methods of extraction are employed. But more often we find concentration attempted before sizing, the general result being that poorer work is done, as these machines were never intended to concentrate two different grades of material at the one time. It must surely be evident that classification of the pulp is absolutely necessary before proper concentration can be effected, as this operation is entirely dependent upon the size and specific gravity of the particles treated, and the same argument will undoubtedly apply to plate amalgamation.

At the present time the system of treatment after amalgamation is subject to great variation in different mills; in some the whole of the sands are treated in bulk by cyanide, in others, the concentrates are extracted and treated by chlorination, while the bulk of the tailings is sized into coarse sands and slimes. The coarse sands are cyanided in vats and the slimes treated by filter presses, or further concentrated on canvas-covered slime-tables.

The treatment of the ore should certainly be divided into two separate and distinct operations—*i.e.*, First, the pulverisation of the ore—which is purely mechanical; Second, the extraction of the gold—which is partly chemical and partly a mechanical operation.

The Pulverisation of the Ore.

The first thing the metallurgist has to decide is the fineness of the crushing or the size of particle which gives the most economical results. This depends on the character and composition of the ore and it is necessary to ascertain not only its value and percentage of mineral contained, but the condition and form in which the gold exists; because the crushing need only be to that degree of fineness which will liberate the contained gold, or allow it to be extracted by some chemical methods applied to the after-treatment of the tailings.

Although it is generally admitted that gold exists in pyrites in a metallic state, its excessively fine state of division renders mechanical separation practically impossible without first decomposing its enveloping sulphide, and, even if liberated, water-concentration would not save it. Therefore, where the main richness of the ore lies in its mineral matter, comparatively coarse crushing may be admissible so as to avoid reducing those valuable sulphurets to slime which is both difficult to save and treat. Then probably there are cases where ore is plentiful, and mining costs so low, that it is more profitable to lose the extra gold that would be liberated by fine crushing in order to treat a larger quantity, the object being to secure the maximum of profit rather than produce the cleanest possible tailings.

Grizzlies, Rock-breakers, and Self-feeders.

Without the addition of these, no stamp mill can be considered complete, as the ore from the mine is too large to feed direct into the mortars. Large pieces are apt to break the screens, prevent uniform and steady working, and thus decrease the efficiency of the stamps. The grizzlies on which the ore is dumped consist of iron bars set on an inclined plane to suit the material, and spaced a similar distance apart as the bottom ends of the rock-breaker's jaws; all material small enough passes through and the balance goes to the breaker, both discharging into the same hopper. There are two main types of rock-breakers in general use: in one the stone is crushed between a flat fixed jaw and a reciprocating one, while in the other the fixed jaw is circular the moving one gyrating inside it. As the work upon them is most irregular they must be driven by themselves, and, owing to their vibrations and the dust produced, are best kept in a building apart from the other machinery. As crushing in a breaker is performed at about one-fifth the cost of that in a stamp mill, it is advisable to reduce in this manner as fine as possible; for this purpose two sets of rock-breakers are often used with a grizzly between. They are placed one above the other and set to break to two different grades.

In small mines with easily-broken ore, where motive power is costly and labour cheap, hand breaking and feeding may be admissible, but at its best feeding by hand is most irregular. On the other hand, the automatic feeders increase the capacity of the mill by keeping a steady and uniform supply of ore; and as the die is always kept covered with a thin layer of material, the wear of the shoes and dies is less and much more even. With an even wear the stamper-stems are less liable to break and a greater crushing-surface is maintained: in fact the great advantages due to the use of rock-breakers and self-feeders must be evident to all with any knowledge of the subject, and mills without them cannot possibly do the same amount of work as a modern one on the same class of ore.

The Stamper and Lifting Mechanism.

As the result of long experience five stampers in each mortar-box has been fixed upon as the most convenient number, and each five head is known as a battery. It is usual for each two batteries or ten head to have a separate cam-shaft, independently driven from the main driving shaft, an arrangement which allows of that portion being stopped without in any way interfering with the rest of the mill, and at the same time equalises the strain on the cam-shaft.

The stamper, which gives the total falling weight, consists of four parts—*i.e.*, The stem, head, tappet, and shoe, the two former containing over 70 per cent. of the total weight.

The stem varies in length from 9 ft. to 16 ft., and in diameter from 2¼ in. to 3¾ in., and is only subject to wear near the guides.

The head or boss is of almost universal pattern from 16 in. to 20 in. long and of the same diameter as the shoe; it is cast with two sockets, the upper portion being bored to receive the tapered end of the stem, and the lower portion recessed to receive the shank of the shoe. Key-ways through the head admit of the insertion of a tapered steel drift, by means of which the shank of the shoes or end of the stamp-stem can be driven out. The shank of the shoe enters the head and holds it in its place, and the butt forms the wearing-face of the entire stamp. Its diameter varies with the weight of the stamp and the drop given, usually in such proportion as to give from 11 lb. to 14 lb. per square inch of crushing-surface.