

country; (3) a machine that will reduce the ore at a much less cost than by the stamping-battery.

There will be a difficulty at first to contend against in introducing new machinery to supersede the stamping-battery, which has heretofore been recognized here as the best method for reducing auriferous quartz; for, although the mining community is a very intelligent one, it is also a very conservative one, and looks with suspicion on any improvements in mining-machinery until they are thoroughly tested; and even then some are very loth to adopt them. It must, however, be patent to any person that, unless a better class of machinery is employed in the reduction of auriferous quartz, there are many of the present mines that must either suspend operations or continue working from hand to mouth, without giving the shareholders that remuneration they are entitled to for the outlay of their capital. This subject has lately been well ventilated in California, and different machines have been constructed for reducing ores, amongst which are machines constructed on the stone-breaking principle, and with steel rolls; the latter being now deemed the most effective. In 1882 the Bertrand Mill-owners, in Nevada, introduced steel rolls for crushing, and were so successful with their machines that the dictum that hitherto prevailed—viz., that stamping-batteries were the most efficient method of reducing ore—was shown to be a fallacy; for not only are the rolls much cheaper in the first instance, but, having fewer wearing parts, the maintenance is but trifling compared to stamps; and the quantity and fineness of material crushed is also far greater than by a stamping-battery, in proportion to the power employed for working the machinery.

On examination of the principle of crushing-machines, the quantity of material crushed must be in proportion to the area of the crushing-surface, whether it be by pressure or weight. Therefore the area of the surface of a stamping-battery is in proportion to the number of stamps employed and the speed at which they are driven.

To analyse the crushing effect of rolls against stamps, it will be necessary to take into account the crushing-surface of both. Say, taking the average of stamps at 8in. in diameter, making seventy-five blows per minute, and steel rolls 26in. in diameter, and 15in. long, making a hundred revolutions per minute—the area of stamp-head, being 50·26 square inches, multiplied by the number of blows per minute, gives 3,769·5 square inches crushing-surface for each stamp used. The rolls being covered with steel tires 2½in. in thickness, to get the average crushing-surface during the time the tires last the rolls have to be taken at 24in. in diameter, or 24 by 3·1414 by 15 by 100—equal to 113,090·4 square inches; which, if divided by the crushing-surface of each stamp per minute, shows the rolls to be capable of crushing as much as a stamping-battery of thirty heads; but were the speed of the rolls increased to 150 revolutions per minute, then they would be equal to forty-five heads of stamps.

In conducting experiments on the percentage given with the different classes of water-wheels at the Thames two years ago, I found that the best-constructed Leffel turbine only gives 67 per cent. of the power due to the head of water, whereas these wheels are guaranteed to give from 77 to 80 per cent. with a brake; thus showing that a large amount of power was expended in overcoming the friction of a stamping-battery. Indeed, it can be seen at a glance that the amount of friction in lifting the stamps from a state of repose each time, causing them by friction to revolve, must be very considerable. It may be adduced in favour of stamps that the sudden drop gives an impact to the blow, which it may do to some extent; but this may be entirely discarded, as it is more than balanced by the extra amount of material that there is in the stamping-mortar over that between rolls, which causes the stamps in many instances to cushion, and therefore destroys the effect of the blow. The duty done by stamps cannot be calculated on the same principle as a ram falling on the head of a pile, because the quantity of loose material that lies in the mortar alters the condition of the blow entirely. The stamp has not only to crush the material, but likewise has to force it through the grating, which must be taken as power wasted. Whatever system is adopted in feeding stamps, there can never be the uniformity there is with rolls, neither can the particles or grains of the crushed material be so uniform in character. To take everything into account, even the greatest advocates for stamps must admit there is much useless power expended in reducing ore by this method. Stamps have a maximum of velocity, which can be soon reached, beyond which the fall is reduced; but with rolls held rigidly together the action is constant at any given time: the greater the velocity of the rolls the greater the crushing-power, as the crushed material must be in proportion to the area of the crushing-surface.

No better criterion can be given for the necessity of improved crushing-machinery than that of the great expenditure entailed in crushing the auriferous quartz at Te Aroha. The quartz has to be conveyed from some of the mines to the crushing-battery for nearly two miles on a tramway which has several steep grades, and these grades are fitted with brakes for lowering the trucks, which entails a deal of manual labour, thereby increasing the cost of haulage to a considerable extent; but the crushing-battery, although one of the best in the colony, is very imperfect. After the crushed material has passed through the gratings over the quicksilver and blanket-tables the residue contains about as much gold, if not more, than is extracted from it. This has been satisfactorily proved by the tailings being crushed in Berdans, and after leaving the first sets of these Berdans they were operated on a second time, and still found to contain sufficient gold to pay for manipulation. The character of the gold on this field is extremely fine, and requires a different system of treatment to that adopted in any of the Australian Colonies; but this is a field where there is ample room for great improvements to be made,