, the idea of adopting knowledge and skills from the West in order to build a strong nation capable of defending its independence became a matter of urgency for the Japanese after Perry's use of gunboat diplomacy in 1854, which forced Japan to open to the world. With the arrival of Westerners came the gradual disintegration of the seclusion policy and the opportunity, and the means, to learn firsthand from foreigners.

Preparation for the Opening of the Country *(Kaikoku)*

When relations with the West resumed in the 1850s the Japanese had no experience of travelling or studying abroad, they had no large ships sturdy enough to endure long ocean voyages and little experience of open sea navigation due primarily to the strict regulations on shipbuilding throughout the seclusion period, and few Japanese possessed sufficient knowledge of Western nations or their languages to enable them to study under Westerners or travel freely in those countries. However, certain developments during the seclusion period made the transition easier.

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[114] Inuzuka Takaaki, *Meiji Ishin Taigai Kankeishi Kenkyū,* Tokyo: Yoshikawa Kōbunkan, 1987, p. 182. From the Memoirs of Shimazu Nariakira.

The concept of travelling great distances within Japan for the purpose of study, a custom known as *yūgaku,* was not alien to the educated Tokugawa population. Despite restrictions on travel even within Japan, towards the end of the Edo era it was common for scholars to travel to different regions of Japan to enrol in a particular school.[115] *Yūgaku* was often undertaken for the purpose of introducing new subjects to *han* schools, or by men from areas without such a school. Although *yūgaku* began in the late 1600s, it became widespread in the nineteenth century, encouraged by the spread of Western Learning and promoted by the threat of foreign aggression. Many of the prominent scholars of the *bakumatsu* period undertook *yūgaku.* Sakuma Shōzan studied in Edo before setting up a military school teaching European techniques in his native Matsushiro *han.* This school itself was popular with other *yūgakusha*, including the Chōshū samurai, Yoshida Shōin, well known for attempting to smuggle himself aboard Perry's ship in 1854. Yoshida also studied in Nagasaki and Mito before establishing his own school in Chōshū. Western schools teaching military arts, like that of Sakuma Shōzan and also the Bakufu Naval College in Nagasaki were particularly popular, attracting students from across Japan. Some of the most prominent members of the Meiji government including Itō Hirobumi, Ōkuma Shigenobu, Etō Shinpei, Saigo Takamori, Kido Kōin, Ōkubo Toshimichi were *yūgakusha* in Nagasaki.[116]

The spread of Dutch and Western studies (*rangaku* and *yōgaku*) throughout the Tokugawa period also ensured that a small segment of the Japanese population had

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[115] *Nagasaki Yūgakusha Jiten* lists over one thousand *yūgakusha* to Nagasaki during the Edo period. Hiramatsu Kanji, *Nagasaki Yūgakusha Jiten*, Hiroshima: Keisuisha, 1999.

[116] *ibid.*

some knowledge of the West. Many of the first *ryūgakusei* were selected from students of Western studies and therefore, although none of them had experienced life abroad, many had some knowledge of the West and had experienced life in different *han*, where the environment, while not foreign, was unfamiliar to them. *Yūgaku* and the study of *rangaku* and *yōgaku* all helped prepare the Japanese for the progression onto *ryūgaku* abroad.[117]

Western Employees of the Japanese Government in the Nineteenth Century – The *Oyatoi*

In 1854 the Tokugawa Bakufu established a naval school in Nagasaki, the Nagasaki Kaigun Denshūsho, initiating a policy of hiring foreign advisers and teachers with the employment of twenty-two Dutch Naval instructors to teach Japanese students at the school. In the following decade and a half leading up to the Restoration, the government and individual domains hired some two hundred foreign nationals, primarily to teach technical subjects, medicine and language.[118] Because of historical links with Holland and the close relationship which developed with France, the majority of foreign employees during the *bakumatsu* years came from these two countries.[119] Among the major employers were the naval schools in Nagasaki and Kobe, staffed by Dutch instructors, the Yokosuka iron works and dockyard, staffed by the French and the Kaisei Gakkō staffed by American, British, German and French

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[117] Ishizuki Minoru, *op. cit.*, and Cobbings, Andrew, *op. cit.*

[118] Jones, H. J., "Bakumatsu foreign employees", *Monumenta Nipponica*, 29/3 (1974), pp. 305-27.

[119] Of the two hundred or so foreign employees of the *bakumatsu* period at least eighty were French, about sixty were Dutch, thirty British and a few American and German. *ibid.*

teachers. Scottish merchants arrived in Japan as soon as the treaty ports opened but there do not appear to be any who were employed by the Bakufu government.

When the Meiji government took control, it discarded many of the outdated Bakufu feudal policies, which were a barrier to modernization, but it retained and developed the policy of hiring Westerners to aid in the transfer of knowledge and technology. Westerners were employed in every government ministry to begin implementing the ambitious modernization plans of the new leaders and although many difficulties were encountered in the early years most were overcome with time and experience.

Many of the higher *oyatoi* positions were filled on the recommendation of foreign diplomats, bank managers, directors of established trading firms or existing *oyatoi* with whom the Meiji leaders were on good terms, a method which ensured a certain level of reliability and saved the government much time. However, when this method was not employed, the Japanese often ran into difficulties. Inexperience in dealing with foreigners during the first few years resulted in much time and money being wasted dealing with undesirable *oyatoi* who had made their way into the system. Once in government employ, foreigners were difficult to dismiss without causing problems with the treaty powers. With experience and a greater understanding of Western-style contractual agreements they were able to reduce such problems over the following years. In 1870 the Ministry of Foreign Affairs issued all government departments with the first *Instructions for the Hiring of Foreigners* (Gaikokujin yatoiirekata kokoroe jōjō), covering procedures for investigating candidates, and for drawing up terms of employment and dismissal.[120] It was the first of many guidelines and directives issued over the following years.

Foreign employees were often young and were usually hired on short contracts of two to five years. Many were hired for specific projects such as the construction of railways or telegraphs and they were usually also expected to be involved in the training of young Japanese in these areas. If they were capable and hard working their contracts could be extended and in some cases they moved to other departments.

The government paid high salaries to attract well-qualified, skilled engineers, teachers, advisers and workmen, salaries which the new government could ill afford. Salaries were generally split into five categories, determined by the education and training of the individual *oyatoi.* Salaries above ¥400 (or $400) were paid to those in management or to university principals. Professors and skilled engineers of university graduate level received salaries between ¥300 and ¥400. Highly skilled workmen, assistant professors or language teachers usually received salaries between ¥200 and ¥300. Salaries between ¥100 and ¥200 were paid to workmen or elementary school teachers and salaries under ¥100 to ordinary workmen.[121] At the time when Iwakura, one of the

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[120] Details of the 1870 policy can be seen in chapter 3 of Umetani Noboru, *Oyatoi Gaikokujin (gaisetsu),* Tokyo: Kashima Shuppan Kai, 1968, and Jones, H. J., "The formulation of Meiji policy toward the employment of foreigners", *Monumenta Nipponica,* 23/1-2 (1968), pp. 9-30. Hazel Jones describes the document as evidence that "a core of officials existed who possessed sound, critical judgement of foreign persons and things while accepting the necessity of foreign assistance" and that they had developed "an increasing understanding of Western customs and practices and of a certain sophistication in dealing with foreigners".

[121] Nihon Kagakushi Gakkai, *Nihon Kagaku Gijutsushi Taikei* Volume 1, Tokyo: Daiippōki Shuppan, 1970.

highest government officials, received a monthly salary of $600, the majority of *oyatoi* received salaries of between $100 and $700.[122] Several *oyatoi* received more than $700 and at least ten received higher wages than any Japanese official. The two highest paid *oyatoi* were Kinder of the Mint Bureau and William Walter Cargill of the Railway Bureau who received salaries of $1045 and $2000 respectively.[123] According to one *oyatoi*, William Griffis, these foreign servants were paid "liberal wages" but given "not a shred of power" for the Japanese were determined to maintain full control over their own affairs. Despite some early struggles with *oyatoi* who resented their lack of authority, they succeeded in doing so.[124]

The majority of foreign employees were hired during the first decade and a half of the Meiji period at the start of Japan's period of modernization. After 1885 their numbers began to decline as Japanese products of the new system trained in the application of Western technology emerged to replace them. The policy of hiring foreigners was always intended as a temporary measure to initiate the development of modern institutions and the education system, and to begin the training of Japanese. The replacement of foreigners by Japanese, a process known as *nihonjinka,* was part of the government's plan for modernization. The speed and success with which this process was achieved is an indication of the commitment of both the Japanese and the foreign employees.

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[122] To give an idea of how large these salaries were, a 10kg bag of rice cost approximately $1 at this time.

[123] The salaries of several high profile *oyatoi* and high level Japanese government officials are given in Umetani Noboru, *op. cit.*, pp. 92-94.

[124] William Griffis's introduction in Brunton, Richard Henry, *School Master to an Empire,* edited and annotated by Edward R. Beauchamp, New York, London: Greenwood Press, 1991.

Over the entire Meiji period the central government hired more than 3000 Westerners, while local governments and private companies hired many more.[125] The *oyatoi* were drawn from twenty-five different countries, the largest group, of almost one third, came from Britain.[126] The Ministry of Public Works, which sponsored major technical projects, was the largest employer, hiring over 900 *oyatoi* during its fifteen-year existence.[127] In 1872, 72% of the total number of *oyatoi* in government employ (153) was in the Ministry of Public Works, and of these, 68% were British. The majority of these *oyatoi* were technology specialists, most prominent in the Railway, Lighthouse and Telegraph Bureau. The reason Britain featured so prominently in these technical fields was a consequence of her early industrial development. By the middle of the nineteenth century Britain had an extensive railway and telegraph network and prosperous overseas trade routes and as a result she had the most advanced knowledge in these fields and she also had a large number of highly experienced engineers available to work abroad.

As no distinction was made in official documents between the different regions of

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[125] Umetani Noboru, *op. cit.*, p. 57.

[126] UNESCO has identified 2,299 foreign employees between 1868 and 1889. The largest contingent, at 928, was British, Americans coming second with 374. The majority of foreign employees in this list were government *oyatoi* but there are also several private employees listed among them. UNESCO Higashi Ajia Bunka Kenkyū Sentaa (UNESCO East Asia Culture Research Centre), *Shiryō Oyatoi Gaikokujin,* Tokyo: Shōgakukan, 1975.

[127] According to Umetani Noboru, the Ministry of Public Works hired 976 foreigners. The Ministry of Education was the second highest employer of *oyatoi* at 853 but the British did not feature prominently in this department. High concentrations of British *oyatoi* were also found in the Mint bureau and banking systems of the Finance ministry and in the Navy ministry. Umetani Noboru, *op. cit.*, pp. 69-74.

Great Britain when hiring *oyatoi*, it has proved difficult to determine an accurate value of the percentage of Scots among the British *oyatoi*. I have been able to identify approximately sixty Scots from information in various sources (Appendix 1), but I suspect that the number is much higher.[128] Of the Scots identified, most were employed by the Ministry of Public Works. Several of these Scots were senior engineers supervising highly technical projects and were in a position to contribute significantly to the modernizing projects. The role of Scots *oyatoi* in the Lighthouse, Railway, and Telegraph Bureau, in engineering education, shipbuilding and in sanitary engineering will be discussed in the following chapters.

Overseas Students to the West - The *Ryūgakusei*

Although the policy of hiring foreigners was implemented in 1854, several years passed before Japanese were permitted to study abroad. The first major change in the travel policy came in 1860 with the dispatch of an official diplomatic mission to America to ratify the commercial treaty of 1858.[129] This was a turning point in Japan's history, for it was the first time in over two centuries that Japanese had been permitted to leave the country. Three further diplomatic missions and two groups of *ryūgakusei* were sent abroad on official visits before the ban was finally withdrawn and replaced

[128] UNESCO *op. cit.* This book lists 2,299 *oyatoi*, including some private employees hired during the early Meiji years. Information on many of them is scarce and therefore it is difficult to determine where many of them originated. My assumption that there are likely to be more Scots is partly based on the fact that there are many Scottish surnames among the British employees.

[129] The first mission, which included 77 Bakufu officials, left Tokyo in January 1860 travelling via Hawaii to San Francisco and Washington D.C. where they met with the American President. Their return journey was via Hong Kong and they arrived back in Kanagawa in September 1860. Tomita Hitoshi, *Umi o Koeta Nihonjin Meijiten,* Tokyo: Nichigai Associates, 1985, p. 12.

in 1866 by a passport system, granting the Japanese the right to travel abroad, albeit under tight restrictions.[130] The first official dispatch of *ryūgakusei* was a group of fifteen young men sent to Holland by the Bakufu in 1863 and the second was a group of six students sent to Russia in 1865.[131] Three more Bakufu missions and two groups of *ryūgakusei* were dispatched between 1866 and 1868.

Prior to 1866 the only Japanese permitted to travel abroad were official Bakufu travellers. However, the lenient punishment dealt to Yoshida Shōin after his failed attempt to sneak aboard Perry's ship in 1854 was a clear indication of a change in official attitudes towards the seclusion policy. Up until this point, violation of the seclusion policy was punishable by death. This change in attitude and the value

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[130] In December 1862, 38 Japanese selected by the Bakufu, led by Takenouchi Yasunori, left Nagasaki aboard a British ship and travelled to several countries in Europe via Hong Kong and Ceylon. The Mission had two purposes, one was to negotiate the postponement of the opening of the treaty ports of Hyogo, Niigata and the cities of Osaka and Edo; in which they succeeded, and the other was to investigate the situation of each country visited. Fukuchi Genichirō, Fukuzawa Yūkichi, and Matsuki Kōan were among the members. They returned to Japan in December 1863. The following Bakufu Mission under the supervision of Ikeda Nagaaki left Yokohama aboard a French ship in December 1864. There were 38 members of the Mission including several teenagers. The purpose of the Mission was dual; to arrange compensation for attacks on French citizens in Japan and also to try to gain support for the closing of Yokohama port. Agreements were made but later scrapped and the officials of the Mission punished. The 1865 Bakufu Mission, under Shibata Takenaka, travelled to France to negotiate the use of French machinery and engineers for the construction of Yokosuka ironworks and to observe Western industry. Tomita Hitoshi, *op. cit.*, p. 14.

[131] The original plan, negotiated with the first American Minister, Townsend Harris, was to send a group of students to study military arts in the U.S.A. while monitoring the building of two steam warships ordered by the Bakufu as part of their policy to strengthen naval defence. Due to the outbreak of the American Civil War, the steam warship order was transferred to Holland, as was the *ryūgaku* plan. Eleven students from the Gunkan Sōrenjo School were sent to military schools, naval shipyards, machinery plants and iron factories in Holland, two Nagasaki Medical Hospital students were sent to a military hospital and two Banshoshirabesho students studied at Leiden University.

attached to Western knowledge encouraged some Japanese to ignore the ban and travel abroad illegally with the help of Westerners living in Japan. These illegal travellers were known as *mikkōsha*. Prior to the first official Bakufu mission, there were at least two illegal attempts made by Japanese to travel abroad. Yoshida Shōin's failed attempt to steal aboard Perry's ship in 1854 is well known. However, only one year later Tachibana Kōsai reached Russia successfully, returning to Japan several years later.[132] From the 1860s the number of illegal travellers increased. Saitō Kenjirō travelled to France with the help of a French aristocrat, Comte de Montblanc, and Niijima Jō travelled to the United States to study Christianity.[133] Groups of *mikkōsha* from Chōshū and Satsuma travelled to Britain in 1863 and 1865 respectively. Among the latter two groups, several played a major role in the Restoration movement and in the Meiji government afterwards.

Inoue Kaoru, one of the Chōshū *mikkōsha* wrote later,

> I endeavoured to do something for the cause of my country. I thought that the best way to enable her to oppose foreign aggression was to begin by reconciling the elements of Occidental and Oriental civilization, and with this object in mind I travelled to Nagasaki and Hakodate to seek men who could impart to me something of Western learning and knowledge. But, to my great regret I found that there were no such persons excepting interpreters or people with a smattering of knowledge concerning military or marine affairs. I also failed to find any means of making investigations as to science or art. I consequently determined to proceed incognito to Europe in order to obtain some knowledge of Western civilization by making personal investigations, with the object of utilizing the results after I returned home....But to leave the country was at that time strictly forbidden....and I had to wait for an

[132] Tomita Hitoshi, *op. cit.*, pp. 365-6.

[133] Cobbing, Andrew, *op. cit.*, pp. 22, 23.

opportunity of secretly getting away through the influence of a member of the British Legation staff.[134]

Most of the first *ryūgakusei* travelled abroad with the intention of learning as much about Western technology as possible but with inadequate language skills and insufficient formal science education few were able to proceed beyond a basic education. While their educational achievements were generally of little note, their experience of living in a different culture and their observations of Western society, allowed them to play a unique role in their country's transition. Rather than being the medium of introducing and transferring high-level Western technology and skills to Japan, these students, played a wider role introducing the Western world to Japan.[135] These *bakumatsu* pioneers helped paved the way for modernization and were very important in the transition to a modern state. Their observations and experiences in the West on the one hand greatly impressed them but on the other, convinced them that the gap was not too large for Japan to catch up.

Approximately one hundred and fifty Japanese *ryūgakusei* travelled to the West between 1860 and 1868, of whom approximately one third went to Great Britain, one fifth to both the United States and France, and one-eighth to Holland. Small numbers were also found in Russia, Germany and Belgium.[136] However, due to the scarcity of

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[134] Okuma, Shigenobu, *Fifty Years of New Japan, (Kaikoku Gōjūnenshi),* London: Smith, Elder & Co., 1910, p. 424.

[135] Fukuzawa Yūkichi travelled to Europe in the early 1860s and on his return wrote a book on the situation of the West, *Seiyō jijō,* which later became a best seller.

[136] Ishizuki put the number of illegal Japanese travellers between 1860 and 1867 at approximately 90, and the number of official Bakufu students at 65. This does not include members of the Bakufu missions. Ishizuki Minoru, *op. cit.*, pp. 153 and 104.

official records on illegal travellers this number can only be a very rough estimate. Of the fifty or so *ryūgakusei* who travelled to Britain, at least six studied in Scotland. These six were all members of groups of *mikkōsha,* most of whom travelled to Britain with the help of Thomas Glover. According to Andrew Cobbings, Glover's influence can be seen in the fact that by early 1866 there were five Japanese students in his native Aberdeen compared with nine in London and one in Glasgow.

The destinations of these early *ryūgakusei* were not determined by government policy and did not reflect a particular bias towards any one country but were more influenced by the advice and assistance of individual foreign residents in Japan. The decision to send the first official group of *ryūgakusei* to the United States was very much influenced by the American Minister, Townsend Harris. However, with the outbreak of civil war this plan was abandoned, and the students were sent instead to Holland, a country with which the Japanese had long been familiar. The Russian Consul in Hakodate, I. Goskevich, the British Minister, Harry Parkes, and the French Minister, Leon Roche, all played a role in convincing the Japanese to send the later groups of *ryūgakusei* to their countries.

In the case of illegal students, for whom official channels were closed, foreign merchants were often the ones who advised and helped them to study abroad. Thomas Glover, merchant in Nagasaki and agent for Jardine, Matheson and Company was on particularly good terms with men from the Chōshū and Satsuma clans and he is thought to have helped more than twenty-five Japanese to leave Japan secretly and study in Britain.[137] Considering that he helped more than a quarter of the total number of illegal *ryūgakusei*, and that many of them became leading members of the Meiji government, his role was significant. The foreign ministers and merchants had varied motives for recommending study in their respective countries. Some aimed to strengthen official ties with Japan, others hoped to increase trade or gain commercial advantages, while others had a genuine desire to help the Japanese. While there is little doubt that Glover did hope to profit from his dealings with the Japanese, his motives do not appear to have been entirely commercial.

The first Japanese known to have visited Scotland was Yamao Yōzō. He was one of a group from Chōshū known as the *Chōshū Five* who travelled to Britain with the help of S. J. Gower and Jardine & Matheson. After two years in London he entered an apprenticeship at Napier shipyards in Glasgow and took evening classes at Anderson College. Nagasawa Kanae, the youngest member of the Satsuma group of nineteen *mikkōsha*, stayed with Thomas Glover's family and attended the local grammar school in Aberdeen. In the same year, one of three *mikkōsha* from Chōshū, Takeda Yōjirō, two officers from Hizen, Ishimaru Toragorō and Mawatari Hachirō and an officer from Aki, Nomura Fumio (Hiroshima) spent time in Aberdeen. Ishimaru Toragorō and Mawatari Hachirō may also have studied at Anderson College in Glasgow.[138]

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[137] Among the *mikkōsha* helped by Glover were groups from Satsuma, Chōshū and Hizen who travelled to Britain in 1865. Cobbing, Andrew, *op. cit.*, pp. 27, 28.

[138] According to the book, *John Anderson's Legacy*, Ishimaru Toragorō and Mawatari Hachirō studied at Anderson College in Glasgow. However, there is no reference to where this information came from. Butt, John, *John Anderson's Legacy: The University of Strathclyde and its Antecedents 1796-1996*, Tuckwell Press in Association with the University of Strathclyde, 1996, p. 89.

As with the policy of hiring foreign advisers, the Meiji government retained the policy of sending Japanese abroad.[139] Because of the expense involved in sending people abroad many of the first *ryūgakusei* were sponsored by the central government, local *han*, private companies or well to do families. These sponsors, some of whom had been *ryūgakusei* themselves, sent students to the West to learn what they could about modern institutions there. The breadth of subjects studied was vast, but particular attention was paid to those of immediate value in the modernization process; technology, education, finance and government. On their return they were expected to utilize the knowledge and expertise which they had learned for the benefit of their country.

Over the first few years of the period, the central government issued guidelines for its departments on sponsoring *ryūgakusei*. The purpose of these guidelines, based on the experiences and observations of earlier *ryūgakusei* and travellers, was to increase the efficiency of the *ryūgaku* system while reducing unnecessary costs. They outlined improved selection procedures and specified which subjects were of greatest priority for the Japanese government and which countries were the most suitable models for these subjects. In the case of government sponsored students, specifications on age, prior education and length of study period were stricter than for private students.[140] Different countries were targeted for different aspects of modernization and as a consequence of these first guidelines, students of technical subjects like engineering

[139] Immediately after the Restoration all overseas students were ordered home. However, this was only a temporary measure.

[140] Details of the December 1870 *ryūgakusei* regulations can be seen in Watanabe Katoichi, *Bakumatsu Ishin no Umi,* Tokyo: Naruyama Doshoten, 1999, p. 72.

tended, although not exclusively, to go to Britain, students of medicine to Germany, students of education to the United States and students of law to France. By the turn of the century this trend had begun to change. Great Britain attracted a great many students during the early Meiji period, but its popularity declined as its influence on the world scene began to wane. The Japanese began to look instead to the rapidly developing countries of Germany and the United States, which they considered more appropriate models. The trend was reinforced by a shift in government away from the pro-British faction to a pro-German one.

In 1871 the Ministry of Public Works, the Kōbushō, issued its own guidelines on Ministry-sponsored *ryūgakusei*. Each department in the Ministry was expected to select two or three students per year from among those with experience of Western studies or technical studies. The period of study would range from 18 months to 3 years depending on the subject to be studied and the ability of the student. Students would receive a return fare to the country of destination, money for outfit and an allowance of between $900 and $1500 per year, again depending on the individual. On their return to Japan, the government-sponsored students were obliged to spend a period of seven years in government employ.[141]

According to the *Kaigai Tokōsha Sōran* list, approximately 4,200 Japanese travelled abroad during the period 1861-1912. Not all of these people were *ryūgakusei* for there are also members of diplomatic and investigative missions and tourists among this

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[141] Nihon Kagakushi Gakkai, *Nihon Kagaku Gijutsushi Taikei* Volume 8, Daiippōki Shuppan, 1970, pp. 347-57 and Tsuchiya Shigeaki, *Kindai Nihon Zōsen Jishi*, Tokyo: Shin Jinbutsu Oraisha, 1975, pp. 177-8.

number.[142] However, the majority of these travellers can be considered as *ryūgakusei*. The government sponsored most students during the first two decades of the Meiji period. As Japan's own education system developed the number of government sponsored students decreased and those who did go went to receive specialized training after completing a basic education in Japan. In accordance with the regulations set out in the *ryūgakusei* law of 1870, most of these students entered government employ, at least initially, on their return to Japan. In contrast to the declining numbers of government sponsored *ryūgakusei*, numbers of privately funded overseas students continued to rise.[143] The increasing number of privately sponsored students was a consequence of Japan's economic development. As Japan became richer, more private companies and individuals could afford to send students abroad.

During the period from 1861 until the end of the Meiji period in 1912 over 1,700 Japanese travelled to the United States and Germany. Britain was the third most popular destination, attracting over 1,100 Japanese. From the *Bakumatsu Meiji kaigai tokōsha sōran* list a table has been constructed to show the most popular educational

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[142] Tezuka Akira, *Bakumatsu Meiji Kaigai Tokōsha Sōran*, Tokyo: Kensakuhen, 1992, and Tomita Hitoshi, *op. cit.*, provide information on numbers and destinations of *ryūgakusei* during this period and are a valuable source of information. However, these numbers are only approximate. I have identified about 24 *ryūgakusei* in Scotland who are not included in one or both of these lists. Information on these 24 was obtained mainly from university matriculation records.

[143] The trend in the number of privately sponsored students has not been researched for this thesis but it would appear from glancing through Tezuka Akira's extensive list of *ryūgakusei* that their numbers rose considerably over the Meiji period. There are probably a number of reasons for this trend. Firstly, government-sponsored students declined sharply after the first decade of the Meiji period. Secondly, modernization created greater wealth among the general Japanese population so individuals could better afford to send their children abroad to study. Thirdly, it became much easier and more acceptable to travel abroad.

facilities for Japanese *ryūgakusei* during this period. (Appendix 3) According to the list, Berlin and Munich Universities attracted the largest numbers of *ryūgakusei;* 216 and 120 students respectively. The most popular British university, eleventh on this list of institutes of higher education, was Cambridge University, attracting 36 students. The Universities of London, Glasgow and Oxford attracted 33, 27 and 25 respectively.

Unfortunately this data covers the entire Meiji period and makes no distinction between the early Meiji period, when there were fewer *ryūgakusei* and when Britain was one of the most popular destinations, and the later period when many more Japanese travelled abroad to America and Germany. For the purpose of this thesis data on the period before 1900 would be more valuable but this has not been compiled as yet. A random sampling of names of *ryūgakusei* to German universities listed in Tezuka Akira's book was carried out and it would appear that the majority studied in Germany after 1900.

I have constructed a list of Japanese *ryūgakusei* in Scotland between 1860 and 1900 from various sources (Appendix 2).[144] At least seventy-two Japanese travelled to Scotland at this time. Thirty-seven of these Japanese studied at Glasgow University, twenty-one at Edinburgh University, fifteen at the Glasgow and West of Scotland Technical College and its predecessor Anderson College and one at Aberdeen University. Some of these students studied at more than one university in Scotland,

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[144] These numbers have been calculated from the following sources: Glasgow and Edinburgh University matriculation records, Glasgow and West of Scotland Technical College Register of Students, Tezuka Akira, *op. cit.*, Tomita Hitoshi, *op. cit.*, and Kita, Masami, *Kokusai Nihon o Hiraita Hitobito Nippon to Sukottorando no Kizuna,* Tokyo: Dōbunkan, 1984.

and one or two in other countries. Glasgow University was the most popular Scottish University and ranked in the top three British universities.[145]

Glasgow University's engineering and science departments attracted the majority of Japanese students at that university.[146] Glasgow University was popular because it was situated in the heart of the second largest industrial centre in Great Britain and it had a well-established department of engineering closely associated with local industries. William Thomson and William Rankine were among several eminent scientists and engineers who built Glasgow University's reputation in engineering education. William Thomson and William Rankine were academics but unlike the majority of their colleagues at the time were also practically minded men. Their talent for applying theory to practice enabled them to forge close links with industry. Engineering students who were sent over to Britain were usually expected to undertake a period of practical training to complement their formal studies and Glasgow was an ideal location for both. The Japanese required practical training as much as theoretical in order to develop modern industry in Japan. The University also had close ties to the Imperial College of Engineering in Tokyo, through the Scottish professors working there and several graduates of the College were sent to Glasgow.

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[145] In addition to the twenty-seven Japanese students identified by Tezuka as students in Glasgow before 1912, I have identified eleven more who studied there before 1900. We can assume that there were also several more students at the other Universities of Cambridge, London, and Oxford but without consulting the matriculation records there, I cannot be sure of the exact numbers.

[146] Apart from two medical students, all of the Japanese *ryūgakusei* were in the science and engineering departments. There are probably a number of reasons for this. Firstly, Japan chose to look primarily to Britain for engineering and technical studies but not for other subjects such as Law or Medicine. Secondly, the science and engineering departments in Glasgow University offered some of the best and most advanced technical courses in the world.

Anderson College and the Glasgow and West of Scotland Technical College (GWSTC) as it later became, like Glasgow University attracted students of engineering for similar reasons. Unfortunately matriculation records for Anderson College no longer exist, and therefore it is impossible to know the exact number of Japanese who studied there before the establishment of the GWSTC in 1888. We know that three Japanese studied at Anderson College before 1868 and twelve between 1888 and 1900, so it is not unreasonable to assume that several more studied there during the twenty years between 1868 and 1888. The close association of Henry Dyer, principal of the Imperial College of Engineering from 1873 until 1882, with the GWSTC after 1882 was probably one reason for the large number of Japanese students there.

In contrast only four of the Japanese *ryūgakusei* in Edinburgh University studied science and engineering. The others studied divinity, medicine and, the majority, law. Although Edinburgh University also had an engineering department, the city was not a major industrial centre and the University was not as closely associated with local industries as Glasgow University and Anderson College. The engineering section at the University of Tokyo employed three Scots from Edinburgh University but no particular ties formed between the two Universities. Edinburgh University's famous medical school attracted students from all over the world but surprisingly did not attract many Japanese. The Japanese preferred instead to take the German model for Medicine.

Throughout the whole period from the beginning of overseas travel in 1861 to the end of the Meiji period, Japanese *ryūgakusei* were spread over several countries, mostly in

Europe and the United States. In the early years of the Meiji period there was no overwhelming concentration of *ryūgakusei* in any one country as was often seen in the case of students from the colonies, but there were obvious preferences in certain countries for certain subjects. The first *bakumatsu* students went to Holland, and France, while many of the illegal students headed for America and Great Britain. While personal contacts continued to be important in determining *ryūgakusei* destinations into Meiji, government policy, based on experience and reputation, was the most important factor. The subject to be studied often determined the destination and the majority of students initially went to the United States, Great Britain, Germany and France. Glasgow University, Anderson College and the ironworks and shipyards in the city attracted both government and privately sponsored students because of Glasgow's world-renowned reputation in heavy engineering.

Conclusion

The Meiji government invested a great deal of money and time in both the *oyatoi* and the *ryūgakusei* and placed high expectations on them. *Oyatoi* were brought over to initiate the modernization process and the training of young Japanese and it was expected that their services would be dispensed with as soon as the Japanese became proficient in the work themselves. The government did not want to rely on foreign employees and foreign imports indefinitely. Not only was it a matter of expense but also of pride. While the majority of Japanese were trained under foreign employees in Japan, a smaller number of intelligent and talented Japanese were sent abroad by the government to learn as much as possible about their fields with the intention of becoming leaders on their return.

The *oyatoi* were paid well but life was not always easy. They had to adjust to working in a different country with an alien language, culture and climate. They were often frustrated by their lack of authority and sometimes resented having to take instructions from Japanese who they believed to be unqualified to do so. Many took ill and some died in Japan far from their home and family. The opportunity to work in Japan was a challenge and for some the experience was beneficial to their later careers. For others, however, finding work on their return home was more difficult.

The *oyatoi* were expensive, often difficult to deal with and not always reliable but the majority of them contributed, on some level, to the transfer of knowledge and skills from the West which enabled the Japanese to modernize. In general the policy was effective and the advantages far outweighed the disadvantages.

Life was equally difficult for the *ryūgakusei*. They too had to deal with an alien culture, language and unfamiliar climate. There was enormous pressure on them to learn, made greater by language difficulties. Some were plagued by ill health and many died prematurely, perhaps as a result of the pressure to live up to the high expectations placed upon them. Judging by the contributions of most of the early *ryūgakusei* to modernization on their return home the policy was a success.

CHAPTER TWO

ENGINEERING EDUCATION

Following an introduction to the development of engineering education this chapter investigates the Scottish influence on the development of Japanese engineering education during the Meiji period, paying particular attention to the Imperial College of Engineering, Tokyo University and Glasgow University. In the first part of the chapter, focus has been placed on Henry Dyer, a graduate of Glasgow University and Principal of the Imperial College of Engineering from 1873 until 1882. Dyer designed the curriculum, administered the college and taught civil and mechanical engineering. Other Scottish professors at the college and in the Engineering Department of Tokyo University are also introduced.

The second half of this chapter concentrates on graduates of the Imperial College of Engineering and Tokyo University, who studied in Glasgow. These students enrolled in classes at Glasgow University or at Anderson's College and most received training in nearby engineering firms. Their activities in Glasgow and on their return to Japan, where the majority were appointed to high-level positions in the Ministry of Public Works or in the private sector, are investigated.

The Development of Engineering Education in the West

The success with which the Industrial Revolution took its course owed much to the skilled engineer. The rapid transition to mechanization created a demand for mechanical engineers to design and build new machinery for factories and for transport. Increased industrial production resulting from mechanization, in turn, placed demands on civil engineers to build roads, bridges and railways to transport raw materials to factories and manufactures to the markets. Britain was the first nation to enter into an industrial revolution and was also the first to tackle the large-scale training of engineers.

The British developed a practical approach to engineering training in the form of a pupilage system. Young men were apprenticed to engineering offices for three or four years during which time they were expected to learn the trade by observing the engineers at work. If they were intelligent enough they would eventually "have opportunities of seeing actual work in the field, or of designing some parts of actual machinery, and of assisting in the erection of more or less important works."[1] Little or no theoretical education was given in such circumstances but many of the more intelligent apprentices supplemented their training with part time classes at local colleges or universities.[2] As technology advanced through the nineteenth century the need for formal theoretical training led to the establishment of engineering departments in colleges and universities across the country.

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[1] Jenkin, Fleeming, *A lecture on the education of civil and mechanical engineers in Great Britain and abroad, being a public inaugural address delivered in the University of Edinburgh, 3 November, 1868* Edinburgh: Edmonston & Douglas, 1868. Institution of Civil Engineers, *Engineering Education in the British Dominions*, Edinburgh: The Institution, 1891, p.201.

[2] The Stevenson family, discussed in the chapter on lighthouses, and Henry Dyer, discussed later in this chapter, can be taken as examples. In the early 1800s while he was an apprentice at his stepfather's office, Robert Stevenson took classes at Anderson College during vacations and later at Edinburgh University. His sons took classes at Edinburgh University during their apprenticeships at their father's firm. Henry Dyer took night classes at Anderson College while working as an apprentice at James Aitken & Co. Foundrymen of Cranstonhill, Glasgow.

The Europeans, who joined the industrial revolution later than Britain, placed greater emphasis on theoretical studies from the start. Higher technical schools were established where engineering students received specialized theoretical training before embarking on any practical work. In 1877 John Scott Russell wrote of the French and the Germans: "They had felt their inferiority in the great objects of manufacturing and constructive skill, in which, in 1851, we [British] held supremacy...They saw that the profusion of our raw materials gave us vast advantages in time and money. They were discriminating enough to see also that in mere raw material, mere mechanical power, and mere brute labour, competition with us was hopeless. And they argued thus: the one thing we can set against the English wealth in raw material is greater skill in using what we have. The way to compete with them in mechanical power is to apply higher science in the treatment and application of it."[3]

Although the British continued to believe that their practical approach to training engineers was superior to the European system, they were forced to acknowledge that theoretical training such as was offered in Europe was also necessary for British engineers if they were to remain leaders of the industrial world. "I have the confident hope, from the anxiety which is now manifested to increase the ranks of our profession, and the desire to have the best possible preparation for it, that even in the theoretical branches we shall shortly have to acknowledge no inferiority to any other nation. In the practical branches we are admittedly superior."[4] Fleeming Jenkin, Professor of

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[3] Quote from John Scott Russell on Systematic Technical Education, in *The General Report of the Imperial College of Engineering for the period 1873-1877*, Tokei [Tokyo], 1877, p. 17.

[4] Institution of Civil Engineers, *op. cit.*, p. 192.

Engineering at Edinburgh University from 1868, supported the pupilage system but urged that more time be allocated to theoretical study. When talking of the many skills required by engineers in 1868, he remarked, "Colleges cannot teach young men all these things, and my own experience has confirmed the conclusion, that a gentlemanly man of fair education and intelligence, after working as a pupil for three years in a civil engineer's office, is, for subordinate positions as a civil engineer, a more useful man than the pupil of a foreign school." However, he added, "As they rise in their professions, engineers are called upon to display higher and somewhat different qualities. The civil engineer may be called upon really to design great works and novel works; and here Englishmen feel sadly the want of a sound theoretical training."[5]

During the eighteenth century education was widely available in Scotland and had developed a broad curriculum as has been described in the introduction. The openness to new ideas and the increasing importance placed on practical teaching were significant features of the Scottish system. Scottish Universities also began to cater to new demands by offering practical courses, particularly Glasgow University. Robert Dick and later John Anderson, both Professors of Natural Philosophy at Glasgow University, were firm believers in the value of practical experimentation and incorporated experiments into their lectures. Anderson believed that "theories without experiments have been the great bane of philosophy in every age and in every country.... We must despise every theory that does not rest upon decisive experiments, or well established facts."[6] In addition to formal university classes, both men ran an

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[5] Institution of Civil Engineers, *op. cit.*, p. 202.

[6] Butt, John, *John Anderson's Legacy: The University of Strathclyde and its Antecedents 1796-1996*, East Linton: Tuckwell Press in Association with the University of Strathclyde, 1996, p. 10.

extremely popular experimental Philosophy evening class for Glasgow citizens. In John Butt's opinion, "The notion that learning should simply enrich the individual gave way, in his [John Anderson's] mind, to the idea that knowledge should be used in the service of society."[7]

When John Anderson died in 1796 he left detailed instructions in his will for the creation of a university dedicated to the improvement of science. Although he left no money, he did leave a substantial collection of scientific instruments and books on which the university was founded. His instructions were carried through in the same year and the university became successively Anderson's Institution (1796-1828), Anderson's University (1828-77), Anderson's College (1877-86), The Glasgow and West of Scotland Technical College (1866-1912), the Royal Technical College, Glasgow, (1912-64), and finally Strathclyde University. Anderson's can be considered as the first technical college in Britain and was an important step forward in the development of applied science and engineering. However, other establishments were slow to follow. On the continent, in contrast, technical colleges began to emerge rapidly from the 1820s and Britain fell sadly behind.

The majority of universities and colleges in Britain were reluctant to introduce applied science and engineering subjects into their formal curriculum. However, Glasgow University was more progressive than most and established a Chair of Civil Engineering and Mechanics in 1840. Dublin University (Trinity College) established a School of Engineering in 1842 but the University of Edinburgh did not establish a

[7] Butt John, *op. cit.* p. 11.

Department of Engineering until 1868 and the two ancient universities of England, Oxford and Cambridge were much later in the 1880s.[8] Among the new universities, University College London began teaching civil engineering in 1850 and established a Department of Civil and Mechanical Engineering in 1872 and Owens College, Manchester, founded a Professorship in Civil and Mechanical Engineering, and Geometrical and Mechanical Drawing in 1868.[9]

An important feature of Glasgow University and Anderson's College was the close link which developed between them and local industry. These links were forged by practically minded professors like Joseph Black (1728-99), John Anderson (1726-96), William John McQuorn Rankine (18-1872) and William Thomson; later Lord Kelvin (1824-1907), helping to build Glasgow's reputation for engineering education.

The Development of Engineering Education in Japan

The engineer in Japan played as crucial a role in the country's development as he had in the West. Although scientific study had been neglected in Japan during the seclusion period and innovation had been stifled by the tight restrictions of the Tokugawa regime, when the country opened, it embraced Western technology and invested heavily in the education of engineers. By entering industrialization later than Europe, the Japanese had the advantage of their experience. The Europeans learned from Britain's example

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[8] Institution of Civil Engineers, *op. cit.*

[9] Kita Masami, "Nisso hikaku keizaishi no ichi kōsatsu: Henry Dyer. Dyer Kenkyū" [A view on the comparative socio-economic history between Scotland and Japan, A study on the foreign employee, Henry Dyer], *Sōka Keizai Ronshū,* 9/2 (1979), pp. 71-93, and Institution of Civil Engineers, *op. cit.*, p. 35.

and the Japanese likewise were able to "select judiciously from the experience of the predecessors to shorten the process of trial-and-error learning and to avoid some of their mistakes."[10]

The Japanese had been exposed to Western technology during the seclusion period through their intercourse with the Dutch but its importance was not fully appreciated until after Perry's arrival. His display of naval power convinced the Japanese of the need to acquire military technology to protect themselves. They determined to acquire modern warships, weapons, and machinery from the West as quickly as possible to strengthen defences against possible invasion by a Western power. At the same time the Bakufu government took steps towards introducing formal technical education; for it was clear that without an understanding of the technology behind these modern machines, the Japanese could not hope to be able to use them. In 1855 the Bakufu established the Nagasaki Kaigun Denshūsho Naval School with the assistance of the Dutch. Dutch naval instructors were hired at the school to train young Japanese cadets in subjects related to Western military arts such as steam mechanics, gunnery, and shipbuilding. This was perhaps the beginning of modern technical education in Japan.

The Japanese soon discovered that the price of military power was high. Greater knowledge of the West led them to conclude that industrialization and foreign trade would provide the economic strength necessary to transform Japan into a military power. Great Britain's rise to naval supremacy had been preceded by a period of rapid economic growth fuelled by the industrial revolution and an expansion of foreign trade

[10] McCormick, Kevin, *Engineers in Japan and Britain*, London and New York; Routledge, 2000, p. 12.

in the products of industrialization. This idea was embraced by the Meiji government which placed importance on the promotion of industrial technology and consequently on technical education.

Technical education emerged in two stages. During the first stage, individual government bureau established small technical schools to train lower class engineers as quickly as possible. These schools provided only basic engineering training to Japanese who were quickly dispatched to assist on technical projects being undertaken by that bureau. At this time foreign engineers directed most of these projects. The telegraphy Denshin Gijutsu no Denshū and the lighthouse Shūgikō in the Ministry of Public Works, and the Seisaku Gakkyōba and Yokosuka Gassha, in the Ministries of Education and Navy were examples of such schools. In the second stage, which required a greater investment of time and resources, government ministries established higher technical schools providing advanced technical education. These schools were intended to train engineers capable of planning and directing the most advanced technical projects and replacing high level foreign engineers. The Imperial College of Engineering, Tokyo University, Kaigun Sōrenjo (later Heigakuryō), Sapporo Nōgakkō; administered by the Ministries of Public Works, Education, Navy and the Kaitakushi, were examples of such schools but the Imperial College of Engineering and Tokyo University were the pioneers, laying the foundations of engineering education in Japan.

The Imperial College of Engineering (Kōbudaigakkō)

The Ministry of Public Works, established in October 1870 to facilitate the progress of technical public works projects, was crucial in Japan's modernization, not only because of the extensive engineering projects undertaken but because it succeeded in nurturing the first generation of elite Japanese engineers. As the majority of work undertaken by each department in the Ministry was highly technical and relied on a large number of foreign employees, there was a great incentive to educate and train engineers quickly. During the initial stages of modernization the Ministry relied heavily on foreign employees to carry out the technical work. At the peak in 1874 there were over three hundred foreign employees but by the time the Ministry was abolished in 1885, their numbers had declined significantly as Japanese engineers, trained by foreign employees in Japan and sometimes also in foreign countries, took over many of these positions. The education and training of engineers then fell into the hands of the Japanese themselves. The Kōbudaigakkō and the foreign instructors there played a major role in the transformation.

The Imperial College of Engineering was established on the recommendation of Itō Hirobumi and Yamao Yōzō, the Minister and Vice Minister of Public Works, respectively. Both men were convinced of the need for a higher technical school and submitted a proposal on the subject to the Meiji government in April 1871.[11] In response to their proposal, the Kōgakuryō was established under the Bureau of Engineering in 1872.

While Itō was touring the United States and Europe with the Iwakura Mission in 1872, Yamao received permission from the Ministry of Finance to hire foreign professors for

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[11] The content of the proposal is quoted in Yoshida Mitsukuni, *Oyatoi Gaikokujin 2 (sangyō)*, Tokyo: Kashima Shuppan Kai, 1979, p. 110.

the College. He sent word to Itō to find appropriate individuals in Britain for the positions. On his arrival in London, Itō contacted an old acquaintance, Hugh Matheson, for assistance. Through Matheson's friend, Lewis Gordon, an engineering consultant and former Professor of Engineering at Glasgow University, he was referred to Professor Macquorn Rankine, serving Professor of Engineering at that University. Rankine recommended a talented young man by the name of Henry Dyer, one of his final year students, for the position of Principal to the College.[12] Eight other appointments were made through Macquorn Rankine and William Thomson.[13] The original nine professors were Henry Dyer, Principal and Professor of Civil and Mechanical Engineering; W. E. Ayrton, Natural Philosophy; D. H. Marshall, M.A., Mathematics; Edward Divers, M.D., F.C.S., Chemistry; Edmund F. Mondy, A.R.S.M., Drawing; and William Craigie, M.A., English Language and Literature; George Cawley, Robert Clark, and Archibald King were general assistants who "took charge

[12] In the September 15th 1882 edition of the *Ross-shire Journal* Matheson is quoted as saying "Several of those who are now prominent members of that government had been placed under my care at an early period; and years after their return to their own country and when the revolution occurred which abolished the daimios and established a partially constitutional government, several of my friends became ministers of the states and they requested me to assist them in founding at Tokei [Tokyo], the capital of Japan, an institution which would train young men for efficient service in the Public Work Department, which, for the first time was felt to be all important in the development of the country. This was [a] very responsible commission, but I did not shrink from it, and having taken counsel with an eminent friend, now no more, Prof. Lewis Gordon, I submitted the scheme of a college with a Principal and half a dozen professors, which I was in due time authorized to establish. I was fortunate on the advice of late Professor Macquorn Rankine of Glasgow in choosing as Principal a young man of 24, Mr. Henry Dyer." This article is quoted in Tezuka Tatsumaro, *Eigakushi no Shūhen*, Tokyo: Azuma Shobō, 1868, p. 352.

[13] Macquorn Rankine was Professor of Engineering at Glasgow University from 1855 until his death in 1872. William Thomson was Professor of Natural Philosophy at Glasgow University from 1844 to 1899. Both eminent scholars and practically minded men they played a prominent role in building the reputation of Glasgow University's Engineering Department.

of the practical parts of the instruction in engineering."[14]

The Engineering College's connection with Scotland began with Yamao Yōzō. Yamao was one of the first Japanese; if not the first, to visit Scotland in 1866. He travelled to Glasgow via London at a time when the Bakufu ban on foreign travel was still in place. Yamao, Itō and three other companions, usually referred to as the *Chōshū Five*, were given secret passage to London aboard a ship belonging to the merchant firm of Jardine & Matheson in 1863.[15] This firm, established by two Scots, William Jardine and Hugh Matheson, was one of the largest merchant firms in the East and had established offices in Japan as soon as the treaty ports were opened. On their arrival in London, Hugh Matheson made arrangements for their studies and accommodation and probably arranged for Yamao to work in Scotland. During a two-year stay in Glasgow Yamao worked as an apprentice in Napier Shipyards on the Clyde and attended evening classes at Anderson College along with many Scottish workmen. It is probable that the engineering school, which Yamao envisioned in Japan, was greatly influenced by Anderson College and his experience there. Coincidentally Henry Dyer had studied at Anderson College at the same time as Yamao. Although they were not

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[14] Dyer, Henry, *Dai Nippon; The Britain of the East: A Study in National Evolution*, London: Blackie & Son, 1905, pp. 3, 4.

[15] Itō Hirobumi, Yamao Yōzō, Inoue Kaoru (Shiji Bunda), Inoue Masaru (Nomura Yakichi), and Endō Kinsuke were the five Chōshū *mikkōsha,* illegal travellers, who travelled secretly to Great Britain in 1863 while the Bakufu ban on foreign travel was still in place. Initially they all entered the University College London but Itō and Inoue Kaoru returned to Japan within a year after hearing of the Shimonoseki incident. Endō returned to Japan in 1866 and Yamao and Inoue Masaru returned in 1868. Endō studied economics while Inoue Katsu studied mining and railway at University College. Yamao moved to Glasgow to study shipbuilding. Tomita Hitoshi, *Umi o Koeta Nihonjin Meijiten,* Tokyo: Nichigai Associates, 1985.

personally acquainted with each other at that time, Dyer recognized Yamao when he arrived in Japan.[16]

For the duration of the Engineering College's existence, the link with Scotland and particularly with Glasgow University remained strong. Professor Rankine died in 1872 but William Thomson continued to recommend new professors and tutored several of the young Japanese students sent over from the College.[17] Among the twenty-four foreign professors hired at the Imperial College of Engineering from 1873 to 1885, at least half were Scots, educated in Scottish Universities. Among them were several Glasgow graduates including Henry Dyer (C.E., M.A., B.Sc.), A.W. Thomson (C.E., B.Sc.), William Barr, Thomas Gray (C.E., B.Sc.), Thomas Alexander (C.E.) and William Gray Dixon (M.A.).[18] Other Scottish professors included David Marshall (M.A. Edinburgh University), William Craigie (M.A. Aberdeen University), James Main Dixon (M.A. St. Andrews University). While neither Scottish nor graduates of Scottish Universities, John Perry, William Aryton, Edmund F. Mondy, and John Milne,

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[16] Dyer wrote, "I was pleasantly surprised to recognize in Mr. Yamao, the Acting Vice-Minister of Public Works, a man whom I had seen as a student in the evening classes of Anderson College, Glasgow (now incorporated in the Glasgow and West of Scotland Technical College), when he was learning the practice of shipbuilding in Napier's yard. I did not make his personal acquaintance during his stay in Glasgow but his connection with that city gave us much in common." Dyer, Henry, *op. cit.*, p. 2.

[17] "Dyer, Gray, Ayrton, Perry, Ewing and Knott, personally recommended by Lord Kelvin himself, came to the Far East and inspired the young students with the spirit of research". Olive Checkland, *op. cit.*, p. 181 (Quoted from the Kelvin Centenary Oration and Addresses Commemorative, Glsgow, 1924, pp. 69-70). In appreciation for his services to Japan, the Japanese government conveyed the Order of the Sacred Treasure, first class, upon him in 1901. Kita Masami, "Nisso hikaku keizaishino ichi kōsatsu 2: Scotland kikokugo no Henry Dyer. Dyer kenkyū", *Sōka Keizai Ronshū* 9/4 (1980), pp. 39-51.

[18] Thomas Alexander studied engineering in the same class as Dyer. Kita, Masami, *Kokusai Nihon o Hiraita Hitobito Nippon to Sukottorando no Kizuna,* Tokyo: Dōbunkan, 1984, p. 109.

were closely connected to Glasgow University. Perry, Ayrton and Mondy all worked with Sir William Thomson at the University and Milne worked with a close friend and business associate of Rankine's, John Elder of Elder's shipyard on the Clyde.[19] Appendix 4 lists all of the employees of the Kōbudaigakkō (twenty-seven) from its establishment in 1873 until its absorption into Tokyo University in 1885.

The majority of professors were young and only recently graduated. However, like many of the leaders in the Meiji government, their youth and inexperience were more than compensated for by their enthusiasm. When Dyer was selected for the position of Principal to the new Engineering College he was only 24 years old but he was well suited for the new position. He was intelligent and well educated and had several years of practical engineering experience. Born in Bothwell, near Glasgow, on August 16th 1848, he was educated at a local school in Shotts, Wilson's school, before entering the Shotts Iron Works where his father also worked. In 1863, his family moved to Glasgow and Henry entered an apprenticeship at James Aitken & Co. Foundrymen of Cranstonhill, Glasgow. During his apprenticeship he continued his education at night classes in Anderson College.[20] In 1868 he entered the University of Glasgow where he studied, with the help of a Whitworth scholarship, for five years. He excelled in his

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[19] Kita suggests that most of the professors were linked to William Thomson and the Scottish academic network. David Marshall worked with Professor Tait at Edinburgh University, a close associate and friend of Thomson's. Divers worked at Queens College with Thomson's brother, James. Richard O. R. Jones is said to have been the son of a friend of Thomson's. Josiah Conder's link with the network was possibly through his teacher W. Burgus, a friend of the architect who designed the buildings for Glasgow University in the West End. The connection with Craigie is not clear although it is possible that Thomson knew him because he owned land in Ayr where Craigie taught at a local school.

[20] Dyer served an apprenticeship under Alex. C. Kirk and Thomas Kennedy. *Who Was Who*, Vol 2, 1916-1928, London: Adam & Charles Black, 1962, p.315, and www.cs.strath.ac.uk/contrib/hb/.

studies, winning prizes in a range of subjects while at the University. [21] He obtained a Certificate of Proficiency in Engineering Science (C.E.), a M.A. and a B.Sc. in 1870, 1872 and 1873 respectively.[22]

Over and above his excellent qualifications, Dyer had shown a particular interest in engineering education before his appointment. In *Dai Nippon* he wrote, "Fortunately, for some time previously I had made a special study of all the chief methods of scientific and engineering study in the different countries of the world and of the organization of some of the most important institutions, with the intention of devoting myself to the advancement of engineering education in Britain, so that I had fairly definite ideas both as to what was desirable and what was possible."[23]

Dyer sailed for Japan in April 1873, accompanied by Mr. Hayashi, Itō Hirobumi's private secretary.[24] His time on the voyage was spent writing a draft of the Calendar of the proposed College and on his arrival in Tokyo he presented it to the Acting Vice-Minister of Public Works, Yamao Yōzō. According to Dyer his calendar was

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[21] Among the many prizes awarded to Dyer while at Glasgow University were the Arnott Prize of £15 for the encouragement of the Study of Experimental Physics and the Watt Prize of £10 for the best essay on "The Influence of the Newtonian Principles on the Progress of Science during the Eighteenth Century". He also received an experimental scholarship to work in the laboratories of Sir William Thomson in his final year. www.cs.strath.ac.uk/contrib/hb/. 2002.

[22] The B.Sc. was introduced at Glasgow University in 1872 and Dyer was one of the first students to obtain the degree.

[23] Dyer, Henry, *op. cit.*, p. 2.

[24] According to UNESCO Dyer's contract was five years from 3rd June 1873. UNESCO Higashi Ajia Bunka Kenkyū Sentaa (UNESCO East Asia Culture Research Centre), *Shiryō Oyatoi Gaikokujin,* Tokyo: Shōgakukan, 1975. According to Dai Nippon, Dyer sailed from Southampton early in April 1873, two months earlier than recorded in UNESCO. Dyer, Henry, *op. cit.*, p. 2.

accepted by the Government without change of any kind.[25]

Admission to The Imperial College of Engineering was by competitive examination covering English, Arithmetic, Geometry, Algebra, Geography and Physics, and was to be open to all Japanese subjects between the ages of 15 to 18.[26] The entrance examinations were initially of an elementary kind but the standard was to be raised each year as the general education system adapted to provide suitable candidates.[27] The first admission examinations for the College were held in August 1873 and only thirty students passed.[28] Additional students were admitted as day scholars and a total of fifty-six students were accepted into the College in its first year.[29]

The difficulty in finding students was not due to a lack of interest on the part of the Japanese but rather due to a lack of qualified students. Some knowledge of basic science and fluency in the English language were requisite for students wishing to pursue a course in engineering in Britain but in Japan few students were familiar with

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[25] Dyer, Henry, *op. cit.*, p. 2.

