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For the Arizonian.

The Reduction of Silver from its Ores.

To many of your readers engaged in mining operations, a few notes on the different methods employed to reduce silver from its ores may not be uninteresting, but these necessarily must be confined to the general principles of the metallary of silver ouly.

The reduction of some of the useful metals from their ores by fusion was well known by the ancients, reaching beyond the time when regular records were made in writing, and probably even beyond that period when this was invented. The reduction by the aid of quicksilver is, however, comparatively new, and if quicksilver was used at all, it was only employed for the extraction of virgin gold from its ores. Fusion also must have been an uncertain and mysterious operation, simply based on experiments or accidental discovery, and not as in our days on well established and proved principles of chemistry. The first successful application of mercury for the extraction of silver from its ores was made in the sixteenth century by Bartolome de Medina in Mexico, whence it was transplanted by Fernandez Velasco to Peru. Attempts to introduce it into the mines of Europe failed, and only two hundred years afterward the subject was revived by Baron Bern of Vienna. In the seventeenth century Alonzo Barba, an Andaluz, while in South America, discovered a considerably modified process, by which the ores were treated in a copper kettle, from whence it received the name of Caze (a kettle) amalgamation. Baron Bern's experiments were based on this discovery. His modified plan was partially successful, but still the process was imperfect. This partial success, however, caused intelligent miners to investigate the matter further, and resulted finally in the erection of the greatest, and even now most perfect, amalgamation works at Halsboucken, near Freyburg in Saxony, from which it was universally called the Freyburg amalgamation. After great alteration, barrels were substituted for kettles, and in place of agitation, these were so arranged as to revolve on an axle. By far the greatest mass of silver is extracted by either of the foregoing process of amalgamation. It must, however, not be supposed that they can be indiscriminately applied; on the contrary comparison of ores, climate, and locality and material have to determine which is the most proper method to make mining pay. In most instances the Freyburg or barrel process will succeed where others fail, provided this is under the surveillance of a good, practical chemist.

During the last fifteen years a new process to extract the silver, without the use of quicksilver, has been introduced by Mr. Augustin, a metallurgist, from the Mansfield mines in Germany, which for products of the furnace and certain classes of ores, promises complete success, and an abolishment of all amalgamation: it is called Augustin's process of extracting silver.

Another new process has lately been introduced by a Mr. Ziervogel, from the same locality. We find then in use—

1st. The Furnace.
2d. The Mexican or patio amalgamation.
2d. The Caze (or kettle) amalgamation.
4th. The Freyburg or barrel do.
5th. Augustin's method by salt, without mercury.
6th. Ziervogel's method, without salt or mercury.

NO. 1—FURNACE.

Ores are generally turned over to the furnace when they contain considerable quantities of lead, copper, and some other metals; also when fuel is very cheap and abundant; when a rigorous climate prevents chemical action in the patio, and for some other reasons. The ores are then smelted for the predominating metal. If this be lead, a simple refining after fusion will oxidize the lead, forming litharge, and leave the silver nearly pure on the herd of the refining furnace. If copper predominates, the ore is generally roasted and passed once or twice through the furnace, to separate from the metal the accompanying rock of the vein, and to expel most of the volatile metals. The resulting metallic product is then smelted together, with certain proportions of lead. This mixture is run into cakes, which are then subjected to a species of sweating process under moderate fire, which causes the greatest quantity of the lead in combiuation with the silver to ooze out of the cakes, leaving these honeycombed skeletons behind, consisting of the original material, (deprived of its silver) with some lead. The silver lead is then refined in the same way as that obtained from the furnace from lead ores. This process of separation has been superceded in most large establishments of the barrel amalgamation.

NO. 2—MEXICAN OR PATIO AMALGAMATION.

No material alteration has been made since its discovery in the sixteenth century, and it is most remarkable that such a complicated process could have been so far perfected in those times without the aid of chemistry. This process is principally used in the Spanish American countries, and excellently adapted for them, their climate and their sterile plains and barren mountains, their want of fuel and difficult access for transportation of heavy machinery. By far the greatest portion of the silver is reduced by this process. The process is as follows:

