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THE BEGINNINGS OF MINING AND METALLURGICAL EDUCATION IN JAPAN

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RESUMEN

Japón fue una sociedad muy cerrada hasta 1853, cuando tuvo que abrirse a Occidente. La educación en minería, metalurgia y geología comenzó aproximadamente hacia 1861 cuando William P. Blake (1826-1910), un graduado de la Universidad de Yale (EEUU), fue a Japón para organizar la primera Escuela de Minas. Fue seguido por otros ingenieros de Gran Bretaña, Francia y Alemania y miles más de otras disciplinas. En el presenta trabajo se resume el papel que jugaron estos ingenieros y científicos y el impacto de sus contribuciones en la sociedad japonesa.

PALABRAS CLAVE: Era Meiji, Mathew C. Perry, William P. Blake, Curt Adolf Netto, Metalurgia, Escuela Imperial de Ingeniería, Revuelta de Ashio, Terremotos, Geología, Kotano Honda.

ABSTRACT

Japan was a closed society until 1853 when it was forced to open to the West. Mining, metallurgical, and geological education started there around 1861 when William P. Blake (1826-1910) a graduate from Yale University in USA went to Japan to organize the first School of Mines. This was followed by other metallurgists from Great Britain, France, and Germany and thousands from other disciplines. The role and contributions of these engineers and scientists and their impact on Japan is briefly outlined.

KEY WORDS: Meiji era, Mathew C. Perry, William P. Blake, Curt Adolf Netto, Metallurgy, Imperial College of Engineering, Ashio revolt, Earthquakes, Geology, Kotano Honda.

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INTRODUCTION

China was the dominating power in Asia in ancient times and was a model for other neighboring countries especially Japan. The Japanese adopted similar hieroglyphs like in China and many other customs. Although the ancient Chinese have mastered casting of bronze, produced metallic zinc and white copper (a copper-nickel alloy) before the Europeans, and Marco Polo had reported on the splendor of Chinese court in the thirteenth century, mining and metallurgy were taught in China only towards the end of the nineteenth century. A similar situation existed in Japan, and both countries were closed societies that were opened only by Christian missions and foreign traders supported by gunboat diplomacy. Trade with China was already in the hands of the Arabs, Persians, and Turks for many centuries but opening these societies to the West was considered essential after the Industrial Revolution in England to keep its textile mills and blast furnaces in operation.

Before the mid nineteenth century, Japan was not interested to have commercial or cultural relations with the rest of the world. The Japanese emperor was a ceremonial figure, living powerless in the ancient capital Kyoto. For centuries the power had rested in the hands of a military leader called the *shogun* who ruled with the help of the lords, or *daimyo*, who dominated the provinces. The shogun himself ruled from Edo (the present Tokyo). They all belonged to a warrior class called the *samurai*.

In the early seventeenth century, alarmed by the behavior of European traders and missionaries, the Japanese government expelled all foreigners and forbade Japanese to travel abroad. The islands were cut off from the outside world except some Dutch merchants who were allowed, under strict regulations, to have a trading post on an Island in Nagasaki Bay. There were some Japanese scholars, however, who read books imported by the Dutch and understood that knowledge was increasing among the Europeans and argued that it

was time for Japan to open its gates and admit new ideas. But such voices were ignored or suppressed by the government. For example, the German physician on the island in Nagasaki Bay Philipp Franz von Siebold (1796-1866) (Fig. 1) was expelled from Japan in 1828 and his Japanese interpreter was put to death when it was learned that he was collecting information about Japan. Von Siebold wrote numerous books about Japan, its fauna and flora between 1832 to1853 and was a major contributor about Japanese civilization to the Western world.

Figure 1. Philipp Franz von Siebold (1796-1866).

JAPAN OPENS TO THE WEST

The gate was forced open in 1853 by the US Commodore Mathew C. Perry (1794 –1858) (Fig. 2) who brought four warships to anchor in Edo Bay, and delivered a letter from his President asking to supply US ships with food and water and for agreements to trade. The *shogun* and his advisers were impressed by the ships and guns and decided to agree. As soon as the USA was allowed to trade, other Western nations demanded and had to be given the same rights.

Figure 2. US Commodore Mathew C. Perry (1794 –1858).

