

Every practical milling method treats the separation and recovery of flake, flour, or molecular gold as subsidiary and as of secondary importance to the treatment of the ore for the separation and recovery of the grosser particles of gold; whereas the only method whereby flake or flour gold can be milled without loss is to make the recovery of gold in this state the main object of the extraction process, and this can only be done by reducing the whole of the gold-bearing ore to a uniform and impalpable powder, comminution being carried to the last possible degree without hardening or hammering the ore during the process.

Smelting processes are expensive, but have heretofore been necessary for the reduction of refractory ores, as prior to my invention it was impossible to mill such ores satisfactorily. My process consists, essentially, in reducing the entire body of gold-bearing ore, whether free-milling or refractory, as well the gold or gold compounds therein as the gangue and other materials associated therewith, to a state of such fine pulverisation that there will be no distinction between one particle and another in regard to size—*i.e.*, all the free gold will be in a flour, flake, or molecular condition, and all the other materials will likewise be powdered, the reduction being accomplished without hammering, pounding, or compressive grinding. This reduction to practical uniformity in the minuteness of the particles of the whole mass will predispose to chemical change, and will prepare the mass for new chemical combinations, so that uncombined gold will the more readily be taken up and amalgamate with mercury, and gold in combinations in the minute particles will the more easily leave these combinations to form a new one by amalgamation.

In practice I find that ore-powders passing through screens having from one hundred to three hundred meshes to the linear inch are sufficiently fine, but finer states of division may be obtained, and may be necessary with some ores. All gold-ores, with the exception of such as have their gold chemically united to a baser material, contain a percentage of flour or flake gold varying from 30 per cent. to 100 per cent. of the total amount of their gold.

Many mines which show assay-values of from \$18 to \$34 per ton in native gold never produce any such values by practical working, for the simple reason that from 40 per cent. to 70 per cent. of their native gold is in the flour, flake, or molecular condition, and is largely lost or wasted in the methods of extraction now used. Now, the value of my process, its novelty and utility, appear in this: the saving of all, or practically all, of the gold in such ores, thereby rendering them of nearly their gross values, as indicated by chemical analyses, and, furthermore, in rendering possible the milling of refractory ores such as are ordinarily smelted. The process by which I realise these conditions and effect this saving, and the apparatus by means of which I carry out this process, will now be described, describing the one with the other for the sake of brevity.

I have illustrated the apparatus in the accompanying drawings, in which like letters of reference indicate corresponding parts, and in which—Figure 1 is a view of the essential portions of the apparatus as seen in vertical section, the figure being in the nature of a diagram; Figure 2 is a view showing in detail one of the parts; and Figure 3 is a view showing in detail the guards or gratings used to prevent the outflow of large pieces of ore from the cylinder.

In the drawings, the letter A indicates an elevator or conveyer arranged to feed broken or crushed ore from any suitable rock-breaker or ore-crusher [not shown] into a hopper B, whence it falls by gravity through the inclined chute *b* into a pulverising cylinder C. The pulverising cylinder C may be made of any suitable material, and may be mounted and operated in any convenient manner; but the arrangement shown in the drawings, and about to be described, is the one I prefer. As shown, this cylinder revolves on hollow trunnions, which open into both its closed ends, and these trunnions run in suitable boxes *d d*, secured to a supporting-frame D. The cylinder may be strengthened and further supported by rollers arranged beneath it between the trunnions. The trunnion *c* at the receiving end of the cylinder receives the neck of the chute *b* within its inner periphery at its outer end, and the joint between the two is made as close as possible in order to prevent waste. The opening in this receiving trunnion is the frustum of a hollow cone flaring toward the interior of the cylinder, this structure facilitating the delivery of the broken or crushed ore from the hopper into the cylinder, and preventing stoppage or clogging of the ore within the trunnion.

The trunnion *c*¹ at the discharge end of the cylinder is provided with suitable guards or gratings *c*² of iron or steel bars at its inner end, to prevent the outflow of coarse pieces of ore or the like, while the spaces between these bars will allow the comminuted materials to escape as soon as they rise above the middle of the cylinder. This trunnion *c*¹ has its outer end flared to assist in the outward feed of the pulverised ore. The cylinder is provided with a man-hole *c*³, by means of which access may be had to the interior, and has at or near one of its ends the gear-wheel C¹ secured to it, the said wheel meshing with a gear-wheel upon a power-shaft P. In practice I find the best results are obtained from a porcelain-lined cylinder from 8 ft. to 12 ft. in length, having a diameter of from 6 ft. to 8 ft., and I charge this cylinder with about 3 tons of loose Norway flint pebbles or large pieces of ore, ranging in size from 1 in. to 2 in. in diameter. Setting the cylinder in rotation, crushed ore is fed into it by gravity from the hopper B, and as it passes from the receiving end of the cylinder to the discharge end the ore is ground between the porcelain lining and the pebbles and between the pebbles themselves, and the pieces of ore rubbing against each other are gently worn away by self-attrition, the whole operation resembling as closely as possible the natural destruction and wearing-away of rock whereby placer deposits are formed.

It is to be noted that the friable materials used as described act by attrition upon the malleable constituents of the ore, wearing and tearing them gently and progressively. It will be seen that no ore will be discharged through the trunnion *c*¹ until the total mass within the cylinder rises to the level of the said trunnion, and is forced outward by the flow of crushed ore through the trunnion *c* at the receiving end.

While it is true that the cylinder, if revolved at sufficient speed, would cause the crushed ore to pulverise itself without the use of flint pebbles or large pieces of ore, still, experience proves that