Bull. 35

UNIVERSITY OF NEVADA BULLETIN

VOL. XXXV JUNE 20, 1941 No. 4

GEOLOGY AND MINING SERIES No. 35

An Investigation as to the Presence of Commercial Quantities of Mercury and Gold in the Dry Lakes of Nevada

By
JAY A. CARPENTER

PRICE 25 CENTS

PUBLICATION OF THE NEVADA STATE BUREAU OF MINES
AND THE MACKAY SCHOOL OF MINES
JAY A. CARPENTER, *Director*

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PUBLISHED QUARTERLY BY THE
UNIVERSITY OF NEVADA
RENO, NEVADA

Entered in the Post Office at Reno, Nevada, as second-class matter under Act of Congress, July 16, 1894. Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized April 21, 1919.

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AN INVESTIGATION AS TO THE PRESENCE OF COMMERCIAL QUANTITIES OF MERCURY AND GOLD IN THE DRY LAKES OF NEVADA

INTRODUCTION

In the last two decades there have been many public announcements of the discovery of commercial quantities of mercury and gold in the dry lakes of Nevada and the neighboring States.

Most of these lakes are barren alkali flats, sinks, or basins, dust or crust covered when dry and a slippery mud when wet. The surface, and for considerable depth, is for the most part a clayey silt carried down and deposited here from the erosion over countless centuries of the surrounding rocky terrain. These clays, sands, and muds contain soluble salts of sodium, and to a much less degree those of potassium, mainly as the chlorides, sulphates, and borates.

These dry lakes are for the most part on the public domain, and due to these soluble salts are subject to lease from the United States Government upon very easy terms as to work or payments required to hold the lease. In many cases the land is "railroad land" held under a purchase contract obtained after examination by the railroad's land department.

FANTASTIC CLAIMS OF GREAT POTENTIAL WEALTH

In the last decade these reputed valuable discoveries of mercury and gold have been reported in California at China Lake, Bristol Lake, Edom or Palm Springs Lake, Amboy Flats, Lavic Lake and Owens Lake, and in Nevada at Silver Lake, Rawhide Lake, Mud Lake, Migual Marsh, Leete Marsh, Teel's Marsh, and Columbus Marsh. Judging from these reported wide occurrences, the deposition of mercury and gold in dry lakes is not exceptional but rather quite general.

Of these occurrences, the greatest claims of potential wealth have been made for Columbus Marsh, 40 miles westerly from Tonopah, Nevada.

The following quotations are from letters written by enthusiastic parties who in turn quote men presumably ranking high in the mining profession:

"The Columbus Marsh is one of the greatest discoveries of minerals ever found. We checker-boarded 10 acres and cored 13 holes 20 feet deep and took 79 samples weighing 3,000 pounds, and they averaged $21.75 per ton. The highest test in gold was $125 per ton, and the lowest $6 per ton, and the mercury 8.0% for the highest and $24 per ton for the lowest. The assays are based on mercury at $1.25 per pound and gold at $35 an ounce."

"The mercury content was determined by retorting in sealed steel retorts mixing the dry pulp with iron filings and lime," and the gold "was recovered by amalgamation then driving the mercury off by heated nitric acid and weighing the button left."

The "accuracy and modest results obtained" of the above sampling at Columbus Marsh are supported by the reputed statements of at least three "prominent metallurgists and chemists."

The accompanying map shows several assays from each hole, with an indicated tonnage to a 20-foot depth over the 10 acres of 400,000 tons of an average value of $21.75.

Quoting again. "A well 255 feet showed values all the way down better than the 20 feet at the top so we do not know where the bottom is." "In addition to the above sampling more than 300 samples were taken at random on the various parts of the lake. The reports are that the samples taken (on the 10-acre tract) are the lowest general average heretofore taken." "Columbus Marsh is an area of about 30 square miles" and only "640 acres of it will produce 160 million tons averaging over $20 per ton."

Any mining engineer using his slide rule and acquainted with the phenomenal record of the Big Bonanza on the Comstock will be simply astounded by the above estimates of mineral wealth.

However, to quote: "The average value of $24 per ton was for gold and mercury alone, whereas, the greatest values contained in this material is platinum, which element, however, has so far escaped them all on account of its peculiar atomic structure." "By the use in the future of physio-electro chemistry in the sub-atomic physics of Columbus Marsh greater value in other precious metals will be obtained." Again it is stated, to quote, "much of the material from Columbus Marsh has been tested with the spectroscope and with blowpipe, etc. determining the presence of platinum. The materials were also subjected to high frequency effect and ionization, followed by polarization in magnetic fields; then separated by their values in the bombarding tube which visualized the results." The "results" were apparently a guarded secret.

