

# **MINING AT BISBEE**

## **CHAPTER 4**

# **A HISTORICAL OVERVIEW**

## **MINING HISTORY**

**1930 - 1975**

SLIDE 1

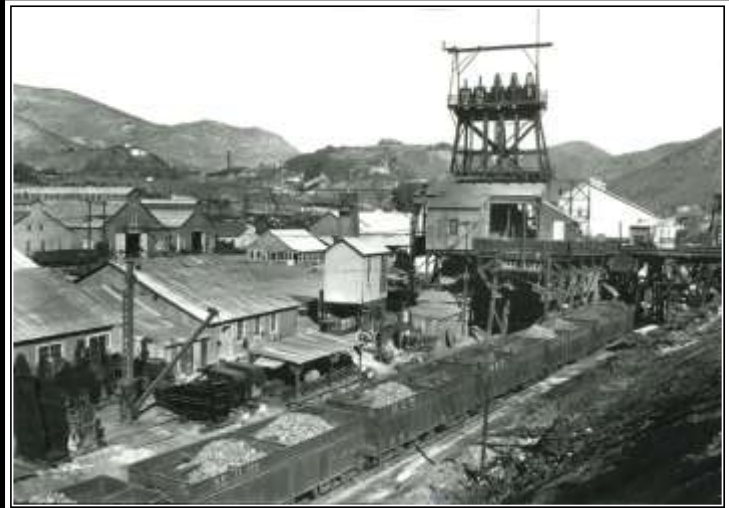
# MINING IN BISBEE

## A HISTORICAL OVERVIEW

MINING HISTORY  
1930 - 1975

JUNCTION SHAFT  
AND  
MINE YARD  
C-1940

PART 4



GRAEME LARKIN COLLECTION

## SLIDE 2

### THE C&A MERGES WITH PHELPS DODGE

- THE DEPRESSION DEEPENED IN THE EARLY 1930s AND COPPER PRICES CONTINUED TO BE LOW, VERY LOW. LITTLE OR NO PROFIT CAME FROM ANY OF BISBEE'S MINES AND CASH WAS SCARCE
- PRODUCTION HAD BEEN DRASTICALLY CUT, MANY MINERS WERE LAID OFF; WAGES AND WORKING DAYS WERE CUT. THOSE LUCKY ENOUGH TO HAVE A JOB, WORKED BUT 3 DAYS A WEEK
- TIMES WERE EXTREMELY DIFFICULT FOR THE THREE MINING COMPANIES AT BISBEE AND NO RELIEF WAS IN SIGHT. INDEED, AS HISTORY WOULD SHOW, NONE WOULD COME FOR YEARS
- BY LATE 1931, THE CASH-STARVED C&A WAS UNABLE TO CONTINUE AND DESPITE FIERCE OPPOSITION FROM GORDON CAMPBELL, ITS PRESIDENT, THE C&A BOARD OF DIRECTORS AND THE MAJORITY OF ITS SHAREHOLDERS AGREED THAT THE C&A MUST BE MERGED WITH PHELPS DODGE. THIS WAS COMPLETED IN OCTOBER OF THAT YEAR
- WITH THE MERGER COMPLETED, PD STOPPED OPERATING ALL OF ITS OWN MINES ON NOVEMBER 1<sup>ST</sup> 1931. ONLY THE CAMPBELL AND JUNCTION MINES CONTINUED TO OPERATE UNDER THE NEW OWNERS, THOUGH AT A MUCH REDUCED LEVEL
- LEASES WERE GIVEN TO A NUMBER OF SMALL MINERS TO MINE THE REMAINING ORES IN THE CZAR, HOLBROOK AND SOUTHWEST
- PD CLOSED ITS SMELTER AT DOUGLAS AND OPERATED ONLY THE NEWER, MORE EFFICIENT C&A SMELTER
- THE SHATTUCK DENN HAD SOME CASH, BUT WISELY CHOSE TO INVEST IT IN IMPROVING ITS ASSETS AS OPPOSED TO PRODUCING COPPER AT A LOSS, SO THE DENN WAS CLOSED AS WELL ~~~~~

### SLIDE 3

#### AT THE END OF 1931, ONLY TWO MINES REMAINED OPEN

1931 WAS A DIFFICULT YEAR FOR ALL OF AMERICA AND BISBEE WAS NO EXCEPTION. THE WORST WAS YET TO COME. ONLY THE CAMPBELL AND JUNCTION MINES REMAINED OPEN AND COPPER WAS AT EIGHT CENTS A POUND, BUT WORSE YET, THERE WERE NO BUYERS. 1932 SAW COPPER AT BELOW FIVE CENTS STILL WITH FEW BUYERS. LESS THAN 900 MEN WORKED IN ALL OF THE MINES AND MOST WERE WORKING 12 TO 15 DAYS PER MONTH INSTEAD OF THE NORMAL 25 DAYS WITH THE WORK WAS SPREAD AMONG AS MANY AS POSSIBLE.

WHILE EVERY EFFORT WAS MADE TO CUT COSTS, PD WAS STILL PREPARED TO INVEST IN THE FUTURE. MECHANIZATION WAS WIDELY EMPLOYED TO IMPROVE PRODUCTIVITY AND REDUCE EXPENSES WHERE EVER POSSIBLE

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JUNCTION MINE AND  
TIMBER YARD -1932  
GRAEME LARKIN  
COLLECTION



GRAEME LARKIN COLLECTION  
CAMPBELL MINE -1934



In 1930, Walter Douglas retired because of his declining health. He had successfully done much to save PD at Bisbee some 30 years earlier through driving the essential modernization which allowed the mining of lower grade ores. Now, even though he was leaving, the legacy of his prudent management over the years would play a huge role in saving both PD and Bisbee yet again.

Phelps Dodge entered the economic horrors of the depression with substantial cash reserves. It would be the wise use of this cash which kept Bisbee alive and indeed improved the mines here.

PD's new president, Louis Shattuck Cates believed in the future of the industry based on his many years with Kennecott Copper and he believed in the possibilities of Bisbee. Thus, in the face of unprecedented low copper prices, Phelps Dodge not only acquired the C&A, but they were to invest substantial sums in making their new mines better and more productive through modernization and mechanization.

To be sure, this was a gamble. No one had any idea of how deep the ongoing depression would be or how long it might persist. This gamble, this investment in the worst of times, would poise

Phelps Dodge to be in a position to materially contribute to the resolution of a much greater crisis for America, most of a decade later, as it was plunged into a war, the likes of which had never been seen before. Bisbee's copper would be available because of this foresight and help to win the war in a very real way.

#### **SLIDE 4**

### **THE 1930S WERE A PERIOD OF MECHANIZATION**

**THE UNPRECEDENTED LOW COPPER PRICES ACCELERATED THE DRIVE TO INCREASE PRODUCTIVITY AND THEREBY LOWER THE COSTS. THIS CAME IN EVERY POSSIBLE ACTIVITY. IN SOME INSTANCES, THE CHANGES WERE PART OF AN ONGOING TREND, SUCH AS HAULAGE**



GRAEME LARKIN COLLECTION  
EMPTYING 1 TON CARS PULLED BY A TROLLEY  
MOTOR CAMPBELL MINE -1939



GRAEME LARKIN COLLECTION  
MULE PULLING 1/2 TON CARS C - 1910

**BY 1930, ALL OF THE MULES HAD BEEN REMOVED FROM THE UNDERGROUND AND REPLACED BY ELECTRIC HAULAGE ON EVERY LEVEL AND LARGER CARS WERE IN GENERAL USE AS WELL**

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The early trolley motors were quite small, seldom weighing more than two tons. This small size limited the number and capacity of mine cars which could be hauled. Soon locomotives weighing five tons were employed which could pull up to ten tons of ore in as many cars.

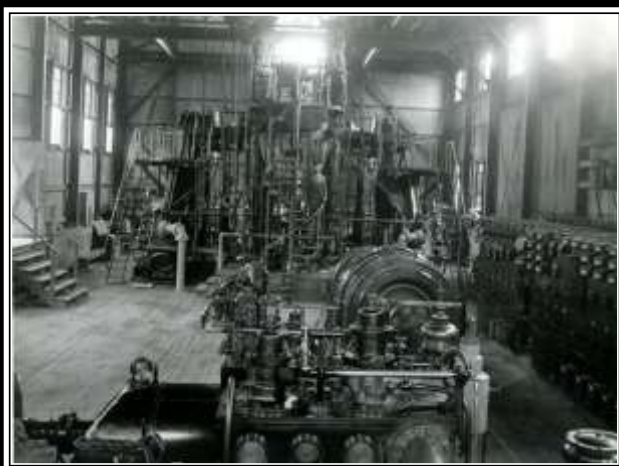
Gable-bottom, side discharge cars which could hold about one ton of sulfide ore, largely replaced the smaller, end-dump half ton cars. The gable-bottom cars were later totally replaced by rocker dump cars of variable sizes with half-ton H-cars used in mucking crosscuts or for short hauls and one ton E-cars for longer hauls.

## SLIDE 5

### HOIST WERE MADE FASTER AND SAFER

**HISTORICALLY, STEAM OR COMPRESSED AIR POWERED, SPOOL TYPE HOIST HAD BEEN EMPLOYED AT BISBEE . THESE USED FLAT, WOVEN STEEL CABLE UP TO SIX INCHES WIDE FOR HOISTING AS BOTH HIGH CAPACITY ,ROUND STEEL CABLE AND VARIABLE SPEED, ELECTRIC MOTORS OF SUFFICIENT SIZE WERE UNAVAILABLE DURING THE EARLY YEARS.**

**NOW, ORE SKIPS NEEDED TO BE HOISTED FASTER AND SAFER TO ENHANCE ORE HANDLING EFFICIENCIES. NEW, ROUND CABLE HOIST WITH LARGE GROOVED DRUMS WERE INSTALLED AT ALL OF THE OPERATING SHAFTS BY 1934, EXCEPT FOR THE SUNRISE**



GRAEME LARKIN COLLECTION  
LOWELL MINE FLAT CABLE HOIST C - 1912



GRAEME LARKIN COLLECTION  
CAMPBELL MINE ROUND CABLE HOIST - 1935

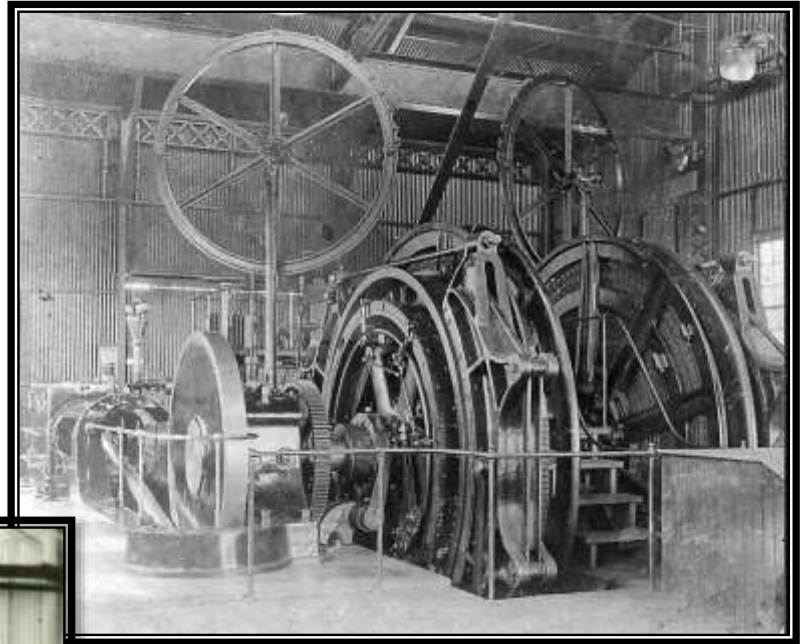
High quality, round steel cable of sufficient strength and length to hoist from the deeper mines was only available after most of the hoist had already been installed at Bisbee. The older hoist used flat cable or rope as it was called and this was typically made in the mine shops using 8 - 12 smaller cables and woven in a steel wire mesh. Dependable, round steel hoisting cables came only in later years.

The spool types of hoists were much like a spool of ribbon with each layer wound on top of the preceding. Running such hoist was an art as each revolution of the hoist either took up or let out a different amount of cable than the previous or the next revolution. This was because with each revolution, the diameter of the spool was either increased or decreased by twice the thickness of the cable. As the cable neared its end with the cage near the bottom, a revolution of the spool let out or took in a very small length of cable. Conversely, when the spool was near full, with the cage near the top, every revolution let out or took in a substantial length of cable.

With the introduction of round wire rope, this feature disappeared as the drums were typically large diameter and when a second or third lap of cable was added to the drum, the relative change in diameter was insignificant.



This change made counter-balancing of the hoist much simpler. This meant that when one cage or skip would be lowered, its weight plus that of the cable could be used to aid in lifting the upward bound unit. The drums would engage on the drive shaft and the upward movement of one had a corresponding downward movement of the other. This aspect was of great significance when hoisting ore from a shaft pocket as many trips from the same location were made, thus as one skip was in position to be full drum the other was in position to dump at the surface. Time and electrical power were both saved by this procedure.



Left: Weaving flat rope hoist cable in the C & A rope shop – 1916.

Above Gardner Mine flat rope hoist 1904.

Both - Graeme Larkin collection

## SLIDE 6

### IMPROVED DRILLING BROUGHT IMPROVED BREAKAGE



AUTOMATIC FEED LEYNER DRILLS  
ON TYPICAL BAR AND COLUMN  
SETUPS, IN A CUT AND FILL STOPE  
(L) AND IN A CROSSCUT (BELOW)

1939

GRAEME LARKIN COLLECTION

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**AUTOMATIC FEED LEYNER DRILLS IMPROVED A MINERS ABILITY TO DRILL THE BLAST HOLES BY MAKING THE BIT LAST LONGER, REDUCING THE FREQUENCY OF STEEL CHANGES. INTEGRAL DRILL STEEL, WHICH HAD THE BIT FORMED ON THE DRILL STEEL WERE IN USE UNTIL 1940 WHEN DETACHABLE BITS TOOK OVER.**



Even though these machines were still very heavy and mounted on bar and column setups, they were a marked improvement over the early column-mounted, hand crank feed drills in that steady pressure at the correct level was now applied to the drill. This dramatically improved the life of the bit as too much pressure applied by the machine operator did not allow the bit enough travel distance to strike the rock with force, instead it rotated against the hole bottom wearing the chisel edge away. Too little pressure would have the bit too far away from the hole bottom and the striking force was actually absorbed by the chuck which held the steel and not the rock. This caused premature failure of the chuck or drill steel.

From the time pneumatic drills were first introduced in 1905, until 1939, all drill steel had the bit formed on the end. This was known as integral drill steel. When the bit was dull, the whole steel was sent to the blacksmith shop for sharpening and re-tempering. This meant that huge amounts of heavy drill steel were taken out of and returned to each mine every day. Also, the constant re-sharpening and re-tempering of the drill steel caused it to become shorter by natural wear and often become brittle from excessive heating and cooling during the repeated process.



Detachable, screw on bits were tested in 1937-1938 and found to be very acceptable in terms of penetration and life. BY 1939, all integral steel was replaced by steel with threaded ends and detachable bits. Now, it was usually only the bits that left the mine to be re-sharpened and not the bit and steel. This was a significant improvement for the miners as they only worried about small bit holders at the start of a shift instead of bundles of steel. For the company it was a substantial cost savings as well, both on labor for handling the steel and in time sharpening the bits. Material savings were also experienced through reduced steel consumption.

## SLIDE 7

### THE WAY BROKEN ROCK WAS HANDLED CHANGED

**IT WAS THE HAND SHOVEL THAT MOVED MOST OF THE BROKEN ROCK AT BISBEE FROM 1877 UNTIL 1933 WHEN EFFECTIVE MECHANICAL METHODS WERE INTRODUCED. FIRST CAME THE COMPRESSED AIR OPERATED OVERSHOT LOADERS THAT LITERALLY THREW THE BUCKET LOAD OF ROCK INTO THE ATTACHED MINE CAR AND WAS USED LARGELY IN CROSSCUTS**



GRAEME LARKIN COLLECTION  
EIMCO OVERSHOT LOADER WORKING IN A  
CROSSCUT IN THE CAMPBELL MINE - 1939



GRAEME LARKIN COLLECTION  
HAND SHOVELING  
BROKEN ROCK IN A  
CROSSCUT - 1920

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COMPRESSED AIR SLUSHER MOVING  
BROKEN ROCK IN A STOPE - 1938

**MUCKING IN STOPES WAS GREATLY SIMPLIFIED BY TWIN-DRUM SLUSHERS TO PULL A RAKE BACK AND FORTH, DRAGGING THE BROKEN ROCK TO A RAISE CONNECTED TO THE LEVEL BELOW**

Shovels (or “muck sticks”) as they were frequently called) were not totally replaced, but their use was now largely for minor cleanup or the odd, small mucking task. This was an enormous improvement in efficiency and the arduous task of shoveling tons of rock a day for many men literally disappeared, almost overnight.