[26] The age limit was later raised to 20. Imperial College of Engineering, *Regulations of the Imperial College of Engineering, 1882.*

[27] Imperial College of Engineering, *Calendar of the Imperial College of Engineering, 1873,* p. 1.

[28] "It was with difficulty that we obtained thirty students who were able to pass fairly in English and elementary mathematics. However, as the staff of the College was already in Japan, it was evident that we could not sit down and wait till matters improved, so that immediately after this examination we opened the College with these thirty as Cadets, and in addition admitted [an]other twenty as day scholars." Imperial College of Engineering, *The General Report of the Imperial College of Engineering for the period 1873-1877*, Tokei [Tokyo], 1877, p. 21.

[29] Some of the students came from the existing training schools in the Lighthouse, Telegraphy and Shipbuilding Bureau. A list of the students can be seen in the Calendar of the Imperial College of Engineering for 1873, p.26.

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The Ministry of Public Works invested heavily in the Engineering College and in the students themselves. They constructed and furnished new buildings for the school, equipped laboratories with the latest apparatus, and paid high salaries to the foreign instructors. All of the students in the first two years and most in the following years were sponsored by the Ministry and were provided with all utensils and apparatus necessary during the six years of study.[30] They also arranged and paid for some of the most promising students to study in Britain. In return for this high investment the student was responsible for "the strict observance of the regulations, and for his serving seven years under the government, after the completion of the prescribed six years of theoretical and practical training...In the event of a student leaving College before he has finished the entire term of training, or his resigning his appointment under Government before completion of the stipulated term of seven years, his surety will be required to pay all expenses incurred on the student's account up to the date of his leaving."[31] The Ministry had high expectations but the activities of many of the graduates illustrate that they were not unrealistic ones. The Kōbudaigakkō graduates made contributions in all areas of engineering in Japan. They replaced many of the highly paid foreign employees and undertook advanced engineering projects with as much skill as any engineer in the West.

Because of the difficulty in finding qualified students for the College, a preparatory

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[30] Yoshida Mitsukuni, op. cit., p. 118.

[31] Imperial College of Engineering, *Calendar of the Imperial College of Engineering, 1873*, p. 2.

school was opened in February 1874. [32] Students spent two years preparing for entry into the College. As classes at the Imperial College of Engineering were conducted entirely in English, language instruction was an important part of the course. However, financial cutbacks led to its abolition in 1877. Although the Minister of Public Works, Itō Hirobumi, was of the "opinion that there were now sufficient other schools in the country to supply students for the College", Dyer was afraid that "its abolition was somewhat premature."[33]

From Dyer's own experience of theoretical and practical engineering in Scotland and his knowledge of European technical education, he designed a curriculum, which combined the best elements of European engineering theory with the practical teaching employed in Britain.[34] The structure of the College itself was probably modelled on Glasgow University for Dyer later wrote that the first modern colleges in Japan "were to a large extent staffed by men of different nationalities, and they of course caused them to be moulded, to a certain extent, on lines to which they had been accustomed." The staff at the Engineering College, he added, "was British, and largely Scottish" suggesting that the Imperial College had been "moulded" along Scottish lines. As Dyer himself drew up the College regulations and arranged the general layout

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[32] "In order to provide properly qualified candidates for the entrance examination the preparatory school was opened in February 1874, and for nearly three years we had on an average about 180 scholars, and from among these we were able to get fairly prepared candidates for entrance to the College." Imperial College of Engineering, *The General Report of the Imperial College of Engineering for the period 1873-1877*, Tokei [Tokyo], 1877, p. 21.

[33] *ibid.*, p. 22.

[34] It has been suggested that Dyer's curriculum was greatly influenced by the Ecole Polytechnique Federale established in Zurich, Switzerland in 1855. Also known as the Eidgenossische Technische Hochshcule in German.

of the College buildings, his statement suggests that he used the system to which he was accustomed. To an outside observer the College would have been little different from one found in Glasgow for all of the professors were British and classes were taught in English. Students wore uniforms of the type worn in Britain including a "Scotch" cap, lived in apartments furnished along British lines and were even served British meals twice a day.[35]

The course "extended over six years, the first and second of which were devoted to the general training required for all departments of engineering. At the beginning of the third year the students selected the special departments, which they wished to follow. The technical courses were – (a) Civil Engineering, (b) Mechanical Engineering, (c) Telegraphy, (d) Architecture, (e) Practical Chemistry, (f) Mining, and (g) Metallurgy. Naval Architecture was added a few years later. One half of the third and fourth years were spent at College, and the other half at practical work. The last two years of the course were spent entirely at practical work."[36]

Practical experience was an integral part of the course. "In the college mere book work was made of secondary importance, and by means of drawing offices, laboratories, and practical engineering works the students were taught the relations between theory and practice, and trained in habits of observation and original thought. The College being in the Department of Public Works, the students had the run of all the engineering establishments and public works under its control, and in this way they had

[35] Yoshida Mitsukuni, *op. cit.*, p. 118.

[36] Dyer, Henry, *op. cit.*, p. 5.

exceptional advantages."[37] Students had access to the engineering works at Akabane, which were initially under Dyer's personal direction, where they received much of their real engineering experience. Machinery for use in the Public Works Department was often made there. In later stages of their studies, students observed and assisted on engineering projects undertaken by the Ministry.

Japanese language was added to the curriculum at the College as it was "found that the great majority of students have studied foreign learning to the almost complete neglect of their own language."[38] However, the students spoke among themselves in Japanese and as a consequence did not readily pick up spoken English. In order to "remedy this defect" students' dialectic societies were established. A regular system of gymnastics was also added for health reasons as the students had "neglected to take sufficient physical exercise."

Students were examined regularly on both course and practical work. At the end of the second year they were examined on the general scientific courses, which would determine whether they could proceed on to the third year. At the end of the fourth year they were tested on the technical course and on passing would proceed onto the practical course. After satisfactorily completing practical reports and the final examination at the end of six years of study the students would be awarded a Bachelor of Engineering (B.E.) diploma by one of the seven departments. Students were divided into three classes,

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[37] Dyer, Henry, *op. cit.*, p. 5.

[38] Imperial College of Engineering, *Calendar of the Imperial College of Engineering 1882*, p. 47.

> "1°. Those who have highly distinguished themselves during the College course and in the final examinations. 2°. Those who have not attained the standard required for the first class, but who are above a certain minimum standard and 3°. Those who fail to reach this minimum standard." [39]

First class diplomas were awarded to students who obtained 200 marks or above and second-class diplomas were awarded to students who obtained 100 or above. Students receiving less than 100 marks received only a document to state that they had attended the College. Final marks were calculated from results of the practical course, the principal subject of the technical course, the general course and the subsidiary subjects of the technical course.

When classes commenced in 1873 the majority of new buildings, including the main lecture theatres, were still under construction so Dyer "made arrangements to commence the classes in a neighbouring *yashiki.*"[40] William Anderson designed the first College buildings and several more were erected under the superintendence of Colin A. McVean, H. B. Joyner, Thomas Waters and Mr. De Boinville of the Survey Bureau. When the new buildings in the Toranomon area of Tokyo were completed in 1877 the College transferred to the new site and was officially opened in 1878 under the new title of Kōbudaigakkō. In attendance at the opening ceremony were many distinguished guests including the Meiji Emperor, senior government officials and foreign diplomats. The College was originally placed under the Bureau of Engineering but was later transferred to the Ministry's direct control. With the abolition of the

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[39] *ibid.*, p. 24.

[40] Imperial College of Engineering, *The General Report of the Imperial College of Engineering for the period 1873-1877*, Tokei [Tokyo], 1877, p. 24.

Ministry of Public Works in 1885, responsibility for the Kōbudaigakkō was transferred to the Ministry of Education, Monbushō, and in accordance with an Imperial Ordinance (No. 3) the College was amalgamated with other colleges in 1886 into the Teikoku Daigaku, or Imperial University.

In 1879, six years after classes began in the Kōgakuryō, twenty-three of the original fifty-six government-sponsored students graduated; three in civil engineering, five in mechanical engineering, one in telegraphy, four in architecture, six in applied chemistry, two in mining and two in metallurgy.[41] Of these, eight were awarded first-class diplomas, fourteen second-class diplomas, and one third-class.[42] As government-sponsored students these graduates were expected to enter government service for seven years. First class graduates were to receive a starting salary of ¥30 per month; second-class graduates ¥25, and third-class graduates ¥20. Among the graduates eleven of the most promising students were selected for postgraduate study in Great Britain for three years at the Ministry's expense. They were Minami Kiyoshi, Ishibashi Ayahiko (Civil Engineering), Takayama Naokata, Arakawa Shinichirō, Miyoshi Shinrokurō (Mechanical Engineering), Shida Rinzaburō (Telegraphy), Tatsuno Kingō (Architecture), Takamine Jōkichi, (Applied Chemistry) Kondō Yoshizō (Mining), Obana Tōkichi, and Kurimoto Tadashi (Metallurgy).[43] The remaining

[41] From the original class of fifty-six students, twenty-three graduated in 1879, and eight in the following year. Refer to graduate lists taken from Ōkurashō, *op.cit.*, p. 975-8.

[42] Initially students who graduated with third-class honours were not awarded a Bachelor of Engineering degree (B.E.) but the system was later changed and third-class graduates received the degree. Yoshida Mitsukuni, *op. cit.*, pp. 118,19.

[43] Minami Kiyoshi, Takayama Naokata, Miyoshi Shinrokurō, Shida Rinzaburō, Tatsuno Kingo, Arakawa Shinichirō, Kondo Yoshizō, received first class degrees, Ishibashi Ayahiko, Takamine Jōkichi, Obana Tōkichi, Kurimoto Ken received second class degrees. Ōkurashō, *op. cit.*, p. 976.

twelve were assigned to different bureaux under the Ministry to work as engineers.

In 1882 Dyer resigned from his position at the Imperial College of Engineering and returned to Scotland for personal and family reasons. Dyer deserves the greatest credit for the success of the College, which was, by the time he left, turning out twenty to thirty highly trained engineers each year. The College, which became the Engineering Department of the Imperial University, was the foundation upon which Japanese engineering education was built. The College was created upon Dyer's ideals, ideals which he put into practice with the aid of the other professors of the College. In an article published on May 6th, 1898, in the magazine *The Engineer*, Dyer's successor, Edward Divers, wrote, "there is, it may truly be said, one to whom, almost alone, Japan owes its well-organized and elaborated system of engineering education, namely, Dr Henry Dyer of Glasgow".[44] Dyer was proud of his achievement but also gave credit to his colleagues, citing the "enthusiastic manner in which the various members of the staff entered on their duties" as the main reason for the College's great success. He also acknowledged that Yamao Yōzō had given him constant support throughout his term of nine years and a considerable degree of freedom in administering the new College. "I wish to bear testimony to the whole-hearted support which he (Yamao) gave to all my proposals for the education of engineers, and to his personal kindness on every possible occasion. To his efforts much of the success of the College was due."[45]

Dyer wrote that the success of the College could be measured by the "excellent work, which the students have done since they left College, as there are few engineering or

[44] This quote was taken from Dyer, Henry, *op. cit.*, p.9.

[45] Dyer, Henry, *op. cit.*, p. 3.

industrial works in Japan in which they are not to be found taking an active part in the management."[46] Marquis Itō was quoted as saying "Japan can boast today of being able to undertake such industrial works as the construction of railways, telegraphs, telephones, shipbuilding, working of mines, and other manufacturing works entirely by the hands of Japanese engineers is mainly attributable to the College so ably established and set in motion by you (Henry Dyer)."[47]

In appreciation of his contribution to engineering education Dyer was awarded the Order of the Rising Sun, Third Class, and given the title of Honorary Principal of the College. Some years later after the College had been absorbed into Tokyo Imperial University he was appointed Emeritus Professor of that University. In 1908 he was also awarded the Order of the Sacred Treasure, Second Class.[48] In 1915 the Ministry of Education granted him the degree of *Kōgaku Hakushi,* Doctor of Engineering. The regard with which many of his students held him was also shown by his election as an honorary member of the Institutions of Civil Engineers, Mechanical Engineers and Naval Architects, in Japan by his former students.[49]

Dyer on his Return to Scotland

For the first year after leaving Japan Dyer spent most of his time in Europe "in the

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[46] Dyer, Henry, *op. cit.*, p. 6.

[47] Dyer, Henry, *op. cit.*, p. 7.

[48] Dyer's Order of the Rising Sun medal, Order of the Sacred Treasure medal and certificates are held in the Edinburgh City Library (Fine arts department, special collections).

[49] Iseki, K. R., *Who's Who In "Hakushi" in Great Japan, Volume 5, (Dai Nippon Hakushiroku 5)*, Tokyo: Hattensha, 1931, p. Eng 241,42.

study of educational institutions and the inspection of engineering works."[50] On his return to Scotland he became one of the Trustees of the Young Chair of Technical Chemistry in Anderson's College and when the College was amalgamated into the Glasgow and West of Scotland Technical College he became a life governor there. In this post he was able to apply methods used at the Imperial College of Engineering, contributing greatly to the development of the College. He wrote, "When that College was formed by the amalgamation of existing scientific institutions in Glasgow, I was able to transfer from Japan the programme of studies of the Imperial College of Engineering to the Glasgow institution which is the successor of the College in which the Vice Minister of Public Works and I studied as apprentices in the evening classes."[51] He applied for the Chair of Naval Architecture in the University of Glasgow twice in 1883 and 1886 and for the position of Principal of Heriot Watt College in Edinburgh but was unsuccessful in each application.[52] He became a Governor of the Glasgow and West of Scotland Agricultural College and of the West of Scotland College for Domestic Science. In 1891 he became a member of the Glasgow School Board and later its Chairman. He also dedicated much of his time to writing articles and books primarily on engineering education.[53]

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[50] Dyer, Henry, *op. cit,* p. 11.

[51] *ibid.*

[52] Henry Dyer Testimonials for the John Elder Chair of Naval Architecture and Marine Engineering, Glasgow University 1886. Extract from the Glasgow Herald of 15th May 1886. (Copy held in Glasgow University and Strathclyde University archives).

[53] For a list of publications by Dyer see Kita Masami, "Nisso hikaku keizaishi no ichi kōsatsu: Henry Dyer., *op. cit.*, pp. 71-93 and Robin Hunter's web page on the Strathclyde University website www.cs.strath.ac.uk. Robin Hunter is a direct ancestor of Henry Dyer's sister. Dyer published few articles in Japan. His responsibilities at the Imperial College were perhaps too time-consuming to allow him time to write.

Although Olive Checkland wrote that "on his return to Scotland he failed to find full time employment" and that "Dyer's predicament in re-entering Scottish life after almost a decade in Japanese service deserves sympathy", there is no evidence to suggest that he was discontented with the life he led.[54] Dyer's responsibilities at the GWSTC made good use of his experience and abilities and through his writing he was able to share his opinions and ideas on engineering education with a wide audience. Having full-time paid employment with any one University may have restricted both the time he dedicated to his writing and the freedom with which he expressed his opinions.[55] Whatever his method, Dyer dedicated his life to the improvement of engineering education.

In 1890 he was awarded a D.Sc. from Glasgow University and an honorary degree of LL.D.

Ryūgakusei from the Imperial College of Engineering

The first eleven *ryūgakusei* from the Imperial College of Engineering were dispatched to Britain to further their education and gain valuable practical experience in their chosen fields. They departed from Yokohama in February 1880 and arrived in London

[54] Checkland, Olive, *Britain's Encounter with Meiji Japan*, Basingstoke: MacMillan, 1989, p. 183, 185.

[55] Dyer had very strong opinions on the subject of engineering education, which Checkland suggests may have worked against him when looking for employment. Checkland wrote that Dyer's paper to the Institute of Civil Engineers, London in 1878 "was perhaps an attack indirectly not only on the piecemeal provision of technical education in the UK but also on those in the Institute who were anxious to maintain the pupilage system." Checkland, Olive, *op. cit.*, footnote 52, p. 293.

where they were met by the resident Japanese consul and another member of the consulate staff, Minami Tamotsu, Minami Kiyoshi's brother. Minami, Takayama, Miyoshi, Shida and Takamine proceeded from there to Glasgow, Arakawa to Manchester, Ishibashi to various lighthouse construction sites and Tatsuno, Kondō, Obana and Kurimoto remained in London to pursue their individual studies.[56]

On arrival in Glasgow Minami, Takayama and Shida enrolled in classes at Glasgow University for one year.[57] All three were exceptional students. Shida came first in natural philosophy, first in higher mathematics, second in advanced mathematics, and won the Cleland Medal in natural philosophy for the best dissertation, on magnetic susceptibility. Takayama came second in advanced civil and mechanical engineering and was awarded the Harvey first prize and the Walker third prize.[58] Minami came seventh in civil and mechanical engineering and received the Walker third prize along with Takayama, and the Harvey third prize.[59] Following their year studying at University, the three men entered a period of training, Shida at the Glasgow Post Office, Takayama at Motherwell Ironworks and Minami first in McLaren's Ironworks then on various railway construction sites, including the Scottish Caledonian Railway and a railway in Spain connected with Jardine & Matheson.[60]

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[56] Ōkurashō, *op. cit.*, p. 803.

[57] Glasgow University Matriculation records, 1880.

[58] Henry Dyer was also awarded the Walker and Harvey prizes during his studies at Glasgow University.

[59] Kita Masami, *Kokusai Nihon o Hiraita Hitobito*, chapter 6.

[60] Shida Rinzaburō is thought to have spent a period of time training at the main branch of the Glasgow Post Office but no record of this has been found there. His name would have appeared on the official Post Office record book if he had received a salary. It is possible that he worked there in an unsalaried position. Shida Katsunori, *Senken no Hito Shida Rinzaburō no Shōgai*, Tokyo: Nyūmedia, 1993, p. 64.

Takamine enrolled in classes at Anderson College for a year and a half and toured factories around Britain.[61] Miyoshi worked in Napier's shipyards for two years under A. C. Kirk and Agnew before enrolling at Glasgow University in 1882 for one year.[62] He studied naval architecture and won the Robert Duncan prize.[63] Ishibashi trained at the Eddystone lighthouse under the Chief Engineer of Trinity House, J. N. Douglas, but also toured lighthouses and engineering works related to lighthouse construction in Scotland, France and the USA.[64] He is known to have visited Young's Paraffin Oil Co., Glasgow, in 1880 where Richard Brunton, former Chief Engineer to the Japanese Lighthouse Bureau, was then working.[65] He also worked for a period on the Clyde Harbour works.[66] Because of the strong connection between the Scottish and the Japanese lighthouse services it is also very possible that Ishibashi, as a student of lighthouse construction, spent some time at lighthouses in Scotland.[67] Arakawa studied at Manchester University and researched the weaving industry, Tatsuno worked in a construction company and later entered the London Royal College of Arts,

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[61] Unfortunately the matriculation records for Anderson College are no longer in existence. According to Minami Kiyoshi den, Takamine attended Glasgow University but his name does not appear in the Glasgow University matriculation records. Murakami Kyōichi, *Minami Kiyoshi Den: Daitetsudōka Kōgaku Hakushi Minami Kiyoshi Kun no Keireki*, Kinoshita Tateyasu, 1904. (Reprinted in Noda Masaho, Harada Katsumasa, Aoki Eiichi, *Meijiki Tetsudōshi Shiryō, Volume 5; Tetsudō Kaden (1) Minami Kiyoshi Den*, Tokyo: Nihon Keizai Hyōronsha, 1980.

[62] Zōsen Kyōkai, *Zōsen Kyōkai Kaihō*, Volume 8, 1910, and Glasgow University Matriculation record for 1882.

[63] *Kokusai Nihon o Hiraita Hitobito*, p.190.

[64] Iseki, K. R., *Who's Who In "Hakushi" in Great Japan*, Volume 5, (Dai Nippon Hakushiroku 5), Tokyo: Hattensha, 1931, p. 13 (Eng).

[65] Takahashi Zenshichi, *Oyatoi Gaikokujin 7 (tsūshin)*, Tokyo: Kashima Shuppan Kai, 1969, pp. 180.

[66] Murakami Kyōichi, *op. cit.*, p. 38.

[67] There do not appear to be any references to Ishibashi in the Stevenson letterbooks of 1880.

and Kondō, Obana and Kurimoto entered the Royal School of Mines in London. With the exception of Takayama, who returned to Japan in 1882 due to ill health, and Kondō who died in Hong Kong on his way home in 1881, the government-sponsored students returned to Japan at the end of three years.[68]

While in Scotland the Japanese *ryūgakusei* were given a living allowance of £12 per month, the equivalent of ¥120. Initially they lived at the home of Mr. Colin Brown, representative of the Jardine Matheson Company in Glasgow, who charged them £8 per month for rent.[69] The students were unhappy about their living situation and the amount of rent charged and eventually moved into other accommodation.

Financial restraints prevented the Ministry of Public Works from sponsoring more groups of students from the Imperial College of Engineering to study abroad. However, several more graduates travelled to Britain privately to study there. In 1881 Naitō Masatomo graduated from the Mechanical Engineering Department with a second-class degree and made his way to Glasgow where he enrolled in marine engineering classes for one year in 1882. At the same time he studied applied mechanics in evening classes at Glasgow Mechanics Institution. He was also an apprentice draughtsman at R. Napier & Sons and it is likely he remained at the firm until 1885 when he returned to Japan.[70] In 1883 Watanabe Kaichi graduated from the Civil Engineering Department with a first-class degree and followed Naitō's example

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[68] Tezuka Akira, *Bakumatsu Meiji Kaigai Tokōsha Sōran*, Tokyo: Kensakuhen, 1992.

[69] Murakami Kyōichi, *op. cit.*, pp. 31, 2. There is no reference to the amount of rent charged after they left this address but presumably it was much less.

[70] Glasgow University Matriculation Album and notes on Japanese students written by Shoji Katō in Strathclyde University Archives General file #1.

by travelling to Glasgow. He stayed at the same address in Glasgow as Naitō had and enrolled in engineering classes at Glasgow University in 1884.[71] At the end of two years, Watanabe was awarded a B.Sc. and C.E.[72] After graduating he joined the firm of Benjamin Baker Construction Co. and assisted on the construction of the Forth Rail Bridge. He returned to Japan in 1888. In 1886 one of Naitō's classmates, Mano Bunji, first-class graduate of mechanical engineering (1881) enrolled in engineering classes at Glasgow for a year. He was sponsored by Monbushō. He came second in advanced mathematics, first in natural philosophy and received the Walker third prize and the Harvey first prize.[73] Following this he worked in Armstrong's factory in Newcastle before returning to Japan in 1889. In 1888 another of Naitō's classmates, Suda Toshimichi, second-class graduate in mechanical engineering (1881) and Shin Tsuneta, first class graduate in mechanical engineering (1885), enrolled in spring classes in naval architecture at the University.[74]

A total of nine graduates of the Imperial College are known to have studied at Glasgow University, one at Anderson College and one more, Ishibashi, spent at least some of his time in Scotland. Fewer graduates appear to have studied south of the border and therefore the concentration in Glasgow is notable. Glasgow University had a well-established engineering department and was located in the heart of one of the

[71] According to Kita Masami these two men lived under the care of Mrs Workman, 353 Bath Cresent. *Kokusai Nihon o Hiraita Hitobito, op. cit.*, p. 191.

[72] Watanabe studied natural philosophy, mechanical engineering, mathematics, technical drawing, astronomy, chemistry and received the Walker 5th prize. *Kokusai Nihon o Hiraita Hitobito, op. cit.*, p. 191.

[73] *Kokusai Nihon o Hiraita Hitobito, op. cit.*, p. 192.

[74] Information in this paragraph was obtained from Glasgow University Matriculation records, Ōkurashō, *Kōbushō Enkaku Hōkoku*, 1888, and *Kokusai Nihon o Hiraita Hitobito, op. cit.*

largest industrial centres in Britain. The presence of Sir William Thomson and his close ties with local industry also attracted the Japanese. These attributes placed the University ahead of many other British Universities and Colleges. Those Japanese students who studied with Thomson held him in high esteem and on his 80th birthday in 1904, Masuda Reisaku, Taniguchi Naosada, Watanabe Kaichi, Mano Bunji, Gotō Makita and Tanakadate Aikitsu sent a telegraph of congratulations.[75]

Of the nine *ryūgakusei* who studied in Scotland, four of them later taught in the Imperial College of Engineering or in the Engineering Faculty of the Imperial University. The *ryūgakusei* list in Appendix 2 summarizes the details of these *ryūgakusei*. Shida became a Professor in the College in August 1883 and continued to teach in the Engineering Faculty of the Imperial University. Takayama became an Assistant Professor in the College when he returned in 1882 and a full Professor in the Engineering Faculty of the Imperial University. Miyoshi became an Assistant Professor at the Imperial College and a full Professor of Naval Architecture in the Engineering Faculty of the Imperial University. Mano Bunji returned to Japan in 1889 to become a Professor in the Engineering Faculty of the Imperial University.[76]

Engineering Education in Kaisei Gakkō and Tokyo University

Engineering education was not limited to the Kōbudaigakkō nor to the Ministry of Public Works but the Kōbudaigakkō was undoubtedly the primary facility for

[75] Shida Katsunori, *Senken no Hito Shida Rinzaburō no Shōgai*, Tokyo: Nyūmedia, 1993, p. 63.

[76] The activities of some of these students in railway, shipbuilding, and telegraph engineering will be discussed in the main chapters of this thesis.

high-level engineering education during the early Meiji period. Tokyo University's Engineering course also played an important role and like the Kōbudaigakkō was closely associated with Scottish engineering education.

Tokyo University was established in 1877 under the direction of the Ministry of Education as a result of the merging of two older schools, Tokyo Kaisei Gakkō and Tokyo Igakkō Medical School. Both of these schools were established during the Tokugawa era and were continued by the new government.[77] The Law and Science Faculties of Tokyo University were created from the Departments of Tokyo Kaisei Gakkō and the Medical Faculty from the Tokyo Igakkō. On its establishment Tokyo University had four Faculties; Science, Literature, Law and Medicine. The Science Faculty was made up of the following Departments: Chemistry, Engineering, Mathematics, Natural Philosophy, Astronomy, Biology, Geology and Mining. In 1886 Tokyo University and the Kōbudaigakkō (Imperial College of Engineering) joined to become the Imperial University. The Imperial University's science curriculum closely followed that of the Kōbudaigakkō. In 1897 the Imperial University was renamed the Tokyo Imperial University.

At the beginning of the Meiji period the Kaisei Gakkō was staffed mainly by Japanese professors who taught Dutch, English, French, German, Russian and some elementary mathematics, chemistry, geography, astronomy, and mechanics. Over the following

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[77] Tokyo Kaisei Gakkō originated as the Bakufu Yōgakusho, established in 1855 to translate foreign books into Japanese. Its name changed in 1856 to the Banshoshirabesho, in 1862 to the Yōshoshirabesho and in 1863 to the Kaiseijo. By this point it was no longer a translation bureau but also a school. Nihon Kagakushi Gakkai, *Nihon Kagaku Gijutsushi Volume 8*, Tokyo: Daiippōki Shuppan, 1964.

decade the school was enlarged, renamed and reorganized several times, foreign teachers replaced Japanese staff and the curriculum was expanded and improved.[78]

From 1869 until the creation of Tokyo University in 1877, Tokyo Kaisei Gakkō hired sixty-eight *oyatoi* teachers. Of these, twenty-eight were science teachers. At the time of the establishment of Tokyo University there were twelve foreign teachers in the Science Faculty, five American, three French, two German, and two British.[79] The two British professors were Robert William Atkinson, Professor of Analytical and Practical Chemistry, and Robert Henry Smith, Professor of Civil and Mechanical Engineering.

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[78] In July 1870 domain lords were asked to send two or three talented young men from their *han* to study at the school in an effort to improve and enlarge the school. In 1872 foreign employees, from Britain, France, Germany and the USA took over from the Japanese teaching staff with Guido Verbeck, as principal. As the professors taught in their respective languages, much time was dedicated to language study. Nevertheless, a wide range of subjects was taught including algebra, geometry, physics, chemistry, physiology, history, and literature. In a typical thirty-hour week for an advanced student in 1872, sixteen hours were spent studying science and mathematics. The Kaisei Gakkō was renamed the Daigaku Nankō in 1869, Nankō in 1871, Nankō-Daiichi Daigakuku Daiichiban Chūgaku in 1872, Kaisei Gakkō in 1873, Tokyo Kaisei Gakkō in 1874 then became part of Tokyo Daigaku in 1877. In 1874 the school became a *senmongakkō* in which specialized science courses replaced general courses. Advanced students from the Kaisei Gakkō entered the new course while less advanced students were sent to the newly established Tokyo Gaikokugo Gakkō. English became the primary teaching medium of the school although temporary classes were continued in German and French for the benefit of students who had studied these languages but eventually German classes were discontinued. At this point there were three English courses of law, chemistry and engineering, and one temporary French course in physics. Ichikawa Norikazu, "Meiji shoki no enjinia kyōiku kikan to Kumamoto shusshin no enjinia", *Dobokushi Kenkyū* 18, Doboku Gakkai 1998.5, pp. 277-286, and Nihon Kagakushi Gakkai, *Nihon Kagaku Gijutsushi Volume 8, op. cit.*

[79] Checkland, Olive, *op. cit.*, p. 24.

Robert Henry Smith was hired in 1874 as the first Professor of Civil and Mechanical Engineering at the College and was responsible for organizing the new Engineering Department. He was hired for four years at a salary of ¥350 per month. Smith, who had been educated at Edinburgh University, but was not a graduate, was recommended to the post by Fleeming Jenkin, Professor of Engineering at Edinburgh University and selected by Professor Alexander Williamson of University College, London. [80]

At the end of four years in 1878, Smith was replaced by a graduate of Edinburgh University's Engineering Department, James Alfred Ewing. Ewing was born in Dundee in 1855, and received his early education there before entering the University of Edinburgh in 1871 at the age of 16 where he studied engineering under Professor Tait and Professor Fleeming Jenkin.[81] During one of his summer vacations he worked with William Thomson on submarine cable-laying expeditions to Brazil and the River Plate.[82] Tait and Jenkin were both associates of William Thomson. In 1878 William Thomson recommended Ewing, who was 23 years old, for the position of Professor of Mechanical Engineering at Tokyo University.[83] He received a salary of ¥350 per month with an additional ¥30 for living expenses.

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[80] Williamson had studied under Graham, Professor of Chemistry at Glasgow University and was part of a Scottish academic network which included professors dedicated to science education like Fleeming Jenkin and also William Thomson. Checkland, Olive, op. cit., and Arimoto Tateo, "Kōbudaigakkō to kōgaku jūshi no dentō – Tokyo, London, Glasgow jinmyaku", *Jōhō Kanri* 42/3, (1999/6), pp. 257-260.

[81] *Who Was Who*, Vol 3, 1929-1940, London: Adam & Charles Black, 1941, p. 426, Edinburgh University First Matriculation Book, 1871-72, and The Royal Society of Edinburgh, *Proceedings of the Royal Society of Edinburgh*, Edinburgh: The Royal Society of Edinburgh, 1935, Obituary Notices, pp.150-3.

[82] The three expeditions were during one summer vacation from the University of Edinburgh. Rice, David Talbot, *The University Portraits,* Edinburgh: University Press 1957, p. 67.

[83] Nakamura Seiji, *Tanakadate Aikitsu Sensei,* Tokyo: Chūō Kōron, 1946, p. 69.

Ewing lectured in mechanical engineering, teaching classes on thermodynamics, electricity, magnetism and mechanics. His classes were small and he taught no more than four hours per day but he also spent time in research with his students. Results of his and his students' combined research on magnetic induction were published in the 1885 *Philosophical Transactions* in London. Ewing also had a great interest in earthquakes and was one of the founders of the Seismology Society of Japan in 1880. He devised instruments for measuring and recording earthquakes and wrote a *Treatise on Earthquake Measurement.*[84]

On receiving an invitation to become Professor of Engineering at the newly established University College Dundee, Ewing returned to Britain in June 1883.[85] He was awarded the Order of the Sacred Treasure, Third Class, by the Japanese government for his contribution to engineering education in Japan and the Japanese Ministry of Education conferred upon him the degree of *kōgaku hakushi* (Doctor of Engineering) in 1915.[86] In 1890 he was elected to the Professorship of Mechanism and Applied Mechanics in the University of Cambridge. He also consulted for engineering firms and the government. During the First World War he supervised work in the infamous Room 40. In his later years he was elected Principal and Vice Chancellor of the University of Edinburgh.

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[84] Rice, David Talbot, *op. cit.*, p. 67.

[85] At this time Tanakadate Aikitsu sent a recommendation for Ewing which is recorded in the Lecturers meeting minutes. Ewing was appointed to the position without an interview though there were seventeen candidates, thought to be because of Kelvin's recommendation. Kita Masami, *op. cit.*, p. 138.

[86] Iseki, K.R., *op. cit.*, pp. Eng. 242,3.

In September 1883 Ewing's replacement, Cargill Knott arrived to begin the new term.[87] Cargill Gilston Knott was educated in Arbroath before entering Edinburgh University in 1872 where he too studied under Professor Tait. In 1873 he entered Professor Tait's Natural Philosophy Laboratory along with several other students, including James Alfred Ewing. The Professor's assistant at the time was D. H. Marshall soon to become Professor of Mathematics at the Kōbudaigakkō. Knott published his first paper with Marshall later that year. After graduating from Edinburgh University with a B.Sc., he continued to work in Tait's laboratory.[88] In 1879 he was promoted to an Assistantship in Natural Philosophy with Professor Tait, where he continued Tait's research on thermo dynamics and magnetism. In 1883 at the age of 27 he was involved in the founding of the Edinburgh Mathematical Society, becoming secretary and treasurer. In the same year James Ewing resigned from the Chair of Engineering at Tokyo University, and returned to Scotland. Ewing, Thomson and others recommended Knott for the position of Professor of Physics at Tokyo University.

Knott taught in Japan from 1883 until 1891, receiving a monthly salary of ¥370 per month plus ¥30 living expenses. During his term in Japan his research interests focused on magnetism and seismology. In 1887 he conducted a magnetic survey of Japan along with several of his students, including Tanakadate Aikitsu. The results of the survey were published in 1889.

When he returned to Scotland he was appointed to the Lectureship in Physics at

[87] Nakamura Seiji, *op. cit.*, p. 69.

[88] Edinburgh University Alumni and Staff index, special collections.

Edinburgh University in 1892, teaching applied mathematics to engineering students and junior physics to medical students. [89] His research interests were in electricity, magnetism, seismology, and elasticity and he published many papers throughout his career. When he left Japan in 1891 he was decorated with the Order of the Rising Sun, Fourth Class. [90]

Ryūgakusei from Kaisei Gakkō and Tokyo University

In June 1876 two graduates of the Science Department of Kaisei Gakkō, Taniguchi Naosada and Masuda Reisaka, were sent to Glasgow. They were among the second group of *ryūgakusei* selected by Monbushō to study abroad.[91] Masuda had studied civil engineering from 1873 until 1876, presumably under Robert Henry Smith, and it is possible that Smith influenced the Ministry's decision to send these students to Scotland.[92] Both students enrolled at Glasgow University from 1876 until 1878, receiving various prizes for their studies and graduating with a C.E. and B.Sc. in 1878.[93] Taneguchi entered an apprenticeship at a mechanics factory in Glasgow and travelled in Europe and the USA before returning to Japan in 1881. Masuda worked at the McLaren's Ironworks in Glasgow and later at an Edinburgh firm before returning

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[89] The Royal Society of Edinburgh, *Proceedings of the Royal Society of Edinburgh*, Edinburgh: The Royal Society of Edinburgh, 1935 Obituary Notices, pp.150-3.

[90] The Medal which he received, Order of the Rising Sun, Fourth Class, is stored in the Edinburgh University Library.

[91] In 1875 Monbushō selected the first group of eleven promising students to study abroad for five years. Nine were sent to USA, one to France, and one to Germany but none to Britain. Nihon Kagakushi Gakkai, *op. cit.*, p. 376.

[92] Iseki, K.R., op. cit., p. Eng. 12.

[93] Glasgow University Matriculation Album, session 1876-7.

to Japan in 1881.[94]

After his return to Japan, Taneguchi was employed as a Professor at the Tokyo Shokkō Gakkō in 1884 and in 1886 he became a Professor in the Science Faculty of the Imperial University. In addition to his lecturing position he worked as a consulting engineer to the Nōshōmushō Ministry of the government. Masuda entered the Kōbushō as a railway engineer and after retiring from his official position in 1891 he contributed to railway engineering in several private railway companies.[95]

In 1888 a third Monbushō *ryūgakusei,* Tanakadate Aikitsu, was sent to Glasgow. Tanakadate entered the Kaisei Gakkō in 1876 and became a student of the Science Faculty of Tokyo University in 1878 where he studied natural philosophy under James Ewing and Thomas Mendenhall. He graduated in 1882 and became an Assistant Professor in 1883. In 1887 he spent six months working with Cargill Knott on a magnetic survey of Japan as mentioned above. When he travelled to Glasgow he entered Glasgow University studying under William Thomson. He enrolled in natural philosophy classes over the summer of 1888 and continued to study from the autumn of 1888 until the summer of 1890.[96] During his two years he gave four papers at the University on earthquake measurement methods. He stayed at the same address in Glasgow as another Japanese *ryūgakusei,* Iwata Buyata.[97] From Glasgow he travelled to Germany where he studied magnetism at Berlin University for one year before

[94] *Kokusai Nihon o Hiraita Hitobito, op. cit.*, p. 183.

[95] Masuda is also discussed in the railway section of this thesis.

[96] Glasgow University Matriculation album session 1888-89 and 1889-90.

[97] *Kokusai Nihon o Hiraita Hitobito, op. cit.*, p.194.

returning to Japan.[98]

On his return to Japan he was appointed Professor of Natural Philosophy in the Science Faculty of the Imperial University where he taught until 1917. His research in the following years focused on seismology and later on aeronautics. He was considered a pioneer in the field of natural philosophy in Japan and contributed greatly to higher education. He also advocated the use of *romaji* in Japan.

Other *Ryūgakusei* who contributed to Engineering Education

In addition to the *ryūgakusei* from the Kōbudaigakkō, the Kaisei Gakkō and Tokyo University there were several other Japanese who studied engineering in Scotland and returned to Japan to contribute to engineering education. We see from Appendix 2; the list of *ryūgakusei* to Scotland, that at least five Japanese students from other schools did so. Goto Makita, graduate of Keiō Gijuku, studied at Glasgow University for two years and returned to the Keiō Gijuku as a Professor. Fukuzawa Sanpachi, son of Fukuzawa Yūkichi and graduate of Keiō Daigaku, received a B.Sc. from Glasgow University and later became a Professor at the Keiō Daigaku. He also established the Fujihara Kōgyō University (later Keiō University's Engineering Department) in 1940. Iwane Yūai, graduate of Tokyo Kōtō Kōgyō Gakkō, studied at Glasgow University for six years and at the GWSTC for four of these years. He was employed as a Professor in Osaka Kotokōgyō School. Miyoshi Bunta studied at Glasgow University for one year and became a Professor at the Imperial University. Lastly, Ogawa Shigen who studied

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[98] Tomita Hitoshi, *Umi o Koeta Nihonjin Meijiten,* Tokyo: Nichigai Associates, 1985, p. 377.

in Edinburgh became an Assistant Professor at the Kōbudaigakkō.[99]

Engineering Education at the Kōbudaigakkō and Tokyo University

Although engineering was taught at Tokyo University and Kōbudaigakkō (until 1886), the curriculum and style were very different. Tokyo University's Science Faculty developed over several years, the curriculum and teaching style being influenced by professors from several different countries. The curriculum at the Kōbudaigakkō in contrast was carefully designed and supervised by Henry Dyer and the teaching staff all came from Britain. Courses at Tokyo University were divided into preparatory, basic and specialised scientific sections whereas courses at the Kōbudaigakkō were divided into preparatory scientific, technical and practical sections. As a result, graduates of Tokyo University, although highly educated in scientific theory, had little practical experience, whereas Kōbudaigakkō graduates were practical engineers with a high level of theoretical knowledge. Nonetheless, Tokyo University graduates received a higher starting salary than Kōbudaigakkō graduates.

From its establishment in 1873 until its amalgamation into the Imperial University in 1886, 211 students graduated from the Kōbudaigakkō: forty-five in Civil Engineering, thirty-nine in Mechanical Engineering, nine in Naval Architecture, twenty-one in Telegraphy and Electrical Engineering, nineteen in Architecture, twenty-five in Applied Chemistry, forty-eight in Mining and five in Metallurgy. During the same

[99] According to Tezuka Akira, Ogawa studied in Edinburgh *kōka daigaku.* This may refer to the School of Arts of Edinburgh, now Heriot Watt University. Tezuka Akira, *Bakumatsu Meiji Kaigai Tokōsha Sōran*, Tokyo: Kensakuhen, 1992, p. 222.

period fifty-eight students graduated in engineering subjects from the Science Department of Tokyo University, approximately one quarter of the graduates of the Kōbudaigakkō: five in Applied Chemistry, seven in Mechanical Engineering, thirty in Civil Engineering and sixteen in Mining and Metallurgy. There were no naval architecture, telegraphy, or architecture classes in Tokyo University.

Conclusion - The Scottish contribution to Engineering Education in Japan

The Kōbudaigakkō was the most important facility for the training of high-level engineers in the early Meiji period, followed by Tokyo University's Engineering course. Engineering education in both of these facilities was greatly influenced by Scotland, through Yamao Yōzō, William Thomson, Henry Dyer, a number of Scottish professors and several Japanese *ryūgakusei* who studied in Scotland. It has been said that Yamao's proposal to create a facility dedicated to the education of engineers was greatly influenced by his experience in Glasgow, particularly with engineering education in Anderson College. It is also probable that the College influenced Henry Dyer's ideas on engineering education for he too had studied at the institute.

William Thomson and his colleagues at Glasgow and Edinburgh Universities recommended the majority of engineering professors for the Kōbudaigakkō as well as three professors for Tokyo University.[100] Although not all the professors were Scots, the majority of them were either educated in Scottish Universities or had worked with

[100] The lists of Scottish employees in Japan in Appendix 1 and of British employees at the Kōbu daigakkō in Appendix 4 give a summary of the subjects taught, the contracts and salaries of the Scottish professors.

William Thomson in Glasgow. Several government sponsored *ryūgakusei* studied at Glasgow University, many under William Thomson, and of those the majority contributed in some way to engineering education on their return to Japan. The success of the Kōbudaigakkō owes much to both Henry Dyer, who designed and supervised the curriculum for the College, and Yamao Yōzō, who was primarily responsible for the creation of the College and supported Dyer throughout his term in Japan. The success of engineering education in general, likewise owes much to the Scottish professors but also to the crucial planning and support of the Japanese government.

The influence of Scottish engineering education also reached beyond these facilities. A number of *ryūgakusei* who studied in Scotland taught engineering at other facilities such as the Keiō Gijuku, and the Osaka Kotokōgyō School and possibly at other Colleges.

CHAPTER THREE

MODERN LIGHTHOUSES

This chapter investigates the Scottish influence on modern Japanese lighthouses and in particular focuses on the role of the Edinburgh firm, D. & T. Stevenson, consultants to the lighthouse service from 1868 until 1876, and Richard Henry Brunton, Chief Engineer during the same period. Brunton designed and built lighthouses, lightships and buoys around Japan's coast and D. & T. Stevenson designed the illuminating apparatus for these lights. Both were also involved in the training of Japanese engineers. This chapter also discusses the role of Scottish lightkeepers and artisans and acknowledges their valuable input to the service. George Charleson, as one of the longest serving foreign employees in the bureau, was a lightkeeping instructor from 1869 until 1881 and as such trained the majority of Japanese lightkeepers during that period. A list of the British employees in the Lighthouse bureau is given in Appendix 5, together with information on their work, duration of contract and salary. The Scottish employees also appear in the list in Appendix 1. Finally, contributions made by two Japanese students who studied in Edinburgh are considered.

Lighthouses in Britain

Few lighthouses existed around the British Isles before the seventeenth century although their presence there and around the world has been recorded for centuries.[1] As European trade with the wider world grew in importance, the level of sea traffic around the coasts increased dramatically, creating a greater need for navigational aids such as these. From the seventeenth century in England, the Crown began granting permission to individuals to erect and maintain lighthouses, allowing them to charge levies at nearby ports to cover their costs. In the absence of a central lighthouse authority, construction, maintenance and therefore the efficiency of each lighthouse varied greatly from one to the next. Eventually a central body was established with the granting of a license to the Brethren of Trinity House to build and supervise lighthouses. The acquisition of privately owned lighthouses, some of which provided substantial profits to the owners, was a long process and the problem of standardization remained for some time. Finally in 1836, all lighthouses in England, Wales and the Channel Islands came under the jurisdiction of Trinity House.

The case in Scotland was different. Until the Act of Union with England in 1707, which brought an expansion of trade with the Americas, the need for beacons was not as keenly felt. In the late eighteenth century, calls for improvements in marine

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[1] The earliest written record of a lighthouse is of the Pharos of Alexandria built by the Egyptian Emperor Ptolemy in the third century BC, one of the seven Wonders of the Ancient World. The Romans too, built lighthouses throughout their empire, and were probably responsible for Britain's first. This is thought to be the lighthouse in the grounds of Dover castle originally built by Emperor Caligula. An identical one was also built on the other side of the English Channel. The Lighthouse Society of Great Britain, http://www.lsgb.co.uk. (2000)

navigation safety led to an Act of Parliament in 1786, which established a board of trustees in Scotland, known as the Commissioners of the Northern Lighthouses. From their initiation, they supervised the construction of all modern lighthouses in Scotland and were responsible for all aspects of their management.[2] This ensured a level of standardization not present in England. A system of levies was introduced and regulated by the Commission to cover their costs.

The earliest beacons were simple bonfires fuelled by wood or coal. The light which they emitted was weak and variable at best, and their efficiency varied greatly with factors such as the quality of fuel locally available, the weather conditions and the management of the beacons. They were least effective in stormy and foggy conditions when their need was greatest. Few advances were made in navigational aids until the boom in sea trade during the seventeenth century. Substantial progress was made first in the lighthouse buildings, which began to appear in increasing numbers around the coasts of Europe, followed much later by advances in illumination. The invention of the Argand lamp and its introduction into lighthouses was the first major step in improving lighthouse illumination. It was followed by the invention of the Fresnel lens and the introduction of reflectors, which together produced significantly stronger and more stable light emissions. By the end of the eighteenth century candles and oil, being more convenient to transport and oil lamps easier to maintain had begun to replace the less efficient coal and wood fuels. These in turn were replaced by petroleum oil and

[2] While there were many examples of royal authorisation to build lighthouses granted to private individuals in England, only one royal authorisation was granted in Scotland and this was in the mid 1600s. http://www.lsgb.co.uk. (2000)

later by gas and electricity, which gave the brightest and most stable emissions.[3] Fog signals were improved by the introduction of compressor horns in the mid-nineteenth century, which replaced bells and guns. With the explosion in the numbers of lighthouses around the coasts of Europe it became necessary to add distinguishing features. Each light was given a distinctive pattern of flashes, in which the length of flash and the length of the interval varied.[4]

Lighthouses in Scotland – The Stevenson family

Shortly after the establishment of the Commissioners of the Northern Lighthouses, Thomas Smith, an Edinburgh lamp-maker, was appointed first engineer in 1787. On his retirement the appointment passed to his stepson and business partner, Robert Stevenson. The next appointment was Robert's eldest son, Alan, and when he retired due to ill health, Robert's second son David. David resigned from the position to avoid the tedious paper work but continued, in partnership with his brother Thomas, to design and build lighthouses for the Commissioners.[5]

When Robert Stevenson replaced Thomas Smith as Engineer to the Commissioners he was thirty-four years old. By this time he had worked alongside his stepfather for

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[3] The famous lighthouse on the island of May in Scotland, which was built in 1636, used coal until the change to oil in 1816. It required 400 tons of coal per year and three light keepers to keep the fire lit. Tōkōkai, *Nihon Tōdai Shi*, Tokyo: Tōkōkai, 1969, p. 516.

[4] *ibid.*, p. 516.

[5] For general information on the lighthouse Stevensons refer to Mair, Craig, *A Star for Seamen,* London: John Murray, 1978; and Royal Museum of Scotland, *The Enterprising Scot; Scottish Adventure and Achievement,* Edinburgh: Royal Museum of Scotland, 1986.

sixteen years and was well acquainted with the lamp making business and with all aspects of lighthouses. He had gained practical experience both in the Edinburgh workshop and on lighthouse sites. He had accompanied his stepfather on annual lighthouse tours and assisted in the design and construction of several lighthouses. He also valued education highly and attended formal engineering classes first at Glasgow University then later at Edinburgh University to supplement his practical training.[6] Further he made an extensive study of lighthouses in England and Wales so that by 1806 he was well qualified for the position.

In 1811 he established his name in the field of civil engineering with the completion of the Bell Rock lighthouse. Located eleven miles off the coast of Arbroath, and visible only at low tide, the rock presented greater difficulties and dangers than any land lighthouse. Robert and his team of workmen spent five summers constructing the lighthouse, working only when tides and weather conditions permitted [7] The lighthouse building itself was a great feat of engineering and worthy of admiration.

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[6] Robert first attended the classes of Professor John Anderson at Glasgow University. As mentioned in the introduction Anderson was well known for his practical teaching at a time when science professors tended to confine their teaching to pure science. He visited engineering workshops and discussed practical problems with the workmen. When he died, his instructions were that the funds he left were to be used to establish a Technical College for ordinary citizens. This college was named Anderson College and survives to this day as Strathclyde University.

[7] Robert arranged for himself and his workmen to live aboard a ship moored near the Rock during each building season to save precious time. When weather conditions permitted they rowed from the boat over to the rock and commenced their work. A forge was set up on the rock so that the blacksmith could sharpen blunted tools on site rather than send them back to shore. Robert overcame difficulties in moving the huge building stones on the rock by building a short railroad from the landing site to the building site and he also designed and built a special crane to lift the stones, approximately a ton in weight, into place. Mair, Craig, *op. cit.*, pp. 68 - 81.

Considering the conditions under which it was built, it is regarded as one of the greatest achievements in world lighthouse history.

Robert Stevenson established his own civil engineering firm soon after completion of the Bell Rock lighthouse. When not occupied with lighthouse duties he dedicated his time to a variety of engineering projects across Scotland and occasionally in England. These included work on harbours, canals, roads and bridges. Three of Robert's children followed in their father's footsteps by becoming civil engineers. They each served apprenticeships in their father's firm and received a solid grounding in civil engineering, relating to a broad range of engineering works including lighthouses. They too were encouraged to supplement their practical experience through study tours abroad and formal classes at the University of Edinburgh. David became a member of the Institute of Civil Engineers.

Robert Stevenson's Bell Rock lighthouse is perhaps the best-known of the lighthouses built by that family, but each of the Stevensons earned a reputation for inventiveness and for an ability to excel under difficult physical conditions and in remote and relatively inaccessible sites. They regularly experimented with optics and incorporated their improvements into their lighthouses. Their inventiveness and expertise in lighthouse design and construction was complemented by their broad knowledge of all other aspects of lighthouse work. For each lighthouse they would employ and direct their own tradesmen and would train their own light keepers. They routinely inspected the existing lighthouses, arranged for provisions of fuel and stores and executed repairs.

Lighthouses in Japan

As in Britain, beacons had been in use around the coast of Japan for centuries prior to the Meiji era.[8] In contrast to lighthouse development in the West few advances were made in Japanese lighthouses during the eighteenth and nineteenth centuries. They had remained relatively primitive and were barely able to support the existing level of domestic shipping. With the sudden influx of large foreign merchant and passenger vessels after the conclusion of the commercial treaties, marine safety in Japanese waters became a major issue with the powers.[9]

In an 1866 Tariff Convention between Japan, France, Great Britain, the Netherlands and the United States of America, the issue of navigational aids was addressed. The 11th article of the convention stipulated that, "The Government of Japan will provide all the Ports open to foreign trade with such lights, buoys or beacons as may be necessary to render secure the navigation of the approaches to the said Ports."[10] Later that year in November the British Minister, Harry Parkes, having obtained opinions on

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[8] The *Manyōshū* mentions the burning of torches along the coast of the islands of Iki, Tsushima and Tsukushi on the route to China, to guide ships carrying envoys there. Tōkōkai, *op. cit.*, p. 4.

[9] According to a *Kōbushō* survey carried out in 1883, there were 130 lighthouses on Japan's coast at the end of the Edo period. Tōkōkai, *ibid.*, p. 4.

[10] The tariff convention which was signed on June 25th, 1866, is quoted in the appendix of the Japan Directory for 1872. Tatewaki Kazuo, *Bakumatsu/Meiji Zainichi Gaikokujin Kikan Meikan DaiichiMaki* 1861-1875 (The Japan Directory) Tokyo: Yumani Shobō, 1996. The enormous financial burden which this created for the Japanese government was eased by the release of part of the indemnity from the Shimonoseki incident three years earlier. The foreign powers had agreed to waive two thirds of the indemnity in return for concessions from Japan, which included the early opening of Hyōgo Port and the lowering of import taxes. The release of the indemnity had nothing to do with the lighthouse agreement, but some of the money was directed into the lighthouse project. Tōkōkai, *op. cit.*, p. 10.

the best positions for buoys, lightships and lighthouses around the open ports from a number of ships' captains of different nationalities, presented the Bakufu with a proposal naming ten sites. Two of the sites proposed by Parkes overlapped with an earlier agreement made with the French to erect three lighthouses on the approach to the newly formed Yokosuka iron works. Based on Parkes' proposal, the Bakufu placed with him an order for equipment for eight lighthouses in December 1866.[11] Equipment for the three lighthouses agreed with the French had already been ordered from France but no more orders were placed with them.[12] In mid 1867 a second order for five lighthouses was made through Parkes, followed by a request to find a suitable engineer and assistants to build these lighthouses.[13] The Japanese possessed neither the technology nor the skilled engineers necessary to fulfil the agreement and consequently sought assistance from the foreign powers. Parkes forwarded the

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[11] Parkes' prominent role in the negotiations, which led to the tariff convention of 1866, may have been the main factor in the Bakufu's decision to seek British assistance in place of French. The majority of ships visiting Japanese ports and the largest portion of trade came from Britain so it was in the interests of the British to improve marine safety in Japanese waters. In a letter to Parkes the Bakufu wrote, "It is impossible to decide where the lighthouses should be erected until accurate enquiries shall have been made, but, in the meantime, we intend to procure the required apparatus. Three lights have already been ordered from France. For the other eight we ask your kind offices with His [Her] Britannic Majesty's Government, in order to get the apparatus through them." Quoted in Brunton, Richard Henry, *School Master to an Empire,* edited and annotated by Edward R. Beauchamp, New York, London: Greenwood Press, 1991, p. 1.

[12] Verny of the Yokosuka Iron Works, Amet of the French Navy, Hewett of the British Navy and Goldsborough of the American Navy carried out the first survey of lighthouse sites in Edo bay during October 1867. As had been arranged prior to the 1866 Tariff Convention, the first lighthouses were built by the French, under Verny. They built all four lighthouses in Edo bay; Kanonsaki, Noshima, Shirogashima and Shinagawa, beginning work in September 1868. The last of the four lights was completed in August 1870. The Yokosuka Iron works managed all aspects of these lighthouses until December 1871 when they were transferred to the Lighthouse Bureau. Tōkōkai, *op. cit.*, pp. 11-14.

