MINING.

A CHINESE SYSTEM OF GOLD MINING.

BY HENRY LOUIS, A. R. S. M., ETC., *in the Engineering and Mining Journal.*

The District of Tomoh, one of the Siamese-Malayan states, has been worked for gold by the Malayans and Chinamen for 150 years. The methods pursued are, of course, exceedingly primitive, but a record of them will be useful in compiling a history of gold mining and gold milling. In early times the Malayans used to work the alluvial deposits for gold, but, after these deposits had been exhausted, they ceased regular operations, because they did not relish the continuous hard labor requisite in working the quartz reefs. Immigrant Chinamen afterward appeared on the scene and applied their energies with success. Every now and then the Malayans would descend on the Chinamen's camp and exterminate it. This they did partly for recreation and partly to capture the proceeds of the Chinamen's hard work. Such disasters did not prevent other companies of immigrants from coming to the gold fields; and so, with a few breaks of this kind, the deposits have been worked continuously to the present day. Very few Europeans have ever been allowed to come near the workings; in fact, I believe that I was only the fourth foreigner that had ever been there.

This gold occurs in narrow veins and leaders of quartz intersecting and intercalated among irregularly upheaved and contorted highly metamorphosed micaceous and chloritic schists. The veins vary from three inches to three feet in thickness and are sometimes very rich. The extreme heat and moisture of the climate have in many places changed the rock to soft red, purple and yellow clays to great depths. In mining the gold a small water-furrow is first brought in at the highest possible level on a suitable hill side, and the stream is turned down the hill. By means of this stream and a heavy ironshod crowbar the earth and surface rock are broken and sluiced away. Any pieces of gold-bearing quartz that are seen in the tail race are picked out, but hardly any efforts are made to recover the loose gold. The surface of the shales which have been laid bare by the crowbars and water current are then searched for quartz veins. The quartz is dug out by rude picks and carried in baskets to the crushers. The excavations generally go in an upward direction into the side of the hill, but they cannot go far on account of the impossibility of preserving timbers in such a damp climate. The work of mining is done very slowly; a party of 27 miners, on my visit, considered half a ton of quartz as a very satisfactory day's output.

The quartz on being extracted is broken with hammers so as to pass a 1½ in. ring and is then carefully hand-picked to separate the apparently barren rock from pieces showing visible gold and sulphurets. I say "apparently" barren rock because on assaying many samples of this refuse I have found from three to ten pennyweights per ton in it. The crushing of the ore is effected by tilt hammers, worked either by foot power or by water power. The foot power hammer is the older type; and the water power mill, in batteries of from three to six hammers, was first introduced about 12 years ago. The foot power mill is made entirely of wood with the exception of the hammer head, which is of hard quartzite. The mortar is also cut out of a solid piece of quartzite. A man working eight hours will crush from 70 lbs. to 100 lbs. of stone to a size which will go through a width of mesh equal to 36 to 40 holes per square inch, the sieve being made of strips of rattan one-tenth inch thick. The hammers of the water mill are worked by long, straight cams, if such a term is permissible. The average number of drops for each head is 27 to 32 per minute; the height of drop is two ft., and the effective falling weight is 70 lbs. The crushing capacity of a six-hammer mill varies from 850 to 1,400 lbs. per 24 hours, according to the hardness of the rock. On each shift, day and night, two men look after and feed the mill, while a third does the sieving. Another man is usually employed in searching for boulders suitable for hammer heads. On examining the crushed ore, I found it varied very much in fineness, and that a great deal was crushed far too fine. The size of the hole used at the power hammer is the same as with the foot power hammer, viz., 0.05 in., and fully 80 per cent. will go through 0 024 in. holes, and 40 per cent. will go through 0.008 in. holes.

This crushed ore is periodically taken out in wooden pails to another Chinaman, who sits beside a reservoir of running water and works the "dulang." This washing implement is an obtusely conical wooden dish about 2 ft. in diameter, cut from the spurs of hard-wood trees. It resembles the South American "batea," though it has straight conical sides instead of curved conical ones. The conical point is carefully rounded off. The dulang is filled with 10 to 15 lbs. of crushed ore and is given the usual panning motion while held just under the surface of the water in the reservoir. The barren pieces of quartz escape over the edge. When nearly cleaned the gold and concentrates are transferred to a smaller, very carefully made and polished dulang about a foot in diameter. The final separation of the quartz is effected here, and the gold is separated from the sulphurets by a skillful jerk. The sulphurets are stored and sometimes, but not always, treated for the recovery of gold. The gold from the dulang is melted over a small forge provided with a box-shaped wooden blower of the usual Chinese type. Charcoal is used as fuel, and the crucibles employed contain only about a couple of ounces. The gold dust is melted with borax and nitre as fluxes, and the slag is lifted off with an iron rod. The gold is granulated by immersion in water. The principal impurities appear to be sulphur, arsenic, and traces of copper and lead.

During my stay a wash-up of 2,000 lbs. of crushed ore was made, with what was considered as good results. From this 2,000 lbs. there were obtained the following: Rough gold before melting, 3 oz. 11 dwts. 7 gr.; 5½ lbs. of sulphurets for retreatment, yielding 16 dwts. gold; 28½ lbs. of sulphurets supposed to be cleaned, yielding 6 dwts. of gold; total gold, 4 oz. 13 dwts. 7 gr. These two parcels of sulphurets gave by fire assay, per