The overshoot loaders were often referred to as “Finleys”, after the early machines designed and made by the Finley Company. However, most were actually manufactured by Eimco. These compressed air operated loaders completely changed the way a crosscut was mucked by reducing the amount of physical labor and time needed to do so. Hand mucking took two men four hours

to cleanup a four foot round, a “Finley” could muck a six foot round in two hours if it had the available empty mine cars, which was almost always the case.

The empty car was hooked to the mucking machine and it moved with it until full when it was switched out for an empty. Temporary, two track “super switches” were used to allow for the rapid change of cars. The super switches had two sets of parallel rails for holding several empty cars on one side and several loaded cars on the other. This reduced the amount of switching a motor would have to do to keep the process moving smoothly.

Slushers are twin drum cable hoist which rotate in opposite directions as activated by hand leavers, with one pulling the muck filled rake to the raise then the other would pull the empty rake back to the broken rock and the process repeated. Pulleys would be wedged or rock bolted into the working face or attached to support timber with a cable sling. Both electric and compressed air slushers were widely used with the 440 V electric slushers employed where larger, more powerful machines were needed or in semi-permanent situations

## **SLIDE 8**

### **THE JUNCTION SHAFT IS DEEPENED BY 400 FEET**

**IT WAS THE DARKEST PART OF THE DEPRESSION AND COPPER HAD BEEN LESS THAN 5 ¢ A POUND, BUT TO ASSURE THE FUTURE, EVEN MORE MUST BE INVESTED. STARTING IN 1933, PD BEGAN TO DEEPEN THE JUNCTION SHAFT WITH THE CORRECT BELIEF THAT GOOD ORE WOULD BE FOUND . WORK STARTED ON THE 2300 LEVEL AND THE PROJECT WAS EXPECTED TO GO TO THE 3300 LEVEL, A 1000 MORE FEET. THE EXISTING SKIP HOIST WOULD NOT BE ABLE TO EFFICIENTLY HANDLE THE ADDITIONAL DEPTH OR THE TONNAGE TO BE RAISED EACH AND EVERY DAY. A NEW LARGER HOIST WAS INSTALLED FOR THE SKIP COMPARTMENTS — NUMBERS THREE AND FOUR — TO MEET THE EXPECTED DEPTH AND TONNAGES. THE TONNAGE CAPACITY WAS TESTED AND IT EXCELLED, BUT THE DEPTH WAS NOT AS THE SHAFT NEVER REACHED THE PROPOSED DEPTH OF 3300'. THAT HONOR WOULD BE RESERVED FOR THE CAMPBELL, 30 YEARS LATER**

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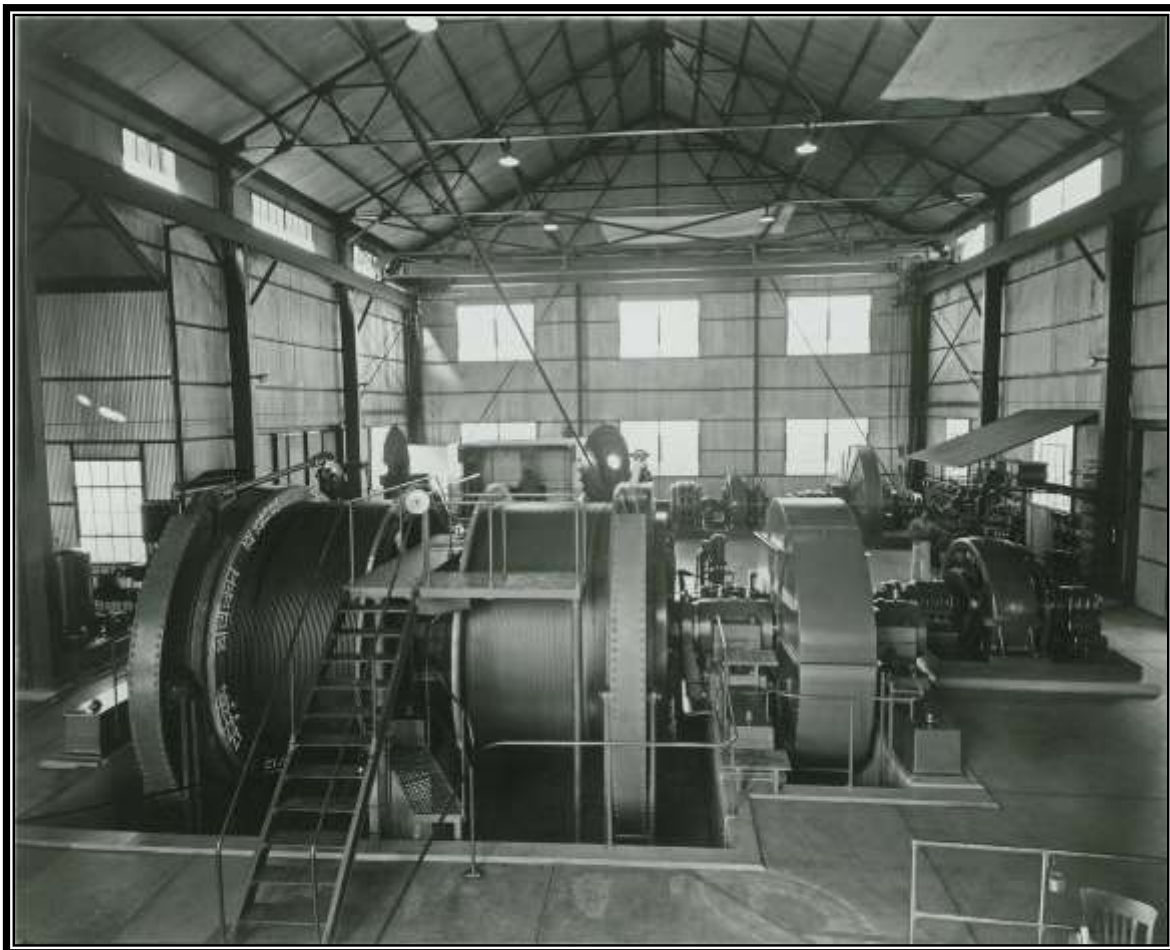
GRAEME LARKIN COLLECTION

JUNCTION SKIP HOIST DURING INSTALLATION 1934

Two views of the impressive skip hoist for compartments three and four at the Junction Mine. Top view in 1963, some five years after its use had been discontinued. It was, however maintained in operating condition until a few years later when an expansion of the Lavender Pit Mine forced its removal.

Bottom view in 1934 after the instillation of the fine hoist had been completed.

Graeme Larkin collection



## SLIDE 9

### NEW IDEAS ARE USED TO SAVE SUBSTANTIAL COSTS

ON THE 2300 LEVEL NEW BOOSTER PUMPS WERE INSTALLED TO HANDLE THE HEAVY WATER FLOWS FOR WHICH THIS MINE WAS WELL KNOWN. THESE PUMPS LIFTED THE WATER TO THE HUGE PUMP STATION ON THE 2200 LEVEL FOR FINAL PUMPING TO THE SURFACE. ON THE 2700 LEVEL, A 150 FOOT LONG PUMP STATION WAS CUT IN BAD GROUND. STEEL SUPPORT WAS INSTALLED TO KEEP IT OPEN AND THREE, 1,500 GPM PUMPS PUT IN PLACE. THIS PREEMPTIVE APPROACH KEPT WATER FROM BECOMING THE SERIOUS PROBLEM IT HAD ALWAYS BEEN AND MADE THE PROJECT LESS EXPENSIVE.

THE STANDARD SPACING BETWEEN LEVELS OF 100 FEET WAS CHANGED TO 133 FEET. LEVELS WERE ESTABLISHED AT THE 2433, 2566 AND 2700 FOOT DEPTHS. IN 400 VERTICAL FEET, AN ENTIRE LEVEL AND THE ASSOCIATED DEVELOPMENT COSTS HAD BEEN ELIMINATED. THE 2700 WOULD BE THE LOWEST LEVEL EVER DEVELOPED IN THE JUNCTION MINE

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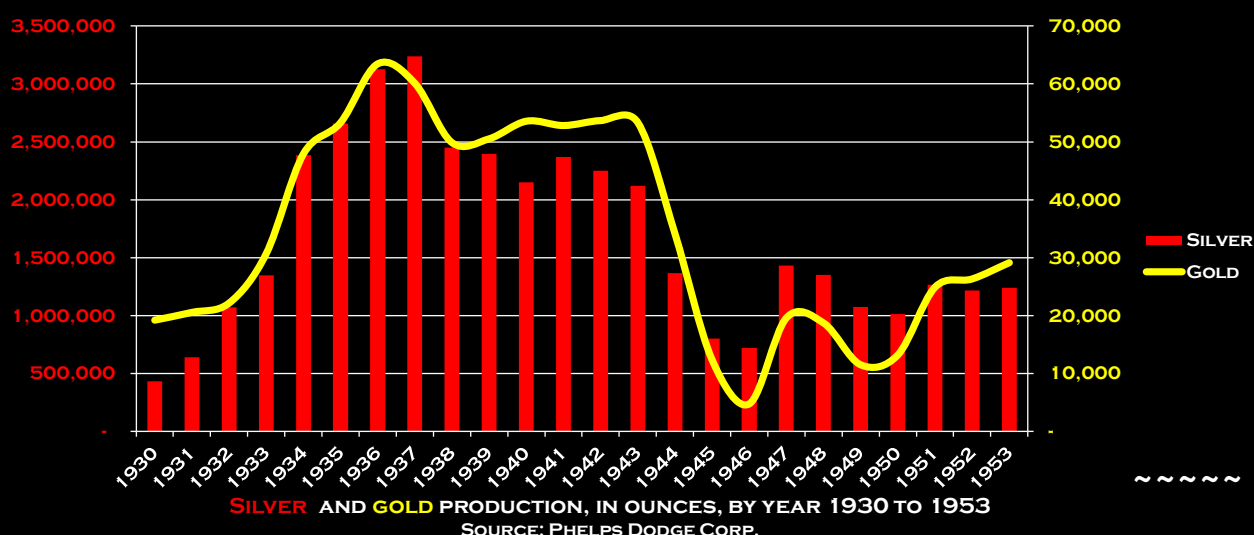
GRAEME LARKIN COLLECTION  
JUNCTION 2700 LEVEL STATION - 1973



## SLIDE 10

### SOME RELIEF IS GIVEN BY GOLD AND SILVER PRICE HIKES IN 1934

THE EFFECTIVE NATIONALIZATION OF BOTH GOLD AND SILVER IN EARLY 1934, TO STABILIZE THE US CURRENCY, GAVE THE BELEAGUERED METAL MINING INDUSTRY A BOOST. PRICES FOR BOTH METALS INCREASED QUICKLY AND SUBSTANTIALLY. PD THEN CONCENTRATED ON THE HIGH GOLD AND SILVER ORES IN THE CAMPBELL OREBODY AND REOPENED THE COLE TO MINE KNOWN HIGH PRECIOUS METAL ORES. AS SHOWN BELOW, BOTH GOLD AND SILVER PRODUCTION INCREASED DRAMATICALLY IN RESPONSE TO THE PRICE INCREASE CAUSED BY GOVERNMENT ACTIONS



The economic depression and the epidemic of bank failures in the early 1930s led to sweeping reforms in the nation's monetary structure. Gold was priced at \$20.67 per ounce when the depression began. Executive proclamations issued by President Franklin D. Roosevelt in March and April 1933 prohibited gold exports except under government license, and called in all gold and gold certificates from general circulation, thus ending the gold standard. It also became a criminal offence for U.S. citizens to own or trade gold anywhere in the world, with an exception of some jewelry and collector's coins. Gold was effectively nationalized by this highly controversial action.

On October 25, 1933, the Reconstruction Finance Corporation began buying newly-mined gold at the arbitrarily fixed price of \$32.36 per ounce. A effective 56.5% increase in the price for the metal. Then under the Gold Reserve Act of January 30, 1934, the country returned to a modified gold standard with a devalued dollar. The act gave the president authority to lower the weight of the gold dollar to between 50 and 60 percent of its former gold content. The following day the president issued a proclamation reducing the gold content of the dollar to 59 percent of that established by the Gold Standard Act of 1900, or from 23.22 to 13.71 grains of fine gold. This effectively raised the price of gold to \$35.00 per ounce, a further 8% increase in the price.



The years 1933 and 1934 were also marked by important legislation regarding silver which, like gold, substantially increased the price of the white metal. Under the Thomas Amendment to the Emergency Farm Relief Act of May 12, 1933 (commonly known as the Inflation Act), the president was given the power to restore unlimited coinage of silver under a bimetallic system. The Silver Purchase Act, which was signed by the president on June 19, 1934, authorized the nationalization of silver and declared it to be the policy of the United States to have the silver holdings of the U.S. Treasury ultimately make up a maximum of one quarter of the value of the nation's combined monetary gold and silver stocks. On August 9, 1934, the president issued an executive order requiring that all silver in the United States, with the exception of certain categories such as silver coins, fabricated silver, and silver owned by foreign governments, be delivered to the mints to be coined or held as bullion for later coinage. Under the Silver Purchase Act and subsequent legislation, the Treasury purchased large quantities of silver abroad and from domestic producers, which tended to raise the price of the metal and curtail the monetary use of silver abroad, especially in China and India and to a lesser degree, Mexico.

The impact of these actions effectively created a boom for both gold and silver miners as the value of their product was dramatically increased and prices guaranteed almost overnight. While it was not the original intent of the acts, many mines were put back into production to take advantage of this mini-boom for the industry and Bisbee was no exception as high gold/high silver areas were preferentially mined.

## THE DENN MINE REOPENS

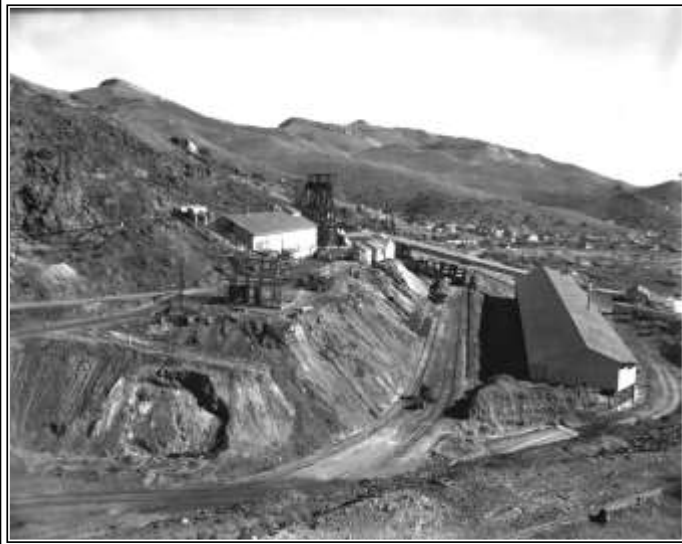
BETWEEN LATE 1931 AND MID-1932, SHATTUCK DENN CHOSE TO SPEND A SUBSTANTIAL AMOUNT OF MONEY SECURING THEIR BEST ASSET AT BISBEE. THE WHOLE 2400+ FEET OF THE DENN SHAFT WAS GRADUALLY STRIPPED OF ITS TIMBER AND CONCRETE TO 3 FEET THICK PLACED. THIS FAITH WOULD BE REWARDED WHEN THE MINE WAS REOPENED IN 1934. DEVELOPMENT ON THE 2200 LEVEL THAT YEAR HIT THE TOP OF AN UNCOMMONLY LARGE, HIGH GRADE OREBODY. THE NEXT TWO YEARS WERE SPENT DEVELOPING WHAT TURNED OUT TO BE ONE OF THE FEW OREBODIES FOUND AT BISBEE WITH MORE THAN ONE MILLION TONS OF ORE. IT EXTENDED TO BELOW THE 2700 LEVEL AND WOULD ULTIMATELY YIELD MORE THAN 2,250,000 TONS OF ORE. THIS FIND LITERALLY SAVED THE COMPANY AND ALLOWED IT TO PRODUCE 2½ TIMES MORE COPPER IN 1936 THAN IT HAD EVER PRODUCED BEFORE. IT ALSO PAID ITS SHAREHOLDERS A SPECIAL 25% DIVIDEND, MORE THAN A THIRD OF WHOM LIVED IN BISBEE AT THE TIME ~~~~~



GRAEME LARKIN COLLECTION  
DENN MINE - 1934

**SLIDE 12**

**THE WORST IS OVER BY 1936**



GRAEME LARKIN COLLECTION

**SACRAMENTO MINE COMPLEX - 1936**

**BY MID-1935, COPPER DEMAND AND PRICES HAD RECOVERED SOMEWHAT. THE INVESTMENT IN MECHANIZATION HAD BROUGHT IMPORTANT COSTS REDUCTIONS, THUS IT BECAME FEASIBLE TO REOPEN A FEW OF THE MINES WHICH WERE CLOSED IN 1931.**

