ORE POTENTIAL

OF

THE DEADBROKE MINE

AND OTHER

NORTHERN BLACK HILLS CONGLOMERATE ORES

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SUMMARY AND CONCLUSIONS

1. Present evidence strongly favors a Cambrian placer origin for the gold ores in the basal Deadwood conglomerate.

2. Projection of surface Homestake orebodies indicates that at least ten million ounces of gold have been eroded and shed northward into the lower member of the Deadwood formation. Only about 3% of this has been mined from conglomerate ores and Recent placer derived from them.

3. The best areas for finding additional conglomerate ores are in the Deadbroke mine, west of the Deadbroke in the area north of Blacktail Gulch, and north of the Hidden Treasure mine.

4. Consultants' reports on the Deadbroke mine indicate that 276,000 tons of ore with a grade of 0.269 ounces gold per ton are present. A evaluation of this reserve at gold price of $100 per ounce indicates that the mine has a present value of about $350,000.

5. These ores present an attractive supplemental ore reserve potential for Homestake since the grade is comparable to Homestake ore and over 90% recovery can probably be achieved in our mill circuit.

6. To evaluate the most promising areas, 2000 feet of surface diamond drilling and unwatering and sampling of the Deadbroke mine are proposed.

GENERAL

History and Production

The Cambrian Deadwood formation in the Black Hills contains in many places lenticular beds of conglomerate at its base, which unconformably overlie Precambrian metamorphic rocks. In several restricted areas, at Rockerville, west of Hill City, and particularly north of Lead, this conglomerate is gold-bearing. The early miners called this rock "cement ore" because of its appearance. These deposits were among the first occurrences of lode gold discovered in the Black Hills and work on them commenced almost immediately. The first stamp mill brought into the Black Hills reached Deadwood on September 26, 1876, and was erected to crush the conglomerate ores from the Hidden Treasure mine. Development of these ores proceeded rapidly and reached a peak in 1878 when 500 stamps were reportedly in operation. As these deposits were close to the surface and easily worked, they were virtually exhausted by 1881. However, some activity was reported on the conglomerate deposits east of the Caledonia open cut and north of Blacktail Gulch as late as the turn of the century.

It is impossible to estimate the total production from these deposits, but Connolly (1927) stated that they yielded at least several hundred thousand dollars. The Hawkeye-Pluma mine reportedly produced at least $188,724 in gold (9130 oz) during its latest period of operation and the Deadbroke has been credited with a production of $300,000 (14,514 oz).

Of all of the cement ore mines, the richest were those upon the divide between Deadwood and Blacktail Gulches. Some of the conglomerates taken from there, according to Devereux (1882), yielded $50 (2.5 oz Au) per ton. Ore from the Pinney open cut, on the divide between Bobtail and Deadwood Gulches, was also reported to have been very rich, and likewise some of that taken from the Deadwood-Terra mine. That from the area east of the Caledonia open cut was characteristically lower in gold content. Assays of the pillars in the Hawkeye-Pluma mine were about 0.30 - 0.50 ounces per ton while those on the wall only ran 0.10 ounces. Orebodies on the northeast side of Blacktail Gulch did not, as a rule, yield more than 0.20 ounces per ton. The Durango, on the west side of the Homestake open cut was also low grade.

Since cement ores were only mined from a few erosional remnants of Deadwood, it is obvious that these deposits covered a much wider area before Recent erosion dissected the area. Very little of the Homestake lode was affected by recent erosion, except where Deadwood Gulch cut through north of the DeSmet orebody. It is inescapable to conclude that a large percentage of the gold recovered from

placers in the Lead-Deadwood area was derived from the erosion of these conglomerates. Lincoln (1937) estimated that $4,000,000 (about 200,000 oz) in gold was produced from these placers. It is thus clear that the basal Deadwood conglomerate (in the area north of Lead) was at one time the locus of a large gold reserve.

