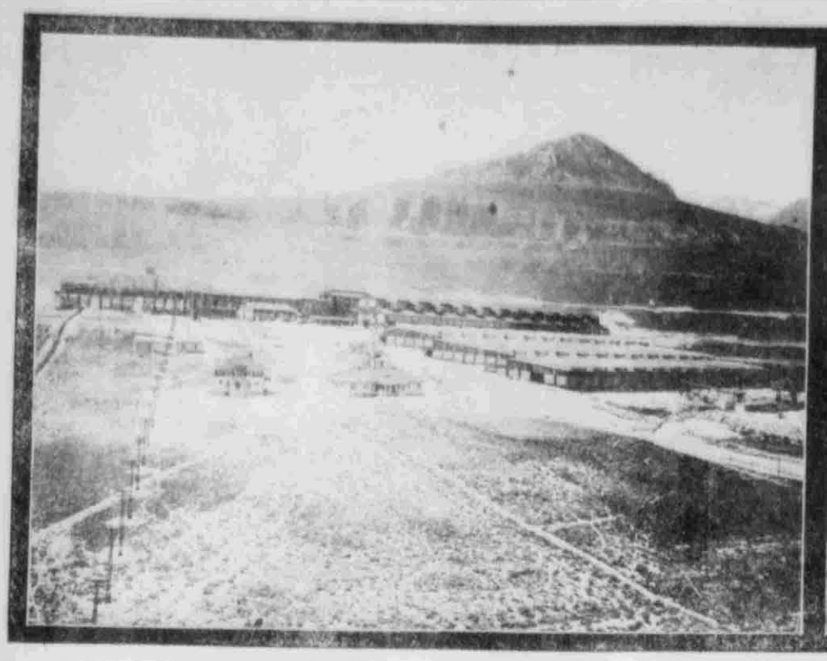
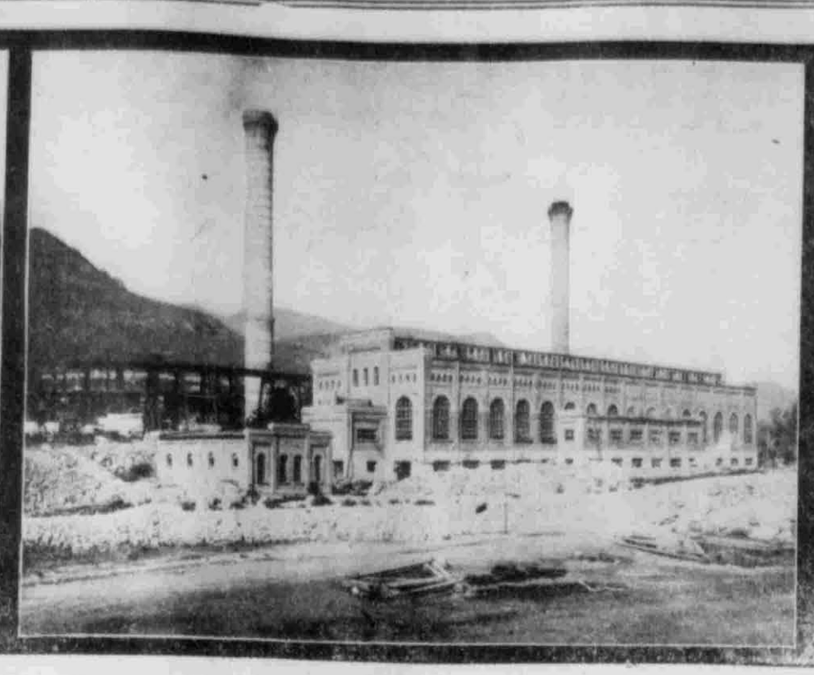
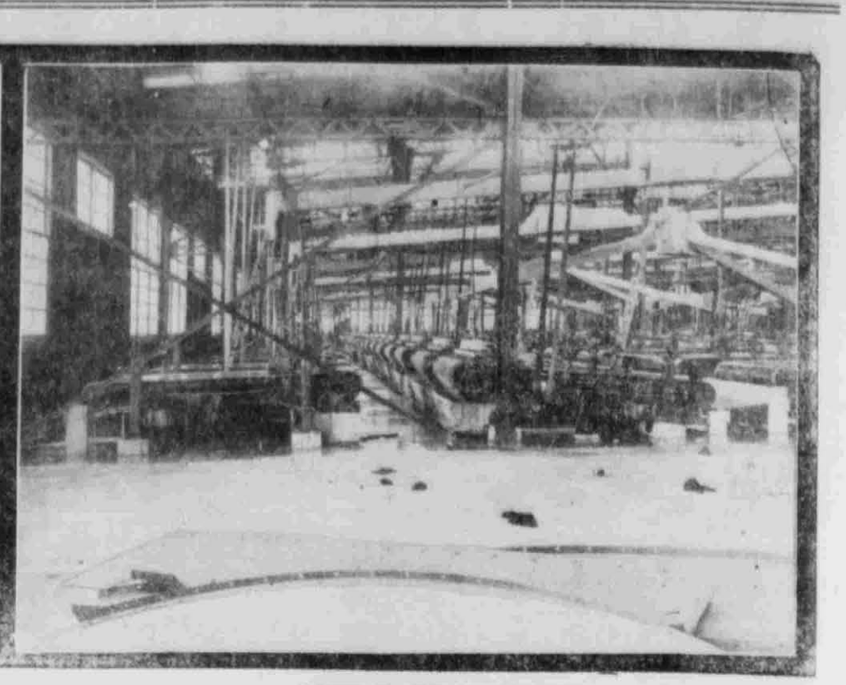
ORE CONCENTRATION METHODS USED AT GARFIELD.