**THE SACRAMENTO WAS REOPENED AND BEGAN TO PRODUCE ORE FROM AREAS PREPARED EARLIER FOR HIGH-TONNAGE, BULK MINING. HIGHER GRADE OXIDE OREBODIES WERE ALSO MINED AT THIS TIME.**

**IT WAS ALSO A YEAR OF EXPANSION, THE FIRST IN A WHILE, WITH MINING EXTENDING INTO NEW AREAS ADJACENT TO THE LOWELL AND GARDNER MINES. THE MINES WERE AGAIN WORKING SIX DAYS A WEEK**

**LESSEES WERE PRODUCING INCREASINGLY IMPORTANT AMOUNTS OF ORE FROM THE CZAR, SOUTHWEST, WHITE TAILED DEER, BRIGGS AND HOLBROOK MINES ~~~~~**

## SLIDE 13

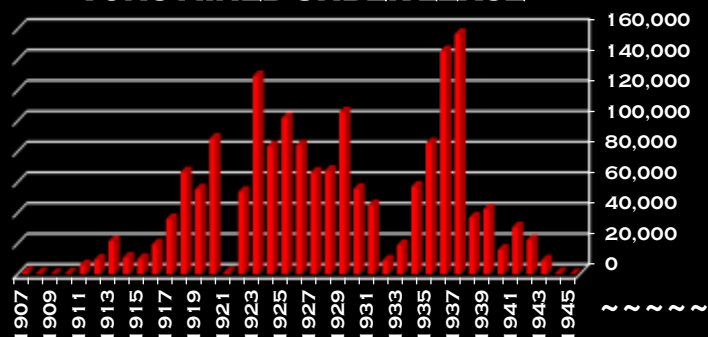
### MINING BY LEASES BECOMES MORE IMPORTANT

ALL OF THE MINING COMPANIES IN BISBEE HAD LEASED SOME OF THEIR GROUND TO SMALL MINING GROUPS TO EXTRACT THE MINOR AMOUNTS OF ORE THAT REMAINED ONCE THEY HAD EXTRACTED THE MOST PROFITABLE PORTIONS. THESE SMALL MINERS COULD OPERATE MUCH CHEAPER THAN THEIR LARGE COUNTERPARTS. BOTH THE BORAS AND NIGHTHAWK MINES WERE DEVELOPED AND SUCCESSFULLY OPERATED UNDER LEASES IN THE 1920s. DURING THE DEPRESSION, WHEN A GREAT MANY MINERS WERE UNEMPLOYED, A RELATIVELY LARGE NUMBER OF LEASES WERE GIVEN BY PD TO WORK IN THE MINES THEY HAD OPERATED FOR YEARS. AREAS IN THE CZAR, SOUTHWEST, UNCLE SAM, HOLBROOK, HIGGINS AND SPRAY MINES WERE TURNED OVER TO THESE INDUSTRIOUS INDIVIDUALS. IN EARLY 1944, ALL LEASES WERE ABRUPTLY TERMINATED WHEN THE LESSEES, AND NOT PD, WERE PAID A BONUS BY GOVERNMENT FOR WAR TIME PRODUCTION



GRAEME LARKIN COLLECTION  
BORAS MINE - 1961

### TONS MINED UNDER LEASE



The Copper Queen began the practices of leasing areas which contained the remnants of the orebodies they had mined in 1904, but the amount mined was almost insignificant. By 1907, production from the leased properties began to have an impact.

Locally these individuals were called “leasers” even though they were, in truth, lessees. Usually the areas leased were the irregular fringes of larger orebodies which had reached the economic limit for the company.

Oft times, they were men who could not continue working for the company because of age or injury and the leases were given by the CQ or C&A to help.

The small miners could mine cheaper, often much cheaper as they had little in the way of overhead cost. Almost always the leasers were doing the work themselves, with few employees. In many instances, the leasers hired Mexicans as miners and paid lower than normal wages (*this was, unfortunately, common for the time and the leasers were following the norms of the era*) to these hard workers, but it was all about survival in a difficult economic environment. They tended to make their access openings small to save money and reused timber, pipe and rail over and over. By terms of their contract, all ores mined were smelted by the Copper Queen and the

leasers paid on the assay value of the material mined. The Copper Queen furnished some services. The shafts and hoisting equipment, except for at the Spray, were maintained by the company. Compressed air was provided to the general lease area as was drill water.

It was a hard, very hard way to make a living as a leaser and most just managed to get by. Visits by the author to the leased areas not long after they were closed for good, spoke of a difficult work environment in an already hard place to work. Narrow, low drifts, little timber, small pipe and outdated equipment were the rule for these men, not the exception, but times were different, times were hard for most, at least they had work. Often it was a family enterprise with father and sons or brothers working together. They were the bosses and workers at the same time.

I have often wondered about the dinner table discussion in these families. How they must have been about the mine and their plans for tomorrow, the disappointment of today. Many more tons were undoubtedly mined at the table than ever were in the mine. I had the privilege to know many of these men and to hear their stories.

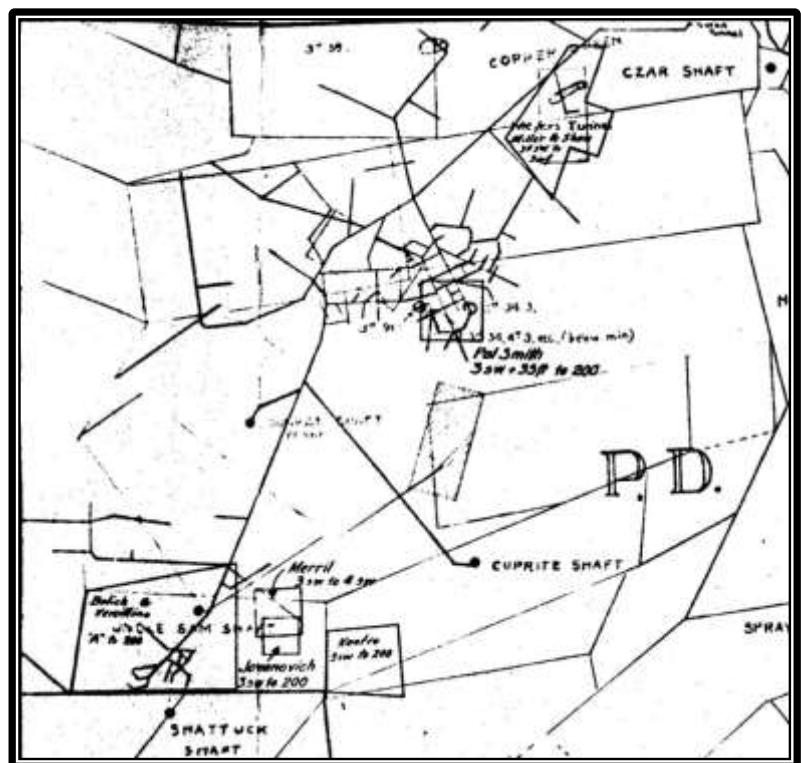
A few however, did well when they found ores the company had missed. They could ship more than one or two railcars a month to the smelter and could then invest in better equipment or do more exploration. One or two even made small fortunes, but most just enough to come back tomorrow.

The work accomplished by some of these leasers was impressive. Some of the waste from the Sacramento pit was placed over the Spray shaft in 1919. Leasers reopened the shaft by coming up under this loose mass of generally large rocks and extended the shaft through more than 100 feet of this material. An impressive feat.

Both the Boras and Nighthawk mines were developed by leasing companies where small, public companies had the lease, employed miners, developed the ore and, in general provided all of the services and facilities. However, on occasion, the Copper Queen did do development work for them on a contract basis.

The C&A leased the Irish Mag mine area beginning in 1913 and later the Oliver and Cole were leased as well. From 1925 onward, the Shattuck mine was largely operated by leasers. This lasted until 1947 when the mine was closed because the ores were exhausted.

During World War Two, the Metals



AREAS LEASED ON THE 3 LEVEL SOUTHWEST MINE  
1934. THIS IS THE SAME LEVEL THE MINE TOUR USES  
TODAY



Reserve Company of the US Government contracted with a number of mining companies to mine lower grade material with a premium to be paid over the metal price to assure the operator of a fair profit. Many of the leasers took advantage of this opportunity and mined lower grade ores as these were far more available than the high grade needed to cover operating costs. In 1944 the premium for mining the low grade was paid ----- the leasers were given the premium for the ores they had mined. PD was incensed. The company had always assumed and indeed insisted that the ores were PD's not the leasers and it should get the premium, but a local accountant had read the law more carefully and he successfully represented the leasers. The day after the leasers were advised of their good fortune, PD canceled all of the leases. The leasers were not allowed to even go into the mine to recover their equipment. PD had each develop an estimate of the value of the equipment and materials remaining underground, sent their engineer in to confirm the numbers and paid the leasers for their equipment. Most of the tools and such remained in the mines for years as PD made no effort to remove it, so deep was the resentment.

But the story of leasers in Bisbee was one of good. Much more ore was recovered than might have been otherwise. Many more men were given jobs, particularly during the depression, than would have been employed otherwise and a few, a very few did well enough to establish other businesses in Bisbee or elsewhere and use the experience they had gained to make these new ventures a success.

## SLIDE 14

### THE LAST NEW SHAFT IS SUNK AT BISBEE

THE STEADILY IMPROVING COPPER PRICE OF THE MID-1930S, BROUGHT WITH IT RENEWED HOPE AND THE BELIEF THAT ADDITIONAL RESERVES SHOULD BE SOUGHT. GEOLOGICALLY, THE UNEXPLORED AREA BETWEEN THE CAMPBELL MINE AND TIN TOWN LOOKED VERY PROMISING THUS, THE DECISION WAS TAKEN TO SINK A NEW SHAFT TO EXPLORE IT. IN 1936, THE GALENA SHAFT WAS STARTED AND, OVER THE NEXT SEVERAL YEARS, SANK TO AN EVENTUAL DEPTH OF 1,407 FEET. EXPLORATION DRIFTS WERE CUT ON SEVERAL LEVELS; TO NO AVAIL. ORE WAS NEVER FOUND IN ANY OF THE WORKINGS OR BY DIAMOND DRILLING. THE SHAFT DID BECOME IMPORTANT AS A VENT FOR THE FIRE GASSES IN 1948 WHEN SECTIONS OF THE CAMPBELL CAUGHT FIRE AND BURNED FOR YEARS ~~~~~



GRAEME LARKIN COLLECTION  
GALENA SHAFT - 1937

Some of the best geologic minds of the time were involved in the selection of the site for the Galena shaft as well as the layout of the exploration drifts and the thousands of feet of diamond drilling completed. Nothing of worth was ever found. The failure of the Galena joined the Silver Bear, Powell, Congdon and Warren shafts as yet one more testament of just how very difficult it was to find ore at Bisbee, even inside the mineralized area.

## SLIDE 15

### THE CAMPBELL AND JUNCTION ARE FLOODED

EXCESSIVE WATER IN THE EASTERN PART OF THE DISTRICT HAD LONG BEEN A PROBLEM, BUT A CONTROLLABLE ONE. PUMPING RATES FROM THE 2200 LEVEL STATION HAD LONG AVERAGED BETWEEN 5,500 AND 6,000 GPM WITH THE LOWER LEVELS CONTRIBUTING A BIT MORE THAN 50%. THEN EXPLORATION EAST OF THE CAMPBELL FAULT ON THE 2700 BEGAN IN 1936. THREE MORE 1,500 GPM PUMPS WERE INSTALLED ON THE 2700 LEVEL JUNCTION IN 1936 AND TWO, 2,000 GPM PUMPS ON THE 2700 LEVEL CAMPBELL IN 1940. HUGE CONCRETE AND STEEL WATER DOORS WERE INSTALLED ON THE 2566 AND 2700 LEVELS AS A PRECAUTION. DIAMOND DRILL HOLES WERE USED TO PROBE FOR WATER AHEAD OF THE DEVELOPMENT. IN SPITE OF THESE AND MANY OTHER EFFORTS, A BLAST IN 12 XC ON THE 2700 HIT AN UNMANAGEABLE FLOW OF WATER IN AUGUST, 1941 . THE WATER DOOR ON THE 2700 WAS CLOSED AND BOLTED, BUT THE ONE ON THE 2566 WAS OPEN. BOTH MINES FLOODED TO 123 FEET ABOVE THE 2566 LEVEL ~~~~~



GRAEME LARKIN COLLECTION  
WATER DOOR – 12XC 2700 LEVEL  
CAMPBELL MINE - 1962

When 12 crosscut blasted into the watercourses, the flow of water was estimated at more than 50,000 gallons per minute. Well in excess of the combined pumping capacity at the mine. But water doors were supposed to contain unexpected water like this, what went wrong?

In development headings where water is a potential threat, massive 12 foot thick concrete plugs were keyed into the rock in a stable area. A huge 2 inch thick curved and gusseted steel door is mounted on the upstream side of this concrete plug. The fit was perfect on matching, machined steel faces to prevent leaks. Every penetration in the plug, such as power cables, compressed air and drill water lines were carefully designed and placed to withstand several times the expected pressure. A 10 to 12 inch drain pipe was placed in the plug as it is cast and a high pressure valve mounted on the outside end. The water doors on the 2566 and 2700 levels were built to hold water pressure equal to many hundreds of feet of head.

Blasting in these situations was always done electrically and only after all the men were outside of the water door and it was closed by bolting it shut with four massive bolts. Every safety precaution was taken to protect the workers. The men left 12 crosscut close to the shifts end and the blast fired with nothing unusual observed. The miners left the mine. It was the end of night

shift and it would be several hours before the graveyard cager, who was loading skips just below the 1800, reported a flow of water coming off of the 2566 level. The water door on this level had not been closed and a raise behind the 12 XC water door connected the two levels. Obviously, 12 XC had filled up and the water quickly filled the raise as well.

The huge flow of water had pushed the water door on the 2566 level partially closed, but timber carried by the water had jammed between the door and the frame. By the time the problem was discovered, the flow of water around the partially closed door was geyser-like because of the pressure. Powerful hydraulic jacks were brought in, but even the largest could not match the force of the water. Within hours, the pumps on the 2700 level Campbell were flooded and before long, those in the pump station at the distant, but connected Junction Shaft were lost as well. Two days later the water level was at 123 feet above the 2566 level and stable.

No one was injured because of this flood, indeed no one was ever at risk, but now the water must be removed. Large, deep well pumps were brought in and the skips at both mines were rigged to bail out the water. It would take four months before the 2700 level pumps would be back in action and several more months before work could resume in 12XC again.

When access to 12 XC was regained, it was found that the last blast had broken all but an inch or two of rock between the crosscut and the water course. It took a while for the thin rock wall to fail and this is why the miners did not notice any water flow after the blast, it had been delayed until the thin rock partition could no longer hold back the pressure. Amazingly, no large openings were found where the water was hit, but rather a number of relatively narrow, parallel open spaces had held this immense store of water. These were still discharging a substantial flow of water 20+ years later when I last was in the area in 1962.

The reason the diamond drilling ahead of the advance in 12 crosscut did not detect the water was because the open space containing the water were solution enlarged faults that were more or less parallel to the direction of the cross cut and drilling straight ahead did not intercept these features. In later development efforts, a fan of holes, in all directions, would be drilled looking for just such features. This mistake would not be repeated.

## SLIDE 16

### WWII AND ITS IMPACT ON BISBEE MINING

**WORLD WAR TWO HAD A HUGE IMPACT ON THE MINES AT BISBEE IN SEVERAL WAYS. THE OBVIOUS WAS THE INCREASED DEMAND FOR METALS - COPPER — LEAD — ZINC TO SUPPORT THE WAR EFFORT. THE CONFLICT IN EUROPE HAD ALREADY CAUSED THE COPPER PRODUCTION TO RISE FOLLOWING THE DOLDRUMS OF THE DEPRESSION, BUT NOW THE NEED WAS FOR AMERICA, THE NEED WAS REAL, THE NEED REQUIRED RESOURCES — MEN — EQUIPMENT — BOTH OF WHICH WERE BADLY NEEDED EVERYWHERE.**

**GOLD MINING WAS DEEMED AS NONESSENTIAL AND WAS SUSPENDED IN 1942 BY ORDER L-208 WITH THE MEN AND EQUIPMENT FREE FOR OTHER USES, NOTABLY COPPER MINING. HOWEVER, THIS DID LITTLE TO RESOLVE THE SHORTAGE OF MEN AS THE COMPETING FACTORS OF THE DRAFT, WHICH TOOK 450 FROM BISBEE'S MINES, AND THE VERY ATTRACTIVE WAGES PAID IN DEFENSE PLANTS TOOK MANY MORE. THE GOVERNMENT STEPPED IN TO HELP BY ASSIGNING SOLDIERS TO WORK IN THE MINES INSTEAD OF THE BATTLEFIELDS OF EUROPE OR THE PACIFIC.**

**GOVERNMENT INTERVENED IN ANOTHER WAY. TO AVOID THE RUNAWAY PRICE SEEN DURING THE FIRST WAR, COPPER AND OTHER COMMODITIES WERE PLACED UNDER PRICE CONTROLS WHICH WERE NOT LIFTED UNTIL 1946. HOWEVER, CONTRACTS FOR METALS WERE GIVEN WHICH ALLOWED FOR THE MINING OF LOWER GRADE ORES AT A PROFIT. ~~~~~**

Early in 1941, it became apparent to those in charge of the Nation's defense mobilization that we faced a critical shortage of nonferrous metals, notably copper, and a comparable shortage of machinery and supplies to produce them. Responsive to this situation, the Office of Production Management (OPM) and its successor, the War Production Board (WPB), issued a series of Preference Orders. These gave the producers of mining machinery and supplies relatively high priorities for the acquisition of needed materials. They also gave to those mines, which were deemed important from the standpoint of defense or essential civilian needs, a high priority in the acquisition of such machinery. Gold mines were classified as nonessential and eventually were relegated to the lowest priority rating. These orders prevented the gold mines from acquiring new machinery or supplies so that, by March of 1942, they were reduced to using only the machinery and supplies which they had on hand.