Many Japanese were furious, especially the *samurai*. Some of them attacked foreigners, but this only made matters worse, as the *shoguns* then had to pay compensation. The situation, however, changed in 1868 when Emperor Mutsuhito (Fig. 3) came to power and ensured the supremacy of the imperial government. He adopted the name *Meiji* for his reign and moved the imperial court to Edo, which was re-named 'the eastern capital' or Tokyo. The *daimyo* were reduced from being lords of their provinces to being simply governors representing the emperor; the country was divided into prefectures with prefects taking orders from the emperor's ministers. The army and the navy were reorganized copying the most successful European models, a ministry of education was founded, the first newspapers appeared, the European (Gregorian) calendar was adopted, and freedom of worship to all religions was allowed.

Figure 3. Japanese Emperor Mutsuhito (1852-1912) whose reign was known as Meiji. He overthrew feudalism and led reform towards Westernization.

The government did its best to encourage trade and industry in the Western style. The first railway, between Tokyo and the port of Kanagawa (now known as Yokohama), was opened in 1872, and by the end of the century Japan had over 6000 kilometers of railway and by 1900 she was able to make for herself whatever she needed, including heavy steel goods. All this was supported by a banking service copied from the USA. Postal service, telegraphic service, customs service, meteorological observation, a science museum, and light houses were also started during this period.

In 1875, Joseph Hardy Neesima (1843-1890) (Fig. 4) a Japanese convert to Christianity and the first Japanese to study in USA, founded the Doshisha College in Kyoto, a Christian establishment which literary means "one-purpose institution", to become over the years Doshisha University, one of the most important in Japan

today. The Academy of Foreign Languages was evolved in 1877 into the University of Tokyo.

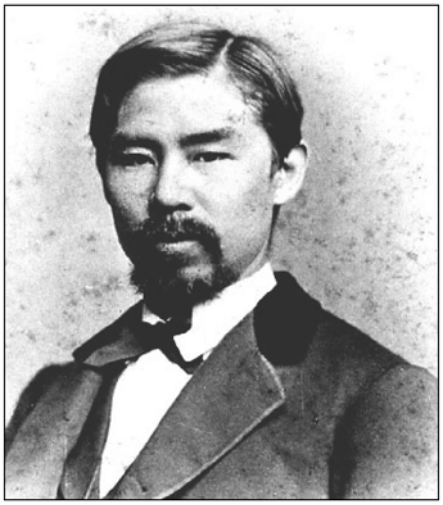

Figure 4. Joseph Hardy Neesima (1843-1890).

Sending students to study abroad

Students were sent abroad to get Western education. For example, the Freiberg Mining Academy received 45 Japanese students from 1765 to 1939 to study geology, mining, and metallurgy (Fig. 5) but this number is very small as compared with the 801 Russian students and 324 US students.

Figure 5. Professor Emil Bahlsen at the Freiberg Mining Academy with his Japanese students (Bergakademie Freiberg).

Hiring foreign specialists

Another way to accelerate westernization of the country was hiring foreign specialists/ Japan actively hired experts from Europe and USA to help her developing science and technology. It is estimated that more than 3,000 were hired by the Government and thousands more in the private sector. They were highly paid; in 1874, they numbered 520 men, during which time their salaries represented 33.7 % of the annual budget. They were usually contracted for three years after which Japanese replacements took over their places. The system was officially terminated in 1899. Nevertheless similar employment of foreigners persists in Japan, particularly within the national education system and professional sports. Until 1899, more than 800 hired foreign experts continued to be employed by the government, and many others were employed privately. Also many German medical doctors were hired to teach medicine at the University of Tokyo. Two of these became well known: Erwin Bälz (1849-1912) and Paul Mayer who was in Japan from 1877 to 1894. Prominent among the engineers were:

William P. Blake (1826-1910) (Fig. 6) was born in New York City, graduated in 1852 from Yale University, worked as a chemist in New Jersey Zinc in Baltimore (1852-54), appointed geologist for Pacific Railroad (1854-56), went to Japan to organize the first School of Mines (1861-63). When back home he was appointed professor of geology and mining, then director School of Mines, University of Arizona (1895-1905).

