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Travelling in China

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TRAVELLING IN CHINA[1]

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ABSTRACT

The changes that took place in China between 1984 and 2004 are remarkable. Visits were made to universities, research institutes, metallurgical industry, and many cultural centers within five trips during this twenty years period. The impressions of these visits are outlined.

INTRODUCTION

In October 1981 I met Dr. Chen Chia-Yung, a distinguished Chinese hydrometallurgist and Deputy Director of the Institute of Chemical Metallurgy of the Academia Sinica in Beijing, at the *Second World Congress of Chemical Engineering* that was held in Montreal. While we were taking lunch together he invited me to give a short course on hydrometallurgy at his Institute. He confirmed this invitation by a letter as soon as he returned home, which I accepted with pleasure. The invitation resulted in five trips to China during the 20-years period 1984-2004 (Tables 1 and 2 - see Appendix A for Table 2). In addition, a Chinese scholar from the Uranium Ore Processing Institute in Beijing spent one year in my laboratory at Laval University in 1985 and a Chinese delegation from Nantong University visited me in Quebec City in 2006.

During my first trip in 1984 I leaned to my surprise that the first two volumes of my *Principles of Extractive Metallurgy* were translated into Chinese in 1975 (Figure 1). Since they were by then out of print, my colleagues got copies for me after much effort. In 1986, two of my papers were translated into Chinese: "Extractive Metallurgy at Laval University" (Figure 2) and "The Recovery of Rare Earths from Phosphate Rock" (Figure 3). Incidentally, the Chinese have a specialized journal devoted to rare earths because of the immense deposits they possess (Figure 4). It was in this journal that my paper was published.

[1] Dedicated to Professor Chen Chia-Yung on his eightieth birthday who was the first to introduce me to china.

Table 1. Trips to China.

Dates	Cities visited	Remarks
May 1- 26, 1984	Beijing Changsha Zhuzhou Shanghai	Short course, seminars, industrial and cultural visits
May 5 – June 7, 1990	Hong Kong Guangzhou Changsha Kunming	Short course, seminars, industrial and cultural visits
October 14 -18, 2001	Shanghai	Seminar and cultural visits
March 29 – April 15, 2002	Kunming Hong Kong Shanghai Beijing	Conference, seminars, cultural visits
October 16 – 24, 2004	Xi'an Beijing	Conference, cultural visits

Figure 1. Chinese translation of Principles of Extractive Metallurgy.

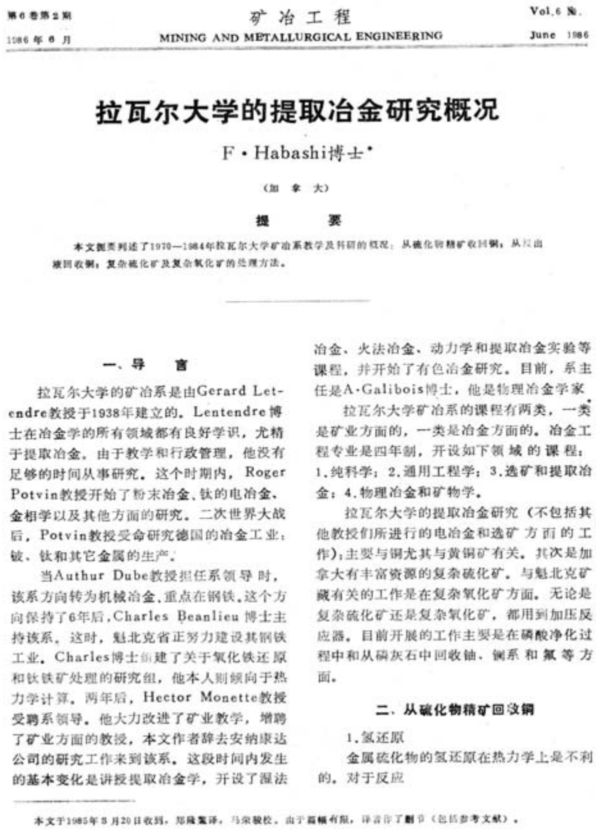
HISTORICAL BACKGROUND

From ancient times China was the master of the Far East and her civilization was copied by Japan and other countries. The ancient Chinese have mastered casting of bronze, produced metallic zinc and white copper (a copper-nickel alloy), and used coal before the Europeans. They invented paper and gunpowder and monopolized silk production for centuries. They manufactured high quality porcelain; the name kaolin is derived from Kaoliying - a locality near Beijing (Figure 5).

Although Marco Polo had reported on the splendour of Chinese court in the thirteenth century, the country was socially and politically backward. 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.

The ancient Chinese civilization was so well established that the last rulers of the Manchu Dynasty were so convinced of the superiority of the Chinese way of life. They refused to acquire anything more than the most superficial knowledge about the West. Imperial regulations even prohibited Chinese from travelling abroad and teaching their language to foreigners. They were unaware that social and

technological revolution in Europe were producing traders and missionaries prepared to probe and settle the far corners of the world.



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拉瓦尔大学的提取冶金研究概况

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（加 拿 大）

提 要

本文概要列述了1970—1984年拉瓦尔大学矿冶系教学及科研的概况；从硫化物精矿收回铜，从溶液回收铜，复杂硫化矿及复杂氧化矿的处理方法。

一、导 言

拉瓦尔大学的矿冶系是由Gerard Letendre教授于1938年建立的。Lentendre博士在冶金学的所有领域都有良好学识，尤精于提取冶金。由于教学和行政管理，他没有足够的时间从事研究。这个时期内，Roger Potvin教授开始了粉末冶金、钛的电冶金、金相学以及其他方面的研究。二次世界大战后，Potvin教授受命研究德国的冶金工业；铍、钛和其它金属的生产。

当Authur Dube教授担任系领导时，该系方向转为机械冶金，重点在钢铁。这个方向保持了6年后，Charles Beanlieu 博士主持该系。这时，魁北克省正努力建设其钢铁工业。Charles博士组建了关于氧化铁还原和钛铁矿处理的研究组，他本人则倾向于热力学计算。两年后，Hector Monette教授受聘系领导。他大力改进了矿业教学，增聘了矿业方面的教授，本文作者辞去安纳康达公司的研究工作来到该系。这段时间内发生的基本变化是讲授提取冶金学，开设了湿法冶金、火法冶金、动力学和提取冶金实验等课程，并开始了有色冶金研究。目前，系主任是A·Galibois博士，他是物理冶金学家

拉瓦尔大学矿冶系的课程有两类，一类是矿业方面的，一类是冶金方面的。冶金工程专业是四年制，开设如下领域的课程：1.纯科学；2.通用工程学；3.选矿和提取冶金；4.物理冶金和矿物学。

拉瓦尔大学的提取冶金研究（不包括其他教授们所进行的电冶金和选矿方面的工作），主要与铜尤其与黄铜矿有关。其次是加拿大有丰富资源的复杂硫化矿。与魁北克矿藏有关的工作是在复杂氧化矿方面。无论是复杂硫化矿还是复杂氧化矿，都用到加压反应器。目前开展的工作主要是在磷酸净化过程中和从磷灰石中回收铀、镧系和氟等方面。

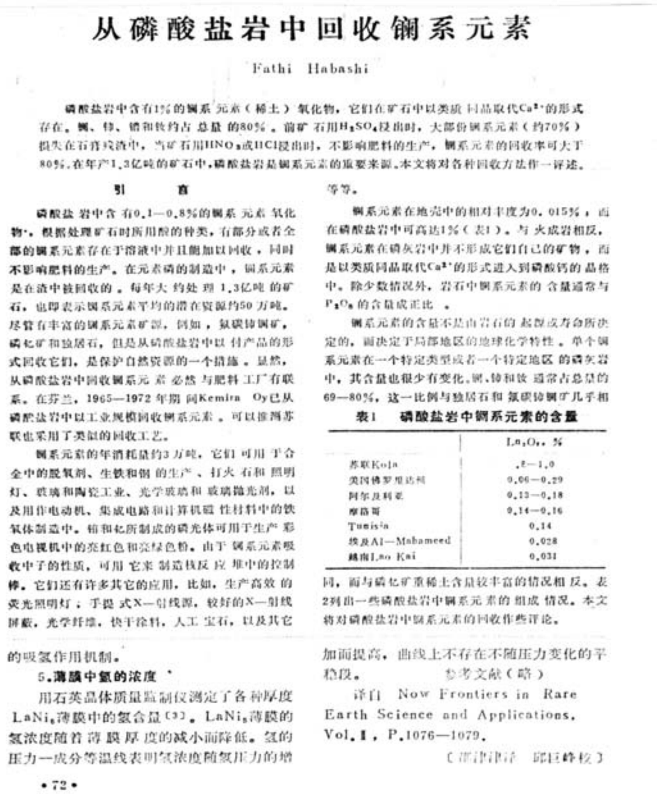
二、从硫化物精矿回收铜

1.氢还原

金属硫化物的氢还原在热力学上是不利的。对于反应

本文于1985年8月20日收到，郑隆鳌译，马荣骏校。由于篇幅有限，译者作了删节（包括参考文献）。

Figure 2.- Extractive Metallurgy at Laval.



