PROGRESS ON THE COMSTOCK LODE

Difficulties Which Caused the Shutting Down—Engineering and Other Advantages That Have Alighted the Reopening

Written for "Mines and Minerals," by R. L. Herrick

Nevada has been engaged in "boosting" such a multitude of new camps in the last few years that the old camps of the Comstock Lode have been all but forgotten by the public. Seldom has there been mentioned, except perhaps, in the gorgeous prospectus of a promoter boosting his property better than the Comstock, which produced $650,000,000.

In the absence of data we must assume that the flooding of these last groups of mines took place at a time when the majority of them had practically worked out their highest value. In the judgment of two of the principal newspapers, the Comstock Lode, since their recent drainage, is apparent that they, at least, lacked development rather than ore. The increasing cost of water, however, has undoubtedly delayed the installation of new pumping plants or immediate abandonment. With no ore reserves, the great expense of such a plant could be borne only by the stockholders, the majority of these, however, have probably purchased their holdings at the fancy figures of the mad boom, and the dividends in most cases falling to approximate their first investment, they viewed the closing of the mines with indifference. The absence of a drainage scheme to such stockholders, if it was attempted, naturally ended in failure.

Gold Hill Pumping Association, comprised of the six companies: Air-driven Dow pumps were installed on the Crown Point drives and the water pumped to the Sutro tunnel. After the expenditure, recorded at $440,000, in lowering the water to 1,150 feet, the attempt was made in vain; the Sutro tunnel fell through.

Common Stock Manipulations.—With the exception of this above-recorded attempt the period of abandonment of the mines in 1898. During these 14 years, although the mines themselves were idle, the stocks were for no means so. The period may aptly be referred to as that in which the mines filled up with water while the "water" (unwarranted values) was squeezed out of their stocks. The obvious ways by which this was accomplished is too generally understood to need explanation here. It suffices to explain that in the year of 1898 it seems probable that the majority of active stockholders, in twenty-four of the principal mining companies belonged to that hopeful class hard to dismay by dissim of forebodings and hard to freeze out by the usual simple process of levying assessments. They had bought in at fair prices with the understanding that the mines were to be reope and not to be discouraged by ordinary means. A fact not generally understood, however, is that during this period of abandonment the control of the mines was in the hands of a coterie consisting mainly of brokers, located for the most part, on Pine Street, San Francisco. This power was theirs, not by virtue of ownership of the majority of stock, however, but through their manipulation of proxies and personal friends to the executive offices of the mining companies.

The significance of this particular concentration of power will become apparent from the description given below of the Comstock Lode Pumping Association.

The Comstock Lode Pumping Association.—The concentration of the majority of the mines' executive offices within the hands of the Pine Street brokers had led to a close working arrangement.
About two years ago the United States Geological Survey began a study of the waters of the Great Lakes in connection with an extensive investigation of the economic value of surface waters in the United States. For a year a 1-gallon sample was collected each month from each lake at a point where the water would probably represent the normal quality of the discharge. The waters were shipped in special containers to the water-testing laboratories of the Survey at Washington, D.C., and were analyzed from one to three months after collection.

Mr. R. B. Dole, under whose direction the analyses were made, states that the most noticeable feature in a cursory examination of the analytical data is the slight variation in the concentration of the waters from month to month, the total variation, as shown by the dissolved solids figures, being only 18 parts per million, or 15 per cent. As rivers of ordinary size may vary 200 to 500 per cent. and even large rivers, like the Mississippi, may change 50 per cent. in their mineral content during the year, this annual fluctuation of 15 per cent. is very small. The average monthly fluctuation in the discharge of the Great Lakes is considerably more than 15 per cent., ranging from 40 per cent. in St. Marys River to 27 per cent. in St. Lawrence River at the foot of Lake Ontario.

The chemical composition of the water does not, therefore, bear a fixed relation to the quantity of water discharged. Mr. Dole gives the probable reason for this comparative steadiness in concentration as the absence of large rivers and the low ratio between the areas of the drainage basins and the lake surfaces.

Though the lake waters do not change greatly from month to month, they differ a great deal from one another in concentration. Lake Superior is least strongly mineralized; Lake Michigan is twice as high in total solids, and Lake Huron is but little less mineralized than Lake Michigan. Lakes Erie and Ontario are practically alike in mineral content, holding about 2 1/2 times as much solids in solution as Lake Superior. Reason for the striking difference in the lake waters is found in the character of the geologic formations in the drainage basins tributary to them.

Comparison of the analyses of the lake waters with those of tributaries to the system shows, according to Mr. Dole, that the lakes are almost invariably softer than their affluents.