BIRD'S EYE VIEW OF UTAH COPPER MILL.



NEW POWER PLANT.



PORTION OF VANNER ROOM.

No doubt there are a good many persons living in Salt Lake who do not appreciate the importance of the milling enterprises at Garfield, where the ores of the Utah Copper and Boston Consolidated mines of Bingham are brought to undergo initial treatment before going to the smelter and refinery.

Millions of dollars have been expended during the past two years in providing facilities to extract the metallic contents of the vast tonnages of ore that are to come from the mines of the "Old Reliable" camp over in the Oquirrh range. The Garfield smelter, or the first unit of it was completed last year and placed in commission; the second unit is now being built and will be ready early in 1908. The Boston Consolidated Mining company is erecting a concentrating mill designed to treat 3,000 tons of ore daily and it is expected that the first unit containing five sections of capacity for the treatment of 500 tons each, will be ready before the end of the present year. The Utah Copper company the first to undertake the construction of a concentrator at Garfield, is treating 2,000 tons of ore every day and in all probability when the present uncertainty in the copper market will have passed and better transportation facilities will have been provided, the company will go ahead with the construction of the second unit, and bringing the capacity of the plant up to 6,000 tons a day.

The accompanying illustrations show a general view of the mill, power house and a portion of the vanner room in the main building with the long rows of vanners.

UTAH COPPER MILL.

The mill building proper is 400 x 600 feet and the frame is of structural steel. The sides are corrugated iron. The floors are concrete, surfaced with cement; are arranged in steps, sloping downward to insure proper drainage. The building is well lighted by monitors on the roof. The crushing department consists of rolls, screen and Chilean mills, set in a broad alley extending the whole length of the building, which is clear for the travel of a powerful overhead crane. This crane has been provided so that in case of any portion of this heavy machinery getting out of repair or becoming damaged, it can be lifted bodily out of place and a new one substituted, if necessary.

Not long ago, William Renton Ingalls, editor of the Engineering & Mining Journal, and who stands at the head of his profession as a mining and metallurgical engineer, visited the plant and he gives an interesting description of how the ore is received from the cars of the Rio Grande Western, which brings it from the mines 27 miles away down to the place of reduction, and follows its travels all the way down to the concentrate bin from which the product is again loaded onto cars and sent on to the Garfield smelter for further treatment.

"The ore," says Mr. Ingalls, "comes in on a track behind the mill, passing over a scale, and is dumped into a long bin, on the top of which there are three railway tracks. This bin is constructed in timber, the sides being built up of plank, laid flat, 12 in. wide at the bottom and diminishing in width toward the top. In front of this bin are the coarse crushing departments, of which there are two, each of 3,000 tons daily capacity, arranged symmetrically with respect to the main mill building. It is aimed to dump the ore received from the mine into hoppers directly connected with the two crushing departments, i.e., so long as the mill is crushing 6,000 tons of ore per day and the railway delivery is the same, the ore dumped from the railway cars will pass directly through the large breakers. This involves the dumping of the ore normally at two places. The remainder of the bin, which is of total capacity for 15,000 tons of ore, is for reserve. There are two passageways under the bin in which large electric larries are operated. When it is necessary to take ore from the reserve portions of the bin, it is drawn off through gates, operated by compressed air, into the larries, which then fit to the hoppers, from which the breakers are fed by gravity.