Description and Occurrence of Ores

The conglomerate is composed of boulders of quartz and quartzite with minor quantities of schist fragments which decrease in abundance with distance from the Homestake lode. These schist fragments reportedly contained high gold values at the Pinney open cut above Terraville. The gold-bearing conglomerate is cemented by limonite where oxidized and pyrite in unoxidized portions. However, barren conglomerate is cemented by fine-grained quartz (Irving, 1944). The gold is localized near the Precambrian unconformity and Devereux noted that only the lowermost five or six feet would generally pay for mining and milling. At the Deadbroke mine, however, one stope was reportedly mined to a height of fifty feet. Devereux further states:

> "In general where conditions had been such as to allow the subsidence of other materials of high specific gravity the gold was most abundant, ordinarily with large quartz boulders or with pebbles of hematite. The latter were seldom found without gold being attached to them, the pebbles themselves having a smooth polished surface. In general, the position of the gold was always such as to point to its great specific gravity as the locating cause and not to solution or precipitation. In fact, the many curious positions in which I observed the gold were such that no satisfactory explanation could be found except the one noted above. Upon one quartz boulder, which had lain directly upon the schists, I found, after removing the decomposed talc from the bottom, that grains of gold of almost exactly the same size were arranged in ribbon-like layers in such quantity that half an ounce could probably have been covered by the hand. Each grain of gold is generally covered with a thin coating of oxide of iron, which needs a blow to loosen it."

The gold was localized in pay streaks arranged in sinuous patterns reminiscent of stream meanders.

The Precambrian bedrock below the conglomerate often carried mineable values in gold. Devereux cites cases where the Precambrian schists were worth mining to depths of ten feet and Irving states that in places in the Deadbroke Mine, three feet of underlying schist carried about 0.15 ounces per ton in gold. Devereux describes instances where he noted thin films of gold in the cleavage planes of

the schists below the conglomerate and attributed these occurrences to a small amount of solution and reprecipitation of the gold during oxidation of the pyritic matrix of the conglomerate.

Although some of the gold may have been remobilized, the bulk of it occurs as free gold in the matrix of the conglomerate in the form of flakes and nuggets which resemble placer gold. The ores were free-milling and 90-95 percent of the gold was commonly recovered by amalgamation only.

Table 1 is a compilation of the gold fineness of the bullion produced from various lode mines in the area. The bullion yielded from the Cambrian replacement deposits actually has more gold relative to silver than the ores themselves because the percent recovery of gold was greater than that for silver. It is obvious that the bullion produced from the conglomerate mines was, by far, purer than any other mine in the area, including Homestake, and very much different than that from the Cambrian replacement deposits. This fact is also significant because the fineness of placer gold is always slightly greater than that from its lode source. This is due to the greater solubility of silver under the influence of weathering.

In an attempt to determine the nature of the Cambrian erosional surface at the time the conglomerates were deposited, the writer constructed a structure contour map on the top of the unconformity (Plate I). The contours follow almost exactly the form of the areal extent of Poorman formation. Since the Poorman is an easily weathered phyllite, one would intuitively suspect that it would form just such a trough on the generally northward-sloping land surface during Cambrian time and, consequently, be the site of one or more northward-flowing streams. Admittedly, there has probably been some modification of the unconformity surface during uplift of the Black Hills and the intrusion of the numerous igneous bodies in the area. However, the correspondence of structure contours with Precambrian geology seems too good to be purely circumstantial.

It is significant that the richest of the conglomerate deposits, those on the ridge above Terraville and on the divide between Deadwood Creek and Blacktail Gulch, lie near the center of the trough. The Deadbroke Mine, north of Blacktail Gulch, also lies along the trough.

Cement ores in the mines not on Poorman bedrock (such as the Durango, Harrison, Hawkeye-Pluma, Gentle Annie, and Monitor) also appear to be localized in local topographic lows on the Precambrian surface. This is shown on Plate II prepared by Noble. The cement ore east of the open cut lay along a meandering trend adjacent to a high area of Precambrian rock directly adjacent on the west.

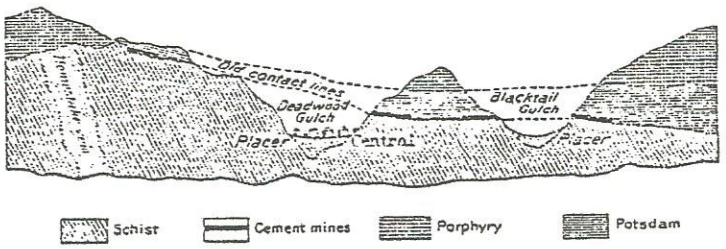

Figure 1. Idealized geological section northward from the Homestake Lode - (Devereux, 1882)

From the structure contours, the low appears to actually be two channels merging and flowing to the northeast along a larger depression. This pattern, however, may only be an artifact of later tilting of the area. The presumed northeasterly trending channel was never explored in mine workings because the conglomerate was unoxidized and uneconomic to mine in that area.