Soon thereafter, a severe shortage of skilled labor developed in the nonferrous metal mines. This was due in part to the expanding need for nonferrous metals, and in part to a depletion of mining manpower as a result of the military draft and the attraction of higher wages paid by other industries. It became apparent that the only reservoir of skilled mining labor was that which remained in the gold mines. Pressure was brought to bear on the WPB to close down the gold



mines with the expectation that many gold miners would thus be attracted to the nonferrous mines.

As a part of this conservation program, WPB, on October 8, 1942, issued Limitation Order L-208. That order was addressed exclusively to the gold mining industry which it classified as nonessential. It directed each operator of a gold mine to take steps immediately to close down its operations and, after seven days, not to acquire, use or consume any material or equipment in development work. The order directed that, within 60 days, all operations should cease, excepting only the minimum activity necessary to maintain mine buildings, machinery and equipment, and to keep the workings safe and accessible.

On November 19, 1942, Order L-208 was amended to prohibit the disposition of certain types of machinery or supplies without the permission of an officer of the WPB. Each mine operator was required to submit an itemized list of all such equipment held in inventory and to indicate which items he would be willing to sell or rent. On August 31, 1943, L-208 was further amended to permit disposition of equipment, without approval of the WPB, to persons holding certain preference ratings. The order, thus amended, remained in effect until revoked on June 30, 1945.

The Metals Reserve Office was established to encourage the maximum exploitation of the vital metals. This was accomplished through the issuance of contracts to mine lower grade ores at a reasonable profit than the fixed price for copper might make otherwise unprofitable. Phelps Dodge had such an agreement and mined low grade ores in the Sacramento, Junction and Campbell mines under this agreement until it was suspended in late 1944.

Time Magazine -Aug. 3, 1942

*The U.S. is producing a lot less copper this year than it could if the copper mines could keep their miners from drifting off to greener pastures: higher-pay West coast shipyards and factories. Don Nelson and the C.I.O. Mine, Mill & Smelters Union are agreed: high pay in war plants is playing hob with mining, just as it is playing hob with West Coast lumbering (TIME, June 29). ---*

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-----*In Arizona one shaft of Phelps Dodge's Bisbee mine is short 200 men out of 450*

## SLIDE 17

### SOLDIER MINERS COME TO BISBEE

BEGINNING IN 1942, NEARLY 900 FURLOUGHED SOLDIERS WERE ASSIGNED BY THE GOVERNMENT TO WORK IN THE MINES AT BISBEE, WITH VERY MIXED RESULTS. MORE OFTEN THAN NOT, THESE MEN HAD NO MINING EXPERIENCE AND SOME WERE LITTLE MORE THAN REJECTS OR MISFITS. IN 1943, OF THE 437 SOLDIERS ASSIGNED, ONLY 20 HAD ANY MINING EXPERIENCE. THESE WERE AMONG A FEW WHO DID MAKE A TRUE CONTRIBUTION. SOME OF THESE MEN WERE STILL WORKING HERE IN 1975 WHEN THE MINES CLOSED

WHILE MEN WERE DESPERATELY NEEDED IN MINES EVERYWHERE, THE PROGRAM WAS NOT HIGHLY REGARDED BY MANY OF THE MINE OPERATORS AS SKILLED MINERS AND MECHANICS MOVED TO OTHER VITAL INDUSTRIES AT HIGHER PAY AND WERE REPLACED BY SOLDIERS WITH LITTLE, IF ANY EXPERIENCE. THIS LOSS OF SKILLS WAS PAINFUL TO PD AS WELL



GRAEME LARKIN COLLECTION  
CARTOON LAMPOONING THE SOLDIER MINER  
PROGRAM - 1944

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Among the soldier miners assigned to Bisbee were a number of blacks. Historically, Bisbee had very few black residents and none in the mines as the opportunities for them were limited at best, given the temper of the times and the strong prejudice of the miners themselves against all of non-European descent. Indeed, in spite of the large Mexican population, few worked underground except for a small number employed by lessees. Mexican-Americans had long been employed in many surface positions. In any event, this changed for the better with the labor shortages brought about by the war, as soon many of Mexican descent were working underground.

As for the soldier miners, the assigned black soldiers at Bisbee only wanted to do what was needed of them and went to work. Unlike Butte (see below) Bisbee put these men to work underground as an isolated group in the small Uncle Sam mine without incident underground, but then there were no labor unions at Bisbee either. There were problems however, with some of the townsfolk's when these men went to the local restaurants and bars, as numerous Texans (as the *Bisbee Daily Review* called them) now in town demanded segregation, even killing one black soldier miner in a fight in a local bar.

(Time Magazine, 1942) *Among all the labor bigwigs who attended the C.I.O. convention this month in Boston, no man had more unpleasant news on his mind than Left Wing Communist-inclined Reid Robinson, president of the International Union of Mine, Mill and Smelter Workers. Coming up to Boston for a love feast with Phil Murray and the boys he ended up taking a trip across the continent in a U.S. Army bomber trying to quell mutiny among his own miners.*

*Cause of the hurried trip was the flat refusal of Mine, Mill and Smelter Workers Local No. 1 at Butte, Mont, to allow Negro workers down the shafts of Anaconda Copper. This was in grim defiance of C.I.O.'s strong pro-Negro policies. It was also in defiance of the U.S. Army, and of an Administration patently striving to promote amicable Negro-white relations among the labor forces of this country.*

*The rumpus at Butte goes back to last month when the Army furloughed 4,000 soldier miners in an effort to ease the terrific shortage of labor in the nonferrous mines. In Utah a few of the new recruits were turned down because of physical disabilities which the Army had passed but which would not stand up in the face of stiff health requirements of the Utah mines. But to Butte were assigned 30-odd physically healthy furloughed Negro soldiers who had only to meet the requirements of Mine, Mill and Smelter Workers Local No. 1—so old it is known as the "mother local"—headed by an old time, plain-spoken Irish miner, Jim Byrne.*

*Local No. 1's requirements proved stiffer than the army had expected. When the first 14 Negroes appeared at the pit, 100 miners on the night shift walked out but were urged back to work by the management. Subsequently the whole local refused to work as long as a single Negro was below ground. It was at that point that Mr. Robinson was called from Boston, arrived in Butte for a Sunday meeting held in the Fox Theater. Solemnly 1,700 miners listened to telegrams from Phil Murray, Paul McNutt, General Brehon Somervell. Solemnly they voted to stick by their guns.*

*This week the Anaconda copper mines were still open, though not operating at full capacity for want of labor. The Negroes were still in Butte, but all above ground. The C.I.O., the Army and the Administration were sputtering. Anaconda, for once no one's whipping boy, could say with Daniel M. Kelly, mine manager: "We're just on the sidelines in all this show." Said Mr. Byrne of Local No. 1: "We're going on the theory that this is still a democracy."*

**SLIDE 18**

**THE LOGISTICS OF HANDLING HUNDREDS OF TEMPORARY MINERS**

**GOOD OR BAD, THE SOLDIER MINERS NEEDED TO BE HOUSED AND FED. THIS WAS NO SMALL TASK AS BISBEE HAD LITTLE IN THE WAY OF EXCESS HOUSING AVAILABLE. IN 1942 SOME 200 TRAILERS WERE PLACED AND 59 HOUSES WERE CONSTRUCTED TO MEET THIS PRESSING NEED.**

**JOHNSON ADDITION NEAR THE JUNCTION MINE AND BAKERVILLE NEAR THE CAMPBELL MINE WERE CHOSEN AS THE SITES TO BUILD THE FACILITIES. EVEN WITH THIS, ADDITIONAL SPACE WAS NEEDED FOR THESE MEN. THE YMCA WAS TURNED INTO A DORMITORY AS WAS THE FORMER C&A OFFICE IN WARREN. CONTRACTS WERE LET WITH LOCAL RESTAURANTS TO FEED THIS LARGE MASS OF MEN WHO WERE WORKING THREE SHIFTS A DAY. THE LOCAL BARS DID THEIR BEST TO KEEP THE SOLDIER MINERS SUPPLIED WITH DRINK AS WELL**



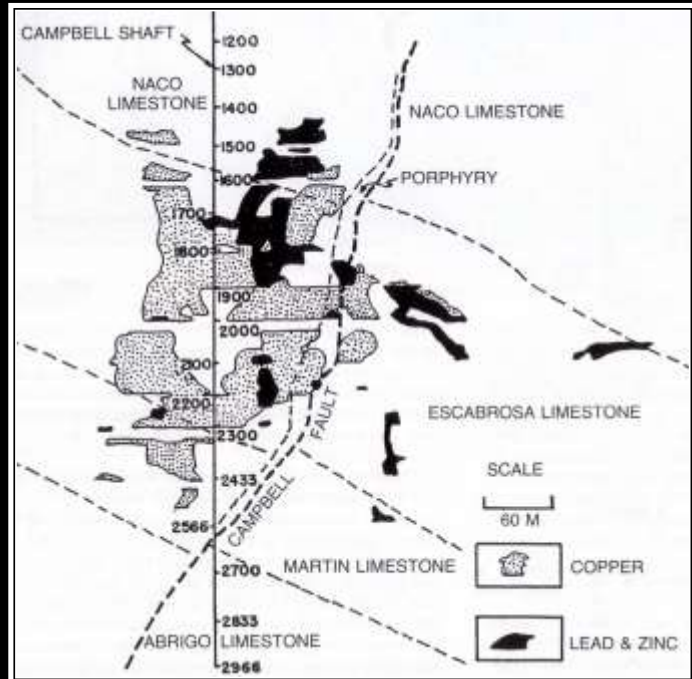
GRAEME LARKIN COLLECTION  
TRAILERS AND OTHER TEMPORARY HOUSING IN  
BAKERVILLE, NEAR THE CAMPBELL SHAFT  
1943

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## SLIDE 19

**LEAD AND ZINC BECAME MORE IMPORTANT THAN COPPER**  
**WITH THE END OF WAR CAME THE END OF THE HUGE DEMAND FOR COPPER.**  
**INDEED, WITH LARGE AMOUNTS OF ARTILLERY SHELL CASINGS BEING**  
**RETURNED FROM THE NOW QUITE BATTLEFIELDS, THERE WAS NOW A**  
**SURPLUS OF COPPER ON THE MARKET. FOR A WHILE, EVEN THE COPPER**  
**PENNY COINS WERE MADE OF OLD**  
**SHELL CASINGS. THE SURPLUS OF**  
**COPPER BEARING SCRAP**  
**NATURALLY REDUCED THE PRICE**  
**OF COPPER. THIS TRICKLED BACK**  
**TO THE MINES IN THE FORM OF**  
**REDUCED COPPER PRODUCTION.**

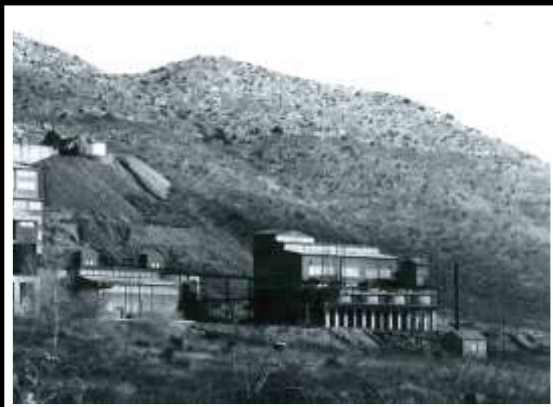
**HOWEVER, THE DEMAND FOR**  
**LEAD AND ZINC REMAINED HIGH.**  
**FORTUNATELY, LARGE RESERVES**  
**OF LEAD/ZINC SULFIDE ORES HAD**  
**BEEN DISCOVERED, PARTICULARLY**  
**IN THE CAMPBELL AND JUNCTION**  
**MINES AS WELL AS IN THE DENN .**  
**THESE METALS WOULD NOW**  
**BECOME VITALLY IMPORTANT TO**  
**BISBEE ~~~~~**



**CROSS SECTION OF THE CAMPBELL SHAFT SHOWING**  
**LEAD/ZINC ORES MINED**  
**AFTER HOGUE & WILSON - 1950**



## A CONCENTRATOR FOR LEAD/ZINC RECOVERY IS BUILT



GRAEME LARKIN COLLECTION  
LEAD/ ZINC CONCENTRATOR NEAR DON LUIS  
1946

**TOTAL COPPER PRODUCTION FOR THE DISTRICT IN 1946 WAS REDUCED TO THE LOWEST LEVELS IN MANY YEARS AS THE FOCUS SHIFTED TO LEAD/ZINC MINING INSTEAD.**

**THE SHATTUCK DENN MINING COMPANY WAS WELL PLACED FOR THIS CHANGE AS IT HAD**

**BEEN RECOVERING THESE METALS FOR SEVERAL YEARS, INCLUDING PROCESSING PD'S ORES. PD HAD TO PLAY CATCH-UP. IT HAD HISTORICALLY SENT RAW ORE TO CUSTOM PROCESSING PLANTS. MORE PROFIT WAS TO BE HAD IF PROCESSING WERE DONE IN A PLANT AT BISBEE.**

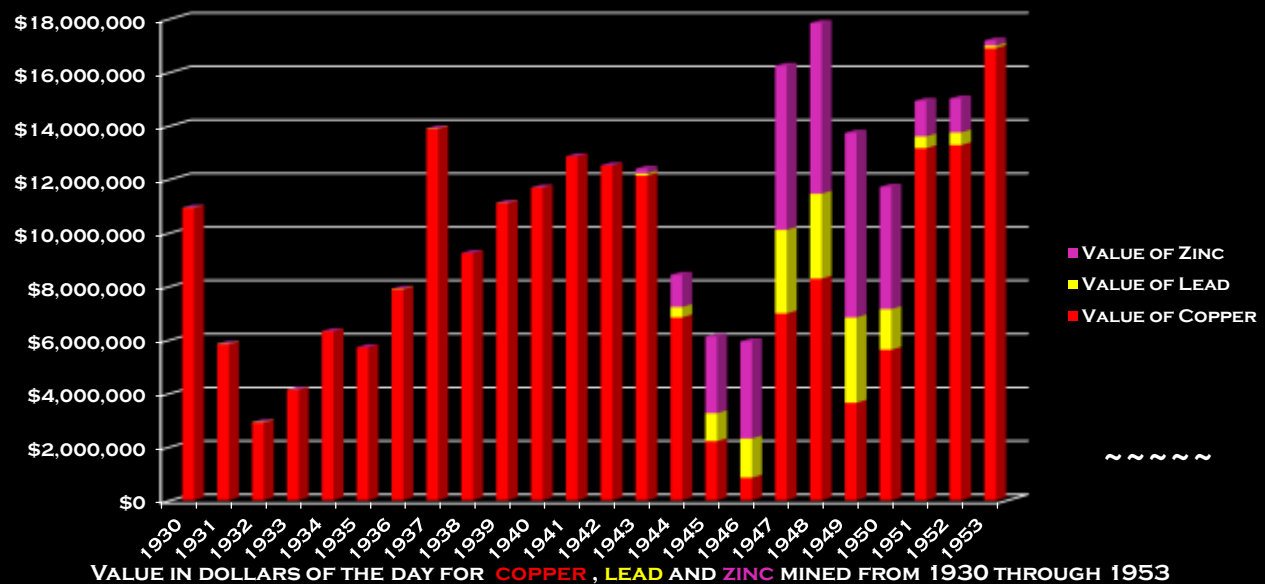
**IN 1945, A NEW, 400 TON PER DAY PLANT WAS BUILT NEAR THE SACRAMENTO CONCENTRATOR. THEN, IN 1947 IT WAS EXPANDED TO HANDLE 900 TONS PER DAY. THE EMPHASIS WAS NOW SQUARELY ON LEAD AND ZINC AND WOULD REMAIN SO FOR A WHILE EVEN THOUGH COPPER CONTINUED TO BE MINED AS WELL. BY 1950, COPPER WAS RECOVERING, BUT LEAD AND ZINC CONTINUED TO BE MINED THOUGH IN DIMINISHING QUANTITIES UNTIL 1953 WHEN SHIFTING METAL PRICES AGAIN CHANGED THE FOCUS TOTALLY BACK TO COPPER FOR GOOD**