从磷酸盐岩中回收镧系元素

Fathi Habashi

磷酸盐岩中含有1%的镧系元素（稀土）氧化物，它们在矿石中以类质同晶取代Ca^{2+}的形式存在。镧、铈、镨和钕约占总量的80%。前矿石用H_2SO_4浸出时，大部份镧系元素（约70%）损失在石膏残渣中，当矿石用HNO_3或HCl浸出时，不影响肥料的生产，镧系元素的回收率可大于80%。在年产1.3亿吨的矿石中，磷酸盐岩是镧系元素的重要来源。本文将对各种回收方法作一评述。

引 言

磷酸盐岩中含有0.1—0.8%的镧系元素氧化物。根据处理矿石时所用酸的种类，有部分或者全部的镧系元素存在于溶液中并且能加以回收，同时不影响肥料的生产。在元素磷的制造中，镧系元素是在渣中被回收的。每年大约处理1.3亿吨的矿石，也即表示镧系元素平均的潜在资源约50万吨。尽管有丰富的镧系元素矿源，例如，氟碳铈镧矿，磷钇矿和独居石，但是从磷酸盐岩中以付产品的形式回收它们，是保护自然资源的一个措施。显然，从磷酸盐岩中回收镧系元素必然与肥料工厂有联系。在芬兰，1965—1972年期间Kemira Oy已从磷酸盐岩中以工业规模回收镧系元素。可以推测苏联也采用了类似的回收工艺。

镧系元素的年消耗量约3万吨，它们可用于合金中的脱氧剂、生铁和钢的生产、打火石和照明灯、玻璃和陶瓷工业、光学玻璃和玻璃抛光剂，以及用作电动机、集成电路和计算机磁性材料中的铁氧体制造中。钇和钆所制成的磷光体可用于生产彩色电视机中的亮红色和亮绿色粉。由于镧系元素吸收中子的性质，可用它来制造核反应堆中的控制棒。它们还有许多其它的应用，比如，生产高效的荧光照明灯；手提式X—射线源，较好的X—射线屏蔽，光学纤维，快干涂料，人工宝石，以及其它等等。

镧系元素在地壳中的相对丰度为0.015%，而在磷酸盐岩中可高达1%（表1）。与火成岩相反，镧系元素在磷灰岩中并不形成它们自己的矿物，而是以类质同晶取代Ca^{2+}的形式进入到磷酸钙的晶格中。除少数情况外，岩石中镧系元素的含量通常与P_2O_5的含量成正比。

镧系元素的含量不是由岩石的起源或寿命所决定的，而决定于局部地区的地球化学特性。单个镧系元素在一个特定类型或者一个特定地区的磷灰岩中，其含量也很少有变化。镧、铈和钕通常占总量的69—80%，这一比例与独居石和氟碳铈镧矿几乎相同，而与磷钇矿重稀土含量较丰富的情况相反。表2列出一些磷酸盐岩中镧系元素的组成情况。本文将对磷酸盐岩中镧系元素的回收作些评论。

表1 磷酸盐岩中镧系元素的含量

	Ln_2O_3, %
苏联Kola	.8—1.0
美国佛罗里达州	0.06—0.29
阿尔及利亚	0.13—0.18
摩洛哥	0.14—0.16
Tunisia	0.14
埃及Al—Mahameed	0.028
越南Lao Kai	0.031

的吸氢作用机制。

5.薄膜中氢的浓度

用石英晶体质量监测仪测定了各种厚度$LaNi_5$薄膜中的氢含量[3]。$LaNi_5$薄膜的氢浓度随着薄膜厚度的减小而降低。氢的压力一成分等温线表明氢浓度随氢压力的增加而提高，曲线上不存在不随压力变化的平稳段。

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译自 Now Frontiers in Rare Earth Science and Applications, Vol.I, P.1076—1079.

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Figure 3. Recovery of Rare Earths from Phosphate Rock

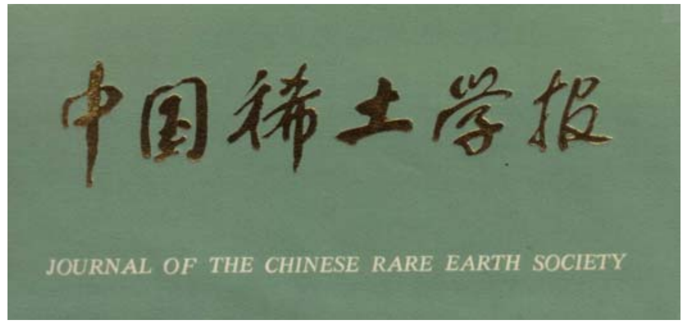

Figure 4. Journal of the Chinese Rare Earths Society.

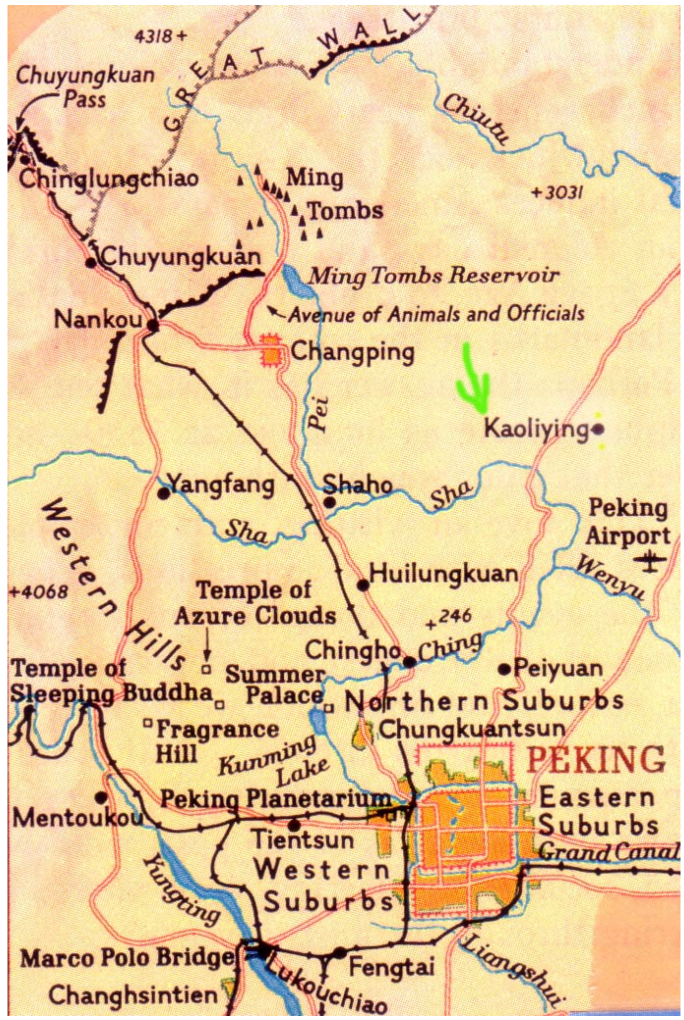

Figure 5. Kaolying , a locality near Beijing.

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. Corruption was widespread, originating in the imperial palace, while ignorance and superstition were 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. Thus, the situation was reversed: Japanese imperialism became the dominating force in the Far East.

Towards the end of the seventeenth century, Christian missionaries were in all provinces and many Chinese natives were converted to Christianity. European merchants also penetrated the

empire. The Portuguese retained Macao, the French, Dutch, and British followed suite. In 1784 came the first ship from the United States. Chinese tea, silks, and cotton were in great demand.

Figure 6. Herbert Hoover (1874-1964).

The Opium Wars

Opium from British India became an important article of exchange although it was prohibited by the Chinese government. Interference in Chinese ancient customs by Christian missionaries caused a prolonged controversy which ended with persecution of the missionaries and their converts. Hostilities broke out and the British fleet defeated the Chinese in what became known as the Opium Wars of 1839-42 and 1856-60. Treaties were signed which gave large concessions to the foreign powers to pay off the indemnity. This included the cession of the island of Hong Kong to Britain, permitting foreign envoys to reside in Peking (now known as Beijing), legalizing the importation of opium, and other privileges.