The Durango and Harrison mines also appear to be localized in a depression on the top of the Precambrian. However, gold was also produced from the lower contact ore zone in these mines and the exact distribution of conglomerate ore is rather uncertain.

Genesis of Ores

Devereux was convinced that most of the gold in the cement ores was detrital. Irving thought that it was probable that some gold had been introduced with the pyrite that serves as cementing material for the unoxidized gold-bearing conglomerates but stated that this hypothesis would hardly be provable, to say nothing of determining the amount of hydrothermal gold contribution.

Noble (1950), on the other hand felt that these deposits were a result of Tertiary mineralization. He stated:

> "This study casts so much doubt on the placer origin that this line of evidence can have little weight. The mineable portions of the deposits are the oxidized portions of leaner pyritic replacements of the conglomerate, and the space distribution of the gold which originally suggested a placer origin is probably attributable to a small amount of solution and redeposition of gold during oxidation. These pyritic replacements are identical with the pyritic replacements of Cambrian dolomite in the Tertiary ores of the Bald Mountain districts, a few miles to the west."

The proof for a Cambrian placer origin of most of the gold in these ores is as follows:

1. Recent proof by Rye (1972) that the Homestake orebody is Precambrian in age and thus subject to Cambrian erosion.

2. Stratigraphic evidence that the Homestake lode was emergent at the time the Cambrian conglomerate was deposited.
   a. Thinness of the deposit near the Homestake outcrop and its thickening further away.
   b. Absence of or very thin conglomerate over the Homestake outcrop.

TABLE 1.

Comparison of fineness of gold produced from the cement ores, Homestake, and replacement ores in the Deadwood formation.

	Mine	Bullion Fineness $\frac{Au \times 1000}{(Au + Ag)}$
	Cement Ores	915
	Homestake	820
Deadwood Replacement Ores	Bald Mountain	401
	Golden Reward	336
	Mogul	326
	Lundberg, Dorr, & Wilson	420
	Wasp #2	338
	Maitland	546
	Annie Creek	728
	Monarch	599
Average of Deadwood Replacement Ores		372

c. Coarser nature of the conglomerate nearer the Homestake outcrop, and the presence of many pebbles and boulders of undecomposed schist, which could not have persisted far from the shore from which they were derived. In fact, the frequency of these schist fragments decreases rapidly with distance from the Homestake lode.

3. In the Pinney open cut, fragments of Precambrian schists making up the conglomerates were found to carry high values in gold.

4. "Pay streaks" situated in definite channelways as though deposited by concentrated strong currents as placers usually are, and not aligned in long narrow shoots as is typical of Tertiary age deposits in other districts of the northern Black Hills.

5. The restriction of these channelways to troughs in the unconformity on top of the Precambrian, both on the scale of individual orebodies and in the district as a whole.

6. The gold invariably is in the lower part of the conglomerate as though concentrated there as a result of its high specific gravity. Some of it even lies in the Precambrian bedrock below the gravel, caught in the irregularities of the schist.

7. The gold of the cement ore, as described by both Devereux and Irving and as seen by the writer himself, has all of the physical characteristics of placer gold, occurring as "shot gold", or in smooth rounded grains, slight flattened. One nugget observed by Devereux weighed 0.15 ounces and one seen by Irving was about one half inch in diameter.

8. The gold of the cement ore is invariably lower in silver than the gold of the nearby Homestake lode, a condition we might well expect if this is placer gold derived from the Homestake.

9. The gold of the cement ores was, for the most part, coarse enough to be caught by amalgamation, and panning of crushed cement ore yields visible particles of free gold. In the ore of the higher parts of the formation (of undoubted Tertiary replacement origin), no free gold can be obtained by panning (except in oxidized very high grade ores), gold cannot be recovered by amalgamation, and recovery by cyaniding is very poor in unoxidized ore.

10. That some of the gold was introduced by solutions into the cement is conceded by both Devereux and Irving, but they claimed to be able to readily

distinguish between introduced gold and detrital gold. The fact that the two types of gold present were different enough to be easily distinguished is added evidence of their difference in origin.