Another consulting engineer states: "I have proven the existence of unbelievable values in the dry lakes of Nevada. The predominant commercial metals in evidence are mercury, gold, silver, and metals of the platinum group. The quantity of these metals proven to be present by my small test unit is startling and almost unbelievable to myself. The composite samples of material from surface to 20 feet in depth taken by myself on Columbus Marsh show an average mercury content of approximately 14 pounds per ton, with gold and silver values of approximately $2.90 per ton; samples taken from 220 to 325 feet in depth showed recoveries in excess of 100 pounds of mercury and $12 in gold and silver."

"Leete Marsh near Fernley proved values from surface to 20 feet averaging 16 pounds of mercury and $1.75 in gold throughout the northern or dry section of the lake. On Rawhide dry lake samples, reported to have been taken over an area of 8,000 acres and to a depth of 15 feet, we obtained an average recovery of 13 pounds of mercury per ton and $1.18 in gold values."

A mining man writes "I received a report upon a 17 pound sample of mud from the Migual Marsh in the Goodsprings District showing 5½ pounds mercury, $2.65 in gold, and $1.23 in platinum. The sample was taken from a bore hole by a six-inch auger and at a depth of 13 to 20 feet."

One "mining engineer" states that care must be taken in sampling for the mercury content. He states, quote, "I sampled one section of Columbus Dry Lakes. When these samples were run, I was scared to death almost for they showed mercury in percentages, and gold running into hundreds of dollars per yard. This was when it was WET and FRESH, and after we put it in the SUN TO DRY it seemed to lose its great values very rapidly, and the only conclusion I was able to come to was that the mercury salts were evaporated by the sun's rays."

Various and contradictory statements are made as to the form in which the gold and mercury occur in the lake muds.

In one case, both are considered to be in the metallic state easily recovered by amalgamation and retorting and easily determined by standard methods.

However, other statements read as follows:

"Ordinary quicksilver is recovered by retorting. It is impossible for me to determine what inhibiting element present in lake material prevents this normal reaction."

"The lakes which have been found to contain the most attractive values are those composed of volcanic ash or dust, in which the values are distributed in the shape of extremenly fine metallic salts. After precipitating, these salts during subsequent ages have been acted upon by complex saline solutions. The resultant metallic salts are of an extremely complex nature, making them irresponsive to the usual routine methods of analysis, and the majority of assayers will not deviate from their routine which has proven highly efficient when applied to values contained in igneous and sedimentary ores."

"I have termed the marsh material a chemical mud as the majority of the metallic values occur as chemical compounds."

"In commercial operation, gold and silver have been recovered averaging $3 a ton where repeated fire assays on this material showed twenty-three cents a ton. Properly conducted cyanide tests with unheard-of strengths of solution showed $3.15 a ton."

"The reason for these strange results is that the major quantity of the gold content is from one to seven-thousandths of a millimeter in diameter and incased in a black hydro-carbon humus of two to three times that diameter." "The specific gravity of the gold values has been found to be approximately 2.6, the normal weight of chalk, instead of 19.0, the normal weight of gold. This naturally precludes economic recovery by any of the old specific gravity methods."

PROPOSED METHODS OF METALLURGICAL TREATMENT

Many methods have been proposed and plants built for the recovery of the "valuable metals" from the dry lake muds. In practically every case there is required a special patented mechanical unit in order to cope with this extraordinary ore.

Some of the simpler units are vibrating concentrating tables, including amalgamating devices.

One device is described "as a simple yet effective dynamic impact machine which scrubs the gold, mercury, platinum and silver of a filament of carbon which adheres to the metal, thus allowing it (the metals) to come down in amalgamation; then it (the pulp) is run

through a syphon under 50 pounds pressure of water taking off through a trap the precipitates which are then refined for mercury and run through a retort for the balance of the metals, a very simple but highly effective procedure."

Other methods are based on electrolytic action. One such method is described as follows:

"After the material is completely disintegrated by agitation and screened, it is passed through the unit in a sodium chloride solution acting as the electrolyte.

"All dry lake waters, or waters under the lake beds which are available for operating purposes, have up-to-date shown sufficient sodium salts to meet all requirements without any further additions.

"The recovery unit or table is provided with a continuous flowing film of mercury over a silvered copper floor of the table, which floor represents the cathode for the electrolytic action. Graphite bars placed horizontally at regular intervals, with their lower surfaces submerged in the flowing stream of pulp are used as anodes.

"A direct current of the proper voltage is supplied to the table to bring about the desired electrolytic reactions.

"The material carried by the sodium electrolyte solution passes through the table between the anodes and the flowing mercury cathode. During this contact the metallic salts contained in the pulp are electrolytically decomposed to their metallic and component parts, the metallic particles being driven or 'electro-plated' into the flowing film of mercury from which they are recovered by practically orthodox methods.

"The foregoing is a brief outline of some of the salient features involved in our process (which is fully covered by patent application); however, the many details and necessary adjuncts in connection with its successful operation are not described."

