

capital so tied up is but a fraction of the cost of timbering these great stopes. Moreover, the system is as safe as mining can be made, the roof of stopes always being near the men, and there can be no wrecks occasioned by a cave. Further, there being no danger from timbers giving way, tremendous blasts can be employed and the ore broken down in great quantities at a time. One drill will frequently break down 75 to 80 tons in 24 hours.

On the 300 level, the pillars come directly below those on the 200, but in future levels the distance will be increased from 100 feet to nearly 175 to allow of less rock being left between levels, and less development having to be done.

SURFACE MINING.

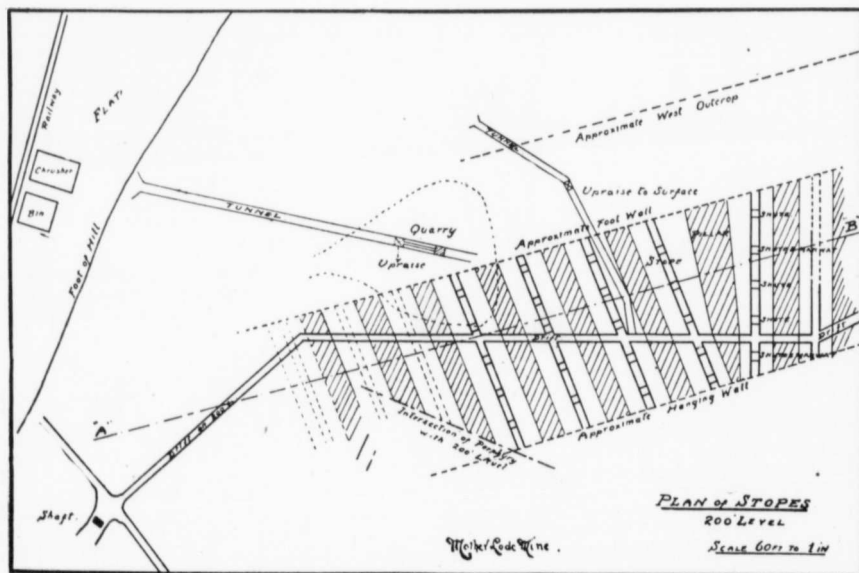
To supplement the output from underground, a great amount of ore is now obtained by quarrying. In the hill which rises some 260 feet over the surrounding flat, a quarry (or "Glory Hole," as it is locally styled,) is in

As quarrying proceeds, other raises will be made, and the level of quarry floor at the same time be lowered until the flat level is reached and the tops of stopes encountered, when these latter may be emptied. The present Gates crusher will take care of all ore from shaft as at present, its capacity being from 400 to 500 tons per 24 hours when fed with ore properly broken.

THE CYANIDE-ASSAY FOR COPPER.†

By HARRY HUNTINGTON MILLER.

IN spite of its recognised irregularities, the cyanide-assay for copper has always been popular among volumetric methods, being easy and rapid, and reasonably accurate when the solution tested contains nothing but pure copper and ammonium salts. In order to secure this condition, however, especially in operat-



operation, this quarry being 110 feet above the flat and 50 feet above collar of shaft. Ore is at present run down a gravity tram to Gates crusher, and thence over conveying belts to bins on the flat. This No. 5 crusher experience has shown to be far too small to admit of economical work, the ore having to be reduced to 10 inch size in order to pass into crusher. This reduction has mainly to be effected by "bulldozing" with high per cent. dynamite, the rock being too hard for hammer breaking. To obviate this difficulty, and to permit of cheaper handling, a tunnel has been driven into the hill from level of flat. This connects by a 12 x 12 upraise with the quarry. In a pit on flat next the railway an immense Farrell crusher, with jaw opening 2 x 3 feet, is now being installed.

Ore will be dropped down the upraise, and there loaded into cars having a capacity of four tons. Trains of these will be drawn by mules to the crusher pit, where they will be dumped, by compressed air, over a grizzly leading to crusher. The screenings and crushed ore will be elevated to a bin beside the railway.

ing on low-grade ores, tailings and slags of complex composition, it is the practice to precipitate the copper from the ore solution,—usually by means of metallic zinc or aluminum. The copper thus precipitated in the metallic form must be dissolved again; and the separation is never, in practice, complete, since an appreciable amount of the copper remains behind in the first solution, and the second solution always contains some of the other metals of the gangue; so that the result is at best but partially satisfactory.

On the other hand, if this course is not pursued, but (as is the practice in many laboratories) the first solution, with or without previous filtration, is treated with an excess of ammonia and the resulting precipitate of Fe, Al, etc., is filtered off, the difficulties in the way of an accurate assay are still greater. A portion of the copper remains behind in the precipitate, necessitating a second and sometimes a third solution and re-precipi-

† From a paper read before the American Institute of Mining Engineers.