11. Fossil placers of Cambrian age are found in other places in the Black Hills, far removed from any possible effect of Tertiary mineralization. This proves the ability of the environment to form such deposits.

On the other hand, proof indicative of Tertiary hydrothermal origin are:

1. The fact that the cementing material for the conglomerate in auriferous areas is invariably pyrite, or, if oxidized, limonite.

2. The presence of many iron stained fractures in the backs of cement ore stopes similar in character to the "verticals" closely associated with Tertiary orebodies in other stratigraphic horizons of the Deadwood formation.

3. The presence of thin films of gold along the foliation planes of the schists underlying the cement ore deposits.

The writer thinks that the evidence strongly favors a placer origin for most of the gold in the basal conglomerate of the Deadwood formation. However, there probably has been superposition of Tertiary mineralization over the conglomerate ores, particularly in the Durango and Harrison mines, which has made direct interpretation of origin difficult. Otherwise, the ores closely resemble fossil placers in other parts of the world such as the Tertiary gold-bearing channel gravels in California. The following discussions of ore potentials in the conglomerates are based on the hypothesis that the major values in these ores were a result of placer concentrations of gold derived from the Homestake orebodies during Cambrian erosion.

ORE POTENTIAL

General

Production records indicate that the Main Ledge and Caledonia orebodies yielded 9,829 ounces of gold per foot of depth at the surface (Plate VI). If one assumes that this value persisted above the unconformity and Cambrian erosion removed only 1000 feet of these orebodies, nearly ten million ounces of gold have been shed into the basal portion of the Deadwood formation. A very similar figure can be arrived at by assuming that the gold content of the orebodies above the unconformity was a mirror image of that below. This may be

considered a minimum figure since there was probably more Cambrian erosion than 1000 feet and, considering the shift of gold values to the west with increasing depth, there could have been orebodies present east of the Caledonia that are now completely eroded. Since the amount of gold produced from the basal Deadwood conglomerate, either directly in lode mines, or indirectly from recent placers, has been on the order of 300,000 ounces, the potential remaining in the lower member of the Deadwood is obvious.

The cement ores offer attractive potential supplemental ore sources since they are free-milling and should be compatible with Homestake ore in our mill circuit. Also, the anticipated grade would be similar in value to that presently being produced at Homestake.

As stated before in this report, due to the ease of mining and extraction, most of the cement ores were mined very early in the mining history of the Black Hills. Some of these mines may have some ore left in pillars, along walls of stopes, and in stacked conglomerate beds above the one that was mined. However, this ore would be difficult to evaluate since most of the mines are inaccessible and, except for the last possibility, the tonnages would be very small and difficult to mine. The grade would also probably be much lower than that previously produced.

Allsman (1940) considered the area north of Blacktail Gulch to have the best possibilities for development of new ore in the basal conglomerate. The lower grade of the ores in this area made them unattractive to the early operators. Also, the limited outcrop of the conglomerate made surface prospecting for these deposits difficult.

Area North of Blacktail Gulch

Geology

The geology of the area north of Blacktail Gulch is characterized by the abundance of Tertiary igneous rocks which overlie and mask the lower measures of the Deadwood formation (Plate III). The types of intrusives in age sequence are: feldspar, porphyry, quartz feldspar porphyry, and rhyolite.

The feldspar porphyry is generally sill-like in form and changes stratigraphic position in the Deadwood through offsets along vertical fracture planes. Widespread alteration of this rock has formed a characteristic loose granular material in which are found scattered spherical boulders of unaltered porphyry. The intrusive is also cut by numerous vertical fractures and fracture zones which are impregnated with limonite.

The quartz feldspar porphyry is characterized by abundant phenocrysts of smoky quartz crystals embedded in a granular matrix of feldspar. The large intrusive of this rock type in the eastern portion of the area appears to be largely discordant but does spread a little laterally just above the unconformity along its western edge.

The rhyolite is a very fine-grained felsite which only rarely contains visible phenocrysts of feldspar or quartz. The main intrusive of this rock type is a sill about 400 feet thick which overlies the feldspar porphyry and masks the underlying geology over a large segment of the northern part of the area.

North of Blacktail Gulch, only 18 inches of auriferous conglomerate was exposed on the outcrop at the Gustin Claim, although a few feet of barren conglomerate is present farther to the east. However, the basal portion of the Deadwood thickens to the north as the rhyolite sill above the conglomerate moves higher into the Deadwood formation.