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The reason for this difference is apparent: As the lake surfaces are large in proportion to their corresponding land drainages, a great part of the rain falls directly into the lake waters and dilutes them; on the other hand, rain falling upon the land becomes more or less impregnated with mineral salts before it reaches the lakes in the normal run-off. This fact has an important relation to the industrial consumption of the waters, and shows the importance of locating intakes outside of the influence of tributary streams.

The Waters of the Great Lakes

More than four million people, living in a hundred cities, obtain water for domestic and industrial uses from the great inland seas on the northern boundary of the United States; and boiler water for the enormous land and water traffic that joins these cities to one another and to the rest of the world is derived from the same source. The chemical composition of these waters is therefore a matter of great interest to both sanitarian and chemical engineers, and a study of their composition is also valuable because the comparatively equable condition of the lake waters allows them to serve as a standard for comparison with other waters in the Northern region.
Although the last contract with the Tunnel Company guaranteed an expenditure of but $125,000, up to the time of the writer’s visit to the Association had expended the sum of $327,772.73, thus nearly completely repaying the great work whose first cost of construction was more than $5,000,000.

Caving Along the Lode.—Although negotiations with the Tunnel Company extended over a long period before being brought to a mutually satisfactory conclusion, the work of unwatering the lode was being steadily pushed all the time. During the period of abandonment, the great stope once so splendidly timbered was crushed in along the length of the lode from end to end. A great scar, which may be plainly seen from any point of vantage, extends along the surface parallel to the lode, showing that an extensive movement has taken place along and down the strike. The extent of this movement is not known, measurements taken on the 1,600-foot level of the old Con. Virginia shaft showed that the distance moved is at least 16 feet. Not only the stopes, but hundreds of miles of workings excavated in the bonanza days are thus known to have collapsed. In unwatering the old mines, therefore, it will be understood that danger was ever present due to the menace of great subterranean reservoirs of water held back only by the caved portions of the drifts connecting with the shaft.

The C. & C. Pumping Plant.—Owing to its excellent condition and favorable location for draining its neighbors, the C. & C. shaft was selected by the Pumping Association for the installation of its pumping plant, the water level at the start of operations standing about 26 feet below that of the Sutro tunnel connection (1,650 feet). It will of course be understood that below the water level the shaft was in good condition, but the stations were caved, as were many of the drifts, and contained an immense amount of debris which had to be removed. All of this work we pass over, and from here on devote our description strictly to the pumping operations.

The water was lowered 500 feet, from the 1,650-level of the Sutro tunnel to a depth of 2,150 feet, by the use of hydraulic elevators acting on the injector principle. The main column pipe extending to the surface supplied a maximum of 200 miners’ inches under a pressure of about 900 pounds per square inch at the 2,150-foot level, the velocity of the stream at the injector showing 1,600 gallons per minute. The raise of 14’ x 14’ timbers spaced on 4-foot centers and lagged, was driven from the shaft, to the tunnel level. On the 2,150-foot level was then excavated a great pump chamber, 20 feet wide by 119 feet long and 20 feet high in the clear, supported by 15” x 14” timbers spaced on 4-foot centers and lagged. Eventually was installed the pumping plant shown in Fig. 7, consisting of 314” x 24” double-acting Riedler pumps, each with a pumping capacity of 1,600 gallons of water per minute from the sump on the level to the Sutro tunnel, each operated by a 500-horsepower Westinghouse induction motor.

Although equipped at the start of operations in 1899 with a fan of 100 pumps, the water work wasted the work of the Association exhausted and no more immediately forthcoming. Not a fortunate and noteworthy event taken place, after the lowering of the water level a little over 100 feet, the saving event was the striking of the large ore body, shown in Fig. 1, on the 1,750-foot level of the Consolidated Virginia. This proved to extend into the Ophir ground so that both of these companies were quickly benefited by the joint work of the Association.

The following shows the production and dividends paid by these two companies since the strike in 1898.

