

ket, being usually about 990 to 997 fine. If the ore contain gold it will be found in the brick with the silver.

This process, if proper care be taken in manipulation, will save 90 per cent. of the assay-value. Great care requires to be taken to keep the quicksilver in proper condition: it should be kept perfectly clean, in order to utilize its full amalgamating properties and prevent flouring. 'Flouring' is a term used by millmen, and signifies that quicksilver has segregated or divided itself into myriads of small particles, so fine that they may be held in suspension in almost still water. When quicksilver is in this condition great loss occurs, not only in quicksilver itself, but in silver, as each particle contains more or less. In mills where the greatest care and attention are bestowed the loss in quicksilver from various causes is considerable—generally from  $\frac{3}{4}$  lb. to 1 lb. for every ton of ore crushed. This, however, has been reduced of late by allowing the tailings to run into one or more Duncan concentrators, or a machine equally as effective, when a large percentage of the quicksilver and amalgam escaping the settlers is caught, as well as the sulphurets, if any are contained in the ore."

From what I have seen of the ore in the Ohinemuri District, it is especially adapted for chloridizing, and either amalgamating or lixiviating. In amalgamation the bullion will contain both gold and silver, and also a portion of the base metals, which can afterwards be separated by refining; while by the lixiviation process the metals can be extracted separately. The experiments made by Mr. Skey at the Colonial Laboratory on some of the stone from Waihi show that even by roasting and amalgamating with cyanide of potassium about 9 to 10 per cent. of the gold is lost, and 40 per cent. of silver. If this loss is made in making an analysis, where every care is taken to get out as much as possible, when the operation has to be conducted on a large scale the loss will be almost certain to be greater; whereas, by the lixiviation process nearly the whole of the metals can be obtained. This question is attracting considerable attention at the present time in America, and able papers have been written on the subject in the *Mining and Engineering Journal*, of New York. From these, and also from private information of the mode of treatment in America, the following process would be suitable for the ores that have to be dealt with here:—

*Crushing the Ore.*—The ore, on being brought to the place of treatment, is put through a pulverizer, or stone-breaker, which reduces it to a maximum size of about 1½ in. in diameter; afterward this is crushed dry with either steel rolls or stamps, so as to pass through a grating not finer than a hundred holes to the square inch. The coarser the crushed material is, consistent with the fineness of the metallic gold in the ore, the better—it is better adapted for the roasting process. Crushing with two sets of steel rolls, the same as those used by the Bertrand Company, in America, will be found to be far more economical than a stamping-battery, as the wear and tear is far less, and they do not require the same amount of power to drive them as a stamping-battery. There is no class of crushing-machinery that requires more power to work it than stamps, as they have always to be lifted from a state of repose; but with rolls, they are always in a state of momentum. The Bertrand Company, Nevada, finds that two sets of rolls can crush as much ore as a fifty-head stamping-battery.

*Roasting Process.*—The crushed material is now taken to a reverberatory furnace, which is constructed with three hearths, each from 10 ft. to 12 ft. square, with the corners cut off, so that the ore can be better handled in the furnace with rakes, slices, or hoes. The upper and lower hearths have each a man-hole on the top to charge them as required. The crushed material is put in on the upper hearth, and exposed to a gentle heat with an abundant excess of air. The sulphide takes fire and burns, and the metal and sulphur is thus oxidized with the abundance of oxygen from the air. This oxidized part of the sulphur goes off into the flues and up the chimney, while the remaining portion of the sulphur combines with portion of the oxidized metal, forming metal sulphate. The other portion of the metal, with the exception of silver, is formed into oxide; but the silver remains as a sulphate or becomes metallic, and gold remains in a metallic state. Antimony and arsenic are oxidized, and partly go off in fumes and partly combine with metal oxides, forming antimonates and arsenates. Silver is left either in a metallic state or in the form of sulphates, and the base metals are converted into either oxides or sulphates. When the charge is sufficiently oxidized on the upper hearth, it is raked down to the next, or middle hearth, where it is subjected to a greater heat, which causes some of the metal sulphates that were formed on the upper hearth to decompose: the sulphur oxide flies off, and the metal oxide remains, while a small portion of them is volatilized to some extent; but any lead-sulphate is not decomposed. Iron- and copper-sulphates are decomposed before silver, the latter requiring a greater amount of heat; the principle being to allow the stuff to remain on this hearth until all the iron- and copper-sulphates are decomposed.

*Chloridizing Process.*—The material is now raked down to the lower hearth and mixed with a certain proportion of salt, depending on the character and richness of the ore, varying from 1 to 20 per cent. of the weight of the ore. Some mix the salt with the ore before putting it into the furnace; but it is better and more economical to mix with salt in the last process by mixing it thoroughly with the ore in the furnace. During the whole of the roasting and chloridizing process the ore requires to be constantly stirred with slices and hoes, and only kept in thin layers on each hearth. As soon as one hearth is cleared a fresh charge is again made. The salt, being a compound of sodium with chlorine, is the cheapest method of producing chlorine. The chlorine of the salt, under the action of heat, is transferred to other metals by different agencies, but chiefly by means of sulphur and oxygen, for which sodium has a great affinity. When the metal sulphate is heated in conjunction with sodium chloride the sulphur and oxygen form sodium sulphate, and the other metals take the chlorine, forming chlorides. Sulphur is therefore necessary in the chloridizing process, as without it sulphates cannot exist. The higher sulphur-oxide or sulphuric anhydride produces a decomposition of the salt and the liberation of chlorine. The latter acts upon the remaining sulphides, and to a certain extent on oxides and metallic silver, converting them into chlorides. As the heat increases the base-metal chlorides are decomposed, giving off the chlorine remaining, or volatilizing as chlorides of a lower degree, or by absorbing oxygen from the air become oxychlorides or oxides. Silver-chloride is, however, not decomposed by heat. Some of the iron-