[13] *ibid.*, p. 13.

requests to the Foreign Office, which in turn passed them on to the Board of Trade. In late 1867 the Board of Trade contacted the civil engineering partnership David & Thomas Stevenson of Edinburgh with a request to supply the necessary lights and personnel for the Japanese lighthouses.[14]

The Japan Lights and Scotland

At the time of the request David and Thomas Stevenson built lighthouses for the Commissioners of the Northern Lighthouses in Scotland, as had their brother Alan, their father, Robert, and his stepfather, Thomas Smith, before them. By 1867 the Stevenson family had erected sixty-one lighthouses around the rugged coast of Scotland and had designed several more in Singapore, New Zealand, Newfoundland and India.[15] These lighthouses had been built to withstand extreme sea conditions, and the fact that they had done so without exception, was testimony to the skill of the designers and builders. The choice of the Stevenson brothers to supply lights to Japan was therefore not a surprising one.

The Stevenson brothers accepted the request from Japan and were contracted to manage all aspects of the supply of equipment and personnel for the Japan lights. This included designing the lights, and after securing the services of suitable tenders,

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[14] In a letter to the Board of Trade dated 7th November 1867 the Stevensons acknowledge receipt of the Board's request to provide lights for Japan. D. & T. Stevenson Company letter book No. 36, 1866-67.

[15] In 1849 following a request from the Government Surveyor of Singapore, the Stevensons designed a lighthouse for the Pedra Branca rock. In 1861 a request was received to build a lighthouse for the Alguada Reef off the tip of Burma and other requests came from New Zealand, Newfoundland, China and of course Japan. Mair, Craig, *op. cit.,* p. 172.

ordering the necessary equipment for the apparatus, inspecting and shipping it, and employing skilled engineers, workmen and light keepers to be sent out to design, build and maintain the lighthouses. All dealings were coordinated through the Board of Trade until 1872 so that no direct communication took place between the Japanese government and the Stevenson's firm before this.[16] The Stevenson firm was paid according to the time spent on the work; in designing lights, employing personnel and other paperwork, plus a percentage of the cost of the apparatus built in Britain under their direction.[17]

In mid November 1867, the firm of D&T Stevenson submitted a preliminary report to

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[16] Although the Stevenson firm managed all aspects of the contract, the Board of Trade maintained a supervisory role up until 1872, approving all final arrangements made by them. However, I found no evidence in the Stevenson Letterbooks to suggest that the Board of Trade ever objected to any decision made by them.

[17] In a letter to the Board of Trade dated November 15th 1867 the Stevenson firm gives details of the terms on which they were employed by the other foreign Boards and which they propose to keep the same for the Japanese contract. "1st A fee of 6 percent for all payments to us for accounts conducted under our own direction in this country where the works are of considerable accounts such as the lighthouse apparatus. Where detailed plans are sent out to facilitate the execution of the work in the country the assistants' time for tracings [?] charged. 2nd For works including the small outlay of two or three hundred pounds but yet requiring all the trouble of design and specifications attaching to a larger work, the India Board fixed the rate at 10 percent. 3rd For all works executed in the country by the Resident Engineers such as dwelling houses or lighthouse towers of which no design or plans are furnished by us no charge is made. 4th For any designs and plans furnished by us and sent out to be executed there we have been in the habit of charging a fee for the design depending on the time occupied, and our assistants time for preparing the plans, but no further charge based on the cost of execution in the country. 5th For trouble connected with corresponding and meeting with candidates, for examining into their qualifications and instructing them as to our views of their duties, and the nature of our designs we have generally a fee to be charged depending upon the time occupied. 6th For visits to Birmingham or Paris for the purpose of conference with contractors or testing their apparatus the time and expense has been charged." Stevenson letterbooks, 1867-68.

the Board of Trade setting forth their opinions on different aspects of the Japanese project.[18] The first section addressed the "Appointment of Engineers", which they wrote was "the first duty to be attended to". Three positions were to be filled. Firstly, that of chief engineer with a salary of $450 per month, "to commence from date of leaving England by Southampton", plus £200 for outfit and a first class passage to Japan (£154.10s) for himself, and, if married, for his wife. Secondly, two assistant engineer positions with a salary of $150 per month, plus £100 for outfit and a first class passage to Japan.[19] With regard to the payment of the engineers' salaries, the Stevensons' wrote, "We should suggest for consideration that the salary begin at the date of appointment and not at the date of leaving this country as the engineers will be occupied previous to their departure in preparing themselves."[20] By early March three engineers had been selected, Richard Henry Brunton for the position of Chief Engineer, and Colin A. McVean and Arthur W. Blundell for the assistant engineer positions. Brunton was officially appointed on February 24th, 1868, and received half of the agreed salary, $225 (£48-5-7), from this date until his departure. McVean was officially appointed on March 10th and received half of his salary of $75 (£16 1 10 1/2) from that date.[21] Likewise Blundell received half salary from the date of his

[18] "Report as to Lights Proposed to be Erected by the Government of Japan" November 15th, 1869. Sub-headings in the report include: Appointment of Engineers, Lightkeepers, Lighthouse towers, Dwelling houses, Stations to be first established, System of lighting to be adopted, Oil, and Execution of work. D. & T. Stevenson Company Report book, No. 14, 1867-1871.

[19] Memorandum relating to the employment of engineers submitted to the Japanese government by Harry Parkes dated July 22nd 1867, is printed in Yokohama Kaikō Shiryōkan (Yokohama Archives of History), *R. H. Brunton Nihon no Tōdai to Yokohama no Machizukuri no Chichi,* Yokohama: Yokohama Kaikō Shiryō Fukkyū Kyōkai, 1991, p. 84. The terms and conditions of Brunton's work contract can be found on pp. 85-86.

[20] Stevenson Company Report book No. 14, 1867-1871.

[21] Stevenson letterbook No. 36, 1867-68.

appointment. It would appear that the Japanese government had taken the Stevensons' suggestion to pay the engineers from the date of appointment into consideration.[22]

None of the three men was a lighthouse engineer but they were nevertheless experienced engineers whom the Stevensons' judged suitable for the positions. On the matter of appointing engineers for Japan, the Board of Trade had written to the Stevensons, "If you cannot get engineers who have been trained to Lighthouse service, as the number of these is small, the Board of Trade thinks an active and intelligent Engineer with a general knowledge of his profession would soon under your training, acquire such knowledge in these matters as would be sufficient. When he is selected, he and his assistants should proceed as soon as possible to Japan, and visit the sites proposed for their lights, design the buildings and send home sufficient plans and data to enable you to design and construct the apparatus. It would also be very essential that one or two experienced light keepers should accompany the engineers."[23]

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[22] Mr. Hamilton Lee Smith was the Stevenson Company's first choice for the position of Chief Engineer but he withdrew his name shortly afterwards. "We have received several applications for the situation of Chief and assistant engineers for the Japanese government. After fully considering the applications for the appointment of chief engineer, we are of opinion that Mr. H. Lee Smith is on the whole the best candidate for the situation. Mr. Smith is a member of the Institution of Civil Engineers and has had large experience of foreign works. We can speak personally as to his integrity, and his testimonials as to his foreign work which we inclose [enclose] are highly satisfactory. We have therefore to recommend his appointment as chief engineer." However, in a letter to the Board of Trade dated February 19th, 1868, they write, "In consequence of Mr. Hamilton Lee Smith having been called on to carry out works in India which rendered it necessary for him to resign the appointment for Japan we now beg leave to recommend Mr. R. Henry Brunton one of the candidates for the first appointment." Stevenson letterbook No. 36, 1867-1868.

[23] Brunton, R. Henry, *op. cit.*, p. 3.

Richard Henry Brunton, born in Kincardine, Scotland, was educated and trained as a civil engineer in Scotland.[24] His career of more than ten years had been spent mainly in railroad works, making surveys, taking levels and preparing drawings and plans for railroads, but he also had varied experience in other areas of civil engineering including the planning of harbours, drainage of towns, surveying for and laying out reservoirs.[25] He began his career as an apprentice to Mr. P. D. Brown, and later in 1859 to Mr. John Willet of Aberdeen. On completion of his apprenticeship, he entered employment with Mr. Willet for six years as an assistant working on the construction of several railway lines in Scotland.[26] In 1864 he moved to London to continue working on railways, first in the employment of Messrs. Galbraith and Tolme, and later as principal assistant to Mr. Henry Bolden. While in the service of Mr. Bolden, he applied for an appointment with the Indian government "but was rejected as being too young and inexperienced".[27] He was admitted as an Associate Member of the Institution of Civil Engineers in April 1868 and as a Full Member in 1873.[28] Colin Alexander McVean, born in the West of Scotland, had over ten years experience as a civil engineer. He had worked on railways in Scotland, including the Caledonian Railway, and on railways in Turkey and had also worked in connection with the Admiralty Survey. Blundell had worked on the London and South Western Railway

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[24] He was born on December 26th, 1841, son of Richard and Margarert Brunton. His father was a lieutenant in the Royal Navy. Yokohama Kaikō Shiryōkan, *op. cit.*, p. 44.

[25] Yokohama Kaikō Shiryōkan, *op. cit.* pp. 82-83.

[26] Obituary in the Minutes of the Proceedings of the Institution of Civil Engineers, quoted in Yokohama Kaikō Shiryōkan, *op. cit.*, p. 44.

[27] William Elliot Griffis's introduction to Brunton, Richard Henry, *op. cit.* p. 1.

[28] A copy of the admissions for membership into the Institution can be seen in Yokohama Kaikō Shiryōkan, *op. cit.*, p. 11.

and had experience with water works, drainage, irrigation, roads and bridges.[29]

From their appointment until their departure for Japan, the three engineers undertook a period of training with the Stevenson Company, spending time at their firm in Edinburgh and on site at several lighthouses.[30] Having signed final contracts between themselves and the Board of Trade in May 1868, they received their passage money, allowance for outfit and an advance of one month's pay. For Brunton this amounted to a total of £794 and for McVean and Blundell, £318.17.6.[31] They set off from

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[29] In a letter dated March 3rd 1868 to the Board of Trade, the Stevenson Company wrote, "Sir, We have now to inclose [enclose] the application and testimonials of two candidates for the office of Assistant Engineer for Japan. First Mr Colin McVean whose engineering experience of 11 years, partly on Foreign Service and also his connection with the Admiralty survey, we think fully qualify him for the first assistantship. We are personally aware that his character is good." Stevenson Letterbook No. 37, 1867-68, p. 613. Also in Yokohama Kaikō Shiryōkan, *op. cit.*, p. 47. In a letter dated March 18th 1868 to the Board of Trade, the Stevenson Company wrote, "Sir, We inclose [enclose] the testimonials and application of Mr. A. W. Blundell for the appointment of assistant engineer for Japan. We have had an interview with Mr. Blundell here today which has impressed us favourably as to his qualifications, while the varied nature of his experience consisting of surveys for water works, drainage and irrigation as well as for roads and bridges would we think make his services valuable for one of the Japan appointments and we have to recommend him accordingly." Stevenson Letterbook, 1867-68, p. 670. Also refer to Yokohama Kaikō Shiryōkan, *op. cit.*, p. 47.

[30] In a letter to Mr. Cunningham of the Commissioners to the Northern lights, the Stevenson firm request that the three engineers be permitted to spend some time at lighthouses for training purposes. "It is desirable that the gentlemen who have been appointed should be made fully aware of the details of the duties of lightkeepers. We shall feel obliged if the Commissioners would grant authority for the Engineers to visit in succession and to remain a day or two at Southerness and St Abbs lighthouses". Letter dated March 14th 1868. In another letter to the Principal keeper of Girdle Ness, and Covesea Lighthouse of April 14th 1868 they write "Please allow the bearers who are going to Japan to construct lighthouses to examine the apparatus and study the work of the lightroom in its different departments." Stevenson Letterbook No. 36, 1867-68.

[31] Stevenson Letterbook No. 36, 1867-68, letters of 23rd May 1868. Brunton also received £85 passage money for his servant.

Southampton on June 13th, 1868, arriving in Yokohama on August 8th. On his departure from Scotland, Brunton carried with him instructions from the Stevenson brothers on how to proceed with his duties in Japan. His first duty on arrival was to put himself "in immediate communication with the English authorities and to take their advice" as to their "further communications with the Japanese government." Brunton did so, reporting to the British Minister, Harry Parkes. Parkes had played a prominent role in the lighthouse agreement and took a keen interest in Brunton's work, supporting him throughout his term in Japan. The letter ended with a reminder that "it would be desirable that you send us monthly statements of all your proceedings in order to keep us fully aware of what is doing".[32]

While preparations were being made to hire engineers, the Stevenson Company set to work designing lanterns and apparatus for three first-class lights and two floating lights. They had received documents through the Board of Trade from various sources in Japan, including British and French Naval personnel and diplomats, with information relating to the proposed Japanese lighthouses.[33] In their preliminary report of November 1867 to the Board of Trade, the Stevenson brothers concluded that there was sufficient data available to allow them to begin preparing lanterns and apparatus for five of the eight required lights; for the lighthouses at Iōshima, Shiomisaki, Rock Island (Mikomoto), and the light ships for Yokohama and Hakodate harbours.[34]

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[32] Stevenson Letterbook No. 36, 1867-68, letter dated 5th June, 1868 from the Stevensons to Brunton.

[33] Stevenson Letterbook No. 36, 1867-68, p. 809.

[34] "Of the eight additional lights required Captain Bedford and the Elder Brethren think that only some of them are so particularized as to warrant their construction being proceeded with out further data and in this opinion we fully concur as it would be undesirable to order apparatus until the requirements of the coast had been fully ascertained." Stevenson Company Report Book No. 14, 1867-1871.

By mid January 1868 the Stevenson firm had drafted the specifications for these lights and invited venders in both England and Scotland to submit estimates for their work. Based on these estimates and on first hand knowledge of the companies and their products, they made recommendations to the Board of Trade on February 21st, which were duly accepted. The services of Messrs Chance of Birmingham were secured to supply glasswork and holophotes, Messrs Milne & Son, and Messrs Slight of Edinburgh to supply the lanterns, reflectors and apparatus jointly and Mr. Smith of Blair Street, Edinburgh to furnish stores.[35] In early March Messrs Chance, Messrs Milne & Son, and Messrs Slight were asked to begin work on three first-class fixed lights. On receiving further details relating to the lighthouse sites, the Stevenson brothers laid out specifications for two more lights in a report to the Board of Trade on the "lighting of the Bay of Yeddo" [Edo] on February 22nd, estimating the "total liabilities for the seven lights exclusive of towers" at £10,800. The venders were again

[35] All of these companies were engaged by the Stevenson brothers to supply apparatus and stores for the Scottish lighthouses as well as for the Indian, New Zealand and Newfoundland lighthouses. "In obedience to instructions we have obtained offers for the construction of the Lanterns and apparatus for three first class fixed lights and two light ships and we have now to report the results for their lordships' consideration and approval." "The offers of Messrs Milne and Slights are so nearly of the same amounts that we should recommend the work to be divided between them as follows in order to insure [ensure] speedy execution." "It may be proper in reporting on these offers to direct attention to the fact that the workmanship produced by Messrs Milne & Messrs Slight is of the very highest character as shown by specimens of their work in the late Paris exhibition which decidedly excelled that of other British manufacturers. Indeed from our own knowledge we have no hesitation in reporting that better workmanship and materials cannot be produced." "In the event of the offers being accepted the total liabilities (including Messrs. Chances offers already accepted) for three first class lights and two floating lights with a year's supply of stores, exclusive of oil, will be about £7300." February 21st 1868. Stevenson Letterbook No. 36, 1867-68.

invited to submit estimates for the additional lights.[36]

The engineers arrived in Japan in August 1868 but did not immediately launch into lighthouse work. For the first three months they were assigned to various duties, Brunton to the supervision of the construction of the Lighthouse Bureau's new buildings in Yokohama, and McVean and Blundell to the surveying of the foreign settlements in Yokohama and Osaka respectively.[37] It was not until November that Brunton was able to proceed with his instructions from the Stevenson brothers. One of Brunton's first tasks was to "make inquiry as to two vessels for the floating lights at Yokohama and Hacodate". If he could not find suitable native vessels, which could be converted into floating lightships, then it would be necessary to have them built.[38] In November 1868 Brunton made arrangements for a ship's carpenter in Yokohama, A. Drake, and Japanese workmen to build the first lightship for Yokohama bay in the newly established factory in the Lighthouse Bureau. On its completion, apparatus, lanterns, lamps, and stores, sent from Edinburgh in June 1869, were fitted.[39] The lightship was the first of Brunton's navigational aids to become operational in

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[36] The Stevenson Company lists the following seven lighthouses in their February 22nd report: "1. The first order fixed light intended for Rock Island can be used at Nosima, 2. A second order flashing light will be prepared for Lake Segami and 3. A fixed red floating light for Yokohama all in the gulf of Yeddo. 4. 1st order fixed at Iwo Sima Nagasaki, 5. 1st order fixed at Siwo Misaki 6. 2nd Order revolving for Oosima (site not yet fixed), 7. Floating light for Hakodate." "total liabilities for the seven lights exclusive of towers £10,800." Stevenson Letterbook No. 36, 1867-68. Noshima was one of the lighthouses built by Verny but it appears that the Stevenson firm supplied the lights and apparatus.

[37] Yokohama Kaikō Shiryōkan, *op. cit.*, p. 49.

[38] Stevenson Letterbook No. 36, letter of June 5th 1868.

[39] The apparatus, lanterns, lamps, and stores for both floating lights at Yokohama and Hakodate were sent on the second shipment from Scotland in June 1869. The first shipment consisted of the lanterns for Ōshima, Sagami and Noshima sent via the Clyde in September 1868.

December 1869. Construction of the Honmoku lightship, named the *Kaishō Maru*, cost ¥29,644, 84 *sen* 8 *ri* of which, equipment amounted to ¥4,354.[40]

Having secured arrangements for the construction of the lightship Brunton set to work on his next task, to "examine the various sites for the proposed lighthouses which are marked approximately on the charts in your possession, and to prepare the foundations for the iron towers which are being made in this country for Iwo Sima and Siwo Misaki."[41] With no ship at his disposal, "Sir Harry Parkes, who was most anxious that no time be lost in beginning the lighthouse work, urged the British Admiral on station [Sir Henry Keppe], to detail a dispatch boat from among the vessels then under his command for this special service. He detached H.M.S. *Manila* under Captain Johnson".[42] Brunton and Blundell set off on their first inspection tour of lighthouse sites aboard the British Navy steamer, the *Manila* on November 21st. For a month and a half the engineers surveyed the coastline at all of the proposed sites and collected data on the availability of local supplies and labour. Four months after their return to Yokohama, in April 1869, work began on the lighthouses at Kashinosaki (Ōshima), Shiomisaki, and Mikomoto (Rock Island) and in June 1869 on Iōshima.[43] McVean was placed in charge of preparations at Mikomoto and he and Blundell spent alternate months on the island during its construction.[44]

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[40] Tōkōkai, *op. cit.*, p. 21 and Yokohama Kaikō Shiryōkan, *op. cit.*, p. 52.

[41] The English spelling of Iwo Sima and Siwo Misaki is that of the Meiji era. The modern spelling of these names is Iōshima and Shiomisaki.

[42] Brunton, Richard Henry, *op. cit.*, p. 53.

[43] Appendix 7 gives details of all the lighthouses and lightships built under the direction of Henry Brunton.

[44] Yokohama Kaikō Shiryōkan, *op.cit.*, p. 57.

By September 1868 three first-class lanterns had been inspected and were ready for shipment from Scotland.[45] The Stevensons dispatched "a list of the contents of the packages containing the lanterns for Oosima, Segami and Nosima lighthouses in Japan and also instructions which we have drawn up for Mr. Brunton's guidance in fitting up the lanterns".[46] The second shipment of apparatus, lanterns, lamps, and stores for the floating lights at Yokohama and Hakodate was ready by early June 1869. The third shipment containing iron towers and lanterns for Sagami and Iōshima, apparatus and stores for Rock Island, and Shiomisaki was also nearing completion.[47] However, the latter shipment never reached Japan, as the steamer on which it was being transported, the *Elleray*, sank off the coast of Formosa in early 1870 with the loss of the entire cargo.[48] With the exception of the iron towers, all apparatus was re-ordered from

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[45] All equipment for the Japanese lights was sent to the Stevenson Company before shipment to Japan and was inspected by Alexander Coats of Edinburgh. The first lanterns were shipped from the Clyde in September 1868 through Jamie Henderson of Glasgow. The Stevenson Company suggested to the Board of Trade as with apparatus for India, that the Japanese shipments be sent from the Clyde as transport costs to the Clyde were lower than to any other British port and the possibility of breakage on route much reduced. Later shipments were not made from the Clyde.

[46] Stevenson Letterbook No.36, 1867-68, letter of October 24th 1868, from the Stevenson Company to the Board of Trade. The list of contents was four pages long and the detailed instructions to Brunton for unpacking and fitting up the lanterns, five pages (approximately A4 size sheets).

[47] The lanterns and apparatus were not always installed in the lighthouse they were originally intended for. For example the lighthouse at Noshima in Edo Bay received the lantern intended for Mikomoto. This lighthouse was actually built by the French and not by Brunton. In both the first and third shipments the Stevenson Company list includes a lantern for Sagami so it can be assumed that the lantern in the first shipment was placed elsewhere.

[48] The Stevenson firm received a telegraph from Brunton in February 1870 which they forwarded to the Board of Trade on February 18th, 1870 informing them that "Barque 'Elleray' totally lost. have Sir Harry Parkes authority to reorder everything shipped in her if insured, except towers." Fortunately the shipment was insured for £5100.

Scotland. Brunton had one iron tower built for Iōshima lighthouse but decided to build the Sagami lighthouse with stone.

Lighthouse ships

Brunton's first inspection tour of lighthouse sites had been conducted from the British Navy steamer, the *Manila*, as the Lighthouse Bureau had no suitable vessel of its own. It was clear, however, that the Lighthouse Bureau would require a ship, not only for future inspections and surveys but also for transporting materials and supplies to lighthouse sites. On Brunton's return to Yokohama in January 1869, he, with the approval of both Harry Parkes and the Japanese government, made arrangements to buy the *Sunrise*; later renamed the *Tōmyōmaru*, from the British firm of Aspinall, Cornes & Co. for a price of $60,000. Captain Albert R. Brown, some British officers and a native crew were employed in February 1869 to sail the ship.[49] It was in this ship that Brunton made his second inspection trip from July 7th to August 2nd, 1869. The 374 ton vessel proved to be too small for the Bureau and was replaced within a year by a larger and more powerful vessel of 800 tons, the *Thabor.* This ship was purchased from the French Messageries Imperiales (Postal Steamship Company) in the spring of 1870 for $90,000 and the *Sunrise* was transferred to the Telegraph Department.[50] The *Meiji Maru,* 1027 ton topsail schooner, joined the *Thabor* in 1875 and replaced it in 1879; it was in turn replaced by the *Shinhatsuda Maru* in 1896.[51]

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[49] Brunton, R. H., *op. cit.*, p. 64.

[50] Tōkōkai, *op. cit.*, p. 24, Brunton, R. H., *op. cit.*, p. 74 and Yokohama Kaikō Shiryōkan, *op.cit.*, pp. 56-57.

[51] The *Meiji Maru* was built at Napier Shipyards on the Clyde. After twenty-one years in the lighthouse service it was sent as a training ship to a merchant naval college in 1896 where it remained until 1964.

Hiring of artisans

In January 1869 the Stevenson Company received a memorandum from Japan requesting them to engage three artisans for the Japanese lighthouse service. As the Japanese had no experience of building and fitting these modern lighthouses, they turned to the Stevenson Company for assistance. The artisans would receive a monthly salary of $120 commencing from the date of departure from Southampton, £50 for outfit and money to purchase a set of tools not exceeding £20, travelling expenses to Southampton, and a second class passage for the artisan and his wife to Yokohama.[52] The Stevenson Company contacted the firm of Messrs. Milne from whom they ordered much of the apparatus for their lighthouse work to ask about suitable workmen.[53] Two of the three artisans selected to go to Japan were employees of the firm. Thomas Wallace was an ironworker, or mechanic, chiefly employed on lighthouse apparatus, and John Russell was a foreman of joiners and a carpenter acquainted with lighthouse work. Both came highly recommended by the Stevensons who wrote, "Both of them are strictly steady men and first class workmen."[54] The third artisan was John Mitchell, a mason employed at Lochindaal lighthouse.[55] Prior to their departure, all three received £50 for their outfit, travelling expenses from Edinburgh to Southampton and

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As Japan's oldest iron ship, the *Meiji Maru* became a national cultural asset in 1978. Watanabe Katoichi, *Bakumatsu Ishin no Umi,* Tokyo: Naruyama Doshoten, 1999, p.190.

[52] Stevenson Letterbook No. 36, 1867-68, p. 547, letter of January 29th 1868 to A. J. Napier.

[53] In a letter of January 15th, 1869, the Stevenson brothers ask Milne if he could recommend any artisans to go to Japan. Stevenson Letterbook No. 36, 1867-68, p. 511.

[54] Stevenson Letterbook No. 36, 1867-68, p. 553, letter of February 1st 1869.

[55] Stevenson Letterbook No. 36, 1867-68, letter of March 31st 1869 to R.H. Brunton.

a second-class ticket for the sea journey to Yokohama. Russell and Wallace received an additional £50 advance in pay and £20 for tools. John Russell, accompanied by his wife and two children, John Mitchell, and Thomas Wallace left Southampton on a P&O steamer for Yokohama on April 3rd 1869 and arrived in Japan on May 31st.[56] John Mitchell's wife followed at the end of May and Wallace's wife some time later.

Among the new Lighthouse Bureau buildings established in the autumn of 1868 was a factory where most of the carpentry and metal work for the Lighthouse Bureau was to be carried out and it is assumed that the three artisans spent most of their time there. Their skill and expertise were valuable to the Japanese, who had little or no experience of this type of work themselves. At least twelve foreign artisans, all of whom were British, were hired to work in the lighthouse factory, including carpenters, metal workers and masons. Of these, five were hired through the Stevensons' company. The others may have been hired from the Yokohama foreign settlement. Under the direction of these foreign employees the Japanese workmen built and repaired beacons, lightships, lighthouses and equipment.[57] The overall supervision of the factory was placed in the hands of Brunton, and later MacRitchie and Fisher.

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[56] Russell received £10 travelling expenses for himself, his wife and children from Edinburgh to Southampton. Mitchell and Wallace received £5 each. Mitchell's wife received passage tickets for the steamer on April 29th, plus £7 travelling expenses from Aberdeen to Southampton. Wallace's wife was to travel later and would receive all travelling expenses before departure. The Stevenson firm advanced money to the artisans, claiming it back from the Board of Trade later. Stevenson Letterbook No. 36, 1867-68, p. 693, letter of March 22nd 1869; Yokohama Kaikō Shiryōkan, *op. cit.*, p. 64.

[57] The factory was also put to public use as in the case of the construction of the iron Yoshida Bridge.

Hiring of Lightkeepers

No sooner had the artisans left than the Stevenson brothers received a communication from the Board of Trade requesting the engagement of three lightkeepers for Japan. With preparations for the construction of the first lighthouses underway, the next step was to employ and train lightkeepers to maintain them. The terms of their employment were,

> 1st. Pay $100 per month equal to about £265 per annum payable from date of arrival in Japan. 2nd. Half pay from the date of engagement till arrival in Japan. 3rd. £50 to be paid before leaving this country for outfit. 4th. Travelling expenses, second class to be paid to port of departure in this country and then to Yokohama in Japan by the Cape. 5th. The same for the lightkeeper's wife if married and family not exceeding two in number.[58]

Having contacted Mr. Cunningham, the secretary for the Board of Northern Lighthouses, the Stevensons were put in contact with several interested candidates. The Stevensons explained that the lightkeepers "will be under the lighthouse establishment there who are composed of Scotch engineers sent out from this country. Everything as regards interpreter and the station he may go to will be arranged by them. We presume his duties will ultimately at least be more of a superintendent of lightkeepers than a mere lightkeeper."[59] Mr. Cunningham recommended three lightkeepers; George Charleson, assistant lightkeeper at Davaar Lighthouse, Niven Kerr, lightkeeper at the Isle of May lighthouse, and Joseph Dick, lightkeeper at Little

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[58] For full details of the agreements for the employment of three lightkeepers, refer to Appendix 6. Stevenson Letterbook No. 37, 1868-69, letter of May 25th 1869.

[59] Stevenson Letterbook No. 37, 1868-69, p. 906, letter of June 25th 1869.

Ross lighthouse.[60] However, Niven Kerr's application was rejected because he had four children and in the terms of the agreement, the Japanese government would pay travelling expenses for only two. James McIntosh, assistant lightkeeper at Corsewall lighthouse was selected in his place. On November 16th the three lightkeepers and Mrs. Charleson left for London on the North British railway and sailed by the *Black Watch* to Yokohama on November 20th 1869. Almost a year later, Mrs Dick and her child travelled to Japan by the Peninsular and Oriental steamer vessel *Pera* which left Southampton on December 19th 1870.

The first three lightkeepers, George Charleson, Joseph Dick, and James McIntosh were all first class lightkeepers hired through the Stevensons and sent to Japan in late 1869. George Charleson became the head instructor at the experimental lighthouse in Yokohama and contributed greatly to the establishment of the lightkeeping system in Japan. He was the last *oyatoi* to leave the Lighthouse Bureau in 1881. Joseph Dick was also promoted to instructor and stayed with the Bureau until 1879. MacIntosh was fired from the service after two years and is thought to have gone to work in the lighthouses in China. The British lightkeepers and later the Japanese keepers were divided into classes, depending on their ability and experience. During the six years following their appointment, approximately twenty-two more lightkeepers were hired. It is assumed that most of them were hired from the treaty ports in Japan, as they did not appear in the Stevenson's letterbooks. According to *The Scotsman* of October 15th 1872, "there are at present thirteen European lightkeepers. Of these, two are trained lightkeepers from the Scotch lighthouse service, the remaining eleven being appointed

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[60] Stevenson Letterbook No. 38, 1869-70, p. 64, letter to Board of Trade, September 20th 1869.

in Japan and trained under the directions of the engineers."[61]

Changes in the *Oyatoi*

In mid 1869, McVean resigned from his position as assistant engineer in the Lighthouse Bureau. It is unclear why McVean left the service after little more than a year especially as he remained in Japan for seven more years. It has been suggested that the harsh conditions on the island of Mikomoto where McVean worked from April 1869 influenced his decision to leave the service.[62] However, it is possible that he felt his talents could be put to better use elsewhere or that he was offered a more lucrative position. It is known that he re-entered Japanese government service in July 1871, and that the conditions of his employment were greatly improved. He was employed as Surveyor General to the Survey Bureau with a salary of $300 per month; double that of the assistant engineer position in the Lighthouse Bureau.[63] During the two-year interval between leaving the lighthouse service in July 1869 and entering the Survey Bureau in July 1871 McVean remained in Yokohama and worked as a consulting engineer there.[64] It would appear that he was more content with his work in the Survey Bureau for he remained there five years and it can be assumed that the Japanese

[61] The Scotsman Newspaper October 15th 1872.

[62] Yokohama Kaikō Shiryōkan, *op.cit.*, pp. 57-58.

[63] According to the Stevenson Company letterbooks McVean and Blundell's salaries were to be $150 per month in the Lighthouse Bureau. However, according to Tōdaishi McVean and Blundell received a salary of ¥300. UNESCO only records McVean's employment with the Survey Bureau not with the Lighthouse Bureau. It seems unlikely that the government would double McVean's salary within a year. Tōkōkai, *op. cit.*, p. 618.

[64] Yokohama Kaikō Shiryōkan indicates that McVean worked in Yokohama after leaving the Lighthouse Bureau but gives no further details. Yokohama Kaikō Shiryōkan, *op. cit.*, p. 64.

government were happy with his work for his salary was raised periodically. By the time he left the Bureau in 1876 his monthly salary was $550, only $50 less than Brunton's salary of $600.[65]

In the spring of 1870 Blundell too resigned from the lighthouse service.[66] One year later, in May 1871, he entered employment in the Railway Bureau first as an assistant supervisor of construction of the Yokohama-Shinbashi (Tokyo) railway line at a salary of $350 per month.[67] He continued as an engineer in the service of the Railway Bureau until July 1875.

Following McVean's departure and Blundell's notification of his resignation, the Lighthouse Bureau was forced to seek replacements. In January 1870 Samuel Parry who had been hired temporarily as an assistant to McVean during his survey of the Yokohama settlement in December 1868, was hired.[68] At the same time Brunton

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[65] Brunton received an initial salary of $450 per month, which was raised to $600 in 1870. It remained at this value until he left Japan. McVean's salary was raised to $350 after one year in the Survey Bureau, then again to $450 after three years when his contract was renewed. It was raised by $50 each year thereafter. UNESCO Higashi Ajia Bunka Kenkyū Sentaa, *Shiryō oyatoi gaikokujin,* Tokyo: Shōgakukan, 1975, pp. 384, 423.

[66] According to Tōkōkai, McVean's contract ended on July 25th 1869 and Blundell's on April 4th 1870. In the Yokohama Kaikō Shiryōkan McVean's contract is said to have ended on September 1st 1869 and Blundell's on May 4th, 1870. It would appear that Brunton did not inform the Stevensons of McVean's resignation until early 1870 when Blundell too had given his notice. In a letter written by the Stevensons to Brunton on February 24th, 1870, the Stevensons wrote, "We are sorry to hear of the resignation of Mr McVean and Mr Blundell". Tōkōkai, *op. cit.*, p. 618, Yokohama Kaikō Shiryōkan, *op. cit.*, p. 64, Stevenson Letterbook No. 38, 1869-70.

[67] UNESCO, *op. cit.*, p. 384.

[68] Parry was presumably in the treaty port of Yokohama when he was hired in December 1868. The Stevenson Company had no connection with his employment.

contacted a British engineer by the name of Sterling Fisher and offered the position of assistant engineer to him.[69] Having determined Mr. Fisher's willingness to accept the job he forwarded the necessary documentation to the Stevensons in April 1870. The Stevensons were acquainted with Mr. Fisher and recommended him to the Board of Trade saying "as we know Mr. Fisher to be thoroughly competent we recommend that the appointment be offered to him in the first instance". Mr. Fisher entered a period of training with the Stevensons, as had his predecessors, before departing for Japan on July 9th 1870.[70] Before his departure he received £445.5s to cover his advance in salary, his outfit, and travelling expenses.[71]

In August 1870 John Russell, the carpenter hired by the Stevensons one year earlier, died in Yokohama. The Japanese government provided his widow with a "liberal allowance" of $600 and "a sum of $450 has been placed to her credit in the oriental bank for which she can draw the interest. This sum is at the disposal of the English minister and is intended for the raising of her children." A letter expressing the government's satisfaction with Mr. Russell's work in Japan was sent to the Stevenson Company through the Board of Trade and was forwarded to Russell's former

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[69] In early 1870 the Stevenson Company wrote to the Board of Trade, "We have heard from Japan of Mr. McVean's resignation but nothing further has reached us on the subject excepting that some correspondence has taken place between Mr. Brunton and an Engineer in this country as to his succeeding Mr. McVean from which we suppose that if the vacancy is to be filled up at all it may be done directly by the authorities there without referring the matter to us." Stevenson Letterbook No. 38, 1869-70.

[70] Stevenson Letterbook No. 38 and 39, 1869-70, letters of June 15th and July 4th to R. H. Brunton.

[71] Fisher received £100 advance in salary, £150 for outfit, £154.1s travelling expenses from Southampton to Japan, £15.15s travelling expenses from Edinburgh to Southampton and for visiting lighthouses and £25 for defraying freight on extra luggage and incidental expenses on passage to Japan. Stevenson Letterbook No. 38, 1869-70, letter of June 8th, 1870.

employers, Messrs. Milne. Mrs. Russell remained in Yokohama and married a plumber in the lighthouse service in July 1871.[72]

With the loss of Russell word was sent to the Stevenson Company in November 1870 to find an artisan to replace him. Once again they inquired at the firm of Messrs. Milne of Edinburgh if a suitable workman was available and willing to take up this position in Japan. What was required was "a workman in metal who has been employed in lighthouse work. A good workman who is steady and respectable and could direct as to the fitting up of apparatus sent out from this country".[73] The artisan was to be employed on the same terms as his predecessors with a slightly increased monthly salary of $150. On December 9th, 1870 William Simpkins was recommended to the Board of Trade for the position. The Stevenson Company wrote, "He is well recommended by his present employers Messrs. Milne & Son as a very steady and good workman."[74] The Stevenson Company were anxious to point out that over and above his practical experience he was a well-educated workman and had won several prizes for his studies.[75] Simpkins received £50 for outfit and £50 advance in salary,

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[72] Stevenson Letterbook No. 39, 1870-71, letters of November 23rd 1870 and July 14th 1871.

[73] Stevenson Letterbook No. 39, 1870-71, letter of November 26th 1870.

[74] According to UNESCO, *op. cit.*, p. 299 and and Tōkōkai, *op. cit.*, p. 618, Simpkin's contract began on November 3rd, 1870. However, according to the Stevensons Letterbook No. 39, 1870-71, Simpkins was not recommended for this position until December 9th.

[75] Stevenson Letterbook No. 39, 1870-71, p. 555 and 576, letters of December 9th 1870 and December 14th to Board of Trade and letter of January 27th 1871 to Brunton. "He served an apprenticeship with Messrs. Lang & son, engineers and millwrights, Edinburgh, and has since been nearly three years in the employment of Messrs. Milne & Son engaged at lighthouse work. He will be 28 years of age next month, is married but has no family. His early education has been good and he holds the [?] Prizes awarded by the Science and Art Departments of Council on Education. 1st. Machine construction and drawing. 2nd. Acoustics light and heat. 3rd Steam and [?]. 4th Second class certificate for pure mathematics. Also

train tickets to Southampton and passage from Southampton to Yokohama for himself and his wife.[76] He and his wife departed from Southampton on the Peninsular and Oriental Steam Navigation Company's steamer of February 18th, 1871 arriving in Yokohama on April 18th from where they proceeded to Akashi lighthouse.[77]

Thomas Wallace and John Mitchell were due to complete their three-year contracts in May 1872 and although both had expressed a willingness to remain for a further term they had required an increase in salary, which the Japanese government had refused. Brunton wrote to the Stevenson Company in February 1872 asking them to hire an artisan to replace Thomas Wallace. There was no need to replace Mitchell, he wrote, "as the Japanese themselves are pretty well up in mason work and we have no large stone buildings to erect." The artisan was to receive a monthly salary of $150, half salary from the date of signing the agreement to arrival in Japan, £50 for outfit and travelling expenses from Scotland to Yokohama.[78] In May, James Milne recommended John Herdman and on June 6th Mr. Herdman, his wife and child departed from Southampton on a P&O steamer to Yokohama.[79]

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certificate of proficiency in Natural Philosophy, School of Arts, Edinburgh."

[76] Stevenson Letterbook No. 39, 1870-71, letter of January 12th 1871 to the Board of Trade.

[77] Stevenson Letterbooks No. 39, 1870-71, letter of May 12th 1871 from Brunton to the Stevenson firm.

[78] Full details of the terms of employment can be seen in Stevenson incoming Letterbook, February 17th 1872.

[79] "In reference to an artisan to take the place of Thomas Wallace for Japan we beg in recommending John Herdman. He has been with us for a number of years and has always conducted himself to our satisfaction. He is remarkably adapted for erecting lanterns or any apparatus when skill and attention is required he can solder on burness and do any repairs required and will be able to keep up his positions and instruct the natives." Letters of May 8th and May 25th 1872 from James Milne to the Stevenson firm. Stevenson Letterbooks No. 39, 1870-71.

Expansion of the lighthouse agreement

By the end of 1871 the majority of lighthouses and lightships stipulated in the 1866 agreement with the Western powers were in place and operational around the treaty ports. Verny of the Yokosuka ironworks had supervised the construction of the first lighthouses in Edo bay at Kanonsaki, Noshima, Shinagawa and Shirogashima, the last of which was illuminated in August 1870. Brunton had been given the task of supervising the construction of the remaining thirteen, of which two lightships and eight lighthouses had been completed by December 1871 and the remaining three were close to completion.[80]

Fulfilment of the agreement did not bring an end to lighthouse construction in Japan. The Japanese government's ultimate objective was not simply to improve the safety of navigation around the treaty ports for the benefit of the Western powers but to do so around the entire coast of Japan for the benefit of its own shipping. The treaty lighthouses had been given highest priority but they were in fact only the first step. The government had already asked Brunton to continue in his position as Chief Engineer, building lighthouses and supervising the work of the Lighthouse Bureau. By the end of 1871 he had already made a start to five additional lighthouses at Tenpōsan, Nabeshima, Tsurishima, Irōsaki and Matoya.[81]

In a letter of September 28th 1871 to D. & T. Stevenson, the Japanese government

[80] Appendix 7 lists the dates each lighthouse/lightship became operational.

[81] Three of these sites in the Osaka area were proposed by Brunton after his initial inspection tour in 1868-69.

wrote of its intention to build more lighthouses around the Japanese coast and expressed a desire to retain the services of the Stevenson Company as consulting engineers:

> The lighthouse materials which our Government through the good offices of the English government have obtained have given great satisfaction and we are aware that you have been the means of procuring the various articles sent out and now arriving. There will be many more lighthouses required on our coast and we are therefore anxious that you should continue your service on our behalf. But as we are desirous no longer to cause trouble to the English government in this matter we would be glad if you would act for us directly.[82]

As a result of negotiations a new arrangement was made in which the Japanese government dealt directly with the Stevenson Company which continued much as before to manage all aspects of the supply of equipment to Japan up until 1877. [83]

Training of Japanese and *Ryūgakusei*

Most of the foreign employees in the Lighthouse Bureau were involved in the training of Japanese at some level. On the job training was carried out under British engineers, carpenters, metal workers and masons on lighthouse construction sites, in the lighthouse factory, under British lightkeepers in the lighthouses, and under British

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[82] Stevenson Letterbooks No. 40, 1871-72, letter of September 28th 1871.

[83] The Japanese asked the Stevenson Company if they "might be inclined to make some reduction" on the cost of their services owing "to the extensive orders which you will probably receive from this government"; "we wish to take advantage of Mr. Brunton's return to England for a short time for him to negotiate terms with you and come to a final arrangement concerning them." Stevenson Letterbook No. 40, 1871-72, letter of April 13th 1872, from Sano Todai no Kame, Commissioner of Public Works, Lighthouse Section.

crew aboard the lighthouse ships. Lightkeepers were trained on site at the newly established lighthouses under one or two British lightkeepers until the establishment of an experimental lighthouse in the grounds of the Lighthouse Bureau in March 1874. From this point trainee lightkeepers received two months training at the experimental lighthouse and two months at a real lighthouse. Having referred to lighthouse manuals from Scotland, England, France and the USA Brunton put together a booklet of working regulations for Japanese lighthouse keepers which formed the basis of light keeper training in Japan for many years. George Charleson was placed in charge of training. The experimental lighthouse and a laboratory established in September 1873 were also used to test and adjust equipment arriving from Scotland. After completion of the experimental lighthouse on March 18th, 1874 the Meiji Emperor visited the Lighthouse Bureau to observe the progress made in modern lighthouses.

When the treaty lighthouses were near completion in 1871, the Lighthouse Bureau began to place greater emphasis on formal training. A training school, the Shūgikō, was established in the Lighthouse Bureau in May 1871 where students received instruction in various subjects concerned with lighthouses including surveying, construction, and mechanics from British instructors.[84] Samuel Parry was appointed Principal to the school.[85] After three years this school was absorbed into the Kōgakuryō (later Kōbudaigakkō) Engineering College, which took responsibility for the training of high-level engineers for most engineering fields.[86]

[84] Details of the course can be found in the *Kōro Hyōshiki Nenpō* of 1902, p. 6.

[85] Parry, who had been employed as an assistant engineer in 1869, was placed in charge of overall instruction and was replaced in 1873 by C. Farman. Tōkōkai, *op. cit.*, p. 618.

[86] The Shūgikō was closed on January 19th 1874 and the students joined the Kōgakuryō. Ōkurashō, *Kōbushō Enkaku Hōkoku*, 1888, p. 620.

In April 1871 the Lighthouse Bureau issued regulations on overseas students and in 1872 two young men were selected to travel to Britain for further study. Fujikura Kentatsu (Kinjirō), who had worked as Brunton's translator, was sent to Edinburgh in March 1872 and was followed in June by a student of the Shūgikō, Sugi Kōichirō.[87] These two men are listed among the *ryūgakusei* to Scotland in Appendix 2. In a letter of June 26th 1872, George Wauchope, accountant to the Lighthouse Bureau, enclosed a translated letter from Sano Isumi Tami of the Lighthouse Bureau to the Stevenson Company. "By the American mail leaving this port today [22nd June 1872] Mr. Sugi Shigetoshi departs for Europe with the intention of studying lighthouse architecture in your care for three years and I beg to request your granting him every assistance to promote his education in that particular branch."[88] Sugi Kōichirō and Sugi Shigetoshi are probably the same person, although according to *Kaigai Tōkōsha Sōran*, Sugi Kōichirō was a native of Tokyo while Sugi Shigetoshi was a native of Yamaguchi.[89] Fujikura and Sugi Kōichirō trained with the Stevenson Company and studied at Edinburgh University.[90] According to the Stevenson Company, "Mr. Kinjiro is very attentive and anxious to acquire information."[91]

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[87] *Kōro Hyōshiki Nenpō*, 1902, p. 8.

[88] Stevenson Letterbook No. 42, letter of June 26th 1872 from George Wauchope to the Stevenson firm.

[89] Kita, Masami, *Nihon o Hiraita Hitobito: Nippon to Sukottorando no Kizuna,* Tokyo: Dōbunkan, 1984, p. 79; Edinburgh University, *First Matriculation Record,* session 1872-73 and 1873-74, and Tezuka Akira, *Bakumatsu Meiji Kaigai Tokōsha Sōran*, Tokyo: Kensakuhen, 1992, p. 476.

[90] Edinburgh University, *First Matriculation Record,* session 1872-73 and 1873-74. According to these records, Sugi Kōichirō studied at the University for two years from 1872-4 and Fujikura for one year from 1873-74. Fujikura's name in the records appears as Fujikura Kinjiro.

[91] Stevenson letterbook No. 42, letter of August 12th 1872 to Brunton.

On August 9th, 1872 Brunton, who was on leave in Britain, wrote to the Stevenson Company on the subject of Japanese students. The Lighthouse Bureau wished to place additional students, then travelling with the Iwakura Mission, with the Stevenson Company but Brunton was unsure if the plan was feasible or indeed acceptable. In reply the Stevenson Company expressed their understanding and willingness to help but suggested that further discussion would be necessary to decide on the best options for training, whether with the Stevenson Company or with other firms.[92] At the time the Iwakura Mission was touring Britain and Brunton accompanied them on part of the trip. When they travelled to Scotland in mid October, they visited the Stevenson Company to discuss arrangements for further lighthouses in Japan but presumably the subject of Japanese *ryūgakusei* was also discussed. However, there is no record of the

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[92] Letter of August 9th 1872 from Brunton to the Stevenson firm: "I have also received letters from Mr Sano informing me that besides the pupil mentioned several others are on their way to this country with the Embassy and asking me to try to get you to instruct them… Of course it is quite out of the question for you to be troubled in your office with these young men and it is ridiculous to ask you but I hope that you will not be unwilling seeing the difficulties they have in acquiring really useful information in giving your name and your supervision in some way to their education. Perhaps you could depute some good practical man who under you would devote his time to instructing them." In reply the Stevenson firm wrote to Brunton on August 12th, "We shall be most happy to afford any assistance and advice…. You are quite right that the objects in view could not be attained by their entering our office or indeed any engineering office as we do not see that their efficient instruction could be secured by such an arrangement and perhaps your suggestion as to appointing some competent practical persons in the various departments to teach them under our superintendence may be the most likely method of carrying out the wishes of the Government…. Before deciding on my cause however we should like to have an opportunity of going over the whole matter with you, the points to be considered being the number of pupils, the sort of education they require and in how far it is [?] or elementary. Also the branches of engineering they would study, Railway, Harbours, Rivers, Lighthouses, Telegraphs, Engine works, Mines. We shall be happy to confer with you as to this and what is the best advice to offer to the Government.' Stevenson Incoming Letterbook No. 84, 1871-72, Japan Lights, letter of August 12th 1872 from Brunton and Stevenson Letterbooks No. 42, letter of August 12th 1872 to Brunton.

discussions which took place and no evidence has been uncovered to indicate how the other students were dealt with. It is possible that some remained in Scotland with the Stevenson Company or with related engineering firms.

In January 1873 two additional Japanese students from the lighthouse Shūgikō were sent to Britain but no evidence has been found to indicate where they trained.

Fujikura Kentatsu and Sugi Kōichirō returned to Japan in July 1874. Sugi was employed as an instructor of technical drawing at the Kōbudaigakkō, assisting Edmund Mundy and later William Barr, from 1878. In 1882 he was promoted to a full Professor and replaced William Barr.[93] His activities between 1874 and 1878 are unknown but in accordance with the regulations for government-sponsored *ryūgakusei* he would have been obliged to work for the government on his return to Japan, probably in the Lighthouse Bureau or at the College. Fujikura entered the Lighthouse Bureau as an engineer. He worked his way up the ranks as an engineer and in 1879 was placed in charge of lighthouse construction, replacing James MacRitchie. In 1885 he was appointed Chief of the Lighthouse Bureau.

Oyatoi in the Lighthouse Service

The Lighthouse Bureau employed approximately one hundred foreign *oyatoi* during the fifteen-year period from 1868, when the lighthouse project was initiated, until 1883 when Japanese employees replaced the last *oyatoi.* Appendix 5 lists the British

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[93] Tezuka Akira, *op. cit.*, p. 476 and Kita Masami, *op. cit.*, pp. 109 and 220.

employees of the Lighthouse bureau with a summary of the type of work carried out by each, the salaries and dates of contracts. The majority of *oyatoi* were British, half employed at the headquarters in Yokohama and at lighthouses, while the other half worked on the lighthouse ships. The earliest engineers, artisans, and lightkeepers who were hired by the Stevenson Company, were mostly Scottish, many having been recruited from local Edinburgh companies with whom the Stevenson Company dealt or from the Commissioners to the Northern Lighthouses.

The Meiji government's policy of dispensing with foreign employees as soon as Japanese had been trained for their jobs, a process known as *Nihonjika*, was successfully achieved within a decade and a half. The Japanese had acquired the necessary expertise, through formal and on the job training under the foreign *oyatoi,* to undertake all of the lighthouse work without foreign assistance. The Department continued for some years to rely on foreign imports, particularly of lighting apparatus, but this also declined with time.

Throughout Brunton's term in Japan, he worked closely with the Stevenson brothers. The firm, with its long experience of lighthouse construction, maintained an advisory role, initially providing very detailed advice on all aspects of lighthouse construction and apparatus.[94] In return Brunton supplied detailed information which allowed the Stevenson Company to design appropriate apparatus and lights. Brunton had only a

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[94] Over the first year or two the Stevenson Company sent various memoranda to Brunton with advice on various aspects of lighthouse design. One example is the December 1868 memorandum on the design of iron, stone and timber lighthouses with advice on earthquake zones. Stevenson Letterbook No 37, memorandum of December 4th 1868.

few months training in lighthouse engineering before travelling to Japan but he was an experienced civil engineer, and proved to be a very efficient lighthouse builder. His skill is evident when we consider that some of his stone and brick structures are still standing today, more than a century after their construction.

Brunton's contributions to Japan's modernization do not end with lighthouses. As an experienced civil engineer he was consulted on various other government projects including railway, telegraph, harbour and drainage works.[95] He also recommended several engineers for service in Japan. He wrote two books about his work in Japan and several articles which provide us with valuable information. When he returned to Scotland he received ¥2,000 in recognition of his contributions and later became an adviser to the Japanese Lighthouse Service. He worked as manager in Young's Paraffin Oil Company and later established his own construction company. He died in 1901.

Conclusion - The Scottish contribution to the Lighthouse Service in Japan

From 1868 until 1877, the Edinburgh civil engineering firm of D. & T. Stevenson acted as consultants to the Japanese Lighthouse Department, designing and supplying the majority of equipment, hiring the first engineers, artisans and light keepers and training at least two Japanese *ryūgakusei*. Of those *oyatoi* sent out by the Edinburgh

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[95] The first railway in Japan was planned and built on the basis of a proposal by Brunton. He was asked to give advice on telegraphs and recommend a telegraph engineer. He also designed plans for Osaka port, designed and built an iron bridge in Yokohama and a drainage system for the Yokohama foreign settlement Yokohama Kaikō Shiryōkan, *op. cit.*

firm, several had a lasting impact on the Japanese Lighthouse Service. Richard Henry Brunton as Chief Engineer completed 27 lighthouses, two lightships and several beacons and buoys around the coast of Japan during his eight-year service in Japan from 1868 until 1876, helped establish a training facility for engineers, and implemented the first lightkeeper's regulations, based on those of the Scottish Lighthouse Service. George Charleson and Joseph Dick, as instructors, trained the majority of Japanese lightkeepers during their long service from 1869 until 1881 and 1879 respectively. William Simpkins supervised the majority of work in the lighthouse factory in his nine years as superintendent of works. The two *ryūgakusei* who trained with the Stevenson Company and attended classes at Edinburgh University, Fujikura Kentatsu and Sugi Kōichirō, returned to Japan to contribute to the lighthouse service and engineering education. In addition to the above there were many more *oyatoi,* mostly British including several more Scots, who contributed to the development of the Lighthouse Service.

CHAPTER FOUR

SHIPBUILDING

This chapter begins with an introduction to the development of shipbuilding over the centuries prior to the Meiji period and investigates Scottish links with the Japanese shipbuilding industry after 1868. The shipyards of the Clyde and the naval architecture classes at the University of Glasgow and at the Glasgow and West of Scotland Technical College attracted a large number of Japanese *ryūgakusei.* Most of the men who trained in Glasgow returned to careers in shipbuilding. Particular attention is paid to Miyoshi Shinrokurō, who contributed greatly to the education of naval architects in the Imperial University Tokyo. The activities of several other Glasgow *ryūgakusei,* who worked in both naval and private shipyards, are also given consideration.

The island nations of Japan and the United Kingdom, with total land areas of 377,800 and 240,883 square kilometres, located on the edge of continental Asia and Europe respectively, share similarities in geography and location that have dictated a close dependence on the sea and shipping.[1] The sea has always provided a rich source of food, a means of transportation and, in the past, the only mode of communication with the outside world.

In the seventeenth century the expansion of Europe's foreign trade with the wider world acted as a stimulus for advances in naval architecture and consequently in

[1] Figures for Japan are taken from Kōdansha, *Japan: Profile of a Nation*, Tokyo: Kōdansha, 1995. Figures for the UK from *Whittaker's Scottish Almanack 2001*, London: The Stationery Office Ltd, 2001.

related fields of navigation and navigational aids. In contrast, these fields in Japan entered a period of comparative stagnation heralded by the introduction of the seclusion policy. Domestic shipping continued under tight restrictions but the greatest stimulus for development present in the West, that of foreign trade, was absent in Japan.