<table>
<thead>
<tr>
<th>Company</th>
<th>Total Production</th>
<th>Dividends Paid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consolidated</td>
<td>$934,900</td>
<td>$1,998,706.09</td>
</tr>
<tr>
<td>Ophir</td>
<td>$251,790</td>
<td>$251,790</td>
</tr>
<tr>
<td>Total</td>
<td>$2,186,690</td>
<td>$2,250,496.09</td>
</tr>
</tbody>
</table>

It is now apparent why the Consolidated Virginia was enabled to step into the breach in the year 1902, and advance the Pumping Association $10,000 to pay for the installation of the Ophir Riedler pumps, the situation of the dewatering of the ore bodies below the 2,150-foot level. Below this level, the sheat water was lowered by again using hydraulic elevators as before, draining down to the 2,470-foot level. At this level today is installed a single elevator which raises 3,000 gallons per minute to the 30,000-gallon Riedler pump tank, requiring for its operation 1,400 gallons per minute fed from the surface by the column pipe under a pressure of about 1,100 pounds per square inch. That this one pumping plant has been instrumental in lowering the water over the entire lode is shown by the decreased levels in the shafts today, below what they were before pumping. In the working of the Union, Ophir, Mexican, Sierra Nevada, Best & Belcher, the water now stands at the 2,450-foot level; in the Combination shaft the level has been 200 feet, while even in the distant Overman shaft it decreased 600 feet before the start of the pumps in the Ward. Greatly encouraged by this success, the management has purchased a 5-step centrifugal pump, with its motor, to be installed on the 2,450-foot level. This will relieve the hydraulic elevator so that it can be used to pump to the top of the centrifugal as sinking progresses another 500 feet to the 2,950-foot level.

The Ward Shaft Association.—Foreseeing the success of the Comstock Pumping Association, the year 1903 was marked by the organization of the Ward Shaft Association, composed of nine of the original twenty-four companies which had organized the former. These companies contributed their pro rata to the first organization in order to devote their funds to the support of a plant entrusted with the draining of their mines which could be accomplished from the C. & C. shaft. The Ward Shaft Association consisted of mining companies whose properties extend for nearly a mile along the middle and southern portion of the lode; namely, the Gould & Curry, Savage, Chollar, Potosi, Bullion, Alpha Consolidated, Exchequer, and Julia Consolidated.

The Ward shaft, like the C. & C., was selected for the pumping-installation for its apparent excellent condition and favorable location for draining purposes. Had its true condition beneath the water level been foreseen, it is probable that a new shaft would have been sunk without attempting the repair of the Ward. At the time operations started, in the Ward, the water level stood 1,950 feet below the center of the Sutro tunnel. At the time of its abandonment, 20 years previously, it had been sunk to a total depth of 2,481 feet, although the Sutro tunnel was only about 300 feet distant from its 1,900-foot level, no connection between the two had ever been driven. After remining down to this level, therefore, the connection was made, greatly improving ventilation and thus lowering the high temperature. In reopening the shaft below this level, the pumping of considerable flows of hot water necessitated the installation of an extensive temporary pumping plant. This consisted of the following three units:

1. This lifted the water to the 2,330-foot level above, on which was located a centrifugal pump belted to a 50-horsepower Westinghouse induction motor.

This centrifugal pump lifted the water up its last stage of 230 feet to the 2,200-foot level on which was located a 41” Knowles vertical triple pump geared to a 100-horsepower Westinghouse induction motor. This last pump made the final lift of 800 feet to the Sutro tunnel, pumping 300 gallons per minute.

Having drained the shaft below the 2,400-foot level, this temporary plant was replaced by a 5-step centrifugal pump installed on the center of the shaft operated by a 200-horsepower motor driving at a 1,720 revolutions per minute, that makes one lift of 800 feet to the Sutro tunnel, pumping 600 gallons per minute from its sump, which is kept full by the circulating caver.
together as they did, they were enabled to plan and adopt a method of joint work between the mines for the unwatering of the entire lode. This resulted in the organisation of the Comstock Mining Association in 1898, composed of the four principal mining companies owning the property extending from the Utah on the north, along the lode south to the Alta, as shown in Fig. 1. The governing board of this association consisted of the presidents of the various mining companies whose management a superintendent directed the actual mining work. Whether this form of organization was responsible for the many well-known abuses of power and of inside information to manipulate the market stock quotations during the moneys spent during the Stock-Market boom was a question.

It is, of course, understood that the proposal of the Association to unwater the lode at once created an active market for the mining stocks. The buyer thus became liable to such assessments as were allowed by law, namely, a maximum frequency of once in 90 days. The funds thus raised were of course supposed to be devoted to the unwatering of the lode, each mining company of the Association paying its pro rata cost of the common work. Had all of these funds been promptly and economically expended, it is safe to say that the condition now only recently attained by the mines would have been reached several years ago with the necessary damping to the mining business, the annual report of that particular company will read like the London Punch and constitute a joke book of unconscious humor to the mining engineer. For instance, the expenditures published by some of the mining companies sometime show that if it became necessary to economize, and either discharge some of the multitudinous heads of the office force or give the miners and extended leave of absence. To this end the mining engineers were shut down, while the salaries continued to dry up the drizzle from stockholders' assessments. These are harsh statements. It is true, yet so often were they made to the writer at the time of his visit and became the knowledge of the profession, that it was assented, it will prove no revelation to those most interested. Whenever it becomes easy and more profitable to work the stockholders for assessments, than to work the mines for precious metal, we may say that the mining engineer and contractor cannot conceive plans for development that shall restore great mines to the list of producers, yet let those plans be submitted to a broker's office, and the view point changes from the engineering to the market position.