COURSE CRUSHING SECTION.

"Each coarse-crushing division has two No. 7½ Gates breakers, reducing the ore to 1.5-inch size, which deliver to two 42-inch belt elevators, which deliver to trommels with 0.5-inch perforations, the oversize going to two sets of 28x31 inch rolls, provided with rolled-steel tires, as are all the rolls in the mill. These rolls run at 60 rev. per min. Their product, 0.5 inch in size, is lifted by a 26-inch belt elevator, which delivers it to a series of belt conveyors for distribution to a storage bin of 15,000 tons capacity in the back of the mill, extending the full width of the latter. Between the elevator and the conveyors there is a mottled Vezin sampler, designed to cut out 1 per cent of the ore as a sample; but this will not be done as a regular thing, the uniformity of the ore being considered such that constant sampling is unnecessary. The distributing conveyors are 200 feet long, 24-inch belts, contained in a traveling frame, which is movable in either direction, while the belt can be run either way. The discharge of the ore is over the end of the conveyor, the distribution being effected by the lengthwise movement of the whole apparatus. In this way the use of trippers is avoided.

"From the bin just described the ore is drawn to the 32 sections of the mill, each of which is a precise duplicate of the others. In each section the ore passes first to two sets of rolls, 16x36 inches, in parallel, running at 80 rev. per min., which deliver to two 22-inch belt elevators, which deliver to four cylindrical trommels covered with steel plate with ¼-inch perforations. The oversize from the trommels goes back to the rolls, while the undersize goes to hydraulic classifiers. The fine products of the classifiers go to the tables; the coarse and heavy products go to six jigs. The hutch-work of the jigs goes to four Wilfly tables, which make a finished concentrate. The tailings from the jigs and Wilfly tables are received by a 20-inch belt elevator which delivers to three Chile mills. The latter are supposed to crush to approximately 40-mesh size. Their product passes to hydraulic classifiers and thence to the slime tables, which are modified Johnson vanners. These have corrugated belts for the treatment of the coarser material and smooth belts for the finer. There are 92 vanners per section, or a total of 1,104 in the mill.

DISPOSAL OF CONCENTRATE.

"The disposal of concentrates and tailings throughout the mill is by gravity. The concentrates flow to a series of rectangular masonry bins below the mill, with suitable overflows for the water and filter-bottoms. From these bins the mineral is removed by a crane and clam-shell bucket and loaded directly upon the railway cars.

"This is only a sketchy account of the milling process, but perhaps it gives a clearer idea of the nature of the latter than a more detailed description would do. Apparently the details of the treatment, especially of the finer material, have not yet been fully determined, wherefore it is premature to give a flow-sheet."

COSTS AND EXTRACTION.

"The cost of power will be the largest single element in the milling of these ores. The cost of coal to the Utah company will be probably in the neighborhood of $2.50 per ton and the cost of a horsepower per annum will be probably about $60. I believe that somewhat less is estimated, but the figure mentioned above is more likely to be the actual one. The Boston company secures electric power under a contract that has not been published, but is doubtless less than $48 per horsepower per annum, at which price other contracts have been made. At $60 per horsepower and 360 days operation, the power cost per ton of ore would be 16.7 cents. If 1 horsepower were used per ton of ore. At $48 per horsepower, 360 days' operation, and 0.9 horsepower per ton of ore the cost would be 12 cents. The preliminary estimates of the cost of milling this ore were 45 cents per ton. The Utah Copper company is said now to be doing it for 30 cents per ton, but is not yet incurring repair charges on account of repairs and renewals. If the estimates of power consumption and cost are approximately correct, it is fair to assume a probable milling cost of 35 cents for the Utah Copper company, and 30 cents for the Boston Consolidated. The wages for the Bingham are $2.50 per eight hours; of common labor, $2.

BASIS OF EXTRACTION.