Shipbuilding in Britain

Advances in engineering, which accompanied the industrial revolution, in combination with the expansion of foreign trade and the abundance of conveniently placed natural resources were key factors in the development of shipbuilding in Britain. The transition from wind to steam power which gave advantages in speed and the change from wood to iron ships which made possible the building of larger, lighter ships, allowed the British shipbuilding industry to take the lead in the field of steamship building and remain ahead of rival nations during the nineteenth century. Among the principal centres of shipbuilding in Britain, which included the Thames, the Mersey and the Tyne in England and the Forth, the Tay, the Dee and the Clyde in Scotland, the Clyde became the centre of iron steamship building by mid century.

Shipbuilding on the Clyde thrived during the nineteenth century for a variety of reasons. One of the greatest advantages was its proximity to large coal and iron fields which provided the crucial raw materials for the emerging steam and iron shipbuilding industry. Its other major advantages were access to a large population of skilled and semi-skilled labour and the presence of numerous local innovators in the field of marine engineering.

During the first stage of Scotland's industrial revolution, textile manufacturing was Scotland's major industry. Increased mechanization over the period encouraged local industries to produce their own machines with the result that mechanical engineering progressed rapidly. The skills developed during this early stage were readily applied to later stages of the industrial revolution in which steam power and iron played a major role. Clyde shipbuilders were fortunate to have at hand a population of skilled labour experienced in engineering and metal work, when the industry took off.

The reputation of the Clyde's shipbuilding industry was also due to a large extent on the work of local innovators such as James Watt, Henry Bell, David and Robert Napier, and John Elder. James Watt's invention of the separate condenser led to the use of steam power in the textile industry and this in turn led to experimentation in ship propulsion. Henry Bell built the first passenger steamboat, the *Comet*; David and Robert Napier improved the marine engine, and John Elder invented the compound engine which reduced the rate of coal consumption in steam ships by about a third, cutting costs and providing additional shipping space for cargo.[2] Elder also invented the triple compound engine which was improved by A. C. Kirk of Robert Napier & Sons.[3]

One of the first to experiment in the field of steam ships was William Symington, who

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[2] Henry Bell (1767-1830) was trained as a wheel-wright and ship builder and worked in London for a period before returning to Helensburgh. Fyfe Alistair, *Scottish Inventors,* Glasgow: HarperCollins, 1999, p.29.

[3] Moss, Michael, *The Clyde: A Portrait of a River,* Edinburgh: Cannongate Books, 1997, p. 16.

built a wheel paddle steamer, the *Charlotte Dundas,* using Watt's double acting engine in the early nineteenth century. This was followed in 1812 by Henry Bell's *Comet*, which was successfully run in open waters. John Wood of Port Glasgow built the ship and the engineers John Robertson and David Napier designed and built the engines. The *Comet,* which ran between Greenock and Glasgow, was the first major breakthrough in steamships and signalled the beginning of steam-ship building on the Clyde.[4] According to Michael Moss, forty-two steamships were built on the Clyde between 1812 and 1820, approximately 67 per cent of all steam ships constructed in the United Kingdom. By the 1820s steam technology had been adopted in most of Britain's major shipbuilding centres, which were then able to compete with the Clyde. However, with the transition to iron shipbuilding, a technique developed in England, the Clyde once again took the lead.[5]

The cousins David and Robert Napier made a huge contribution to the early steamship industry in Britain, being responsible for the greatest advances in the design and construction of the marine engines during the 1820s. Following the success of the *Comet*, David Napier, who had supervised work on the ship's boilers, ordered a ship from William Denny in 1818, The *Rob Roy,* in which he placed his own engine. The *Rob Roy* also proved a success on the Greenock and Belfast route and led Napier to build several more steamers for Clyde routes.[6] The Napiers continued to build and

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[4] General information on the early progress of the Clyde can be found in Jones, Leslie, M. A., *Shipbuilding in Britain Mainly Between the Two Wars*, Cardiff: University of Wales Press, 1957, Moss, Michael, *op. cit.*, and Slaven, Anthony, *The Development of the West of Scotland, 1750-1960,* London & Boston: Routledge and Kegan, 1975.

[5] Moss, Michael, *op. cit.*, p. 14.

[6] Jones, Leslie, M. A., *op. cit.*, p. 18.

improve marine engines and in doing so were also responsible for nurturing a whole generation of Clyde innovators.[7] Michael Moss wrote, "The majority of the Clyde marine-engine works and iron shipyards established in the mid-nineteenth century were set up by former employees" and describes Robert Napier's firm as the "Kindergarten of Clyde Shipbuilders." The firms of Todd and MacGregor, William Denny & Bros, J & G Thomson (later John Brown Shipbuilding and Engineering Co. Ltd.), and Randolph and Elder (later the Fairfield Shipbuilding and Engineering Co) were all established by former employees of either David or Robert Napier.[8]

Clyde shipbuilders were among the pioneers of iron steamship building in Britain.[9] Todd and MacGregor established the first British iron shipyard on the Clyde in 1836 and Robert Napier established a yard in Govan in 1841. In the following twenty years Robert Napier built over seventy ships for passenger markets across the globe. By the

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[7] Michael Moss quotes the naval architect and engineer John Scott Russell as saying: "From the commencement of steam navigation in Great Britain, no great strides appear to have been made until the year 1818, when Mr David Napier, the engineer, entered on the construction and improvement of steam navigation.... It is to Mr David Napier that Great Britain owes the establishment of deep sea communication by steam vessels, and of Post Office Steam packets." Moss, Michael, *op. cit.*, p. 13.

[8] Tod and MacGregor shipyard was established in 1834 by David Tod and John MacGregor, former engine works managers with David Napier; William Denny & Bros, Dumbarton, was established in 1844 by William Denny, former ship designer and chief draughtsman; J & G Thomson was established in 1847 by James and George Thomson, former engine works managers; and Randolph and Elder was established in 1852 by John Elder, former chief Draughtsman.

[9] The Tyne, Wear and Tees, were also among the leading iron steamship building regions in Britain. As with the Clyde they had the advantage of close proximity to the iron and engineering industries. Horsley in Staffordshire built the first ocean-going iron vessel, the *Aaron Manbey,* in 1821. Birkenhead shipyards built the *Rainbow* in 1838, and Todd & Macgregor built the *Royal Sovereign* and the *Royal George* in 1839. Walker's on the Tyne launched the *Prince Albert* in 1842. Jones, Leslie, M. A., *op. cit.*, p. 11, 25.

1840s the Clyde was Britain's leading centre for iron steamship building and despite competition from other regions it retained its lead over the following decades. Between 1851 and 1870 over a third of all iron ships constructed in the United Kingdom were built on the Clyde.[10] Towards the end of the 1870s steel began to replace iron and by 1889, ninety-seven per cent of the ships built on the Clyde were built of steel.

William Thomson and William MacQuorn Rankine, both Professors at Glasgow University, also contributed to Clyde shipbuilding. William Thomson made improvements to the navigational compass, eliminating the effects on the iron ship of the compass. Rankine made improvements to the hull design, which was further improved by William Denny III. The first Institution of Engineers and Shipbuilders was founded in Scotland in 1857, almost three decades before any in England.[11]

Shipbuilding in Japan

The great advances in shipbuilding made in the West during the late eighteenth and early nineteenth centuries were not mirrored in Japan. Despite Japan's dependence on the sea, conditions during the Tokugawa period had not been as conducive to advances

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[10] "In the 1840s virtually all iron tonnage in Britain emanated from the Clyde, and even between 1851-60, when the compound engine had appeared, when surface condensers and high pressure boilers were gaining popularity, and when Lloyds had prepared separate rules for iron ships, the Clyde produced 87 per cent of all iron tonnage in Britain and 68 per cent in the following decade. For twenty years from 1851 to 1870 the Clyde shipbuilders poured out the prodigious figure of over 70 per cent of all iron tonnage launched in Britain." Slaven, Anthony, *The Development of the West of Scotland, 1750-1960,* London & Boston: Routledge and Kegan, 1975, p. 132.

[11] Jones, Leslie, M. A., *op. cit.*, pp. 15, 16.

in the field as they had been in the West. The withdrawal of international trade in the seventeenth century under the seclusion policy, the implementation of restrictions on ship size and the absence of an industrial revolution had deprived the shipping industry of the major stimuli to development present in other seafaring nations.[12] However, domestic trade which thrived in the favourable climate of the Tokugawa period provided a modest stimulus to shipping and while few major advances were made, the Tokugawa Japanese were proficient shipbuilders.

According to a Russian captain who was captured and imprisoned in Japan in 1811, Japanese shipbuilders were skilled carpenters and craftsmen and their sailors able seamen. In his diary written while in a Japanese prison, he wrote prophetically that the Japanese, with some training in Western shipbuilding and naval techniques, would soon create a modern navy as advanced as any in the West.[13] However, it was several decades before the Japanese took up the challenge and by this time steam engines and the development of iron ships in the West had widened the technology gap much further.[14]

Although aware of Japan's weak defensive capabilities prior to Perry's arrival, the Bakufu had been unwilling or unable to remedy this defect. As soon as this weakness

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[12] Warships larger than 500 *koku*, transport ships larger than 600 or 700 *koku* and ships with more than two masts were prohibited. Occasionally ships up to 1000 *koku* were permitted at the discretion of the Bakufu. Yokokura Tatsuji, *Edo jidai fune to kōro no rekishi*, Tokyo: Oyamakaku Shuppan, 1971, p. 8.

[13] Nihon Kaiji Kagaku Shinkō Zaidan, *Bakumatsu/Meiji no Yōshiki Fune*, Tokyo: Fune no Kagakukan, 1990, p. 3.

[14] General information on early shipbuilding in Japan was taken from, Yokokura T., *op. cit.*, p. 8, Teratani Takeaki, *Nihon Kindai Zōsenshi Josetsu*, Tokyo: Gennandō Shoten, 1979, and Zōsen Kyōkai, *Nihon Kinsei Zōsenshi*, Tokyo: Kōdōkan, 1911 (reprinted 1980).

was exposed to the world in 1853, the Bakufu took action, by withdrawing the long-term ban on the construction of large ships, building the first Western-style ship and asking the Dutch for assistance in creating a modern navy. 1853 was one of the most significant years for modern shipbuilding in Japan.

The lifting of the ban on the construction of warships above 500 *koku* in June 1853 removed one barrier to progress and led to the establishment of several shipyards dedicated to the construction of Western-style ships. The first ships to be built in such yards were the *Hō-ō Maru,* a 3000 *koku* sailing ship built by the Bakufu at Uraga in May 1854, the *Asahi Maru,* built by Mito *han* at the request of the Bakufu at Ishikawashima at the mouth of the Sumidagawa river in 1856 and the *Shōhei Maru* built by Satsuma *han* in 1854.[15] The Japanese had no experience of building these types of ships and were armed only with translated Dutch manuals as their guide. As a result the first Western-style ships to be constructed were Western in little more than outward appearance. However, they marked the beginning of a transition in Japanese shipbuilding.

In 1854 the Japanese were given the opportunity to learn Western shipbuilding techniques directly under Western guidance. When a Russian ship, the *Diana*, sank off Heda, Izu in 1854 leaving its crew of 5800 stranded, the Russians requested, and were

[15] *The Hō-ō Maru* was 132ft by 30ft. *The Asahi Maru* was 79ft by 32ft by 24ft (depth), approximately 750 tons with three masts. *The Shōhei Maru* was 90ft, by 24ft, by 14ft (depth), approximately 370 tons with 3 masts. Problems with *The Asahi Maru* meant that it was not fully functional until some years later. It was chiefly used as a transport ship. In 1855 Satsuma presented *The Shōheimaru* to the Bakufu. It was used for some time as a training ship at the Nagasaki Kaigun Denshūsho. Zōsen Kyōkai, *op. cit.*, p. 25, and Teratani Takeaki, *Nihon Kindai Zōsenshi Josetsu*, Tokyo: Gennandō Shoten, 1979, *op. cit.*, pp. 4-6.

given permission to build a sailing ship in Japan.[16] Under the guidance of the Russian crew, Russian and Japanese carpenters and workmen built a 75-ton schooner in the village of Heda. The captain of the Russian crew, Putiatin, named the ship the *Heda* on its completion in May 1855.[17] Putiatin and a crew of 48 left Japan a few days after the launching of the Heda.[18]

Armed with the Russian architectural plans of the Heda ship, Russian tools and Japanese carpenters with experience of Western shipbuilding, the Bakufu proceeded to build ten more of the same type of ship.[19] Several of the master carpenters involved in this project contributed greatly to Japan's modern shipbuilding industry in the following years.[20]

The knowledge and experience gained through the construction of the *Heda* was a

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[16] The ship was damaged during a tsunami off Shimoda and was towed into Heda Bay for repairs, when it experienced another storm and was sunk. Tsuchiya Shigeaki, *Kindai Nihon Zōsenshi Josetsu*, Tokyo: Shin Jinbutsu Oraisha, 1975, p. 72.

[17] In November 1856 the Russians presented the Japanese with a ship in return for Japanese assistance in building the *Heda*. The *Heda* was a two-mast schooner, 24m by 7m. The cost of construction, covered by the Japanese, is estimated at 3100 *ryō*. Tsuchiya Shigeaki, *op. cit.*, p. 76.

[18] Half of the Russian crew had already returned to Russia aboard an American merchant ship, which had stopped by Shimoda earlier in the year. The remaining crew of over 200 was able to leave Japan on a German ship two months after Putiatin's departure. When the last group of Russians left Japan, they took one Japanese, Tachibana Kōsai, secretly with them. After several years studying in Russia he returned to Japan. Tsuchiya Shigeaki, *op. cit.*, p. 78.

[19] Six of these ships were built at Heda and taken to Shinagawa after completion in December 1856. The remaining four were built at Mito *han's* Ishikawashima yard and handed over to the Bakufu. Watanabe Katoichi, *Bakumatsu Ishin no Umi,* Tokyo: Naruyama Doshoten, 1999, p. 82 .

[20] Two of the master carpenters were sent to the Nagasaki Kaigun Denshūsho Naval training school and one to Holland in the first group of overseas students sent by the Bakufu. They later worked in the Bakufu shipyards at Ishikawashima and Yokosuka; *ibid.*, p. 79.

valuable step towards modernization but it was only the beginning. Modern shipbuilding also required knowledge of steam power and mechanical engineering. Saga and Satsuma were among the first to experiment with steam power and produced model engines in 1855. A full sized steam ship was built in Nagasaki in 1857 under the guidance of the Dutch, but the first to be built without foreign assistance was the *Chiyoda* in 1866. The 60-horse power steamship was designed and built by graduates of the Nagasaki Kaigun Denshūsho Naval School at Ishikawashima and took four years to complete.[21]

While efforts were being made to improve domestic shipbuilding the Bakufu pursued a separate policy of acquiring modern ships from abroad. In January 1854 the Bakufu approached Donker Curtius in Nagasaki to arrange the purchase of a modern warship from Holland.[22] The ship, named the *Kanrin Maru*, arrived in Japan in 1857. Prior to its arrival, the Dutch King presented the Japanese with a warship, the *Soembing* in 1855. This ship, which was renamed the *Kankō Maru,* was Japan's first steamship and the start of its modern navy. The British Queen Victoria presented the Bakufu with another steamship in 1858, the Emperor, renamed the *Banryū Maru.* Two additional ships were ordered from Holland, the *Chōyō Maru* and the *Kaiyō Maru*, which arrived in Japan in 1858 and 1867 respectively, and one from the United States, the *Fujiyama*

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[21] The men who planned and supervised the work were experienced shipbuilders. Some had been involved in the building of the *Heda* under Russian supervision and some had studied at the Nagasaki Kaigun Denshūsho under the Dutch. At least one had travelled to the United States on the *Kanrin Maru.* Construction of the *Chiyoda* was suspended in 1864, when Hita Hamagoro, one of the engineers in charge of the project, was sent to Holland for further training and to buy equipment for the expansion of the shipyards at Ishikawashima. Most of the equipment for the ship was ordered from the Nagasaki ironworks. Tsuchiya Shigeaki, *op. cit.*, p. 142 and Watanabe Katoichi, *op. cit.*, p. 81.

[22] Zōsen Kyōkai, *op. cit.*, p. 55.

Maru. These new ships formed the basis of Japan's navy and were all used for the training of naval cadets. The Bakufu also bought several second hand ships through Western merchants in Nagasaki and Yokohama, including the *Hōshō Maru* which was used as a training ship in Nagasaki. From 1855 until the Restoration in 1868 the Bakufu bought, built or was presented with a total of fifty-four Western style ships; nine warships, and forty-five transport ships.[23]

Several domain lords pursued a similar policy of buying new and second hand ships from abroad. For most of them, buying ships through Western merchants in the treaty ports was cheaper, easier, quicker and more reliable than building their own. Thomas Glover was one of the most prominent Nagasaki merchants from whom the Japanese bought ships. Several of the first ships ordered through Glover were built at Alexander Hall & Co. of Aberdeen including three warships, the *Hōshō Maru* (1868), the *Jōshō Maru* (1869) and the *Wenyu Maru* (1870). Although the Bakufu encouraged domains to strengthen local coastal defences, the enthusiastic manner in which Satsuma and Chōshū, both traditionally hostile to the Bakufu, pursued the policy must surely have caused concern in Edo and may even have intensified the Bakufu's drive to build a modern navy.

The Start of Modern Naval Training in Japan

[23] Twenty-eight of the fifty-four were steam ships, and the remaining twenty-six, sailing ships. Twenty were built in Japan, fourteen in Great Britain, eleven in the USA, four in Holland, and one in France. The origins of the remainder are unknown. Of the fifty-four, only 28 - eight warships and twenty transport ships - were of any real use. Twenty-six were either sold, broke down, or were too old to be of much use. Zōsen Kyōkai, *op. cit.*, p. 89 Tsuchiya Shigeaki, *op. cit.*, p. 136.

Creating a modern navy was not simply about acquiring modern ships but also about learning how to use them. In 1854 arrangements were made with the Dutch to establish a modern naval training facility in Nagasaki, the Nagasaki Kaigun Denshūsho. When the *Kankō Maru* arrived from Holland in 1855 its crew became the first instructors at the school and the ship became the first training ship. Japanese naval cadets and students, recruited from the Bakufu and a number of domains, were given instruction in a range of subjects including navigation, naval architecture, surveying, gunnery, and mechanics.[24] This was the beginning of the formal training of Japanese in Western naval architecture.

Following the establishment of the Nagasaki Kaigun Denshūsho Naval College, proposals were made to build a workshop and shipyards nearby. Equipment, material and engineers for the project were brought from Holland in 1856 and construction began under the supervision of the Dutch. When the repair factory was finally completed in May 1861 it was named the Nagasaki Seitetsujo. The Nagasaki Seitetsujo, which evolved into the Nagasaki Shipyards in April 1871, was Japan's first workshop for making and repairing steam engines and equipment for Western ships.[25]

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[24] Among over two hundred students there were thirty-seven Bakufu students from Tokyo, forty-eight students from Saga *han*, twenty-eight from Fukuoka, sixteen from Kagoshima, fifteen from Hagi, twelve from Tsu, five from Kumamoto, four from Fukuyama and one from Kakegawa. Saga *han* was one of two domains responsible for the security of Nagasaki and it was also one of the more enlightened *han* in the country, encouraging the study of *rangaku.* It is probably for these reasons that Saga was so well represented in the naval school. Only twelve Bakufu students were accepted by the school in 1856 and twenty-six in the following year. Zōsen Kyōkai*, op. cit.*, pp. 58, 107 and Watanabe Katoichi, *op. cit.*, p. 113.

[25] The Dutch instructor of steam mechanics at the Nagasaki Kaigun Denshūsho College was placed in charge of the repair and production of steam machinery at the factory. Watanabe Katoichi, *op. cit.*, p. 86.

It was also the site of the construction of the first steam ship in Japan in 1857 and a valuable training facility for students of the Kaigun Denshūsho.

A second naval training College, the Kaigun Sōrenjo was established in Tsukiji, Edo in 1857.[26] Instructors for the new College were selected from among the first graduates of the Nagasaki Kaigun Denshūsho and were dispatched to Tokyo in March 1857 aboard the *Kankō Maru*, which was to become the new school's training ship.[27] [28] Classes began in September 1857. The conveniently located College near the centre of Bakufu control in Edo became the main naval training facility and the Nagasaki College was closed in July 1859 after only four years in existence.[29]

The transferral of naval training away from Nagasaki was the first step in the removal

[26] The school was renamed the Kaigunsho in 1866 and after the Restoration it became the Kaigun Heigakkō.

[27] The *Kankō Maru,* the *Kanrin Maru*, the *Chōyō Maru* and the *Hōshō Maru* were all used as training ships at the Nagasaki and Edo Naval schools. When the *Kankō Maru* was dispatched to the Tokyo school in 1857 it was replaced in Nagasaki in August by the *Kanrin Maru*, which arrived in Japan with the second group of thirty-seven Dutch naval instructors for the Nagasaki school. When this ship was dispatched to Edo in 1858 the *Hōshō Maru* was purchased for the Nagasaki school until the *Chōyō Maru* arrived from Holland. When the Nagasaki naval school was closed the two ships were sent to Tokyo. In 1860 The *Kanrin Maru* sailed to San Francisco with a Japanese crew led by American naval officers. The ship accompanied the Bakufu mission to the United States. Nihon Kaiji Kagaku Shinkō Zaidan, *op. cit.*

[28] Zōsen Kyōkai, *op. cit.*, pp. 58, 90. After three years at the Edo Kaigun Sōrenjo, the *Kankō Maru* was lent to the lord of Saga *han*, Nabeshima Kansō and it was used as a training ship in Saga until 1863. From 1864 until 1865 it was used as a training ship at the Kobe Kaigun Sōrenjo. After the Restoration it was transferred to the new government. It was taken to Ishikawashima in 1873 and dismantled in 1876. Tsuchiya Shigeaki, *op. cit.*, p. 125.

[29] The staff and students were informed of the closure in February and the school was officially closed in July. Watanabe Katoichi, *op. cit.*, p. 115.

of Japan's modern navy to Edo. In 1865 the process was taken a step further with the establishment of a large naval yard at Yokosuka near Edo. This yard was built on a huge scale compared with that in Nagasaki and at enormous cost, estimated at approximately $2.4 million. Assistance was sought, not from the Dutch, whom the Japanese no longer regarded as the best example of Western progress, but from the French, with whom they had developed close relations. The necessary machinery and materials were ordered from France and French engineers were hired. François Verny, a French naval engineer, was hired through the French Ministry as superviser and an additional forty French naval engineers were employed to manage the yard and train Japanese engineers.[30] Formal training was given at the Yokosuka Gassha school, as well as on the job training in the workshops.[31]

Naval training at the Edo Kaigun Sōrenjo continued to follow the Dutch model taught in Nagasaki until 1867 when arrangements were made to introduce a British model at the school. In October 1867 a British naval group of twelve led by Commander Richard E. Tracey arrived in Yokohama to begin teaching at the school. Classes began in November with approximately eighty students but were disrupted by the upheavals of the Meiji Restoration. In early 1868 the British Minister recalled the British naval instructors to Yokohama and the school was closed.

The Bakufu established a third naval school in Kobe, the Kobe Kaigun Sōrenjo, in

[30] The twenty-six year old Verny had been employed building gunships in Shanghai when he was invited to Japan. He arrived in Yokohama in February 1865.

[31] Zōsen Kyōkai, *op. cit.*, p. 908.

1863 but plans fell through and the school was officially closed in April 1865.[32] Saga *han* established a naval training school of its own after the closure of the Nagasaki Kaigun Denshūsho. This school, the Mietsu Kaigunsho, hired instructors from among the graduates of the Nagasaki school.

The first men to learn Western shipbuilding and naval techniques in Japan trained at Heda and later at the Nagasaki and Edo Naval Schools. In 1862 the process was taken a step further with the dispatch of an official group of *ryūgakusei* to Holland. The majority of these Bakufu students were enrolled in naval schools in Holland and received training in local shipyards before returning to Japan several years later.[33] They were the first of many overseas students to study naval architecture.

Local clan chiefs shared the sense of urgency for a modern navy and, encouraged by the Bakufu, took independent steps towards achieving their goal. Several of the local clans followed the Bakufu's example and dispatched men to Heda, Nagasaki, and Edo and, despite the continuance of the ban on overseas travel until 1866, abroad. Chōshū was the first clan to disregard the ban and send men secretly to Britain in 1863. Among the five students sent, one trained in a Glasgow shipyard. After spending two years in general study in London, Yamao Yōzō arrived in Glasgow where he entered an apprenticeship at Napier's shipyard on the Clyde. On his return to Japan two years later he became an official of the new government and during his many years service

[32] Zōsen Kyōkai, *op. cit.*, p. 64.

[33] Nine of the members were naval students, eight of whom were graduates of the Nagasaki Kaigun Denshūsho. In 1867 half of them returned to Japan aboard the *Kaiyō Maru*, which had been ordered by the Bakufu from Holland. Tsuchiya, *op. cit.*, p. 147.

he contributed to the development of many areas of engineering in Japan including shipbuilding.

At the time of the Meiji Restoration, the Bakufu had established shipyards and repair yards at Uraga, Ishikawashima, Heda, Nagasaki, Yokohama, and Yokosuka; more than fourteen private yards had been established by local domain lords.[34] A naval training college and a school for engineers had also been established. The foundations for Japan's modern shipbuilding industry had been laid.

Shipbuilding during the Meiji Period

The Japanese shipbuilding industry progressed slowly over the *bakumatsu* and early Meiji period. Modernization of the industry required a huge investment of capital and time and during the early 1880s shipbuilding was still in its infancy, the few major yards having produced only a handful of modern ships. While the Japanese shipyards were developing, foreign shipyards, particularly British yards, met the demand for modern warships and large merchant ships in Japan. The smaller and less advanced Japanese yards were used mainly for repairing ships or for making small civilian ships. As in other areas of engineering Japanese were trained under foreign engineers both at Japanese yards and foreign yards and as they became more proficient in the work, they relied less on foreign instructors and foreign yards. Progress was driven by a desire to create a modern navy, which was, as it had been for the Bakufu, high on the new government's priority list but it was accelerated further by the Meiji government's

[34] Teratani Takeaki, *op. cit.*, p. 5.

encouragement of trade and the development of a merchant navy. By the end of the Meiji period Japanese shipyards were turning out some of the largest and most advanced ships in the world.[35]

Of the Bakufu shipyards which passed into the hands of the Meiji government after the Restoration, only Yokosuka was continued as a naval shipyard. The Uraga and Ishikawashima yards were closed in 1876 and the latter was sold into private hands.[36] The Nagasaki yards were continued until 1884 when they too were sold into private hands. The sale of the Ishikawashima and Nagasaki shipyards to private companies marked the end of public management of the shipbuilding industry and the beginning of a new era of private shipbuilding. The number of private yards increased gradually through the 1880s and more rapidly during the 1890s. The Sino-Japanese war, which created a demand for modern battleships and transport carriers, and the implementation of the Shipbuilding Encouragement Law of 1896, which "granted bounties to Japanese subjects for the construction of vessels above 700 tons" acted as a stimulus to the industry.[37]

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[35] According to Saigusa, Japanese shipbuilding had almost reached world standards by the end of the nineteenth century, as illustrated by the construction of two large steam ships, the *Hitachi Maru* (6172 ton) in 1898 and the *Awa Maru* (6309 ton) in 1899. However, the Japanese still relied on foreign assistance to build them. Scottish engineers and advisers were hired by Mitsubishi to draw up design plans and supervise construction; materials were imported from Britain. Both of these ships were ordered by Nihon Yūsen and built at Mitsubishi's Nagasaki Shipyards. Saigusa Hiroto, Nozaki Shigeru and Sasaki Takashi, *Kindai Nihon Sangyō Gijutsu no Seiōka*, Tokyo: Tōyō Keizai Shinpōsha, 1960.

[36] The *Hō-ō Maru* was the only ship built at the Uraga yard. After its construction, the yard was used as a repair yard. Several ships were built at the Ishikawashima yard, which was conveniently located on a main shipping route at the mouth of the Sumidagawa river. Watanabe Katoichi, *op. cit.*, p. 82.

[37] Checkland, Olive, *Britain's Encounter with Meiji Japan*, Basingstoke: MacMillan, 1989, p. 69.

Naval Architecture Education

The Restoration disrupted training in the shipyards and at the naval school in Tsukiji but by mid 1869, hostilities had more or less come to an end and attention began to focus on naval training once again. Plans were made to reopen the Kaigun Sōrenjo in Tsukiji.[38] When this school opened in January 1870 over forty students were recruited from sixteen *han*. The largest contingent came from Satsuma, Chōshū and Saga.[39] Following a decision to introduce the British Naval System into the school, twelve students were sent to train in Great Britain in 1871 and a request was made to the British Navy to provide instructors for the school in Tokyo. In July 1873, thirty-four British naval instructors arrived in Japan under the command of Major Douglas.[40] The first students graduated from the school in November 1873. By the 1880s all the British instructors had been replaced by Japanese but the Navy continued to hire a few British Naval officers in advisory positions.[41] The school was renamed the Kaigun Heigakuryō in 1870 and the Kaigun Heigakkō in 1876 and was eventually merged with the Imperial University

The Yokosuka Gassha, which had also closed during the Restoration, reopened in 1871.[42] Training at Yokosuka differed from that of the Kaigun Sōrenjo in various ways.

[38] The school was established under the Heibushō; the government ministry in charge of the navy and army.

[39] Watanabe Katoichi, *op. cit.*, p.118.

[40] After two years service in Japan Douglas was replaced by Lieutenant Jones of the British Navy in 1875.

[41] Checkland, Olive, *op. cit.*, p. 58.

[42] The school was renamed the Kaigun Kōgakkō in 1889 and then the Kaigun Zōsen Kōren Shūsho in 1897.

It was a training facility for lower and intermediate engineers rather than Naval Officers and the system was French rather than British. However, both facilities were central in the development of Japan's navy.

The specialized training of high-level naval architects was begun in the Kōbudaigakkō Engineering College. Naval architecture was introduced into the curriculum at the Imperial College of Engineering under the Mechanical Engineering Department and in 1882 a separate Naval Architecture Section was created.[43] Charles West was hired as the first lecturer of naval architecture. West was born and educated in Ireland and worked in a Glasgow shipyard from 1869 until his departure for Japan. During his time in Glasgow he was a frequent visitor to Lord Kelvin's experimental laboratory and it is thought that Kelvin recommended him for the position of Professor of Naval Architecture at the Kōbudaigakkō.[44]

Ryūgakusei and Naval Architecture Education

In preparation for the introduction of naval architecture at the Kōbudaigakkō, Miyoshi Shinrokurō, a first-class graduate of the Mechanical Engineering Department of the College was sent to Glasgow in 1880.[45] Glasgow was the leading shipbuilding centre

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[43] Naval architecture students received practical experience in either the Yokosuka or Nagasaki shipyards. The first students to graduate in Naval Architecture were in 1883. Miyoshi Shinrokurō "Waga Daigaku ni okeru Zōsengaku" *Zōsen Kyōkai Kaihō, Volume 8,* 1910, p. 13.

[44] According to Kita Masami, West was educated at Dublin University before going to work in the Birkenhead Shipyard in Britain. Kita Masami, *Nihon o Hiraita Hitobito: Nippon to Sukottorando no Kizuna,* Tokyo: Dōbunkan, 1984, p. 230.

[45] Miyoshi Shinrokurō was born in Edo on July 21st 1857. His father was a Bakufu Officer. He studied in Shizuoka at the Prefectural school there with his older brother and returned to Tokyo in 1872. In 1873

in the world at the time and the College had strong links with the University there. Miyoshi was one of eleven students selected from among the first graduates of the College to study in Britain, sponsored by the Ministry of Public Works. Five of the Ministry-sponsored students including Miyoshi were sent to Glasgow. On arrival in Glasgow he entered Robert Napier's shipyard where he learned the theory of shipbuilding and machinery while carrying out practical training under Alexamder C. Kirk and Agnew for two years.[46] From the autumn of 1882 until the summer of 1883 he studied Naval Architecture at Glasgow University.[47] Glasgow was an ideal location for both theoretical and practical study of naval architecture. In the summer of 1883 at the end of the specified three-year period of study abroad, he returned to Japan.

On Miyoshi's return to Japan in 1883 he joined the Department as an Assistant Professor. In 1886 when the College merged with Tokyo University to become the Imperial University of Tokyo, Miyoshi was promoted to a full Professor of Naval Architecture at the University's College of Engineering, where he remained until 1909. West also transferred to the new University and continued to teach until 1903. From the introduction of the subject in 1883 until 1907, 189 students graduated in Naval Architecture.[48] Miyoshi is said to have contributed more than any other man to the

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he became a government-sponsored student at the Kōgakuryō and graduated with a first class degree in November 1879. Zōsen Kyōkai, *Zōsen Kyōkai Kaihō Volume 8*, April 1910, p. 1 and Ōkurashō, *Kōbushō Enkaku Hōkoku*, 1888, p. 976.

[46] Henry Dyer also served his apprenticeship under Alexander C. Kirk a decade and a half earlier. It is probable that Dyer arranged Miyoshi's training in Glasgow.

[47] While at the University he received the Robert Duncan prize. Kita Masami, *op. cit.*, p. 190, Glasgow University Matriculation Album 1882.

[48] Of these graduates, forty-two became engineers in the Navy Ministry, twenty-three in the Communications Ministry, four in the Nōshōmushō, seventy-eight in private shipyards. Fifteen became

development of naval education in Japan.

Miyoshi's activities were not restricted to the Imperial University, Tokyo, or to naval architecture education alone. In 1887 he established the Tsukiji Kōshū Gakkō (Assistant Engineers School) with a colleague, and acted as administrator until 1898, when he became Principal. By 1910 the school had trained over 5000 engineers, contributing significantly to the development of Japan's industry.[49] In 1897 he was appointed Engineer to the Department of Communications becoming the Chief of the Marine Section of the Mercantile Marine Bureau.[50] In the same year he, with several colleagues, established the Shipbuilding Association, acting as Vice Chairman and Director in the following years. Interestingly the Shipbuilding Association Committee in 1904 (established in 1897) composed of sixteen members, included seven Glasgow *ryūgakusei*: Miyoshi Shinrokurō, Miyabara Jirō, Shin Tsuneta, Mano Bunji, Suda Toshinobu, Terano Seiichi, and Kojima Monya.[51]

Miyoshi was one of many Japanese *ryūgakusei* who travelled to Scotland to study naval architecture. Matriculation records from the University of Glasgow and the Glasgow and West of Scotland Technical College show that eighteen Japanese students studied naval architecture and related subjects there before 1900. Many of

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supervisers in shipping companies, and seven became teachers. *Nihon Kinsei Zōsenshi, op. cit.*, p. 913.

[49] *Zōsen Kyōkai Kaihō Volume 8, op. cit.*, p. 3.

[50] *Zōsen kyōkai kaihō Volume 8, op. cit.*, Iseki, K. R., *Who's Who In "Hakushi" in Great Japan, Volume 5, (Dai Nippon Hakushiroku 5)*, Tokyo: Hattensha, 1931, p. Eng. 24.

[51] Miyoshi Shinrokurō, Miyabara Jirō, Shin Tsuneta, Mano Bunji and Suda Toshinobu were directors, and Terano Seiichi and Kojima Monya were councillors. Shipbuilding Association Report, 1904, second publication.

these students, perhaps all of them, spent a period of time gaining practical experience in the Clyde shipyards. Several more Japanese, who did not take formal classes, are thought to have trained on the Clyde. Miyabara Jirō, who is discussed below is just one example. It is impossible to calculate the exact number of Japanese who trained in the Glasgow shipyards, for in some cases company records no longer exist and in other cases Japanese apprentices do not appear in them, as they were not treated as ordinary apprentices.[52] In 1889 the government made a contract with Thomas Law Company in Glasgow to send two Japanese students per year from their Mercantile Shōsen Gakkō School to train for a period of four years at the company.[53] Among the other Glasgow shipyards known to have accepted Japanese trainees were Fairfield, Napiers, and Lobnitz. It was also common for the Japanese to send men for a period of months or years to observe or supervise work on ships ordered for Japan.

The Naval Architecture section of the Imperial University, Tokyo, employed three other Japanese Professors who had studied or trained in Glasgow before 1900: Miyabara Jirō, Terano Seiichi and Yamamoto Nagakata. Miyabara Jirō spent at least a year in the Fairfield Shipbuilding and Engineering Co., Glasgow from 1875, studying practical marine engineering after graduating from the Kaigun Heigakuryō Naval College in Tokyo. When Miyabara left Glasgow he spent three years at the Greenwich Naval College and a period of time at the Naval Construction Company (present

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[52] According to Olive Checkland, "Japanese names rarely appear in the ordinary apprentice books, for of course the Japanese apprentices were different. They were not as others, young men signing on for a period of years to learn a single trade; they were often highly educated, well-trained engineers who needed to sample a wide variety of processes within any one firm." Checkland, Olive, *op. cit.*, p. 151.

[53] *Nihon Kinsei Zōsenshi*, *op. cit.*, p. 877. I have not been able to confirm who or how many Japanese trained at Thomas Law's firm.

Vickers) in Barrow-in-Furness in Cumbria.[54] After returning to Japan briefly in 1883 he was sent back to Britain by the Navy Ministry as Superintendent of the design and construction of the warships *Naniwa* and *Takachiho* at the Armstrong Mitchell Company in Tyneside.[55] When he returned again to Japan in 1886 he was appointed Sectional Chief of Marine Engineering in the Bureau of Naval Construction in the Naval Ministry with the additional post of Professor to the College of Engineering, Imperial University Tokyo in 1888.[56] Miyabara taught Naval Architecture at the Imperial University from 1888 until 1893.

Terano Seiichi graduated from the Naval Architecture Section of the College of Engineering in the Imperial University Tokyo in 1890. After two years of postgraduate study on ship design and engineering he was appointed Assistant Professor at the University in July 1892.[57] In June 1897 the government sent him to Britain, where he studied naval architecture under Dr. J. H. Biles at the University of Glasgow for one year and received practical training at J. Fowlers Company. On his return to Japan in 1899 he was appointed full Professor of Naval Architecture at the Imperial University, Tokyo, occupying the second Chair of Naval Architecture.[58] Like Miyoshi he was a talented and progressive man who contributed greatly to naval architecture education. In 1918 he was elected Dean of the College of Engineering at the University.

Yamamoto Nagakata travelled to Britain as a privately funded *ryūgakusei* in 1890. He

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[54] Iseki, K. R., *op. cit.*, p. 67, and *Nihon Kinsei Zōsenshi*, *op. cit.*, p. 909.

[55] Usui Masami et.al., *Nihon Kingendai Jinmei Jiten*, Tokyo: Yoshikawa Kōbunkan, 2001, p. 1032.

[56] Iseki, K.R., *op. cit.*, pp. Eng. 66-7.

[57] Iseki, K.R., *op. cit.*, pp. Eng. 86-7 and Yoshikawa Kōbunkan, *op. cit.*, pp. 691- 2.

[58] Iseki, K.R., *op. cit.*, pp. Eng. 86-7.

studied naval architecture and related subjects at Glasgow University and graduated with a B.Sc. in 1895. During his first year he also attended classes at the Glasgow and West of Scotland Technical College in mathematics and theoretical mechanics.[59] From his return to Japan in 1895 until 1921 he worked for Mitsubishi in their Nagasaki and Tokyo shipyards. From 1919 he gave lectures at the Imperial University Tokyo and became a Professor in the Engineering Faculty of the Imperial University in 1921.[60] He moved to Osaka in 1930 and was appointed Professor at the Osaka Kōgyō Daigaku.[61]

The Scottish Naval architect, Percy Hillhouse, was also involved in naval architecture education in Japan. Former Professor of Naval Architecture at Glasgow University, he became appointee to the Chair of Naval Architecture at the Imperial University Tokyo from 1898 until 1901.[62]

Ryuugakusei and the Japanese Navy

At least eight of the Japanese who studied in Glasgow before 1900, returned to work in naval shipyards: Naitō Masatomo, Miyabara Jirō, Iwata Buyata, Ōkubo Tatsu, Fuji Terugorō, Nakajima Yosohachi, Odagiri Enjū, and Kazama Tokujirō.

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[59] Glasgow and West of Scotland Technical College Register of Students, 1890.

[60] Kita Masami, *op. cit.*, pp. 195-196.

[61] Kita Masami, *op. cit.*, p. 197 and Tomita Hitoshi, *Umi o Koeta Nihonjin Meijiten,* Tokyo: Nichigai Associates, 1985, pp. 618-19.

[62] Checkland, Olive, *op. cit.*, pp. 70 and Takeuchi Hiroshi, *Rainichi Seiyō Jinmei Jiten,* Tokyo: Nichigai Associates, 1995, pp. 342-3.

Naitō Masatomo graduated from the Imperial College of Engineering in May 1881 with a second-class honours degree in Mechanical Engineering and travelled to Glasgow in September as a privately funded student to study naval architecture.[63] From 1882 until 1883 he enrolled in marine engineering classes at Glasgow University during the day and applied mechanics evening classes at the Glasgow Mechanics Institution, predecessor of the Glasgow and West of Scotland Technical College (GWSTC). He was also an apprentice draughtsman at Robert Napier & Sons and it is likely he remained at the firm until 1885, when he returned to Japan.[64] He entered the Japanese Naval Ministry as a fifth-class engineer and later became Chief at the Onohama Military shipyards. He died in 1902 at the early age of 44.

Iwata Buyata matriculated at Glasgow University in 1887, where he studied naval architecture, mechanical engineering and related subjects. He also attended evening classes at the nearby GWSTC from 1888 until 1889 and again from 1890 until 1891 and summer classes at Edinburgh University in 1888 and 1889.[65] In 1893 he graduated from Glasgow University with a B.Sc. and returned to Japan, where he was appointed engineer at the naval shipyards at Onohama and later at Yokosuka. During the war with Russia he was involved in the planning of torpedo boats, which earned him a promotion. Later he taught at the Kaigun Kikan Gakkō.

Ōkubo Tatsuo was a student in London for one year and a trainee at Armstrong's

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[63] Ōkurashō, *op. cit.*, p. 805.

[64] Glasgow University Matriculation Album and Strathclyde University Archives General file #1.

[65] Glasgow University, Edinburgh University and Glasgow and West of Scotland Technical College Matriculation Records.

shipyard in Newcastle before enrolling in classes at Glasgow University in 1895. For three years he studied naval architecture at the University and trained at Lobnitz shipyards before returning to Japan. He held various positions in the Japanese Navy relating to shipbuilding. He was Superintendent of the Yokosuka Shipyards, Director of the Maizuru Naval Works, and Director of the Sasebo Naval Works and reached the rank of Vice-Admiral.

Fuji Teragorō, Odagiri Enjū, Nakajima Yosohachi - graduates of the Kaigun Kikan Gakkō Naval School - and Kazama Tokujirō, all naval engineers, were sent to Glasgow during the last decade of the nineteenth century. Fuji enrolled at Glasgow University in 1896 until 1899, Odagiri from 1897, Nakajima and Kazama from 1899 until 1901. All studied naval architecture, mechanical engineering and related subjects at the University. Odagiri, Nakajima and Kazama also attended evening classes at the Glasgow and West of Scotland Technical College, Odagiri from 1897 until 1899, and Nakajima and Kazama from 1899 until 1900.[66]

On their return to Japan; Fuji in 1899, Odagiri in 1899, Nakajima and Kazama in 1901, they resumed duties in the Navy. Fuji's career ended in tragedy when he committed suicide in 1914 over a bribery scandal involving the British company Vickers. Odagiri worked his way up to Captain and later worked for the Kawasaki shipyards. Nakajima became an instructor at the Naval University, worked in the Yokosuka shipyard and was promoted to Rear Admiral in 1912. Kazama Tokujirō became superintendent of

[66] In the GWSTC records Odagiri's classes included Machine Construction and Drawing and Valve Gears, Nakajima also took classes in Machine Construction and Drawing and Kazama in Electrical Engineering. Glasgow and West of Scotland Technical College Register of Students, 1897-1900.

shipbuilding and after several years reached the position of Rear Admiral.

In addition, another *ryūgakusei* who studied engineering at Glasgow University for one year, Urano Kisaburō entered the Japanese Navy. It is unclear at this point if he worked in the shipbuilding field.

Ryūgakusei and Private Shipyards

Scottish engineers and advisers were often hired in private shipyards in Japan and generally Japanese students of naval architecture who travelled to Glasgow and did not join the Navy, entered one of the major private shipyards. Archibald King from Glasgow was hired as a ship designer at the Ishikawashima Hirano shipyards. Mitsubishi hired several Scots from the Lobnitz Shipbuilding Company at Renfrew. Of the Glasgow *ryūgakusei,* Motoki Kōtarō and Shin Tsuneta worked for the Ishikawashima Hirano yards, Yamamoto Nagakata and Kawada Ryōkichi worked for the Mitsubishi shipyards in Nagasaki and Tokyo, Suda Toshinobu worked for Nihon Yūsen Kaisha, and Ryōtarō Hirano Hunter entered his father's shipbuilding company, Osaka Tetsu Kōsho. Kojima Monya became an engineer for the shipbuilding section of the Government Communications Ministry. Odagiri Enjū, after reaching the rank of captain in the Japanese Navy left to work for Kawasaki shipyards.

Ishikawashima Hirano shipyards

Archibald King (1848-1886) was hired by Hirano Tomiji as Chief Engineer at the Yokohama Seisakusho workshop of the Hirano Ishikawashima shipyards in 1880.[67] Hirano rented the Ishikawashima shipyards and the Yokohama workshop from the government in 1877 and 1879 respectively and established his own shipyard which he named the Hirano Ishikawashima shipyards.[68] This was the first privately managed shipyard of the Meiji period. The Yokohama Seisakusho, which Archibald King was placed in charge of, made engines and machinery for ships as well as for general use. Archibald King had formerly been employed by the Ministry of Public Works at the Kōgakuryō as an instructor of practical engineering and model making from 1873 until 1875. During his term at the school he had also worked at the Akabane works. He had a talent for designing ships and was responsible for the design of the *Chokai*, the first class gunship ordered by the Japanese Navy in the mid 1880s. Unfortunately King died in 1886 at the age of 38 before the completion of this ship.

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[67] According to UNESCO King was first hired by Hirano in July 1876 on a three-year contract which was renewed in 1879 and 1884. His salary started at ¥150 and increased to ¥200 in 1877. UNESCO Higashi Ajia Bunka Kenkyū Sentaa (UNESCO East Asia Culture Research Centre), *Shiryō Oyatoi Gaikokujin,* Tokyo: Shōgakukan, 1975, p. 255.

[68] The Ishikawashima Hirano shipyard originated as Mito *han's* Ishikawashima yard being established in 1854. The yards were transferred to the Meiji government and when they decided to discontinue the yards in 1876 they rented them to Hirano Tomiji, a former employee of the yards and previously of the government's Nagasaki Ironworks. Hirano left the Nagasaki ironworks in 1871 when they were transferred to the Ministry of Public Works and moved to Ishikawashima. Hirano renamed the yard the Ishikawashima Hirano shipyard and in 1889 he was able to buy them from the government. Hirano also rented the government ironworks at Yokohama, renaming them the Ishikawaguchi Seitetsujo and incorporated them into the Ishikawashima Hirano shipyards. The factory was relocated to Ishikawashima in 1884. Teratani Takeaki, *Kindai Nihon no Zōsen to Kaigun*, Tokyo: Naruyamadō Shoten, 1996, p. 128.

Motoki Kōtarō travelled to Glasgow in 1880 as a privately funded student and enrolled in naval architecture, mechanical engineering, mathematics, and architecture classes at the University of Glasgow. He returned from two years study at the University in 1882 and entered the Ishikawashima Hirano shipyard. Motoki's father was a business partner of Hirano Tomiji.[69]

Shin Tsuneta, a graduate of the Kōbudaigakkō in 1885, enrolled in naval architecture classes in the spring term at Glasgow University in 1888. On his return to Japan he entered the Ishikawashima shipyards, becoming both an executive and Chief Engineer. He received a *Kōgaku Hakushi* (Doctor of Engineering) in 1901. He was a member of the Institution of Mechanical Engineers and published numerous papers on engineering. He established his own consulting engineering firm and worked for several private companies. In 1917 he bought the Yokohama Engine and Iron Works (Yokohama Kikan Tetsukōsho) from a British company and managed it jointly with Uchida Nobuya.[70]

Mitsubishi Shipyards

Mitsubishi shipbuilding had a strong connection with Glasgow and particularly with Lobnitz & Co., a shipbuilding company on the Clyde. John F. Calder, from Mid Lothian, Scotland and a former employee of Lobnitz & Co., arrived in Nagasaki

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[69] On his matriculation form at Glasgow University his father's occupation is shown as the manager of a shipyard. Kita Masami, *op. cit.*, p. 185.

[70] Yoshikawa Kōbunkan, *op. cit.*, p. 147.

around 1867. He was an engineer aboard the *S. S. Coquette* when he arrived but he stayed in Nagasaki and joined the engineering company of Boyd & Co. In 1876, he moved to Yokohama to establish a branch of the company there. In 1879, when it was taken over by Mitsubishi Mail Steam Ship Company, he became an employee of Mitsubishi at the works known as the Yokohama Engine Works (Yokohama Seitetsujo).[71] He was transferred to Mitsubishi's Osaka Ironworks, the Osaka Tetsukōsho, in 1879 as manager, then to the Nagasaki Dockyards and Engine Works in 1884, when the company rented them from the government. He was placed in charge of the Nagasaki works and remained with Mitsubishi in Nagasaki until his death in 1892. He was buried in the Sakamoto International Cemetery there.[72] Mitsubishi hired a small number of around seven *oyatoi* at a time but also invited advisers from Lobnitz on many occasions. According to Saigusa almost every engineer hired after Calder came from the Clyde. Several employees, like Calder, remained with the company for many years.[73]

In 1876 when Kawada Ryūkichi left for Glasgow he travelled with the Lobnitz family who had been visiting Japan.[74] He entered an apprenticeship at Lobnitz shipyards in Renfrew in 1877 where he studied marine engineering and at the end of seven years in May 1884 he received certification of his apprenticeship. During his term in Scotland

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[71] In a joint venture Iwasaki Yatarō's company Yūbin Kisen Mitsubishi Kaisha and Boyd Shōkai bought a machine factory near Yokohama which was named the Mitsubishi Seitetsujo. In 1879 Iwasaki's company took full control of the management. Teratani Takeaki *Kindai Nihon no Zōsen to Kaigun*, Tokyo: Naruyamadō Shoten, 1996, p. 129.

[72] Earns, Lane R. and Burke-Gaffney, Brian, *Across the Gulf of Time: The International Cemeteries of Nagasaki*, Nagasaki, Nagasaki Bunkensha, 1991, p. 65.

[73] Saigusa Hiroto, op. cit., pp. 65-66.

[74] Kita Masami, *op. cit.*, p. 185.

he studied office and fieldwork in engineering at Glasgow University from 1878 until 1879.[75] When he returned to Japan he was employed by Mitsubishi at their Nagasaki Engine Works (Seitetsujo) from September 1884.[76] Kawada's father was involved in the management of Mitsubishi and became General Director of the company in 1883.[77]

Yamamoto Nagakata, discussed above, returned to Japan from Scotland in December 1895 and was appointed Chief Engineer at the Mitsubishi Nagasaki shipyards, supervising draftsmanship. In 1917 he was transferred to Mitsubishi's Tokyo shipyards as Chief Engineer where he remained until 1921.

By the end of the nineteenth century Japanese shipbuilding was rapidly approaching world standards and Mitsubishi was at the forefront. In 1898 and 1899 two large steam ships, the 6172 ton *Hitachi Maru*, and the 6309 ton *Awa Maru* were built for Nihon Yūsen Kaisha at Mitsubishi's Nagasaki shipyards.[78] Although a few Scottish engineers and advisers were involved in the design and supervision of these ships, the construction of these large modern ships was a clear indication that Japanese shipbuilding had advanced significantly.

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[75] Letter of recommendation from Lobnitz & Co., quoted in Checkland Olive, *op. cit.*, p. 286.

[76] He was also known for developing a new variety of potato by combining Scottish and American potatoes. Kita Masami, *op. cit.*, pp. 185 and 188.

[77] Checkland, Olive, *op. cit.*, p. 151.

[78] I am unsure if *Hitachi Maru* is the correct romanization.

Nihon Yūsen Kaisha

Suda Toshinobu graduated from the Kōbudaigakkō in 1881 with a second-class degree in Mechanical Engineering and worked as an engineer in the Kobe Kawasaki Kōsakubun Bureau of the Ministry of Public Works, and later in the Nōshōmushō Shipping Bureau. In 1887 when Nihon Yūsen Kaisha ordered a ship from Britain he accompanied Albert Brown as superintendent at the shipyard. While in Glasgow he enrolled in naval architecture spring classes at Glasgow University in 1888 with Shin Tsuneta and stayed at the same address in Glasgow as Naitō Masatomo. Suda returned to Japan in 1892 and entered the Yokohama Shucchōsho of Nihon Yūsen Kaisha. In 1915 he became Vice President of Nihon Yūsen Kaisha. He received a *Kōgaku Hakushi* (Doctor of Engineering) in 1899 and a medal for his contributions during the war with Russia and he was also a Director of the Yokohama Dockyard Company.

Kojima Monya, who studied at Glasgow University in 1897, became an engineer for the shipbuilding section of the Communications Bureau but died in 1907 at the age of 33.

Conclusion: Scottish Contribution to Shipbuilding in Japan

Several Western countries contributed to the early development of the Navy and modern shipbuilding in Japan during the *bakumatsu* years but Britain and France were most prominent during the Meiji period. The French connection with Japanese shipbuilding was primarily at the government Yokosuka yard. At the time of the Restoration, the Yokosuka works were still under construction. They passed into the hands of the new government and came under the supervision of Yamao Yōzō. Verny and twenty-three other French employees remained at Yokosuka continuing with the construction and everyday management of the works and as a result, the ties with France remained strong. However, the decision to introduce the British Naval System into the Japanese Navy led to British Naval Officers, naval architects and engineers being hired in Japan and Japanese students being sent to train in Britain. British Naval Officers wire hired as instructors at the Kaigun Sōrenjo throughout the 1870s and as such laid the foundations for naval instruction in Japan.

Scottish *oyatoi* were not prominent in the government shipyards but they were found in several of the major private yards, and the Scottish link was particularly strong in Mitsubishi. The Scottish influence on Japanese naval architecture is more obvious in the case of Japanese *ryūgakusei* who studied in Glasgow. . Scottish employees in this field are included in the list in Appendix 1 and Japanese *ryūgakusei* to Scotland are listed in Appendix 2. The majority of naval architecture *ryūgakusei* in Glasgow were involved in shipbuilding on their return to Japan, in the navy, in education or in private shipyards. Glasgow-trained Japanese naval architects and engineers contributed to naval architecture education in the Imperial University and were found in all of the major shipyards during the Meiji period. The University of Glasgow, the Glasgow and West of Scotland Technical College and the Glasgow shipyards played a significant role in their training. As well as providing technology and training for Japanese students, the Clyde shipyards also supplied the majority of large warships and transport ships to the Japanese Navy in the early years.

CHAPTER FIVE

OTHER AREAS OF SCOTTISH INVOLVEMENT

RAILWAYS

After an introduction to railway development up to the mid nineteenth century, this chapter investigates the Scottish influence on Japanese railways from the Meiji period with particular emphasis on three Japanese overseas students, Masuda Reisaku, Minami Kiyoshi and Watanabe Kaichi.[1] These three men studied under Scottish Professors at the Kaisei Gakkō, the Kōbudaigakkō and Glasgow University and trained in engineering firms in Scotland. On their return to Japan they played a prominent role in the development of both government and private railways. The chapter also discusses the general role of foreign employees and introduces one Scottish engineer, John Diack who was involved in railway construction from the beginning of the railway project.