The Arrival of Westerners

The country was flooded with Westerners who went to exploit China's natural resources. Among these was Herbert C. Hoover (1874-1964) (Figure 6) a mining engineer from Stanford University who was hired in 1897 by Bewick, Moreing, and Company, a major London-based consulting firm, to examine and manage mines in China. After displaying excellent abilities he was offered in 1898 the position of chief engineer of the Imperial Bureau of Mines of Chihli and Johol provinces in China. He assembled an American technical staff to work with him, but, the Boxer Rebellion of 1900 put an end to his government position and in 1901 he became the general manager of the Chinese Engineering and Mining Company which operated the Kaiping mines in north of Tientsin, one of the richest coal mines in the world. The mines were opened in 1878 to provide coal for the steamer fleet transporting grain and rice from Shanghai in the Yangtze delta to Tientsin to feed the capital, and the first Chinese railways were inaugurated in 1881 to transport this coal. The mines were heavily in debt to foreigners because of mismanagement before Hoover took over.

In the fall of 1901, the Belgian Companie Internationale d'Orient purchased the majority of the business from other European and Chinese investors and appointed Emile Franqui (1863-1935) the Belgian consul in Shanghai with a Belgian technical staff to replace the Americans. The company beloged to Emperor Leopold II of Belgium. Edgar Sengier (1879-1963) another Belgian engineer who joined a consulting firm in Birmingham was sent in 1907 to Shanghai to direct this company. Both Franqui and Sengier became later directors of Union Miniere du Haut Katanga.

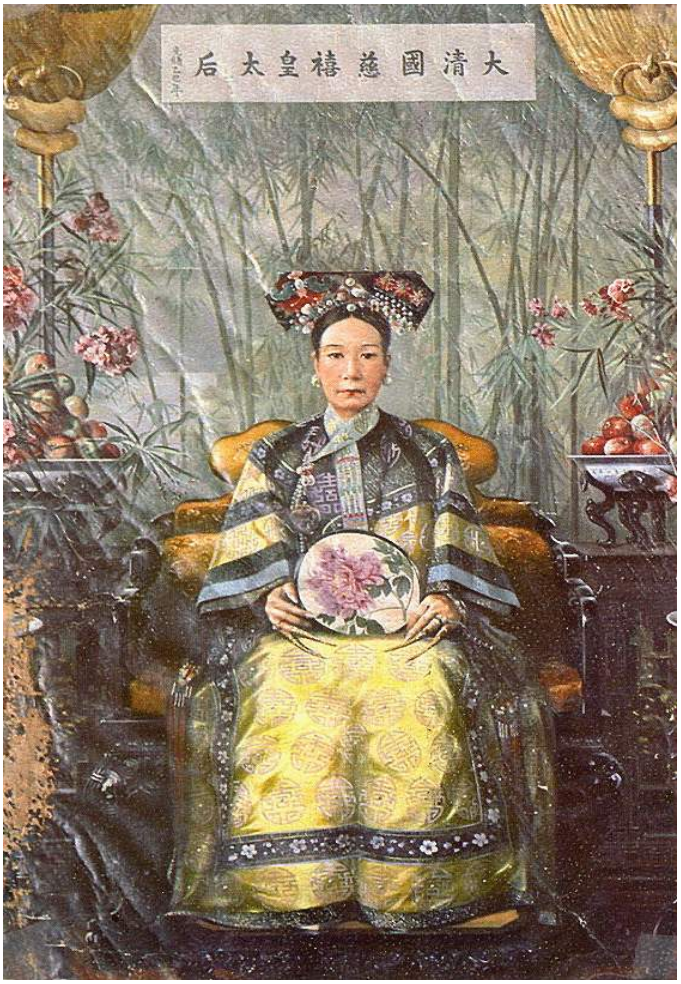

Figure 7. Empress Dowager Tzu His (1834-1908).

The Boxer Rebellion

Anti-foreign feelings culminated in the bloody "Boxer Rebellion" of 1900 in which the Chinese massacred the foreigners and the Chinese Christians. Incidentally, Herbert Hoover and his wife were there and survived the events unharmed. He documented it in his *Memoirs*. When order was established, the Manchu government of Empress Dowager Tzu Hsi (Figure 7) had to pay heavy indemnities and foreign troops occupied certain quarters. Some of these indemnities were paid against leasing ports.

Modern China

The empress died in 1908 and was succeeded by a 2½-years old boy under whose reign the Chinese Revolution started in 1911. The boy abdicated in 1912 and Sun Yat-Sen elected president of the republic. Thus ended the rule of the Manchus who came from Manchuria in 1644. Incidentally, the boy-emperor became in 1934 the head of the Japanese puppet state of Manchuko (Manchuria).

Sun Yat-Sen (1866-1925) (Figure 8) was born in a Christian family in a village near Guangzhou (formerly known as Canton). After receiving his early education in both Chinese and Western schools, he moved to Hawaii in 1879, where he attended College. In 1883, he

returned to China to continue his studies. He later moved to Hong Kong and in 1892 graduated from Medical College.

Figure 8. Sun Yat-Sen (1866-1925).

Seeing the weakness of the imperial Manchu court and the influence of foreign powers, Sun gave up his medical career to pursue political reform. In 1894, together with a group of overseas Chinese youths, Sun established his revolutionary organization the Society for Regenerating China in Honolulu, Hawaii designed to build an independent, democratic, and prosperous China. Over the next 16 years, Sun and his followers launched ten futile attempts to topple the corrupt imperial Manchu court. Finally, on October 10, 1911, forces loyal to Sun took over Wuchang, the capital of Hubei Province. Thereafter, other provinces and important cities joined the revolutionary camp and declared independence from the Manchu government. On December 29, 1911, Sun was elected provisional president of the new and was inaugurated on January 1, 1912, the founding day of the Republic of China.

To preserve national unity, Sun relinquished the presidency on April 1, 1912, to military strongman Yuan Shih-Kai (1859-1916) (Figure 9), who declared himself emperor in 1915. Sun and other leaders formed the Kuomintang party dedicated to the creation of a parliamentary system in China. He moved the revolutionary effort to Japan until Yuan Shih-Kai's death in 1916. In 1917, the Provisional Assembly elected Sun to lead the Chinese Military Government based in Guangzhou, and in 1921 Sun assumed office as president of the newly formed government in Guangzhou. He devoted the rest of his life to uniting China's feuding factions believing that the communist system was not suitable for China. He died of illness at the age of 59 in Beijing. His mausoleum was erected in Guangzhou.

Figure 9. Yuan Shi-Kai (1859-1916).

Figure 10- Chiang Kai-Shek (1887-1975)

The Civil War. Chiang Kai-Shek (1887-1975) (Figure 10) was born in Chekiang, served in the Japanese Army, assisted Sun Yat-Sen in building Chinese Nationalist Army after declaration of Republic in 1911, trained in Red Army in 1923, succeeded Sun Yat-Sen as leader

of Kuomintang after his death in 1925. Under his leadership the Kuomintang fought civil war against Communist Party 1927-1949, against the Japanese 1931-45, in a "united front" with the Chinese Communist Party, received support from the USA, from Nazi Germany, and from the USSR until 1945, fled with his forces to Taiwan in January 1949. Mao Ze-Dong (1893-1976) (Figure 11) the leader of the Chinese Communist Party proclaimed the Peoples Republic of China in 1949.

The Great Leap Forward. In 1957, Mao Ze-Dong called for an increase in the speed of growth of socialism. He began the Great Leap Forward, establishing special communes in the countryside using collective labour and mass mobilization. The movement was intended to increase the production of steel and to raise agricultural production. As the peasants were working in urban centers on steel production, much of the crop was not harvested. The peasants were ill-equipped and ill-trained to produce steel. Local authorities continually reported unrealistic production numbers, which hid the problem for years. Steel production did show growth but much of it was impure and useless. The movement turned into a disaster.

Figure 11. Mao Ze-Dong (1893-1976).

The Cultural Revolution. Between 1966 and 1969, Mao encouraged the so-called Red Guards to take power from the Chinese Communist Party authorities. The movement was to secure Marxism-Leninism in China as the state's dominant ideology and to eliminate political opposition. It developed an anti-intellectual character when universities and research centers were closed for several years and Buddhist temples plundered. In the chaos that ensued, many died and millions were imprisoned. This period has been a period of economic stagnation. Later on Red Guard units ended up fighting each other for supremacy. It ended with the death of Mao in 1976 and the arrest of the Gang of Four which included Mao's wife. Relations with USSR broke in 1969.

The Four Modernizations. The goal of the "Four Modernizations" was to strengthen the sectors of agriculture, industry, science, and defence. Class struggle was no longer the focus as it had been under Mao. The political climate in the 1970s and 80s promoted the creation of a society of civilized and productive citizens all working toward the welfare of the country and contributing to the modernization effort.

The Tiananmen Square Protests. The Tiananmen Square protests were a series of demonstrations led by students, intellectuals, and labour activists between April 15, 1989 and June 4, 1989. The protestors came from various groups, ranging from intellectuals who believed the Communist Party was corrupt and repressive, to urban workers who believed that inflation and widespread unemployment was threatening their livelihoods.The resulting crackdown on the protestors by the government left many dead.

Figure 12. Hong Kong.