ESTIMATES MADE OF THE COST OF PLANT AND PROCESSING

One advocate states: "The entire cost of handling materials and the recovery of their contained values in a plant treating 500 tons of raw material per day should not exceed 30 cents per ton, and the capital investment required is comparatively very small, as the material is found in such condition that it does not require costly mechanical units to prepare it for treatment."

Based on the expected high recovery for this exceptionally low cost, the net operating profits would be most intriguing. In some cases the machines or processes are offered for sale or for use under a royalty basis. This appears generous considering the ease of leasing dry lake areas.

In many cases the use of the patented machine or process and a lease on an acreage go together in one financial venture as, to quote, "we will enter into a deal with you and your associates by which we will give you a sublease on ..... acres of our land in the Columbus Salt Marsh, near Coaldale, Nevada; said land shall be as near the center of the property controlled by us as possible and shall conform

to all the terms imposed in our master lease with the United States Government, with no special terms and conditions imposed on us. The royalty shall be the same as in the master lease.

"You are to furnish the sum of $15,000 to be used for the erection and completion of a 150-yard plant. The capital shall first receive their money back out of 80 percent which will represent 100 percent of our gross, the other 20 percent being royalty to the landowners. The capital shall then receive 49 percent and we 51 percent of a corporation to be formed."

TECHNICAL INVESTIGATIONS AS TO THE PRESENCE OF MERCURY AND GOLD IN THE DRY LAKES

The claims made of a high content of mercury and gold in the dry lakes as set forth in the quotations above, are all made by those having leases on acreage, or having patented devices for the metallurgical treatment of the mud bottoms. It is but natural that self-interest causes exaggeration of statements. Such statements in turn naturally cause even conservative investors to investigate. The results of such investigations are as follows:

A reliable assayer of southern California states: "I have made a number of assays on the Columbus Marsh muds as well as hundreds of assays on the dried lakes in this part of the country, and I have never been able to find any of the values claimed to exist in them."

A reliable engineer writes: "One assayer in Los Angeles who assayed about 600 samples from Columbus Marsh advised me that these samples showed no traces of gold nor platinum by the standard methods of assay."

It is true that samples brought in to investor's offices by parties interested in leased acreage, have panned metallic mercury and assayed for gold, but new samples taken by the investor's engineers have failed to do so.

A reliable mining man of Tonopah states that four of his acquaintances took at different times their own samples from Columbus Marsh and they were unable by any known process to detect either gold or quicksilver in their samples.

Director Walter S. Palmer of the Nevada State Analytical Mining Laboratory states: "In 1937, we were brought samples of the desert basins in this State, including Columbus Marsh, to be assayed for gold and quicksilver and we were unable to get either metal."

All of the above checks were made by the accepted methods of assaying. However, the claim is often made that these standard methods fail to recover the metals that special new methods do. Professor Palmer states: "A method of fire assaying the lake muds for gold was described to me which was claimed would recover from four to six times as much gold as the ordinary fire assay. Using a sample which was presumed to give gold by the ordinary method of assaying, I followed the directions carefully as given me but the results were negative in every assay."

The most difficult cases to check are those in which the presumed mercury and gold content of the "chemical mud" can only be recovered