The railway revolutionized overland travel in Japan during the late nineteenth century as it had done in Europe and the United States half a century earlier. However, the events which led to the introduction of the railway in Japan were quite different from those which led to its introduction in Europe. Railways were a product of the Industrial Revolution in Europe, arising from a need to transport large quantities of fuel and raw material such as coal and iron to the factories and subsequently to transport large quantities of the products of industry to the market. Industry did not play a major role

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[1] Refer to Appendix 2 for a summary of their education and achievements.

in the introduction of railways to Japan, at least initially, for railway construction began before the country had industrialized. Japan's motive for introducing the railway was more political than economic: as a government tool to strengthen central control over a country recently emerged from feudal rule. As industrialization progressed, economics played a greater role in railway construction.[2]

The Birth of Railways in Britain

Prior to the introduction of railways in Britain, goods were transported inland by road or river. However, both had their limitations. The primitive dirt roads could not sustain heavy cargo and navigable rivers were few and far between. With the increasing demand for coal to fuel the Industrial Revolution, more convenient methods were sought. One solution was to build a network of canals across the country, which greatly alleviated the problem. However, canals were expensive and could not easily be re-routed as new coal shafts opened and old ones closed. This problem was tackled with wagonways. These consisted of rails along which carts were pulled by horse. They were used to carry coal short distances from the pit head to the nearest navigable river, canal or iron foundry. Their use on Tyneside and in Shropshire has been recorded from the seventeenth century. They were convenient because they could be realigned or extended at less expense than a canal and they could use gravity as well as horsepower on the downhill slope from the mouth of the pit. Their use over long distances, however, had to await the advent of the steam locomotive, when they were reborn to become the railways.[3]

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[2] Harada Katsumasa, *Tetsudō to Kindaika,* Tokyo: Yoshikawa Kōbunkan, 1998.

[3] Robertson, C. J. A, *The Origins of the Scottish Railway System, 1722-1844,* Edinburgh: John

The Birth of Railways in Japan

With few navigable rivers, roads were the major routes of passage inland in Japan as they had been in Britain. However, the great advances in the field of engineering in Britain during the early nineteenth century, which led to the construction of canals, railways and the improvement of inland roads, were not mirrored in Japan. There were two major reasons for this. The first was the absence of an industrial revolution such as had stimulated progress in Britain. The second was the existence of Tokugawa policies which discouraged progress by tightly restricting travel. By the mid 1800s Japan had no railways and its domestic road network, while extensive, was still primitive and unsuitable for the transport of heavy loads or rapid movement of people or goods.

The introduction of the *sankin kōtai* (Alternate Attendance) system in 1635 had led to the construction of hundreds of roads to link every province of the country with Edo. The government introduced travel restrictions in 1654 to discourage large-scale movement of people for any reason other than to fulfil their duty to pay homage to the shōgun in the capital. To ensure that these restrictions were adhered to, the government discouraged anything which would facilitate overland travel, including road improvements and the building of bridges.

Knowledge of the railway and the locomotive engine had reached Japan by the 1840s through European books and manuals on the subject and some of these were translated

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Donaldson Publishers, 1983.

into Japanese. However, it was not until 1854 that the Japanese were given the opportunity to observe a real working model of a steam locomotive. The Russian Admiral Putiatin, on a mission to establish formal relations with Japan, sailed into Nagasaki Bay in July 1853. Although he failed in his objective to establish formal relations with Japan he succeeded in impressing a group of Saga clansmen with a demonstration of a small 21-centimetre model steam locomotive on board his ship in January 1854.[4] This was Japan's first encounter with a locomotive engine. Only months later, a second demonstration of a steam locomotive was given, this time on Japanese soil by the American, Commodore Perry. Perry had succeeded in negotiating a treaty of friendship between Japan and America and on the signing of the treaty he presented the shōgun with many gifts from the American people. One of these gifts was a quarter-size steam locomotive, which was demonstrated to Bakufu officials in Yokohama and later in the grounds of Edo castle. The locomotive, fuelled by coal, was capable of reaching speeds of up to 32 kph and greatly impressed the onlookers.[5]

These spectacles were witnessed by a privileged few but the impact was felt far beyond. Officials of Saga *han* were so impressed with the steam engine and its applications that they gave orders for a model engine to be built in Saga. Although the *han's* ultimate aim was to build a steam ship, they built a model locomotive first. Using translated manuals and observations made of the models demonstrated by Putiatin and Perry, they successfully produced a 40cm model of a steam locomotive with two

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[4] Ericson, Steven J., *The Sound of the Whistle: Railroads and the State in Meiji Japan*, Cambridge: Harvard University Press, 1996, p. 4.

[5] *ibid.*, p. 4.

carriages at the Seirenkata (sho) research facility in Saga city.[6] The Lord of Saga *han*; Nabeshima Kansō, held a party in 1855 to demonstrate the model engine to local people. Among the observers was a young man by the name of Ōkuma Shigenobu, who became one of the Meiji Oligarchy and a leading advocate of the introduction of the railway.

Building Railways

Saga was one of the first *han* to realise the potential of steam power but interest in the steam locomotive grew steadily once the treaty ports opened.[7] Many Westerners were eager to show off the products of their advanced technology in Japan. Some did so out of pride, others hoped to profit from trade, some genuinely wanted to help the Japanese, but for the majority, the motive was probably a mixture of all of these. The railway, one of the greatest symbols of Western progress, was no exception. The Japanese had observed Putiatin's and Perry's model steam locomotives. However, Thomas Glover, a Scottish merchant living in Nagasaki, was the first person to bring a full-sized steam locomotive to Japan, in 1865. The British-made Iron Duke engine with two passenger carriages, on loan from the Shanghai exposition, was operated along 600m of rails in Ōura for one month, after which time it was returned to Shanghai. For the majority of

[6] The engine was made of iron and fuelled by alcohol. This model still exists today in the archives of the Nabeshima Hōkōkai in Saga city and was displayed in the Saga Prefectural Museum in 1999 at the 'Kindaika no Kiseki' exhibition. A model can also be seen at the Banseibashi transport museum.

[7] Several *han* imported model steam locomotives through foreign merchants in the treaty ports during the early years. One of the earliest examples of an imported steam locomotive was a small 20cm model bought by Western scholars of Chōshū *han* in Nagasaki in 1860. It can still be seen in the Hagi City Museum today.

Japanese who had never travelled abroad, this was their first opportunity to observe a full sized steam locomotive in action. It is difficult to determine the exact impact of this display for there is little on record about the event. According to the British paper, the *Railway Times* of July 22nd 1865, the locomotive made an impression on those who saw it. "A railroad with a locomotive engine and tender, is in operation on the Bund at Nagasaki and excites a great deal of attention among the Japanese who come from far and near to see it."[8]

By the mid 1860s the Japanese were seriously considering the idea of constructing a railway in Japan. Between 1865 and 1867 several railway proposals were put forward and finally in 1867 the Bakufu councilors, the rōjū, accepted an American proposal to build the first railway from Tokyo to Yokohama.[9] No sooner had the agreement been concluded than the Bakufu were ousted from power and replaced by a new government who promptly annulled it. Despite American insistence on its validity, at the end of a year's negotiations the contract was cancelled in February 1869.[10]

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[8] A photocopy of this very short article in *The Railway Times* of July 22nd 1865 can be seen in Kawasaki Takao, *Tetsudō Hyakunen Kinenshi - Tetsurin no Todoroki*, Tokyo: Kyūshū Ryokyaku Tetsudō, 1989, p. 24.

[9] Godai Tomoatsu and a group of Satsuma men made one of the first proposals in 1865 to build a railway from Kyoto to Osaka using foreign capital. In 1866 a French banker put forward a proposal to build a railway with French capital. In 1867 a Bakufu official by the name of Kurimoto proposed a railway from Edo via Kyoto to Osaka and in 1867 C.L. Westwood, a resident of Yokohama, proposed a railway from Edo to Yokohama. Harada Katsumasa, *Nihon tetsudōgyō no keisei 1869-1894*, Tokyo: Nihon Keizai Hyōronsha, 1998, p. 20. The plan which was accepted was for the railway to be constructed by Americans with American capital although the Japanese were to be permitted to supervise the work. The project was to be completed within three years and fares could not be higher than 25% above European and American prices. Eventually the Japanese government would be able to buy the railway from the Americans for 1.5 times the cost price.

[10] Doboku Gakkai, *Meiji Igo Honpō Doboku to Gaijin,* Tokyo: Doboku Gakkai, 1943, p.81.

The Meiji government was not opposed to railway construction in itself, although there was opposition within their ranks, but they did object to foreign domination of the railway. They accepted the fact that they would require foreign assistance to build a railway, for they had neither the capital nor the level of engineering expertise required for such a project, but they wanted to have control over its construction and management without conceding authority or land to a foreign power as had occurred in other parts of Asia.

The British Minister Harry Parkes has been given credit for convincing the Meiji government to build the first railway and for securing British involvement. Parkes took a keen interest in Japan's modernization and lost no opportunity in promoting British interests. During a famine in 1868 he made a convincing argument for the introduction of the railway, explaining that a railway could alleviate such food shortages because it could transport food quickly from areas where there was no shortage. This appealed to the Japanese who were anxious to strengthen central government control over the country.[11]

In March 1869, Henry Brunton, Chief Engineer to the Lighthouse Department, and former railway engineer in Britain, presented his views on railway construction to the Meiji government. Brunton advised the government to build the first railway itself using capital directly from the government treasury, supplemented if necessary with foreign capital obtained by way of a loan. Because of the expense of construction and

[11] Harada Katsumasa, *Tetsudō to Kindaika,* Tokyo: Yoshikawa Kōbunkan, 1998, p. 45.

the time involved he proposed that the government begin with the route between Yokohama and Tokyo. Construction of this route would be straightforward and not too expensive, for the terrain was relatively flat. It was a short, but potentially profitable route because of the trade between the two centres. It could be extended to Kyoto at any time and would clearly illustrate the efficacy of the railway to critics. Using his experience of railway construction in Britain he estimated the cost of construction, including the price of land and labour at approximately 40,000 Mexican Dollars per mile for the twenty-four-mile route. An additional $150,000 for engines and other necessities would bring the total to $950,000. He calculated that the line would yield a net annual return of at least ten per cent.[12] His report also proposed obtaining the necessary material and labour from Britain. Foreign engineers and workmen could be employed, as they were in other government departments, to carry out the work until such time as the Japanese could become proficient in the work themselves. Brunton's report met the Meiji government's criteria; the Japanese would maintain complete control over the construction and management of the railway and would not be required to lease territory to foreigners. His report formed the basis of the government's railway policy.

On the recommendation of Harry Parkes the Japanese contracted an Englishman, Horatio Nelson Lay, to raise a loan of £1,000,000 in London, buy equipment and hire the necessary engineers and personnel to allow them to begin construction of the line from Edo to Hyogo with a connecting branch to Yokohama and a line between the Biwa Lake and the Port of Tsuruga.[13] One million pounds was not sufficient to pay for

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[12] Fox, Grace, *Britain and Japan, 1858-1883*, Oxford: Clarendon Press, 1969, p. 386.

[13] Fox, Grace, *op. cit.*, p. 387, Doboku Gakkai, *op. cit.*, p. 82 and Ōkurashō, *Kōbushō Enkaku Hōkoku*,

the construction of all of these first lines, therefore the Tokyo Yokohama line was started first in accordance with Brunton's recommendation. It was not long before the Japanese government became disenchanted with Lay, for instead of acquiring a private loan discreetly as they had expected, he advertised the Japanese railway loan in *The Times* in London and raised the money on the London stock exchange. To complicate matters further, he tried to profit from the arrangement by raising the loan at an interest rate of nine percent while charging the Japanese twelve percent.[14] Insisting that Lay had misled them, the government decided to withdraw Lay's contract in June 1870. They turned to the Oriental Bank for assistance, appointing it to settle Lay's dismissal and take over his position, managing the loan and employing necessary personnel for the railway project. Once Lay's dismissal had been settled in November 1870, the Oriental bank placed one of its employees from its Yokohama branch, William Walter Cargill, in charge of the railway project in Japan.[15]

By the spring of 1870 several British engineers had arrived to take up their positions in

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1888, pp. 403-6.

[14] Lay was a former British government employee in China and arrived in Japan claiming that several British capitalists were looking to lend money to the Japanese government. An agreement was settled with the Meiji government on December 14th 1869 in which he was to raise a loan of one million pounds by July 31st 1870 for the Japanese railways. The interest rate of the loan was settled at twelve per cent and repayment would be made in twelve annual instalments beginning July 27th 1873. Two following agreements, which Lay drafted himself, granted him greater powers and contracted him to buy necessary equipment in Britain and appoint engineers to carry out the work in Japan. Lay took advantage of his powers and raised the loan, not privately as he had led the Japanese to believe, but on the London stock market. Although he intended to charge the Japanese government twelve percent interest as laid out in the agreement, he raised the loan in London at an interest rate of nine percent. Fox, Grace, *op. cit.*, p. 387, and Tatewaki Kazuo, *Meiji Seifu to Igirisu Tōyō Ginkō*, Tokyo: Chūō Kōronsha, 1992, pp. 74-90.

[15] The Oriental Bank was carrying out a similar role in the Osaka Mint. Doboku Gakkai, *op. cit.*, p. 83.

the newly established Railway Section under the Ministries of *Minbushō* and Finance.[16] Before his dismissal, Lay had hired several men on the recommendation of Sir Harry Parkes and Preston White, a railway adviser to the British and Spanish governments.[17] Edmund Morell was employed as Chief Engineer at a salary of $700 per month; and John England, John Diack and Charles Shepard as assistants at salaries of $400, $300 and $300 respectively. In the summer, fifteen more British men, among them engineers, rail layers, carpenters, and masons, joined the four engineers.[18] During 1871 fifty more British engineers, medical officers, secretaries, engineers, storekeepers, locomotive mechanics and train drivers joined the Railway Bureau.[19] A list of employees of the Railway bureau, their positions and salaries can be found in Appendix 8.

Edmund Morell, born in Knottinghill, London in 1841, studied civil engineering at King's College, London and at colleges in Germany and France before embarking on a career as an engineer on railroads in New Zealand, Australia and Ceylon. He arrived in Japan on March 9th 1870 along with John Diack. Diack was born in Aberdeen in 1828 but little is yet known about his activities or those of John England and Charles

[16] Ōkurashō, *op. cit.*, pp. 403-6.

[17] According to Tatewaki Kazuo, on Harry Parkes' recommendation, Lay stopped by in Ceylon on his way home, met with Morell and hired him as Chief Engineer to the Railway Section. Many of the other railway personnel were hired on recommendation from Preston White. Tatewaki Kazuo, *op. cit.*, p. 85, and Doboku Gakkai, *op. cit.*, p. 84.

[18] *Kōbushō Enkaku Hōkoku* lists nineteen foreign employees in the railway section in 1870. Absent from the list are the names of two assistant engineers, Bryant and Lane, who returned to Britain soon after their arrival, angered by Lay's dismissal. Ōkurashō, *op. cit.*, pp. 403-6, and UNESCO Higashi Ajia Bunka Kenkyū Sentaa, *Shiryō Oyatoi Gaikokujin,* Tokyo: Shōgakukan, 1975, pp. 378, 466.

[19] Ōkurashō, *op. cit.*, pp. 403-6. There are also some names in UNESCO which are not in the *Kōbushō* list.

Shepard before they arrived in Japan.[20] Diack's original contract with the Meiji government was from March 1st 1870 for five years and was extended for one year.[21]

While Diack, England and Shepard made a start on surveying the line between Yokohama and Tokyo, Japanese workmen began levelling the land around Shiodome and reclaiming land around Yokohama and Kanagawa in preparation for the railway line.[22] Although not as technologically advanced as the West, the Japanese had developed civil engineering techniques which enabled them to carry out such work. With the arrival of the first group of British workmen, work began on the railway itself. On the advice of British engineers the railway was built on a 3 foot 6 inch gauge.

Lay had arranged for all material and equipment; the sleepers, rails, locomotives, carriages and ticket machines, to be imported from Britain. However, when the engineers arrived in Japan they found that some of the British material was unsuitable for Japan and made allowances for the differences. Relatively cheap durable native wood was substituted for the expensive iron sleepers, reducing costs substantially. Lay had given little thought to the suitability of the materials, to the cost of the project or to Japanese interests. The engineers took Japanese needs into consideration using Japanese materials where possible to keep costs down, earning their admiration and gratitude. Japanese workmen were also employed and were expected to learn the necessary skills on site and later also in the repair factories built at Shinbashi and Kobe.

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[20] Takeuchi Hiroshi, *Yokohama Gaijin Bochi: Yamate no Oka ni Nemuru Hitobito*, Tokyo: Santōsha, 1985, p. 47.

[21] Takeuchi Hiroshi, *op. cit.*, p.47, and Doboku Gakkai, *op. cit.*, p. 93.

[22] According to Doboku Gakkai the engineers began surveys of the route from Tokyo to Yokohama from Shiodome on March 25th. Doboku Gakkai, *op. cit.*, p. 93.

Morell encouraged the Japanese to train engineers so that they would not have to rely on expensive foreign engineers.[23]

In mid 1871, when William Cargill was summoned back to the London offices of the Oriental Bank, the Japanese government was reluctant to let him go. They wrote to the President of the Bank, Charles Stuart, requesting that Cargill remain in Japan to continue to supervise the railway project. An arrangement was made in which Cargill was hired directly by the Japanese government for a term of five years from January 1872 at an impressive monthly salary of $2,000.[24]

In July 1870, the government established railway offices in Osaka and Kobe in preparation for the second railway line between these two cities and in June 1871 an office in Kyoto for the railway connecting Osaka with this city.[25] Responsibility for the Railway Section was transferred to the Ministry of Public Works on its establishment in October 1870.[26] In August 1871 a Railway Bureau was established under the direction of Inoue Kaoru.

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[23] In 1871 the Ministry of Public Works made plans to establish a college of engineering and some say its establishment was greatly influenced by Morell's advice on the subject to the government.

[24] The Oriental Bank is thought to have laid down the conditions of Cargill's employment to the Japanese government. Cargill was a special case, for no formal contract was drawn up and he was paid far more than any other foreign employee. The second highest paid *oyatoi* after Cargill was Kinder of the Mint at a monthly salary of $1,045. Ōkurashō, *op. cit.*, p. 367 and Tatewaki Kazuo, *op. cit.*, p. 98.

[25] Ōkurashō, *op. cit.*, pp. 364-5.

[26] On his arrival in Japan, Morell submitted a paper offering his opinion on the subject of establishing a ministry to promote public works, such as the railway, roads, and lighthouses. This paper is said to have been the stimulus for the creation of the Ministry of Public Works. Ōkurashō, *op. cit.*, p. 90.

In the summer of 1871, the Railway Bureau's Chief Engineer, Edmond Morell requested leave to travel to India to recuperate from the tuberculosis he had contracted in Ceylon. Morell's hard work and tireless effort had gained the respect of his Japanese employers, who accepted his request and presented him with ¥5000 to help with expenses during his period of leave. Four Japanese officials were instructed to accompany Morell to India where they would observe railway construction and operation while Morell recovered from his illness. Morell died on September 23rd before departing from Yokohama and the officials' trip was cancelled.[27] Several days after his death, Morell's wife also died and both were buried in the Yamate foreigners' cemetery in Yokohama.[28]

Morell was sadly missed but work continued on the railway under the supervision of Charles Shepard.[29] As soon as the first stretch of line from Yokohama was completed, test rides were made along the short route. In the autumn of 1871 Kido Takayoshi, Ōkuma Shigenobu, Goto Shōjiro, Sanjo and Ōkubo Toshimichi, among other government officials, were given the opportunity to ride in the locomotive.[30] By June 1872 the railway line between Yokohama and Shinagawa had been completed and a temporary rail service was started between the two stations on June 12th. With an average speed of 40.8kph the journey took thirty-five minutes.[31] The remaining line

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[27] Ōkurashō, *op. cit.*, p. 365, and Doboku Gakkai, *op. cit.*, p. 92.

[28] Ōkurashō, *op. cit.*, p. 365 and Doboku Gakkai, *op. cit.*, p. 92.

[29] Doboku Gakkai, *op. cit.*, p. 95.

[30] Ōkubo, who was originally opposed to the railway, is said to have converted after one of the test journeys.

[31] On the first day of the temporary service, two return journeys were scheduled but this was increased to six the following day due to the enormous demand.

between Shinagawa and Shinbashi was completed in September.[32] Two and a half years after Morell, Diack, England and Shepard's arrival, the first railway line in Japan was officially opened on October 14th 1872 by the Meiji Emperor. Criticism of the railway turned to praise and the government officials involved in the railway project and several of the senior *oyatoi* were presented with gifts for their contributions.[33] The train service, which took fifty-three minutes, was to be open to all who paid, regardless of position or rank. Fares were set at ¥1.50 *sen* for first class, ¥1 for second class and 50 *sen* for third class.[34]

Once Diack and England had completed their surveys on the Yokohama line they were dispatched to the Osaka railway office in July 1870 to begin the survey of the twenty-mile route between Kobe and Osaka. Construction was completed by November 1873.[35] The line between Kyoto and Osaka was the third to be built and it was officially opened in February 1877. Arthur Blundell, who had originally been sent over to Japan by D. & T. Stevenson to work in the Japanese Lighthouse Bureau, was

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[32] Although the majority of *oyatoi* in the railway service were British, the station buildings at Yokohama and Shinbashi were designed by an American architect; T*he Japan Weekly Mail*, June 15th 1872.

[33] Ōkuma Shigenobu and Itō Hirobumi received ¥600, Inoue Kaoru, Head of the Railway Bureau, and his three assistants received ¥400. Cargill, Shepard (Chief Engineer), Rowing (unsure of correct spelling; Assistant Engineer), Galway (Transport Chief), his assistant; Christie, Hart (Foreman), Annand (Steam Engine Chief) and the doctors, Purcell and one other (unsure of English spelling) received various gifts. Ōkurashō, *op. cit.*, p. 368.

[34] *The Japan Weekly Mail* announced the railway fares on April 27th 1872. At $1.50 for first class, $1.00 for second and 50 cents for third, the paper wrote it was "evident that these prices are much too high". For comparison, . *The Japan Weekly Mail* quotes the price of a 10kg bag of rice at 36 *sen* at the time. *The Japan Weekly Mail,* April 27th 1872.

[35] Fox, Grace, *op. cit.*

placed in charge of the surveying of this route.[36] By this time the total mileage of railway lines in Japan was seventy-one.

After leaving the Railway Bureau, Diack remained in Yokohama as an architect. He was employed by the Ministry of Public Works again in the Eizen Bureau from 1878 until 1881. He remained in Japan until his death in 1900.

The railway was an expensive project. It is estimated that ¥15 million, almost 50 % of the Kōbushō expenditure from 1870 until the Ministry's abolition in 1882, was spent on the railway.[37] Until 1881 all railway construction was carried out by the government. In 1881 the Nippon Tetsudō Kabushiki Gaisha was given approval to build a railway, laying the foundations for private railways.[38]

Training of Civil and Mechanical Engineers

Training engineers was as important for the railway as it was for other engineering fields. As in other bureaux, training was given to Japanese on site by foreign *oyatoi* during the construction of the first railways. The need for high level civil and mechanical engineers capable of designing and implementing advanced railway plans was soon addressed by engineering courses at the Kōbudaigakkō, the Kaisei Gakkō and Tokyo University.

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[36] Doboku Gakkai, *op. cit.*, p. 90.

[37] Uda Tadashi, *Kindai Nihon to Tetsudōshi no Tenkai*, Tokyo: Nihon Keizai Hyōronsha 1995, p. 82.

[38] Shima Yasuhiko, *Nihon Shihon Shugi to Kokuyū Tetsudō*, Tokyo: Nihon Hyōronsha, 1950, p. 94.

Between 1873 and 1885 forty-five students graduated from the Kōbudaigakkō in civil engineering and thirty-nine in mechanical engineering. During the same period thirty students graduated from Tokyo University (including Kaisei Gakkō students) in civil engineering and seven in mechanical engineering. The majority of professors in these subjects were Scots. Henry Dyer, Principal of the Kōbudaigakkō College, taught Civil and Mechanical Engineering from 1873 until 1882. Arthur Watson Thomson taught Civil Engineering from 1878 until 1881, as did Thomas Alexander from 1879 until 1885. W. M. Angus was Assistant Professor of Mechanical Engineering from 1878 until 1881 and Archibald King was an instructor of Practical Engineering at the College and at the Akabane works attached to the College. John Perry was the only full Professor of Civil Engineering who was not a Scot. Dyer, Thomson and Alexander were all graduates of Glasgow University. In Tokyo University the Civil and Mechanical Engineering course was taught successively by three Scots professors; Robert Henry Smith from 1874 until 1878, Alfred J. Ewing from 1878 until 1883 and Cargill Knott from 1883 until 1891. Ewing and Knott were both graduates of Edinburgh University and Smith was educated at the University although he did not graduate.

In addition to the Kōbudaigakkō and Tokyo University a small Railway Bureau school was established in May 1877. Two British railway engineers, Thomas Shervinton and Edmund Hortham, were responsible for instruction in a range of subjects relating to railway engineering, including mathematics, surveying, civil engineering, and mechanical engineering. However, as both the Kōbudaigakkō and Tokyo University taught these subjects at an advanced level the railway school was abolished in 1882.

Twenty-four students graduated from the school.[39]

Ryūgakusei to Scotland

During the early years of the Meiji period, while the Japanese education system was developing, the government pursued a *ryūgakusei* policy of sending talented students abroad for further training. Both the Ministry of Education and the Ministry of Public Works sent engineering students from the Kaisei Gakkō (later Tokyo University) and the Imperial College of Engineering abroad to study. In 1876 the Ministry of Education sent two graduates of the Mechanical Engineering Section of the Kaisei Gakkō, Masuda Reisaku and Taniguchi Naosada, to Glasgow.[40] They enrolled in engineering and science classes at Glasgow University and graduated two years later with a B.Sc. and a Certificate of Proficiency in Engineering Science (C.E.).[41] Both were exceptional students and Masuda received the Walker Prize (2nd) and the Harvey prize (2nd). From 1878 until his return to Japan in 1881 Masuda trained at McLaren's Ironworks in Glasgow, the Clyde Harbour Works and Bryce Company in Edinburgh to gain valuable practical experience.[42] On his return to Japan he was appointed Chief Assistant Engineer to the Department of Engineering works and was promoted to

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[39] Doboku Gakkai, *op. cit.*, p. 84.

[40] Tomita Hitoshi, *Umi o Koeta Nihonjin Meijiten,* Tokyo: Nichigai Associates, 1985, p. 536.

[41] Glasgow University Album, session 1876-7, and Kita Masami, *op.cit.*, p. 183.

[42] Kita Masami, Kokusai Nihon o Hiraita Hitobito: Nippon to Sukottorando no Kizuna, Tokyo: Dōbunkan, 1984, pp. 182-3; Tomita Hitoshi, op. cit., p. 536, Murakami Kyōichi, D*aitetsudōka Ko Kōgaku Hakushi Minami Kiyoshi Kun no Keireki*, Kinoshita Tateyasu, 1904, and Murakami Kyōichi, *Minami Kiyoshi Den*, Kinoshita Tateyasu, 1909. The latter two references are reprinted in Noda Masaho, Harada Katsumasa, Aoki Eiichi, Meijiki Tetsudōshi Shiryō, Volume 5; Tetsudō Kaden (1) Minami Kiyoshi Den Hoka, Tokyo: Nihon Keizai Hyōronsha, 1980. p. 38.

Second Engineer of the Railways in 1889. In 1891 he resigned from his government position and entered the Nihon Tetsudō Kaisha as Chief Engineer where he supervised work on the Tokyo – Aomori railway line. He became Director of the Tsuruga Railway Bureau and was appointed Engineering Inspector of Railways in 1896.[43] Masuda died in 1917 aged 64.

In 1880 the Ministry of Public Works sent twelve graduates of the Kōbudaigakkō to Britain to study. Five were sent to Glasgow and among them was Minami Kiyoshi, first-class graduate in Civil Engineering.[44] Minami enrolled in engineering and science classes at Glasgow University in 1880. During the summer he worked at McLaren's Ironworks, the same ironworks as Masuda had trained in. By chance the foreman at McLaren's had been foreman on the Kobe - Kyoto railway line in Japan some years earlier and was of great help to Minami during his time there. In the following year he worked in the Clyde Harbour Works. Ordinarily the office required a premium of between ¥1000 and ¥3000 to enter but Minami had influential friends in the government and was allowed to enter without the premium. Previous Japanese trainees, Masuda Reisaku and Ishibashi Ayahiko had paid this premium to enter the Works. Afterwards he worked in the Chief Engineer's office on the Caledonian Railway in Scotland, again without having to pay a premium. At the end of 1881 Minami left Glasgow University and went to work with Jardine Matheson on railways in Spain. In 1882 he travelled around factories and railway construction sites in the

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[43] Iseki K.R, *op. cit.*, p. Eng 13.

[44] Minami had formerly been a student at Keio Gijuku and Kaisei Gakkō. Tomita Hitoshi, *op. cit.*, p. 564.

United States before returning to Japan in 1883.[45]

On his return to Japan in 1883 Minami began a remarkable career in railway construction. As a government sponsored *ryūgakusei* he was obliged to spend a period of seven years in government employ. He was appointed Commissioner to the Engineering Department of the Ministry of Public Works with a monthly wage of ¥50 and was instructed to begin surveying the route between Takasaki and Karuizawa and later between Takasaki and Yokogawa. Once these surveys were completed, Minami was placed in charge of the construction of the railway line between Takasaki and Yokogawa. At the time he was promoted to Gonsho gichō and his monthly wage was doubled to ¥100. He was later placed in charge of the construction of railway lines between Numazu and Daifu, and Numazu and Hamamatsu.

In 1890 Minami resigned from his official position in the government and became Chief Engineer for the Sanyō Railway Company. While in this position he also acted as Adviser to the Chikuho Railway Co., from 1892, and as Chief Engineer to the Bantan Railway Co., from 1893. During the Sino-Japanese war he was placed in charge of railway transportation between Onomichi and Hiroshima and for his contributions to the war effort he was decorated with the 6th Order of the Rising Sun. When he resigned his position as Chief Engineer in the Sanyō Railway Company in 1895, he became Adviser to the company and established his own civil engineering consulting office in Osaka. The company was involved in surveying, designing and supervising construction of railways and other civil engineering projects as well as

[45] Murakami Kyōichi, *op. cit.*, pp. 38-9.

importing foreign machinery and material. He was elected President of the Hankaku Railway Company and also acted as Adviser to the Tokushima, Chuetsu, Nanao, and Karatsu Railway Companies and the Hanshin Electric Railway Company, before being elected President of the Karatsu Railway Company in 1900.

Minami's career spanned only two decades but he has been referred to as the father of Japanese railroads because of his remarkable contribution to railway construction in Japan both in the public and the private sector. He was involved in railway construction across the country, often working on more than one project at a time, and published numerous papers on railway engineering. In 1891 the Japanese Ministry of Education awarded him a *Kōgaku Hakushi* (Doctor of Engineering). He died in 1904 of a heart attack at the age of 50.[46]

In 1884 another graduate of the Civil Engineering Department of the Imperial College of Engineering entered Glasgow University but this time as a privately sponsored student. Watanabe Kaichi graduated at the head of his class with a first-class degree in Civil Engineering in 1883 and initially entered the Railway Bureau of the Ministry of Public Works as an engineer.[47] Watanabe followed the example of Naito Masatomo, a graduate of the Mechanical Engineering Section of the College in 1881 who had studied in Glasgow.[48] Watanabe was granted permission from the Ministry of Public Works to study abroad and resigned his official position. He matriculated at Glasgow

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[46] Tomita Hitoshi, *op. cit.,* p. 564 and Iseki K.R., *op. cit.*, p. Eng 13.

[47] Kita Masami, *op. cit.*, p. 191 and Iseki K.R., *op. cit.*, p. Eng. 41.

[48] Ōkurashō, *op. cit.*, p. 810 According to Kita Masami, Watanabe stayed at the same address as Naito: c/o Mrs. Workman, 353 Bath Crescent; Kita Masami, *op. cit.*, p. 191.

University in 1884 and graduated two years later with a B.Sc. and C. E.[49] During his summer vacation in 1885 he worked at the Circle Dockyard in Glasgow and after graduating he worked as an apprentice student and later as an engineer with Benjamin Baker and John Fowler on the construction of the Forth Rail Bridge, the largest iron bridge in the world at the time. In the summer of 1887 he toured industrial sites in Europe and in January 1888 he resigned from his position with Baker & Fowler and returned to Japan in April via the United States, where he observed railway and industrial sites.[50] During his *ryūgaku* period he carried out extensive research on various civil engineering projects around Britain and the United States, including the construction of undergrounds in Glasgow and London, cable tramways in Edinburgh, and canal and harbour works in the North of England.

When Watanabe returned to Japan in 1888 he was appointed Departmental Director of Civil Engineering in the Nippon Doboku Kaisha (Nippon Public Works Company), a position he held until 1892.[51] While in this position he was involved in the design and supervision of several railway and tram projects and lectured on railway engineering at the private Kōshu Gakkō (Assistant Engineers' School).[52] On resigning his position he

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[49] Kita Masami, *op. cit.*, p. 191.

[50] Iseki K.R., *op. cit.*, p. Eng 42.

[51] The government paid College fees for the majority of students, including Watanabe, at the Imperial College of Engineering and in return required the students to work for the government for a period of seven years or pay the fees back. Watanabe worked for the government for only a year before leaving for Glasgow and did not appear to hold any official positions on his return to Japan. Naito, who was also a privately funded *ryūgakusei* in Glasgow, returned to an official position in the Japanese Naval Ministry, where he served for several years.

[52] He designed and supervised construction of the Akita – Tsuchisaki horse tramway in 1889, the Koriyama-Mihara horse tramway in 1891, and supervised surveys for the Sangu Railway Co. in 1890.

entered the Sangu Railway Company as Chief Engineer and Manager. From 1894 until 1897 he was President of the Company. While serving in this Company he became Engineering Adviser to the Toyokawa Railway Company in 1896. In January 1897 he became Managing Director and Chief Engineer of the Hokuetsu Railway Company and became its President in 1907. He was Director of the Tokyo Electric Railway Company from 1903, Managing Director of the Keihan Electric Railway Company and Director of the Korean Colonization Company from 1905. During his long career he held an impressive number of managerial and advisory posts in a variety of different companies; primarily in the railway field, but also in gas, timber and shipbuilding.[53] He was elected Member of the Institution of Civil Engineers London in 1888 and held numerous posts in railway and civil engineering societies and associations in Japan. He died in 1933 at the age of 75.

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[53] In 1907 he was elected Auditor of the Kigyō Bank, Director of the Manchurian Industrial Co., Director of the Sakura Cement Co., Director of the Ina Electric Tramway Co., Auditor of the Dai Nippon Salt Industrial Co. In 1911 he was Auditor of the Tokyo Gas Industrial Co., Director of the Kansai Gas Co.; in 1912 President of the Ishikawashima Dockyard Co.; in 1913 Director of the Kyoto Electric Railway Co.; in 1914 he was Auditor of the Keio Electric Railway Co.; in 1915 he was President of the Kansai Gas Co.; in 1917 he was Director of Imperial Casting Co.; In 1918 he was Director of the Keio Electric Railway Co., President of the Tsukishima Ironworks Co., Director of the Fukushima Tiber Co., Adviser to the Naigai Industrial Co., President of the Tōyō Electric Machinery Manufacturing Co., Director of the Chōsen Central Railway Co., Auditor of the International Steamship Co., Auditor of the Daido Electric Power Co., Auditor of the Musashi Electric Railway Co., Auditor of the Ryoko Takurin Railway Co.; In 1921 he was President of the Toroll Co., President of the Ina Electric Railway Co.; in 1922 he was Director of the Shinkeihan Railway Co., Director of the Keihan Land Co.; in 1923 he was President of the Chōsen Railway Co.; in 1924 he was Director of the Nara Electric Railway Co., Auditor of the Tsurumi Harbour Railway Co.; in 1926 he was Director of the Tenryugawa Electric Power Co., Auditor of Oita Cement Co.; in 1927 he was Auditor of the Kyoto Electric Light Co., and in 1928 he was Auditor of the Kurama Electric Railway Co.: Iseki K.R., *op. cit.*, p. Eng. 41.

Conclusion - The Scottish contribution to Japanese Railways

The Railway Bureau hired over three hundred *oyatoi* between 1870 and 1885. The majority of these *oyatoi* were British and approximately twenty percent were skilled civil engineers and artisans. After 1875 their numbers began to decline and by 1885 almost all had been replaced by Japanese engineers and workmen.[54] William Walter Cargill and John Diack were Scots who held high level positions in the Railway Bureau. The foreman at McLaren's Ironworks in 1881 during Minami Kiyoshi's training there had been a foreman on the Kobe – Kyoto railway but his name is not known at this point. It is reasonable to assume that there were several more Scots among the *oyatoi*.

The Scots did play a significant role in the development of Japanese railways. Thomas Glover demonstrated the first full-sized railway locomotive on Japanese soil and Henry Brunton's proposal was the basis for the first railway line to be constructed in Japan, from Yokohama to Tokyo. Scotland's most significant contribution to the railway was through the education of civil and mechanical engineers, particularly at the Imperial College of Engineering, at Tokyo University and Glasgow University. The first generation of graduates, many of whom replaced foreign *oyatoi* in the Railway Bureau during the 1880s, was taught primarily by Scottish Engineering Professors and several continued their education in Glasgow. Among the Glasgow

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[54] The Railway Bureau hired 19 *oyatoi* in 1870 to begin construction of the Yokohama Shinbashi railway line and by 1872 the number had risen to 83. In 1874 during construction of the Kobe – Osaka line there were 115 *oyatoi*. Their numbers declined steadily from 1875. By 1887 there were only fourteen *oyatoi* remaining in the Bureau and most of them were replaced by the 1890s. Murakami Kyōichi, *op. cit.*, p. 79.

ryūgakusei, Masuda Reisaku, Minami Kiyoshi and Watanabe Kaichi returned to Japan to impressive careers in railway engineering, contributing to both the public and the private railway systems.

TELEGRAPHY AND ELECTRICAL ENGINEERING

'How to bring the distant near, to convey a man's thoughts or wishes, commands or fears, instantly to one who is far beyond speaking distance, has been an object of solicitude from very early times.'[1]

After a brief introduction to the development of the electric telegraph, this section investigates the Scottish connection with the Japanese Telegraph Service and electrical engineering education during the Meiji period. A number of Scottish employees were employed by the Telegraph Bureau but few details of their lives in Japan have been uncovered. The main focus is Shida Rinzaburō, graduate of the Imperial College of Engineering and pioneer of electrical engineering research in Japan. Shida spent a period of three years in Glasgow, studying under William Thomson (Lord Kelvin), and training in the Glasgow Post Office. On his return to Japan he taught at the Kōbudaigakkō (Imperial College of Engineering) and carried out pioneering research in the field of electricity.

The electric telegraph, which was first patented in 1837, revolutionized long distance communication across the world in the nineteenth century. It spread rapidly along railway systems in Britain where its usefulness was first clearly demonstrated and was adopted by the governments of Europe as a military and political tool. It arrived in Japan with Westerners in the mid nineteenth century and as with many other technological advances of the time, the electric telegraph was quickly adopted by the Meiji government.

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[1] Dodd, George, *Railways, Steamers and Telegraphs: A Glance at their Recent Progress and Present State*, London: Chambers, W&R 1867.

Development of the Electric Telegraph in Britain

Prior to the introduction of the electric telegraph, a variety of methods had been used to communicate over long distances, including flags, lanterns, rockets, beacon fires, guns, trumpets, and drums. By the early nineteenth century the system commonly used by European governments was a semaphore system designed by the Frenchman, Claude Chappe. Messages were sent and received by operators stationed in a series of towers positioned at some distance from each other but within sight. Signals were sent by opening and closing wooden shutters in various combinations.[2] The system worked well but had its limitations especially in bad weather when the signals could not be seen by operators in adjacent towers.

The concept of sending messages over long distances by electricity began to attract enormous interest during the eighteenth century. The phenomenon of electricity had fascinated people for years but the discovery of the Leyden jar in 1745 made experimentation more straightforward. Scientists were able to demonstrate that electricity travelled through conducting material almost instantaneously and it was not long before they began to experiment with electric telegraphy.

In Britain an article on the subject of electric telegraphy entitled "An Expeditious Method of Conveying Intelligence" appeared in the February 17th 1753 edition of the *Scots' Magazine,* describing a signalling system which used twenty-six wires, one for each letter of the alphabet. It is not known whether the author, who simply signed his paper C.M., ever built the type of telegraph he describes.[3] However, the feasibility of

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[2] Kieve, Jeffrey, *The Electric Telegraph: A Social and Economic History*, Newton Abbot: David & Charles, 1973, p. 16.

[3] Kieve suggests that 'C.M.' was Charles Marshall of Paisley, 'a clever man… who could make lightning speak and write upon the wall'. Kieve, Jeffrey, *op. cit.,* p. 14.

the electric telegraph had been openly discussed and in the following decades several attempts were made to develop this type of communication system. In 1816, Francis Ronalds gave a demonstration of an electric telegraph in his garden at Hammersmith, which Jeffrey Kieve suggests was probably "the first electric telegraph capable of practical use."[4] Two decades later, in 1837, the electric telegraph was patented by two Englishmen, William Fothergill Cooke and Professor Charles Wheatstone.

No one individual can claim to have invented the electric telegraph. Rather its creation was a combination of efforts of many individuals in many countries. Although Cooke and Wheatstone were the first to take out a patent, others like Samuel Morse in the USA, Steinheil in France and Edward Davy in Britain had already given practical demonstrations of their own electric telegraphs. Indeed Cooke's interest in the electric telegraph was first stimulated by a demonstration of Baron Pawel Schilling's needle telegraph at a lecture in Heidelberg. Nevertheless, much credit can be given to Cooke and Wheatstone for promoting the use of the electric telegraph in Britain.

Cooke did not have the strong scientific background and understanding of electrical theory which Wheatstone had, but he made up for this with his energy, determination to succeed and his ability to convince others of its practical benefits. Soon after receiving the patent, Cooke approached several railway companies with his ideas for the electric telegraph. In his first demonstration to the London and Birmingham Railway Company, he succeeded in impressing the chief railway engineer, Robert Stephenson, but was less successful in convincing the railway company to install the system, probably because of the considerable cost of the project. His demonstration had attracted the attention of others including Isambard Kingdom Brunel, engineer to the Great Western Railway, and in May 1838 Cooke made an agreement with the

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[4] *ibid.*, p. 17.

company to build a 13 ½ mile telegraph line from Paddington to West Drayton which was completed in July 1839. This was the first electric telegraph to be put to daily use and it proved a success.

Progress was slow initially but the success of the line along the Great Western Railway and the following Blackwall line gradually convinced sceptics of its advantages. In 1845 the Cooke and Wheatstone partnership was installing or working approximately 550 miles of line along railway systems, including an 88-mile line along the London and South Western Railway linking the Admiralty in London with Portsmouth.[5] By mid century the government, police, railway companies, shipping companies, newspapers and even mines were using the electric telegraph.

For the next two decades the telegraph network in Britain continued to develop under private companies.[6] By 1868 there were 21,751 miles of telegraph line run by five major telegraph companies and several railway companies.[7] In 1870 the network was nationalized and came under the jurisdiction of the Post Office. Nationalization initially brought increased coverage, added convenience and cheaper rates. Outlying areas which had been neglected by private companies were now linked to the network and telegraph offices were conveniently placed in major Post Offices across the country. By 1872 the total number of messages sent had increased by 50 per cent.

It was not long before the British turned their attention to linking their island with the outside world. By November 1851 the first international submarine cable, between Dover and Calais, was opened to the public. After several aborted attempts the Atlantic cable was successfully laid and linked Britain with North America. The

[5] *ibid.*, pp. 37.

[6] In contrast, the electric telegraph system in continental Europe developed as a state monopoly.

telegraph spread rapidly across the globe and by 1867 a line ran all the way from Europe through Russia to Vladivostok.

Telegraphs in Japan

Prior to 1853 a few Japanese *rangaku* scholars like Hiraga Gennai; discussed in the introduction to this thesis, were familiar with the phenomenon of electricity. Knowledge of electricity and its applications became more widespread after the end of seclusion. Among the many gifts presented to the shōgun on the signing of the Treaty of Friendship by Admiral Perry in 1854 was an electric telegraph.[8] Demonstration of the device stimulated interest among the Japanese and prompted the Dutch at Dejima to present the Japanese with a second electric telegraph. In 1865 the Bakufu ordered telegraph equipment from France and sent several Japanese to study telegraphy in Britain.[9] Although interest grew it was not until after the Meiji Restoration that the first telegraph line was established in Japan.

In late 1868 Terashima Munenori, the appointed Governor of Kanagawa, put forward a proposal to link Kanagawa with Edo by electric telegraph. Terashima, originally from Satsuma, one of the more enlightened areas of Japan had travelled to the West twice during the *bakumatsu* years and was probably familiar with the technology. In December 1869 the government decided to adopt the telegraph and placed Terashima

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[7] Kieve, Jeffrey, *op. cit.*, p. 73.

[8] This telegraph was an embossing Morse type. On the outer lid was written "For the Emperor of Japan" but it was never delivered to the emperor. It was taken to the Banshoshirabesho and was later transferred to Daigaku Nankō then to Tokyo Teikoku Daigaku. It is now housed in the Communications Museum: Yokohama Denpōkyoku, *Yokohama no Denshin Hyakunen*, Yokohama: Yokohama Denpōkyoku, 1970, p. 4.

[9] Nihon Denshin/Denwa Kōsha Denshin Denwa Jigyōshi Henshū Iinkai, *Denshin Denwa Jigyōshi,* Volume 1, Denki Tsūshin Kyōkai, 1959, p. 7.

in charge. Terashima was responsible for the Lighthouse Project and had three foreign engineers working for him. Richard Henry Brunton was Chief Engineer. He had trained as a railway engineer in Britain and as such was familiar with the British telegraph system. Terashima asked Brunton for assistance in obtaining the necessary equipment and trained personnel for the project. Brunton consulted his father in law, George Wauchope in Edinburgh, who recommended George Miles Gilbert from Leith, a telegraph engineer working on the Scottish railways, as supervisor to the Japanese Telegraph Service.[10] Wauchope had a contract drawn up for Gilbert which was signed in Edinburgh on February 1st 1869; the 20th day of the 12th Month of the first year of Meiji according to the Japanese calendar.[11]

Gilbert was hired on a three-year contract at a monthly salary of $150.[12] Before departure he was to receive £49 for outfit, his train fare to Liverpool and a second-class passage on a steamer from Liverpool to Yokohama. He was to be provided with a two or three-room house while in Japan and would receive a return passage to Britain at the end of his three-year contract. Gilbert arrived in Japan on September 7th, 1869.[13]

Within a week of Gilbert's arrival in Japan, work was begun on the Japanese Telegraph Service. The first line was a short 840-yard line running from the Yokohama Lighthouse Office in Benten to the Kanagawa *saibansho* (government office) on the

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[10] Takahashi Zenshichi, *Oyatoi Gaikokujin 7 (tsūshin)*, Tokyo: Kashima Shuppan Kai, 1969, pp. 186.

[11] According to Takahashi Zenshichi, Gilbert's contract was signed on February 1st 1869 and he arrived in Japan in August of the same year. In *Kōbushō Enkaku Hōkoku*, Gilbert's contract began in the 12th month of the second year of Meiji. Takahashi Zenshichi, *op. cit.*, p. 182, and Ōkurashō, *Kōbushō Enkaku Hōkoku*, *op. cit*, p. 598.

[12] Gilbert's salary is stated as ¥250 in the *Kōbushō Enkaku Hōkoku* list of *oyatoi* in the Telegraph Department. After completion of the Tokyo-Yokohama line his salary was raised from $150 to this value. Ōkurashō, *op. cit.*, 1888, p. 598 and Takahashi Zenshichi, *op. cit.*, p. 184.

[13] Details of Gilbert's contract are given in Takahashi Zenshichi, *op. cit.*, p. 182.

main street in Yokohama.[14] The equipment used is thought to have been that ordered by the Bakufu from France before the Restoration. The line was reserved for government use only. On the successful completion of this first line, work began on the next project to link Yokohama with Tokyo. 593 telegraph poles were placed along the 32 km route which followed the *Tōkaidō* road from the Yokohama *saibansho* to the Custom House at Tsukiji in Tokyo. Brunton was responsible for planning and surveying the line while Gilbert was in charge of the construction, installation of equipment, testing and servicing the line. Once the line was in place, Gilbert's salary was raised to ¥250. Nine other individuals took part in construction, which took approximately three months and cost ¥4273.[15]

On January 26th 1870 telegraph transmissions between Yokohama and Tokyo commenced.[16] The line was opened to the public at a charge of one *fun* for each Japanese *kana* character. When transmission in European languages began in April, the charge was one *bō* for every 20 words.[17] The first government regulations regarding the telegraph were announced prior to the commencement of public transmissions, explaining its use and charges. An explanation appeared in the European newspapers in April under Henry Brunton's name.[18] In the first three months of telegraph service approximately 3000 messages were sent and in the following year, 1870, about 11,000.[19]

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[14] First Report of the Chief Commissioner of Imperial Government Telegraphs, Japan, June 30th of 8th Year of Meiji, printed in Yūseishō (Ministry of Posts and Telecommunications), *Yūsei Hyakunenshi Shiryō* Vol. 19, Tokyo: Yoshikawa Kōbunkan, 1969, p. 16.

[15] Yokohama Denpōkyoku, *Yokohama no Denshin Hyakunen*, Yokohama: Yokohama Denpōkyoku, 1970, pp. 13-15. Gilbert was the only *oyatoi* hired by the Telegraph Department at this point.

[16] Yokohama Kaikō Shiryōkan, *R. H. Brunton: Nihon no Tōdai to Yokohama no Machizukuri no Chichi,* Yokohama: Yokohama Kaikō Shiryō Fukkyū Kyōkai, 1991, pp. 50-2.

[17] Yūseishō, *op. cit.*, p. 28.

[18] Nihon Denshin Denwa Kōsha, *op. cit.*, p. 404.

[19] *ibid.*, p. 10.

On Brunton's first inspection trip of lighthouse sites in late 1868 he met with Itō Hirobumi in Osaka and was asked to buy telegraph equipment for a line between Kobe and Osaka.[20] Following the completion of the Tokyo-Yokohama line, the line between Kobe and Osaka was started and opened to the public in September 1870. In July 1870 plans were made to build a line all the way from Tokyo to Nagasaki. At the time a Danish telegraph company was laying a submarine cable from Shanghai to Nagasaki and had applied to the Japanese government to extend the line to Yokohama. However, the Japanese government was determined to build a landline itself and pushed forward with its plans. Construction was delayed until the arrival of equipment, engineers and workmen from Europe in mid 1871. The first part of the line from Tokyo to Kobe was opened in 1872 and the remaining line to Nagasaki opened in February 1873. There were twenty intermediate stations along the 870-mile route. On completion of the Tokyo – Hokkaido line in 1874 the islands of Kyushu, Honshu and Hokkaido were linked. By June 1875, the electric telegraph ran over 4,282 miles, through forty-five telegraph stations and in 1875, 466,000 messages were sent. The total cost of construction from 1869 to 1875 was ¥1,761,640 and the total revenue amounted to ¥249,299.[21]

The Telegraph Bureau hired at least sixty-seven *oyatoi* between 1869 and 1885. Of these sixty-two were British and at least nine were from Scotland. It is very possible that many more of them were also from Scotland but their origins are unclear at this point. Among the *oyatoi* were engineers, electricians, inspectors, and clerks working along the telegraph lines, teachers at the telegraph school and crew on the Telegraph

[20] Yokohama Kaikō Shiryōkan, *op. cit.*, p. 55.

[21] Yūseishō, *op. cit.*, p. 51.

Bureau's ship, the *Denshin Maru*.[22] All nine of the Scots identified came from the Edinburgh area. Among them were Edward Gilbert, Chief Telegraph Engineer and highest paid *oyatoi* in the Bureau, George Miles Gilbert and his son Arthur Gilbert both District Superintendents. Three others were inspectors, Thomas Hobson, William Raffin, and Daniel Sinclair. Thomas Donaldson was a mechanic, Robert Robertson, a construction foreman and James Stewart a secretary. Edward Gilbert was recommended for the position by Henry Dyer of the Imperial College of Engineering.[23] George Miles Gilbert was hired through George Wauchope.

In June 1872 at the end of three years, the first *oyatoi* of the Bureau, George Miles Gilbert returned to Scotland. Two and half years later, in January 1875, he was re-hired on a three-year contract. Several months earlier, in October 1874, Gilbert's son, Arthur E. Gilbert, was hired as a District Superintendent on a four-year contract at a monthly salary of¥150. It is unclear whether Edward Gilbert, also from Edinburgh, was related to George. He was hired as Chief Engineer in April 1874 for five years at a monthly salary of ¥500.[24] His salary was raised each year and by 1878 had reached ¥625. George and Albert returned to Scotland in late 1878.

Responsibility for telegraphs was originally placed under the Lighthouse Section of the Gaimushō (Ministry of Foreign Affairs) then transferred to the Minbu-Ōkurashō (Ministry of the Interior and Finance) and later to the Minbushō. In October 1870

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[22] Refer to the list of Telegraph Bureau *oyatoi* in Appendix 9.

[23] Henry Dyer wrote "Soon after my arrival in Japan I impressed on the Vice Minister of Public Works the desirability of a more complete organization and on my suggestion Mr. Edward Gilbert of the North British Railway Company's service was engaged, along with a competent staff of assistants to organize and develop the [telegraph] system." Dyer, Henry, *Dai Nippon; The Britain of the East: A Study in National Evolution*, London: Blackie & Son, 1905, p. 144.

[24] UNESCO Higashi Ajia Bunka Kenkyū Sentaa (UNESCO East Asia Culture Research Centre), *Shiryō Oyatoi Gaikokujin,* Tokyo: Shōgakukan, 1975, p. 255.

telegraphs were transferred to the Kōbushō (Ministry of Public Works) and placed under the Railway Bureau in May 1871. In September a Telegraph Department was established directly under the Kōbushō. With the abolition of the Kōbushō in 1885, the Telegraph Bureau was transferred to the Teishinshō (Ministry of Communications).

Training of Japanese

In preparation for the opening of the Tokyo - Yokohama line several Japanese students were selected from a Kanagawa school for training as telegraph operators. Gilbert drew up instructions on how to use the telegraph equipment and instructed the students along with Brunton. As the telegraph network increased so did the demand for operators. By the end of 1872 the Bureau was training almost one hundred operators in the use of the Breguet Alphabetical, Morse Printing, and Single Needle Instruments. In 1873 a training school was established at Shiodome in Tokyo and later also in Osaka.[25]

One of the first Japanese to become a telegraph engineer was a soldier of Kanagawa prefecture, Ueshima Masatoshi. He was originally attached to the Telegraph Service to protect Gilbert against *jōi* fanatics during construction of the first telegraph line but later became Gilbert's assistant.[26] In January 1878 a Telegraph Engineering School was established at Shiodome, teaching surveying, construction and related subjects. The school was named the Denshin Gijutsu no Denshū.