HONG KONG

Hong, means "trading company", Kong, means "glorious" (Figure 12). In June 1997 Hong Kong returned to China. Before this date Canadians did not require a visa to enter Hong Kong but crossing to mainland China from there was an inconvenient experience because of the pass control procedure. Under the "*One Country, Two Systems*" policy, Hong Kong retains its own legal system, currency, customs policy, cultural delegation, international sport teams, and immigration laws. Canadian still do not need a visa to enter Hong Kong but a visa to China is still necessary. In 2002 I entered Hong Kong from Kunming with a valid Chinese visa on my way to Shanghai. Although I was only on transit but I needed another visa to return to China ! This was an unimaginable situation because it was too late to get a visa and I had to spend a night at an airport hotel till next day when the office re-opens and in vain to try to communicate with my host who was supposed to wait for me in Shanghai airport.

A new airport in Hong Kong was recently constructed by levelling off two nearby islands (Figures 13 and 14). It is one of the largest and most impressive in the world.

BEIJING

Beijing, the capital of China since 1949 was formerly written Peking and was known in imperial times as Peiping. "Bei" means North and "Jing" means Capital (Figures 15 and 16). The former capital from 1911 to 1949 was Nanjing which means the "South Capital", was formerly written Nanking. The city is characterized by *Tiananmen Square* which is rectangular in shape and is the world's largest square that covers 440,000 square metres (Figure 17). Around the square and not far from it are located the main city attractions.

The Forbidden City. The Forbidden City is 720,000 square metres was the imperial residence of the Ming and Qing emperors for five centuries now known as the Palace Museum (Figure 18 and 19).

Figure 13. Hong Kong islands.

Figure 14. Hong Kong new airport.

The Museum of Chinese History is located in Tiananmen Square/ It has a large array of antiquities and Chinese art depicting Chinese cultural history.

Temple of Heaven. Not far from Tiananmen Square is the Temple of Heaven is China's largest temple, was built in 1420 AD during the Ming Dynasty to offer sacrifice to Heaven (Figures 20 and 21). The Temple is enclosed with a long wall and has the Gate of Complete Virtue. The most magnificent buildings are the Circular Mound Altar, Imperial Vault of Heaven, and Hall of Annual Prayer for Good Harvest. Also, there are some additional buildings and temples connected by a wide bridge called Sacred Way.

Bell museum. Bells are a Chinese invention. The Bell Museum was set up in the Great Bell Temple located on the western outskirts of Beijing, displays about 700 bells made of bronze, iron, and jade some dating from 1100 BC (Figure 22). The museum illustrates the history of Chinese metal casting. The largest bell was cast on orders of a Ming Emperor who took power in 1403 after a coup. After feeling guilt of his misdeeds he hoped to divert public indignation by casting the bell. The bronze bell weighs 46.5 tonnes and its sound can be heard 50 kilometres away. The bell was originally kept in the Imperial Longevity Temple. Shipping the bell from the foundry to the temple was a problem, since there was no vehicle that could handle it. A ditch was dug along the way, filled with water to make an ice route in winter. The bell was then placed on a huge sleigh and was hauled to its destination by oxen. In 1733 it was moved to the present site.

Figure 15. Beijing map.

Figure 16. Beijing detailed map.

The Summer Palace. The Summer Palace, in the north western suburb of Beijing was built in 1750, has marble boat (Figure 23) and magnificent bridges (Figure 24). Here are some of the names of the locations in the palace: Pavilion of Clear Sound, Pavilion of Unimpeded Sound, Pavilion of the Fragrance of Buddha, Hall of Benevolence and Longevity, Hall of Happiness and Longevity, Hall of Industrious Government, Garden of Virtuous Harmony, Garden of Harmonious Unity, Garden of Clear Ripples, Cloud-Dispelling Hall, Precious Cloud Pavilion, Sea of Wisdom, Longevity Hill, Jade Spring Hill.

Figure 17. Beijing Tianamen Square.

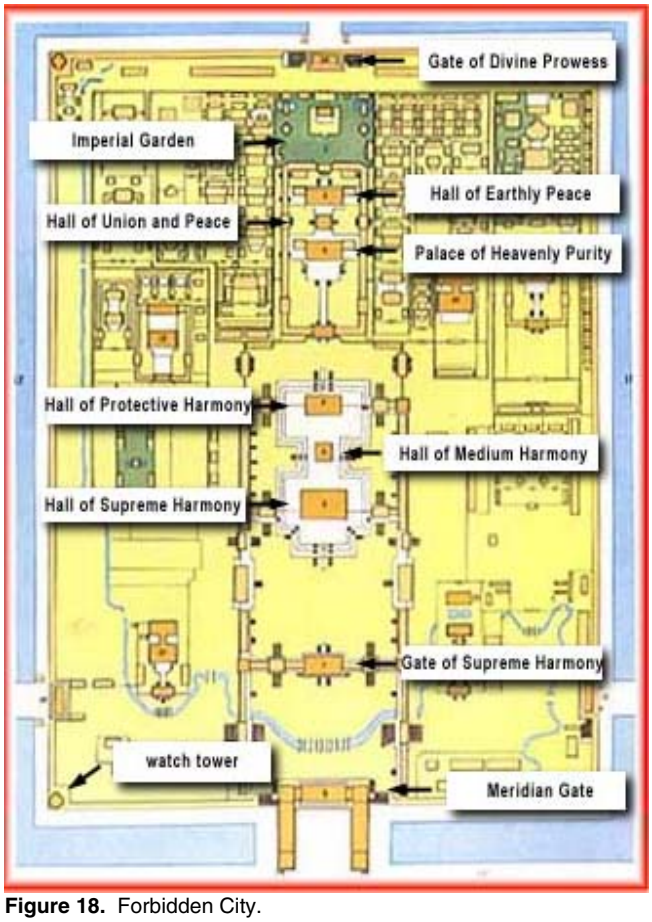

Figure 18. Forbidden City.

Figure 19. Palace Museum in Forbidden City.

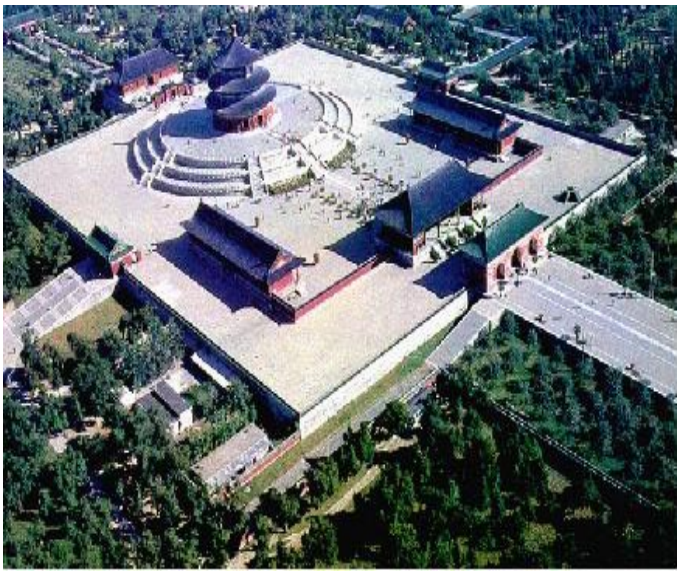

Figure 20. Temple of Heaven complex.

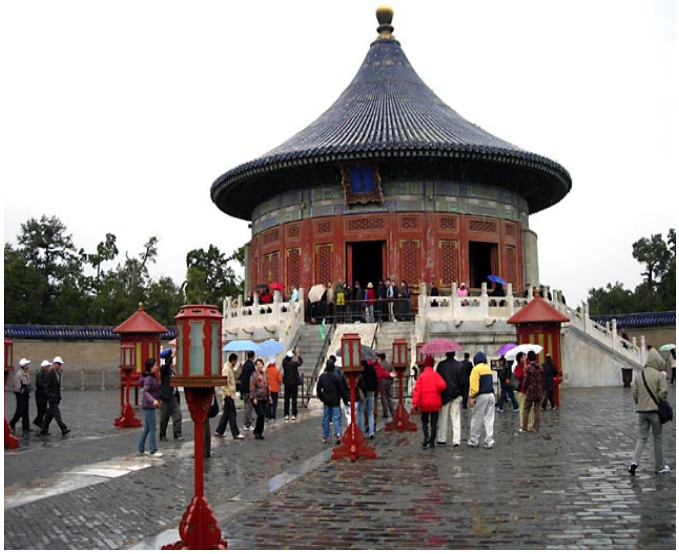

Figure 21. Temple of Heaven.

Figure 22. Bell Museum, Beijing.

Ming Tombs. Ming Tombs are located about 50 km northwest from Beijing where the mausoleums of 13 emperors of the Ming Dynasty (1368 - 1644) are located. Only two tombs are open to the public (Figure 25). The Dingling is an underground palace about 27 meters deep, was unearthed between 1956 and 1958. The road is lined with stone statues of warriors, civil officials, and animals, e.g., lions, camels, elephants, etc., (Figures 26 and 27).