The ore is first freed from any valueless rock, then they are separated and sorted, thence crushed, and finally ground to an impalpable powder, in the rude but well known arrastras, or horse-mills. This powder is transferred to the "Patio," a floor closely paved with rocks. It is there spread over circular surfaces of different sizes, and but eight inches or one foot thick. Here they are mixed with from two to five per cent. of salt, first with shovels, and afterwards by treading it well with horses, mules or oxen. Next day this is renewed for half an hour, and then one-half or one per cent. of mazistral (copper pyrites) is added, after which mixing is continued. These additions are called "incorporation." After this, mercury is sprinkled over, by being poured through a canvass bag, after which the whole mass is again well trodden by animals. Their treading is resumed every other day, until a trial is made in a horn spoon, by washing of the mixture, shows that all the quicksilver has been taken up by the silver. It requires generally two more additions of mercury and the necessary mixing of the ores before the silver is all converted into amalgum. This process requires careful watching, and a skilful, experienced operator. Mazistral has the property of heating the mass; if used in excess, this will be too hot (as it is called,) if not enough, the mass will be "cold." The consequence of the mass being too hot, will be a loss of quicksilver, by conversion into chloride, or calomel. If too cold, the chemical action upon the whole process ceases more or less. This last is remedied by adding more mazistral, the former state by adding small quantities of lime. Simple as this may seem, it is not so in practice, and requires a great deal of experience. The quantity of quicksilver used for the ores depends upon their richness. In some parts of Mexico, if the ton of ore averages three pounds of silver, about thirty pounds of quicksilver is used, of which four pounds or more are invariably lost. When the amalgamation in completed, that is, when all the silver in the ground ore has entered into combination with the mercury, the mass is brought into large vats, where, by a process of washing, the earthy particles are floated off, while, owing to specific gravity, the silver and mercury remains behind. This residue is pressed through a canvass bag, which permit the passage of the liquid mercury, but not of that combined with the silver as amulgam, which remains behind in proportion of six to one per cent. of silver. This silver amalgam is subjected in an iron or earthen retort to a red heat for some time, which causes the mercury to evaporate, and in this gassy state it is conducted by iron pipes or other contrivance, into a vessel under water, where it condenses, assuming its original liquid form. The silver remains behind in a beautiful porous mass, called Plata Pina in Mexico, in which shape it is ready for market, or it is run into bars by simple fusion. The whole process, after taking the ground ore into the patio, lasts from twelve days to two and three months. This difference is caused by manipulation, composition of the ores, and the climate. Ores which will consume only twenty days in the summer to be reduced, may require two or three months in the winter. In order to make some ores available for this process, they have to undergo the process of roasting in a reverberating furnace.

NO. 3—AMALGAMATION (DE CAZE,) IN KETTLES.

This mode of amalgamating silver ores was discovered in the seventeenth century by Alonzo Barba in South America. It is as follows:—After the ore is finely ground in the arrastra, about 150 pounds of it is placed in a copper kettle, and the sides heightened by wooden staves. Salt is added, and the whole mixed with a wooden shovel, with a sufficiency of water to give it a pasty consistence. To this is then added from six to eight times the quantity of quicksilver as silver is supposed to be in the ore, as proved by assay. A slow fire is then lighted, and the mass stirred with the wooden shovel. From time to time trial assays are made in the horn spoon to see whether more quicksilver is required. This manipulation lasts from two to four hours, when the mass is emptied into the washing apparatus, where the earthy matter is washed off. The kettle is at once filled with new material. By this process less quicksilver is lost than by that of the patio, but the residue of the earthy matter contains much more silver. For this reason it is only used for very rich ores, and the residue is reworked in the patio. Mazistral is used at times, but with little profit, owing to its injurious effects on the copper kettle.

NO. 4—THE FREYBURG OR BARREL AMALGAMATOR.

This differs principally from the patio by the rapid reduction of the silver from its ores, and from its small loss of quicksilver. I have only room to give the general routine of this process; more would be out of place, and useless. The ore, as in the patio, is first sorted, crushed, ground fine, and sifted. Then the ore is mixed with from five to ten per cent. of salt, and for four to five hours roasted in a large reverberating furnace; additions of other substances are needed at times. The object of roasting is to expel most of the volative metals, as sulphur, arsenic, antimony, &c., to convert others into oxides, and the silver into chloride, which takes place when the salt decomposes. This requires a careful watch. The ore requires continual stirring up, to expose constantly new surfaces to the action of the heat. Roasting may be deficient, or it may have been carried on to excess, in which case it is termed to be dead. Either state will cause the loss of silver and quicksilver, and moreover produces a very impure silver, other metals having gone in the amalgam of the operation next to be described. If this is the case, another operation of separating and refining is needed. After roasting, the ores are ready for the barrels, which are generally of a size to hold half a ton of ore, and nearly as much more of other matter. To this half a ton of ore, water is added, sufficient to produce a kind of paste. After some time some fifty lbs. of mercury are added, regulated by the richness of the ores; also a small quantity of iron or copper. Whether copper or iron is to be used, can only be ascertained by a practical chemist, as it depends entirely on the composition of the ores. After this the barrels are slowly revolved around on iron axles for a space of eighteen or twenty hours, in which time all the silver is amalgamated with the mercury. This is now settled by a slower motion, then tapped, filtered and retorted, as in the usual mode by the patio process. The earthy mass is then run into the vat, where, by the aid of continued agitation and water, it is worked off, leaving any stray particles of silver amalgam and mercury behind.—The whole operation, after the ore is roasted, occupies from twenty-two to twenty-four hours. The silver is more pure as that from the patio, and the loss of mercury is far less, being but 3½ ounces to 8 ounces of silver produced.