West of the Gustin Claim, the conglomerate is completely cut off by the overlying rhyolite sill. West of Gray Back Gulch, the basal Deadwood appears to be faulted down and is capped by a sill of feldspar porphyry. Presumably, the lower member of the Deadwood thickens to the north in the area west of Gray Back Gulch as it does to the east.

Deadbroke Mine

The Deadbroke, Minerva, Jupiter, and Gustin Companies all mined conglomerate ore from the area north of Blacktail Gulch but all of them operated on the same orebody and their workings here are all considered as parts of the Deadbroke Mine.

The Deadbroke is located about five miles by road from the Homestake Mill at Lead and is developed by a series of drifts and inclines into the hillside. Several times, cave-ins in the backs of the stopes have exposed gold-bearing conglomerate beds above the one that had been mined and one stope was eventually mined to a height of fifty feet.

Production is reported to have been $300,000 at $20.67 per ounce gold (14,514 ounces) from ore averaging about 0.25 ounces per ton. The operators recovered 80% of this value by amalgamation. Later laboratory amalgamation and cyanide tests performed by H. S. Schnitzel indicated a recovery of 97% by a combination of these two methods.

Several consultants have examined the property and have delineated a block of ore 24 feet high and 400 feet wide which contains 276,000 tons. The ore averages 0.269 ounces gold per ton which is close to the value reportedly produced in the past.

A crosscut was driven across the trend of the ore at the northern end of the mine in unoxidized conglomerate, cemented by pyrite. A sample map of this crosscut, dated September 1939 (Plate V), indicates that the ore zone in the crosscut will only run about 0.12 ounces gold per ton. This could mean that the mine has reached the northern limit of the orebody. However, the stratigraphic position of the crosscut is not known and it is possible that it was driven above the ore zone.

An evaluation of the Deadbroke Mine, assuming the consultant's tonnage and grade estimates are correct and a $100 per ounce gold price, is given in Appendix D. Based on this evaluation, the mine has a present value of about $350,000.

Other Targets

The cement orebodies located on the ridge between Deadwood and Blacktail Gulches lie in a zone 2700 feet wide across the axis of the trough in the unconformity. However, the workings of the Deadbroke Mine have only explored a zone 500 feet wide on the east side of this trough. Thus it seems that the area west of the Deadbroke Mine, along the projection of the Hidden Treasure and Esmeralda orebodies, is a prime prospecting target. Only a very thin lens of conglomerate is present in this area on the north side of Blacktail Creek and it is engulfed in the sill of feldspar porphyry. Either the bulk of the conglomerate has been faulted down and is overlain by the sill or the porphyry has intruded along the unconformity and uplifted the Deadwood, which has subsequently been eroded. The former of the two possibilities is favored because of the presence of about 15 feet of flaggy Deadwood limestone and sandstone included in the porphyry on the north side of the creek. This sequence of rocks occurs stratigraphically above the conglomerate. It is anticipated that the basal measures of the Deadwood will thicken northward as they do in the adjoining Deadbroke Mine. If any orebodies are present in the conglomerate west of the Deadbroke, the tonnage and grade anticipated would be similar to that expected in the Deadbroke Mine.

Irving (1904) stated that the conglomerate in the Hidden Treasure Mine was cut out by a northeasterly - trending rise in the Precambrian surface. The extent

It is anticipated that the basal measures of the Deadwood will thicken northward as they do in the adjoining Deadbroke Mine. If any orebodies are present in the conglomerate west of the Deadbroke, the tonnage and grade anticipated would be similar to that expected in the Deadbroke Mine.

western limit of the conglomerate in that area. It is obvious that this limit is aligned almost precisely with the fault that was mapped along Blacktail Creek. It is possible that the so-called rise in the Precambrian was in fact, a scissors fault that cut off the conglomerate on the Northwestern side of the Hidden Treasure Mine, and depressed the basal Deadwood along Blacktail Creek. Further evidence of this scissors motion is the elevation of the base of the Deadwood to near the top of the hill in the southwestern corner of Plate III.

Since the basal Deadwood is not exposed west of the fault in Blacktail Gulch, the area between the Hidden Treasure Mine and Blacktail Gulch has potential cement orebodies. It is not possible to estimate with any confidence the tonnage and grade potential in this area, but considering the value produced in the Hidden Treasure, the grade should be quite good.