Advanced training in Telegraphy and Electrical Engineering

The first educational facility in Japan to provide advanced training in telegraphy and

[25] Yūseishō, *op. cit.*, p. 44.

[26] Takahashi Zenshichi *op. cit.*, p. 184.

electrical engineering was the Kōbudaigakkō. The Electrical Engineering Department at the College was the first in the world. William E. Ayrton was hired as Professor of Telegraphy from 1873 until 1878 and was followed by Thomas Gray from 1878 until 1881.

After graduating from University College London in 1867, Ayrton moved to Glasgow to work in William Thomson's experimental laboratory. He spent a period working as telegraph engineer to the Indian government then returned to Scotland to work as a telegraph engineer with a railway company. While in this position he was recommended for the position in Japan, probably through William Thomson.[27] Ayrton's replacement, Thomas Gray, was a graduate of Glasgow University.

Ayrton carried out valuable research on electricity in addition to his teaching duties while in Japan. He published over fifty papers during his five years at the College, several in co-operation with his colleague John Perry, Engineering Professor at the College. Because electricity was a comparatively new field, even in the West, Japanese students of electrical engineering had an advantage over students in other engineering subjects. Ayrton's research activities also ensured that the field progressed in Japan at a similar speed as in the West.

The college was an ideal facility for the training of engineers. The professors were young, intelligent and enthusiastic and the facilities were modern and extensive. As a Kōbushō facility the students had access to government public works where they could receive valuable practical training. In 1878 several students of the Electrical Engineering Department were sent to observe repairs being carried out on the submarine telegraph cable between Hakodate and Aomori. Among these students was

[27] Shida Katsunori, *Senken no Hito Shida Rinzaburō no Shōgai*, Tokyo: Nyūmedia, 1993.

a fifth-year student, Shida Rinzaburō, who became the first graduate in Electrical Engineering in 1879. Twenty-one students graduated from the Electrical Engineering Department of the Kōbudaigakkō during its existence, from 1873 until 1885.

***Ryūgakusei* to Scotland**

Ishimaru Toragorō (Yasuyō) was one of the first Japanese to study in Scotland. He was born in Saga in 1836 and studied *rangaku* in a local school before entering the Kaigun Denshūsho Naval School in Nagasaki in 1855. In 1866, Ishimaru and a fellow naval school graduate; Mawatari Hachirō, travelled secretly to Britain with the consent of Saga *han* and the help of Thomas Glover. They travelled first to Glover's hometown of Aberdeen and are also thought to have studied engineering at Anderson College in Glasgow.[28] While in Europe they joined Saga's representative at the Paris Exposition, Sano Tsunetami, and made a study tour of several countries. On his return to Japan Ishimaru established a school in Saga, the Keirinsha, where he taught a variety of subjects, including natural philosophy, mathematics, and English. At least three of his students at the Keirinsha later studied telegraphy at the Kōbudaigakkō and will be mentioned later. In 1871 Ishimaru entered government service and was appointed head of the Telegraph Bureau in August 1872 where he oversaw the construction of the Tokyo – Nagasaki telegraph line. In 1874, he moved to the Finance Ministry where he was placed in charge of the Mint.[29]

In accordance with the Kōbushō's guidelines, the Telegraph Bureau sent students abroad for training. Two students were sent to Britain in 1872 and one in 1873.[30]

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[28] Butt, John, *John Anderson's Legacy: The University of Strathclyde and its Antecedents 1796-1996*, East Linton: Tuckwell Press in Association with the University of Strathclyde, 1996, p. 89.

[29] Hiramatsu Kanji, *Nagasaki Yūgakusha Jiten*, Hiroshima: Keisuisha, 1999, pp. 323-4.

[30] Yokohama Denpōkyoku, *op. cit.*, p. 23, and Ōkurashō, *op. cit.*, pp. 500, 502.

Unfortunately their destinations in Britain are unknown. One of them, Terasaki Gentarō, returned from Britain after three years and taught at the Denshin Shūgikō and also worked as Gilbert's translator.

Shida Rinzaburō graduated from the Kōbudaigakkō with a first-class degree in electrical engineering in 1879 and was selected for further study abroad. He was one of eleven graduates who were sponsored by the Ministry to study in Britain in 1880. Shida and four others, Minami Kiyoshi, Takayama Naokata, Miyoshi Shinrokurō, and Takamine Jōkichi, were sent to Glasgow. It is thought that Shida, Minami and Takayama all stayed at the same address in Glasgow initially.[31] During his stay in Glasgow Shida studied natural philosophy under Professor William Thomson and mathematics under Professor William Jack and achieved spectacular results in his year at the University.[32] Lord Kelvin is reported to have remarked later that Shida had been his best student.[33] For general eminence in natural philosophy (among students of the first year), he was voted first by his classmates. He came first in the natural philosophy higher mathematics class (among students of the second year), second in senior mathematics and for his essay, *The Best Experimental Investigation of Magnetic Susceptibility*, he received the Cleland gold medal in natural philosophy.[34] His activities were reported in the Japanese newspapers.

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[31] His address on the Glasgow University Matriculation record is 18 Markland Terrace, Hillhead. One year later in July 1881, a letter from Shida to Sir William Thomson is addressed, 2 Salisbury Terrace, Hillhead (the spelling of this address is unclear). Shida Katsunori, *op. cit.*, p. 55, Glasgow University matriculation record for 1880-81 and letter of July 8th 1881 from Shida to Sir William Thomson in London; Kelvin Papers, Cambridge University Library.

[32] Shida's name appears in the University matriculation record for 1880-81, the registration record of Lord Kelvin's Natural Philosophy class and in the University Prize list, Glasgow University Archives.

[33] Kita Masami quoted from the book by David Wilson, *William Thomson, Lord Kelvin, his way of teaching Natural philosophy,* John Smith and Sons, Glasgow, 1910.

[34] Glasgow University Degree and Prize list. The Cleland medal Shida received is still held by the Shida family. Shida Katsunori, *op. cit.*, p. 59.

Before beginning formal classes at the University in the autumn of 1880 Shida worked with William Thomson.[35] In mid July, while Thomson was vacationing in the Isle of Wight with his wife, Shida sent a report of his work to Thomson. On July 28th, he wrote again from Millport, where he had spent two weeks "enjoying both picturesque views and fresh air".[36] On his return to Glasgow at the end of July (perhaps at the beginning of August) he spent part of his time at the University and part at the Post Office, where he received practical experience in telegraphy.

It is possible that Shida took part in an Atlantic expedition in 1881, for he wrote to William Thomson in July 1881 thanking him for arranging a visit to a Dr. Simens in connection with an Atlantic Expedition and explaining that his supervisor Mr Matheson was "very glad and thankful to you [Thomson] to hear of the arrangement."[37] Shida is thought to have continued his training in the Glasgow Post Office in 1881 but his name does not appear on official records.[38] On March 6th 1883 Shida sailed from Naples and arrived in Japan in April. For several weeks prior to his departure he made an investigative tour of various countries in Europe, including a visit to the Paris Electrical Exposition and a study of German systems of Posts and Telegraphs while in Berlin. He also met with Itō Hirobumi in Berlin.[39]

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[35] When Shida left for Glasgow he carried with him a reference from John Perry to William Thomson.

[36] Letter of July 28th 1880 from Shida in Millport to Sir William Thomson on the Isle of Wight. Kelvin Papers, Cambridge University Library.

[37] Letter of July 8th 1881 from Shida in Glasgow, to Sir William Thomson in London; Kelvin Papers, Cambridge University Library. I am unsure of the spelling of the Doctor's name, Simens or perhaps Siemans.

[38] Glasgow Central Post Office suggested that if Shida was not paid by the Post Office then his name would probably not appear in their records.

[39] Letter of March 10th 1883 from Shida, on board the *Ava*, to Sir William Thomson in London; Kelvin Papers, Cambridge University Library.

Shida greatly respected Thomson and was inspired by his work. For years after his return to Japan, Shida continued to correspond with Thomson on a professional and personal level. Several letters from Shida to Kelvin are kept among Kelvin papers in Cambridge University Library. Kelvin is said to have referred to Shida as his best student and was greatly saddened by his early death.

On his return to Japan, Shida was appointed Professor at the Kōbudaigakkō, and Assistant Engineer in the Telegraph Department.[40] He received an initial monthly salary of ¥50. On the reorganization of the Kōbudaigakkō he was appointed Acting Head Professor at the College of Engineering, Imperial University in 1886, later being elected Councillor of the University. In 1887 he also became Principal of the Tokyo Telegraph School. On the abolition of the Kōbushō in 1885 he transferred as Assistant Engineer to the Communications Ministry. He was later promoted to Engineer and in 1889 became Director of the Engineering Bureau having reached the second rank of *Sonin.* He was also a member of the Investigation Committee of the Local Communication Business, the Examination Committee of Civil Service, and the Committee of the City Improvement of Tokyo.

During his career as Professor at the Kōbudaigakkō, and later at the Imperial University, Shida carried out research on various aspects of electricity; magnetism, electrical resistance in liquids, electricity generation, telephones, and electric lighting, and published numerous papers in both Japanese and Western journals. In a letter to Sir William Thomson in 1885 Shida wrote of his development of a new instrument "for

[40] In 1883 Shida wrote to Sir William Thomson, "Although my post is not yet quite fixed, yet I think I shall be appointed the professor of natural philosophy in the Imperial College of Engineering and at the same time, the Telegraph department wished to have me to take some share in the business of that department so that my time will be divided, at least for the present between the College and the Telegraph Department." Letter of May 16th 1883 from Shida at the Imperial College of Engineering to

continuously recording the strength and direction of a varying electric current", "for making observations of both regular and irregular variations of earth currents which are present in the telegraph wires."[41] In recognition of his contribution to research in electrical engineering he was granted the degree of *Kōgaku Hakushi* in 1888.

Shida also carried out research on wireless communication and was able to demonstrate the phenomenon across a river using water as a conductor in 1885. His experiments were carried out more than ten years prior to Marconi's breakthrough in wireless communication and although Shida's method was not developed it is clear that he was at the cutting edge of electrical research at the time. Shida died in 1892 at the young age of 37, depriving Japan of one of its most talented scientists.

Shida was one of the founders of the Denki Gakkai (Electricity Association) in 1888 and acted as secretary in its first year. Among the committee members and those who gave papers in the first session, several were graduates of the Kōbudaigakkō's Electrical Engineering Department.[42] Three of the Committee members, including Shida, were from Taku and one of the Councillors from Ogi, both small towns in Saga prefecture, and had all studied at Ishimaru Toragoro's English *juku,* the Keirinsha, before moving to Tokyo.[43] Ishimaru may have influenced these men in their choice of future career.

Sir William Thomson in Glasgow; Kelvin Papers, Cambridge University Library.

[41] Letter of November 5th 1885, from Shida at the Imperial College of Engineering to Sir William Thomson in Glasgow; Kelvin Papers, Cambridge University Library.

[42] Shida Rinzaburō, Yamakawa Gitarō, Tamaki Bentarō, Asano Ōsuke, Ōi Saitarō, and Kanda Senkichi, were all graduates of the Electrical Engineering Department of the Kōbudaigakkō. All worked at the Telegraph Bureau and/or the Kōbudaigakkō and contributed to the *Denki Gakkai* over the years. Ōkurashō, op. cit., pp. 975-8, Nihon Kagakushi Gakkai, *Nihon Kagaku Gijutsushi Taikei Volume 19 (Denki Gijutsu)*, Tokyo: Daiippōki Shuppan, 1969 and Shida Katsunori, *op. cit.*, pp. 81-4.

[43] Secretary Shida, Tsuruta , Treasurer Ishii from Taku and Nakano from Ogi. Shida Katsunori, *op. cit.*, pp. 81-4.

The Scottish contribution to the Telegraph service and Electrical Engineering in Japan

The Telegraph Bureau hired over sixty *oyatoi* from 1869 until 1885 and of these, I have identified nine Scots, all from the Edinburgh area. The link with Edinburgh was initiated by Henry Brunton, who, through his father in law in Edinburgh, recommended the first telegraph engineer, George Miles Gilbert. It is possible that the other Scottish *oyatoi* were also hired through this route. By 1885 Japanese had replaced the majority of *oyatoi,* the higher positions being filled by graduates of the Kōbudaigakkō. William Ayrton, Thomas Gray and later Shida Rinzaburō, professors at the Kōbudaigakkō, were responsible for the training of Japan's first generation of telegraphy and electrical engineers and all were strongly influenced by William Thomson. Ishimaru Toragoro through his experience of study in Scotland is also thought to have influenced a number of Japan's first electrical engineers through his teachings at the Keirinsha School and in the Telegraph Bureau.

SANITARY ENGINEERING

Britain led the world in the Industrial Revolution and as such was also the first to experience the many problems associated with rapid urbanization and major changes in society which came with industrial progress. The supply of water, the disposal of sewage and the control of water-borne diseases became major issues in the mid-nineteenth century.

Supplies of water in small rural communities traditionally came from local springs, wells, and rivers and raw sewage was applied to agricultural land nearby. "Water-borne epidemics were automatically confined by the comparatively small number of people obtaining their water from the infected source, and by the lack of communication between isolated centres of population." [44] Local water supplies were unable to cope with the growing demand from the expanding towns and cities of the industrial era therefore it was necessary to pipe water from distant large rivers or lakes. Sewage and household waste was initially collected in communal cesspits throughout the towns and cities and as the population increased so did the numbers of cesspits. The concentration of sewage pits in relatively small areas led to the deterioration in the surrounding living environment and infectious diseases like cholera and typhoid became endemic.

A growing awareness of problems related to sewage disposal led to the *Towns Improvement Clauses Act* of 1847 which was the first of many government Acts to address the problem of sewage disposal. Open sewage pits were discouraged and recommendations were made to replace them with a system which removed the

[44] Skeat, William Oswald and Dangerfield, Bernard John, *Manual of British Water Engineering Practice* (4th edition), Volume 1: Organization and Management, Cambridge: Published by Heffer for

sewage from the immediate locality. The sewage was either sold for agricultural use or disposed of into the sea or public rivers. Some of these rivers were also used to supply drinking water.[45] In London a drainage system was constructed to pipe sewage, household waste and rainwater away from residential areas into the river Thames. Problems were soon encountered with the new system. As the recipient of the entire city's waste the Thames became so polluted that it was a source of disease epidemics itself. As a result the sewage system was extended to pipe waste further down the river and into the English Channel.

From 1848 a series of Public Health Acts began to deal with the sanitary problems associated with overcrowding and disease, including sewage disposal.[46] In 1857 a Sewage Commission was appointed to investigate and report to the government on sewage disposal. Their initial findings recognised serious health risks associated with sewage and recommended two methods of disposal, that of direct application to land as the most favourable method and that of precipitation. Further Commissions were established and together their findings and recommendations were incorporated into revised Public Health Acts over the following decade.

Local town governments were placed in charge of sewage disposal and were expected to provide an adequate sewage system for their district. A further Act in 1866 gave the central authority power to take action against local governments if they neglected their duty.[47] As in London, it was found that the disposal of sewage into rivers only temporarily solved the problem of sewage related health problems. Rivers became

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the Institute of Water Engineers, 1969, p. 26.

[45] Kershaw, G. B., *Modern Methods of Sewage Purification,* London: Charles Griffin & Company Ltd., 1911, p. 4.

[46] Skeat, William Oswald, *op. cit.*, p. 27.

[47] Kershaw, G. B., *op. cit.*, p. 4.

extremely polluted and a breeding ground for water-borne diseases. *The Local Government Act Amendment Act* of 1861 stipulated that sewage was to be purified before discharge into rivers but purification methods were still primitive and the problems continued.[48] In 1865 and again in 1868 a Royal Commission on River Pollution was established to investigate the problem. In 1876 the first *Rivers Pollution Prevention Act* was issued.[49] Each new Act over the following decades led to gradual improvements in the general system. From these developments emerged the field of sanitary engineering.

Sanitary Engineering in Japan

As elsewhere, rural communities in pre-industrialized Japan acquired their water from local springs, wells, and rivers and disposed of drainage water into rivers and raw sewage onto agricultural land. During the years leading up to the Edo era and throughout the period, rapidly expanding urban populations placed a strain on the traditional system and led to the development of public water systems.

When Tokugawa Ieyasu moved his command to Edo in 1590 the town was small and located on the edge of a large expanse of marshland. To accommodate the incoming population Ieyasu had areas of marshland reclaimed and arranged for water to be piped in from the outlying districts. The resulting Kanda water system was expanded over the years and is generally considered as the first large-scale public water system in Japan. It is unclear whether the technology was developed in Japan or adapted from a Western import. The major cities of Europe already had public water systems which may have been introduced to Japan by the Portuguese or Spanish. The Japanese system

[48] Sand filter beds had been used to purify water from the early nineteenth century. One of the first was built by John Gibb at Paisley in 1804. Skeat, William Oswald, *op. cit.*, p. 30.

however, differed in several respects to those in Europe at the time.[50]

In 1654 a second water system was established in present day Shinjuku to cope with Edo's expanding population. Water was piped over forty kilometres from the Tamagawa River to the new works. Technically the Japanese waterworks were less advanced than the European equivalents in cities such as London and Paris. However, the scale of the Edo works appears to have been the largest in the world at the time. It is estimated that the two major water systems, the Kanda Waterworks and the Tamagawa Waterworks, supplied 60 per cent of Edo's population of over 1.4 million at the end of the eighteenth century. London's water system is estimated to have supplied 70 per cent of the population of just less than 900,000.[51] Several more small-scale systems were constructed in Edo but most were in use for only a short time. Similar systems were constructed elsewhere in Japan but the high cost of construction limited their spread in rural areas which continued to obtain their water from nearby wells and rivers up until the Meiji period.[52]

At the beginning of the seventeenth century sewage and household waste in Edo was spread onto land set aside within the city where it was absorbed into the soil. As the city grew, these areas of land gradually disappeared as new buildings and roads were constructed and it was necessary to find an alternative method of disposing of the waste. Sewage and drainage water were treated separately. By the mid-seventeenth century a system of drains had been constructed along the edge of the city's roads to carry waste and rainwater. In some areas the waste was carried to collection points in the city and was taken away at regular intervals. In other areas, these drains carried

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[49] Kershaw, G. B., *op. cit.*, pp. 13-14, and Skeat, William Oswald, *op. cit.*, p. 56.

[50] Nihon Suidō Kyōkai, *Nihon Suidōshi*, Tokyo: Nihon Suidōshi Hensan Iinkai, 1967, p. 7.

[51] Nihon Suidō Kyōkai, *op. cit.*, pp. 8-9.

[52] Tezuka Tatsumaro, *Eigakushi no Shūhen*, Tokyo: Azuma Shobō, 1868, p. 68.

waste to the nearest river. Sewage was collected and transported by horse or by boat to agricultural land on the outskirts of the city. Because sewage was a valuable commodity many companies were established to deal with its collection and transportation.[53]

The devastation caused by epidemics after the opening of the treaty ports turned attention towards improving sanitary conditions in Japan. Before the Restoration there had been two outbreaks of cholera in Japan, in 1822 and in 1858. The first epidemic was introduced to Nagasaki via a Dutch ship and the second by an American ship. The outbreak which began in 1858 spread across the entire country and claimed tens of thousands of lives.[54] After the Restoration cholera epidemics became more frequent, occurring every few years. Likewise, other infectious diseases such as dysentery and typhus became more common as interaction with the outside world increased.

Efforts were made across the country to improve the management of water supplies and sewage disposal during the early Meiji years but these actions had proved insufficient to control the spread of cholera and other infectious diseases. By the 1880s it was clear that more must be done. In May 1884 the Ministry of the Interior's Sanitary Bureau dispatched two men, Nagayo Sensai and Nagai Hisaichirō, to Europe to investigate the conditions of water and sewage works there. Nagayo Sensai had travelled with the Iwakura Mission in the early 1870s and had become interested in sanitary engineering. While in London, Nagai joined the International Public Health Exposition (*Bankoku Eisei Hakurankai*) where he is thought to have met a young Scottish sanitary engineer, William Kinninmond Burton. Nagai may have been influential in the decision to invite Burton to Japan as the first Professor of Sanitary

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[53] Kurita Akira, *Edo no Gesuidō,* Tokyo: Seiabō, 1997.

[54] Nihon Suidō Kyōkai, *op. cit.*, p. 61.

Engineering at the Imperial University Tokyo. Japan selected Britain as a model for sanitary engineering for numerous reasons. Britain had developed advanced water and sewage systems and the country shared some geographical similarities with Japan.

In 1883 plans were made to build the first large-scale modern waterworks in Japan at Yokohama. Some improvements had already been made to the Yokohama water system at the beginning of the Meiji period but they were insufficient to deal with the expansion of the town from an estimated population of 28,589 in 1868 to 79,570 in 1883.[55] Following the cholera outbreak of 1882, several proposals outlining sanitary improvements were submitted to Kanagawa prefecture including two from the Consuls of Britain and the United States of America. In response to the growing problem, the prefecture hired Henry Spencer Palmer on a three-month contract in 1883 to investigate possibilities for improvement to the Yokohama water system. Palmer was a British army sanitary engineer who was visiting Yokohama at the time. Kanagawa prefecture submitted Palmer's plan to the Ministry of the Interior and when permission was granted to go ahead with the plan in 1885 they hired Palmer again to direct the work at a monthly salary of ¥500.[56] When Palmer travelled to Japan he brought with him four other British assistants. The project, which cost over one million yen, was completed in 1887.[57]

Sanitary engineering was first introduced as an independent university subject in 1887. Prior to this the subject had only briefly been touched upon in civil engineering courses. In response to the growing problems associated with sanitary conditions the Ministry of Education hired William Burton as the first Professor of Sanitary Engineering. He was hired on a three-year contract at a salary of ¥350 plus ¥40 for

[55] Nihon Suidō Kyōkai, *op. cit.*, p. 10.

[56] Doboku Gakkai, *Meiji Igo Honpō Doboku to Gaijin,* Tokyo: Doboku Gakkai, 1943, p. 207.

living expenses in May 1887.[58] His lectures focused on sewage and water systems but also touched on other aspects of engineering related to water. Burton taught only five hours per week but he was involved in various research projects with his students. During one of his research trips to examine the Yokohama water supply in October 1894 one of his students was accidentally drowned.[59] In addition to his teaching position Burton also acted as a consulting sanitary engineer to the Ministry of the Interior. He was dispatched to investigate and design improved water supplies across the country.[60]

After the cholera epidemic of 1886 an investigative committee was established in Tokyo and in 1889 they published their first report detailing an improved sewage and drainage system. On the committee was William Burton, Professor of Sanitary Engineering at the Imperial University. The report recommended that sewage and drainage water be kept separate and that a continuous filtering system be introduced. This type of system had only recently been introduced in Britain. Because of the enormous cost of the project however, it was not implemented.

This was not the first plan to improve Tokyo's water system. Prior to this in 1874 Cornelis Johannes Van Doorn, a Dutchman employed by the Ministry of the Interior to carry out river improvements including flood control and reclamation of land, had been asked to make a survey of the existing Tokyo water system and submit a plan for improvement. He presented his findings to the Department but they were never carried out. A second investigation was carried out in 1883 by Johanes D'Rijke but the results

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[57] Nihon Suidō Kyōkai, *op. cit.*, p. 169.

[58] UNESCO Higashi Ajia Bunka Kenkyū Sentaa, *Shiryō Oyatoi Gaikokujin,* Tokyo: Shōgakukan, 1975, p. 351.

[59] Takeuchi Hiroshi, "Waga kuni eisei kōgaku no onjin W. K. Burton no koto", *Kōshū Eisei* 35/11 (1971), pp. 59-61.

were set aside once again. D'Rijke was also a Dutch civil engineer employed by the Meiji government and had built the first modern sewer in Japan in 1872. In 1888 the matter was addressed again and two independent proposals were submitted, one by the government's investigative committee and one by a private enterprise led by Shibusawa Eiichi. The consulting engineers on these plans were William Burton and Henry Palmer respectively. The plan finally adopted for Tokyo was based on Burton's plan but also combined elements of Palmer's plan.[61] Work began on the project in December 1892 and was completed in December 1898. Water was drawn from the Tamagawa River as before, filtered and piped with the aid of pumps and gravity into the city to provide for a population of 1.5 million. The cost of the project was estimated at ¥6.9 million.[62] Palmer did not live to see the project completed for he died the year after work began.

Over the following two decades, large-scale modern waterworks were built at Hakodate, Nagasaki, Osaka, Hiroshima, Tokyo, Kobe, Okayama, Shimonoseki, Aomori, Akita, Wakamatsu, Sasebo, and Mito. These projects were built with government assistance and most were designed by Burton or Palmer.[63] Nine further projects were begun during Meiji and completed during the Taisho period.[64] Several more small-scale private projects were also undertaken.

Burton was born in Edinburgh in 1856, the son of a well-known historian, John Hill

[60] Nihon Suidō Kyōkai, *op. cit.*, p. 248.

[61] Tezuka Tatsumaro, *Eigakushi no Shūhen*, Tokyo: Azuma Shobō, 1868, p. 70.

[62] Takeuchi Hiroshi, *op. cit.*, pp. 59-61.

[63] Doboku Gakkai, *op. cit.*, pp. 200-1.

[64] Hakodate (completed 1889), Nagasaki (completed 1891), Osaka (completed 1895), Hiroshima (completed 1898), Tokyo (completed 1898), Kobe (completed 1900), Okayama (completed 1905) and Shimonoseki (completed 1906). The projects under construction at the end of the Meiji period were in Kyoto, Sakai, Niigata, Takasaki, Nagoya, Kōfu, Moji, and Kokura. Nihon Suidō Kyōkai, *op. cit.*, p. 11.

Burton. He was educated at the Edinburgh Collegiate School, a private technical school. At the age of 17 he entered an apprenticeship at the Edinburgh firm of Brown & Brothers and in five years became a Chief Designer. In 1880 he joined his uncle Cosmo Innes in a joint enterprise in London working as a sanitary engineer and in 1881 he was accepted as an Associate Member of the Institute of Civil Engineers. He was offered the position of Professor of Sanitary Engineering at Tokyo University while in London. [64]

Burton's contract was renewed for three years on May 25th 1890 and again for a further three years on May 25th 1893. In the following year he married a Japanese woman, Arakawa Matsu and in 1896, after teaching for almost a decade, his contract came to an end. He was awarded the Order of the Rising Sun, Fourth Class for his contributions to public health through sanitary engineering education and his improvements to water and sewage systems across the country. [65] When his contract ended, Gotō Shinpei, the Sanitary Bureau Chief, with whom Burton had worked in the past, invited him to continue his sanitary engineering work in Taiwan. He entered the Formosan Administration Bureau of the Imperial Japanese Department where he planned improvements to water and sewage facilities there. He took ill while in Taiwan and returned to Japan where he died in August 1899. He was buried in Aoyama

[64] Tezuka Tatsumarō wrote that Burton studied at King's College, Cambridge, as did Takeuchi Hiroshi initially. However it is now known that he was an occasional student at King's College, London. Tezuka Tatsumarō, *op. cit.*; Takeuchi Hiroshi *op. cit.*, p. 59; Inaba Kikuo, *Gesuidōron no Rekishiteki Tanbō*, Tokyo: Nihon Suidō Shinbunsha, 1980, p. 155; Takeuchi Hiroshi, *Rainichi Seiyō Jinmei Jiten,* Tokyo: Nichigai Associates, 1995, p. 293; Inaba Kikuo, "Burton no yume: sono seigai o tazunete", *W. K. Burton: Tanjō Hyakugojū Nen Kinen Kōenkai,* W. K. Burton Tanjō Hyakugojū Nen Kinen Jikkō Iinkai, 2006, and Katō Shōji, "Waga kuni eisei kōgaku no shiso Burton", *W. K. Burton: Tanjō Hyakugojū Nen Kinen Kōenkai,* W. K. Burton Tanjō Hyakugojū Nen Kinen Jikkō Iinkai, 2006.

[65] Tezuka Tatsumarō, *op. cit.*, p. 71, 2, and UNESCO Higashi Ajia Bunka Kenkyū Sentaa, *Shiryō Oyatoi Gaikokujin,* Tokyo: Shōgakukan, 1975, p.351.

cemetery.[66]

Burton was a keen photographer and together with several Japanese founded the Nihon Shashin Gakkai - The Photographic Society of Japan. He published two books on photography, *The ABC of Modern Photography,* and *Burton's Modern Photography.*[67]

Conclusion: The Scottish Contribution to Sanitary Engineering in Japan

Burton arrived in Japan in May 1887 and remained in the employ of the Japanese government until 1896. As the first Professor of Sanitary Engineering, he trained Japan's first generation of sanitary engineers. In addition to his teaching and research duties, Burton acted as a consulting engineer to the Ministry of the Interior, investigating and planning modern water systems in many of the major cities, including Osaka, Kobe, Hiroshima, Okayama, Shimonoseki, Sendai, Nagoya, Fukuoka, and Moji. In 1893 he also designed an underground sewage system in Shimonoseki. At the end of his teaching contract he continued to work for the Japanese in Taiwan.

Sanitary engineering was not one of the highest priorities for the government during the early period of modernization. Several projects had been undertaken to improve water and sewage systems on a small-scale but it was not until the end of the century that attention was directed to this area of engineering. The government decided to bring a specialist from the West to teach the subject at Tokyo University. This specialist was also expected to plan and advise on sanitary engineering projects across

[66] *Rainichi Seiyō Jinmei Jiten, op. cit.*, p. 293.
[67] *ibid.*, p. 293.

the country.

Sanitary engineering developed later than the other engineering fields investigated in this thesis and, as a consequence, relied less on foreign assistance. Western technology was already well established in Japan as was advanced technical education. By the turn of the nineteenth century there were large numbers of Japanese with the training and practical experience required to carry out modern civil engineering projects. The number of foreign *oyatoi* in government service had declined significantly. Consequently Scottish influence in this field was not as strong as in other areas. The services of a number of high-level *oyatoi* were retained during this period but very few new foreigners were hired, except in some specialized fields. Sanitary engineering was one such area and William Burton was one of the few foreigners hired during this period.

CONCLUSION

"The best proof, however, of the value of the training which they received is the excellent work which the students have done since they left College, as there are few engineering or industrial works in Japan in which they are not to be found taking an active part in the management."[1]

Henry Dyer, Principal of the Kōbudaigakkō, was referring to the students of his college when he wrote this but his remarks could just as easily be applied to this thesis. The aim of this study was to demonstrate that Scotland played a unique and important role in the development of engineering in Japan through the education and training of engineers. My argument was that the Scottish system of education and training nurtured well educated but practically minded engineers suited to the task at hand, that of absorbing Western technology into Japan and applying this technology to practical projects such as the construction of lighthouses, railways, telegraphs, and ships.[2] This thesis has revealed the "the excellent work" which these men have done and has demonstrated that "there are few engineering or industrial works in Japan in which they are not to be found taking an active part in the management". This research has led me to conclude that Scotland played a major role in laying the foundations of Japanese engineering education, modern lighthouses and telegraphs and, in addition, a significant role in government railways, shipbuilding and sanitary engineering.

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[1] Dyer, Henry, *Dai Nippon; The Britain of the East: A Study in National Evolution*, London: Blackie & Son, 1905, p. 6.

[2] The contribution of Tokugawa education must also be acknowledged. High literacy rates achieved during the Edo era and knowledge of Western technology obtained through the study of *rangaku* undoubtedly eased the transition to modernity.

How can we assess Scotland's contribution to Japanese engineering or indeed any nation's contribution to such a complex process? Contributions were made by many different individuals, in a variety of ways, some more obvious and better documented than others. It is impossible to say with certainty where individual contributions begin and end or indeed to decide how much credit should be given to their country of origin or foreign influence in general. Clearly it is an oversimplification to judge foreign achievements by the success of the technical projects carried out under foreign supervision, ignoring completely the native Japanese input. Foreign employees and Japanese *ryūgakusei,* who had been trained abroad, played a crucial role in the rapid transfer of knowledge from the West in each area of modernization but it was the Japanese government who created an environment in which this was possible and it was the Japanese who carried out the majority of the work, albeit initially under foreign supervision. When drawing conclusions therefore, we must keep in mind that any assessment of foreign contribution is inexact and subjective. The space dedicated to any one individual here does not necessarily indicate that his achievements are any more significant than the others. It is entirely possible that great achievements are yet to be uncovered and it is hoped that this study will provide a base from which further research can be undertaken.

The primary task to be tackled in the research of this thesis was to identify Scottish employees of the Meiji government and Japanese *ryūgakusei* in Scotland between 1865 and 1900. The next step was to investigate what type of work the *oyatoi* performed in Japan, and in the case of the *ryūgakusei,* what they studied in Scotland and then examine how this contributed to the overall technology transfer. Forty-eight

Scots were identified among approximately 1000 British *oyatoi* hired by the Meiji government (Appendix 1) and seventy-two Japanese *ryūgakusei* were found to have studied in Scotland (Appendix 2). It is difficult to provide accurate statistics in this area because information recorded in the documents of the Meiji period is limited and only occasionally is the birthplace or place of residence in Britain stated. As a result it is possible that many Scots have been excluded from this study. *Ryūgakusei* numbers are also difficult to determine, particularly for privately funded students who did not enrol at a Scottish University or train at a company where records still exist.

Details gathered on the Scots *oyatoi* and *ryūgakusei* to Scotland summarized in Appendices 1 and 2 reveal that the majority of both worked in technical fields in Japan. Approximately seventy per cent of the Scots *oyatoi* identified were hired in the Ministry of Public Works and around seventy per cent of the Japanese students studied scientific and technical subjects in Scotland, pursuing careers in engineering on their return to Japan. This is not surprising for Scotland, and Britain as a whole, was the most technically advanced nation at the time.

Appendix 1 also reveals that approximately half of the Scots *oyatoi* received monthly salaries of ¥300 and above. Salaries of between ¥300 and ¥400 were paid to professors and skilled engineers of university graduate level and salaries above ¥400 were generally paid to employees in management or to University principals. This suggests that at least half of the Scots identified were university educated and/or very highly skilled and held responsible positions in Meiji Japan. It is, therefore, not surprising that details of these individuals presented in chapters' two to five reveal that engineers and professors of engineering, trained in Scotland, were involved at the highest level in the development of each of the engineering fields studied. Indeed, it was common to find well-educated and highly skilled Scots in prominent administrative, engineering and educational positions abroad, especially in the British colonies and, as this thesis demonstrates, also in places like Japan.

By the mid eighteenth century Scotland's education system was one of the best and most extensive in Europe, boasting public (non private) schools in most parishes and five universities, which were attended by a higher ratio of the population than those in any other European nation. Universities and colleges in Scotland developed not only as places of higher learning but as training centres for the professions. As such they offered a broad curriculum, including practical science teaching at affordable rates to the average Scot. Professors interested in the practical uses of their science were known to forge strong links with local industry and in many cases were able to supplement their income with their industrial exploits. Glasgow's university and colleges, more than other cities', developed close links to industry and were the first in Britain to incorporate engineering education into their curricula, enabling engineers to gain advanced theoretical knowledge to complement the practical training they received "on-the-job". Many Scottish engineering firms such as that of D. & T. Stevenson in Edinburgh encouraged their engineers to take university classes and praised the educational achievements of artisans with which they worked. These qualities would have appealed to the Japanese who wanted to industrialize but had neither the theoretical nor the practical knowledge of modern engineering to do so.

This thesis has shown that Scottish professors dominated advanced engineering education in early Meiji Japan. The principal establishment for the education of engineers from 1873 to 1885 was the Kōbudaigakkō. The teaching ethic at the Kōbudaigakkō was essentially Scottish in that it incorporated considerable practical work into the theoretical study. This was largely due to the influence of the first principal, Henry Dyer, a graduate of Anderson College and Glasgow University who designed the curriculum, administered the college and taught civil and mechanical engineering. Approximately half of the foreign professors employed at the Kōbudaigakkō were Scots, educated at Scottish Universities.[3] Of those who were not, several had close connections to Glasgow University before their appointment to Japan. The first three engineering professors at Tokyo University, and its predecessor, Kaisei Gakkō, from 1874 until 1891 were also Scots, educated at Edinburgh University. This thesis argues that for a small nation such as Scotland the dominance of Scots professors is significant and their work undoubtedly influenced engineering education in Japan.

Among the graduates of the Kōbudaigakkō and Tokyo University, eleven are known to have studied in Scotland and from the amalgamation of the two schools into the Imperial University in 1886 until 1900 a further five graduates travelled to Glasgow to study. Of these sixteen students, seven became engineering professors at the Imperial University on their return to Japan. The Kōbudaigakkō, Tokyo University and the Imperial University, Tokyo were the leading facilities for the education of engineers and nurtured a whole generation of high-level Japanese engineers, who became involved in every field of engineering. A number of the *ryūgakusei* who had studied in Scotland were involved with other engineering schools across the country; both in the

[3] The remaining professors came predominantly from England, one from Ireland and several of unknown origin.

establishment of these facilities as well as teaching at them. Therefore, this study has demonstrated that the influence of Scottish educated engineering professors was far reaching in that it extended to all engineering fields both in the leading universities in Tokyo and in other colleges across the country.

The first decade of lighthouse engineering in Japan was also greatly influenced by Scotland. The Edinburgh engineering firm of D. & T. Stevenson acted as consultants to the Japanese lighthouse service for nine years from 1868 until 1877. During these eleven years they designed the illuminating apparatus for the majority of lighthouses, lightships and buoys, hired the first engineers, artisans and light keepers and trained at least two Japanese *ryūgakusei*. The Chief Engineer from 1868 until 1876, who was Scottish, designed and built twenty-seven lighthouses, two lightships and several beacons and buoys during his term in Japan. On his return to Scotland he continued to advise the Japanese Lighthouse Service. Two of the original lightkeepers sent out from Scotland served as the principal lightkeeping instructors for more than a decade. Two Japanese *ryūgakusei* from the Lighthouse Bureau studied at Edinburgh University and trained at the Stevenson's firm and one of them served many years in the Lighthouse Department on his return to Japan. It is clear from the research carried out for this thesis in this field that Scotland was the dominant foreign influence. The design and construction of lighthouses was carried out under the supervision of Scottish engineers and the training of lighthouse keepers under Scottish keepers.

Investigations on Scottish employees in the Japanese Railway Department revealed one Scot among the original four principal engineers hired in 1870. He worked for the Railway Bureau from the initiation of construction until 1876. Three Japanese *ryūgakusei* who studied under Scottish professors in Japan and in Scotland, returned to impressive careers in the field of railways, both in government employ and in private enterprises. Research presented in this chapter has revealed that Scotland exerted a great influence on the education and training of these *ryūgakusei.* All three were educated under Scottish professors and received extensive practical training in Scotland which provided them with a firm foundation in civil engineering. The success with which they carried out their work in Japan is testimony to the worth of their training.

Evidence also indicates that Scottish engineers dominated the higher ranks in the Japanese Telegraph Bureau. The Superintendent of Telegraph Bureau from 1869 until 1878, the Assistant Engineer from 1874 until 1878, and the Chief Engineer from 1874 until 1879 were all from Edinburgh. Indeed the latter was the highest paid employee of the Department. Six more Scottish telegraph engineers have also been identified among the *oyatoi.* Of the two professors of telegraphy at the Kōbudaigakkō one was Scottish. Shida Rinzaburō, a graduate of the Kōbudaigakkō, and a student at Glasgow University, stands out as a pioneer in the field of telegraphy and electricity. He taught electrical engineering at the Kōbudaigakkō and at the Imperial University on his return from Scotland. In addition to his teaching duties he carried out pioneering research in electricity and magnetism at the forefront in the field. He was also involved in the establishment of the *Denki Gakkai* (Electricity Association) and served as a committee member for several years. It is the conclusion of this study that the development of electrical engineering in Japan was greatly influenced by Glasgow University and in particular, Sir William Thomson. Both of the telegraphy professors at the Kōbudaigakkō were colleagues of William Thomson, one a former student, and Shida

Rinzaburō studied under him in Glasgow.

The field of sanitary engineering developed much later and has received less attention than the other fields discussed in this thesis. By the time the government invested in this field the Japanese already had considerable engineering experience and had dispensed with the majority of foreign engineers and workmen, continuing to hire only experienced and skilled high-level engineers. One Scot was hired to initiate the teaching of sanitary engineering as an independent subject at the Imperial University Tokyo and to advise on sanitary projects across the country. Indeed he was the only foreign professor of sanitary engineering and one of two main advisers to the Japanese government in this field.

The shipyards on the Clyde and the naval architecture classes at Glasgow University and the Glasgow and West of Scotland Technical College attracted the majority of Japanese *ryūgakusei* in Scotland. Most of these men returned to careers in shipbuilding; in education, in the Japanese navy and in private shipyards. The most outstanding of the Glasgow *ryūgakusei* in this field was Miyoshi Shinrokurō who taught naval architecture, first at the Kōbudaigakkō and then later at the Imperial University, Tokyo, for twenty-five years. The naval architecture section of the Imperial University employed three further Glasgow *ryūgakusei*. This reveals that Glasgow exerted a great influence on Japanese naval architecture education. Miyoshi was one of the founders of the Japanese Shipbuilding Association and was joined on the committee by several other former students of Glasgow University.

Despite extensive research this study has identified only one Scottish engineer among government *oyatoi* in the field of shipbuilding. He was hired for a short time to teach naval architecture at The Imperial University. However, a further two Scots were identified in the Ishikawa Hirano and Mitsubishi private shipyards. Both were high ranking engineers and long term employees, an indication of the importance placed on their experience and ability. Despite a substantial Scottish influence in all other engineering fields it was surprising to find so few Scottish engineers in the field of naval architecture. The main reason for this is that shipbuilding, centred in the government's Yokosuka shipyards, retained a strong French connection originating in the Edo period. Also, because of the huge investment required for development in this field the government chose to buy most of their modern warships from established foreign yards in the early Meiji years rather than invest in their own yards.

The studies outlined in this thesis demonstrate how influential Scotland and its education system was in providing the Japanese with valuable engineering technology, education and training. Using the experience gained from the Scots *oyatoi* and Japanese *ryūgakusei* who studied in Scotland, the Japanese people were thus able to adopt, utilise and develop this technology by themselves. This achievement, in itself, was not exclusive to Scotland. However, from the evidence presented in chapters 2 through 5, it is clear that, proportional to population size, Scotland contributed a much higher number of engineering professors and high-level engineers in these fields compared with other regions of Great Britain or indeed any other nation. In addition, the majority of Japanese *ryūgakusei* to Scotland identified in this study achieved high–level positions in their respective engineering fields and as such greatly influenced their development.

The area in which Scottish influence is most prevalent is engineering education. The Japanese required both theoretical knowledge of engineering and practical experience to enable them to adopt and utilize modern technology. Scotland's education system provided both. The employment of teachers from the technical schools of Europe, which placed emphasis on theoretical teaching with little regard for practical training, was not optimal. Similarly, the English pupilage system which emphasised learning by practical "on-the-job" training, with little time for theoretical studies, was also inadequate. Scots brought the idea of a university as a place of higher learning in addition to a place of practical training, an establishment which equipped its students for all professions. This concept was adopted in Japan, not only in the engineering school, but also in each field of engineering in which the Scots were involved.

The last aspect which must be addressed is the question of whether we can treat nineteenth century Scotland separately from the rest of Britain. The Scottish contribution to world history since the Union of 1707 is too often eclipsed by the history of her larger union partner. This is due, to a large degree, to the assumption that Scotland became assimilated into the British State after the Treaty of Union. Those who take this view may argue that, as a region of Great Britain, Scotland had no unique role to play and therefore a study such as this, dedicated to the region, would be unjustified. However, assimilation was not as extensive as commonly believed. While Union did bring Scotland and England closer both politically and economically it did not create a homogeneous British society and did not destroy Scotland's distinctive characteristics or Scottish national identity. Despite the loss of political independence, life in Scotland continued to be governed by Scottish institutions ensuring that Scotland remained "Scottish" and everyday life for the ordinary Scot continued much as before. This is not to say that Scotland was insulated from English influence, but it did mean that she had some choice over whether to accept or reject it. Her development, although closely tied to her neighbour's, was sufficiently different to justify separate treatment in this study.

In conclusion, this thesis has presented evidence to show that Scottish-trained engineers and professors were influential in the development of all the engineering fields studied and Scotland's approach to engineering education and training was the reason. The blend of practical and theoretical aspects in engineering education, in short, was what Japan required and what made early Japanese engineering education so successful.

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APPENDIX 1

List of Scottish employees in Japan

	Name (English)	Name (Japanese)	Ministry	Bureau	Type of work	Salary	Date of contract	End of contract	Comments
1	Alexander, Thomas	ｱﾚｷｻﾝﾄﾞﾙ･ﾄｰﾏｽ	PW	Kōbu daigakkō	Professor of Civil Engineering (Assistant until 1878)	¥ 350	1879/3/19	1885/12	Refer to main text for details.
2	Black, John Reddie	ﾌﾞﾗｯｸ	Sain	Sain	Journalist	¥ 300	1875		
3	Brunton, Richard Henry	ﾌﾞﾗﾝﾄﾝ･ｱｰﾙ･ﾍﾝﾘｰ	PW	Lighthouse	Chief Engineer	¥ 600	1868/2/24	1876/3/15	Refer to main text for details.
4	Burton, William K	ﾊﾞﾙﾄﾝ･ｳｨﾘｱﾑ･ｷﾝﾆﾓﾝﾄﾞ	E	Imperial university	Engineer & Professor of Sanitary Engineering	¥ 350	1887		Refer to main text for details.
5	Cargill, William Walter	ｶｰｷﾞﾙ･ｳｨﾙﾘｱﾑ･ｦﾙﾄﾙ	PW	Railway	Director of railways	¥2,000	1872/1	1877/2	Worked for the oriental bank in Yokohama before being employed by the Japanese government.
6	Charleson, George	ﾁｬｰﾙｿﾝ･ｼﾞｮﾙｼﾞ	PW	Lighthouse	Lightkeeping instructor	¥ 165	1869/9/14	1881/5/11	Refer to main text for details.
7	Craigie, William	ｸﾚｷﾞｰ･ｳｨﾙﾘｱﾑ	PW	Kōbu daigakkō	Professor of English language and literature	¥ 208	1873/7/1	1876	Refer to main text for details.
8	Diack, John	ﾀﾞｲｱｯｸ･ｼﾞｮﾝ	PW	Railway	Assistant engineer	¥ 420	1870/3	1876/1	Refer to main text for details.
9	Dick, Joseph	ﾃﾞｨｯｸ･ｼﾞｮｳｾﾌ	PW	Lighthouse	Lightkeeping instructor	¥ 125	1869/9/14	1879/6/30	Refer to main text for details.
10	Dixon, James Main	ﾃﾞｨｸｿﾝ/ﾁｸｿﾝ･ｾﾞｰﾑｽﾞ･ﾒｲﾝ	PW	Kōbu daigakkō	Professor of English	¥ 300	1880/1/1	1885/12	Refer to main text for details.

	Name (English)	Name (Japanese)	Ministry	Bureau	Type of work	Salary	Date of contract	End of contract	Comments
11	Dixon, William Gray	ﾃﾞｨｸｿﾝ･ｳｨﾙﾘﾔﾑ･ｸﾞﾚｰ	PW	Kōbu daigakkō	Professor of English	¥ 250	1876/8/20	1879/12/31	Refer to main text for details.
12	Donaldson, Thomas	ﾄﾞｰﾅﾙﾄﾞｿﾝ･ﾄﾏｽ	PW	Telegraph, Mining	Mechanic	¥ 146	1875/6	1878/6	From Leith.
13	Dyer, Henry	ﾀﾞｲｴﾙ･ﾍﾝﾘｰ	PW	Kōbu daigakkō	Principal and Professor of civil and mechanical engineering	¥ 660	1873/6/3	1882/6/1	Refer to main text for details.
14	Ewing, James Alfred	ﾕｰｳｨﾝｸﾞ･ｼﾞｪｰﾑｽ･ｱﾙﾌﾚｯﾄﾞ	E	Tokyo University	Professor of mechanical engineering and physics	¥ 350	1878/9/29	1883.6	Refer to main text for details.
15	Fisher, Sterling	ﾌｨｽｼｪﾙ･ｽﾃﾙﾘﾝｸﾞ	PW	Lighthouse	Assistant engineer	¥ 365	1870/3/19	1875/2/14	Refer to main text for details.
16	Geekie, J. P.	ｷﾞｰｷｰ･J.P.	PW	Railway	Draughtsman	¥ 200	1873/9	1875/3	There was also a JP Geekie in Mitsubishi at the same time.
17	Gilbert, A. E.	ｷﾞﾙﾍﾞﾙﾄ･ｴ･ｲ	PW	Telegraph, Mining	District superintendent	¥ 200	1874/10	1878	Refer to main text for details.
18	Gilbert, Edward	ｷﾞﾙﾍﾞﾙﾄ･ｴﾄﾞﾜﾙﾄ	PW	Telegraph, Mining	Chief telegraph engineer	¥ 625	1874/4/28	1874/8	Refer to main text for details.
19	Gilbert, George Miles	ｷﾞﾍﾞﾙﾄ･ｼﾞｮﾙｼﾞ･ﾏｲﾙ	PW	Telegraph, Mining	Assistant superintendent	¥ 250	1869/12	1872/6	Refer to main text for details.
20	Herdman, John	ﾍﾙﾄﾞﾏﾝ	PW	Lighthouse	mechanic	¥ 150	1872/6/24	1875/7/29	Refer to main text for details.
21	Hillhouse, Percy (B.A.?)		E	Tokyo University	Professor of naval architecture (first appointee)				Refer to main text for details.
22	Hobson, Thomas	ﾎﾌﾞｿﾝ･ﾄｰﾏｽ	PW	Telegraph, Mining	Inspector of telegraphs	¥ 150	1875/6/3	1879/2/20	From Edinburgh Cannongate.

	Name (English)	Name (Japanese)	Ministry	Bureau	Type of work	Salary	Date of contract	End of contract	Comments
23	King, Archibald	ｷﾝｸﾞ･ｱｰﾁﾌｵﾙﾄ	PW	Kōbu daigakkō	Instructor of practical engineering and model making	¥ 141	1873/6/3	1875/6/18	Refer to main text for details.
24	Knott, Cargill G.	ﾉｯﾄ･ｶｰｷﾞﾙ･ｷﾞﾙｽﾄﾝ	E	Tokyo University	Professor of physics	¥ 370	1883/9/5	1888/9/4	Refer to main text for details.
25	MacRitchie, James	ﾏｸﾘｯﾁ･ｼﾞｪｰﾑｽ	PW	Lighthouse, construction	Engineer	¥ 450	1872/3/5	1879/12/31	Refer to main text for details.
26	Marshall, David Henry	ﾏｰｼｬﾙ･ﾀﾞﾋﾞｯﾄ･ﾍﾝﾘｰ	PW	Kōbu daigakkō	Professor of mathematics and physics	¥ 350	1873/6/3	1881/3/26	Refer to main text for details.
27	Martin, C.K. Marshall	ﾏｰﾃｨﾝ･ｸﾗﾚﾝｽ	J	Yokohama court	Translater	¥ 100	1884	1886	Arrived in Japan at an early age in 1873 with a merchant company. Became fluent in Japanese. He later took over the Japan Gazette and became its president. He remained in Japan until 1940.
28	McBride John Adams	ﾏｸﾌﾞﾗｲﾄﾞ	HA	Hypothec	Veterinary surgeon	¥ 350	1876/10/17	1879	
29	McIntosh, James	ﾏｹﾝﾄﾝ	PW	Lighthouse	Lightkeeper - 1st class	¥ 100	1869/8/25	1871/6/22	Refer to main text for details.
30	McVean, Colin Alexander	ﾏｸｳﾞｨﾝ/ﾏｺﾋｰﾝ･ｺｰﾘﾝ･ｱﾚｷｻﾞﾝﾄﾞﾙ	PW	Lighthouse and Survey	Engineer	¥ 300	1868/2	1869.7.25	Refer to main text for details.
31	Meik Charles Scott	ﾒｰｸ･ｼ･ｴｽ	K	Kaitakushi	Engineer		1887	1890	From Edinburgh. Carried out harbour work in several areas of Hokkaido and also in cities across Japan.
32	Mitchell John	ﾐｯﾁｪﾙ･ｾﾞｰ	PW	Lighthouse	Mason/Superintendent of works	¥ 150	1869/1/27	1872/7/3	Refer to main text for details.
33	Murdoch, James	ﾏｰﾄﾞｯｸ	E	Tokyo dai ichi Kōtō chugakō	English and history teacher		1889	1917	From Aberdeen. Natsume Soseki was one of his pupils. He wrote a book entitled The History of Japan.
34	Raffin, William	ﾗｯﾌｨﾝ･ｳｨﾙﾘｱﾑ	PW	Telegraph, Mining	Inspector of telegraphs	¥ 150	1875/6/3	1880/8/31	From Edinburgh.

	Name (English)	Name (Japanese)	Ministry	Bureau	Type of work	Salary	Date of contract	End of contract	Comments
35	Robertson, Robert	ロベルトソン・ロベルト	PW	Telegraph	Construction foreman	¥ 150	1875/6	1880/6	From Edinburgh, Abbeyhill place.
36	Russell, John	ラッセル	PW	Lighthouse	Mechanic supervisor	¥ 105	1869/1/27	1870/7/9	Refer to main text for details.
37	Scott, James	スコット	PW	Mining	Engineer	¥ 270	1870/7/10		From Kincardine. He arrived in Hakodate in 1864 and was employed as a mining engineer. He was employed by the Meiji government from 1870 and remained in Japan until his death in 1925.
38	Shand, Alexander, Allan	シャンド・エー・アレン	F	Mint, Osaka	Chief secretary	¥ 450	1872/8/29	1875/11/1	
39	Simpkins, William	シンプキンス	PW	Lighthouse, construction	Mechanic/Superintendent of works	¥ 190	1870/11/3	1879/7/25	Refer to main text for details.
40	Sinclair, Daniel	シンクルール・ダニエル	PW	Telegraph, Mining	Inspector of telegraphs	¥ 150	1875/6	1879/6	From Bathgate, Drumcross.
41	Smith, Robert Henry	スミス・ロベルト・ヘンリー	E	Kaisei school, Tokyo university	Professor of engineering	¥ 350	1874	1878	Recommended by Fleeming Jenkins and selected by Professor Williamson of University College, London.
42	Stevenson	スティーウンソン	PW	Lighthouse	Consultant		1868		Refer to main text for details.
43	Stewart, James	ステワルト・ゼームス	PW	Telegraph, Mining	Secretary	¥ 180	1875/6	1885/12	
44	Storie, Frank Robert	ストリー・フランク・ロベルト	PW	Manufacture, Construction	Mechanic	¥ 270	18733/27	1880/6/26	
45	Sutherland, Thomas	サザーランド・アレキサンデル	PW	Railway	水底工夫／潜水夫頭	¥ 4.10	1874/7	1877/7	
46	Urquhart, Alexander	アークハルト	PW	Lighthouse	Godown keeper, clerk	¥ 200	1872/2/3	1879/3/31	

	Name (English)	Name (Japanese)	Mi nis try	Bureau	Type of work	Salary	Date of contract	End of contract	Comments
47	Wallace Thomas	ﾜﾚｽ	PW	Lighthouse	Blacksmith/Superintendent of works/Lighthouse inspector	¥ 150	1869/1/27	1872/5/19	Refer to main text for details.
48	Wauchope, George	ｳｵｰｺｯﾌﾟ	PW	Lighthouse	Accountant, secretary	¥ 415	1869/6/12	1876/4/30	Refer to main text for details.
49	Will, John Baxter	ｳｲﾙ	K	Kaitakushi	Ship's captain	¥ 200	1875/10/1	1877/4	From Dundee. Arrived in Japan as one of the crew of a Dent & Co. ship.