"The extraction of mineral by the Utah Copper company is about 70 per cent. In milling ore assaying 1.8 per cent copper the tailings assay in the neighborhood of 0.5 per cent. The Boston Consolidated estimates that its extraction will be at least 65 per cent and expects to do better. How much better it will actually do remains to be seen. In concentrating ore containing 1.8 per cent copper, with 70 per cent extraction, the concentrate contains about 25 per cent copper, the ratio of concentration being 39.1. The cost of shipment of the concentrates to the smelter is 10 cents per ton. The terms for smelting are a private matter of the companies, at least have not yet been disclosed. However, let us assume $8 per ton, 85 per cent of the copper and freight and refining charges of 3.11 and 3.18, respectively, per ton of crude copper. The cost of producing them will be approximately as follows:

Mining 2,000 pounds ore	$0.350
Freight on 2,000 pounds ore	0.220
Milling 2,000 pounds ore	0.233
Administration and general expense	0.152
Freight on 180 pounds concentrates	0.085
Smelting 180 pounds concentrates	0.720
Freight and refining 24 pounds of crude copper	0.248
Total	$1.723

It is expected that the mill will require 6,000 h. p., or 1 h. p. per ton of ore treated. A certain amount of power is to be transmitted to Bingham for operation at the mine, and there is a large surplus for unseen contingencies and future developments.

The electric current is generated at 4,000 volts, and is transmitted to the mill over a line 2,500 feet long, supported by poles of structural steel. The substation at the mill is an absolutely fire-proof building between the two main crushing houses. Here the current is reduced to 400 volts for use in the mill. For transmission to Bingham it steps up to 40,000.

DRIVEN BY MOTORS.

"The driving of the machinery in the mill is by motors, which are segregated not only according to independent sections, but also according to groups of machines, and with a highly developed system of clutches, operated by compressed air, and a perfect system of electrical control, it is impossible to cut out any machine. Centrifugal pumps are employed for the return of the water from the settling tanks. Above the mill there is a reservoir holding 5,000,000 gallons of water and a little higher up there is a smaller reservoir. Near the main building is the office, store house and a well-equipped machine shop.

UTAH COPPER VS. BOSTON CON.

Mr. Ingalls also visited the Boston Consolidated company's plant, which is situated just a short distance west of the Utah Copper company's works. He gives a detailed description and then enters into a comparison of methods of ore treatment. Although the ores to be treated at these mills is practically identical in character there is a marked difference in methods employed in the crushing and treatment of the ore.

"Before entering upon a discussion of methods," says Mr. Ingals, "I make haste to say that both mills have been designed and constructed by accomplished and thoroughly competent engineers, and the differences between them are based upon carefully considered data. Both mills will be successful, but they will not give the same economical results, i. e., the same percentage of extraction of mineral and the same operating cost per ton of ore. However, it will not be a clear-cut contest between the two radically different methods of concentration, for reasons which will be pointed out below, and consequently the economic results will not differ to the extent they might otherwise.

"To the Utah mill attention has been fixed upon the avoidance of unnecessary slimes of the mineral. Following that idea the crushing is done by means of rolls, and after reduction of the ore to a comparatively coarse size, the mineral is extracted as far as possible by means of jigs and Wilfley tables. So far this is certainly a good procedure; the band of clean concentrate that is cut off on the Wilfley tables is broad and thick, and a large percentage of the total mineral is doubtless recovered directly in this way. For the further grinding which is necessary to liberate the remainder of the mineral, logic would appear to indicate the use of more rolls, but instead of that Chilean mills are employed, which are as bad slimers as any other form of crushing machine. Consequently, while a good degree of granularity of product is obtained by the use of rolls down to a certain point, and is well taken advantage of, the character of the pulp is subsequently sacrificed by the use of the Chilean mills.

"In the Boston mill the leading idea appears to have been to secure an uninterrupted descent of the pulp by gravity after the original elevation of the ore. Moreover, it was held evidently that inasmuch as the ore had practically to be slimed anyway, it might as well be done first as last. These considerations pointed to the use of stamps, and while the sliming tendency of stamps was fully recognized, that evil was found to be minimized in the Nissen stamp, because of the far greater area of screen per stamp head as compared with the ordinary gravity stamp. The Nissen stamp is an entirely sound mechanical design, differing from the ordinary stamp substantially only in its greater weight and the arrangement of its mortar. It was carefully tested by the Boston company before adoption and found to be capable of crushing about nine tons of porphyry per day, consuming about 2.5 h. p. per stamp, with reason to believe that nine tons might be somewhat exceeded. However, nine tons was adopted in the estimates, and consequently, although the Boston mill is commonly referred to as being of 3,000 tons daily capacity, the actual estimate is about 2,750 tons.

