with acid, that in some places the water dropping on an iron rail will soon cut it through. The quartz requires to be crushed to the finest powder before the particles of comparatively fine gold adhere to the mercury; and the tailings-plants referred to by Mr. Rickard are either working the tailings coming from batteries where there is means of treating them profitably, or else coming from the foreshore, where they were deposited in the early days of the field. There is no single grinding and amalgamating process that has yet been tried at the Thames which will extract a fair percentage of the bullion; even in some of the tailings-plants they only extract about 50 per cent. of its value. Were the quartz clean, and clear of metallic sulphides, and the gold in a fairly coarse state, the difficulty of saving it by amalgamation would be very little.

There is no doubt the sulphurets requires to be separated from the sand before the latter is ground up in pans, as the grinding up of sulphurets only sickens the mercury and renders it in an unfit state for amalgamation. The whole of the tailings should be concentrated, and only the waste gangue ground up. If this were done, the particles of gold in the grains of silica would be liberated, and adhere to the quicksilver, while the sulphurets could either be roasted before being ground up or treated by another process.

The whole system of treatment, however, hinges on the actual value of the ore. If it is of low grade it will not admit of a costly process being used; and, on the other hand, if rich in bullion it should be treated accordingly. In Freiberg, Saxony, where labour is cheap, it cost over £3 per ton if the ore is at all refractory; and unless it had a considerable value, such methods as adopted there could not be used with our ores. Almost every mining company on the Thames are becoming alive to the necessity of having their ores carefully sampled and analysed, and this will eventually lead to greater attention being given to the extraction of the bullion.

The following is a description of the principal crushing-plants on the Thames field, and the motive-power used in working them, giving the percentage of the theoretical power employed:—

*Cambria Battery.*—This battery consists of twenty-one heads of stamps, each 600lb. in weight, which are lifted 8in. high, making seventy blows per minute; thirteen berdans 3ft. 6in. in diameter, making twenty-eight revolutions per minute; and one of J. C. Fraser's pans, making forty revolutions per minute. The whole of these are driven by a Pelton water-wheel 5ft. in diameter, having a jet 2¼in. in diameter, under a head, the pressure being equal to 58lb. per square inch, which makes the discharge from the jet to be 2·40 cubic feet per second. This is equal to 34·4 theoretical horse-power. Taking the lift and speed of the stamps, this is equal to 17·8 theoretical horse-power, and assuming the berdans absorb 5·2-horse power, and the pan 4·0-horse power, then the percentage that the Pelton wheel gives is equal to $\frac{27}{36\cdot4}$ = 74·2 per cent. The dies or shoes are placed in the mortar when new 4in. below the bottom of the grating, and before the shoes are worn out they are 6in. below the bottom. The gratings used have from 180 to 220 holes to the square inch, and are made of charcoal-iron and punched. There are four plates coated with mercury on each table, the one at the foot of the first drop being 12in., the second one 18in., and the third one 2ft. wide. These are of muntz-metal; and there is a fourth plate at the end of the ripples, 12in. wide, consisting of copper, coated with mercury; after these are the ordinary blanket-tables. In working with the berdans they use 10lb. of quicksilver in each; and in Fraser's pan they use 40lb. of mercury. The waste from the blanket-tables all flows into longitudinal boxes, which are termed buddles, and in these the tailings are deposited, and when full are cleaned out and either re-ground in the buddles and pans, or sold, as the case may be, to those having a tailings-plant.

*Moanataiari Battery.*—This is the largest crushing-battery on the field. It consists of forty-one heads of stamps; twenty-one berdans, 4ft. 6in. in diameter, going at a rate of twenty-four revolutions per minute; and four pans—namely, two of Watson-Denny, one of Price Bros., and one of J. C. Fraser's. The following are the weights of the stamps, taking the shoes as half-worn—namely:—

| | Light Stamps. | Heavy Stamps. |
|---|---|---|
| Heads ... ... ... ... ... ... | 228lb. | 228lb. |
| Three-quarter weight of new shoes ... ... ... | 126lb. | 126lb. |
| Stem or shank ... ... ... ... ... | 220lb. | 220lb. |
| Disc or tappet ... ... ... ... ... | 43lb. | 118lb. |
| Total weight ... ... | 617lb. | 692lb. |

There are twenty stamps, each averaging 617lb., and twenty-one stamps averaging 692lb. The lighter stamps have a drop of 6in., and the heavier ones 8in., and they were making seventy-six blows per minute. These are exerting a force equal to 36·68-horse power—namely:—

$$\frac{(617\times20\times38)+(692\times21\times50\frac{2}{3})}{33000} = \frac{1,292,420}{33,000} = 39\cdot16\text{-horse power.}$$

This crushing-battery of stamps is driven by a Pelton hurdy-gurdy water-wheel 6ft. 8in. in diameter, having a water-jet of 2⅝in. in diameter under a pressure of 60lb per square inch, which is equal to a hydrostatic head of about 138ft.; and as a jet of 2⅝in. will discharge under this head 3·4 cubic feet per second, the theoretical horse-power of the water is $\frac{3\cdot4\times60\times62\cdot5\times138}{33,000}$ = 53·32 horse-power; therefore $\frac{39\cdot16}{53\cdot32}$ = 73·4 per cent. that the Pelton wheel gives of the theoretical power of the water, inclusive of friction in working of the stamps. The twenty-one berdans are driven by a Pelton wheel 3ft. 6in. diameter, having a water-jet of 1⅛in. in diameter, under a pressure of 54lb. per square inch, which is equal to a hydrostatic head of 124·4ft., and the discharge from the jet under this head would be about 8·32 theoretical horse-power; therefore, each berdan takes about 0·4 theoretical horse-power. The four pans are driven by a Pelton wheel, 6ft. 8in. in diameter, having a water-jet of 1½in. in diameter under a pressure of 60lb.