Scots other than Japanese government employees

	Name (English)	Name (Japanese)		Employer	Type of work	Salary	Date of contract	End of contract	Comments
50	Calder, J.F.	ｺｰﾙﾀﾞｰ･ｼﾞｮﾝ		Mitsubishi	Engineer				
51	Earl of Elgin	ｴﾙｷﾞﾝ		British Government	Diplomat		1858		Arrived to negotiate a commercial treaty for Britain in 1859.
52	Faulds, Henry	ﾌｫｰﾙｽﾞ		United Free Presabyterian Church, Sano hospital	Physician	¥ 90	1879/3/27	1880/3	From Ayrshire, educated at Glasgow University. Established the Tsukiji hospital in 1875.
53	Fletcher, Lachlan								
54	Fortune, Robert	ﾌｫｰﾁｭﾝ			Botanist		1860		From Berwick. Worked in Edinburgh Botanic Gardens and Cheswick Botanic Gardens before travelling to China and Japan.

	Name (English)	Name (Japanese)	Ministry	Bureau	Type of work	Salary	Date of contract	End of contract	Comments
55	Gamble, Anne Matilda	ｶﾞﾝﾌﾞﾙ､ｱﾝﾈﾏﾁﾙﾀﾞ		United Free Presabyterian Church, Private family in Chiba	Teacher				Missionary with the United Presbyterian Church of Scotland before being employed in 1876 for three years by a family in Chiba.
56	Glover, Alfred Berry	ｸﾞﾗｳﾞｧｰ･ｱﾙﾌﾚｯﾄﾞ･ﾍﾞﾘｰ		Glover & Co.	Merchant		1867		Thomas Glover's brother
57	Glover, James	ｸﾞﾗｳﾞｧｰ･		Glover & Co.	Merchant		1862		Thomas Glover's brother
58	Glover, Martha Anne	ｸﾞﾗｳﾞｧｰ･ﾏｸｰｻ･ｼﾞｮｰｼﾞ		Glover & Co.	Tutor				Thomas Glover's sister
59	Glover, Thomas Blake	ｸﾞﾗｳﾞｧｰ･ﾄｰﾏｽ		Jardine & Matheson, Glover & Co., Mitsubishi	Owner of Glover & Co. and later adviser to Mitsubishi Company				Arrived in Nagasaki as an employee of Jardine & Matheson in 1859. He later established his own firm.
60	Hay, George	ヘイ、ジョージ		Mitsubishi	Ship's engineer	¥ 90			
61	Keswick, William			Jardine & Matheson	Merchant		1859		He was sent to Japan as a representative of Jardine & Matheson after the opening of the ports in 1859. He established an office for the company in the Yokohama treaty port.
62	Massie, John S.	ﾏｯｼｰ･ｼﾞｮﾝ		Glover & Co.	Merchant		1864		He worked for Glover & Co. and Gribble & Co. He established the International Hotel in Nagasaki in 1872.
63	McDonald, John	ﾏｸﾄﾞﾅﾙﾄﾞ		British Government	Diplomat		1859	1866	From Inverness. Accompanied Sir Rutherford Alcock to Japan in 1859. Died in Japan in 1866.
64	McKenzie, Kenneth Ross	ﾏｯｹﾝｼﾞｰ･ｹﾈｽ		Jardine & Matheson	Merchant		1859		He was sent to Japan as a representative of Jardine & Matheson after the opening of the ports in 1859. He established an office for the company in the Nagasaki treaty port. He later joined Glover & Co.
65	Mitchell, James	ﾐｯﾁｪﾙ･ｼﾞｪｰﾑｽﾞ		Aberdeen yard	Shipbuilder		1859		He established a shipyard in Nagasaki which he named The Aberdeen Yard.

	Name (English)	Name (Japanese)	Ministry	Bureau	Type of work	Salary	Date of contract	End of contract	Comments
66	Oliphant, Laurence	ｵﾘﾌｧﾝﾄ			Diplomat		1860	1861	Born in Cape Town to Scottish parents. Accompanied Lord Elgin to Japan in 1859.
67	Sim, Alexander Cameron	ｼﾑ			Pharmacist		1870		From Aberdeen. Arrived in Kobe in 1870. Worked for a foreign company before establishing his own company of A. C. Sim. He established the KR & AC sports club in Kobe.
68	Stoddart, John	ｽﾄﾀﾞｰﾄ･ｼﾞｮﾝ		Glover & Co., Mitsubishi	Mining engineer		1878		Employed by Thomas Glover to supervise Glover's operations at Takashima coalmine. Later became an employee of Mitsubishi which took over the mine.
69	Sutherland, Thomas			P & O					He established an office for P. & O. in Yokohama and Nagasaki.

SOURCES

UNESCO (1975), Ōkurashō (1888), Takeuchi Hiroshi (1995), Tōkōkai (1969), Yokohama Archives of History (1991), Teraoka Jūichi (1978)

NOTES

PW = Ministry of Public Works
E = Ministry of Education
K = Kaitakushi
HA = Ministry for Home Affairs
F = Ministry of Finance
J = Ministry of Justice

APPENDIX 2

List of Japanese *Ryūgakusei* in Scotland, 1865-1900

	Name	Education in Japan	Place of Study	Subject of Study	Ryū gaku period	Ryū gaku period	Remarks
1	Akizuki Tokujirō		GWSTC	engineering	1890	1894	No further information known about him.
2	Fuji Mitsugorō (Terugorō) 藤井光五郎	Kaigun Kikan Gakkō	GU	naval architecture	1896	1899	Became Professor at the Japanese Naval University
3	Fujikura Kinjirō (Kentatsu) 藤倉見達	Kaisei jo in Yedo. Attended Dr MacAdam's class for Chemistry	EU	lighthouse engineering	1871	1874	Translated for Brunton before going to Scotland. Trained with Stevensons. Worked as an engineer to the Lighthouse Department and became Bureau Chief. Studied at EU 1873-74.
4	Fujimaru T D		EU	law	1892	1893	Studied at EU 1891-93. No further information known about him.
5	Fukuda Yoshinobu 福田令寿		EU	medicine	1893	1902	Studied at EU 1894-99
6	Fukuzawa Sanpachi 福沢三八	Keiō Daigaku	GU	engineering	1900	1904	Son of Fukuzawa Yukichi. B.Sc. from Glasgow University. After Glasgow went to University in Germany. Returned to Japan in 1906. Became Professor at Keiō Daigaku in 1933. Established Fujihara Kōgyō University (later Keiō University's Engineering Dep.) in 1940.
7	Goto Makita 後藤牧太	Keiō Gijuku	GU	natural philosophy	1887	1890	Studied at GU 1888-90. Became Professor at Keiō Gijuku
8	Hirata Jūtarō 平田重太郎		GU	naval architecture	1886	1891	Studied at GU 1889-90.
9	Inoue Chinsei		EU				Studied at EU 1891-93. No further information known about him.

	Name	Education in Japan	Place of Study	Subject of Study	Ryū gaku period	Ryū gaku period	Remarks
10	Ishigami, Toyotane (Hōin?) 石神豊胤	Naval hospital in Yedo, 2 years, University Nanko, 3 years. Japanese and Chinese classics	EU	medicine	1873	1878	Received private instruction in Edinburgh. Studied at EU 1874-75. Died in London on way home in 1878
11	Ishimaru Yasuyo (Toragorō) 石丸安世（虎五郎）		Aberdeen, AC	engineering	1864	1868	Studied English under a man named Fraser in Aberdeen. Founded the Keirinsha school in Imari (Saga), taught at Chienkan (Saga domain centre for Western Learning). Became the first head of the Telegraph Bureau, served as head of the Imperial Mint.
12	Itō Sukenawo		EU	law	1892	1895	Studied at EU 1892-95. No further information known about him.
13	Iwane Yūai (Tomochika) 岩根友愛	Tokyo Kōtō Kōgyō Gakkō	GU, GWSTC	engineering	1900	1906	Studied at GU 1900-1906 and GWSTC 1901-04. Became Professor in Osaka Kotokōgyō School
14	Iwata Buyata 岩田武弥太	Yokosuka shipyards	GU, EU, GWSTC	naval architecture and science	1887	1893	Studied at GU 1887-92. Father was naval officer in Yokosuka. Entered Naval Ministry shipbuilding
15	Kagoshima 鹿児島龍蔵		GU	engineering	1900	1904	Established the Kagoshima Kensetsu construction company
16	Kawada Ryōkichi 川田龍吉	Unknown	GU	engineering	1873	1881	Studied at GU 1878-1879. Said to have worked at Scotland Dock Company. He studied at Glasgow University and trained at Lobnitz & Co. from 1877 to 1884. Worked at Mitsubishi shipyards from 1884.
17	Kazama Tokujirō (Atsujirō) 風間篤次郎		GU, GWSTC	engineering	1899	1901	Studied at GU 1899-1901 and GWSTC 1899-1900.Name in GU record is Tokujirō. Became naval engineer
18	Kojima Monya (Kadoya)	Teikoku Daigaku	GU, GWSTC	naval architecture	1897	1899	Studied at GU 1897-98. Became engineer for the Communication Bureau. Died at age 33
19	Kurahara Korehiro 蔵原惟郭	Han juku, Kumamoto Yōgakkō	EU	divinity	1884	1891	Studied at EU 1890-91.
20	Manabe Kaisaku 真辺戒作	Private, 3 years	EU	law	1870	1878	Studied at EU 1874-75. Died at age 31

	Name	Education in Japan	Place of Study	Subject of Study	Ryū gaku period	Ryū gaku period	Remarks
21	Mano Bunji 真野文二	Shūseigakusha at Numazu, Kō budaigakkō	GU	engineering	1886	1889	Studied at GU 1886-87. Worked at Armstrongs in Newcastle. Became Professor at the Tokyo Imperial University and later at Kyushu Imperial University
22	Masuda Reisaku 増田礼作	Daigakkō Nankō, Higashikō, Kaisei Gakkō	GU	engineering	1876	1881	Studied at GU 1876-77. Trained at McLaren ironworks Glasgow and Bryce カンピング Edinburgh. After Scotland he travelled in Germany and US before returning to Japan. In Matriculation records, his age is indicated as 19 but other records indicate he was born in 1854 which would make him 22. Became engineer for Ministry of Public Works and later worked for a number of private railway companies
23	Matsumura Jinzō 松村任三	Daigaku Nankō, Higashikō,	AU		1886	1888	Also travelled to Germany. Became Professor at the Tokyo Imperial University
24	Mawatari Hachirō 馬渡八郎（俊邁）		Aberdeen, AC		1866	1867	Studied English under a man named Fraser in Aberdeen. Served as head of the Imperial Mint
25	Mie Tsunefiro	Technical school in Japan, 2 years (School of Yedo)	EU	natural philosophy	1872		Studied at EU 1872-74. No further information known about him.
26	Minami Kiyoshi 南　清	Keiō Gijuku, Kaisei Gakkō, Kōbu daigakkō	GU	engineering	1880	1883	Studied at GU 1880-81. Worked at McLaren ironworks, and Matheson company in Spain, Caledonian railway in Scotland. Became engineer for the Railway Bureau and later worked for a number of private railway companies
27	Misuzaki kiichi (Matoichu) 水崎基一		EU	law	1899	1902	Studied at EU 1899-1901
28	Miyahara Jirō 宮原二郎	Kaigun Heigakkō Naval Academy	Fairfield	engineering	1875	1883	Trained at Fairfield shipbuilding and Engineering Co. Glasgow. After Fairfield he studied at Grenich Naval College for 3 years.
29	Miyoshi Bunta 三好文太		GU	natural philosophy	1888	1889	Studied at GU 1888-89. Became Professor at the Imperial University
30	Miyoshi Shinrokurō 三好晋六郎	Kōbu daigakō	GU	naval architecture	1880	1883	Studied at GU 1882-83. Worked at Napier Shipyards, Glasgow. Became Professor at the Tokyo Imperial University and engineer to government. Received medal for his contribution to the Russian war in 1907

	Name	Education in Japan	Place of Study	Subject of Study	Ryū gaku period	Ryū gaku period	Remarks
31	Mochizuki Kotaro 望月小太郎		EU	law	1891	1893	Studied at EU 1892-94.
32	Mori Iga (F)		GU	medicine	1898	1899	Studied at EU 1898-99.
33	Motoki Kotarō 本木小太郎		GU	naval architecture	1880	1883	Studied at GU 1880-83. Father managed a shipyard in Japan with Hirano of Ishikawashima.
34	Nagasawa Kanae 長沢鼎		Aberdeen		1865	1867	
35	Naitō Masatomo 内藤政共	Kōbu daigakō	GU, GWSTC	marine engineering	1881	1885	Address in Glasgow - c/o Mrs Workman, 353 Bath cresent. Studied marine engineering at GU (1882-83), attended evening classes in applied mechanics at Glasgow Mechanics institution 1882-3. Listed as draughtsman at 'R. Napier & sons' (College of Science and arts calendar 1882-83) (Strathclyde University archives). Became Naval officer
36	Nakajima Yosohachi 中島興曾八		GU, GWSTC	naval architecture	1899	1901	Studied at GU 1899-1901 and WSTC 1899-1900. Became instructor at naval college.
37	Narukawa Gitarō 成川議太郎	Tokyo Gaikokugo Gakkō	EU	law	1886	1892	Worked for the Bank of Japan
38	Nasakara C		EU		1894		Studied at EU from 1894. No further information known about him.
39	Nishimura Tadashi 西村貞		GFCTC	education	1878	1880	Only one reference found for this man in Strathclyde University Archives. One of 6 students sent abroad for teacher training. 3 were sent to America, 1 to Germany, 1to France and Nishimura to the Glasgow Free Church Training College or Normal School (1878-80) (predecessor of Jordanhill College) to pursue studies in teacher training in 1875. May have been introduced by Dyer. (Ref. 107/16)

	Name	Education in Japan	Place of Study	Subject of Study	Ryū gaku period	Ryū gaku period	Remarks
40	Nomura Fumio 野村文夫		Aberdeen	engineering	1865	1868	Studied English under a man named Fraser in Aberdeen. Studied at the Board of Trade Navigation School for a year before returning to Japan. Held a post in the Survey Office of the Kōbush ō before entering journalism. Founded Maru Maru Shinbun, influenced by Punch. He also produced the Nihon newspaper and Nihonjin magazine with Shimaji Mokurai. wrote Seiyō bunken roku – Record of Observation of the West
41	Oda Junichirō, Niwa Junichirō 織田純一郎, 丹羽純一郎	Shōheikō	EU		1870	1877	Became writer
42	Odagiri Enju 小田切延寿	Kaigun Kikan Gakkō	GU, WSTC	naval architecture	1897	1899	Studied at GU 1897-99 and WSTC 1897-99 (valve gears, machine construction and drawing). Became Naval engineer
43	Ogawa Shigen 小川資源	Daigakkō Nankō, Higashikō	Edinburgh	engineering	1873	1875	Entered Ministry of Home Affairs and Ministry of Public Works as Assistant Professor at the Kōbudaigakkō
44	Okubo Tatsuo 大久保立	Kaigun Kikan Gakkō	GU	naval architecture	1895	1899	Studied at London 王立技術大学for one year then Armstrongs shipyard in Newcastle, before Glasgow. Studied at GU 1895-98 Trained at Lobnitz shipyard. Entered the Naval Ministry as naval architect
45	Ono Tokica	Yedo college, 5 years	EU		1873		No further information known about him.
46	Ryotarō Hirano Hunter 範多龍太郎, 平野龍太郎		GU	engineering	1886	1893	Received B.Sc.at GU. Son of Edward Hunter (trader in Kobe) and Japanese wife. Entered his fathers company Osaka Testsu kō sho
47	Sano Tojirō 佐野藤次郎	Teikoku Daigaku department of engineering	GU	engineering	1893	1895	Became engineer
48	Satō Kōji		GU, GWSTC	engineering	1898	1902	Studied at GU 1898-1902 (received B.Sc) and GWSTC 1900-1902

	Name	Education in Japan	Place of Study	Subject of Study	Ryū gaku period	Ryū gaku period	Remarks
49	Shida Rinzaburō 志田林三郎	Kōbu daigakō	GU	natural philosophy	1880	1883	Studied at GU 1880-81and worked at the Glasgow post office. Professor at the Kōbudaigakkō and later Imperial University. Engineer to Public Works and Communications Ministries.
50	Shimizu Ichitarō 清水市太郎	Teikoku Daigaku Department of Law	EU	law	1890	1893	
51	Shin Tsuneta 進　経太	Kōbu daigakō	GU	naval architecture	1885	1888	Studied at GU spring term 1888 and in US. Entered Ishikawajima Dockyard and soon became Director and Chief engineer.
52	Shirafji Nobyoshi H./Oliyoshi Shizaffi Yamaguchi	Unknown	EU	medicine	1886	1887	Studied at University of Michigan USA and at EU 1886-7
53	Sirita brothers	Unknown	Lochies Academy, Fife		1872		No further information known about the brothers.
54	Suda Toshinobu 須田利信	Kōbu daigakō	GU	naval architecture	1887	1892	Studied at GU spring term 1888. Attended classes while supervising the building of a ship for the Nihon Yūsenkaisha. Worked for Ministry of Public Works and Kobe Kawasaki Shipyards and Nihon Yūsen Kaisha
55	Sugi Koichirō 杉甲一郎	Private teacher in Japan. Shūgiko Lighthouse School.	EU	engineering	1872	1874	Studied at EU 1872-3 and trained with Stevensons. Became Assistant Professor at Kōbudaigakkō
56	Sugi Shigetoshi 杉重重敏	Unknown	Edinburgh	engineering	1872	1874	Trained with Stevensons
57	Suzuki Yoshio		GU		1898		No further information known about him.
58	Suzuki Yoso 鈴木四十		GU, WSTC	engineering	1898	1902	Studied at GU 1898-99 and WSTC 1898. Worked for セールフレザー会社
59	Takamine Jōkichi 高峰譲吉	Kanazawa han Meirindō, Nagasaki English School, Kyoto Heigaku juku, Osaka juku, Kōbudaigakkō	GU, GWSTC	engineering	1880	1883	Studied at GU and GWSTC 1880-81. Worked at Tennet's St. Rollox Chemical works, the largest firm in Scotland.

	Name	Education in Japan	Place of Study	Subject of Study	Ryū gaku period	Ryū gaku period	Remarks
60	Takayama Naokata 高山直質	Kōbu daigakkō	GU	naval architecture	1880	1882	Studied at GU 1880-81. Worked at Motherwell Ironworks. Became ill in Scotland and returned early to Japan. Became Professor at the Kōbudaigakkō and later the Tokyo Imperial University. Died at age 31.
61	Takeda Masamori	Agricultural College*	GU	medicine	1899	1900	Became doctor in Japanese Navy
62	Takeda Yōjirō		Aberdeen		1866		Became Vice President of the Kōbudaigakkō
63	Tanakadate Aikitsu 田中館愛橘	Morioka han school Shūbunsho, Keio English school, Gaikokugo gakkō, Kaisei gakkō, Tokyo Daigaku	GU	natural philosophy	1888	1891	Studied under Ewing and Cargill Knott in Japan and Kelvin in Glasgow. Studied at GU 1888-90. Became Professor in the Tokyo Imperial University
64	Tanba Yūkurō		Glasgow shipyard		1871	1873	Became vocal supporter of Katakana script and later ran a liquor shop with a katakana sign
65	Taniguchi, Naosada 谷口直貞	Daigakkō Nankō, Higashikō, Kaisei Gakkō	GU	engineering	1876	1881	Trained at a mechanics factory, Glasgow. After Glasgow he travelled in Germany and US before returning to Japan. Assistant clerk at Tokyo Shokugyō Gakkō (Tokyo Technical School) (1881) and later Professor (1884)、Professor at Tokyo Imperial University (1886-1890)、Engineer in Ministry of Agriculture and Commerce. After retiring from government service was elected President of the Osaka Jinzō Hiryō Kabushiki Kaisha (Osaka Artificial Fertilizer, Co., Ltd.) and Director of the Toyo Mokuzai Bofu Kabushiki Kaisha (Toyo Kyanizing, Co. Ltd.) companies
66	Terano Seiichi 寺野精一	Teikoku Daigaku	GU	naval architecture	1897	1899	Studied at GU 1898-99 and trained at J. Fowler & Co. Glasgow. Became Professor in the Tokyo Imperial University
67	Tomiyama Arthur 富山アーサ		GU, WSTC		1900		
68	Urano Kisaburō 浦野喜三郎	Kaigun Heigakkō Naval Academy	GU, GWSTC	engineering	1900	1901	Studied at WSTC 1900-01. Became naval captain

	Name	Education in Japan	Place of Study	Subject of Study	Ryū gaku period	Ryū gaku period	Remarks
69	Watanabe Kaichi 渡辺嘉一	Kōbu daigakkō	GU	engineering	1884	1888	Studied at GU 1884-86. Worked with Benjamin Baker on the Forth Rail Bridge. Address in Glasgow c/o Mrs Workman, 353 Bath cresent. Employed as railway engineer in several private companies
70	Yamaguchi O S	Unknown	EU		1886		No further information known about him.
71	Yamamoto Nagakata 山本長方		GU, WSTC	naval architecture	1887	1895	Studied at GU 1889-94 and WSTC 1890-91. Worked at Nagasaki Mitsubishi shipyards
72	Yamao Yōzō 山尾庸三	Han juku, Meirinkan	AC	engineering	1863	1870	Apprentice at Napier Shipyards, Glasgow. Became Minister of Public Works.
73	Yamasaki Yoshitada		GWSTC		1899		No further information known about him.

SOURCES
Tezuka Akira (1992), Tomita Hitoshi (1985), Kita Masami (1984)

NOTES
EU - Edinburgh University
GU - Glasgow University
AC - Anderson College
AU - Aberdeen University
GWSTC - Glasgow and West of Scotland Technical College
GFCTC - Glasgow Free Church Training College

APPENDIX 3

Top *ryūgaku* destinations from 1868-1912.

	Name of University	**Country**	**Number of *ryūgakusei***
1	Berlin University	Germany	216
2	Munich University	Germany	120
3	Yale University	U.S.A.	59
4	Leipzig University	Germany	56
5	Columbia University	U.S.A.	50
6	Vienna University	Austria	48
7	Strasburg University	Austria	42
8	Heidelberg University	Germany	41
9	Gőttingen	Germany	40
10	Harvard University	U.S.A.	40
11	Cambridge University	U.K.	36
12	Freiburg University	Germany	36
13	Cornell University	U.S.A.	33
14	London University	U.K.	33
15	Breslau University	Germany (Poland)	28
16	Wűrzburg University	Germany	27
17	**Glasgow University**	U.K.	27
18	Oxford University	U.K.	25
19	Paris University	France	25
20	Pennsylvania University	U.S.A.	25
21	Halle University	Germany	24
22	Chicago University	U.S.A.	23
23	Bonn University	Germany	22
24	Michigan University	U.S.A.	22
25	Rutgers University	U.S.A.	21

	Name of University	Country	Number of *ryūgakusei*
26	Freiburg School of Mining	Germany	20
27	Johns Hopkins University	U.S.A.	18
28	University College London	U.K.	18
29	Annapolis Naval School	U.S.A.	15
30	Stanford University	U.S.A.	14
31	Rostock University	Germany	14
32	Erlangen University	Germany	13
33	Princeton University	U.S.A.	13
34	Academie Julian	France	12
35	California University	U.S.A.	12
36	Jena University	Germany	11
37	Oban College	U.S.A.	11
38	**Edinburgh University**	U.K.	10
39	Greenwich Naval College	U.K.	10

Based on information in Tezuka Akira (1992)

APPENDIX 4

List of British Employees at the Kōbu daigakkō 1873-1885

	Name	Name (Japanese	Type of work	Salary		Date of Contract	End of contract	Remarks
1	Alexander, Thomas	ｱﾚｷｻﾝﾄﾞﾙ･ﾄｰﾏｽ	Professor of Civil Engineering (assistant until 1878)	¥ 350		1879/3/19	1885/12/	Born Glasgow 1848. Attended the Glasgow Normal School. Received C.E..from Glasgow University. In same class as Dyer, also a pupil of Rankines. M.A.I. Dublin University. Left Japan when Kōbu daigakkō became part of Tokyo University. Appointed Professor of Civil Engineering at Trinity College, Dublin and later became Emeritus Professor to the College. Awarded Kōgaku Hakushi in 1915.
2	Anderson	ｱﾝﾀﾞｰｿﾝ	Architect	¥ 100		1872/1/28	1885	
3	Angus, W.M.	ｱﾝｶﾞｽ	Draughtsman, Instructor in Practical Engineering	¥ 234		1878/8/4	1881/6/30	
4	Ayrton, William, Edward	ｴﾙﾄﾝ	Professor of Telegraphy & Natural Philosophy	¥ 500		1873/6/30	1878/6/29	Graduated University College London. Researched with Kelvin for one year. Kelvin and Fleeming Jenkin (Edinburgh University) recommended him for Japan. Returned to work at Finsbury Technical College then at City and Guilds of London Institute and Imperial College, The University of London.
5	Barr, William	ﾊﾞｰ	Instructor of Technical Drawing. succeeded Mondy in 1878	¥ 234		1878/8/4	1881/6/30	Graduated Glasgow University. AINA (Associate of the Institute of Naval Architects) Connected to A. Barr, Professor in Civil & Mechanical Engineering at Glasgow University.
6	Brindley George Samuel (captain)	ﾌﾞﾘﾝﾄﾞﾘｰ	Superintending foreman of Akabane works. Instructor in Practical Engineering. Mathematics	¥ 230		1875/12/14	1881/6/	
7	Brinkley, Frank	ﾌﾞﾘﾝｸﾚｰ	Professor of English Literature	¥ 350		18787/1	1880/12/31	Graduated Trinity College.

	Name	Name (Japanese	Type of work	Salary		Date of Contract	End of contract	Remarks
8	Cawley, George	コーレー	Instructor of Practical Engineering, Instructor of Mechanical Engineering	¥ 200		1873/6/29	1878/6/18	
9	Clark, Robert	クラーク	Instructor in Practical Engineering and Technical Drawing Assistant	¥ 150		1873/6/19	1878/6/18	
10	Conder, Joseph Josiah	コンダー	Professor of Architecture	¥ 350		1877/1/28	1882/1/28	Graduated University College, London. Link with the Scottish academic network thought to be through his teacher W. Burgus a friend of the architect who designed Glasgow University building. Later worked at Depart. of Building and Repairs & taught at Tokyo Imperial university until 1888.
11	Craigie, William	クレギー・ウィルリアム	Professor of English language and Literature	¥ 208		1873/7/1	1876/2/29	Received M.A. from Aberdeen University. Taught at a school in Ayr. Returned to Scotland because of health problems and died not long afterwards.
12	Divers, Edward	ダイブルス	Professor of Chemistry	¥ 500		1873/7/1	1885/12	M.D. F.C.S. City of London school and College of Chemistry (1852-3), University College Galway. At 17 (in 1854) he was Assistant to Professor Towney at the Universtiy College of Galway where he remained for 12 years, graduating with MD there in 1860. Worked at Queens College at the same time as Kelvin's brother James. Kelvin's father also worked there many years. Chemistry Professor at Kōbu daigakkōuntil 1881, Principal from 1882-86, transferred to Chair of Inorganic Chemistry in Tokyo University until 1899. Received award from Emperor
13	Dixon, James Main	ディクソン/チクソン・ゼームズ・メイン	Professor of English	¥ 300		1880/1/1	1885/12	M.A. St. Andrew's University. Stayed in Japan until 1897. Received award from Emperor
14	Dixon, William Gray	ディクソン・ウィルリヤム・グ	Professor of English	¥ 250		1876/8/20	1879/12/31	Refer to main text for details.
15	Dyer, Henry	ダイエル・ヘンリー	Principal and Professor of Civil & Mechanical Engineering	¥ 660		1873/6/3	1882/6/1	Refer to main text for details.

	Name	Name (Japanese)	Type of work	Salary		Date of Contract	End of contract	Remarks
16	Gray, Thomas	ｸﾞﾚｰ･ﾄｰﾏｽ	Professor of Telegraphy (Demonstrator in Physics and Instructor in Telegraphic Engineering	¥ 234		1878/10/5	1881/6/3	Refer to main text for details.
17	Rymer Jones, Richard O.	ﾗｲﾏｰｼﾞｮﾝｽﾞ･ｱｰﾙ･ｵ	Instructor of Surveying & preliminary course	¥ 250		1873/1/1	1878/8/31	Son of a friend of Lord Kelvin's. Also employed in the Manufacture Bureau.
18	Kinder	ｷﾝﾀﾞｰ	雛形師			1873/6/1		
19	King	ｷﾝｸﾞ	Instructor of Model Making	$ 117	*	1873		
20	King, Archibald	ｷﾝｸﾞ･ｱｰﾁﾌｵﾙﾄ	Instructor of Practical Engineering and Model Making	¥ 141		1873/6/3	1875/6/18	From 1880 hired at a factory attached to the Ishikawashima Hirano shipyards. Died of Cholera in 1886.
21	Marshall, David Henry	ﾏｰｼｬﾙ	Professor of Mathematics and Physics	¥ 350		1873/6/3	1881/3/26	M.A. Edinburgh University. Was assistant to Professor Tait at Edinburgh University in 1873. Recommended for position in Japan by Rankine. Member of Royal Society of Edinburgh. Professor of Mathematics at ICE until 1879
22	Mew, John	ﾐｭｰ･ｼﾞｮﾝ	Professor of Geology and Mining	¥ 333	*	1876/3/8		
23	Milne, John	ﾐﾙﾝ･ｼﾞｮﾝ	Professor of Geology and Mining	¥ 350		1876/3/8	1885/12	A.R.S.M, F.G.S.. Queens college, Royal School of Mines, London. Worked in Elders shipyards in Glasgow. Elder was a friend of Rankine. Became world famous for his work on seismology. For his work on earthquakes he was appointed FRS in 1887. Married a Japanese woman, Tone, and worked on the Isle of Wight
24	Mondy, Edmund F.	ﾓﾝﾃﾞｰ･ｴﾄﾞﾓﾝﾄﾞ･ﾌｪﾘｯｷｽ	Professor of Metallurgy and Technical Drawing	¥ 208		1873/7/1	1878/6/30	A.R.S.M. Royal school of mines, London. Worked in Kelvin's lab
25	Perry, John	ﾍﾟﾘｰ･ｼﾞｮﾝ	Professor of Civil Engineering and Instructor in Surveying	¥ 333		1873	1879?	B.E., Queens college Belfast. 1870. Royal school of mines, London. Was assistant in Clifton College while working in Kelvin's lab. Returned to UK to Finsbury, later the City and Guilds College and eventually at Imperial College, the University of London 1907

	Name	Name (Japanese	Type of work	Salary		Date of Contract	End of contract	Remarks
26	Thomson, Arthur Watson	トムソン	Professor of Civil Engineering & Surveying Assistant	¥ 234		1878/8/4	1881/6/30	C.E., B.Sc., Glasgow University. First Professor of Engineering at the re-organised Glasgow and the West of Scotland College. 1891 became Professor of Engineering at the College of Science in Poona. Published textbooks jointly with T. Alexander
27	West, Charles Dickenson	ウェスト・チャールス・ヂッキンスン	Professor of Mechanical Engineering	¥ 350		1882/8/16	1885/12	M.A, Trinity College. Took over from Dyer as Professor of Engineering, and continued at Tokyo Imperial University until he died in 1908

SOURCES

UNESCO (1975), Ōkurashō (1888), Takeuchi Hiroshi (1995), Tōkōkai (1969), Yokohama Archives of History (1991), Teraoka Juichi (1978), Kita Masami (198
Checkland, Olive (1989)

NOTES

Note 1 - When the English name or the appropriate translation of a word is unknown it has usually been left in Japanese

Note 2 - Names with a question mark following them are what I assume the name to be from the katakana pronunciation but they may be wrong.

Note 3 - Salaries differ in different sources. The values stated here are taken from Ōkurashō (1888) and indicate the salary at the end of the employee's contract. Those salaries marked by an asterisk are taken from UNESCO (1975).

APPENDIX 5

List of British Employees in the Lighthouse Bureau

	Name (English)	Name (Japanese)	Hired by	Type of work	Salary		Date of contract	End of contract	Comments
1	Bigglestone, Richard, Attwood	ビッグルストン	Head office	foreman, mechanic supervisor	¥ 180		1876/12/15	1880/6/13	
2	Blundell, A. W.	ブランドル	Head office	assistant engineer	¥ 300		1868/2	1870/4/4	Hired by Stevenson firm. Left to join the Railway Bureau.
3	Bowers, William	バワーズ/バウエルス/ボウエルス	Head office	lightkeeping instructor	¥ 125		1870/9/2 & 1875/10.25	1875/4/12&1877/10/24	
4	Brunton, Richard Henry	ブラントン・アール・ヘンリー	Head office	chief engineer	¥ 600		1868/2/24	1876/3/15	Hired by Stevenson firm.
5	Budge, James	バッジ	Head office	lightkeeper - 3rd class	¥ 65	*	1873/9/1	1876/12/11	
6	Burnett, John James	バルネット	Head office	lightkeeping instructor	¥ 100		1876/7/2	1879/7/1	
7	Carsell, W.	カッセル	Head office	carpenter	¥ 100		1870/5/3	1871/2/1	
8	Charleson, George	チャールソン・ジョルジ	Head office	lightkeeper - 1st class and lightkeeping instructor	¥ 165		1869/9/14	1881/5/11	Hired by Stevenson firm. Formerly employed by Northern Lighthouse Commission.
9	Clark, Rowland	クラルク	Head office	lightkeeper - 3rd class	¥ 90		1870/12/12	1873/7/15	
10	Claussen, Ed	クローセン	Head office	lightkeeper - 3rd class	¥ 90		1870/5/16	1873/9/31	

	Name (English)	Name (Japanese)	Hired by	Type of work	Salary		Date of contract	End of contract	Comments
11	Cook?	ｺｯｸ	Head office	shipbuilding supervisor	¥ 150		1876/7/6	1876/9/11	
12	Davis, T.		Head office	道路修造方			1870/8/15		
13	Devlin, J.	ﾃﾌﾞﾘﾝ	Head office	lightkeeper - assistant	¥ 50		1869/11/14	1870/2/7	Fired for bad behaviour.
14	Devlin?	ﾃﾌﾞﾘﾝ	Head office	lightkeeper, assistant	¥ 50		1869/11/14	1870/2/7	
15	Dick, Joseph	ﾃﾞｯｸ	Head office	lightkeeper - 1st class and lightkeeping instructor	¥ 125		1869/9/14	1879/6/30	Hired by Stevenson firm. Formerly employed by Northern Lighthouse Commission .
16	Down, William	ﾀﾞｳﾝ	Head office	lightkeeper - 4th class	¥ 85		1873/11/1	1876/10/23	
17	Drake, A.		Head office	ship carpenter			1868/11.	1870/10.	
18	Egart, H.	ｴｶﾞﾙﾄ	Head office	lightkeeper - 2nd class	¥ 105		1869/8/26	1875/10/22	
19	Farman, Charles	ﾌｧｰﾏﾝ	Head office	instructor	¥ 285		1873/8/5	1874/1/26	
20	Figgins, A.F.	ﾌｲｷﾞﾝｽ	Head office	lightkeeper - 3rd class/Godown Keeper & C	¥ 95	*	1872/2/17	1875/7/31	
21	Figgins, A.F.	ﾌｨｷﾝｽ･ｴｰ	Head office	lightkeeper - 4th class	¥ 95		1872/		
22	Fisher, Sterling	ﾌｨｽｼｪﾙ･ｽﾃﾙﾘﾝｸﾞ	Head office	assistant engineer	¥ 365		1870/3/19	1875/2/14	Hired by Stevenson firm. Brunton recommended.

	Name (English)	Name (Japanese)	Hired by	Type of work	Salary		Date of contract	End of contract	Comments
23	Forest, Thomas	ﾌｫｰﾚｽﾄ	Head office	lightkeeper - 2nd class	¥ 105		1870/5/29	1876/10/17	
24	Hardman, John	ﾍﾙﾄﾏﾝ･ｼﾞｮﾝ	Head office	superintendent of works	¥ 150	*	1872/		
25	Harris, Charles	ﾊﾙﾘｽ	Head office	light keeper - 3rd class	¥ 95		1870/1/29	1875/3/31	
26	Herdman, John	ﾍﾙﾄﾞﾏﾝ	Head office	mechanic	¥ 150		1872/6/24	1875/7/29	Hired by Stevenson firm. Formerly employed by Milne & Sons Edinburgh
27	Hurdle, William	ﾊﾙﾄﾞﾙ	Head office	lightkeeper - 2nd class	¥ 95	*	1870/4/1	1875/10/22	
28	Innes?	ｲﾝｴｽ/ｲﾝﾈｽ	Head office	light keeper - 3rd class	¥ 50		1870/1/1	1871/9/19	
29	Legg, Henry Thomas	ﾚｯｸﾞ	Head office	lightkeeping instructor	¥ 105		1870/12/12	1878/6/28	
30	MacRitchie, James	ﾏｸﾘｯﾁ･ｼﾞｪｰﾑｽ	Head office	engineer	¥ 450		1872.3.5	1879/12/31	
31	Marks, J.	ﾏｱｸｽ	Head office	mason	¥ 150		1869/2/20	1871/3/26	
32	Marley	ﾏﾙﾚｰ	Head office	lightkeeper - 5th class	¥ 80		1871/6/25	1873/6/30	
33	Martin, John	ﾏｰﾃﾝ	Head office	Lightkeeping instructor	¥ 110		1876/7/2	1879/7/1	
34	McIntosh, James	ﾏｹﾝﾄﾝ	Head office	lightkeeper - 1st class	¥ 100		1869/8/25	1871/6/22	Hired by Stevenson firm. Formerly employed by Northern Lighthouse Commission . Fired for bad behaviour.

	Name (English)	Name (Japanese)	Hired by	Type of work	Salary		Date of contract	End of contract	Comments
35	McVean, Colin	ﾏｸｳﾞｨﾝ･ｺｰﾘﾝ･ｱﾚｷｻﾞﾝﾄﾞﾙ	Head office	assistant engineer	¥ 300		1868/2	1870/7	Hired by Stevenson firm. Left to join the Survey Bureau.
36	Mitchell John	ﾐｯﾁｪﾙ	Head office	mason/superintendent of works	¥ 150		1869/1/27	1872/7/3	Hired by Stevenson firm. Formerly employed by Northern Lighthouse Commission at Lochindaal lighthouse
37	Murray, John		Head office	lightkeeper					
38	Oastler, James	ｵｰｽﾄﾚﾙ	Head office	mechanic/plumber/superintendent of works	¥ 157		1869/1.	1877/5/12	
39	Page, Robert	ﾍﾟｰｼﾞ	Head office	assistant accountant/clerk	¥ 200		1869/7/4	1873/7/18	Also worked for the Home Office (naimusho)
40	Parry, Samuel	ﾊﾞｱﾘｰ	Head office	assistant enginneer	¥ 280		1869/12/14	1873/6/7	Parry was formerly employed by Daigaku Nankō. Reference - Kōro hyōshiki nenpō, 1902 p. 282
41	Payne, H. W.	ﾍﾟｰﾝ･ｴｯﾁ･ﾀﾞﾌﾞﾘｭｰ	Head office	lightkeeper - 2nd class	¥ 105		1870/10/26	1875/5/1	
42	Pearce, John	ﾋﾟﾙﾙｽ	Head office	blacksmith/superintendent of works	¥ 200		1869/12/27	1880/9/30	
43	Phelps, Henry	ﾌｨﾘｯﾌﾟ	Head office	lightkeeper	¥ 65		1873/7/8	1873/12/16	
44	Pierce	ﾋﾟﾙﾙｽ	Head office	冶工監督	¥ 200		1869/12/27	1880/9/30	
45	Reddock, George?	ﾚﾄﾞｯｸ･ｼﾞｮﾙｼﾞ	Head office	lightkeeper - 3rd class	¥ 95		1873/2/24	1875/8/31	
46	Roache?	ﾛｰﾁ	Head office	lightkeeper - 4th class	¥ 85		1873/12/20	1876/11/30	

	Name (English)	Name (Japanese)	Hired by	Type of work	Salary		Date of contract	End of contract	Comments
47	Robertson D.	ﾛﾍﾞﾙﾄｿﾝ	Head office	coal (warehouse)	¥ 100		1870/7/14	1871/2/30	
48	Russell, John	ﾗｯｾﾙ	Head office	mechanic supervisor	¥ 105		1869/1/27	1870/7/9	Hired by Stevenson firm. Formerly employed by Milne & Sons Edinburgh
49	Sandeman, F.	ｻﾝﾄﾞﾒﾝ	Head office	instructor	¥ 130		1871/10/3	1874/1/19	
50	Seccleston?	ｾｯｸﾙｽﾄﾝ	Head office		¥ 180	*	1880		
51	Simpkins, William	ｼﾝﾌﾟｷﾝｽ	Head office	mechanic/superintendent of works	¥ 190		1870/11/3	1879/7/25	Hired by Stevenson firm. Formerly employed by Milne & Sons Edinburgh. Later worked for Kosaku Bureau.
52	Smyth William Alex	ｽﾐﾂ	Head office	lightkeeper - 4th class	¥ 85		1871/7/29	1873/12/15	
53	Stevenson	ｽﾃｨｰｳﾝｿﾝ	Head office	consultant					
54	Urquhart, Alexander	ｱｰｸﾊﾙﾄﾞ	Head office	godown keeper, clerk	¥ 200		1872/2/3	1879/3/31	
55	Wallace Thomas	ﾜﾚｽ	Head office	blacksmith/superintendent of works/lighthouse inspector	¥ 150		1869/1/27	1872/5/19	Hired by Stevenson firm. Formerly employed by Milne & Son Edinburgh. Also worked as a lighthouse inspector
56	Wauchope, George	ｳｵｰｺｯﾌﾟ	Head office	accountant, secretary	¥ 415		1869/6/12	1876/4/30	Brunton's brother in Law from Edinburgh. Worked for a British trading company run by Watson in Yokohama after leaving government employ.
57	Sales, John?	ｾﾞｰﾙｽ･John	Head office	鍛冶監督			1880/		
58	Serlin?	ｾﾙﾘﾝ	Head office	instructor	¥ 165	*	1880		

	Name (English)	Name (Japanese)	Hired by	Type of work	Salary		Date of contract	End of contract	Comments
59	Page?	ﾊﾟｯｼﾞ	Head office	lightkeeper	¥ 95		1873/9/1	1876/12/11	
60	Hardy?	ﾊﾙﾄﾞﾙ	Head office	lightkeeper - 2nd class	¥ 105		1870/4/1	1875/10/21	

List of British Employees in the Lighthouse Bureau's ships

	Name (English)	Name (Japanese)	Hired by	Type of work	Salary		Date of contract	End of contract	Comments
61	Allen, J.F.	アルレン	Meiji Maru	Captain	¥ 300		1883/1/30	1893/10/31	
62	Brown?	ブラオン	Meiji Maru	ship officer - 1st class	¥ 165		1879/8/27	1882/2/23	
63	Cameron, William Grant?	ｳｳｨﾙﾘﾔﾑｸﾞﾗﾝﾄｶﾑﾛﾝ	Meiji Maru	ship officer - 1st class	¥ 260		1880/10/1	?	
64	Campbell, John	カンプベル	Meiji Maru	ship engineer, first class	¥ 285		1874/12/10	1880/10/3	
65	Douglas?	ダグラス	Meiji Maru	ship mechanic - 2nd class	¥ 150		1880/10/7	1883/2/28	
66	Greaves?	グリーブス	Meiji Maru	ship officer - 2nd class	¥ 100		1874/12/10	1876/10/13	
67	Harcourt, W. S.	ハーコルト	Meiji Maru	ship officer - 1st class	¥ 166		1876/10/14	1879/9/30	

	Name (English)	Name (Japanese)	Hired by	Type of work	Salary		Date of contract	End of contract	Comments
68	James?	ジェームス	Meiji Maru	ship captain	¥ 310		1882/2/18	1883/1/31	
69	Jamieson?	ジミーソン/ジェミーソン	Meiji Maru	ship officer - 1st class	¥ 150		1882/2/17	1882/5/19	
70	Johnson?	ジョンソン	Meiji Maru	ship officer - 2nd class	¥ 50		1874/12/10	1875/6/9	
71	Leadbetter, A. G.	レッドベットル	Meiji maru	ship officer - 1st class	¥ 160		1876/10/14	1878/8/31	
72	MacIver?	マクイバル	Meiji Maru	carpenter	¥ 40		1874/12/10	1875/6/9	
73	Munro?	マンロ	Meiji Maru	ship mechanic - 2nd class	¥ 100		1874/12/10	1875/4/22	
74	Peters, Robert H.	ビートルス	Meiji Maru	ship captain	¥ 300	*	1874/12/10	1882/2/18	
75	Ross, John	ロッス	Meiji Maru	ship mechanic.- 2nd class	¥ 200		1874/12/10	1880/10/3	
76	Russel, Thomas	ラッセル	Meiji Maru	ship officer - 2nd class	¥ 100		1879/9/10	1879/11/20	
77	Sinclair?	シンクレール	Meiji Maru	ship officer - 1st class	¥ 160		1874/12/10	1875/10/9	
78	Whyte, Alexander	ホワイト	Meiji Maru	ship mechanic - 3rd clas	¥ 160		1874/12/12	1877/11/19	
79	Wran, Robert G.	ラ	Meiji Maru	ship officer - 1st class	¥ 100	*	1876		

	Name (English)	Name (Japanese)	Hired by	Type of work	Salary	Date of contract	End of contract	Comments
80	カロッシー	カロッシー	Meiji Maru	ship officer - 2nd class	¥ 100	1878/9/1	1878/11/7	
81	ジェーエファルレン	ジェーエファルレン	Meiji Maru	ship captain	¥ 300	1883/1/31	?	
82	ビートルス	ビートルス	Meiji Maru	ship captain	¥ 310	1874/12/10	1882/2/18	
83	Booth?	ブーズ	Meiji Maru	ship officer - 1st class	¥ 160	1874/12/10	1876/10/13	
84	マルトマン	マルトマン	Meiji Maru	ship officer - 2nd class	¥ 27	1874/12/10	1875/6/9	
85	Lucas?	リウカス	Meiji Maru	ship officer - 2nd class	¥ 100	1878/11/19	1879/8/5	
86	ロヘルドジーラン	ロヘルドジーラン	Meiji Maru	ship officer - 1st class	¥ 100	1875/6/17	1877/9/11	
87	Brown, Albert Richard	ブラウン、アルベルト・リチャード	Thabor	ship captain	¥ 350	1869/1/16	1880/6	Hired by Brunton. Formerly employed by P&O.
88	Butcher, M.	ブッチェル	Thabor	Second steward	¥ 85	1869/3/16	1872/2/10	
89	Caswell, Samuel John	カスウェル	Thabor	ship engineer -2nd class	¥ 195	1877/3/23	1877/12/6	
90	Gray, James	グレー	Thabor	chief steward	¥ 100	1870/6/3	1875/2/26	
91	Hern?	ヘルン	Thabor	steward - 2nd class	¥ 85	1873/3/26	1873/8/21	

	Name (English)	Name (Japanese)	Hired by	Type of work	Salary		Date of contract	End of contract	Comments
92	Hewitt, J. J.	ヒウイット	Thabor	ship officer - 1st class	¥ 100		1876/		
93	Jones, J.	ジョンス	Thabor	ship engineer - 2nd class	¥ 195		1871/9/24	1877/4/18	
94	Mackenzie	マクケンジー	Thabor	ship engineer - 3rd class	¥ 150		1871/10/25	1872/6/1	
95	MacNab, Archibald Francis	マクネブ	Thabor	ship engineer - 1st class	¥ 175		1870/6/3	1879/4/26	Award from Emperor
96	Nicole	ニッコル	Thabor	ship officer - 2nd class	¥ 110		1873/7/14	1873/8/31	
97	Paterson, H.	パテルソン	Thabor	ship steward - 2nd class	¥ 85		1872/5/21	1873/3/25	
98	Pendered, Joseph	ペンドレッド	Thabor	ship captain	¥ 325		1873/10/9	1879/4/26	
99	Roache, William?	ローチ・ウィリアム	Thabor	水夫頭	¥ 80		1877/5/30	1877/9/22	
100	Taylor, A. C.	テーロル	Thabor	ship officer - 2nd class	¥ 100		1874/8/1	1877/12/6	
101	ウイゾルス	ウイゾルス	Thabor	ship officer - 1st class	¥ 160		1873/2/24	1873/9/24	
102	ウオルクマン	ウオルクマン	Thabor	steward - 2nd class	¥ 70		1872/2/11	1872/5/4	
103	エーヘルン	エーヘルン	Thabor	steward - 2nd class	¥ 85		1874/7/1	1875/2/28	

	Name (English)	Name (Japanese)	Hired by	Type of work	Salary		Date of contract	End of contract	Comments
104	フェイリネー	フェイリネー/フェイクネー	Thabor	水夫小頭	¥ 80		1877/12/5	1879/4/3	
105	マクケウイット	マクケウイット	Thabor	水夫頭	¥ 75		1871/9/27	1872/11/25	
106	Mercer?	メルセル	Thabor	ship mechanic	¥ 150		1872/10/25		
107	Allen, John F	アルレン	Thabor	ship officer - 1st class	¥ 160		1872/1/22 & 1875/1/1	1873/2/24 & 1877/12/6	
108	Brooke, C.A.		Thabor	ship officer - 2nd class					
109	Dunbar, F. E.	タ	Thabor	水夫頭	¥ 80		1873/1/21 1873/10/9	1873/8/21 1877/5	
110	Haswell	ハスウエル	Tōmyō Maru	ship captain	¥ 275		1874/8/1	1874/11/30	
111	Haswell E.W.	ハスウェル	Tōmyō Maru	ship officer - 1st class	¥ 160		1870/6/3	1871/10/23	Also Haswell in Telegraph Bureau
112	Henry W.	ヘンリー	Tōmyō Maru	ship engineer -2nd class	¥ 180		1870/3/16	1871/10/23	Henry also in Telegraph Bureau as Mechanical superviser on board the Bureau's ship.
113	Lucas, I	リュカスト	Tōmyō Maru	ship engineer - 3rd class	¥ 50		1870/4/11	1871/9/2	
114	Wilson	ウィルソン	Tōmyō Maru	ship mechanic	¥ 150		1871/8/16	1872/4/11	
115	アヨンク	アヨンク	Tōmyō Maru	Chef - 1st class	¥ 41		1871/5/18	1872/1/7	

	Name (English)	Name (Japanese)	Hired by	Type of work	Salary		Date of contract	End of contract	Comments
116	アルリョン	アルリョン	Tōmyō Maru	Chef - 2nd class	¥ 29		1871/5/18	1872/1/7	
117	ナック	ナック	Tōmyō Maru	水夫頭	¥ 65		1870/9/2	1871/9/24	
118	Hewitt, J. L.	ヒウイット		ship officer - 1st class	¥ 100		1879/7/10	1880/6	

SOURCES

UNESCO (1975), Ōkurashō (1888), Takeuchi Hiroshi (1995), Tōkōkai (1969), Yokohama Archives of History (1991), Teraoka Jūichi (1978)

NOTES

Note 1 - When the English name or the appropriate translation of a word is unknown it has usually been left in Japanese

Note 2 - Names with a question mark following them are what I assume the name to be from the katakana pronunciation but they may be wrong.

Note 3 - Salaries differ in different sources. The values stated here are taken from Ōkurashō (1888) and indicate the salary at the end of the employee's contra

Those salaries marked by an asterisk are taken from UNESCO (1975).

APPENDIX 6

Details of the contract for the first Scottish Lightkeepers

"Heads of agreements for the employment of three lightkeepers wanted to go out to Japan

1st Pay 100 dollars per month equal to about £265 per annum payable from date of arrival in Japan

2nd Half pay from the date of engagement till arrival in Japan

3rd £50 to be paid before leaving this country for outfit

4th Travelling expenses, second class to be paid to port of departure in this country and then to Yokohama in Japan by the Cape

5th The same for the lightkeeper's wife if married and family not exceeding two in number

6th Dwelling house to be provided free at Japan

7th Lightkeepers to be under orders of the authority at Japan and not to engage in any other occupation

8th Engagement for 5 years at least

9th Should services of lightkeepers not be required after the first year or should his health be bad his expenses home with his family will be allowed the same as in going out.

10th Should he be dismissed for misconduct the expense home will not be paid

11th The lightkeepers will be required to sign a form of agreement which has been prepared by the Board of Trade and signed by several engineers and mechanics who have already been sent out on Japanese employment

12th This agreement will be also signed by the secretary to the Board of Trade on behalf of the Japanese government.

13th The Board of Trade do not become responsible for the fulfilment of the terms of the agreements

14th Lightkeepers will keep in view that in leaving the Northern lighthouse service they lose their retiring allowance and may have to surrender their Policies of insurance for which they will receive [?] value. Possibly by arrangements with the insurance society they may keep on their policies by paying a higher premium.

15th The climate of Japan is excellent and the employment in question affords a valuable opening for any who may wish to go abroad.

16th In the event of any lightkeeper entertaining the proposal he will be furnished with a copy of the Board of Trade agreement for his further consideration

17th It is proper to explain that the apparatus to be used in Japan is similar to that employed in this country and has been made chiefly in Edinburgh and that workmen have already gone from this to fit it up."

Information taken from Stevenson's Letterbooks. Letter of 25th May 1869

APPENDIX 7

Lighthouses and lightships built under the direction of foreign employees between 1868 - 1876

	Name of Lighthouse	Name of Lighthouse - Japanese	Location	Built by	Date of first Operation	Type of Light	Comments
*	Kannonsaki	観音埼	Edo bay	Verny		1st class, fixed white light	
*	Noshima	安房国野島埼	Edo bay	Verny		1st class, fixed white light	Temporary operation 1869/1/10
	Shinagawa	品川	Edo bay	Verny		Fixed red light	
	Shirogashima	城ヶ島	Edo bay	Verny		Fixed white light	
*	Honmoku	本牧	Yokohama harbour	Brunton	1869/11	3rd class fixed red floating light	
*	Kashinosaki (Ooshima)	樫野埼	Kii peninsula	Brunton	1870/6	2nd class revolving white light	
*	Shiomisaki	汐岬	Kii peninsula	Brunton	1873/9	1st class, fixed white light	Original apparatus and stores lost at sea aboard the Elleray. Temporary operation 1870/6
*	Mikomoto (Rock Island)	神子元島	Izu province–small island off Shimoda	Brunton	1870/11	1st class, fixed white light	Original apparatus and stores lost at sea aboard the Elleray. Temporary operation 1869/10
*	Iōshima	伊王島	Nagasaki	Brunton	1871/7	1st class, fixed white light	Original iron towers and lanterns lost at sea aboard the Elleray. Temporary operation from 1870/6
*	Satanomisaki	佐多岬	Satsuma	Brunton	1871/10	1st class, fixed white light	Temporary operation from 1870/3

	Name of Lighthouse	Name of Lighthouse - Japanese	Location	Built by	Date of first Operation	Type of Light	Comments
*	Tsurugisaki (Sagami)	剣埼	Edo bay Miura hanto	Brunton	1871/1	2nd class revolving white light	Original iron towers and lanterns lost at sea aboard the Elleray
*	Hakodate	函館	Hakodate	Brunton	1871/7	3rd class fixed red floating light	Temporary operation 1871/4
**	Isumi (Tomogashima)	由良-今の友ヶ島	Hyogo	Brunton	1872/6	3rd class fixed white light	
**	Esaki	明石-今の江埼	Hyogo	Brunton	1871/4	1st class, fixed white light	
**	Hyogo (Wadamisaki)	兵庫-今の和田岬	Hyogo	Brunton	1872/8	4th class fixed red light	Temporary operation from 1871/6
	Tenposan	天保山	Osaka	Brunton	1872/8	4th class fixed white light	One of 3 sites near Osaka proposed by Brunton after first inspection. Temporary operation from 1871/6
**	Hesaki	部埼	Osaka	Brunton	1872/1	3rd class fixed white light	
**	Rokuren	六連島	Hyogo	Brunton	1871/11	4th class fixed white light	One of five lighthouses agreed on with Parkes April 1867.
	Iroosaki	石廊埼		Brunton	1871/8	5th class fixed red light	
	Matoya (Anjō zaki?)	安乗埼(的矢)		Brunton	1873/4	4th class revolving white light	Temporary operation from 1872/9
	Tsurishima	釣島		Brunton	1873/6	3rd class fixed white light	One of 3 sites near Osaka proposed by Brunton after first inspection.
	Nabeshima	鍋島		Brunton	1872/11	3rd class fixed white light	One of 3 sites near Osaka proposed by Brunton after first inspection.