The barrel process, to be successful, requires, however, in the very start, the outlay of large capital and powerful machinery; when these are wanting, and other things are favorable, the patio is to be preferred. In these different methods of silver extraction, some silver is always lost. This loss is not permanent in the same mine, nor alike in different localities. No rule for estimating it can be given. But experience has proven it to be greatest in kettle amalgamation, next in the furnace, next in the patio, and last in the barrels.

NO. 5—DISSOLVING OF ORES WITHOUT MERCURY.

This process of extracting silver from furnace products and from silver ores is comparatively new, having only come in use within the last fifteen years; but for certain classes of ores, it promises to supercede all the other methods hereafter. A great many of the Arizona ores seem to be particulary adapted for this process. Ores containtng lead cannot be subjected to this process, but those of coppery composition may be profitably treated by it. The process was discovered by the mining engineer Augustin, in Germany, and has been named Augustin's silver extraction The ores by this process are subjected to the same treatment as those used in the barrel amalgamation, until after roasting. But here, in place of rotation in barrels, it is daawn red hot from the furnace, and thus thrown into large wooden vats partially filled with a strong ley of salt and water. Here it remains for some time, and the chloride of silver is taken up by the solution, which, after a while, is filtered, and the silver precipitated with cement copper; it is then washed, melted, and run into bars. The solid residue, if rich in copper, is then smelted, and any copper held in solution in the ley is precipitated, as cement copper with iron. But little more time is required for this process than for that of the barrels; little more wood is consumed; no quicksilver is used nor lost, and the use of powerful machinery is dispensed with. As an offset, however, more salt is used up, and the reputation of the whole process is not yet so well established as that of the Freyburg amalgamation. Immense establishments, however, are now in successful operation in Germany, having in some places been substituted for amalgamation. It would be ridiculous for any one but an experienced, practical chemist, to attempt a trial of it on a large scale.

SILVER EXTRACTION WITHOUT SALT OR MERCURY.

A new process called Ziervogels,' has lately been introduced, where even salt is dispensed with: it only differs from the foregoing in the roasting. The silver, in place of being converted into a chloride by the addition of salt, is changed into sulphate, in which state it is soluble in water. For products of the furnace it has been successful in the Mansfield mines, where Mr. Ziervogel, an engineer, is operating on a large scale; but for *ores*, no such result can yet be claimed in its favor: future experiments, however, may remove all difficulties.—Should this be so, an immense revolution in the metallurgery of metals will take place, and no country will reap greater benefits by it than Arizona.

There is no doubt but that we are on the eve of great changes and discoveries in the reduction of the useful and the precious metals. The old clumsy horses, the uncertain and often unfathomable mysteries of the furnace, will have to make place for the exact chemical laboratory, and its new operations. Most of our present methods in use in metallurgy are certainly behind the present strte of chemistry. H. E.

THE WORLD AS SEEN THROUGH THE PRESS.—The world just now in spite of its churches, its ministers, and its religious institutions, seems in a bad way. In the newspapers there is not much except wife-killing, and other descriptions of murder, swindling, burglary, defalcations of confidential clerks, elopement of wives, husbands, and daughters; marriages of whites to negroes. The whole social life of the country seems out of geer, domestic virtue broken up, and the people intent only on the gratification of lust, avarice and passion. Why is this, and what has led to it? We believe one great cause is in the laxity of family discipline, and in the gradual decay of the stern religious principles of our fathers, the prevalence of sham piety and hypocrisy. Much of this may be attributed to the abominable "isms" of the day, behind which so many find refuge. We have had a full surfeit of all sorts, setting out with a kink in the brain, a crazy, mistaken philanthropy about freedom for niggers; the next brood was Fourierism, or the herding of people in masses like sheep, with none of the sacred privacies of a home. Next came "spiritualism, in which some foolish people regard as oracles certain raps and curious noises on tables, bureaus and walls. Then we have women's rights lecturers, who induced women to believe that nature had fitted her for man's avocations, and that she was oppressed and trampled upon by her husband—a slave—which it was a sin to endure. The next step was "affinity," or the right to select the father of her children as though she had not had the right from the dawn of civilization. This leads to "free love," on a basis little less open and brazen than that of the outcast courtesans of society. We have now the fruits of all this miserable stuff in the uprooting of social virtue, Sickles tragedies, wife murders, seductions, elopements, white and negro marriages, until the mind sickens at the contemplation.