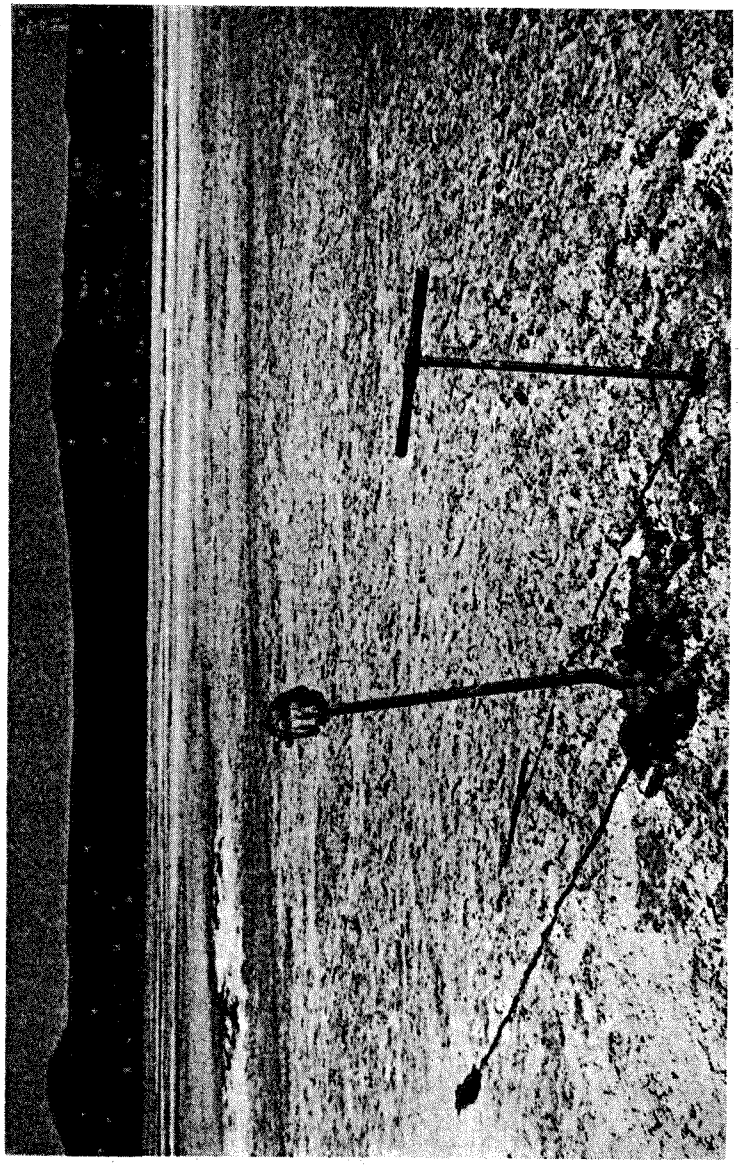

Figure 1. Leete Salt Flat.

by the special process and mechanical device of the patentee or designer, and who by manipulating his own tests can produce an apparent recovery of both metals.

An excellent study of such a process was made by Otis A. Kittle, a mature senior student of the Mackay School of Mines, formerly an attorney at law. Extracts from his thesis "The Dry Lake Mercury Fable" read as follows:

"The intermittent and unsubstantiated reports of mercury and precious metal-bearing dry-lake materials have been cropping up for the last six or seven years. The fact that these ever-recurring reports of fabulously rich concentrations have drawn nothing but incredulous denials from the majority of metallurgical and mining engineers has not served to disprove the contentions of a large clan of psuedo-metallurgists. In some cases even the names of eminently respectable members of the profession have been innocently mentioned in connection with dry lake mineral promotion schemes and contentions as to the likelihood of the values to be found.

"The fact that several such operations are currently fooling their sponsors has indicated the necessity for further experimentation to quantitatively and qualitatively affirm or disprove the contentions of these promoters, both as to the presence of precious metals in dry lake accumulations and as to their mystifying method of recovery. In investigating these recovery processes it is interesting to note that in practically every case the values claimed are supposed to be in such a complex and heretofore unisolated form that they are undeterminable by standard pyrometallurgical practice.

"The United States Bureau of Mines is on record with the following statement regarding these unassayable values:

" 'The Bureau of Mines has in past years investigated a great number of processes where the inventor has claimed to recover precious metal values which were not shown by the standard fire assay or recoverable by the accepted methods of ore treatment. We have never found that the claims for such processes could be substantiated in any degree; * * * '

"Articles appearing in current publications also indicate that a properly conducted fire assay will give as much gold as any other method.

"To add further evidence to the data already in print concerning the dry lake gold and mercury schemes, it was decided to perform a series of experiments based on the methods used by those making these fabulous claims, and on the basis of newly developed equipment in the field of metallurgical determination of minute quantities of elements.

MATERIAL

"The dry lake material tested consisted of six samples, five of which were taken with and under the supervision of Professor Walter S. Palmer, the writer, and a third person as witness from two auger-drilled test holes, one of which was twelve feet deep and the other seventeen feet deep. Both of these holes were drilled in the dry lake on which the old Leete Salt Works was located, situated about twelve miles northeast of Fernley, Nevada, on U. S. Highway 40. (See Figure 1.) The secret process metallurgists claimed that the sites of

both holes had been drilled and tested by their special method with substantial values shown in gold, silver, mercury, platinum, and associated rare metals.

"The sixth sample was taken from the bottom of a sixteen foot pit contiguous to a small recovery plant on Columbus Salt Marsh, situated about a mile west of Coaldale, Nevada. This small pilot installation was designed on the special principles of the new secret process. Supposedly, Columbus Salt Marsh contained around $1,000,000 per cubic acre in mercury, gold and other precious metals.

PROCEDURE

"The first test was made on the Columbus Marsh material. With the idea of following exactly the methods and procedure recommended, this test was made on the same apparatus upon which many claims of rich recoveries had been made. The owners of this device agreed to allow the writer and his associate facilities to make a complete test.