There are possibilities that placers of beach or alluvial fan origin could be discovered in the area north of Blacktail Gulch. It would be expected that these types of deposits would have developed farther to the north (i.e., farther from the source area) and in the sandstone beds above the conglomerate. There is no evidence that these types of deposits have been mined in the past and the possibility of them existing must be presently regarded as purely geological speculation.

PROPOSED EXPLORATION

Figure 2 indicates the property in the areas of interest that should be acquired before initiation of this project. Then, the Deadbroke Mine should be unwatered and thoroughly sampled to confirm the tonnage and grade estimates that have been reported. The mine must also be mapped in detail in an attempt to determine the distinguishing characteristics of the gold-bearing conglomerate and the nature of the orebody itself.

Seven diamond drill holes, totalling 2000 feet in length are proposed. These will be drilled from the surface and will penetrate into the Precambrian. Three of these will be located along Blacktail Creek west of Gray Back Gulch to explore the basal Deadwood measures beneath the feldspar porphyry sill. Three more holes are proposed west of the northern portion of the Deadbroke workings -- in Gray Back Gulch, atop the ridge west of Gray Back Gulch, and in Modoc Gulch. These holes will test the conglomerate in the northern portion of the area and will check the thickening of the Deadwood formation to the north. The seventh hole is proposed in a western tributary of Bessie Gulch to check a drill hole on which ore was reported, but no values given.

Figure 2. Recommended land acquisitions in the Blacktail Gulch vicinity - - red, already owned or under lease; yellow, recommended for leasing or purchase; and pink, public domain recommended for staking.

Scale: 1" = 1000'

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APPENDIX A

DESCRIPTIONS OF MINES

IN THE

BASAL DEADWOOD CONGLOMERATE

Gentle Annie, Hawkeye-Pluma, Monitor

The Gentle Annie, Hawkeye-Pluma, and Monitor mines were opened in the basal conglomerate on the ridge just east of the Homestake open cut. The ridge is capped by a sill of rhyolite porphyry and, in the Gentle Annie, a second sill of the same rock was found intruded between the conglomerate and the underlying schist. The thickness of the conglomerate varies up to 40 feet although it is generally much less than that. Where the conglomerate is completely mined out, the roof of the stopes is a friable, cross-bedded sandstone cut by numerous intersecting iron-stained fractures which cross into the conglomerate.

The most important single orebody in this group was found in the Hawkeye-Pluma mine, where the mine workings intersected a thick mass of conglomerate. Irving (1904, p. 183) described it as "..... a basin of conglomerate, the gold-bearing portion of which forms a channel trending in a general way north and south....." The length of the channel was 1300 feet with an average width of about 60 feet. The southern 400 feet of the channel trended about N. 60°E., while for the remainder of its length, the trend was just west of north.

In general the ore of the western end of the cap was thoroughly oxidized while to the east and south the conglomerate was cemented by unoxidized pyrite. Irving (1904, p. 184) reported that pillars in the stopes of the Hawkeye-Pluma mine carried about 1/2 ounce of gold per ton, although values in the walls were considerably lower.

Partial production records for the Hawkeye-Pluma show an output of $188,724 (9130 ounces gold at $20.67 per ounce).

Deadwood-Terra, Omega, Pinney

The Deadwood-Terra, Omega, and Pinney mines were developed in a small patch of basal conglomerate about 12 feet thick which caps the divide between Deadwood and Bobtail Gulches. The cement of the conglomerate was entirely limonitic in these mines, and the ores were generally of good grade.

The Deadwood-Terra mine was situated directly above the Homestake formation. Although the mine was opened to work the cement ores, when the value of the underlying Precambrian ores was discovered, the workings were extended downward to exploit the latter ores. The main shaft eventually reached a depth of 900 feet.

In the Pinney mine the conglomerate reportedly contained fragments of Precambrian schists which contained high gold values.

Durango, Harrison

The Durango and Harrison mines were opened to exploit the gold-bearing basal conglomerate of the Deadwood formation (west of the Homestake open cut). It was later realized that the overlying beds of the lower contact zone were mineralized carrying both gold and tungsten and operations were extended into the that horizon.