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## SLIDE 21

### LEAD AND ZINC ADD SUBSTANTIALLY TO THE INCOME

THE IMPORTANCE OF BOTH LEAD AND ZINC TO BISBEE IN THE LATE 1940S CAN NOT BE OVERSTATED. WERE IT NOT FOR THE REVENUE RECEIVED FROM THESE TWO METALS, THE MINES WOULD SURELY HAVE BEEN CLOSED THIRTY YEARS BEFORE THEIR EVENTUAL END IN 1975. WHILE LEAD HAD LONG BEEN MINED AT BISBEE, IT WAS DECIDEDLY SUBORDINATE TO COPPER AND ZINC WAS NEVER TRULY IMPORTANT UNTIL 1943. NO LEAD OR ZINC WAS MINED AFTER 1953, THOUGH SUBSTANTIAL RESOURCES REMAIN IN PLACE



## SLIDE 22

### THE POST-WAR YEARS WERE ONES OF EXPANSION

**EVEN THOUGH COPPER PRICES WERE GLUM AFTER THE WAR, PD EXPANDED WITH THE HOPE OF A BETTER DAY, MUCH AS IT ALWAYS HAD. THE DENN MINE AND SURFACE FACILITIES WERE PURCHASED FROM THE SHATTUCK DENN MINING COMPANY IN 1947. ONCE AGAIN, PD WAS THE ONLY MINING COMPANY IN BISBEE. ALSO THAT YEAR, IT BEGAN TO REEQUIPPED THE DALLAS MINE TO THE HIGHEST OF STANDARDS , MAKING IT READY TO BECOME AN IMPORTANT PRODUCER. SOME 50 HOUSES WERE BUILT IN GALENA IN 1948/49, AS PLANNING BEGAN TO MINE THE EAST OREBODY BY OPEN PIT**



DENN MINE  
1958 (L)

DALLAS MINE  
1961 (R)

GRAEME  
LARKIN  
COLLECTION

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The Shattuck Denn generally had the ore they mined processed at the Phelps Dodge smelter in Douglas and because of the labor strike there, this was unable to be performed. Therefore, the Shattuck Denn had to completely shut down operations in Bisbee at the Denn Mine during March 1946 and ultimately the company would not reopen the site. However, on January 31, 1947, the company sent out a notice to their stockholders of a proposed sale of its Denn Mine properties in Bisbee to Phelps Dodge in the amount of \$300,000.00.<sup>1</sup> The sale of the property went through on March 8, 1947 and by April 1; Phelps Dodge had begun production in its newly acquired properties.<sup>2</sup> The Shattuck Denn Mining Corporation would retain their mill and repair shops in Bisbee.<sup>3</sup> However, by 1949 a recession had stuck the copper industry with the price of copper dropping from 23 cents to 18 cents.<sup>4</sup> The primary factor for the decline in price was attributed to an increase of “foreign produced copper,” and the domestic demand for the metal

<sup>1</sup> Norman E. LaMond, “Proxy Statement: Special Meeting of Stockholders March 7, 1947,” (New York: Shattuck Denn Mining Corporation, January 31, 1947), 1, 4.

<sup>2</sup> Mills, 65.

<sup>3</sup> “Shattuck Denn Mining Corporation: Annual Report for the year 1947,” (New York: Shattuck Denn Mining Corporation, 1947), 3.

<sup>4</sup> “Phelps Dodge Mill Closing,” *Nevada State Journal* (Reno, Nevada), 1 June 1949.

being quite low.<sup>5</sup> This dramatic reduction in the value of copper resulted in the Shattuck Denn having to discontinue its mill operation. With their primary source of income now closed, the company began to sell of their remaining properties in Bisbee and was nearly finished with the task by 1950.<sup>6</sup>

The above is excerpted from a research paper authored by Annie Graeme Larkin.

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<sup>5</sup> "Mining: Copper Industry Faces Trouble in All States," *Reno Evening Gazette* (Reno, Nevada), 4 August 1949; "Production of Copper at Mines Slashed as Demand Stays Low," *Wall Street Journal*, 6 June 1949.

<sup>6</sup> "Shattuck Denn Mining Corporation: Annual Report for the year 1950," (New York: Shattuck Denn Mining Corporation, 1950) 3.

## SLIDE 23

### A TRUCK/SHOVEL OPEN PIT MINE IS CONSIDERED

IT HAD ALWAYS BEEN REALIZED THAT THE SMALL SACRAMENTO OPEN PIT DID NOT REMOVE ALL OF THE MINERALIZED PORPHYRY/BRECCIA HOSTED ORES. PROPERTY OWNED BY THE C&A HAD BLOCKED ANY EXPANSION TO THE SOUTH AND EAST, WHILE COPPER GRADES, TOO LOW FOR THE COSTLY MINING METHODS OF THE TIME, PRECLUDED EXPANSION INTO QUEEN GROUND

THE PROPERTY PROBLEM WAS SOLVED BY THE MERGER AND THE AREA WAS REFERRED TO AS THE "EAST OREBODY," BUT IT WOULD BE A WHILE BEFORE THE COMBINATION OF MARKET CONDITIONS AND TECHNOLOGY WOULD MAKE THIS A TRUE OREBODY— SOMETHING WHICH COULD BE MINED AT A PROFIT —

THE OFTEN DRAMATIC FLUCTUATIONS IN THE COPPER PRICE ARGUED AGAINST MAKING THE SUBSTANTIAL INVESTMENT NEEDED TO DEVELOP THE TYPE OF MINE REQUIRED TO SUCCESSFULLY EXPLOIT THE EAST OREBODY, WITHOUT EVEN CONSIDERING THE MANY TECHNICAL RISKS FORTUITOUSLY, THE US GOVERNMENT WAS ANXIOUS TO AVOID SHORTAGES OF CRITICAL MATERIALS AT THIS SAME TIME AND COPPER WAS ON THE LIST. THUS, PURSUANT TO THE DEFENSE PRODUCTION ACT OF 1950, PD AND THE GOVERNMENT ENTERED INTO A PRICE PROTECTION TYPE OF AGREEMENT WITH A FLOOR AT 22¢ PER POUND OF COPPER. THIS AGREEMENT WAS NEVER TO BE USED AS METAL PRICES WERE ALWAYS TO BE ABOVE THE FLOOR PRICE

HOWEVER, THIS AGREEMENT GAVE PD THE COMFORT IT NEEDED TO GO AHEAD AND MAKE THE LARGEST SINGLE INVESTMENT IN ITS HISTORY, TO THAT TIME, —\$25 MILLION — AND DEVELOP THE EAST OREBODY AS A TRUCK/SHOVEL, OPEN PIT MINE ~~~~~

With the United States Military involvement in the Korean War, the government "took steps to increase domestic copper production." Under President Harry Truman, the Defense Production Administration (DPA) was formed with the duty of accelerating "arms production and [regulating] its impact on the civilian economy."<sup>7</sup> The agency would control "such raw materials as petroleum, solid fuels, power, minerals and metals." Before the creation of the DPA, numerous bureaus of the government controlled these areas, but now the new administration would oversee them all. The DPA would also go on to supervise other government agencies such as the National Production Authority (NPA).<sup>8</sup>

Much like during World War II, the government realized the crucial role copper played in war related materials. Therefore, one of the objectives of the DPA was to boost the nation's output of strategic metals. One such tactic was to offer mining companies incentives like "accelerated tax amortization[s]" for the development of such things as "new mines, mills,

<sup>7</sup> Leaming, 25; "Overall Setup for Controls is Established," *Washington Post*, 4 January 1951.

<sup>8</sup> "Forms Agency to Rule Over Output in U.S.," *Chicago Daily Tribune*, 4 January 1951; "Truman Combines Production Offices," *Los Angeles Times*, 4 January 1951; "Wilson Heads Super-Defense Organization," *Washington Post*, 15 December 1950.

smelters and refineries.”<sup>9</sup> Understandably, those in the mining industry were enticed by the government’s offers of fast tax write-offs to begin new projects.

Phelps Dodge was among the mining companies who found the government’s proposal quite attractive. As early as December 1950, even before the DPA became an official agency of the government, newspapers stated that Phelps Dodge was going to begin a new open pit mine in Bisbee “if negotiations with the federal government [were] completed.”<sup>10</sup> In the meantime, Phelps Dodge began excavation in the area known as the Bisbee East ore body. This was the area in which the company hoped to create the open pit mine to extract the low grade ore which was present beneath the soil.<sup>11</sup> During this period test drilling and engineering studies were performed. Additionally, preliminary plans were developed for such necessities as the dump site, a concentrator, personnel and pit shops.<sup>12</sup> Moreover, the company looked toward other items it would need for the project such as the “acquisition of drilling equipment, electric shovels and haulage equipment.”<sup>13</sup>

The above is excerpted from a research paper authored by Annie Graeme Larkin.

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<sup>9</sup> “Nevada Mining Firms Benefit by Tax Setup,” *Nevada State Journal* (Reno, Nevada), 29 August 1951.

<sup>10</sup> “Phelps Dodge Plans New Mine Operation,” *Los Angeles Times*, 7 December 1950; “New Mine,” *Reno Evening Gazette*, 6 December 1950.

<sup>11</sup> “Phelps Dodge May Develop Copper Mine Near Bisbee, Arizona,” *Wall Street Journal*, 7 December 1950; “Investors’ Guide: Phelps Dodge,” *Chicago Tribune*, 22 December 1950.

<sup>12</sup> “Phelps Dodge May Develop Copper Mine Near Bisbee, Arizona,” *Wall Street Journal*, 7 December 1950; Mills, 72.

<sup>13</sup> “Phelps Dodge Drilling New Ore Body,” *Mining Record*, 4 January 1951. This article is from Graeme-Larkin collection scrap book. The page number of this article is unavailable.



## **SLIDE 24**

### **THE TECHNICAL CHALLENGES WERE DAUNTING**

**MOST LARGE OPEN PIT COPPER MINES OF THE DAY WERE RAIL/SHOVEL OPERATIONS SUCH AS MORENCI, AJO, BINGHAM CANYON, BUT FEW TRUCK/SHOVEL MINES WERE AROUND. PD HAD MODEST SUCCESS AT JEROME WITH TRUCKS IN THAT TINY OPEN PIT AND TRUCKS HAD BEEN USED TO HELP DEVELOP MORENCI, BUT THEY HAD BEEN REPLACED BY RAIL HAULAGE**

**A DECISION WAS TAKEN TO TRY TRUCKS AT BISBEE AS THE ORES WERE CONFINED IN SUCH A WAY THAT THE EXIT RAMPS WOULD BE FAR TOO STEEP FOR RAIL USE. RAIL RAMPS CAN NOT EXCEED  $2\frac{1}{2}\%$ ; TRUCKS CAN HANDLE RAMPS UP TO 10%, A HUGE DIFFERENCE BECAUSE THE PIT CAN BE SMALLER, THEREBY REDUCING THE AMOUNT OF WASTE ROCK TO BE MINED**

**HOWEVER, THE LARGEST TRUCK AVAILABLE HELD ONLY 25 TONS AND THE DISTANT, #7 DUMP HAD TO BE USED FOR WASTE DISPOSAL. THIS WOULD BE A HORRIBLY LONG, INEFFICIENT AND EXPENSIVE TRUCK HAUL. RAIL WAS CHEAPER FOR LONG HAULS, SO, A TRUCK/TRAIN TRANSFER POINT WAS TO BE ESTABLISHED ON THE PIT EDGE WHERE HAUL TRUCKS, LOADED WITH WASTE, WOULD DUMP INTO 43 CUBIC YARD, SIDE DUMP, RAIL CARS. THESE WOULD BE PULLED BY ONE OF TWO 1,200 HP DIESEL LOCOMOTIVES TO THE DISTANT DUMP FOR EMPTYING. ONLY 27 TRUCKS WOULD NOW BE NEEDED**

**ELECTRIC SHOVELS WITH SIX CUBIC YARD CAPACITY BUCKETS WOULD BE THE LOADING UNITS AND FIVE OF THESE WOULD BE REQUIRED.**

**ROTARY DRILLS AND CHURN DRILLS, ALREADY ON HAND, WOULD BE USED FOR BLAST HOLES. ADD SEVEN BULLDOZERS ALONG WITH A FEW OTHER THINGS AND THE EQUIPMENT SPREAD WAS COMPLETE ~~~~~**

### **MORE THAN HALF OF LOWELL MUST BE MOVED**

**THE HIGHWAY BETWEEN BISBEE AND LOWELL WAS A PROBLEM AS WAS THE RAIL LINE TO BISBEE. THE RAIL COULD BE ABANDONED, BUT THE HIGHWAY NEEDED TO BE REROUTED. ALSO, MORE THAN 250 PRIVATE RESIDENCES AND 20 BUSINESSES HAD TO BE RELOCATED BEFORE MINING COULD BEGIN. THIS, IN ITSELF, WAS A SERIOUS CHALLENGE. A NEW AREA CALLED "SAGINAW" AND OPEN AREAS IN BAKERVILLE WERE DEVELOPED TO RECEIVE MANY OF THE RELOCATED HOMES . THE FIRST ARRIVED IN LATE 1950**

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GRAEME LARKIN COLLECTION

THE RELOCATION OF PRIVATE HOMES FROM THE LOWELL AREA TO SAGINAW - 1951



Moving of houses from Johnson Addition in 1951. Note the electric shovel loading a haul truck in the background



**A PART OF LOWELL IN 1927, WHICH WAS MORE OR LESS ITS PEAK IN TERMS OF POPULATION, THE JUNCTION MINE IS AT THE CENTER, BUT OTHER NEARBY MINES WERE ALSO WHERE MANY OF THE RESIDENTS WORKED.**

**GRAEME LARKIN COLLECTION**



**THE SAME VIEW OF LOWELL SOME 30 YEARS LATER IN 1957. WHILE MANY MEN REPORTED FOR WORK HERE IN THE JUNCTION MINE, LAVENDER PIT, THE RELATED SHOPS OR THE CONCENTRATOR, FEW LIVED HERE.**

**GRAEME LARKIN COLLECTION**

## SLIDE 26

### EARTH MOVING STARTS WITH THE FIRST BLAST

ONCE THE MOVING OF HOMES AND BUSINESSES WAS COMPLETE, MORE THAN 46 MILLION TONS OF WASTE HAD TO BE REMOVED TO EXPOSE THE ORE, READY THE CONSTRUCTION SITE FOR THE MILL AND RELATED FACILITIES AS WELL AS FOR THE RELOCATION OF THE HIGHWAY. THIS ALL BEGAN IN LATE 1951 WITH THE FIRST BLAST IN WHAT ONCE WAS THE JOHNSON ADDITION SECTION OF LOWELL. TRUCKS AND SHOVEL SOON MOVED IN AND THUS BEGAN A PROCESS WHICH WOULD LAST A BIT MORE THAN 23 YEARS