"Their apparatus consisted of a ten-gallon wooden receiving barrel set on end with a bladed propeller mixing device, which served to condition the pulp by mixing it thoroughly with water, salt, and vinegar. After an hour's conditioning, the mixture was released through a flow control cock into a long, narrow, wooden, U-shaped trough whose run-off end was sufficiently lower than the receiving end to allow free flow of the pulp. The trough bottom was lined with copper and designed as a succession of shallow steps slightly dipping in the direction of flow. A two-inch deep recess in the trough bottom six inches from the receiving end served as a mercury receiver. As the pulp flowed over this pocket, a small amount of mercury was constantly forced over the lip and down the trough. A second recess midway between the two ends of the trough served as an auxiliary mercury trap, while a third recess close to the run-off end of the trough served as the final trap from which the mercury was periodically removed by hand and replaced in the receiving trap. Four adjustable rubber weirs were placed at suitable intervals along the trough to retard the free flow of pulp and insure a maximum contact of pulp with the mercury covered copper plate which covered the entire trough bottom. Ten carbon anodes, connected in series, were arranged along the trough in such a fashion as to dip well into the slowly flowing pulp but without touching the amalgamating plate. The copper plate with its pouches full of mercury served as the cathode to complete a circuit fed by two six-volt storage batteries. The accompanying sketch will serve to clarify the foregoing description. (See Figure 2.)

"Before the test was started the barrel was thoroughly scoured, adhering mercury was scraped from the copper plate and mercury pockets, and a tailings receptacle was carefully cleaned. Ten pounds moist of the Columbus Marsh material was now placed in the barrel with five gallons of water, two pounds of salt, and one-half pint of vinegar. After agitation for forty minutes, the pulp was poured through a twenty mesh screen to eliminate mud lumps and gravel and replaced in the barrel. The mercury, weight 6 pounds, 2.5 ounces, was placed in the receiving trap, the amount in excess of the trap's capacity being allowed to overflow down the plate to the auxiliary and final mercury traps.

"Due to the type of construction of the trough unit, it was impossible to weigh the copper plate. Because of this no accurate check on increase of weight of the cathode could be made during the ensuing test. However, realizing the importance of this unknown factor without which the test remained totally inconclusive, the experiment began.

"To insure a fair trial the pulp was electrolyzed twice, consuming a period of seventy-five minutes. During this time the amperage ranged between ten and seventeen, varying approximately as the pulp electrolyte level was raised and lowered in the trough. When the last of the pulp was discharged the mercury was carefully removed from the traps and the copper bottom plate. The mercury now weighed 6

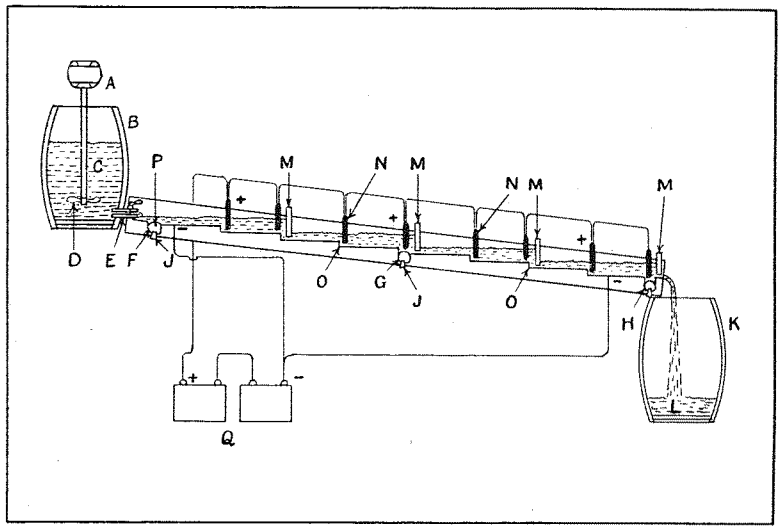

Figure 2. Longitudinal Section of Electrolytic Recovery Device.

A. Conditioning motor.
B. Received barrel.
C. Mixed pulp.
D. Conditioning propeller.
E. Flow control cock.
F. Mercury receiver pocket.
G. Auxiliary mercury trap.
H. Final trap.
J. Mercury pocket plugs.
K. Tailings barrel.
L. Discharge product.
M. Weirs.
N. Carbon anodes.
O. Copper plated steps.
P. Mercury.
Q. Storage batteries.

pounds, 2.81 ounces, indicating an increase of 0.31 ounces. During the test run and immediately thereafter, while the mercury was being weighed, there was ample visible evidence of the presence of considerable sodium mercury amalgam. In spite of the seemingly innocent use of vinegar in the electrolyte, the constant use of tumeric paper during the test indicated the presence of a strong base in the pulp. The fact that the promoter-operators complained of suffering many burns during the handling of the mercury gave some impetus to our suspicions that if any real increase in weight occurred it was probably due to metallic sodium forming a mercury amalgam.

"It is to be noted here that the increased weight of mercury of .31

oz., or practically three-tenths of one percent of the original amount used, indicated a recovery of 0.31 oz. of mercury from 10 pounds of the lake mud, or $3\frac{13}{16}$ pounds per ton. However, a method of determining a small amount of mercury by the use of a great quantity of it in the determination is subject to serious errors due to variation in the original weight of the mercury from mechanical losses or from included impurities.

"A sample of this same Columbus Marsh material was now tested by Professor Palmer to determine the presence of even a trace of mercury. When placed before the fluorescent screen and subjected to the argon-mercury quartz lamp, no evidence of even minute quantities of mercury was present.