The basal conglomerate is about 15 feet thick in both mines, occurring as fill in a northwest trending depression on the surface of the schist. In general, the ore was thoroughly oxidized, but in the Durango mine a few patches of conglomerate cemented by pyrite were found. Much of the gold in both mines occurred in the free state, and according to Irving (p. 208), Devereux reported that the ore was richest at the contact with the schists, and that the gold "was often dissolved and reprecipitated in crevices in the latter rock." Irving also noted that native gold occurred at the top of the conglomerate, directly beneath the siliceous ore at several localities in the mine.

Baltimore and Deadwood, Esmeralda, and Hidden Treasure*

North of Deadwood Gulch and on the divide between it and Blacktail Gulch, is the..... richest area of gold-bearing conglomerate. Upon this area there were three mining operations --- the Baltimore and Deadwood on the extreme western end of the divide, the Esmeralda upon the north side a little to the west of the Baltimore and Deadwood, and the Hidden Treasure mine on the western edge of the area..... the conglomerate in the Hidden Treasure mine is reported to have yielded extremely large amounts of gold. The Algonkian surface slopes upward gradually toward the northwest, and is reported to have finally encountered a northeasterly trending rise, which cuts out all but the upper measures of the Cambrian series. The conglomerate at this point is not now to be seen, but is reported as of great thickness.

*Mine descriptions by Irving (1904).

Deadbroke, Minerva

Both the Minerva and Deadbroke mines were opened by tunnels driven northward into the slope north of Blacktail Gulch. The basal conglomerate is about 2 feet thick on the outcrop but thickens to 22 feet at the north end of the mines, about 600 feet from the portals. Most of the ore was cemented by iron oxides although some small bodies of conglomerates cemented by pyrite were also located. The ores were reportedly of low grade.

APPENDIX B

REPORT ON THE DEADBROKE MINE

TO C. F. WENHAM FROM OLIVER MATHEWS

DECEMBER 30, 1902

Development

The Mine

The mine is reached from the surface through a tunnel 380 feet long. At the end of the tunnel an incline has been sunk on a grade of 31%. At about 100 feet in depth the incline pierces the top of the lower ore measure. At 160 feet it reaches the schist footwall and continues at an average dip of 6 degrees and bearing towards the center of the property for 730 feet. From its breast a crosscut has been driven eastward 400 feet. Beginning at the point where the incline first finds the footwall, an irregular chamber has been stoped out for a length of 480 feet and an average width of 50 feet and height of 8 feet. From a point on the west side of the stope and central to the mine a drift has been driven west 75 feet.

Continuity of the Ore

In the Minerva mine, which adjoins the Deadbroke on the east, extensive work has been done. A drift 400 feet long in that property near the joint side line, serves to show the continuity of the ore in that direction.

The incline and crosscut have been driven as far as possible to maintain even grades, and as the bedrock is quite irregular, it has in a few places been cut and shows part way up the sides of the drifts. At these places drill holes in the roof to the distance of 5 to 6 feet have been made. Nowhere has the top of the ore been reached; the distance drilled being limited to the length of the drill that could be used in the space of the drift.

The west crosscut is entirely in ore. Several cave-ins have occurred in the stope, demonstrating that what was formerly taken for the top of the orebody was in reality only a horizontal parting and exposing 8 or 10 feet more ore with a new roof still of the same material. Six drill holes 6 feet deep were made at the highest points without reaching the upper limits of the ore.

The Ore Deposit

Characteristic of the Conglomerate

A characteristic of the conglomerate beds of the Black Hills is the "tale" seams that occur parallel to the dip of the formation. They are in thickness from

mere seams to several inches and are composed of decomposed porphyry roof of the ore measures.

The Minerva Claim, which adjoins the Deadbroke on the east, extensive work has been done, and has three times been abandoned and left to cave. Each time the cave-in has exposed ore of greater thickness than that which has been removed, until the total height reached is more than fifty feet. Other neighboring properties that were worked continuously for 20 years passed through like experiences.

The roof has been found to be regular in its dip and strike, while the rock bed is, from its nature, less smooth, and is the uncertain element in estimating the thickness of the ore. I do not see any evidence that there are especial shoots in this deposit, but conclude that it is continuous in every direction to the limits of the area formerly occupied by the auriferous gravels of which it is evidently composed. Where the up turned edges of the underlying shale is ragged and project upward, it is thin; otherwise it will have its normal thickness, which the general development of the region would indicate to be not less than 20 feet.