Figure 23. Summer Palace marble boat.

Figure 24. One of the many marble bridges in the Summer Palace.

Figure 25. Map of Ming Tombs.

Figure 26. Road to Ming Tombs.

Figure 27. Official standing on guard.

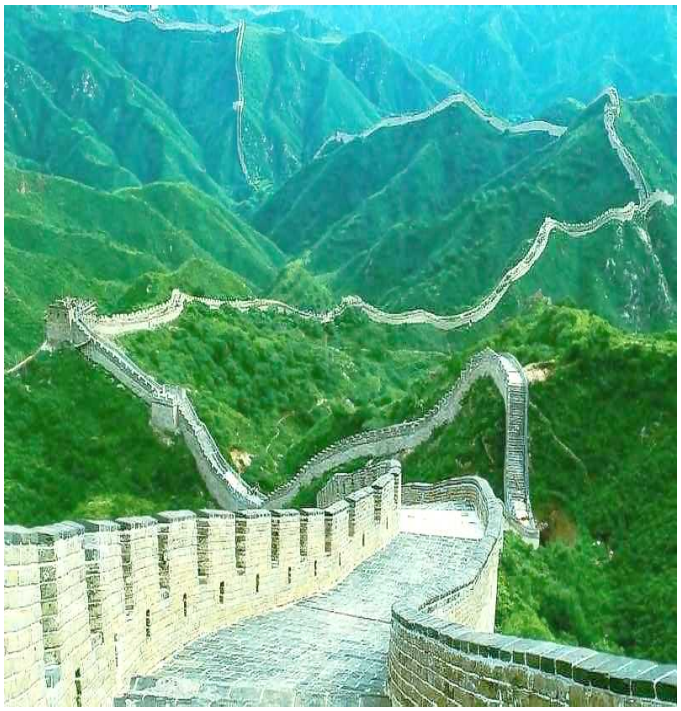

Figure 28. The Great Wall.

Figure 29. The Great Wall, another view.

The Great Wall. The 6,350 km Great Wall was in China's feudal years a defense wall that follows its way across mountains and valleys in the northern part of the country **(Figures 28 and 29)**. Its construction started in the seventh century BC but it was the founding emperor of the Qin, who brought it to completion. Repeated extensions were done in later dynasties until the Ming. The Badaling section in northwest Beijing is representative of Ming sections and is open to visitors.

Beihai Park. Situated in central Beijing, Beihai Park is one of the best-preserved ancient royal parks in China that encompasses over 68 hectares. It includes Taining Palace built in 1179. The area was given the name of Longevity Hill.

Fragrance Hill. Fragrance Hills, situated on the east foot of Western Hills, not far from Beijing Botanical Garden, covers an area of 160 hectares.

Institute of Chemical Metallurgy

This institute is one of the 150 institutes composing the Academia Sinica. Its name changed in 2000 to Institute of Process Technology (Figures 30-32). It is composed of 5 divisions: Analysis, Chemical Engineering, Hydrometallurgy, Solvent Extraction, and Automation.

Beijing General Research Institute Mining & Metallurgy

The Institute has more than one thousand people of whom 650 are engineers. It is one of similar ten institutes in China and is equivalent to CANMET in Canada or the former Bureau of Mines in USA. Known as BGRIMM, it is the Chinese biggest comprehensive research and design organization engaged in mining, mineral processing, mineralogy, metallurgy, and engineering (Figures 33 and 34).

Figure 30. At the Institute of Chemical Metallurgy in Beijing in 1984. From left: Dr. Ke Jia-Jun, Dr. Mao Ming-Hua, FH, and Dr. Chen Chia-Yung.

Figure 31. With members of Institute of Chemical Metallurgy in Beijing in 2002.

Institute of Iron & Steel Technology

This institute has the status of a university founded in 1952 by the amalgamation of some mining and metallurgy departments all over China, considered one of the three key universities in China (Figure 33).

Figure 32. Prof Chen Chia-Yung in 2002.

General Institute of Nonferrous Metals

This is a research institute devoted to metallurgy and material science, includes 1200 people of whom more than 800 are engineers and 80 senior staff. Its speciality was semiconductors and the less common metals. In 1984 it possessed the largest electron microscope in China [1 000 000 volts, magnification 500 000 times].

Figure 33. With Dr, Qui Ding-Fan director of BGRIMM in Beijing 2002.

Figure 34. With members of BGRIMM in Beijing in 2002.

Figure 35. With Prof. Ko at a conference on the history of metallurgy in Korea in 2002. He was rector of Institute of Iron & Steel in Beijing when I first met him.

Figure 36 – The South Railway Station in Beijing

Institute of Uranium Ore Processing

This institute is located 50 km east of Beijing, had 500 engineers, and publishes the quarterly journal *Uranium Mining and Metallurgy* in Chinese with English abstracts. It was from this institute that Dr. Yao Xin-Bao spend a year with me at Laval in 1985 to work on the recovery of uranium from phosphate rock.

Figure 37. China's two largest rivers. Top: Huang He known as the Yellow River. And bottom Yangze River.

CHANGSHA

To reach Changsha by train from Beijing (Figure 36) one crosses China's two main rivers: the Huang He known as the Yellow River and the Yangze (Figure 37). Changsha (Figure 38) is the capital of Hunan Province [Hu = Lake, Nan = South, hence Hunan is the province at the south of the lake], a busy port on the Xiang River. The city is split by the Xiang Jiang River a branch of the Yangzi which created a long sandbank island in the center, hence the name Changsha which can be translated as the Long Sandbank. Hunan was Chaiman Mao's home province and it was in Changsha that he went to school and started his political activity. Changsha has the largest railway station in China because of the many visitors to Mao's birth place. The major city attractions are:

Figure 38. Changsha.

Figure 39. Hunan Provincial Museum in Changsha.

Hunan Provincial Museum. The Hunan Museum was built in 1951 and opened to the public in 1956 (Figure 39). It unfolds the

cultural development of Hunan Province throughout thousands of years.

Figure 40. A well-preserved body from Mawangdui now at the Hunan Provincial Museum.

Mawangdui Han Dynasty Tombs. Mawangdui is an eastern suburb of Changsha, where tombs of officials in Western Han dynasty (206 BC-25 AD) were excavated in 1972-1974. Well-preserved corpses and more than 3000 relics were discovered (Figure 40). The tombs were below a 10 meters of coal bed, which may explain the preservation of the corps. Among the relics unearthed, were lacquer-ware, musical instruments, silk paintings, pottery and Chinese medicinal herbs. There was also a complete text of a Daoist classic written on silk.

State Forest Park. Zhang Jia Jie is China's first national forest park that consists of about 3000 steep rocks that rise high up in various shapes with trees of different kinds, about 4 hours drive from Changsha (Figure 41). Hotels are available for spending the night after climbing the hills during the day.

Changsha Porcelain Factory. The plant employed 2500 workers, produced 15 000 boxes per month each box contained 45 pieces of porcelain. Hand-painted products, under-glaze and over-glaze products were produced.

Central South Institute of Mining & Metallurgy

This institute, became in 1988 Central South University of Technology was founded by the amalgamation of the geology, mining, mineral processing, and metallurgy departments from six universities and polytechnic institutes from all over China (Figure 42).

Changsha Research Institute of Mining and Metallurgy

Before 1970 this institute belonged to the Academy of Sciences, now under the jurisdiction of Ministry of Metallurgical Industry. Staff is more than 1000, composed of 11 departments ranging from rock mechanics and blasting to superconductive materials. The institute is equipped with a pilot plant for various hydrometallurgical and pyrometallurgical research.

Figure 41. Zhang Jia Jie national forest park near Changsha.

Figure 42. With host, Prof. Fu Chong-Yue of Central South University of Technology in Changsha in 1990.

ZHUZHOU

Zhuzhou (Figures 43 and 44) was named Jianning in the past is an important industrial center, 60 km south of Changsha and not far from Shoashan Chairman Mao's birth place. Shao means "Beautiful" and Shan means "Mountain". Shaoshan is now a museum. All the way through from Changsha to Zhuzhou on the road are people riding bicycles, school children going on foot to their school, farmers carrying their produce, hens and dogs are crossing, etc.

Cemented Carbide Industrial Company

This is one of the most important metallurgical plants in China (Figure 45) with 7000 workers in 1984, was constructed with Russian help, produces W, WO_3, WC, Mo, Nb, Ta, rhenium salts, welding electrodes, cutting and piercing tools, dies, lithium niobate, W-Co alloys, and other minor products.

Figure 43. Location map of Zhuzhou.

Figure 44. Zhuzhou.

Nonferrous Metals Plant

This plant was constructed with Russian help and was the biggest in China with 6000 workers. It produced Zn, Cu, Pb, Bi, Cd, Au, Ag, In, Ge, Ga, Se, Te, Tl, Co, Ni, and the six platinum metals.