"A sample of this same material was assayed for gold and silver with completely negative results.

"A working laboratory replica of the apparatus, as described and sketched, was now constructed by Professor Palmer and the writer with but one change. The trough was formed and shaped from a single sheet of copper which could be weighed separately both before and after the experiment was performd.

"A 10-pound composite sample, made up from the samples taken from the Leete Salt Marsh, was now run through the device in strict accordance with the procedure just described. The copper trough and the mercury were weighed before and after the test. In the half-hour period of the test, the 1,000 gram initial charge of mercury and the trough had gained one and one-half grams in weight, or an indicated $6\frac{1}{4}$ pounds per ton of ore. The instant the current was shut off decomposition of sodium made the mercury very active and the adhering water strongly basic. After setting three hours, the mercury was covered with a perceptible white coating of crystalline sodium hydroxide. After standing all night, and then being subjected to thirty minutes agitation in water, the gain in weight disappeared.

"A portion of this composite sample was assayed for gold and silver and subjected to the argon-mercury quartz lamp with negative results in both cases.

"It was now decided to test the device using a strong saline solution only. A 2,700-gram charge of mercury was used this time to determine how great an amount of sodium the mercury could absorb as amalgam under the given conditions. The amperage ranged from 18 to 20 throughout the three hours and five minutes of the test. At the end of two hours trough and mercury showed a gain in weight of 13 grams. At the end of the test trough and mercury showed a gain in weight of 16 grams. It is to be noted that at this point the amalgam was beginning to get mushy in texture. When the current was shut off the decomposition of the amalgam was so rapid that a current of 7 amperes was registered in a standard ammeter.

CONCLUSIONS

"Roscoe and Schorlemmer state that one part of sodium in 100 parts of mercury forms an amalgam having an oily consistency, but with 80 of mercury a pasty mass is obtained. According to this statement, the 6-pound charge of mercury in the first test could have absorbed as much as an ounce of sodium. Since the results of each of the several experiments performed showed that the increase in weight was due to the formation of sodium amalgam, a simple example of standard electrolytic practice, it is to be concluded that the promoters' process is neither novel nor revolutionary; that the gold and other precious metal values claimed are not in the detritus of the many dry lakes and salt marshes throughout the country. Since, in every case, two A. T. duplicate assays showed negative results for gold, and the very sensitive argon-mercury lamp failed to show even a trace of mercury, one can only conclude that these metals are no more concentrated in dry lake detritus than they were in the rocks from which the detritus was originally eroded.

"The writer wishes to express his gratitude to Professor Walter S. Palmer, Director State Analytical Mining Laboratory, for his kind and intelligent supervision and direction of the experiments described."

The above description by Mr. Kittle indicates clearly how the inventor of a process or a mechanical device could through lack of proper technical knowledge deceive himself and become such an ardent crusader that avaricious investors become so enthused that they fail to seek good technical advice until their lost investment in subleases and machines has brought them to a sad and often pitiable realization of their folly.

Mr. Kittle did not attempt to check the reputed recovery of gold by this method. It would have entailed the double retorting of a large amount of mercury for the remote possibility of the recovery of a minute quantity of gold with the whole test as run subject inheritably to many errors.

Professor Walter S. Palmer with thirty continuous years experience in the detection and determination of minerals and metals has presented his conclusions as to the methods used for assaying for gold and the possible presence of gold in the dry lake bottoms in a letter to the Nevada State Bureau of Mines as follows:

> I have received your request for an outline of some of the data which I have collected and the tests which we have run in the State Analytical Laboratory bearing on the subject of the accuracy of the fire assay for gold and the occurrence of gold, silver, mercury, platinum, etc., in the detritus collected in the various dry lakes of this State.
>
> It was in 1913 that I first had my attention called to the fact that some people claim to have found methods of extracting gold from ores that could not be detected by the ordinary fire assay, and that with ores that showed gold on fire assay they could extract as much as three times as much by their secret process. I was informed that some years ago a man had a mill in the Grass Valley district of California and was buying ores from miners and paying them three times as much as their ores would show by ordinary assay. I was further informed that a little later officials were looking for this man for fraudulent promotion of an enterprise and sale of stock in the eastern part of the country.
>
> Since I was teaching fire assaying for gold and silver at that time I was naturally interested in the story and my attention has been called from time to time in recent years to

similar statements. Throughout the literature on the subject, however, one finds general agreement to one fact and that is, that the fire assay for gold is one of the most accurate of the determinations made on metals and this would not be so if there were substances containing an appreciable amount of gold and this gold could not be determined or detected by this method of assaying. The following statement taken from the book "The Sampling and Assay of the Precious Metals," by Ernest A. Smith, is typical of the remarks about the accuracy of the fire assay for gold: "An impression prevails that the results obtained by furnace methods are less accurate and reliable than those obtained by other methods. Although this is true of some of the dry methods that are now obsolete, the accuracy with which small amounts of gold and silver can be determined by the fire-assay probably exceeds that of any known method of analysis for any other metal."