It will now be understood that those engineers entrusted with the solution of the grave engineering problems incident to the unwatering of the lode have been handicapped by few of the profession relish. They have at times been criticized for delays in completing their work, yet, possessed of the foregoing facts and having in mind the record of achievements to follow, their fellows will be able to back their both criticism and commendation where they belong.

The Sutro Tunnel. As this tunnel in good condition constituted the mine to the drainage situation and was so accepted by the Pumping Association, the first work of unwatering the lode was the improvement of the tunnel.

Completed in 1878, by Adolph Sutro, at a cost of about $6,000,000, this great adit with its laterals nearly 8½ miles in length connected most of the shafts, as shown in Fig. 1. Prior to the closing of the mines, the water had been pumped from their lower levels to the tunnel and been carried to its portal through its drainage box.

As the Sutro Tunnel Co.'s sole source of revenue during its years of usefulness before the shut-down had been derived from the bullion-producing mines, their closing spelled disaster to the tunnel. Failing to derive further income from the operation of the tunnel devoted itself to making necessary repairs and replacement of timbers, and maintaining the airway and trackage facilities unimpaired. This was accomplished, for years at annual expense until the intangible volume on the resumption of pumping in 1898, the hot water flowing through it filled with steam was instrumental in causing the rapid decay of the tunnel, leading to the shut-down of the tunnel. Friction then developed between the Tunnel Company and the Association, growing out of the inability of the former to pay the needed repair bills out of its revenue and the inability of the mining Association to pay the necessary funds to the Tunnel Company.

The Association offered the Tunnel Company a certain specified points at an expense not to exceed $18,200. Financed by this sum, almost ridiculous when the magnitude of the needed repair work is considered, the Tunnel Company was able to repair the tunnel sufficiently to keep it open. As a result, the Association declared the cost of repairing the tunnel to be $57,077 for the drain pipe.

The turning point was reached in April, 1905, when the Comstock Tunnel Co. then, as now, managed by the Leonards, negotiated a contract with the Pumping Association, the substance of which was as follows:

During the 5-year period from 1905 to 1910, the Pumping Association, at its own expense, should make all repairs required, install 1,500 sets of new timbers, temperature, and make a 50-inch wooden-stave drainage pipe constructed through it as far as the Ward Shaft connection, for a sum of $125,000 including $57,077 for the drain pipe.

The above agreement continued, during the 5-year period from April 15, 1905. The repairing of the tunnel was well on toward completion, allowing the way open for transportation to the portal, and the completion of the wooden-stave pipe to carry out the hot water.

The Association pledged itself to expend at least $125,000 in these works or any greater sum required to install these improvements.

In consideration of these construction works, the Tunnel Company agreed to allow a 50-per-cent. rebate on the regular royalty income from the mines of the Pumping Association for a period of 5 years from April 15, 1905.

Retimbering.—At the time of the writer's visit, June, 1908, the retimbering of the tunnel was well on toward completion, and the completion of the wooden-stave pipe to carry out the hot water.

This water has a temperature of 160 degrees Fahrenheit in the deepest levels of the Ward shaft, air at the point where it is discharged into the tunnel is considerably cooler. The steam from this water, however, is in a great part responsible for the hot, humid condition of the mine air which formerly limited the continuous working periods to from 15 to 20 minutes. The average dry heat of the mine is probably not much in excess of 105 degrees Fahrenheit where the ventilation is good, although in places where it is poor the mercury registers considerably higher. The addition of steam to these other unbearable temperature of dry heat results in almost unbearable conditions for the miners, greatly increasing the expense of operation by badly impairing their efficiency. Again, the deleterious effect of the steam upon the mine timbers can readily be imagined. The completion of the stave pipe to the tunnel portal will thus constitute a great step toward the economical rehabilitation of the mines, and make bearable the conditions surrounding those engaged in the transportation of their ores to the tunnel portal. It is planned to cover the stave pipe with concrete, in the near future, thus producing eventually a concrete pipe which can be easily repaired and made to last almost indefinitely.