GUANGZHOU

Guang means "Large" and Zhou means "City", hence Guangzhou the Large City, formerly known as Canton, became the first Chinese port regularly visited by European traders (Figure 46). In 1511, Portugal secured a trade monopoly, but it was broken by the British in the late seventeenth century. Following the Opium War in 1842 the city was opened to foreign trade. Following a disturbance, French and British forces occupied Guangzhou in 1856. Later the island of Shameen was ceded to them for business and residential purposes. Under the Communist government, Guangzhou was developed as an industrial center and a modern port, with a great trade to and from Hong Kong. In ancient days, Guangzhou was the capital city for three Chinese dynasties: the South Yue, the South Han, and the South Ming.

Figure 45. Cemented Carbide Industrial Company in Zhuzhou.

Figure 46. Guangzhou, formerly known as Canton.

My wife and I reached Guangzhou from Hong Kong via Kowloon by train (Figures 47 and 48). Major city attractions of Guangzhou are:

Figure 47a. Reaching Guangzhou from Hong Kong by train via Kowloon.

Figure 47b. Guangzhou from Hong Kong.

Sun Yat-Sen' Mausoleum. Guangzhou was the seat of the revolutionary movement under Sun Yat-Sen in 1911; the Republic of China was proclaimed there. From Guangzhou the Nationalist armies of Chiang Kai-Shek marched northward in the 1920s to establish a government in Nanjing. The fall of Guangzhou to the Communist armies in late October 1949, signalled the Communist takeover of all China (Figure 49).

Guangzhou Museum. Guangzhou Museum is set within a five-story tower built in 1380 overlooking the port, called Zhen Hai Lou, i.e., Controlling the Sea. The exhibits explain the city's history all the way back to prehistoric times (Figure 50).

Birds' Valley. This is a unique large park covered by a net and is full of birds.

Figure 48. Dong Fan Hotel in Guangzhou.

Zhujiang Rare Earths Refinery

Zhu = pure, and Jiang = river, hence Zhujiand is Pure River. This is a large rare earths plant in China, located 18 km in the east suburb of Guangzhou, and employed about 1000 workers. It is one of the ten rare earths plants in China It produced 700 tonnes of rare earths oxides per year mostly for export. Raw material is a clay containing 0.1 % rare earths oxides located nearby, that is easily washed out by HCl and precipitated as a 90% mixed oxides. Separation of the individual rare earths was conducted by ion exchange and solvent extraction.

Stone Forest. The Stone Forest is about 120 kilometers from Kunming and covers an area of 400 square kilometres and includes both large and small stone scenic spots (Figure 52).

Figure 49. Sun Yat-Sen's Mausoleum and monument in Guangzhou.

KUNMING

Kunming (Figure 51), capital of Yunnan Province, is literally City of Eternal Spring so named because of its mild weather. It has probably the largest restaurant in the world where an exceptionally magnificent dancing group entertain clients after dinner. It was there that the International Conference on Metallurgical High Technology and New Materials held its banquette in 2002. Major city attractions are:

Figure 50. Guangzhou Museum.

Figure 51. Kunming.

Village of Ethnic Culture. Situated six kilometers south of Kunming, the Yunnan Ethnic Village is on the Dianchi Lake. Each of the 26 ethnic peoples of Yunnan has a village built on the premises symbolizing unity among various ethnic groups (Figure 53).

Kunming Institute of Technology

This institute was formed by the amalgamation of Yunan University (founded in 1931) and the Engineering Institute of Guizhou University (founded in 1942). It underwent numerous changes before becoming in its present status (Figure 56-60).

Figure 52. Stone Forest near Kunming.

Figure 53. Kunming EthnicVillage 2002.

SHANGHAI

One result of the Opium War was the birth of modern Shanghai. In the course of their operations the British sent a combined naval and military expedition that landed in Shanghai. Following closely on the British action, the United States and France acquired the right of trade by their nationals in the Treaty Ports. Thus, in effect, all of China was opened to foreign commerce. Despite the many crises it has faced, Shanghai has developed from a village into one of the world's principal metropolises (Figure 61).

Figure 54. Kunming Ethnic Village 2002.

Figure 55. Kunming Ehnic Village.

Figure 56. Kunming University of Technology.

Figure 57. Kunming University of Technology 1990. Rector Prof. Cai Qiao-Fang.

Figure 58. Faculty members of the Metallurgy Department in 1990. Front row left: Prof. Liu Chung-Ping, FH, Nadia Habashi, Prof. Dai Ni-An. Dr. Ma Keyi.

Figure 59. Kunming 2002.

Figure 60. Kunming 2002, visiting old friends. Left: Prof. Dai Ni-An, Prof. Liu Chung-Ping.

Figure 61. Shanghai Bund 1984

Shanghai Institute of Organic Chemistry

The Institute belongs to the Chinese Academy of Sciences and was founded by the merger of the Institute of Chemistry of the former Central Academy of Sciences with other groups dealing with the physical chemistry of polymers. In 1958, the Institute underwent a large expansion and in 1984 had a staff of 1300 and was composed of 70 departments. A large group was working on the synthesis of organic phosphorus compounds for use as solvents in hydrometallurgy, e.g., separation of the rare earths, precious metals, cobalt-nickel, etc. (Figures 62 and 63).

Figure 62. Prof. Yuan Cheng-Ye, Shanghai Institute of Organic Chemistry, Academy of Sciences 1984.

Figure 63. Shanghai Institute of Organic Chemistry 1984.

Figure 64. East China Institute of Chemical Technology in Shanghai, 1984. Prof. Wang Chen-Ming.

East China Institute of Chemical Technology

This institute was formed by the merger of different departments and was given the status of a key university in 1960. It was re-named East China University of Science and Technology in 1993. The University gradually expanded into a multi-disciplinary university including engineering, science, business, management, administration, humanities and law. The university has at present 16 academic schools. Its School of Chemical Engineering and School of Material Science & Engineering are key educational institutions in China (Figure 64).

Figure 65. Copper foil production at Shanghai Smelter (1984).

Shanghai Smelter

This smelter is situated at Yangpoo District in northeast Shanghai. Annual copper production was 90 000 tonnes including scrap refining (Figure 65). A major amount blister copper was imported from Zambia and Peru. Anodic slimes were treated by the old sulfuric acid roasting process.

Shanghai Jiao Tong University

Shanghai Jiaotong University traces its origin to 1896 when the Business and Telegraphs Office of the Chinese Government founded Nanyang Public School in Xujiahui, Shanghai. In 1904, the Ministry of Commerce took over the school, and changed its name to Imperial Polytechnic College of the Commerce Ministry. When the Republic of China was founded, the college was run by the Ministry of Communications, and changed its name to Government Institute of Technology. It was combined later with some other colleges and in 1928, the name was changed to First Chiao Tung University of the Communications Ministry.

With the end of the Civil War in 1949 some faculties of the university were incorporated into other faculties and engineering faculties from other universities were incorporated to create a specialist engineering university to form Shanghai Jiaotong University (Figures 66-69).

Figure 66. Shanghai Jiaotong University 2002.

Figure 67. With Prof. Ding Jian-Jun at the new campus of Shanghai Jiaotong University in 2002.

Shanghai Museum

Shanghai Museum was founded in 1952 and moved to its present location in a new modern large building in 1996, is very rich in bronze, ceramics, paintings, etc. (Figure 70).

XI'AN

Xian is the capital of Shaanxi province, was the capital city for 13 dynasties such as Western Zhou (eleventh century BC - 771 BC), Qin (221 BC - 206 BC), Western Han (206 BC - 24 AD) and Tang (618 - 907) (Figure 71- 73). It was from there that the Silk Road started (Figure 74). Major city attractions are:

Figure 68. Nanjing Road in Shanghai 2002.

Figure 69. With Prof. Ding Jian-Jun in Shanghai 2002.

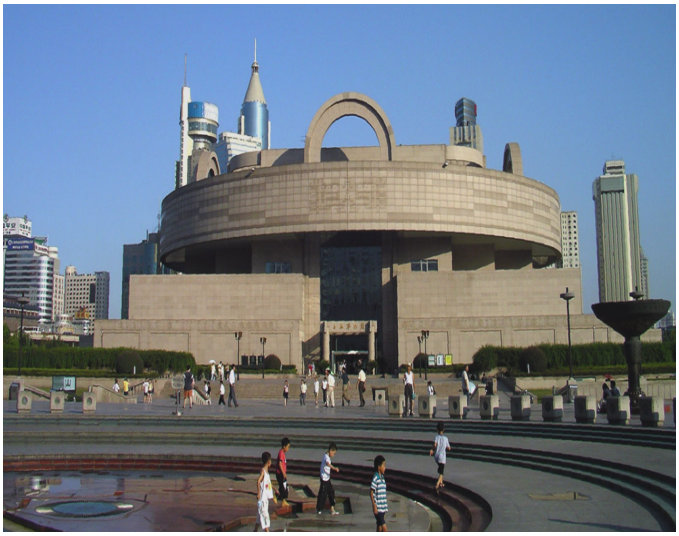

Figure 70. Shanghai Museum.