About six years ago two of our alumni called attention to the fact that certain parties were claiming there was gold in the detritus of certain dry lakes of Southern California in a form that could not be detected by the ordinary fire assay, but could be extracted by certain parties with special machines which they had invented. I was interested in the claim about being unable to secure gold on fire assay and I secured a sample to test. I was unable to secure gold in fire assay. I asked one of these men what results they secured in their investigation and he said that they took in all about fifty samples and had them assayed by a reliable assayer in Los Angeles and the assayer found gold in just one sample of the lot and this sample had been purposely salted with gold before giving the samples to the assayer as a check to see whether the assayer would find it. He did. Last week I asked one of these men for further information and he informed me that up to the present time he has never been able to learn that any one operating such machines has ever produced and sold an ounce of gold produced from dry lake detritus.

In the Arizona Mining Journal of November 15, 1936, there is a very interesting article on the subject "Gold That Cannot Be Assayed by Fire." Considerable data is given to prove that a properly conducted fire assay will give as much gold as any other method. There is also considerable information given in the article to disprove the claim that the dry lakes of Southern California contain gold in a form that cannot be detected by fire assay.

Knowing these facts, I was interested when I heard that plants were being erected on Columbus Marsh in this State, where promoters expected to recover mercury, gold, silver and the platinum group of metals.

It is possible that certain areas around Columbus Marsh, and other marshes, might be found where tailing had accumulated from former milling operations that would show appreciable amounts of mercury and gold on sampling and

assaying. There are such areas for example around Washoe Lake, in Washoe Valley, south of Reno. They are due to the accumulation of tailing from mills that treated ores from the Comstock by amalgamation. One very large mill was located near the present Bowers Mansion, but there is now very little evidence that there was such a mill there at one time. All of the metals in this material can be easily detected and determined by the standard methods of analysis.

The dry lake material is detritus derived from the surrounding hills, weathered from the rocks exposed in those hills, to which in some instances there has been added tailing from mills in the vicinity, and is like tailing produced on milling ores. It will carry those substances found in the original rocks and ores milled. If standard methods of analysis, properly carried out, will not show the presence of gold, silver, mercury, platinum, etc. it is because these metals are either not present or they are in such small amounts as to be of no commercial importance and be comparable to the amount of gold in sea water or in ordinary country rock. It is a well established fact that both sea water and ordinary country rock do contain measurable amounts of gold and this gold can be detected and determined by the standard methods of analysis. It is simply a case of using more than the regular amount of material at the start of the analysis in order to have a weighable amount of the metal at the end of the determination. By using sufficient ore, for example, the platinum and palladium in the Ely, Nevada ores has been determined, although it is in very small amounts.

It has been claimed by some that the only way to secure gold from this dry lake material is to use very large amounts of cyanide and a long time of treatment. It is a well established and easily demonstrated fact that gold goes into solution in cyanide solutions very readily and quite quickly when very fine. It must be very fine in dry lake detritus because the material itself is very fine. Maximum rate of solubility of gold in cyanide solution is obtained with about 0.25 percent potassium cyanide (or its equivalent) in the solution and the rate of dissolution decreases with the stronger solutions to such an extent that with a fifteen percent cyanide solution one will find that the rate of dissolution is about equal to that of a solution containing only 0.01 percent cyanide. Therefore, the claim that large amounts of cyanide and long time of exposures are necessary are hardly supported by recorded facts. The figures quoted can be found in Metallurgy of Gold by T. K. Rose, an authority on the metallurgy of gold.

During the past two months two different parties have described their machines to me. One party said a machine which could treat six yards of material per hour would cost about $750. Since it is claimed that material carrying over sixty pounds of mercury per ton has been found it seems strange that one cannot find any record of any production by any of these machines. With sixty pound material and

present prices and claims of promoters, one should be able to produce about $8,500 worth of mercury per day, not counting anything for the gold, silver, platinum, iridium and other metals that some claim their machines will save. One party handling one make of machine said they did not wish to operate the machines but only to sell them. No doubt they have their reasons but from the figures quoted me I am sure the greater profit would be from operating the machines, at least until the market is so flooded with metal that there is no longer any demand for it. Costs of operation are quoted at less than a dollar per ton.

I believe there is no evidence or records that an ounce of gold or a pound of mercury has ever been extracted from the dry lake material and sold. There are published statements that no gold, silver, etc. has ever been produced and sold. It is my opinion that no commercial production will ever be made from any dry lake material, by any machine, unless that dry lake material will show the presence of gold, silver, mercury, platinum, etc. by properly conducted standard methods of analysis, to be in such amount as to warrant the application of methods for its recovery. No machine is going to recover sixty pounds of mercury per ton of material when standard assays show less than one pound per ton present, unless one has a machine that changes other elements into mercury and this is still impossible to accomplish and when it is perhaps we will not have to start with dry lake material but use the dirt in our back yards.

