Historic Building Appraisal

Mineral Preparation Plant,

Ma On Shan Iron Mine, Sha Tin, N.T.

Historical Interest

Mining Activities in Hong Kong

There are few places in the world comparable in area to Hong Kong having such a varied mineral resources, though not all of them are located in sufficiently large deposits to be worth working. There are currently no active commercial mining operations in Hong Kong, but there were once four major mined sites here. They were, namely, Lin Ma Hang Lead Mine (蓮麻坑鉛礦) which was extracted from 1915 to 1958; Needle Hill Tungsten (Wolfram) Mine (針山鎢礦) from 1938 to 1967; Tai Mo To Graphite Mine (大磨刀石墨礦) from 1952 to 1971, and Ma On Shan Iron Mine (馬鞍山鐵礦) from 1906 to 1976.

Mining resources were extracted elsewhere in Hong Kong at a smaller scale or with a shorter period. For instance, the deposits of lead were mined at Lead Mine Pass (鉛礦凹) and Tai Mo Shan (大帽山). At Mui Wo in Lantau Island, the silvery colour of the lead ore apparently influenced the locals to name the bay there as Silvermine Bay (銀礦灣). Tungsten (also called wolfram) was mined at Castle Peak (青山), Shing Mun (城門) and Ho Chung (蠔涌). Numerous mining operations for quartz (石英) were active in many different areas such as Siu Lam (小欖), Tsing Yi (青衣) and Chek Lap Kok (赤鱲角), to name just a few.

The ores were mainly exported: **iron ores** to Japan, **graphite** to the USA, Britain and Europe, **lead ores** to Britain and Europe, **wolfram** to the USA. Local ceramic and enamelware factories consumed all the **quartz** that was mined. As of 1956, the production of the Hong Kong mines was: **iron ores** (122,963 tons), **graphite** (2,441 tons), **lead ores** (198 tons), **wolfram** (24 tons) and **quartz** (2,985 tons). The marketing of the ores was on contract, c.i.f. terms and payments were made on the world market prices.

Development of Ma On Shan Iron Mine

The principal iron mineral extracted from the abandoned Ma On Shan Iron Mine was magnetite. The significant iron ore body at this location was known at the beginning of the 20th century. The mine was opened in 1906 as an open-cast site until 1953, when it was extended underground. By 1959, the open-cast workings had been abandoned and all ore deposits were extracted underground, the mine workings being accessed by a number of adits that penetrated deep into the mountain. From 1949 to 1976, some 3 million tons of iron ore was extracted and principally exported to Japan.

The first licence to mine the Ma On Shan deposit was issued in 1906 to the

Hong Kong Iron Mining Co. Ltd. (香港鐵礦公司) which was owned by Sir Paul Chater, but the company came into liquidation in 1929. In March 1931 another concern, the New Territories Iron Mining Co. Ltd. (華興礦務有限公司) founded by a Chinese engineer named Paul King, was granted a 50-year Crown Lease of the mine. In 1940, the South China Iron Smelters Co. Ltd. (華南製鐵有限公司) took over the mine. From 1942 to 1944, the mine was operated sporadically by the Japanese who shipped the raw ore to Japan. In 1949, the Mutual Trust Co. Ltd. (大公洋行) took over the mine. In 1953, the Nittetsu Mining Company of Japan (日本鐵礦業株式會社) joined the Mutual Trust Co. Ltd. to operate the mine. In that year the changeover from open-cast to underground mining began.

Exterior wall of 240 ML (1953)

By 1953 the deposit was mined with open-cast method, by which the operation began with the removal of the overburden by stripping from the top to the bottom. After the removal of the over-burden, a series of holes were drilled into the ore body with pneumatic drills and then charged with dynamite. Owing to the support of the geologists and mining engineers from the Nittetsu Mining Company of Japan (日本鐵礦業株式會社) which assisted the Mutual Trust Co. Ltd. in its excavating processes, a great change in the methods of mining took place in 1953 when the miners started to extract the underground iron ore, which was not reachable by the old method of open-cast mining. As a result, the output of iron ore was greatly increased.