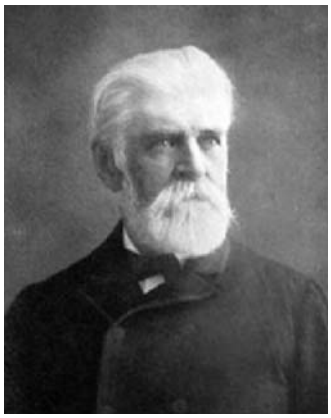

Figure 6. William P. Blake (1826-1910).

Benjamin Smith Lyman (1835–1920) (Fig. 7) was born in Northampton, Massachusetts. He graduated from Harvard University in 1855. After working briefly as a school teacher, he went to study at the Ecole Imperiale des Mines in Paris (1859-60) and at the Freiberg Mining Academy in Saxony (1861-62). Upon returning to the United States, he opened a consulting mining engineering office in Philadelphia. In 1870, Lyman surveyed oil fields in the Punjab for the Public Works Department of the government of British India.

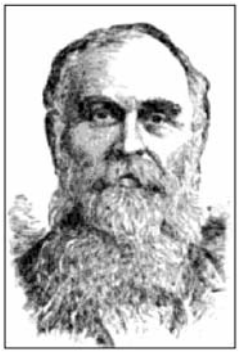

Figure 7. Benjamin Smith Lyman (1835 –1920).

In 1872, he was hired by the Japanese government to survey the coal and oil deposits of Hokkaidō and along the Sea of Japan coastline of Honshu. His survey identified the most promising coal fields for Hokkaidō's eventually successful coal industry. He stayed in Japan from 1873-1879 as chief geologist and mining engineer to the Meiji government (Fig. 8). He published the first geological map of Hokkaidō in 1876. Before leaving Japan, he encouraged his assistants to form the Geological Society of Japan and to publish a journal. He donated his house to the new society for use as its headquarters. Lyman returned to Northampton, and spent the next several years working on his reports.

Figure 8. Lyman and his students in Tokyo.

Francisque Coignet (1835-1902) (Fig. 9) a French mining engineer who traveled extensively. In 1867, he was hired by the Shimazu clan of Satsuma Domain to develop the mines and mineral resources of that domain. In 1868, his services were transferred to the control of the Tokugawa shogunate, who requested that he re-develop the Ikuno Silver Mine in Hyōgo Prefecture, near Kobe through the introduction of Western tunneling techniques and blasting technology. With the Meiji Restoration, his services were transferred to the new Meiji government. In 1874, he published *Note sur la richesse minerale du Japon.* He spent 10 years in Japan developing mining machines. He engaged 24 French technicians to work with him. He was a graduate of the technical school of Saint-Étienne.

William Gowland (1842-1922) (Fig. 10) was born in Sunderland, educated at the Royal College of Chemistry and the Royal School of Mines in London. He worked in the copper industry in England from 1870 to 1892, then was appointed at the Imperial Japanese Mint from 1872 to 1888. Became Professor of Metallurgy at the Royal School of Mines. From 1905 to 1907 he was President of the Royal Anthropological Institute, and from 1907 to 1908 President of the Institution of Mining and Metallurgy. In 1912 he was elected President of the Institute of Metals. He authored *Metallurgy of the Nonferrous Metals* (1914, third edition 1921).

Figure 9. Francisque Coignet (1835-1902). A monument at Ikuno Silver Mine.

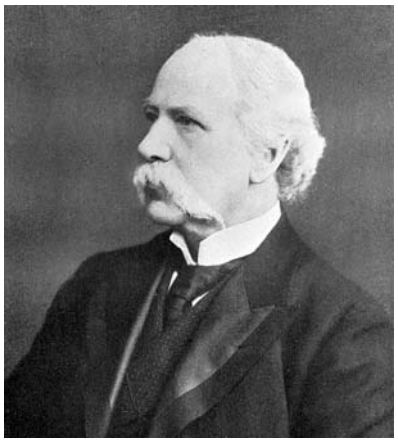

Figure 10. William Gowland (1842-1922).

Henry Dyer (1848-1918) (Fig. 11) was born in a village in what is now known as North Lanarkshire. Around 1865, his family moved to Glasgow where he was employed at a foundry and at the same time, he attended classes at Anderson's College. Upon graduation he was appointed in 1872 Professor of Engineering at the new Imperial College of Engineering in Tokyo. He established a progressive system of engineering education in Tokyo, sent many to Glasgow to complete their education, and helped set up the Akabane Engineering Works, the largest in the Empire of Japan. Many of the major engineering works carried out in Japan at the end of the 19th century were by his former students. When he left Japan in 1882, Emperor Meiji awarded him the Order of the Rising Sun, the highest Japanese honor available to foreigners. When back to Scotland he became Governor of what was previously Anderson's College, where he had been a student, and later to become the University of Strathclyde.