FIRST BLAST IN  
WHAT BECAME  
THE LAVENDER PIT  
1951  
GRAEME LARKIN  
COLLECTION

~~~~~



**SLIDE 27**

**A NEW PROCESSING PLANT WAS BUILT**

**TO PROCESS THE ORES FROM THE PIT, A TYPICAL COPPER, FROTH FLOTATION PLANT WAS CONSTRUCTED . ORE FROM THE PIT WAS FIRST CRUSHED AND GROUND, THEN, WITH ADDED REAGENTS, THE COPPER BEARING PARTICLES, FLOATED TO THE TOP AND WERE RECOVERED. THE COPPER CONCENTRATE WAS THICKENED IN LARGE TANKS, DRIED, THEN LOADED BY CONVEYOR INTO RAIL CARS FOR SHIPMENT TO THE SMELTER IN DOUGLAS. TAILINGS WERE ALSO THICKENED TO RECOVER WATER FOR REUSE AND THEN MOVED, BY GRAVITY ,IN A PIPE MORE THAN THREE MILES TO THE TAILINGS DISPOSAL AREA USED BY BOTH OF THE EARLIER CONCENTRATORS.**



**CONCENTRATOR - 1954 (ABOVE)  
PRIMARY CRUSHER AND CONVEYOR  
UNDER CONSTRUCTION -1952  
(RIGHT)  
GRAEME LARKIN COLLECTION**



## BISBEE'S PORPHYRY ORES ARE DIFFICULT TO CONCENTRATE

BOTH THE EXPERIENCE FROM THE SAC CONCENTRATOR AND RECENT TEST WORK CONFIRMED THAT THAT THE ORES FROM THE OPEN PIT WOULD NOT MAKE A CLEAN, HIGH-GRADE CONCENTRATE. THE COPPER MINERALS WERE SO INTERMIXED WITH WORTHLESS PYRITE, THAT THE CONCENTRATE WOULD CONTAIN A GOOD DEAL OF PYRITE AND THEREFORE, SELDOM EXCEED 16% COPPER. IT WAS NOT UNCOMMON FOR SUCH A PLANT, WITH DIFFERENT ORES, TO PRODUCE CONCENTRATES IN EXCESS OF 25% COPPER. THIS ADDED TRANSPORT AND SMELTING OF LOWER GRADE CONS, MEANT A SIGNIFICANT BURDEN IN BOTH TRANSPORTATION AND SMELTING COSTS.

THE DOUGLAS SMELTER WAS EXPANDED IN 1953/54 TO ACCOMMODATE THE ADDITIONAL, HIGH PYRITE CONCENTRATE WHICH WOULD SOON COME FROM BISBEE'S NEWEST MINE AS WELL AS THE INCREASED TONNAGES OF DIRECT SMELT ORES FROM THE EXPANDING UNDERGROUND MINES

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GRAEME LARKIN COLLECTION  
DOUGLAS, ARIZONA SMELTER OF PHELPS DODGE  
c - 1957

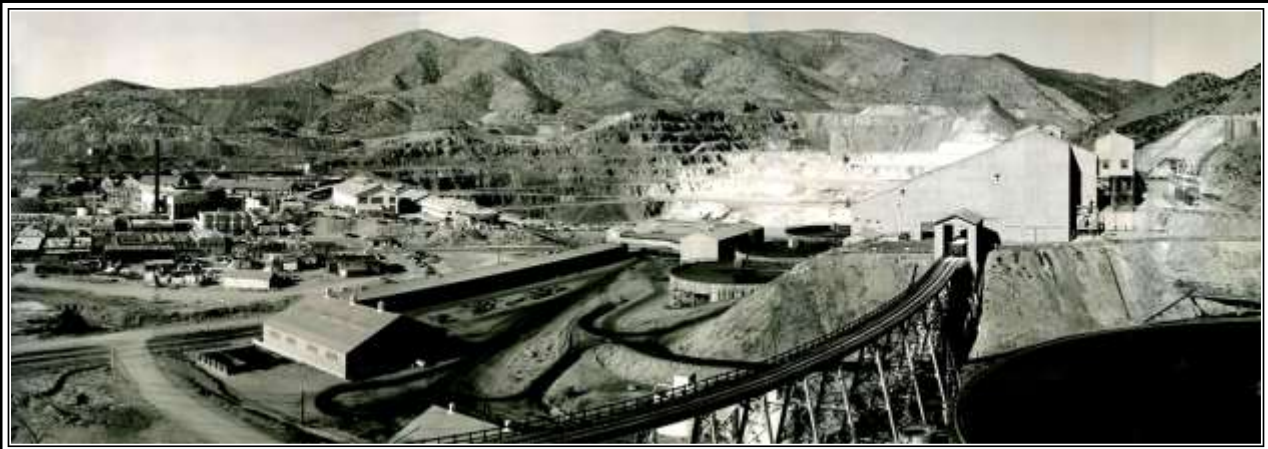


**SLIDE 29**

**THE COMPLETED WORKS WERE IMPRESSIVE**

**IN 1952, HARRISON LAVENDER, GENERAL MANAGER OF OPERATIONS FOR PD AND THE DRIVING FORCE BEHIND THE DEVELOPMENT OF THIS PROJECT DIED. APPROPRIATELY, THE MINE WAS NAMED IN HIS HONOR WHEN DEDICATED IN 1954 AS THE FIRST ORE WAS PROCESSED IN THE GLEAMING PLANT, SITTING ON THE PITS EDGE. HARRISON WOULD UNDOUBTEDLY HAVE BEEN PLEASED WITH THE OUTCOME OF THIS MASSIVE PROJECT AS IT FIRST MET, THEN EXCEEDED THE HOPES OF THOSE WHO DESIGNED IT SO WELL.**

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**LAVENDER PIT MINE AND CONCENTRATOR - 1957**

GRAEME LARKIN COLLECTION

**SLIDE 30**

**TYPICAL OPERATION OF THE EARLY LAVENDER PIT**

**ELECTRIC SHOVELS WITH 6 CUBIC YARD BUCKETS LOAD 25 TON CAPACITY HAUL TRUCKS WITH ORE (LOWER LEFT) FOR TRANSPORT TO THE CRUSHER AND WITH WASTE (CENTER) FOR TRANSPORT TO THE TRUCK/TRAIN TRANSFER DOCK ON THE EAST EDGE OF THE PIT FOR TRAIN TRANSPORT TO NUMBER 7 DUMP AND DISPOSAL. ELECTRIC POWERED, ROTARY DRILLS ON THE BENCHES ABOVE ARE DRILLING 8" DIAMETER BLAST HOLES. WATER SPRAYS AT THE SHOVELS WERE USED TO REDUCE DUST DURING MINING.**

**C -1955**

**~~~~~**

**GRAEME LARKIN COLLECTION**



**SLIDE 31**

**ORE WENT TO THE CRUSHER AND NON-ORE TO # 7 DUMP**

**ON AN AVERAGE DAY, 16,000 TO 18,000 TONS OF ORE WERE CRUSHED AND SENT TO THE MILL FOR PROCESSING AND MORE THAN 30,000 TONS OF NON-MINERAL OR LEACH MATERIAL WERE SENT BY TRAIN TO THE NUMBER 7 DUMP FOR COPPER RECOVERY BY LEACHING OR FOR ULTIMATE DISPOSAL**



**25 TON TRUCK DUMPING INTO THE  
PRIMARY CRUSHER - 1955 (LEFT)**

**RAILCARS DUMPING NON-MINERAL  
MATERIAL ON THE NORTH SIDE OF  
NUMBER 7 DUMP - 1960 (ABOVE)**

**GRAEME LARKIN COLLECTION**

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## SLIDE 32

**BLASTING IN THE LAVENDER PIT WAS A DAILY OCCURRENCE  
AT ABOUT 3:15 PM THERE WAS A BLAST IN THE PIT AS NEARLY 70,000  
TONS HAD TO BE BROKEN EVERYDAY . IT WAS RITUALISTIC TO STOP AND  
WATCH THIS IMPRESSIVE DISPLAY ENERGY FROM THE LOOKOUT ~~~~~**



GRAEME LARKIN COLLECTION

UNCOMMON, DOUBLE BLAST ON THE EAST PIT WALL DURING THE CUT BACK PHASE - 1965

Every day the open pit worked there was one or more blast in the mine, always at 3:15 PM. The local residents seemed to never tire of seeing the spectacle of these blast and many went to the pit lookout point to watch. The ground would shake and a muffled roar would quickly follow.

I am convinced that had a mild earthquake hit Bisbee at close to the blasting time, no one would have noticed, as we had become so accustomed to the ground lightly shaking from the blast.

Bench shots or primary blast, as shown above, were the larger blast type and typically broke between 30,000 and 50,000 tons of material. It was also common to have hard toes in the shovel digging pits as well as large boulders that needed to be broken before going to the crusher. These were drilled with small, mobile drills and shot at the same hour but usually independent of the bench shots. Because the secondary blasts were less constrained, they made much more noise than the substantially more powerful primary blasts.

Once the drilling and blasting foreman had inspected the area to assure that all explosives had indeed been blasted, he would sound the "All Clear" and the night shift would come into the pit to move the equipment back into place and start mining.



**SLIDE 33**

**THE LAVENDER PIT AS A MATURE OPERATION**

**BY THE LATE 1960S, LARGE EARTH MOVING EQUIPMENT HAD EVOLVED SUBSTANTIALLY AND THESE CHANGES WERE REFLECTED IN THE MINING FLEET AT BISBEE. THE OLD 25 TON TRUCKS WERE REPLACED BY 65 TON CAPACITY UNITS AND 9 CUBIC YARD SHOVELS ADDED TO LOAD THE LARGER TRUCKS QUICKER. BLAST HOLE DRILLS (UPPER RIGHT) WERE NOW DRILLING 10" HOLES. MINED NON-MINERAL (CENTER LEFT) WAS NOW TRANSPORTED BY TRUCK TO NUMBER 7 DUMP, REPLACING THE RAIL SYSTEM. ORE MINED (LOWER CENTER) WAS STILL TAKEN DIRECTLY TO THE CRUSHER - 1966**



GRAEME LARKIN COLLECTION



Loading ore into a 65 ton capacity truck using a nine cubic yard shovel - 1963.

Graeme Larkin collection

## SLIDE 34

### A CUT BACK IS MADE TO THE EAST

IN 1963, A CUT BACK WAS INITIATED ON THE EAST SIDE OF THE PIT WHICH REQUIRED THE RELOCATION OF THE PIT SHOPS AS WELL AS SEVERAL OF THE JUNCTION MINE SHOPS. THIS WAS TO BE THE ONLY EXPANSION IN THIS DIRECTION EVEN THOUGH THE MINERALIZATION CONTINUED TO THE EAST AND UNDER THE POST-ORE CONGLOMERATE. THE OVERBURDEN BECAME TOO THICK TO JUSTIFY ANY ADDITIONAL REMOVAL . IT WAS SIMPLY NOT ECONOMIC TO GO ANY WIDER OR DEEPER

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GRAEME LARKIN COLLECTION  
DEMOLITION OF THE JUNCTION MINE  
SHEET METAL (TIN) SHOP - 1963



GRAEME LARKIN COLLECTION  
LAVENDER PIT FINAL EAST WALL SHOWING THE  
ORE/NON-MINERAL CONTACT - 1975



## SLIDE 35

### NEXT, A WESTERN EXTENSION IS ADDED TO THE PIT

DURING THE EARLY 1960s, SURFACE EXPLORATION OF THE AREA WEST OF THE PIT SHOWED THAT SUBSTANTIAL RESOURCES OF OPEN PIT GRADE WERE PRESENT. ACCESS WAS MADE TO OLD 400 LEVEL GARDNER WORKINGS TO TAKE BULK SAMPLES FOR TESTING. THE RESULTS WERE ENCOURAGING AND AN EXTENSION WAS PLANNED TO INCLUDE PART OF THE AREA PREVIOUSLY MINED BY THE HOLBROOK MINE YEARS BEFORE. FIRST, THE OLD SAC PIT HAD TO BE EMPTIED AS IT HAD BEEN FILLED IN 1952 WITH OVERBURDEN FROM THE EARLY STRIPPING FOR THE NEW PIT.

THIS EXPANSION BEGAN IN 1967 AND ADDED MORE THAN 2 YEARS TO THE LIFE OF THE PIT. THE ORES WERE LARGELY FROM THE CONTACT BRECCIA ZONE AT THE LIMESTONE - INTRUSION INTERFACE. SOME LIMESTONE HOSTED ORES WERE MINED AS WELL FROM WHICH MANY FINE MINERAL SPECIMENS WERE RECOVERED IN LATE 1969 AND UNTIL 1972. IN 1973, AN ADIT WAS DRIVEN INTO THE REMNANT OF SAC HILL TO MINE ISOLATED HIGH- GRADE POCKETS IDENTIFIED BY DRILLING MANY YEARS BEFORE.

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GRAEME LARKIN COLLECTION  
HOLBROOK EXTENSION - 1975

## SLIDE 36

### THE LAVENDER PIT CLOSES AT THE END OF 1974

BY THE END OF 1974, THE LAVENDER PIT HAD BEEN ESSENTIALLY EXHAUSTED. THE ACCESS HAUL ROAD ZIGZAGGED DOWN THE 900 FOOT PLUS DEEP HOLE TO THE VERY NARROW BOTTOM. THERE WAS NO ROOM LEFT TO OPERATE THE LARGE EQUIPMENT. IN DECEMBER 1974, IT WAS CLOSED AFTER MINING 376,000,000 TOTAL TONS MADE OF 94, 400,000 TONS OF ORE AND 281,600,000 TONS OF WASTE OR LOW-GRADE DURING ITS 23 YEARS OF LIFE

THE MINERALIZED PORPHYRY EXTENDED TO THE EAST AND UNDER LOWELL, BUT THE OVERLYING WASTE WAS FAR TOO THICK TO JUSTIFY REMOVAL. THE COSTS TO EXPAND WERE PROHIBITIVE, PARTICULARLY WITH THE RELATIVELY LOW COPPER PRICE OF THE DAY. THE MINE COULD NOT EXPAND AGAIN, THUS IT WAS FORCED TO CLOSE

~~~~~



PETER KRESEN PHOTO, GRAEME LARKIN COLLECTION  
LAVENDER PIT - 1974

## SLIDE 37

### LEACHING OF LOW-GRADE FROM THE PIT WAS IMPORTANT

ALONG WITH THE NON-MINERAL MATERIAL FROM THE PIT, MILLIONS OF TONS OF LOW-GRADE MATERIAL WERE TAKEN TO NUMBER 7 DUMP FOR LEACHING. THE LEACH MATERIAL WAS SEGREGATED AND PLACED ON THE SOUTHERN AND EASTERN PARTS OF THE DUMP. NON-MINERAL MATERIAL WAS PLACED ON THE NORTH PART OF THE DUMP. MORE THAN HALF OF THE DUMP WAS DEDICATED TO LEACH MATERIAL AND COPPER RECOVERY. LEACH SOLUTIONS WERE RECOVERED AT THE EAST END AND PUMPED TO THE PRECIPITATION PLANT NEAR THE CAMPBELL MINE FOR COPPER RECOVERY USING SCRAP IRON FOR PRECIPITATION. MANY MILLIONS OF POUNDS OF COPPER WERE RECOVERED OVER THE MORE THAN 50 YEARS THIS DUMP WOULD BE TREATED ~~~~~



GRAEME LARKIN COLLECTION

NUMBER 7 DUMP WITH LEACH PONDS ON THE RIGHT (SOUTH) SIDE OF THE DUMP - 1967

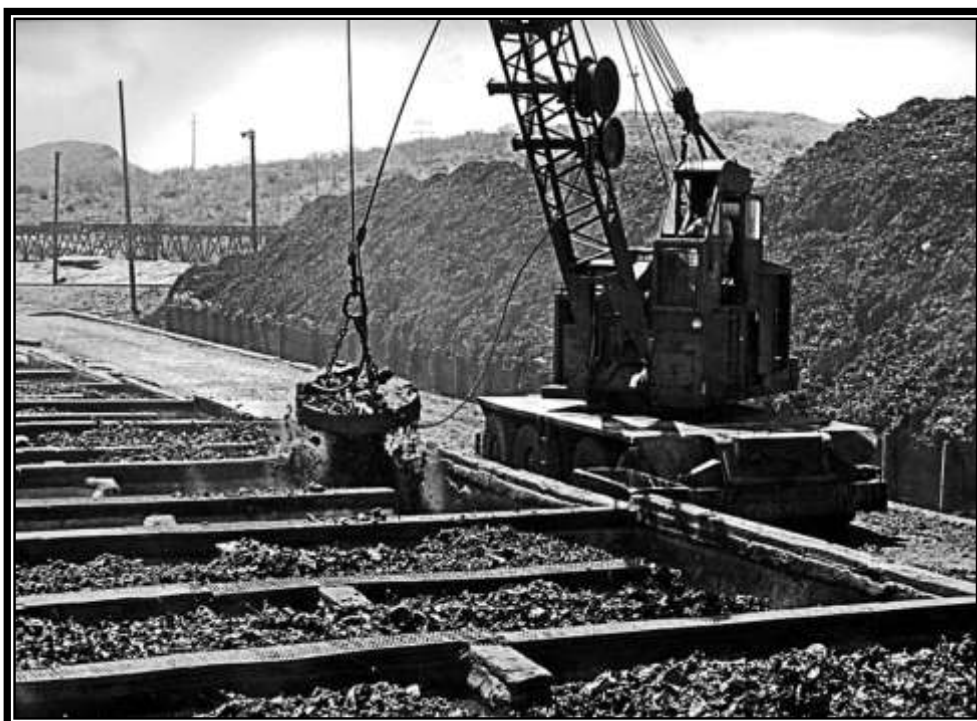
Just as much copper had been recovered for the Sacramento pit low-grade sent to Number seven dump, so would a great deal be recovered from the Lavender pit material sent here. This time, it would be done a bit smarter. The mineralized material was separated from the straight, non-mineral material. It was placed in distinct lifts and leached by building ponds to contain the leach solutions and, hopefully, distribute them more or less evenly through the rock as they worked their way down.

Each lift was leached for as long as possible and, in fact it would be leached even more when the next lift on top of it would be placed under leach and the solutions percolated downward passing through the whole pile on the way to the bottom. Periodic ripping would enhance solution penetration and on several occasions, deep holes were drilled to channelize the water to dry areas.