At 240-m level, an adit or tunnel (地下坑道) was driven into the ore body. Approximately 2 metres high and 2 metres wide, the adit was also used as the main haulage way. At right angle to the adit were driven crosscuts which were also 2 metres high and 2 metres wide. An incline was driven upward to connect the 240-m level (the main haulage way) with several layers of adits at 247 m, 254 m, 261 m and 268 m. The incline provided access for equipment and assisted ventilation inside the network of tunnels nicknamed by the miners as *tei lung* (地龍), literally ‘ground dragons’.

Mineral Preparation Plant (選礦廠) **(1954 & 1963)**

A new era of mining was begun in October 1954, when a fully-mechanized **ore-dressing machine** (also known in this appraisal as “mineral preparation plant”) was installed to screen out iron from other useless minerals. At the time of its installation in 1954, this plant was situated only about 200 m away from the coastline, before land reclamation took place.

The plant was one of the most modern of its kind in Asia at that time. It was installed by the Nittetsu Mining Company of Japan for the Mutual Trust Co. Ltd.

on a rental basis. The construction cost of the plant was HK$1 million, while another HK$650,000 was spent on the electricity facilities powering the machine. The ore-dressing plant was operated day and night unceasingly. Its daily requirement of water was 1,360 cubic metres. The water was directed from the hill stream by an open channel to a concrete water tank which supplied water to the plant.

After the ore-dressing plant went into service since 1954, a vast quantity of crude ore was turned into high-grade concentrate ore (精礦砂). In 24 hours, it was capable of producing 480 tons of iron concentrates (60 percent) from 500 to 700 tons of raw ore, thus making it more marketable. Thus treated the level of concentration of iron of the ore was raised from 30–40% to 60% or more, thus enhancing the quality of the product before shipment to its destination (Japan). This reduction in bulk means a saving in the cost of freight.

In the ore-dressing plant, the raw ore passed through a rather complicated process which involved crushing, iron separation by magnets and filtering, after which the ire was taken by conveyor belt to the stockpile ready for shipment to aboard. In short, the crude ore underwent three processes: crushing, grinding, and desiccating.

(1) **Crushing Section.** At the plant, the raw ore was initially poured into an "Ore Bin" from which it was carried to the **Blake Crusher**; there the ore was crushed to 75 mm. and was delivered to the **Gyratory Crusher** from which the output size was below 50 mm. In the **Cone Crusher** the ore was further crushed to 14 mm. or below, which was the required size of the feed-ore entering the Mill Bin.

(2) **Grinding Section.** From the "Ore Bin" the feed-ore was carried by an Apron Conveyor to the **Conical Ball Mill** in which the ore was mixed with water and was grinded to fine ore pulp (65 mesh). The fine pulp emerging from the Ball Mill entered the **Rake Classifier** where the coarser pulp (+ 65 mesh) would be removed back to the Ball Mill to be grinded again. The finer pulp (- 65 mesh) was pushed into three sets of **Wet Magnetic Separators** where it was separated into "iron concentrates", "middling" and "tailing". The tailing was disposed to the sea while the middling was pumped back to the Separators to be concentrated again. The iron concentrates containing about 54 percent iron content were allowed to enter the **Dry Magnetic Separators** where their iron content was raised to 57 percent.

(3) **Desiccating Section.** The iron concentrates coming from the Magnetic Separators were de-magnetized before they settled at the bottom of a big circulator tank called **Thickener**. From the Thickener they were directed

by a pipe to a **Dorrco Filter** where they were desiccated. The dry concentrates which still contained 9 percent of water passed through an **Automatic Conveyor Scale** where they were weighed before they were collected in stockpiles ready for sale to Japan.

From the stockpiles, the iron concentrates would be taken away by motor vehicles and then loaded onto the barges which tied up alongside a jetty in Tide Cove (Sha Tin Hoi 沙田海). From the barges the iron concentrates were loaded on to ocean-going ships anchored in Tolo Harbour, and shipped to Japan.

The mining authority noticed that the tailing discarded from the ore-dressing plant still contained 10% iron content, so there was an incentive to increase the dressing capacity so as to extract the iron content from the accumulated tailing. In addition, as time went by, given the expanded excavation of raw ore, support from the ore-dressing plant was insufficient. Thus, the establishment of a second dressing plant (第二選礦廠) in 1963. In this separate plant, ore obtained from low-grade dumps was given preliminary treatment (undergoing the processes of crushing, screening and dry magnetic separation) before being passed on to the main plant for final dressing. The second plant (now abandoned) can be accessed through a path ascending the hill slopes at an elevation of 200 metres above sea level. As one walks along the path, one is sure to catch sight of ore waste - some stacking along the side of the path while others upon the slopes of the hills.