City Wall. Xi'an city wall was built initially during the old Tang dynasty (618 -907), and enlarged during the Ming dynasty (1368-1644). It is now 12 meters high, 12-14 meters wide at the top and 15-18 meters thick at the bottom, and is 13.7 km long with a deep moat surrounding it (Figure 75).

Army of Terracotta. Xi'an is most famous for its underground Army of Terracotta. Warriors, arrayed in long columns are from the Qin Dynasty, which first unified China. The soldiers were carved with individual faces on the troops (Figure 76). They also have horses and weapons.

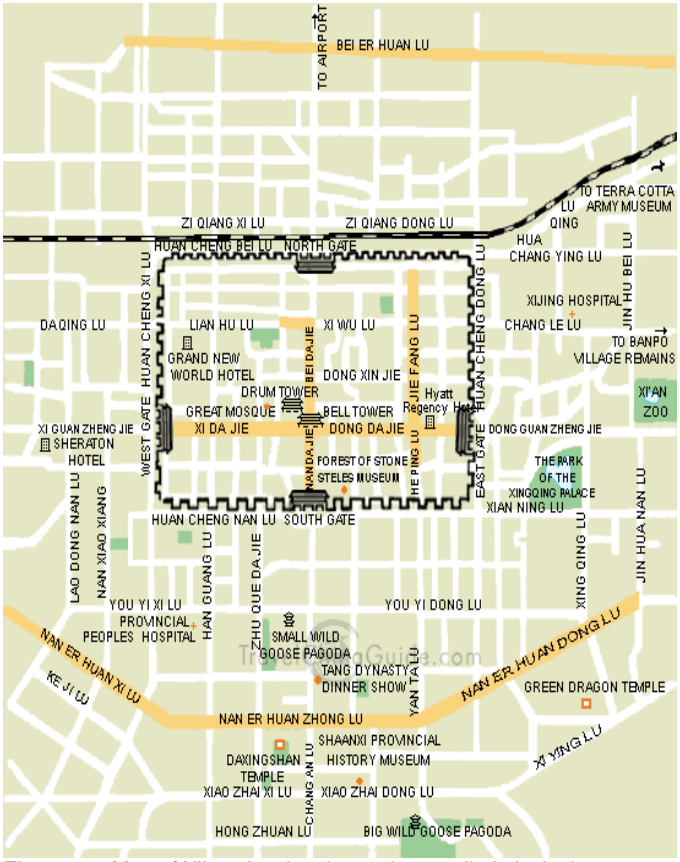

Figure 71. Map of Xi'an showing the ancient walled-city in the center.


Figure 72. View of Xi'an.

Xian Stele Museum. This courtyard-style building was once the Confucian Temple is located near the south gate of the City Wall. It contains over one thousand ancient stone tablets of China dating from the Han to the Qin Dynasty (206 BC~1911 AD) (Figures 77 and 78). The collection looks like a thick forest therefore it is also named the Forest Museum. It was established in 1090 during the Northern Song Dynasty thus some of these tablets have been exhibited at the museum for over 1,000 years. The museum is divided into seven major exhibition halls, which mainly displayed ancient calligraphy, historical records, a dictionary, and stone carvings.


Figure 73. A main street in Xi'an.

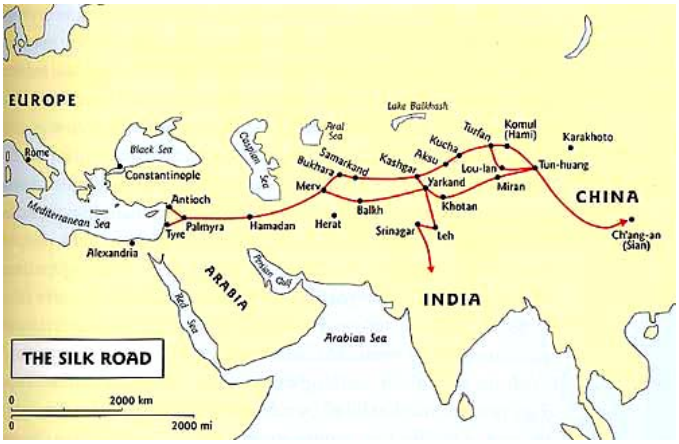

Figure 74. Silk Road started from Xi'an.

Silk Road Monument. The Silk Road started from Xi'an where a monument now stands to mark this fact (Figure 79).

Xi'an University of Architecture & Technology

Xi'an University of Architecture & Technology was founded in 1956 by the combination of the Civil and Architectural Departments of the Northwest Institute of Technology, Northeast Institute of Technology, Qingdao Institute of Technology and Suzhou Industrial Technical Institute. Prof. Lan Xin-Zhe, Dean of School of Metallurgy and his co-workers organized the *International Conference on Hydrometallurgy* in October 2004 (Figure 80, see Appendix B).

A SHORT HISTORY OF HIGHER EDUCATION IN CHINA

The introduction of Western higher education was a direct consequence of the series of humiliations heaped upon China by the foreign powers from the Opium War onwards. This resulted in the influx of Christian missionaries who set up their network of schools, colleges, and universities. In the late imperial period, Chinese statesmen and intellectuals were motivated to strengthen their country. They took view of what the West had to offer but as the century progressed, they recognized that the whole system of education was a major cause of China's weakness.

The first to be established was a school of foreign languages in 1862 under the direction of the Inspector General of Maritime Customs who was a British subject. In 1866 it was granted college status after creating chairs of physics, chemistry, mathematics, and astronomy. A chair for international law was added later. By 1896 some 1000 had passed through the college, most of them had received government financial support. They were subsequently employed as interpreters and secretaries to foreign embassies, as consuls and vice-consuls, or

as teachers in other government schools and arsenals. In 1898 the college was reorganized to become the Imperial University.

Figure 75. Xi'an City Wall.

Figure 76. Xi'an terra cotta army.

Other institutions provided support to defense needs, e.g., the Fuzhou Arsenal, established in 1867, the French and English language schools to train naval officers under foreign management, the opening of China's first modern Military Academy in Tientsin [Tianjin] the capital of the province of Hebei [Hopeh] in 1885, and the Imperial Naval Academy, founded at Nanjing in 1890. Foreign instructors of navigation and engineering were employed. Specialized institutions appeared in other major cities, including a government mining and engineering college at Wuchang, opened in 1892. In 1893 the first medical college and, two years later, the Imperial Pei Yang University in Tianjin were founded. The university also provided a preparatory department for teaching English and mathematics as well as schools of civil engineering, mechanical engineering, mining, and law.

Figure 77. Xi'an Stele Museum.

Figure 78. Xi'an Stele Museum.

Christian missions were also active. They provided Western education at a basic level for the benefit of converts. St. John's College in Shanghai, which was to become one of the most celebrated academic institutions in China began to be built in 1879, although it did not graduate its first class until the 1890s. Missionaries were also active in Shandong, where steps were taken to upgrade a high school to college status in 1882. By 1903 the Jesuits had established Aurora University in Shanghai, which taught mainly in French and provided Faculties of Arts, Law, Science, Civil Engineering, and Medicine.

In 1902 and 1903 the first legislation for a new system of education was passed. Another legislation passed in 1912 under the influence of a German-educated Chinese scholar laid the foundation for a republican system of education. Throughout the twenties, however, the dominant influence was that of American. When the Nationalist government came to power in 1927, these patterns were kept and the subsequent decade saw both European and American influences within a genuinely Chinese system.

Wuchang Mining and Engineering College

Wuchang was the capital of the Wu and Chou dynasties and has preserved its ancient walls, a number of temples, and other monuments. During the nineteenth century it was the political, administrative, and cultural center of the province. The three cities of Wuchang, Hankow, and Hanyang grew with time and formed what is known today as Wuhan the capital of the province of Hupei. It is situated at the confluence of the Yangze and the Han rivers and has

excellent communications by water with neighboring provinces. The Mining and Engineering College was established in Wuchang by the government in 1892.

Figure 79. Xi'an Silk Road Monument.

Peiyang University

Peiyang University was formerly known as Imperial Pei Yang University was founded in 1895 in Tientsin [Tianjin] about 70 km southeast of Beijing. It changed its name to Tianjin University in 1951 after the Hebei [Hopeh] Institute of Technology merged into it. In 1907 Thomas T. Read (1880-?) professor at Colorado School of Mines at Golden, Colorado was sent there to teach mining and metallurgy for three years. He was the first to introduce microscopic examination of metals in China.