It occurs at a horizon considerably above the bed of the streams, and cuts through the hilltops with a regular dip to the north. South of the Deadbroke it has been nearly mined out to the southern limits of the Homestake property. Northward the country rises, bringing the valley bottoms above the horizon of the conglomerate, the overlying porphyry increasing in thickness to several hundred feet.

Ore in Sight

It is apparent that the usual methods of calculation will not apply to this deposit in estimating the ore in sight. The usual vein phenomena are entirely absent. The conglomerates assume more nearly the characteristic of a member in the general geological structure of the region, while the values are locally somewhat uncertain. Experience over a vast area has demonstrated that one day's mill run will not differ materially from that of any other day!

Ore Blocked Out

The Deadbroke Group is situated central to the trend of the deposit and neighboring development has shown the width of the ore beds to be greater than that of the width of this property. It is likely that it will be found to extend over nearly all the territory covered by this Group. It extends south of the

point where discovered in the incline, and shows the same strength in the outer drifts and crosscuts that it does in the central portion around the old stope. The roof of the stope shows a quantity equal to that already removed. There is an area 750 feet long by an average of 350 feet wide that has been exposed practically on four sides, by the crosscuts and incline and by the work in the adjoining Minerva Claims. I have assumed the average thickness of ore remaining to be fifteen feet, which is considerably less than my measurements would seem to justify. This block alone will yield 276,000 tons.

Value of the Ore in Sight

Method of Determining Value of Ore

The methods of determining the value per ton of the ore available for immediate production have been employed. The first was to take samples of the piles broken each day the miner's blasts as the development work progressed. By this method 613 samples were taken that yielded an average per ton value of $5.97.

The second method and the one adopted during my examination, was to break from the walls of the drifts and stopes at intervals of twenty feet fifty to one hundred pounds of ore. The sample after being crushed to the proper fineness was reduced by quartering to a quantity suitable for the assayer. By this method 110 samples were taken which averaged $5.25 per ton.

APPENDIX C

REPORT ON THE DEADBROKE MINE

TO B. C. YATES FROM H. H. STEWART

DECEMBER 30, 1930

In the Deadbroke Mine there is a large body of low grade ore 24 feet or more thick and a crosscut driven after engineers reports were made show the ore to be 400 feet wide. The ore is free milling and 813 samples give an average of $5.56 per ton in gold.

613 samples by Maloney	$5.97 per ton gold
110 samples by Mathews, M. E.	5.25 "
90 samples by Moore, M. E.	5.48 "
	3)$16.73 = $5.56

Amalgamation and cyanide tests made by Henry Schnitzel of Lead and Henry E. Wood, Denver, Colorado show a total recovery of 96%.

Engineer's reports estimate the ore in sight 276,000 tons, but the amount will be much larger as cave-ins in the roof of the Deadbroke Mine have shown that what was thought to be the roof is not and there is a large ore body over the orebody which has been worked. The Gustin and Minerva are valuable claims as the ore was discovered on these claims and worked to the line of the Deadbroke Mine. $300,000 is reliably reported to have been taken from these claims and cave-ins in the roof of these claims show as much ore as was taken out.

The mine makes very little water; a pump running about two hours a day will keep the water out after it is pumped out.

APPENDIX D

EVALUATION OF THE DEADBROKE MINE

Evaluation at $100/oz gold

1.	Tonnage	250,000 tons	(cut from 276,000 tons for pillars)
2.	Sampled grade	$ 26.90/ton	
3.	10% dilution	24.21/ton	
4.	90% recovery	21.70/ton	
5.	Operating Costs:		
	Room and pillar mining	$ 10.00	
	Transportation & storage	1.00	
	Milling	1.50	
	Development	2.00	
	Overhead	3.00	
	Royalty	1.00	
		$ 18.50	cost/ton
6.	Profit per ton	3.29	
7.	Rate of production	250 tons/day	
		or	
		75,000 tons annually (300 days)	
8.	Life of mine based on known reserves	= 3.5 years	
9.	Annual profit	= $247,000	
10.	Total profits	= $864,500	
11.	Present value	= $619,000 (10% interest)	
12.	1 year before production (deferred 1 year @ 5% interest	= $588,000	
13.	40% risk	588,000 x .60 = $352,800	
14.	Present value	$352,800	