Exterior wall of 110 ML (1963)

Another step forward in the development of the mine took place in October 1963, when a new adit was built at **110 ML** to tap new deposits, at a time when the ore body in the upper levels of the mountain was progressively mined out. The location of the adit was selected at 110 metres above sea level, to facilitate fast delivery of raw ore to the mineral preparation plant only 200 metres from the coast. Vertical shafts (ore passes) were made to connect the adits, so that the ore mined at the higher levels could be rolled to the tunnel at **110 ML**. It considerably reduced transportation costs. Previously, the ore had to be transported by vehicles down a winding access road.

The Ma On Shan Mine reached its heyday in the 1950s and 1960s, when 6,000 miners were employed and in excess of 400,000 tons of ore were extracted annually. The miners came from many different parts of China – e.g. Guangdong (廣東), Anhui (安徽), Henan (河南), Hubei (湖北), Shandong (山東). Some of the residents of Rennie's Mill (Tiu Keng Leng) (調景嶺) also worked there. However, mining operations were suspended in March 1976 due to high costs and weakening global demand for iron ore. Many of the miners headed out to Kowloon to find alternative work, and the mining lease expired in 1981.

Architectural Merit

Constructed in 1953, the exterior wall of **240 ML** (240 ML 礦洞外牆) is a concrete structure with a rectangular opening and two large circular openings above to house ventilation fans. The interior of the entrance portal, the start of the tunnel, and another iron gate can be seen. The entrance is partially sealed off with a brick wall, and there is a warning notice in the area erected by the District Lands Office, Sha Tin.

Constructed in 1963, the exterior wall of **110 ML** (110 ML 礦洞外牆) is recessed into the side of the mountain in a cutting which is faced or revetted on either side by concrete retaining walls about 4 metres high marked with faux joint lines to resemble ashlar masonry. The portal itself is an arched opening in a concrete retaining wall with faux joint lines to represent voussoirs. A coarse rubble wall has been built across the entrance to prevent unauthorized access. Two openings have been left for drainage purpose. In the immediate environs of the portal, there is a former engine room (which was a source of electricity for light control) and an office building (which was set up there to supervise the operation of the portal). To the north of the ground outside the portal, there is a pair of rail tracks measuring 14 m long and 0.7 m wide, onto which the crude ore excavated from the mine was conveyed to the ore-dressing plant for sorting.

The original ore-dressing plant (now abandoned) now consists of a series of concrete structures built in steps down the hillside below Ma On Shan Tsuen Road. They were built as engineering structures. The purpose of each structure is also difficult to identify. Some were obviously covered sheds, and some seems to be office and workshops. Other structures are rail pillars for an overhead ore transit railway. The second ore-dressing plant is hidden by thick foliage and much overgrown with dense vegetation that have grown over the structures still lying somewhere on the steep slope, thus making access and inspection very difficult, but it is still possible to identify certain masonry structures.

There are many inclines and ore passes interconnecting the various levels of the mine. The derelict adits or tunnels are still accessible through the portal at the 240 m level and through the 110 m portal. Indeed, a 2,200 m long haulage drive was constructed at the 110 m level out to the the exterior wall of **110 ML**. This main haulage drive was connected to the workings above by a 30^0 incline which extended up to the main working levels at 144 m, 192 m and 240 m. Five main ore passes were constructed up to 144 m level. Mechanical chutes at the base of each of these discharged the ore into mine tubs which were hauled by electric locomotives out to the ore-dressing plant. Another 26^0 incline was constructed from the 144 m level up to the exterior wall of **240 ML**.

Rarity, Built Heritage Value & Authenticity

Ma On Shan Mine is fairly well known internationally at least in geological and mining circles. The iron mine operated for 70 years between 1906 and 1976. Iron is everywhere in evidence but the only deposit which so far has attracted a major commercial extraction is the lenticular magnetite mass at Ma On Shan. Although Hong Kong's past as a manufacturing powerhouse is well documented, the light of publicity has shone less brightly on its iron mining industry.