Figure 11. Henry Dyer (1848-1918).

John Milne (1850-1913) (Fig. 12), a British geologist from Liverpool, studied at King's College, Royal School of Mines, and Freiberg Mining Academy. Obtained doctorate from Oxford University then worked in Cornwall, Central Europe, Newfoundland, and Labrador (1872-74). Taught geology and mining at Tokyo Imperial College of Engineering, now the University of Tokyo (1875-95). He invented the seismograph in 1880 and was co-founder of the Japanese Earthquake Society. Returned to England with his Japanese wife in 1895. Authored: *Earthquakes*, 1883, *Seismology*, 1888, and *Miner's Handbook*, 1894.

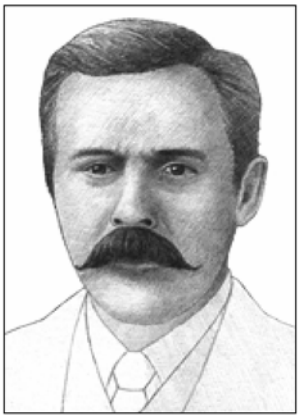

Figure 12. John Milne (1850-1913).

Curt Adolf Netto (1847-1909) (Fig. 13) was born in Freiberg, Saxony. His father was a mine inspector. After graduation from the Freiberg Mining Academy he volunteered in the German Army, was wounded in the French–Prussia War of 1870–1871, and was awarded the Iron Cross. In 1873 he went to Japan to work in a silver refinery in Kosaka, Akita Prefecture. In 1877 he joined the Imperial College of Engineering to teach mining and metallurgy. His metallurgy lectures were translated in Japanese by his students in 1887 and it remained for a long time as a useful book (Fig. 14). Before leaving Japan in 1886 he was received by the emperor who decorated him with the Order of the Rising Sun. When back in Germany, Netto continued his metallurgical researches.

In 1947, a group of engineers at Japan Iron and Steel Institute celebrated Netto's hundredth birthday anniversary in recognition for his service to the Japanese mining and metallurgical industries.

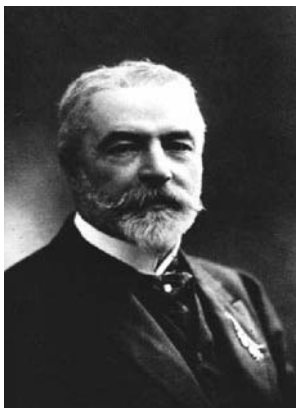

Figure 13. Curt Adolf Netto (1847-1909), a German metallurgist from Freiberg Mining Academy, taught the first courses on mining and metallurgy in Japan.

Figure 14. Netto's metallurgy lecture notes translated into Japanese.

Edmund Nauman (1854–1927) (Fig. 15), a geologist from Germany was hired to introduce the science of geology to Japan, teaching at the *Kaisei Gakkō*, the forerunner to Tokyo Imperial University. He taught geology from 1875 to 1887. He spent ten years in Japan. Together with British geologist John Milne were interested in exploring the origins of the earth and the science of vulcanology. In 1877, they investigated a volcanic eruption on the island of Izu Ōshima near Tokyo. However, by the 1880s, Milne focused more on seismology, whereas Naumann concentrated on his attempts to complete a geological map of the Japanese archipelago.

Naumann conducted numerous geological surveys. In 1879, he speculated that the three major foldings of the Earth's crust, in the pre-Paleozoic, late Paleozoic and Miocene era, and that Japan was composed of two major mountain systems, in the southwest and the northeast. The divide between these mountain systems, a great fault zone which vertically divides the main Japanese island of Honshū from the Izu peninsula in the southwest to Toyama in the northeast, he labeled the "Fossa Magna". According to Naumann's suggestions, the Japanese Ministry of Agriculture and Commerce established a Geology Department in 1878, which began the process of systematically mapping the Japanese

archipelago. The foundation of the Geological Survey of Japan came a year before the foundation of the equivalent United States Geological Survey in the United States.

Figure 15. Edmund Nauman (1854 –1927).