	Name of Lighthouse	Name of Lighthouse - Japanese	Location	Built by	Date of first Operation	Type of Light	Comments
	Sugashima	菅島		Brunton	1873/7	4th class fixed white light	
	Inubosaki	犬吠埼		Brunton	1874/11	1st class revolving white light	
	Shirasu	白洲		Brunton	1873/9	5th class fixed white light	Temporary operation from 1872/12
	Omaizaki	御前埼		Brunton	1874/5	1st class revolving white light	
	Eboshishima	烏帽子島		Brunton	1875/8	2nd class fixed white light	
	Kadoshima	角島		Brunton	1876/3	1st class revolving light	
	Yokohama	横浜港西波止場		Brunton	1874/3/1		
	Haneda	羽田	Haneda	Brunton	1875/3	4th class fixed green light	
	Shiriyasaki	尻矢崎		Brunton	1876/10	2nd class fixed white light	
	Kinkazan	金華山		Brunton	1876/11	1st class fixed white light	

* Lights originally proposed by Parkes in 1866

** Additional lights at Osaka agreed apon in April 1867 in readiness for opening of Hyogo

SOURCES

Tōkōkai (1969), Japan Weekly Mail series of articles on the Lighthouse of Japan (1872), Stevenson Letterbooks

NOTE - Some of the lighthouses were referred to with different names, some were also named in English and these names are shown in brackets.

APPENDIX 8

List of British Employees in the Railway Bureau

	Name (English)	Name (Japanese)	Type of work	Salary	Date of contract	End of contract
1	Aldrich, Arthur Stanhope	ｵﾙﾄﾞﾘｯﾁ･A.S.	secretary & traffic manager	¥ 550	1871/12	1885/12
2	Allen, Alexander	ｱﾙﾗn/ｱﾚﾝ･ｱﾚｷｻﾝﾄﾞﾙ	mechanic/engineer	¥ 116	1871/3	1876/3
3	Amerson?	ｱﾒﾙｿﾝ	車工	¥ 3	1871/9	1872/5
4	Anderson, John	ｱﾝﾃﾞﾙｿﾝ･ｼﾞｮﾝ	train driver	¥ 5.50	1876/8	1885/12
5	Andrew, William	ｱﾝﾄﾞﾘｭｰ	storekeeper	¥ 150	1872/9	1874/11
6	Andrews, William Edwin	ｱﾝﾄﾘｭｰｽ･ﾀﾞﾌﾞﾙｭ	painter	¥ 4	1874/5	1878/3
7	Annand, James	ｱﾅﾝﾄﾞ	頭取役/建築頭取	¥ 192	1871/4	1874/11
8	Barnes, Thomas?	ﾊﾞﾙﾝｽ･ﾄﾏｽ	installer	¥ 3	1873/2	1873/3
9	Bellamy, Thomas	ﾍﾞﾗﾐ･ﾄｰﾏｽ	train driver	¥ 4.15	1875/7	1882/4
10	Benny, Charles?	ﾍﾞﾝｲｰ･ﾁｬｰﾚｽ	secretary	¥ 60	1873/12	1874/12
11	Benny, Charles?	ﾁｬｰﾙｽ､ﾍﾞﾝﾆｰ	secretary, assistant	¥ 60	1873/12	1874/12
12	Benny, G.?	ﾍﾝﾆｰｼﾞｰ	time keeper	¥ 80	1874/6	1874/8
13	Bingham, Thomas	ﾋﾞﾝｸﾞﾊﾑ･ﾄｰﾏｽ/ﾋﾞﾝｶﾞﾑ	platelayer	¥ 3.63	1875/7	1880/10.
14	Black, Robert	ﾌﾞﾗｯｸ･ﾛｰﾍﾞﾙﾄ	fitter	¥ 5.70	1874/2	1880/5
15	Blundell, A. W.	ﾌﾞﾗﾝﾄﾞﾙ	assistant engineer	¥ 420	1871/5	1896/1
16	Bolt?	ﾎﾞﾙﾄ･ｳｲﾝ	inspector	¥ 800	1871/6	1873/6
17	Boyle, Richard Vicars	ﾎﾞｲﾙ･R.V.	engineer in Chief	¥ 1,250	1872/9	1877/2
18	Boyle?	ﾎﾞｲﾙ妻			1873/	
19	Boyle?	ﾎﾞｰｴﾙ	platelayer	¥ 92	1870/7	1872/1

	Name (English)	Name (Japanese)	Type of work	Salary		Date of contract	End of contract
20	Brewman?	ブルマン	secretary	¥	400	1871/1	1873/8
21	Bristow, Herbert	ブリストウ・ヘルベルト	train driver	¥	4.15	1873/8	1879/4
22	Brockley	フロックレ	取締役	¥	100	1871/6	
23	Brockley?	ブロックレ	inspector of railway police	¥	100	1871/6	1874/8
24	Brockley?	ブロックレー	inspector of railway police	¥	100	1871/6	1874/8
25	Brooks, J. M	ブルックス	secretary	¥	125	1871/3	
26	Bryant	ブライアント	assistant engineer			1870/4	
27	Cable?	ケーブル	platelayer	¥	72	1870/8	1872/6
28	Caddell?	カーデル	railway, minting			1871/1	
29	Cameron, William?	カメロン・ウイルヤム	engineer	¥	4.6	1873/1	1873/4
30	Cargill, William Walter	カーギル・ウィルリアム・ヲルトル	director	¥	2,000	1872/1	1877/2
31	Carrol, Anthony	カーロル・アントニー	送車方	¥	4.15	1873/6	1880/5
32	Carroll, Anthony	カロル・アンソニー	blacksmith	¥	3	1872/5	1872/9
33	Carroll, J.	カーロル・ゼー	blacksmith	¥	4.15	1874/2	1880/5
34	Cartman, E.S.?	カートマン・イ・エス	draughtsman	¥	150	1874/1	1875/12
35	Cartman?	カルトマン	不詳	¥	160	1871/12	1871/8
36	Caswell?	カスウェル・エス	mechanic	¥	8	1872/10	1876/8
37	Challons, Anthony	チャロンス゛・アントニ	road layer	¥	3.50	1879/1	1885/6
38	Chambers, John	チェンバ゛ース゛/チャムブルス・ジョン	principal engineer	¥	400	1881/4	1883/4
39	Chapels John?	チャプルス・ジョン	Installation	¥	3.50	1875/1	1876/2
40	Charles, William	チャーレス・ウイルリアム		¥	3	1874/4	1874/6

	Name (English)	Name (Japanese)	Type of work	Salary		Date of contract	End of contract
41	Child, F. A.	ﾁｬｲﾙﾄﾞ	見廻役	¥	100	1872/1	1874/8
42	Christy, F. C.	ｸﾘｽﾃｨ･F.C	locomotive superintendent	¥	400	1871/8	1876/9
43	Cocks, Edward	ｺｯｸｽ･ｴﾄﾞﾜｰﾄﾞ		¥	4.00	1874/5	1877/5
44	Cole, Thomas	ｺｰﾙ	station master?	¥	100	1871/6	1874/8
45	Collins, Henry	ｺﾘﾝｽﾞ/ｺﾘｳｽ･ﾍﾝﾘｰ	platelayer	¥	3.50	1875/7	1877/10.
46	Cooke?	ｸｰｸ	blacksmith	¥	4	1873/1	1873/10.
47	Cooper, James E.	ｸｰﾊﾟ	土木頭取/木工頭取	¥	4.11	1873/9	1876/9
48	Cripps, George	ｸﾘｯﾌﾟｽ･ｼﾞｮﾙｼﾞ	carriage builder	¥	4	1873/6	1877/5
49	Cross, Henry	ｸﾛｽ	platelayer	¥	4.50	1872/8	1877/5
50	Cross, Thomas?	ｺﾛｽ･ﾄｰﾏｽ	metal worker	¥	3.29	1873/8	1874/1
51	Crutchly, George	ｸﾗｯﾁﾘ	carriage builder	¥	4.98	1874/9	1879/5
52	Cutler, William?	ｺｯﾄﾗｰ	carpenter	¥	120	1870/9	1873/8
53	Cutler?	ｺｯﾄﾙ	不詳	¥	3.94	1873/1	1873/8
54	Davidson?	ﾃﾋﾂｿﾝ	mechanic	¥	116	1871/3	1874/7
55	Davison	ﾃﾞｳﾞｨｿﾝ	mechanic	¥	116	1871/3	1874/4
56	Day, James Edward	ﾃﾞｰ･ｾﾞｰﾑｽ･ｴﾄﾜﾙﾄ	engineer	¥	125	1873/8	1876/8
57	Death, W. H.	ﾃﾞｱｽ･ﾀﾞﾌﾘｭｰ･ｴｯﾁ	storekeeper	¥	120	1874/7	1877/3
58	Denny, James	ﾃﾞﾝﾆｰ	platelayer	¥	3.63	1871/4	1880/11
59	Dewing, James, A.	ﾃﾞｭｰｲﾝｸﾞ･J.A	assistant engineer	¥	400	1871/11	1876/4
60	Diack, John	ﾀﾞｲｱｯｸ･ｼﾞｮﾝ	assistant engineer	¥	420	1870/3	1876/1
61	Dillon	ﾃﾞｨﾛﾝ/ｼﾞｮﾛﾝ		¥	3.63	1873/7	

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62	Dillon W	ﾃﾞｨﾛﾝ/ｼﾞｮﾛﾝ･ﾀﾞﾌﾞﾘｭｰ	取締役	¥ 100	1871/6	1874/8
63	Doel, Peter	ﾄﾞｰﾙ	取締役	¥ 100	1871/6	
64	Dougherty	ﾄﾞﾊﾃｨｰ/ﾄﾞﾎﾞﾃｰ	metal worker	¥ 4.15	1871/8	1874/10.
65	Durham, William George	ﾀﾞﾗﾑ/ﾀﾞﾗﾑ･ｼﾞｮｰﾙｼ/W.G	storekeeper	¥ 250	1874/2	1879/9
66	Eager, Richard	ｲｰｸﾞﾙ･ﾘﾁｬﾙﾄﾞ	train driver	¥ 4.00	1873/9	1876/10.
67	Edwards, William	ｴﾄﾞﾜﾙﾄ･ﾀﾞﾌﾞﾘｭｰ	platelayer	¥ 4.00	1871/8	1875/9
68	Elliot, George	ｴﾘｵｯﾄ	secretary	¥ 150	1872/6	
69	Ellis, George	ｴﾘｯｽ	carriage builder	¥ 4.00	1873/5	1876/7
70	England, John	ｴﾝｸﾞﾗﾝﾄ･ｼﾞｮﾝ	principal engineer	¥ 750	1870/4	1877/9
71	Eustace, James	ｲｽﾃｰｽ･ｾﾞｰﾑｽ	汽車転駆	¥ 4	1874/11	1879/6
72	Fennell, Henry John	ﾌｪﾝｴﾙ	metal worker	¥ 4	1873/8	1877/8
73	Ferrell?	ﾌｴﾘｰﾙ	train driver	¥ 3.81	1872/11	1873/6
74	Ferris, Charles	ﾌｪﾘｽ･ﾁｬｰﾚｽ	platelayer	¥ 3.50	1879/2	1882/8
75	Filler	ﾌﾋﾙﾚｰ	mechanic	¥ 116	1871/9	1874/10.
76	Fort, John Wall?	ﾌｫﾙﾄ･ｼﾞｮｰｼﾞ･ﾜﾙｽ/ｳｵｰﾙ	train driver	¥ 4.15	1876/5	1885/12
77	Fort?	ﾎｰﾄ	mechanic	¥ 126	1871/3	1874.00
78	Fortman?	ﾎﾟﾙﾍｯﾄ	不詳	¥ 72	1871/8	1872/11
79	Foster, Henry	ﾌｫｽﾄﾙ/ﾌｫｽﾀｰ･ﾍﾝﾘｰ	train driver	¥ 4.50	1879/2	1883/10.
80	Fritz, Charles?	ﾌﾘﾂ･ﾁｬﾙﾄ	engineer	¥ 4.6	1873/1	1874/6
81	Galway, William	ｺﾞｰﾙｳｪｰ･W.	engineer & Traffic Manager	¥ 600	1871/2	1874/12 1873
82	Geekie, J. P.	ｷﾞｰｷｰ･J.P.	draughtsman	¥ 200	1873/9	1875/3

	Name (English)	Name (Japanese)	Type of work	Salary	Date of contract	End of contract
83	George?	ｼﾞｮｰｼﾞ	carpenter	¥ 3.83	1873/5	
84	Gibson, Charles John	ｷﾞﾌﾞｿﾝ･ﾁｬｰﾚｽ･ｼﾞｮﾝ	assembler/ mechanic	¥ 4.00	1874/5	1878/10.
85	Goodhead, John	ｸﾞｯﾄﾞﾍｯﾄﾞ	train driver	¥ 2.96	1876/9	
86	Gough, John	ｺﾞｰﾌ/ｺﾞﾌ･ﾃﾞｮﾝ	carpenter	¥ 4.11	1873/12	1876/9
87	Gray	ｸﾞﾚｰ･T	mechanic	¥ 116	1871/1	
88	Gray, Duncan	ｸﾞﾚｰ･ﾀﾞﾝｹﾝ	mechanic	¥ 4	1871/10	1875/9
89	Gray, John	ｸﾞﾚｰ･ｼﾞｮﾝ	汽車転駆	¥ 2.84	1873/	
90	Grey Thomas	ｸﾞﾚｰ･ﾄｰﾏｽ	assistant engineer	¥ 400	1870/7	1876/2
91	Haines, George	ﾍｰﾝｽ･ｼﾞｮｰｼ	assembler	¥ 4.15	1875/8	1880/6
92	Haines, George	ﾍｰﾝｽ･ｼﾞｮｰｼ	train driver	¥ 4.00	1876/4	1877/10.
93	Hall, John	ﾎｰﾙ･ｼﾞｮﾝ	train driver	¥ 4	1871/3	1875/6
94	Hall, John	ﾎｰﾙ･ｼﾞｮﾝ	客車庫小頭	¥ 6.75	1877/6	1885/12
95	Halsey, William	ﾊﾙｾﾞ	platelayer	¥ 92	1870/7	1873/12
96	Harding	ﾊｰﾃﾞｨﾝｸﾞ	取締役	¥ 100	1871/6	1874/8
97	Hardy Charles	ﾊｰﾃﾞｨ･ﾁｬｰﾚｽ	assistant engineer	¥ 300	1872/1	1876/7
98	Hare?	ﾍｱ	assistant engineer	¥ 300	1871/1	1872/2
99	Hart, T. ?	ﾊｰﾄ･T.	mechanic		1871/3	1874/1
100	Hawkins?	ﾎｰｷﾝｽ		¥ 3	1874/4	1874/6
101	Hellendool, P. J.	ﾍﾚﾝﾄﾞｰﾙ	station master?	¥ 3.5	1872/3	1877/3
102	Hench, James ?	ｾｰﾑｽﾍﾝﾁｰ	工師	¥ 4	1873/5	1873/7
103	Henderson, P.	ﾍﾝﾀﾞｰｿﾝ	鑵工	¥ 3.50	1873/3	1874/1

	Name (English)	Name (Japanese)	Type of work	Salary	Date of contract	End of contract
104	Hodson, J. A.?	ﾎｯﾄﾞｿﾝ･ｾﾞｰｴｰ	見廻役	¥ 2.50	1875/7	1875/9
105	Holtman?	ﾎﾙﾄﾏﾝ	不詳	¥ 60	1871/11	1872/4
106	Hoon, Robert	ﾌｰﾝ	installer	¥ 6.00	1876/5	
107	Horsley, Lee	ﾎｰｽﾚｰ/ﾎﾙｽﾚｰ･ﾘｰ	mason	¥ 4.50	1875/1	1879/10.
108	Hortham, Edmund Gregory	ﾎﾙｻﾑ･ｴﾄﾓﾝﾄﾞ･ｸﾞﾚｺﾘｰ	principal engineer	¥ 550	1877/09	1882/2
109	Hosking, Richard	ﾎｽｷﾝｸﾞ･ﾘﾁｬｰﾄ	汽車整装夫･汽車組立/汽車器械方	¥ 6.75	1876/4	1885/12
110	Houghton, Frank?	ﾊｳﾄﾝ･ﾌﾗﾝｸ	頭取役	¥ 3	1875/9	1875/10.
111	Houghton, Henry	ﾎｰﾄﾝ	客車荷車頭取兼組立方	¥ 8.20	1873/5	1878/2
112	Hume, T. ?	ﾋｭｰﾑ	storekeeper	¥ 100	1871/3	1875/6
113	Humphrey?	ﾊﾝﾌﾞﾚｰ	blacksmith	¥ 120	1870/3	1872/6
114	Impey, George	ｲﾑﾋﾟｰ	platelayer	¥ 4.38	1873/8	1882/12
115	Jackson, Robert	ｼﾞｬｸｿﾝ/ｾﾞｯｸｿﾝ･ﾛﾍﾞﾙﾄ/ﾛﾊﾞｰﾄ	train driver	¥ 2.96	1876/4	1876/8
116	James, Denny	ｼﾞｪｰﾑｽﾞ･ﾃﾞﾝﾆｰ				
117	James, Eustace	ｼﾞｪｰﾑｽﾞ･ﾕｰｽﾀｽ	train driver	¥ 3.50	1874/11	
118	Johnson?	ｼﾞｮﾝｿﾝ	見廻役	¥ 45	1872/2	1873/12
119	Jones, Edward?	ｼﾞｮﾝｽ･ｴﾄﾞﾜﾙﾄﾞ	platelayer	¥ 92	1871/7	1873/1
120	Joy, George	ｼﾞｮｲ/ﾃﾞｮｲ･ｼﾞｮｰｼﾞ	installer	¥ 4	1875/8	1878/10.
121	Joyner, Henry Batson	ｼﾞｮｲﾈﾙ	assistant engineer	¥ 200	1870/8	1871/11
122	Kinder, Claude William	ｷﾝﾀﾞｰ･C.W./ｷﾝﾄﾞﾙ･ｺﾛｰﾄﾞ	assistant engineer	¥ 300	1873/5	1876/12
123	King, George	ｷﾝｸﾞ･ﾁｪﾙﾁﾞ	mason	¥ 5	1870/7	1875/7
124	King, Richard	ｷﾝｸﾞ･ﾘﾁｬﾙﾄﾞ	train driver	¥ 4	1873/8	1876/5

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125	Kingstone	ｷﾝｸﾞｽﾄﾝ	inspector of railway police	¥ 100	1871/6	1873/6
126	Konrad?	ﾎﾝﾗｯﾄﾞ･ﾌﾗﾝﾚｽｲｶ	storekeeper	¥ 50	1873/3	1873/5
127	Lance, A. R.?	ﾗﾝｽ･ｴｲ･ｱﾙ	installer	¥ 4.25	1873/3	1873/10.
128	Landles, David	ﾗﾝﾄﾞﾙｽ		¥ 4.11	1875/	
129	Lane?	ﾚｰﾝ	assistant engineer		1870/4	
130	Lay, Arthur Flyde	ﾚｲ			1873/5	
131	Lay, Horatio Nelson	ﾚｲ				
132	Lewis, John	ﾙｲｽ/ﾚｳｲｽ･ｼﾞｮﾝ	油漆師	¥ 4	1874/5	1876/8
133	Liddle, Charles	ﾘｯﾄﾙ/ﾘｯﾄﾞﾙ･ﾁｬｰﾚｽ	storekeeper	¥ 150	1873/1	1874/7
134	Livich, Edward	ﾘﾋﾞｯｸ･ｴﾄﾞﾜｰﾄ	platelayer	¥ 4.11	1873/9	1875/11
135	Livich, Edward	ﾘｳｨｯﾁ	platelayer superintendant	¥ 4.11	1873/9	
136	MacDonald, John	ﾏｸﾄﾞﾅﾙﾄ･ｼﾞｮﾝ	train driver, foreman	¥ 6.75	1873/6	1885/12
137	MacShan, D.?	ﾏｸｼｬﾝ･ﾃﾞｰ	metal worker	¥ 4	1874/2	1874/5
138	Malcolm, J.W.?	ﾏﾙｺﾑ･ｼｪｰﾀﾞﾌﾙﾕ	汽車課書記役	¥ 100	1878/7	1878/11
139	Marshall?	ﾒﾙｼﾙ	mechanic	¥ 4	1872/5	1872/8
140	Martin, C.	ﾏｰﾃｨﾝ･ｼｰ	installer	¥ 4	1873/8	1875/10.
141	Martin, Edward	ﾏｰﾃｨﾝ･ｴﾄﾜﾙﾄ	汽車転駆兼造車方･整装夫	¥ 4	1873/5	1877/8
142	Martin?	ﾏﾙﾋﾝ	carpenter	?	不詳	1872/11
143	May, Joseph Charles	ﾒｰｾﾞｰｼ	secretary	¥ 100	1875/9	1878/7
144	McKenzie, J.	ﾏｹﾝｼﾞｰ/ﾏｹﾝﾃﾞｨｰ･ｾﾞｰ	installer	¥ 4	1873/8	1876/1
145	Morell, Edmund	ﾓﾚﾙ･ｴﾄﾞﾏﾝﾄﾞ	chief engineer	¥ 850	1870/3	1871/9

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146	Morley, William	ﾓｰﾘ/ﾓﾙﾚｰ･ｳｲﾙﾘｱﾑ	draughtsman	¥ 270	1874/4	1877/4
147	Nankivell, George	ﾅﾝｷｳﾞｧﾙ	installer	¥ 6.75	1875/2	1885/12
148	Newcomb, Edward	ﾆｭｰｶﾑ/ﾆｭｰｺﾑﾌ･ｴﾄﾜﾙﾄ	engineer	¥ 400	1873/1	1876/10.
149	Newell, James	ﾆｭｰｳｪﾙ/ﾆｭｰｲﾙ･ｾﾞｰﾑｽ	carriage builder	¥ 4.80	1874/9	1878/3
150	Newton, Charles	ﾆｭｰﾄﾝ	platelayer	¥ 3.50	1873/8	1881/2
151	Newton, James	ﾆｭｰﾄﾝ	platelayer	¥ 3.63	1875/2	1879/9
152	Oastler?	ｵｽﾄﾗｰ	carpenter	¥ 96	1871/4	1872/1
153	Ogden, Joseph	ｵｸﾞﾃﾞﾝ･ｼﾞｮｾﾞﾌ	train driver/fitter	¥ 4.15	1874/11	1879/4
154	Page, Walter Finch	ﾍﾟｰｼﾞ･ｳｵﾙﾄﾙ･ﾌｨﾝﾁ.	traffic manager	¥ 500	1874/2	1885/12
155	Pallock, Thomas	ﾎﾟﾛｯｸ･ﾄｰﾏｽ	train driver	¥ 4.15	1874/11	1882/12
156	Palmer, James	ﾊﾟｰﾙﾏ･ｾﾞｰﾑｽ/ﾊﾟｰﾏ	train driver	¥ 3.00	1879/2	1881/12
157	Peak, W.	ﾋﾟｯｸ	汽車整装夫	¥ 3.50	1876/	
158	Penny, George John	ﾍﾟﾆｰ･G.J.	time keeper	¥ 80	1874/6	1874/8
159	Phillips, Charles	ﾋﾟﾘｯﾌﾟｽ	carpenter	¥ 100	1871/2	
160	Pitkin, John	ﾋﾟｯｷﾝ･ｼﾞｮﾝ	platelayer	¥ 3.50	1874/8	1879/1
161	Pitkin, Joseph	ﾋﾟｯｷﾝ･ｼﾞｮｾｳ	platelayer	¥ 3.50	1874/8	1879/1
162	Pitts, William	ﾋﾟｯﾂ･ｳｲﾙﾘﾔﾑ	fitter	¥ 6.75	1876/4	1885/12
163	Platt, William	ﾌﾟﾗｯﾄ･ｳｲﾘｱﾑ	train driver	¥ 5.50	1876/9	1879/8
164	Pole, George Henry	ﾎﾟｰﾙ･ｼﾞｮﾙｼﾞ･ﾍﾝﾘｰ.	secretary	¥ 300	1873/10	1876/10.
165	Pollman?	ﾎﾟﾙﾏﾝ/ﾊﾟｰﾏﾝ	secretary	$ 250	1871/1	1873/8
166	Potter, William Furniss	ﾎﾟｯﾀ	engineer	¥ 300	1874/2	1877/2

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167	Pownell, Charles A. W.	ﾊﾟｳﾈﾙ･ｼｰｴｰ･ﾀﾞﾌﾞﾘｭ	engineer	¥ 550	1882/3	1885/12
168	Pritchard	ﾌﾞﾘｯﾁｬｰﾄﾞ	engineer	$ 4.60	1873/6	
169	Purcell, C.?	ﾊﾟｰｾﾙ/ﾊﾙｾﾙ･ｼ	assistant engineer	¥ 300	1874/3	1875/5
170	Purcell, G.	ﾊﾙｾﾙ･ﾋ	engineer	¥ 300	1874/3	1875/5
171	Purcell, Theobald Andrew	ﾊﾙｾﾙ	doctor	¥ 400		
172	Purcell?	ﾊﾟｰﾙｾﾙ	doctor	¥ 400	1871/5	1873/8
173	Railey, JohnThomas	ﾗｲﾘｰ	train driver		1874/	
174	Railey, William	ﾗｲﾘｰ･ｳｲﾙﾘﾔﾑ	platelayer	¥ 3.63	1874/4	1878/8
175	Randalls, David?	ﾗﾝﾄﾞﾙｽ･ﾀﾞﾋｯﾄ	mason	¥ 4.11	1875/9	1878/5
176	Ray, David	ﾚｰ･ﾀﾋﾞｯﾄ	carpenter	¥ 120	1872/2	1873/4
177	Reeks, Charles	ﾘｯｸｽ/ﾘｰｸｽ･ﾁｬｰﾚｽ	platelayer	¥ 3.63	1875/7	1878/12
178	Reid, David?	ﾚｲﾄﾞ･ﾃﾞﾋﾞｯﾄ	installer	¥ 3.50	1876/3	1876/8
179	Reid?	ﾚｰﾄﾞ	carriage builder	¥ 60	1871/1	1871/7
180	Roberts, Edward	ﾛﾊﾞｰﾂ	train driver	¥ 4	1872/2	1874/8
181	Roberts, H. I.	ﾛﾊﾞｰﾂ	砂利運転方Gravel	¥ 4.15	1873/6	1881/10.
182	Robertson, James	ﾛﾊﾞｰﾄｿﾝ･ｾﾞｰﾑｽ	train driver	¥ 4.15	1871/8	1879/11
183	Robertson, William?	ﾛﾍﾞﾙﾄｿﾝ･ｳｲﾙﾘｱﾑ	installer	¥ 4	1875/4	1875/7
184	Rogers	ﾛｼﾞｬｽ	assistant engineer		1872/7	
185	Rogers, William	ﾛｼﾞｬｰｽ	assistant engineer	¥ 420	1872/6	1875/12
186	Ronald?	ﾛﾅﾙﾄﾞ	連鎖工	¥ 96	1870/8	1873/8
187	Roy, George A.?	ﾛｰｲ･ｼﾞｮﾝ･ｴｰ	汽車掛書記	¥ 80	1875/1	1876/8

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188	Rymer-Johnes, Thomas M.	ライマージョンズ	engineer	¥	450	1873/8	1881/1
189	Scott	スコット	carriage builder	¥	4	1872/9	1873/3
190	Scott, Thomas	スコット・トーマス	train driver	¥	4.15	1875/7	1878/12.
191	Scott, W. J.	スコット・ダブリュ・ジェー	train driver	¥	3.63	1876/8	1880/10.
192	Senior	シニア	汽車転駆			1871/11	
193	Senior, Thomas	シニア・トーマス	mechanic	¥	116	1871/10	1874/10.
194	Seymour, Henry	シーモア/セーモール・ヘンリー	train driver/fitter	¥	3.63	1876/8	1879/3
195	Shann, Theodore	シャン・セラドル	assistant engineer	¥	350	1871/7	1878/11
196	Sharp, William	シャープ・W.	draughtsman	¥	271	1874/4	1877/4
197	Shaw, William	ショー・ウィルリヤム	platelayer	¥	2.63	1872/9	1875/9
198	Shepherd, Charles	シェパード・C.	principal engineer	¥	525	1870/5	1872/9
199	Shervinton, Thomas R.	シャービントンT.R./セルビントン・トーマス・アル	principal engineer	¥	600	1873/1	1881/4
200	Smith	スミッス	secretary	$	200	1872/8	
201	Smith, George	スミス・デョーチ	platelayer	¥	3.5	1870/7	1875/3
202	Smith, J. G.	スミス・セージー	mason	¥	4.11	1875/3	1876/7
203	Smith, J. R.	スミス・J.R.	secretary	¥	250	1871/5	1877/7
204	Smith, Mortimer	スミス・モルチマー	train driver	¥	5.50	1879/2	1885/12
205	Smith, Walter Mackarsay	スミッス・ウオルトル・マカルセー	locomotive superintendent	¥	400	1874/4	1878/8
206	Smith, William	スミツ・ウィスリヤム			?	不詳	1872/10.
207	Stanford, Samuel	スタンフォード・サミュエル	train driver/fitter	¥	4.15	1877/9	1881/7
208	Stone, Thomas	ストーン・トーマス	installer	¥	3	1875/8	1876/1

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209	Sutherland, Alexander	ｿｰｻﾞﾗﾝﾄﾞ/ｻｻﾞｰﾗﾝﾄﾞ･ｱﾚｷｻﾝﾄﾞﾙ	水底工夫／潜水夫頭	¥	4.10	1874/7	1877/7
210	Swift, Thomas	ｽｳｨﾌﾄ	secretary	¥	125	1872/8	1876/2
211	Taylor, A.	ﾃｰﾗｰ/ﾃｰﾛﾙ	platelayer	¥	3.63	1873/7	1879/7
212	Taylor, Thomas?	ﾃｰﾛﾙ･ﾄｰﾏｽ	不詳	¥	72	1870/8	1871/2
213	Taylor, William	ﾃｰﾗｰ/ﾃｰﾛﾙ･ｳｲﾙﾘｱﾑ	assembler	¥	125	1876/3	1877/7
214	Tempest, William	ﾃﾑﾍﾟｽﾄ･ｳｲﾙﾘﾔﾑ	assembler/ mechanic	¥	4.00	1874/5	1877/9
215	Thomson?	ﾄﾞﾑｿﾝ	鐵工	¥	120	1871/7	1873/5
216	Thornicraft, T. C.	ｿｰﾆｸﾗﾌﾄ･ﾃ	doctor	¥	100	1876/7	
217	Thorp, R. W.	ｿｰﾌﾟ	clerk	¥	200	1872/8	1885/12
218	Trevithick, Francis Henry	ﾄﾚｳﾞｨｯﾂ･ﾌﾗﾝｼｽ･ﾍﾝﾚｰ	locomotive foreman	¥	450	1876/9	1885/12
219	Trotter	Trotter	mechanic	¥	4.00	1871/9	1875/1
220	Walker, Thomas	ｳｵｰｶｰ	mason	¥	4.11	1873/9	1876/9
221	Wallace, Charles?	ｳﾗｰｽ･ﾁｬｰﾚｽ	secretary	¥	125	1872/10	1879/4
222	Ward, Robert	ｳｵｰﾄﾞ･ｱｰﾙ	汽車掛兼夜番	¥	5.50	1874/6	1885/12.
223	Warsfard, George	ｳｵｰｽﾌｫｰﾄﾞ	train driver	¥	2.96	1876/	
224	Watson, Jeremiah	ﾜﾄｿﾝ･ｾﾞﾚﾐｱ		¥	4.10	1874/3	1874/8
225	Watt, William	ｳﾜｯﾄ･ｳｲﾙﾘﾔﾑ	assistant engineer	¥	4	1873/6	1873/10.
226	Watt, William	ﾜｯﾄ･ｳｲﾙﾘﾔﾑ	assistant engineer	¥	4	1873/9	
227	Webber, Hugh Brown	ｳｪｯﾊﾞｰ/ｳｴｯﾌﾞﾙ･ﾋｭｰ･ﾌﾞﾗｳﾝ	train driver	¥	4	1873/9	1877/5
228	Wheeler, Edwin	ﾎｲｰﾗ	doctor	$	100	1871/5	
229	Wickler?	ｳｲｸﾗｰ	doctor	¥	100	1871/7	1876/6

	Name (English)	Name (Japanese)	Type of work	Salary	Date of contract	End of contract
230	Wilkinson, Richard	ｳｨﾙｷﾝｿﾝ	train driver	¥ 3.50	1874/11	1876/10.
231	Wilkinson, Thomas	ｳｨﾙｷﾝｿﾝ･ﾄｰﾏｽ	train driver	¥ 4.00	1874/11	1878/10.
232	Wilkinson?	ｳｲﾙｷﾝｿﾝ	secretary	¥ 70	1872/2	1873/6
233	Wilson, A	ｳｨﾙｿﾝ/ｳｨﾄｿﾝ･ｴｰ･	secretary	¥ 100	1872/8	1877/1
234	Wilson, A	ｳｲﾙｿﾝ･ｴｰ	secretary	¥ 100	1872/8	1877/1
235	Winbold	ｳｨﾝﾎﾞﾙﾄ		¥ 94.20	1873/6	
236	Wood, John	ｳｯﾄﾞ･ｼﾞｮﾝ	train driver/fitter	¥ 4.15	1876/5	1880/10.
237	Woodhead, John	ｳｰﾄﾞﾍｯﾄ･ﾃﾞｮﾝ	mason	¥ 4.10	1874/7	1876/3
238	Worth, G. Charles	ｳｵｰｽ	secretary	¥ 115	1872/1	
239	Wright, Frederik B.	ﾗｲﾄ･ﾌﾚﾃﾞﾘｯｷ･ﾋﾞｰ	locomotive superintendent	¥ 450	1878/3	1878/6 1885/12
240	Wylie?	ｳｨﾘｰ/ｳｱｲﾘｰ	mechanic	¥ 200	1871/12	1872/6
241	Young, Andrew	ﾔﾝｸﾞ/ﾖﾝｸﾞ･ｱﾝﾄﾞﾘｳ	train driver	¥ 4.15	1874/11	1878/12
242	Young, John Brown	ﾔﾝｸﾞ/ﾖﾝｸﾞ･ﾃﾞｮﾝ･ﾌﾞﾗｳﾝ	engineer	¥ 400	1873/11	1876/11
243	ｲｽﾃｰｽ･ｾﾞｰﾑｽ	ｲｽﾃｰｽ･ｾﾞｰﾑｽ	train driver	¥ 4	1874/11	1879/6
244	ｳｱﾙｹﾙ	ｳｱﾙｹﾙ	carpenter	¥ 96	1871/2	1873/2
245	ｳｲｯｸﾙｽ･ｼﾞｮﾝ	ｳｲｯｸﾙｽ･ｼﾞｮﾝ	轆轤Potter	¥ 3.50	1873/7	1873/8
246	ｳｵﾄﾝ	ｳｵﾄﾝ	泥工	¥ 120	1870/8	1871/2
247	ｳﾜﾙﾄ	ｳﾜﾙﾄ	train driver	¥ 3.46	1872/6	1873/11
248	ｴﾄﾞﾜﾙﾄ･ﾀﾞﾌﾞﾘｭｰ	ｴﾄﾞﾜﾙﾄ･ﾀﾞﾌﾞﾘｭｰ	unknown	¥ 2.6	1872/10	1873/11
249	ｴﾙﾘﾗｯﾄ･ｼﾞｮｰｼﾞ	ｴﾙﾘﾗｯﾄ･ｼﾞｮｰｼﾞ	secretary	¥ 150	1872/6	1879/3
250	ｶｳﾃﾞﾛｰｲ･ｼﾞｮﾝ･ｾﾞｰ	ｶｳﾃﾞﾛｰｲ･ｼﾞｮﾝ･ｾﾞｰ	secretary	¥ 80	1874/12	1876/7

	Name (English)	Name (Japanese)	Type of work	Salary	Date of contract	End of contract
251	クークル	クークル	train driver	¥ 2.84	1873/9	
252	グーベットション	グーベット・ション	train driver	¥ 4.15	1877/9	1879/11
253	グローブル・ダフリュー	グローブル・ダフリュー	装車方	¥ 4	1873/12	1875/3
254	ゲリー	ゲリー	不詳	¥ 90	1871/10	1873/8
255	ケルメリー	ケルメリー	mechanic	¥ 3	1872/4	1874/7
256	ジョルシ・マイトム	ジョルシ・マイトム	carpenter	¥ 3.83	1873/5	1877/3
257	スノー	スノー	secretary	¥ 80	1872/7	1872/8
258	スボル	スボル	platelayer	¥ 2.5	1872/7	1872/8
259	スロレイス	スロレイス	installer	?	不詳	1872/11
260	セレス	セレス	engineer		1870/	1871
261	ソルークス・ゼー・エム	ソルークス・ゼー・エム	secretary	¥ 125	1871/3	1876/2
262	タボール	タボール	time keeper	¥ 70	1872/9	1873/7
263	チエルデ・ヘーレム/ヘーレム・チエルジ	チエルデ・ヘーレム/ヘーレム・チエルジ	carpenter	¥ 5	1870/7	1875/7
264	チュルレット	チュルレット	車工	¥ 4	1872/9	1873/5
265	チョンラミン	チョンラミン	platelayer	¥ 2.6	1874/2	1875/7
266	ツール	ツール	見廻役	¥ 2	1872/5	1873/1
267	テイメン	テイメン	波止場建築師	¥ 124	1872/5	1874/10.
268	トール・ビー	トール・ビー	取締役	¥ 100	1871/6	1874//8
269	トレット	トレット	車工	¥ 3.46	1871/10	1873/5
270	ピウキン・ジョン	ピウキン・ジョン	platelayer	¥ 3.50	1874/	
271	ヒルリップスシ	ヒルリップスシ	carpenter	¥ 100	1871/12	1874.00

	Name (English)	Name (Japanese)	Type of work	Salary		Date of contract	End of contract
272	ﾌｧｶﾝ/ﾌｧｶﾞﾝ･ｼｰｴｽ･ｴﾌ	ﾌｧｶﾝ/ﾌｧｶﾞﾝ･ｼｰｴｽ･ｴﾌ	assistant engineer	¥	300	1874/2	1877/2
273	ﾌｰﾗｽ･ﾁｬｰﾚｽ	ﾌｰﾗｽ･ﾁｬｰﾚｽ		$	400	1878/12	
274	ﾌﾗｰﾙﾄﾞ	ﾌﾗｰﾙﾄﾞ	見廻役	¥	2.50	1872/4	1874/8
275	ﾌﾚｯｼｮｳﾝ	ﾌﾚｯｼｮｳﾝ	secretary	¥	150	1871/12	1872/6
276	ﾍｰﾙﾄ	ﾍｰﾙﾄ	secretary	¥	60	1872/3	1873/10.
277	ﾎﾟｰﾄ	ﾎﾟｰﾄ	mechanic	$	120	1871/3	
278	ﾎﾟｰﾅﾙ	ﾎﾟｰﾅﾙ	principal engineer			1882/3	1885/12
279	ﾎｵﾝ･ﾛﾍﾞﾙﾄ	ﾎｵﾝ･ﾛﾍﾞﾙﾄ	train driver	¥	6	1876/5	1885/12
280	ﾎﾞｯﾃﾙ･ﾌﾊﾙﾆｽ	ﾎﾞｯﾃﾙ･ﾌﾊﾙﾆｽ	engineer	¥	400	1874/2	1877/2
281	ﾎﾟﾙﾏﾝ/ﾊﾟｰﾏﾝ	ﾎﾟﾙﾏﾝ/ﾊﾟｰﾏﾝ	clerk	$	250	1871/1	1873/8
282	ﾎﾞﾙﾘﾌﾄ	ﾎﾞﾙﾘﾌﾄ	鐵工	¥	105	1871/7	1873/3
283	ﾏｯﾄﾍﾛｽ	ﾏｯﾄﾍﾛｽ	installer	¥	3	1873/8	
284	ﾓﾙﾗﾝﾄﾞ	ﾓﾙﾗﾝﾄﾞ	mason	¥	120	1870/8	1872/1
285	ﾗﾌﾍｰﾄﾞ	ﾗﾌﾍｰﾄﾞ	secretary	¥	70	1872/1	1872/7
286	ﾗﾐﾝ･ﾃﾞﾖﾝ	ﾗﾐﾝ･ﾃﾞﾖﾝ	platelayer	¥	2.63	1874/1	1875/7
287	ﾘｰﾙ	ﾘｰﾙ	不詳	¥	43.27	1870/9	1871/4
288	ﾚｯｾﾝ	ﾚｯｾﾝ	warehouse keeper	¥	150	1871/10	1872/.6
289	ﾛｳﾄﾞﾙｽ･ﾀﾞﾋｯﾄﾞ	ﾛｳﾄﾞﾙｽ･ﾀﾞﾋｯﾄﾞ	泥工兼燗建築方頭取	¥	2.60	1875/	
290	ﾛｯﾂ･ｳｨﾙﾘｱﾑ	ﾛｯﾂ･ｳｨﾙﾘｱﾑ	汽車整装夫	¥	2.96	1876/	
291	ﾜｸ?ﾘ･ﾍﾝﾘ	ﾜｸ?ﾘ･ﾍﾝﾘ	installer	¥	2.5	1873/2	1873/4

SOURCES

UNESCO (1975), Ōkurashō (1888), Takeuchi Hiroshi (1995), Tōkōkai (1969), Yokohama Archives of History (1991), Teraoka Jūichi (1978)

NOTES

Note 1 - When the English name or the appropriate translation of a word is unknown it has usually been left in Japanese.

Note 2 - Names with a question mark following them are what I assume the name to be from the katakana pronunciation but they may be wrong.

Note 3 - Salaries differ in different sources. The values stated here are taken from Ōkurashō (1888) and indicate the salary at the end of the employee's contract. Those salaries marked by an asterisk are taken from UNESCO (1975).

Note 4 - Salaries under 10 yen are daily salaries. All other salaries are monthly

APPENDIX 9

List of British Employees in the Telegraph Bureau

	Name (English)	Name (Japanese)	Type of work	Salary		Date of contract	End of contract
1	Abbey, Richard	ｱｯﾍﾞｲ･ﾘﾁｬﾙﾄ	operator/clerk	¥ 175		1874/10	1881/3
2	Donaldson, Thomas	ﾄﾞｰﾅﾙﾄﾞｿﾝ･ﾄﾏｽ	Mechanician	¥ 146		1875/6	1878/6
3	Driver, A.J.	ﾄﾞﾗｲｳﾙ･ｱﾙﾍﾞﾙﾄ･ｾﾞｰﾑｽ	operator/clerk	¥ 125		1872/10	
4	Driver, George?	ﾄﾞﾗｲｳﾙ･ｼﾞｮﾙｼﾞ	secretary	¥ 100		1874/9	1875/6
5	Dunk, Thomas	ﾄﾞﾝｸ･ﾄｰﾏｽ	inspector	¥ 150		1872/2	1875/4
6	Fisk, Frederick	ﾌｨｽｸ･ﾌﾚﾃﾞﾘｯｷ	inspector	¥ 125		1872/10	1875/1
7	Floyd, Joseph	ﾌﾛｲﾄﾞ･ｼﾞｮｾﾌ	operator/clerk	¥ 100		1875/2	1876/12
8	Foster, John Tasker	ﾌｫｽﾄﾙ･ｼﾞｮﾝ･ﾀｽｸﾙ	district superintendent	¥ 250		1871/7	1879/7
9	Fry, James Octavious	ﾌﾗｲ･ｾﾞｰﾑｽ･ｵｸﾀｳｽ	district superintendent	¥ 215		1871/6	1879/7
10	George, Edgar	ｼﾞｮﾙｼﾞ･ｴﾄﾞｶﾞﾙ	chief superintendent	¥ 375		1871/6	1874/8
11	Gilbert, A. E.	ｷﾞﾙﾍﾞﾙﾄ･ｴ･ｲ	district superintendent	¥ 200		1874/10	1878
12	Gilbert, Edward	ｷﾞﾙﾍﾞﾙﾄ･ｴﾄﾞﾜﾙﾄ	chief telegraph engineer	¥ 625		1874/4/28	1879/4
13	Gilbert, George Miles	ｷﾞﾍﾞﾙﾄ･ｼﾞｮﾙｼﾞ･ﾏｲﾙ	district superintendent	¥ 250		1869/12	1872/6
14	Gilbert, George Miles	ｷﾞﾍﾞﾙﾄ･ｼﾞｮﾙｼﾞ･ﾏｲﾙ	assistant superintendent	¥ 250		1875/1	1878/11
15	Gregory, George Elliot	ｸﾞﾚｺﾞﾘｰ･ｼﾞｮﾙｼﾞ･ｴﾘｵｯﾄ	English teacher	¥ 200		1875/9	1885/12
16	Halifax, T.E.	ﾊﾘﾌｧｯｸｽ/ﾊﾞﾘﾌｪｯｷｽ･ﾄｰﾏｽ;ｴﾄﾞﾜﾙﾄﾞ	assistant superintendent	¥ 150		1871/5/16	1874/7/2
17	Haswell, Edward, Wilson	ﾊｽｳｪﾙ･ｴﾄﾞﾜﾙﾄﾞ･ｳｨﾙｿﾝ	ship captain, Denshin Maru	¥ 250		1871/1	1873/12
18	Hendry, J.	ﾍﾝﾄﾞﾘｰ･ｼﾞｪｰﾑｽ	ship chief engineer, Denshin Maru	¥ 225		1871/10	1873/12
19	Henry, James	ﾍﾝﾘｰ	ship mechanic			1872/10	

	Name (English)	Name (Japanese)	Type of work	Salary		Date of contract	End of contract
20	Hindley?	ヘンドレー/ヘンドリー	ship engineer	¥ 225	*	1873/10/31	
21	Hobson, Thomas	ホブソン・トーマス	inspector	¥ 150		1875/6/3	1879/2/20
22	Housewell	ハウスウェル	ship officier			1872/10	
23	Hume, Hamilton	ヒュウム・ハミルトン	operator/clerk	¥ 145		1878/7	
24	Hunt, John	ホント・ゼー	clerk	¥ 125		1876/2	1877/4
25	Kennedy, William	ケンエディ・ウィルリアム	operator/clerk	¥ 150		1872/1	1878.00
26	Lagden, Charles ?	ラグデン・チャルレス・ホワイトヲルツ	assistant inspector	¥ 100		1872/2	1873/3
27	Larkin, Thomas	ラルキン・トーマス	district superintendent	¥ 250		1871/6	1881/3
28	Longhram, James	ログラン・ゼームス	operator/clerk	¥ 150		1874/2	1879/6
29	Malcolm, J.W.	マルコルム・ジョン・ウィルリアム	language teacher	¥ 125		1873/4	1875/8
30	Marrable, James	マルレブル・ゼームス	operator/clerk	¥ 135		1876/2	1880/9
31	Mason, William Benjamin	メイソン・ウィルリアム・ベンジャミン	telegraph instructor	¥ 210		1874/10	1885/12
32	Mathews, William Gascoin	マッチュウス・ウィルリアム・ガスコイン	inspector	¥ 130		1876/2	1880/10.
33	Mayhew, Joseph	メイヒュ・ジョセル	operator/clerk	¥ 150		1872/1	1877/7
34	McClure, Robert	マックルウル・ロベルト	operator/clerk	¥ 150		1874/10	1877.00
35	Milne, John	ミルン・ジョン	operator/clerk	¥ 174		1878/3	1881/3
36	Morris, Joseph	モリス・ジョセフ	assistant superintendent	¥ 325		1871/6	1881/3
37	O. Edward	オルヘルト・エトワルド	superintendent			1878/4	
38	O'brien, W.F.	オブライン・ウィルリアム・フレデリッキ	operator/clerk	¥ 125		1872/1	1875/3
39	Prowse, Francis	プラウス・フランシス	storekeeper	¥ 135		1872/3	1880/6
40	Pyne, F.C.	パイン・フレデリッキ	operator/clerk	¥ 125		1872/1	1874/1

	Name (English)	Name (Japanese)	Type of work	Salary		Date of contract	End of contract
41	Raffin, William	ラッフィン・ウィルリアム	inspector	¥ 150		1875/6/3	1880/8/31
42	Robertson, Robert	ロベルトソン・ロベルト	construction foreman	¥ 150		1875/6	1880/6
43	Robertson, William Stewart	ロベルトソン・ウイルリアム・ステワルト	operator/clerk	¥ 145		1878/7	1884/1
44	Rymer Jones, John	ジョーンス・ジョン・ライムル	engineer	¥ 180		1874/2	1876/6
45	Sinclair, Daniel	シンクレール・ダニエル	inspector	¥ 150		1875/6	1879/6
46	Skey, James Russell	スキイ・ゼームス・ルッセス	operator/clerk	¥ 150		1874/4	1879/1
47	Smith, J	スミツ・ジョセフ	inspector	¥ 125		1872/7	1875/8
48	Stephen, David	スティウエン・ダウィッド	operator/clerk	¥ 108		1876/2	1879/2
49	Stewart, James	ステワルト・ゼームス	clerk	¥ 180		1875/6	1885/12
50	Stewart, John		surveyor	$ 200	*	1872	
51	Stone, William Henry	ストオン・ウイルリアム・ヘンリー	secretary	¥ 350		1872/2	1885/12
52	Taylor, Alfred	テーロル・アルフレッド	ship officer - 1st class	¥ 90		1874/4	1874/9
53	Taylor, William?	テーロル・ウィルリアム	ship captain	¥ 180		1873/1	1875/5
54	Teale, Walter	ティール・ヲルトル	assistant superintendent	¥ 175		1871/5	1879/7
55	Wade		inspector	$ 125	*	1872	
56	Waite, J.S.	ウェイト・ジョン・シャルマン	inspector	¥ 125		1872/3	1875/6
57	Ward, Frederick	ワルド・フレデリッキ	operator/clerk	¥ 175		1872/1	1879/5
58	Webb, William	ウェッブ・ウィルリアム	operator/clerk	¥ 125		1872/1	1875/2
59	カルステグリッキ・オス	カルステグリッキ・オス	電気製造方	¥ 200		1874/5	1874/6
60	カルドネル・ゼームス	カルドネル・ゼオームス	ship chief engineer, Denshin Maru	¥ 200		1874/4	1875/2
61	コルウィグ・フレデリッキ	コルウィグ・フレデリッキ	operator	¥ 250		1878/3	1879/3

	Name (English)	Name (Japanese)	Type of work	Salary		Date of contract	End of contract
62	トーマス、エドワルドバリフェッキス	ﾄｰﾏｽ､ｴﾄﾞﾜﾙﾄﾞﾊﾞﾘﾌｪｯｷｽ	assistant superintendent	¥ 150		1871/5	1874/10
63	ドライウル、アルベルト、ゼームス	ﾄﾞﾗｲｳﾙ､ｱﾙﾍﾞﾙﾄ､ｾﾞｰﾑｽ	operator/clerk	¥ 125		1872/10/1	1875/10/31
64	ハンファル/ホムプル・ジョン	ﾊﾝﾌｧﾙ/ﾎﾑﾌﾟﾙ･ｼﾞｮﾝ	operator/clerk	¥ 125		1872/1	1873/7

SOURCES
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Glossary of Japanese Terms

Bakufu	幕府	Military government
Banshoshirabesho	蕃書調所	Bakufu translation bureau
Chigaihōken	治外法権	Extra territorial rights. Extraterroriality
Chōshū	長州	Chōshū domain (Yamaguchi)
Daimyō	大名	Lord
Denshin ryō (kyoku)	電信寮(局)	Telegraph Bureau
Edo	江戸	Tokyo
Eizen kyoku	営繕局	Building and Repairs bureau
Fudai daimyō	譜代大名	Vassal of the Tokugawa house
Fukoku kyōhei	富国強兵	Enrich the country, strengthen the army
Gaimushō	外務省	Ministry of Foreign Affairs
Haihanchiken	廃藩置県	Abolition of domains, creation of prefectures.
Han	藩	Domain
Hanseki hōkan	版籍奉還	Return of domain registers to Emperor
Hizen	肥前	Hizen domain (Saga)
Kaikoku	開国	Opening of the country
Kōbu daigakkō (Kōgakuryō)	工部大学校(工学寮)	Imperial College of Engineering
Kōbushō	工部省	Ministry of Public Works
Kogaku	古学	Ancient learning
Koku	石	Measure of capacity. Standardised as the equivelent of 180 litres
Kokugaku	国学	National learning
Kunaishō	宮内省	Ministry for the Imperial Household
Meiji ishin	明治維新	Meiji Restoration
Minbushō	民部省	Ministry of the Interior
Monbushō	文部省	Ministry of Education
Nichibei shūkō tsūshō jōyaku	日米修好通商条約	Commercial treaty of 1858
Nichibei washin jōyaku	日米和親条約	Treaty of Friendship 1854

Glossary of Japanese Terms

Nihonjinka	日本人化	Replacement of foreign employees by Japanese
Nōmushō	農務省	Ministry of Agriculture and Commerce
Ookurashō	大蔵省	Ministry of Finance
Oyatoi gaikokujin	お雇い外国人	Foreign employee
Rangaku	蘭学	Dutch Learning
Rōjū	老中	Senior councillors of the Bakufu
Ryō	両	Gold coin, replaced by the yen after 1868
Ryūgaku(sei)	留学(生)	Study abroad (overseas student)
Sakoku	鎖国	Seclusion
Sankin kōtai	参勤交代	Alternate Attendance System
Satsuma	薩摩	Satsuma domain
Shihōshō	司法省	Ministry of Justice
Shogun	将軍	Military leader
Sonnō jōi	尊皇攘夷	Honour the Emperor, expel the barbarian
Teikoku daigaku	帝国大学	The Imperial University
Terakoya	寺子屋	Temple schools
Tetsudō ryō (kyoku)	鉄道寮(局)	Railway Bureau
Tōdai ryō (kyoku)	灯台寮(局)	Lighthouse Bureau
Tokugawa Bakufu	徳川幕府	Tokugawa military government
Tosa	土佐	Tosa domain
Tozama daimyō	外様大名	Lord who was not a vassal of the Tokugawa house.
Yūgaku	遊学	Travel to a distant domain to study