The adit at 240 ML is one of the first tunnels excavated in 1953 for underground mining, which reflect the improvement in mining method. The adit at 110 ML was the transportation hub of the raw ore extracted from different mining pits inside the mountain. Thus, the exterior walls of 240 ML and 110 ML are valuable as a testimony to the mining history here judging from the production of the mine. The authenticity is largely preserved.

The Mineral Preparation Plant reflects the technical advancement of mining industry in the early post-war times, as well as the collaboration between Hong Kong and Japan. When the mine was closed, the machines were dismantled, leaving only the concrete structures on the site. Besides, the broken concrete slabs exposing the steel bars shows that they might have been deliberately damaged after the machines were dismantled, probably for avoiding illegal occupation afterward. So the ruins' authenticity has been severely compromised.

Social Value & Local Interest

Ma On Shan Iron Mine has been the subject of enquiry of several studies, including school projects, with oral histories from staff who worked there. It has been featured in book chapters, newspaper articles, magazines, etc. The Sha Tin District Council has set up a working group to explore the possibility to develop a theme park of mine. And the Ma On Shan story is told in an exhibition hall of the Hong Kong Heritage Museum, therefore it has some extent of social value for Hong Kong as a whole. Although derelict for decades, the mine and its relics are very popular with hikers. There is a lot of wildlife too and rare botanical species.

The underground adits are still accessible through the external wall of 110 ML and 240 ML. However, the general public would be advised not to attempt to enter the workings in view of their geological conditions, and more importantly, the problems related to safety; for example, roof collapses have occurred, and even where the roofs were supported, the supports may be rotten or corroded and may be easily dislodged. In addition, there are many deep vertical shafts (ore passes), many of which are not adequately protected. The adits are extending in many directions, three-dimensionally, and where one may easily get lost.

Group Value

All of the machinery in the mine, including ventilation fans and winches, as

well as other items of value, including most of the railway tracks, were removed after mining was suspended in 1976. However, there are many reminders of past mining activity. The exterior walls of 110 ML and 240 ML have group value with the Mineral Preparation Plant (選礦廠), Lutheran Yan Kwong Church (信義會恩光堂) and St. Joseph's Church (聖若瑟堂建築群).

References

Davis, S.G. "Mineralogy of the Ma On Shan Iron Mine, Hong Kong," in S.G. Davis (ed.) *Economic Ecology of Hong Kong*. Hong Kong: Hong Kong University Press, 1964.

Kwan Sai Ho. "An Ecological Survey of Soil and Vegetation Contaminated by the Iron Ore Mining at Ma On Shan, Hong Kong". Unpublished M.Phil. thesis, CUHK, 1979.

Lai Chuen Yan, David. "Ma On Shan Iron Mine". Unpublished B.A. thesis, Department of Geography and Geology, University of Hong Kong, 1959.

Leung Sze Kong. "Ma On Shan". Unpublished B.A. thesis, Department of Geography and Geology, University of Hong Kong, 1957.

Shibata, Taketo. "Development Plan of Ma On Shan Iron Mine, New Territories," in S.G. Davis (ed.) *Economic Ecology of Hong Kong*. Hong Kong: Hong Kong University Press, 1964.

Strangle, P.J. & N.W. Woods, "The Geology and Exploitation of the Ma On Shan Magnetite Deposit," *Geological Society of Hong Kong Newsletter* (Hong Kong), Vol. 9, No. 1, 1991.

Yang, J.Y. "Iron Ore & Industry in Japan, China and Hongkong," *Far Eastern Economic Review* (Hong Kong), Vol. 14, 17 July 1952, pp. 84-88.

《馬鞍山風物誌：礦業興衰》編研小組：《馬鞍山風物誌：礦業興衰》，香港：沙田區議會，2002 年。

《馬鞍山風物誌：鞍山歲月，小城今昔》編研小組：《馬鞍山風物誌：鞍山歲月，小城今昔》，香港：馬鞍山民康促進會，2012 年。

朱晉德，陳式立（合著）：《礦世鉅著：香港礦業史》（Hong Kong Mining History, original English title），香港：朱晉德，陳式立，2015 年。