Leaching would last for many years after the last tons were placed. This is a slow, but steady process, one which recovers that resource which is otherwise unrecoverable and lost.



Precipitation cells at the Campbell plant loaded with heavy iron and steel. These were the first cells where the pregnant leach solutions were introduced and the solutions were the strongest to attack and replace the heavy metal. Lighter scrap, such as cans, were in the later cells as thin metal was more quickly replaced.



Loading thin scrap iron, largely cans, into precipitation cells with a crane mounted electromagnet at the Campbell plant



## SLIDE 38

### UNDERGROUND MINING REMAINED IMPORTANT

THE 1950S WERE A PERIOD OF CONTINUED MODERNIZATION AND A DEEPENING OF THE MINES. AS MINING PROGRESSED EASTWARD, THE ORES BECAME DEEPER AND DEEPER. THE DENN SHAFT WAS THE FIRST TO BE SANK TO THE 3100 LEVEL. A CONNECTION WAS MADE WITH THE 2966 LEVEL OF THE CAMPBELL MINE THROUGH AN INTERIOR SHAFT. HOWEVER, IN SPITE OF EXTENSIVE DRIFTING AND DIAMOND DRILLING, ONLY MODEST AMOUNTS OF ORE WERE FOUND.

THE CAMPBELL WAS DEEPEMED TO 3300 FEET IN THE MID 1960S WITH GOOD ORE FOUND ON THE 3100 LEVEL AND A BIT BELOW WITH SMALLER AMOUNTS ON THE BOTTOM LEVEL. A LONG, HOT AND VERY WET EXPLORATION HEADING, 15XC, WAS DRIVEN TOWARD THE PORPHYRY AREA ON THE 3100 LEVEL AND SUBSTANTIAL DRILLING UNDERTAKEN IN THE EARLY 1970S. THIS DEMONSTRATED THE CONTINUANCE OF PORPHYRY STYLE MINERALIZATION , BUT NO NEW ORES WHICH COULD BE MINED ECONOMICALLY BY UNDERGROUND METHODS WERE DISCOVERED IN THIS LAST EXTRAORDINARY EFFORT ~~~~~



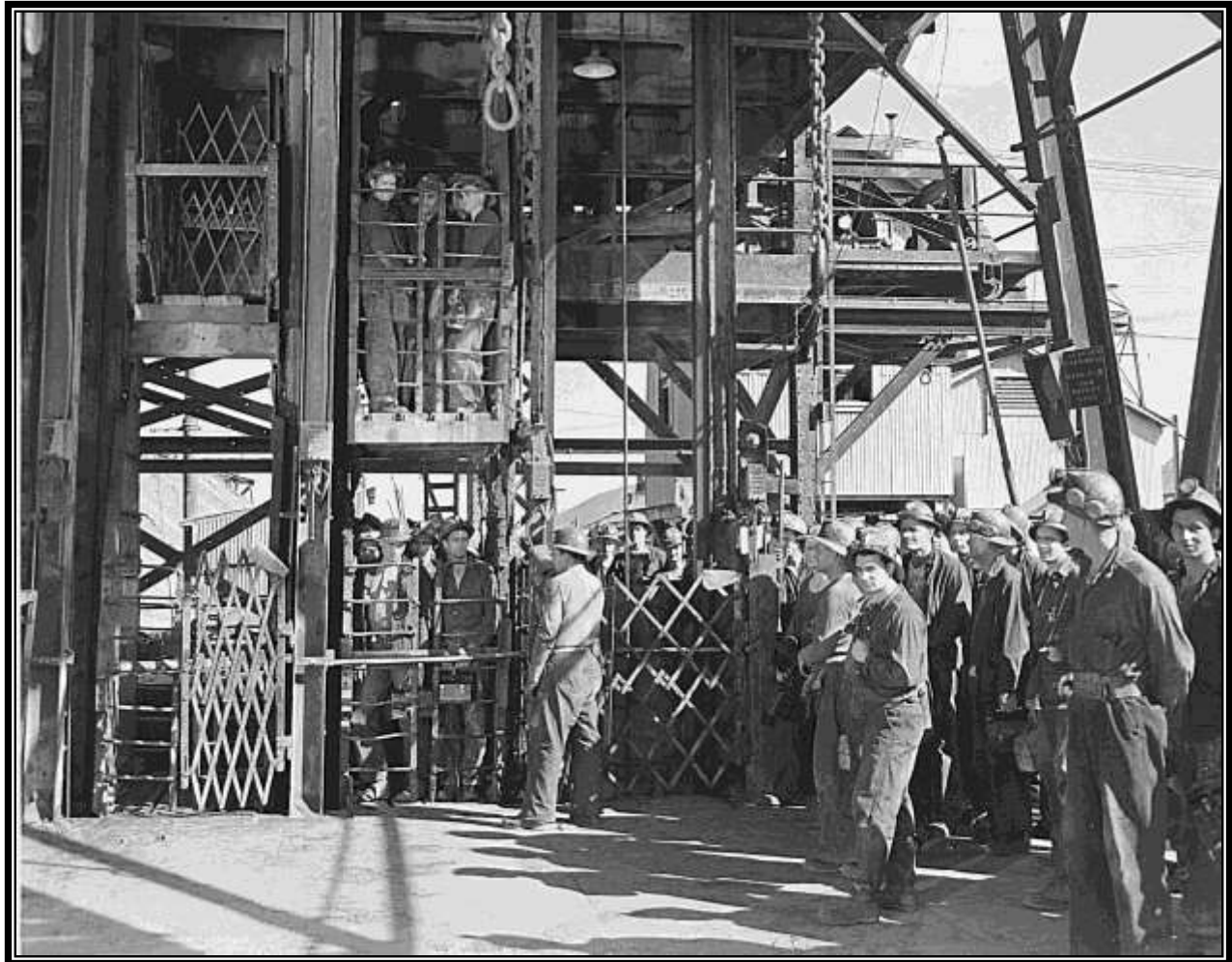
GRAEME LARKIN COLLECTION  
CAMPBELL INTERIOR SHAFT 2966 LEVEL  
1962

Phelps Dodge spent huge amounts of money looking for extensions of the ores at Bisbee. No reasonable geologic theory went untested, but the ores here were always difficult to find. In truth, the best geologic minds recognized that simple luck often played more of a role in finding the ore than scientific theory.

When the deeper levels were developed the ore continued, but in diminishing amounts as the distance to the source in the Sacramento complex increased. Even though the opening of the 3100 level in the Denn was met with only modest success, the Campbell was sank to this depth. Good ore in substantial amounts were found between the 2966 level and the 3100 level. Lesser amounts were found below the 3100 as the shaft was further deepened to 3332 feet and the bottom level was the 3300.

On the 3100 level, 15 XC was used to explore the Sacramento porphyry/breccia complex at depth. It was a long; very hot walk to the face of this working in flowing water more than a foot deep. At the final face, extensive diamond drilling was undertaken with holes more than 1000 feet long pushed out under the pit area to test the nature of the mineralization at this depth. Typical porphyry copper type mineralization was found, but the hoped for high grade contact

breccia mineralization which had been so common in the upper parts of the system, had not developed at these depths. This possibility was well understood before the project began, but the risk was taken.



The afternoon shift being lowered at the Junction Shaft, 1953



**SLIDE 39**

**PROSPECTING FOR NEW ORE WAS A CONTINUAL PROCESS**

**TO SECURE A FUTURE, IT WAS ALWAYS VITAL TO FIND ENOUGH NEW ORE TO REPLACE THE ORE TONS MINED, EVERY YEAR, IF NOT MORE. WITHOUT THIS EFFORT, THE MINES WOULD SOON CLOSE BECAUSE OF A LACK OF ORE.**

**FINDING ORE IN THE UNDERGROUND AT BISBEE WAS NEVER EASY. SELDOM WAS THERE EVER MORE THAN TWO YEARS OF PROVEN ORE ON THE BOOKS. THUS, A CONTINUAL PROSPECTING PROGRAM WAS ABSOLUTELY ESSENTIAL.**

**BY 1930, PROSPECTING WITH DIAMOND DRILLING HAD REPLACED DRIFTING AND RAISES AS THE PRINCIPAL TECHNIQUE OF LOOKING FOR NEW ORE. THIS WAS A MUCH FASTER AND FAR CHEAPER METHOD, BUT A NUMBER WERE NEEDED. BETWEEN 100,000 AND 300,000 FEET WERE DRILLED ANNUALLY REQUIRING AND AVERAGE OF 14 COMPANY OPERATED DRILLS WITH THE OCCASIONAL ASSISTANCE OF CONTRACT DRILLING COMPANIES ~~~~~**



**PETE KRESAN PHOTO  
DIAMOND DRILLING ON THE 2833 LEVEL OF  
THE CAMPBELL MINE - 1974**

## SLIDE 40

### THE JUNCTION MINE IS CLOSED IN 1958

**AFTER MORE THAN 50 YEARS OF OPERATION, THE JUNCTION IS CLOSED AS MINING MOVES TO THE DEEPER ORES TO THE EAST. THE REMAINING ORES IN THE JUNCTION AREA WERE MINED FROM THE CAMPBELL. HOWEVER, THE MINE FACILITIES AND SHOPS CONTINUED TO BE USED UNTIL THE END. THE SHAFT WAS MAINTAINED IN GOOD CONDITION BECAUSE THIS WONDERFUL MINE WAS THE PRINCIPAL PUMPING SHAFT FOR THE DISTRICT . BOTH THE PIT AND MILL DEPENDED ON THIS WATER**



GRAEME LARKIN COLLECTION  
JUNCTION MINE YARD -1967



GRAEME LARKIN COLLECTION  
THE LARGE, JUNCTION SKIP HOIST FOR  
COMPARTMENTS 3 & 4 - 1963

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The Junction mine yard was the center of the maintenance and support facilities for the whole of the operations. It was here that all of the shops were located --- the assay office, electric shop, rock drill repair shop, machine shop, tin shop, pipe shop, rope shop, boiler shop, welding shop, blacksmith shop, carpenter shop, the sawmill and timber framing shop were all here as were the pit shops for truck, shovel and machine maintenance. The central warehouse was here too. So was the safety department with its training center which saw men in and out every day.

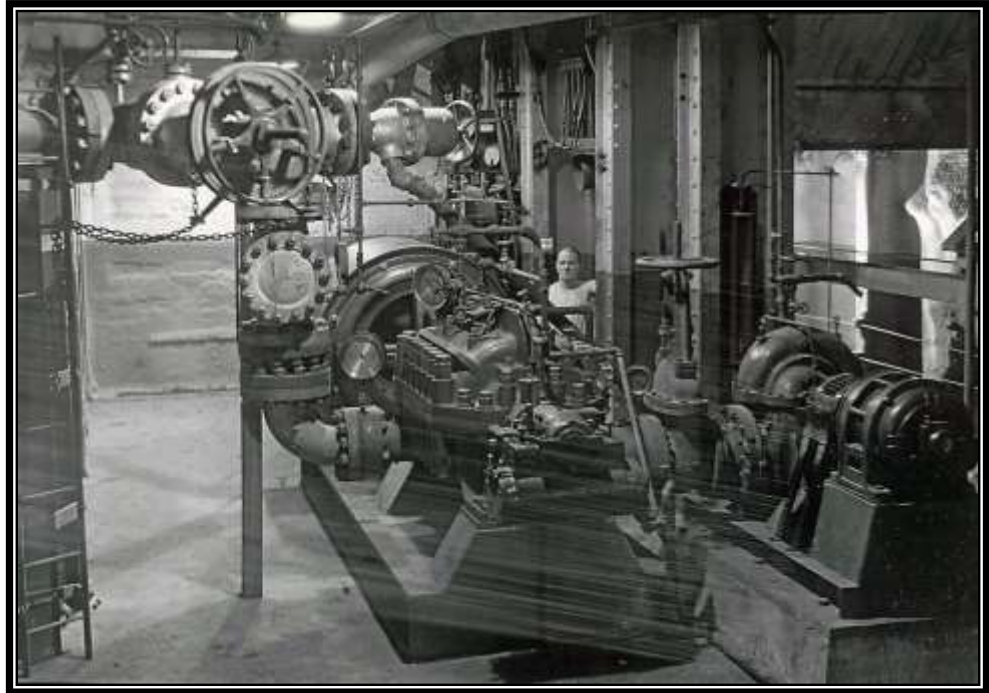
Just outside of the mine yard fence was the employment office where every day there was a line of men seeking work (rustling, it was called). The mine engineering and geology departments were here to provide their essential services as well. Most everything was close to the Junction.

The shaft was maintained as the main pumping facilities for the whole district were located on the 2200 level. For this, the number 1 and 2 compartments had a regularly operating hoist on dayshift only to allow for quick access to the pump station . However, at shift change, the pumpmen actually walked to the Campbell to be hoisted at the end of the day or visa versa at the start of the shift. It was also an emergency escape way in the event of fire as the shaft was downcast, assuring a flow of fresh air from the surface. This inflow of air was also vital for

ventilation of the Campbell mine and large volumes of air came down the Junction shaft. So much so that even in summer, a jacket felt very good when coming up on the cage.

The huge skip hoist for number 3 and 4 compartments, was kept in running condition as well, but seldom used. This beautiful set of machinery was installed in the early 1930s and looked like new well into the 1970s. The pipe compartment was number five and its small hoist was frequently used to check the pump column, compressed air column and electric cables which, together, filled most of the compartment.

The massive pumps on the 2200 had been installed in the 1920s, augmented in the late 1930 and were largely automated in the early 1960s. Every day they lifted nearly four and one half million gallons of water to the surface at a rate of close to 5,000 gallons per minute. Water from the 2200 level was pumped directly from the 2200 to tanks above the pit to provide water for all of the operations, but mostly for the mill. This was an absolutely essential part of the operation.



Number 5 pump on the 2200 level of the Junction Mine was installed in 1935 and was the only centrifugal pump in the group of six pumps with a capacity of 2,250 GPM. Photo – 1938 Graeme Larkin collection

Acid water pumps were on the 1800 level. This acid water was channeled to the 1800 level from all of the old mines in the district. The drainage from the Lavender pit was dropped to the 1600 level of the Sacramento, which was the same elevation as the 1800 level Junction, to be added to the other corrosive, but copper rich waters. The collected waters were then pumped by stainless steel pumps through stainless steel pipe to the surface then by fiberglass pipe to the leach plant near the Campbell for copper recovery.

## SLIDE 41

### BLAST HOLE DRILLING IS MADE SIMPLER

SINCE THE INTRODUCTION OF PNEUMATIC DRILLS IN 1905, MOST OF THE DRILLING IN BOTH CROSSCUTS AND STOPES WAS DONE WITH THE HEAVY, BAR & COLUMN SET UP. IN THE EARLY 1941, DOUBLE DRILL, TRACK MOUNTED JUMBO DRILLS WERE INTRODUCED FOR ALL CROSSCUT DEVELOPMENT. SELF ROTATING STOPERS HAD REPLACED THE MANUAL ROTATION UNITS IN RAISES BY 1950 . BY 1960 JACKLEG DRILLS WERE IN MOST STOPES. THESE SEEMINGLY MODEST CHANGES MADE DRILLING FASTER AND SAFER AS IT WAS NO LONGER NECESSARY TO SET UP THE HEAVY BAR OR HANDLE THE UNWIELDY LEYNER DRILLS ~~~~~



GRAEME LARKIN COLLECTION  
DOUBLE DRILL JUMBO, CAMPBELL MINE  
1950

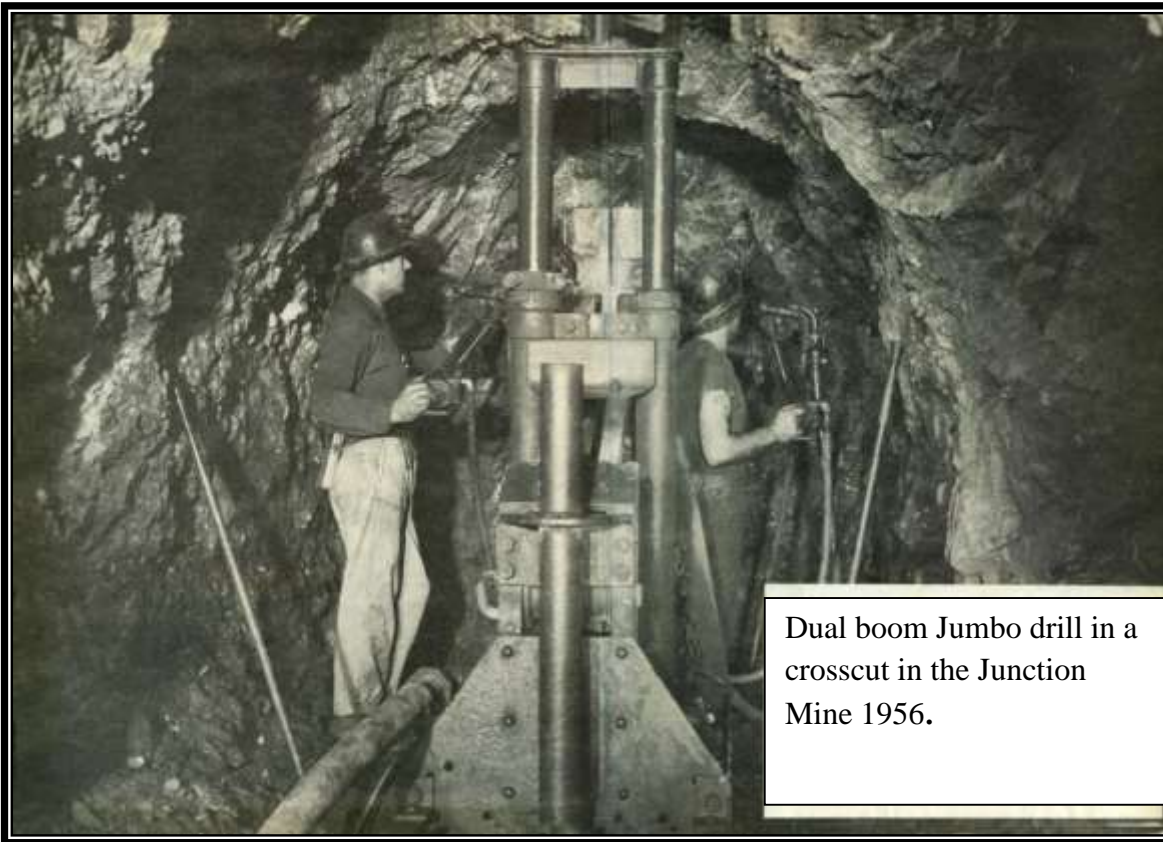


PETE KRESAN PHOTO  
DRILLING WITH A JACK LEG DRILL IN A STOPE, 2833 LEVEL  
CAMPBELL MINE - 1974

Improvements in metallurgy and drill bit designs allowed the development of far superior drill performance and weight. By the end of the 1950s, most of the drills used in stopes were of the much lighter jackleg type and track mounted dual drill “Jumbos” were used in driving crosscuts. The introduction of jacklegs was a substantial enhancement in productivity as it could be moved, setup and used by a single miner.