CHINESE ART AND CULTURE

Since ancient times Chinese art and culture attracted the attention of Europeans. Jade, a sodium aluminum silicate mineral has been appreciated for its beauty (Figure 81). Ornamental world globes are made of gem stones, in different sizes (Figure 82). Silk cloth was greatly valued (Figure 83). Paintings of landscape, dancing girls, etc., sculpture, wood carvings are in abundance. The Chinese dragon is usually depicted as a long, snake-like creature with numerous claws, has long been a symbol of power in Chinese folklore (Figure 84). It was on the national flag of the late Qing Dynasty.

EPILOGUE

The Chinese call their country Zhonghua, i.e., the Middle Kingdom, apparently thinking that China was situated in the center of the world with the barbarians living on its perimeter. Marco Polo in French "Chine" apparently comes from Sanskrit medieval times called it Cathay (the Russian call it Kitai = people), or Old Persian "Sin"; Arabic "A1-Seen".

Figure 81. Jade vessels

The People's Republic of China is a "people's democratic dictatorship led by the working class and based upon the alliance between workers and peasants" (*China Handbook Series: History*, page 182, Foreign Languages Press, Beijing, 1982).

The Chinese of the Han origin are 93% of the population; the remaining 7% are Koreans, Manchu, Mongols, Tibetans, Turkeman, and others of different ethnic origin which they call "minorities" or "nationalities". Moslems which count about 50 millions are also considered a nationality. There are quite a few Islamic restaurants, especially in Shanghai which have name plates written in Arabic (Almata'am A1-islamy).

A one-child family was a law (Figure 85). Further, a husband may be living in one city and his wife and children in another thousand kilometers away for many years, because no permission to change residence. A husband may travel 4 days to see his wife once or twice a year; she lives in a small inaccessible town and he has to change trains and busses many times. Both husband and wife work - six days a week.

During my stay in Beijing in 1984 I was put in Friendship Hotel which is a large complex of many buildings. I had a two-room apartment that lacked decoration, had bulky furniture, a television that had only two channels and operated only 5 – 6 hours per day; most of the programs were about officials receiving visitors and shaking hands. Some programs were educational and teaching English. In others cities the situation was not much different if not worse. In Changsha and Kunming I was put in the respective university guest houses where getting hot water was usually a problem. Propaganda literature was very little; only brochures and magazines were everywhere in multiple languages describing China to foreigners. People were dressed the same blue or grey suits (Figure 86). Since high-heel was unknown it was sometimes difficult to differentiate between a man and a woman.

Figure 82. World globe made of semi-precious stones.

Figure 83. Silk is a Chinese speciality.

Traffic was controlled at intersections by a policeman with a whistle (Figure 87). Bicycles in the streets were by the thousands (Figure 88). Busses were overcrowded. Beijing had a recently opened excellent underground system. Foreigners had to change money in a special currency system. In all my visits and trips I was always accompanied by at least one graduate student who was kind enough to help me in every way even opening the car door to get me in or out.

Academic guests in China were handled by a special bureau in each organization called "Foreign Office" who took care of every minute detail (residence, meals, transportation, guides, week-end trips, etc.). The Chinese authorities are very hospitable people and save nothing to satisfy their guests. However, the situation in academic and industrial circles was intolerable. It was an antiquated system that was at least fifty years behind any Western society. There was lack of hygiene, lack of communications, lack of entertainment, lack of beauty. One might partially escape these problems if he stayed in a five-star hotel - but these were only in very few places, one of these was Guangzhou.

Figure 84. Chinese dragon.

Figure 85. A one-child policy (top poster) created problems for those having girls. The other poster incites the population to care for girls.

Figure 86. Shanghai crowd in 1984 dressed the same.

Chinese food may be a problem to some. Not only milk, cheese and bread were unknown but cooking is mainly done by boiling or heating in steam because no ovens were available. Drinks were available but un-refrigerated; ice was unknown.

A characteristic of Chinese life was the concept of communes. For example a 5000-student university would have a campus that included residences for students (8 in a room), professors, and employees, a hospital, stores, restaurants, post office, kindergarten, primary, and secondary schools for children of employees and professors, residences for school teachers, a guest house for visitors, etc. Thus, the university was actually a large self-sufficient community. A baby may be born on the campus and may stay all his life there. He would get all his education there and might even get a job on the campus after graduation. It was, therefore, a closed system that discouraged movement and enhanced unawareness of the external world.

Chinese students were very eager to learn English. They strongly believed that reading and speaking English was an essential element for progress. English and American teachers were employed in increasing numbers in schools. In fact they play a very important role - they were a window to the West. Conversation classes and discussions usually centered around the way of life in the West: the shopping centers, the credit cards, cars, homes and kitchens, democracy and freedom - things that were hardly known in Chinese society.

In later visits, however, the situation gradually changed while in my last two visits the transformation was complete. I was amazed of the changes that took place: most modern and spacious airports, TV had at least 40 channels with magnificent programs free from political propaganda and which included teaching Western social dancing, Chinese opera, CNN news and other European channels, and many entertaining shows, etc. Modern Western and colourful dresses are now on the streets (Figures 89 and 90). Beautiful buildings were constructed and many more under construction everywhere (Figure 91-93, **for 91 and 93** – see Appendix B). Cars are now widely used which necessitated the construction of more advanced highways (Figure 94-96). Magnificent shops and bookstores packed with all sorts of goods, restaurants and fantastic shopping centers are everywhere (Figure 97-98). It seems that China is now getting to be well prepared for the 2008 Olympics in Beijing (see Appendix B for Figures 95 to 98).

Figure 87. Traffic policeman in Beijing in 1984.

Figure 88. Bicycles by the thousands.

Figure 89. Fashionable silk dresses are now flooding the market

Figure 90. Chinese fashion 2002.

Notes

- Names of cities, provinces, and people have been written differently since the language reform in 1950s.
- The Chinese put their family names first and the given name is usually composed of two syllables, sometimes written as one word but now the tendency is a hyphenated word.
- China has one time system although it exists in four time zones.
- It is said that Huang He River pours annually 48 billion cubic meters of water and 1.6 billion tonnes of yellow silt that is why it is known as Yellow River.

Figure 92. New buildings in Shanghai.

Figure 94. Traffic in Shanghai 2002.

ACKNOWLEDGEMENT

The author acknowledges with thanks the warm welcome and wonderful hospitality received from those mentioned and the many others not mentioned. Special thanks are due to Prof. Chen Chia-Yung and his wife and Prof. Ding Jian-Jun and his wife for the tasty dinners at their homes.

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Appendix A

Table 2. Host organizations. Most of the teaching organizations were formed after the proclamation of the new republic by the fusion of earlier small educational units

Location	Name	Year Founded	Host Person
Beijing	Institute of Chemical Metallurgy[1], Academia Sinica	1955	Prof. Chen Chia-Yang
	Beijing General Research Institute for Mining & Metallurgy	1956	Prof. Qui Ding-Fan
	Institute of Iron & Steel Technology	1952	Prof. Ko Trin
	General Institute of Nonferrous Metals	1940s	Prof. Cao Rong-Jiang
	Institute of Uranium Ore Processing	1958	Prof. Wu Yong-Xing
Changsha	Research Institute of Mining & Metallurgy		Prof. Zhou Zhong-Hua
	Central South Institute of Mining & Metallurgy[2]	1952	Prof. Fu Chong-Yue
	Changsha Porcelain Factory		
Zhuzhou	Nonferrous Metals Plant	1956	Lin Zhen-Ya
	Cemented Carbide Industrial Company	1958	Zhou Zi-Chu
Shanghai	Institute of Organic Chemistry	1950	Prof. Yuan Cheng-Ye
	East China Institute of Chemical Technology[3]	1952	Prof. Wang Chen-Ming
	Shanghai Smelter	1912	
	Jiao Tong University	1904	Prof. Ding Jian-Jun
Guangzhou	Zhujiang Rare Earths Refinery	1966	Yu Zheng-Ming, Chen Sui-Qiang
Kunming	Kunming Institute of Technology	1954	Prof. Yang Xian-Wan
Xi'an	University of Architecture & Technology	1956	Prof. Lan Xin-Zhe

[1] Name changed in 2000 to Institute of Process Technology
[2] Name changed in 1988 to Central South University of Technology
[3] Name changed in 1993 to East China University of Science and Technology

Appendix B

Figure 80. Participants at The International Hydrometallurgy Conference held in Xi'an October 17-20, 2004. Prof. Lan Xin-Zhe, conference organizer at the extreme right on the first row.

Figure 91. Shanghai 2002.

Appendix B (cont'd)

Figure 93. Nanjing Road in Shanghai at night.

Appendix B (cont'd)

Figure 95. Traffic in Shanghai 2002.

Appendix B (cont'd)

Figure 96. Traffic bridge in Shanghai 2002.

Appendix B (cont'd)

Figure 97. Nanjing Road in Shanghai 2002.

Appendix B (cont'd)

Figure 98. Shopping center in Shanghai 2002.