THE PROBABILITY OF COMMERCIAL QUANTITIES OF MERCURY AND GOLD IN THE DRY LAKES OF NEVADA

The usual explanation for the presumed presence of gold and mercury in the dry lakes is that of the erosion over ages of the surrounding terrain and the transportation of the weathered material containing the metals to the depressions below.

Clay is the most common alteration product of igneous rock, and is most easily transported long distances, accounting for its predominance in the lake bottoms.

In contrast gold almost always occurs in ores as metallic gold and mercury as cinnabar, both extremely resistent to change or to transportation from place of origin. This is an axiom among prospectors. By all probabilities then the gold, and the mercury as a sulphide, should be found on the slopes above the dry lakes, or at least as abundant along the old shore line as in the lake bottom.

It is hardly conceivable that the mountains of yesterday could have been so rich in gold and mercury ores compared with their barren remnants of today, as to fill the whole lake bottom with a high residue content. It is conceivable that the detritus of a restricted rich area may have reached a dry lake through one gulch. If so, conventional panning and assaying should determine this conclusively.

The most likely explanation for the proven presence of gold and mercury in the lake bottoms of Nevada is that in the early days of mining in Nevada, gold and silver ores were hauled to a source of

milling water which was most easily obtained from wells near the edge of the dry lakes.

In the "Mineral Resources of the States and Territories West of the Rocky Mountains" by Rossiter Raymond, published in 1869, there is on page 115 the following statement: "Until recently Columbus district has been without reduction works, but during the past year a small mill has been erected to work ores of the neighborhood. Water is found by sinking a few feet in the alkaline flat."

Thompson and West in their "History of Nevada," 1881, on pages 419 and 420 make similar mention of mills and water at Columbus Marsh.

In the Biennial Report of State Mineralogist, State of Nevada, 1875–1876 on page 35, the statement is made that ores from the "General Thomas" mine, the "Mount Deablo Mine," and the "Black Metallic Mine" are treated at Columbus Marsh mills.

As the ores of these mines had a high content of silver, the mills probably used the pan amalgamation process with the introduction and loss of much metallic mercury.

Below such mills at Virginia City, the Indians of those old days panned mercury from along tailing launders, and blanket plants recovered mercury and amalgam in the concentrate. Today, plants cyaniding the old tailings of these mills recover much mercury in retorting the zinc precipitate. Mud shoveled from the bottom of the Carson River below the site of old mills often gives surprising pannings of mercury and amalgam in addition to copper rivets and cut nails.

It is therefore conceivable that lake muds in a restricted area below old mills, no longer recognizable as such, might give assays for gold and mercury from a mixture of old tailing and lake mud. Such a discovery should not be expanded by the imagination from a mole hill into a mountain, or from a few borings to a wide lake bottom of limitless wealth.

CONCLUSIONS

The author of this bulletin as the Director of the State Bureau of Mines has been forced to give much time and study to this subject due to the requests, not only for accurate information, but even for investigation of processes and approval of recovery apparatus.

The aid of the Director of the State Analytical Laboratory and others in this investigation is gratefully acknowledged and appreciated.

In searching for definite published information, all that could be found was references from time to time over the years to discoveries of values in the dry lakes and to plants being erected. No scientific discussions were to be found, or descriptive articles on the results obtained from operating plants.

Much capital has been wasted in these ventures that should have gone into legitimate mining investments. Much of this was due to ignorance and cupidity, but fraudulent practice was often the underlying cause.

Fear of controversy and trouble should not stand in the way of the publication of an honest investigation of a controversial subject. The facts should be made available to the public.

In fairness to all, the claims of these proponents of great metallic

wealth available in the dry lakes have been set forth fully in this bulletin. To the trained mining and metallurgical engineer they appear impractical and visionary. To a tempted investor these claims or like claims should be like a red light at a crossing, as the promised results and wealth have not been produced. He should *stop* dreaming of quick riches, *look* for unbiased competent engineering advice, and *listen* to that advice.

Every engineer or metallurgist connected with these questionable ventures usually furnishes a sketch of his career connecting him prominently and successfully in the past with well-known companies and successful ventures; but this, even if proven, is no proof of present competency or reliability. The State and Federal governments employ experienced open-minded mining engineers to give advice to those who seek it and to recommend reliable competent experts if a special investigation is deemed necessary. Such excellent service has proven invaluable to many a citizen. This bulletin is therefore dedicated to be of service to public officials, advising engineers, and the investing public who along with the author have long felt the need of published data on this controversial subject.

UNIVERSITY OF NEVADA BULLETIN
GEOLOGY AND MINING SERIES

PUBLICATIONS OF THE NEVADA STATE BUREAU OF MINES AND THE MACKAY SCHOOL OF MINES

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