

but average grade value, the saving to the different companies of even a shilling or two per ton was of the greatest importance. This practicability of raising the ore value through the tailings, therefore, meant that the scope for profitable operations was vastly increased, and we may be sure that the wide prosperity which mining has attained in South Africa, in spite of many restrictions imposed by a hostile government, has been due in no small degree to the agency of cyanide. There everything was in its favour and its success was instantaneous and permanent. The ore, which throughout is of the eminently free-milling character and devoid of base mineral, presents no difficulties other than mechanical and connected with the forming of slimes, for treatment. The coarse gold is caught in the old-time fashion on the tables and the finer metal or float portion is held in the tailings, which are caught in scuttling pits and afterwards made to yield up about ninety per cent. of their small value by undergoing treatment in the cyanide vats. In South Africa wet stamping only is in vogue and only the tailings are all the coarse quality gold is easily caught on the plates. In Australia very much the same conditions obtain in respect to the actual use of the solvent. In New Zealand, however, we find that probably more progress has been made in the use of the cyanide process than in any other part of the world, that is to say, in its direct application to the raw ore. Here there is a wide field to operate on in the matter of diversity, from the pure white free-milling quartz to the almost solid mineral sulphurets and it is safe to say they have all been practically tried with various results. One district alone called Ohineivri—of large extent—owes its existence entirely to the agency of the solving process and it is already the largest gold-producing district in the colony. The gold in this part invariably exists in the ore in the fine state of sub-division so fine indeed that when seen it looks like a mere stain in the stone. To attempt to save it by any ordinary amalgamation proved utterly futile as many local companies knew to their cost, and it was not till the Cassel Gold Extracting Company demonstrated their ability to save it by cyanide—they having secured the patent rights—that any hope was held out for the successful development of this field. To-day there are over 500 stamps continually at work and the number is increasing. Of these, 200 head belong to the famous Waiki Company, which produces about \$100,000 of bullion per month and is the most prosperous mine in the colony. The treatment here is direct operation, on the dry stamped ore and this is probably the largest mill in the world adopting such a process, some particulars of the *modus operandi* may prove interesting. The ore as it arrives from the mine is dumped into drying kilns, ten in number, each capable of holding 500 tons, where it is thoroughly dried, preparatory to crushing. Drives into the hill side connect with the bottom of each kiln and as the ore is wanted it is drawn off and trucked out by cable haulage to the rock breakers. These are exceptionally powerful and can each crush 50 tons of ore per hour. After passing through the ore falls into a bin from whence it is conveyed in self tipping cars to the mill hoppers, also by cable haulage. The stamps weigh 1,000 pounds each of the latest design and are driven in batteries of five head, ninety drops per minute. They are fed by challenge ore feeders and are fitted with double discharge motor boxes. Thirty mesh screens are used and it is

found that ninety per cent of the pulverized ore will pass through an eighty mesh so fine in the dry crushing. The dry pulp falling into a covered trough on either side of the stamps is conveyed along a revolving screw conveyor which dumps it into a bucket elevator which in turn lifts it to the desired altitude for proper distribution to the leaching vats in that quarter of the plant. The whole work is done automatically and everything works smoothly and well. The leaching vats are built of concrete and each contains a charge of 250 tons ore and solution combined. The actual time occupied in treatment varies from two to three days, and upon completion the ore is practically worthless. A five per cent. strong solution of cyanide is used, and the extraction is over ninety-five per cent. of gold and about seventy-five per cent. of silver. All the ore treated so far has been free-milling, but as the workings go down the sulphide zone is coming in and it can be seen that modification in treatment will be necessary. So far they have not been able to make a success of mineralized ore treatment by cyanide in New Zealand, and this fact leads us to a general consideration of the process.

The merit of cyanide is based upon its action on the precious metals which in the extremely fine state it readily dissolves—more particularly gold—forming cyanides of gold and silver respectively. When these metals exist in different degrees of fineness in an ore some other method has to be employed in conjunction with the above in order to save the coarse gold—which under any circumstances will not be affected by the chemical. Thus it will be seen that fineness is an absolute essential to successful treatment. The great virtue in dry crushing is that much fine pulverization can be secured, thus rendering the ore thoroughly susceptible to the action of the solvent while the tendency to make slime is obviated, because there is an even reduction and a perfect intermingling of the particles composing the pulp. It is well known that in all settling pits connected with wet crushing mills regular layers of slimes are formed. These constitute one of the most obstinate difficulties to be overcome in using the wet extraction process. Some ore of course do not form slimes so readily as others, but in all cases they occur to a greater or less extent when brought into conjunction with water.

Cyanide has little effect on iron and copper or even the sulphurets of the metals, but their salts have a most pernicious effect on the solvent when existing in an ore, rendering it perfectly inoperative. Now all ores containing much minerals, even copper and iron pyrites or other combinations of these metals will be bound to make sulphates of the same. These latter are soluble and are particularly destructive to the cyanide solution. The other sulphurets of arsenic, antimony, lead and zinc are by no means favourably disposed to cyanide either, and have a decomposing effect upon it, but happily they are never present in an ordinary ore in very large quantities. It is proposed to treat the low-grade Rossland ore by lixivation and a plant is now nearing completion for carry-on of the same. Cyanide will be the principal agent used, but agitation will be employed instead of the stationary percolation and the gold instead of being deposited in the zinc extraction boxes, will be precipitated direct from the charge by means of electrolysis. This will obviate any slimes and percolation troubles and will, if successful, lead, I should think, to