

be typical "vein dikes", forming as the last phase of magmatic differentiation, and very much like other intrusive masses. This theory favors the probability of persistence to considerable depth, as it is difficult to imagine a dike several thousand feet long, as exposed on outcrop, disappearing entirely within three or four hundred feet or less.

There is no obvious theoretical reason why the veins of this area should not extend much deeper and continue to be productive well below the present limits of exploration in most parts of the district.

The metal content of the veins varies rapidly within short distances. All of the quartz carries some gold and silver, according to Spurr, but the high grade ores were localized along narrow sections on either wall, or occasionally toward the middle of the vein. Even within these limits it appears to have been an erratic or "pockety" occurrence for the most part, though one or two of the very rich stopes were "wide enough to swing a wagon", according to one of the mine superintendents of the Bonanza days.

It is probable that much of the ore handled in the early period carried over \$100 a ton in gold and silver. The Humboldt and Prospectus, faulted sections of the same vein, were low grade averaging less than 0.2 oz. gold per ton, and rarely showing samples exceeding one ounce.

The ratio of gold to silver by weight varies from 1:2 at the north end of the district to 1:35 to 45 (Spurr) at the south end. It is not known if this variation is due to differences in the original content of the veins or to secondary concentration of the metals. There is nearly a thousand feet difference in elevation between outcrops in the two localities.

Faulting. One major fault has been recognized, known as the Humboldt Fault, having a strike No. 20 to 30 degrees W., dipping steeply, and with a horizontal displacement of over 600 feet. It has offset the Prospectus and Last Chance veins to the north from the Humboldt and Real Del Monte, which are presumably their respective continuations east of the fault. The Humboldt Fault appears to be the most prominent of a series of more or less parallel faults, and only detailed study and mapping will show the effect of the entire system. Many minor faults and slips are to be seen in the old workings on the Last Chance Hill, and the reports of exploration work by the Aurora Consolidated refer to faulting which interfered with the search for ore in the Humboldt and Juniata veins.

The solution of the various faults, especially in the "highgrade" stope area of Last Chance and Middle Hill, would seem to offer exceptional possibilities of finding new ore bodies.

Mine Development. The earliest work consisted of shafts started in the vein outcrops, from which stoping proceeded as soon as ore was found. In fact, the Wide West and other of the Last

Chance vein system, show stopes which were evidently started as open cuts without any regular shaft sinking. There was very little crosscutting in the course of this mining,--once a "pay shoot" was found, it was followed to its limits and almost no dead work was done either in the walls or along barren parts of the vein.

The next step was to drive tunnels, either for extraction of ore from existing stopes or known ore shoots, or as work by "tunnel companies" for the primary purpose of selling shares, and incidentally to look for "blind" veins. This accounts for the fact that some of the most productive ground was not adequately cross-cut, either by the tunnels themselves or by branches.

A still later stage was the sinking of deeper shafts, such as the Humboldt, Juniata, and Durant. These were well away from the most productive area and opened lower grade material, which could not be profitably worked, except for a small body of ore in the Durant.

The deepest shaft in the district, the 900 foot Real Del Monte, made no production, and there is no record of any conclusive lateral exploration from it, though it is close to the area of bonanza production. Difficulties with water and dispersion of funds by the English company seem to have been the causes of failure there.

The last systematic development was done by the Aurora Consolidated, and consisted of several thousand feet of haulage tunnel, opening two low grade veins in the northern section, the Humboldt and Prospectus, and reaching the Juniata a long way from the central productive area. The writer has not been able to learn the extent of the work on the Juniata, but it seems not to have been extensive as it was carried out chiefly during the last year of the Company's operation. One branch of the haulage tunnel was headed toward Last Chance Hill and the Real Del Monte shaft, but it is not known how far it was driven in this direction. If it is true that the ore deposits are essentially shallow zone type, this tunnel and its various branches, at depth of 400 feet or more, are well below the productive horizon, and of little use for exploration purposes.

In summing up, it may be said that the central and northern parts of the district have had development work well started but never carried to a conclusive point, while the southern end of the area has never been adequately explored except as to the search for rich pockets at or near surface.

Available Ore. There is a limited tonnage on the old dumps which may now be profitably handled, but it is doubtful if this would total 50,000 tons carrying 0.15 ounces or over for the entire district.

In the Humboldt and Prospectus workings it appears from figures in the annual reports of the Aurora Consolidated, that there were left between 60,000 and 100,000 tons of grade worked in 1918, or about 0.17 ounces gold per ton, worth now approximately \$6.00. Little is known as to the details of location, or

availability, except that it is above the haulage level, and doubtless includes the extensions of stopes worked in 1918, along with the ground between the level and the first sublevel above. Inspection of such assay plats as are available, suggests that it might be possible to add materially to the tonnage figures given above, in view of the present price of gold. It would not be difficult to make a revised estimate by surveying the sublevels and stopes as far as they are accessible now, using the old assay plats. This would require first cleaning out parts of the crosscut tunnel, which is probably closed where faults were encountered.

The average grade is probably somewhat below that maintained in the 1915-'18 operations, as the assay plat of the tunnel level shows three crosscuts which average 0.134 ounces gold per ton, worth \$2.58 at \$20/oz., \$4.69 at \$35/oz. The average width is 30 feet and the known length of the ore shoot is 500 feet. Additional crosscutting would be advisable to determine possible extensions of the ore shoot, and also to check up on possible parallel ore shoots in the walls. It would be easy to prospect below the level to a depth of 200 feet by drilling from existing crosscuts. The only exploration below this level is said to have been a winze well out toward the east limit of the ore shoot, or beyond it.

The importance of ore in sight in the Humboldt vein is not enough to warrant the erection of a new mill, but in connection with the operations elsewhere in the district, it is worth consideration.

Open Pit Ore. There is no information at hand on which to base an estimate of possible tonnage from an open cut operation, but there are two sections of the Last Chance Hill area which ought to be investigated. One of these is the line of the Wide West-Last Chance vein system, together with the Real Del Monte vein east of the Humboldt Fault. These veins are 35 to 50 feet in width, including horses of mineralized country rock, and as they dip flatly, 25 to 35 degrees, they could be worked by power shovel, or by mill holes to the old haulage tunnels (not the Prospectus Tunnel). It would need a comparatively small outlay to start such an operation, if examination warrants it. As the early work did not include systematic crosscutting of these veins in which there are several "pay streaks" between walls, and possible parallel veins beyond the recognized walls, it is reasonable to expect that the grade of open pit ore might be materially increased by occasional pockets of high grade, and such richer shoots could then be followed below the limits of open cut work, or reached from below.

Another section worthy of detailed study and sampling, is southwest of the Del Monte shaft. Here for a width of 200 to 300 feet or more there is a "stringer zone" mineralization of the porphyry, including some larger veins that were mined in early days. This ground has apparently not been crosscut from any of the tunnels in the vicinity, but it would only require a few hundred feet of crosscutting from the nearest one to prospect a block 800