"The produce of a ton of ore will be about 23.32 pounds of refined copper. Deducting from the cost per ton of ore the value of the gold and silver recovered, say 15 cents per ton of ore, the net cost is $1.573. On this basis the cost of a pound of copper will be $1.573 plus 23.32 equals 6.75 per pound. Of course it will be perceived that in the above estimate no allowance is made for accidents and unforeseen contingencies. As a broad generalization, without entering into a discussion of the relative position of the two companies, it may be assumed that copper can be produced from the Bingham porphyry ore for about 7 cents per pound when operations are in full swing.

CHEAP COPPER COSTS.

"The ability to produce copper at this low figure is the result of a great deposit of favorable ore that is after all of good grade in comparison with what is mined at Lake Superior and an immense expenditure of capital to work the ore on a huge scale. Without referring to the developments at the mine, the Utah mill has cost about $4,000,000 of which $1,000,000 was for the power plant. The Boston mill has cost about $1,200,000. Reckoning the 6,000-horse power which is actually required for the Utah mill at $90 per horse power, the cost of that mill is about $3,540,000, or about $1.64 per ton of annual capacity. The cost of the Boston mill is about $1.20 per ton of annual capacity. The difference is largely in the matter of power plant, but in other details the Boston mill is a little less costly than the Utah mill.

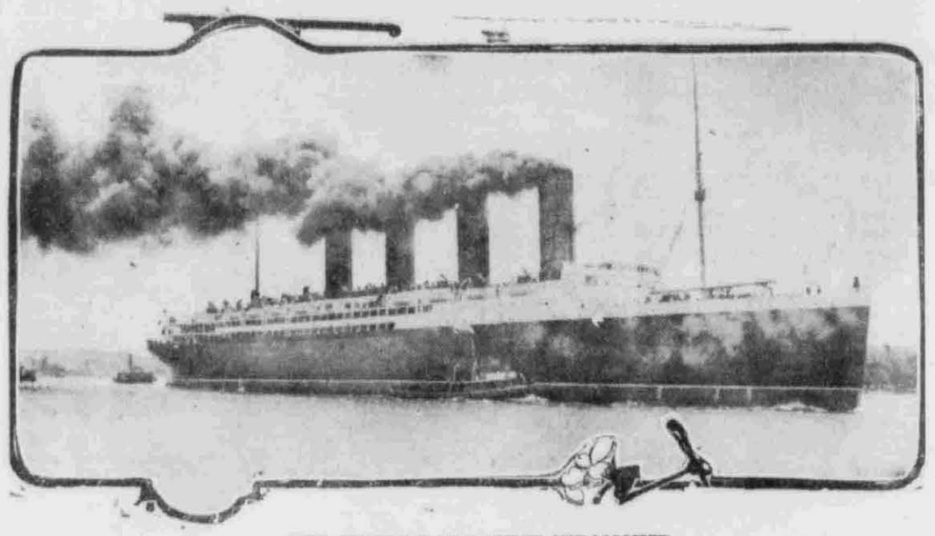
"With its two mills, the Utah Copper company will be able to treat about 5,500,000 tons of ore per annum and produce the equivalent of 58,300,000 pounds of refined copper. The Boston Consolidated can treat 1,000,000 tons of ore per annum and produce the equivalent of 25,320,000 pounds of refined copper."

Gave Her Away.

"The family were discussing the prospective wedding of the only daughter.

"Of course," said the bride-to-be to her father, "you will give me away?"

"I'm afraid I have done it already, me dear," he replied. "I told George only this morning that you had a disposition just like your mother's."



THE WORLD'S GREATEST STEAMSHIP.

The entire maraffine world is interested in the performance of the gigantic steamship Lusitania, the new Cunard turbine liner which has made such marvelous speed on her first trip across the Atlantic. Her speed of 25 knots an hour, although wonderful, is not of so much interest as her turbine engines, which are the first of their kind ever used for a vessel of such proportions.

The Lusitania is 790 feet long and 80 feet in breadth and her engines at full speed have developed more than 70,000 horsepower. It is very likely that, in view of her wonderful performance, similar ships will be built and equipped with turbines, as the best development of marine motive power.