Naumann was also interested in paleontology. In 1881, he published a paper on his findings with regards to the findings of fossilized bones remains of elephants in Japan. He did not excavate fossils, but examined samples unearthed by Japanese and Western antiquarians. The main significance of Naumann's report was his placement of the fossils in the Pliocene era. Due to the quantity of fossils discovered Naumann postulated that Japan was once connected to the Asian mainland via several land bridges through what is now the Korean Peninsula, the Kurile Islands and the Ryukyu islands, and that the climate at the time was tropical.

On his return to Germany he joined the faculty at the University of Munich. He made numerous public comments that were highly critical of Japan. The city of Itoigawa, Niigata in Japan opened a museum in Naumann's honor in 1973. His major works: *Vom Goldenen Horn zu den Quellen des Euphrat* (1893) and *Geologische Arbeiten in Japan* (1901).

IMPERIAL COLLEGE OF ENGINEERING

The first courses on mining and metallurgy in Japan were taught at the newly-founded Imperial College of Engineering in Tokyo in 1877 by Curt Adolf Netto. The Imperial College of Engineering became in 1886 Tokyo Imperial University (re-named University of Tokyo in 1947). From Tokyo University graduated the distinguished Japanese metallurgist Kotaro Honda (1870-1954) (Fig. 16). He became a Doctor of Science in 1903. After studying in Europe from 1907 to 1911, he returned to Japan to become a professor at the Tohoku Imperial University. He developed the thermal balance and was the first to develop in 1916 the first cobalt steel for permanent magnets. He became the president of the Tohoku Imperial University in 1931. He received the first Order of Culture in 1937 and many medals and awards.

Figure 16. Kotano Honda (1870-1954) a distinguished Japanese metallurgy graduate from Tokyo University.

AKITA MINING COLLEGE

Akita Mining College was founded in 1910 in Akita City as the first mining college in Japan. Akita Prefecture has been well known as a rich area in mineral resources for many years and the foundation of a College there was a result of combined effort of the Prefecture Government and the mining companies Fujita, Iwasaki, and Furukawa. The college started with two programs: mining and metallurgy based on the Mining Academy in Freiberg as a model. Over the years, the College expanded and became known as Akita University. In addition, the University has an excellent Mining Museum (Fig. 17) with a large collection of minerals, fossils, and models of metallurgical plants.

Figure 17. Mining Museum at Akita University.

EPILOGUE

Japan accepted the Western ideas probably after observing the humiliation of China by Western powers in the 1840's. She innovated her army, navy, and industry, while the Chinese rulers resisted every effort to renovate because of widespread corruption in the imperial palace and ignorance and superstition everywhere. While the Japanese hired many Westerners in various specialties, China was plagued by intruding Westerners

who went there to loot the country. The result of this was demonstrated in the victorious Japanese army against China in 1895 and against Russia in 1905, and the occupation of Manchuria and Korea. China no longer became the dominating power in Asia and a model for other neighboring countries. The situation was reversed: Japanese imperialism became the dominating force in the Far East and the chief training ground for Chinese students. For example, in 1911 there were 800 Chinese students in USA, 400 in Europe, and 15 000 in Japan.

Problems however resulted from hiring foreign specialists. In 1877 a *samurai* revolt broke out led by a man who thought that change had gone too far. In fierce fighting the revolt was crushed, but the changes were not all gain for the common people; many of them suffered those same evils that had happened to many European workers when their countries went through an industrial revolution.

Industrialization of the mining sector in Japan had also its problems because the engineers did not consider proper waste disposal. In the 1890's the Ashio Copper Mine was responsible for the destruction of large portions of the Kanto Plain through SO_2 emission and other effluents released into the Watarase and Tone rivers. With the livelihoods and health of thousands of farmers at stake, the Ashio Pollution case quickly became a problem for Meiji social reformers. In 1907 Ashio's miners erupted in a three day outburst of violence unprecedented in Japanese labor history. Using dynamite and arson Ashio's angry miners destroyed a large part of Japan's most modern mining complex. In the end it took a declaration of martial law, the use of government troops, and a heavily augmented police force to suppress the riot. By 1910 the Furukawa Company's Ashio Copper Mine stood not only for environmental degradation, but symbolized the darker and more violent side of Japan's transformation into a modern industrial state and economy.

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