In working free ore much less iron is required than in working roasted ore, and the ordinary wear of the battery and pans is generally sufficient. One pound of iron will precipitate 3·85lb. of metallic silver from the chloride; but in practice more than that amount of iron is consumed when there is copper either present in the pulp or added in the form of bluestone. Carbonate of lead is also believed to increase the consumption of iron.

With roasted ore much more iron is required, and when there is a great deal of lead and copper present sometimes as much as 20lb. of iron to the ton are consumed, not including the iron needed to precipitate the silver. The best form in which to use iron in pans is as wrought-iron filings, sifted as fine as possible; but such filings are expensive, and difficult to obtain. The turnings from a lathe are the best substitute. These wrought-iron fragments protect the cast-iron of the pan to a great extent from the corrosive action of the different salts in the roasted pulp, as they are more readily dissolved, thus relieving the pan itself from a large amount of loss.

At the Manhattan Mill, Austin, 10lb. of iron-turnings are used to the charge, and they are almost completely consumed. Four pounds of this iron would be sufficient to precipitate the silver; the other portion, as well as the iron from the pans, is probably employed in decomposing lead- and copper-salts.

Loss of Quicksilver.—The usual loss of quicksilver runs from ½lb. to 3lb. to the ton of ore treated. A reasonable limit of loss in present practice is 1½lb. per ton. The waste is in part owing to the difficulty of completely separating the quicksilver from the sand in the settler; and this is particularly the case with ores which contain carbonate of lead or other heavy minerals. To counteract the mechanical difficulty agitators are sometimes used; riffles and blankets in the sluice-box from the settlers are also occasionally employed. In ordinary cases sufficient separation can be effected in the settler by proper arrangement of the shoes on the muller and the regulation of the speed of rotation; but a certain amount of quicksilver is, no doubt, always carried off in minute globules.

A second cause of the loss of quicksilver is the formation of lead- and copper-amalgams in the treatment of ores containing these metals or in working silver-ores with bluestone. These alloys are pasty substances, which are rapidly reduced to the finest powder by grinding; in other words, the quicksilver is floured, and the separation in the settlers is very imperfect. The most radical cure for this condition of the quicksilver is the addition of sodium-amalgam in the pans before the ore is drawn off. Sometimes the loss is not sufficient to warrant the use of this expensive alloy, and in such cases it is better to gather the quicksilver and amalgam together as well as may be by prolonged treatment in the settler.

In the patio process of amalgamation a very large amount of quicksilver is converted into calomel and lost. In the pan process it is highly probable that one or both chlorides of mercury form to some extent; but these compounds are for the most part reduced by the iron. Were this not the case the loss of quicksilver would be far greater than that actually sustained.

Clean-up Pans.—In most mills which run regularly there is a general clean-up at the end of each month. A very considerable quantity of hard amalgam adheres to the shoes and dies and fills the interstices of pans and settlers, which is removed when new shoes and dies are put in place. In custom-mills a clean-up is sometimes made when each lot of ore has been worked off, if the lots are of considerable value.

Settlers.—The usual size for settlers is a diameter of 8ft. and a depth of 3ft. Occasionally they are found 9ft. in diameter, and 10ft. settlers are reported at two mills. For ordinary work a diameter of 8ft. is sufficient. At the Manhattan Mill, where the settler is used with an iron pan, the settlers are 6ft. in diameter.

There are two different kinds of mullers used in settlers. In the mills on the Comstock and some others the "spider" muller is common. This consists of four arms projecting horizontally from the centre of the muller, and upon each one of these arms a shoe, either of wood or iron, is fastened, which serves to plough up and keep in motion the sand at the bottom of the settler. The other form of muller ends downwards in a round disc of iron, which fills the bottom of the settler to within 3in. or so of its circumference, upon the under side of which long wooden shoes, 3in. thick, radiating to the outside, are fastened. A settler thus arranged is the best for base ores, as it prevents the rubbing and assimilation of the floured particles of amalgam in the bottom of the settler. The muller usually revolves from twelve to fifteen times per minute, although it is sometimes geared to make as many as eighteen revolutions. This, however, is only where very heavy ore is worked, or where the ore has been crushed through a very coarse screen. Such a speed is always attended with more than the usual loss of quicksilver. The greater the diameter of the settler the less ought to be the number of revolutions of its muller. It is customary to keep the charge in the settler until it is time to discharge a pan into it—that is to say, from two to four hours. It is much easier to settle chloridized pulp than that which has not been roasted; for in the process of roasting the particles of quartz, &c., become porous and friable; they are consequently ground finer, and can be retained in suspension in the water with much less motion of the muller.

It requires from fifteen minutes to half an hour to discharge a settler through the series of holes provided for that purpose. The top plug is, of course, first to be drawn, in order that the quicksilver may have as long as possible to settle, and to avoid the production of rapid currents, which might carry off amalgam. A more rapid discharge would defeat these objects.

Agitators.—Agitators are not very frequently used. When they are employed it is more for the sake of concentrating the settler-sands, sweepings, &c., than for catching amalgam. They are usually 7ft. in diameter and about 3ft. deep. The assay-value of the sands recovered in them is usually higher than that of the tailings, and less than that of the ore. Agitators are generally geared to make twelve revolutions per minute.

Tailings.—The tailings of free silver-ores are almost always saved; those from roasted ores are scarcely ever. Tailings from the battery of a gold-mill are handled in different ways, but the following is the usual method; After passing through the screens, the tailings, which contain con-