Also, by the mid-1960s, all drill bits were cross types with tungsten carbide inserts and single use. These harder bits improved drill advance rates and reduced the number of bits needed; one less supply problem.





Dual boom Jumbo drill in a crosscut in the Junction Mine 1956.



1968 advertisement by Phelps Dodge showing a miner drilling with a jackleg drill.

"Down Under" at Bisbee

Once virtually all of Arizona's copper came from underground mines. Among the few remaining such operations is this Phelps Dodge mine at Bisbee. Here skilled miners extract the metal ore so vital to our country's needs. Today most of the state's copper is mined from large open pits such as the one Phelps Dodge also operates at Bisbee.

**PHELPS DODGE**  
 Standing with Arizona for 90 years  
 AJO • BISBEE • DOUGLAS • MORENO  
 Also at Tyrone, New Mexico

## SLIDE 42

### BLASTING IS CHANGED IN A MINOR, BUT IMPORTANT WAY

FROM THE BEGINNING, UNDERGROUND BLASTING HAD USED DYNAMITE IGNITED BY A FIRE FUSE AND BLASTING CAP . THE HOLES WERE EACH LOADED WITH 8 TO 10 STICKS OF DYNAMITE WITH THE FIRST HOLDING THE CAP. THE FUSES WERE THEN LIT TO SET IT OFF THE BLAST. DYNAMITE WAS SAFE TO USE, BUT EXPENSIVE AND THE BLAST SMOKE WAS NOXIOUS CAUSING SEVER HEADACHES. IN THE EARLY 1960S ANFO WAS INTRODUCED TO REPLACE MOST OF THE DYNAMITE FOR BLASTING. THIS NEW BLASTING AGENT WAS PNEUMATICALLY LOADED INTO THE HOLES AFTER ONE STICK OF DYNAMITE WITH THE CAP AND FUSE HAD BEEN FIRST INSERTED TO EXPLODE THE LESS SENSITIVE ANFO



PLACING THE FIRST STICK - 1950



GRAEME LARKIN COLLECTION  
LOADING A ROUND IN A CROSSCUT - 1939



GRAEME LARKIN COLLECTION  
LIGHTING THE FUSES OF A ROUND IN A STOPE - 1939

Dynamite was a safe to use explosive with all around applications. It was water proof and generally not sensitive to rough handling. However, it was not inexpensive and handling it often caused massive headaches as the contained nitroglycerin was absorbed into the skin. These so called “powder” headaches were the bane of many a miner. And too, the smoke from the blast was bad news as well as it too caused these horrible headaches or, if too concentrated even death. (The headaches are the result of the nitro causing the blood vessels to dilate. In the brain, this enlargement of the vessels caused excessive pressure within the brain itself and thus the headache.)

By the early 1950s, an ammonium nitrate – fuel oil mix called ANFO was in common use as a blasting agent in most surface applications, including the Lavender pit. It came as a granular material which flowed fairly easy and was great for pouring down the 8” to 10” vertical blast holes in the pit, but very difficult to put into the small diameter, horizontal or upwardly inclined holes used underground.

The answer came with the use of venture tubes. Compressed air passed through the tube, which created a vacuum effect, sucking the loose ANFO from a sack through a connected hose and into the air stream in a second hose which was inserted into the hole. This carried the ANFO into the



hole with sufficient force to pack it somewhat which kept the otherwise loose material from falling out of upwardly inclined holes. A single stick of 40% dynamite was first inserted into the hole and it was used to explode the ANFO.

Largely gone were powder headaches as well as the horrible smoke from the blast, though the smoke from an ANFO blast was nasty stuff, it would not kill you or make you sick as high concentrations of dynamite smoke could do. Also, a lot of money was saved, making the mines more cost efficient. A true win-win with just a minor change.

### **SLIDE 43**

#### **LITTLE CHANGED IN ORE HAULAGE OVER THE YEARS**

**THE MOST SIGNIFICANT CHANGE IN ORE HAULAGE IN THE LATER YEARS WAS THE NEAR TOTAL USE OF ROCKER DUMP STYLE CARS. THESE CARS WERE NOT NEW, BUT THEIR USE HAD BEEN LIMITED AS THEY WERE HARD TO EMPTY IF THE ORE WAS STICKY AS MOST OXIDES WERE. IN A VERY FEW PLACES, 3 TON CAPACITY GRANBY , RAMP - DUMP TYPE CARS WERE EMPLOYED. THE WASTE HAUL ON THE 1400 COLE TO THE DALLAS AND THE 1800 DALLAS TO THE CAMPBELL WERE THE LAST PLACES WHERE THESE CARS WERE USED BECAUSE OF THE EXCEPTIONALLY LONG HAUL DISTANCES**



GRAEME LARKIN COLLECTION  
EMPTYING A ONE TON, ROCKER DUMP "E" CAR  
2966 LEVEL, CAMPBELL MINE - 1950

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PETE KRESAN PHOTO  
TROLLEY MOTOR PULLING ¾ TON ROCKER DUMP  
"H" CARS 2833 LEVEL, CAMPBELL MINE - 1974

**SLIDE 44**

**UNDERGROUND MINING COMES TO AN END IN 1975**



GRAEME LARKIN COLLECTION  
COLE MINE - 1967

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GRAEME LARKIN COLLECTION  
DALLAS MINE - 1961

**IN JUNE OF 1975, THE COMBINED PRESSURES OF HIGH COSTS AND LOW METAL PRICES BROUGHT AN END TO COPPER MINING IN BISBEE. THE LAST THREE OPERATING MINES - CAMPBELL COLE AND DALLAS WERE CLOSED. SOME SIX YEARS LATER PUMPING WAS STOPPED AND THE MINES ALLOWED TO FLOOD**



GRAEME LARKIN COLLECTION  
CAMPBELL MINE - 1966

## SLIDE 45

### WHEN THE END CAME, IT WAS HARD TO BELIEVE

THE END OF MINING AT BISBEE HAD BEEN FORETOLD MANY TIMES BEFORE BUT IT NEVER HAPPENED. THUS WHEN IT WAS, ONCE AGAIN, SAID THAT THE END WAS AT HAND, MANY DID NOT BELIEVE IT. BISBEE, LIKE ALL MINING CAMPS, HAD ALWAYS LIVED UNDER THE THREAT OF EMINENT CLOSURE, BUT THIS TIME IT CAME. WHEN IT DID END, THE TIMING WAS BAD FOR THE MANY WHO HAD NO REAL SKILLS WHICH COULD BE USED ELSEWHERE. THE LUCKY WERE TRANSFERRED TO PD OPERATIONS AT MORENCI, SAFFORD, AJO, TYRONE OR DOUGLAS. OTHERS WITH ENOUGH TIME WITH PD AND WHO WERE OLDER THAN 50, WERE RETIRED. A FEW STAYED ON TO WORK IN THE LEACH OPERATIONS OR OTHER, TYPICALLY SMALL PROJECTS, FEW OF WHICH LASTED VERY LONG. THE REST WERE LAID OFF

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MOTORMAN PLACING SAMPLE ON TROLLEY MOTOR THE LAST DAY THE UNDERGROUND MINES WORKED JUNE 12, 1975

**SLIDE 46**

**PRECIOUS METALS ARE SOUGHT ONE LAST TIME**

**WHEN GOLD WAS FREED FROM GOVERNMENT CONTROL AND THE PRICE BEGAN TO RISE, PD ONCE AGAIN LOOKED FOR OPPORTUNITY IN THE CAMPBELL OREBODY AND , AFTER IT WAS ACQUIRED ,THE SHATTUCK MINE. SMALL AMOUNTS OF HIGH GOLD/SILVER MATERIALS WERE TO BE MINED FROM THESE AREAS AND THIS WAS TO BE THE LAST MINING IN BISBEE.**

**PD HAD PURCHASED THE SHATTUCK IN 1973, THEREBY COMPLETING THEIR OWNERSHIP OF THE PRODUCING AREA . THE SHATTUCK HAD A LONG HISTORY OF HOSTING PRECIOUS METAL DEPOSITS. AFTER THE PURCHASE, THE SHAFT WAS REOPENED TO THE 800 LEVEL AND SEVERAL LEVELS RECONDITIONED. LATER, SOME MINING TOOK PLACE ON THE 200 AND 300 LEVELS IN HIGH SILVER AREAS**



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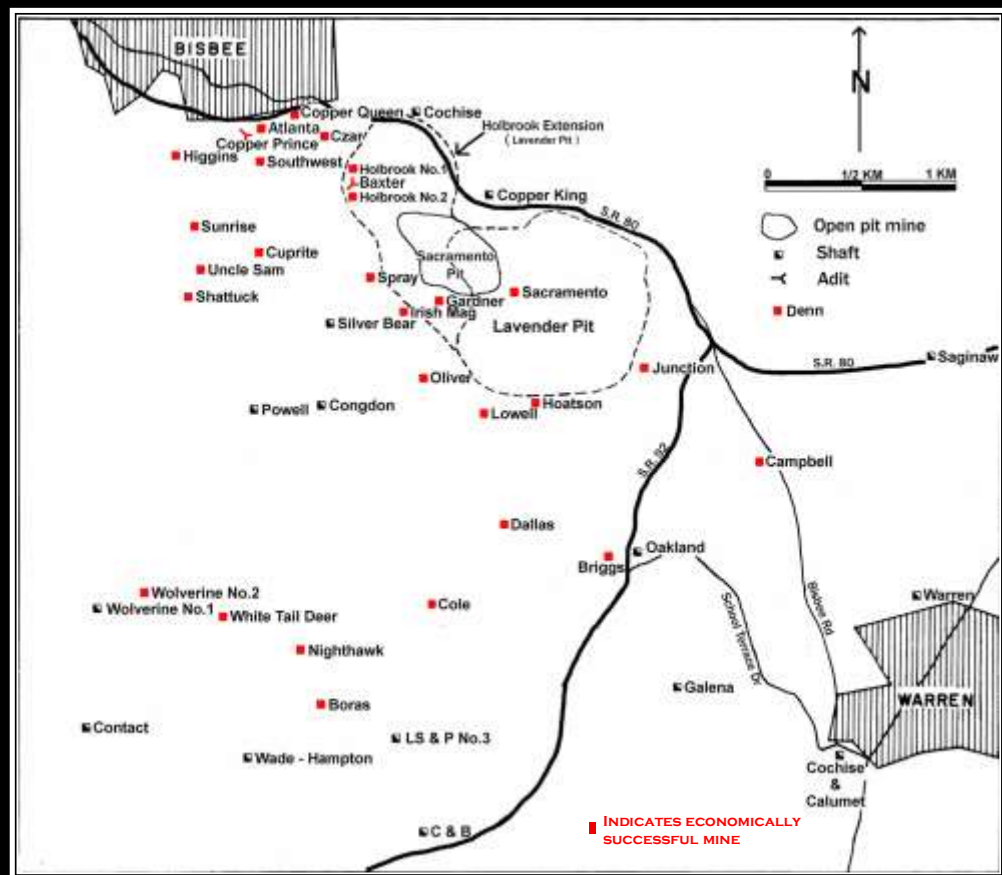
GRAEME LARKIN COLLECTION  
SHATTUCK MINE - 1975

## SLIDE 47

### THE MINES OF BISBEE

OVER ITS LONG HISTORY, THE WARREN MINING DISTRICT HAD MORE THAN 50 MINES. THIS INCLUDED TWO OPEN PITS, 28 ECONOMICALLY SUCCESSFUL AND 15 UNSUCCESSFUL UNDERGROUND MINES IN THE PRODUCTIVE AREA AS WELL AS MORE THAN A DOZEN SMALL MINES OUTSIDE THE AREA OF ORE PRODUCTION

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MINES IN THE PRODUCTIVE AREA OF THE WARREN MINING DISTRICT. AFTER GRAEME, 1981

When mining ended at Bisbee, dozens of individual shafts had been sunk and tunnels driven by a number of mining companies, but just 28 of these and the two open pit mines were economically successful. The orebodies at Bisbee were extremely difficult to find and some of the best geologic experts of the time looked, often in vain for ore.

In all, an estimated 2,210 miles of drifts, crosscuts, stope headings, raises and shafts had been cut into the hills in the search for ore and several times that distance in diamond drilling completed. No doubt, there are even yet a few scattered deposits that all of this effort failed to discover, but they will never be mined, as too little remains. For underground mining, at least, the final chapter for Bisbee has been written.



BORAS	C & C	CUPRITE	CZAR	DALLAS	GARDNER	HIGGINS	HOLBROOK	LOWELL	NIGHTHAWK	SACRAMENTO	SILVER BEAR
On Boras Claim Elev. Collar 5240 <sup>2</sup> Depth 1034' Timbered except 25 concrete at Size Compartments collar 2'-4'-6" x 5'-6" 1'-2'-6" x 5'-6"	On Disbee Claim Elev. Collar 5100 <sup>8</sup> Depth 1835' Timbered Size Compartments 2'-4'-6" x 5'-6"	To 400 Level 400 To 600 On Brother Jonathan Claim Elev. Collar 5609 <sup>2</sup> Depth 912' Timbered Size Compartments To 400 2'-4'-0" x 4'-6" 400 down 2'-4'-0" x 4'-6" 1'-2'-6" x 4'-6"	On General Claim Elev. Collar 5304 <sup>2</sup> Depth 441' Timbered Size Compartments 2'-4'-0" x 5' 1'-3'-6" x 5' 1'-2'-10" x 5'	On Des Moines Claim Elev. Collar 5420 <sup>1</sup> Depth 2032' Concrete to 1800 level, balance timbered Size Compartments 1'-11'-6" x 6" 1'-5'-6" x 6" 2'-4'-10" x 6"	To 1000 Level 1000 To 1400 On Gardner Claim Elev. Collar 5358 <sup>2</sup> Depth 1457' Timbered Size Compartments To 1000 1'-4'-6" x 4' 2'-4'-6" x 5' To 1400 1'-3'-5" x 5'-6"	On Webster Claim Elev. Collar Depth 296' Timbered Size Compartments 3'-4'-2" x 4'-6"	On Baxter Claim Elev. Collar 5353 <sup>2</sup> Depth 645' Timbered Size Compartments 3'-4'-4" x 4'-6" 1'-2'-2" x 4'-6"	On Galena Claim Elev. Collar 5334 <sup>2</sup> Depth 1603' Timbered Size Compartments 3'-4'-4" x 4'-6" 1'-1'-9" x 4'-6"	On Nighthawk Claim Elev. Collar 5350 Depth 749' Timbered Size Compartments 1'-2'-6" x 4'-6" 1'-4'-6" x 4'-6"	On Stars & Stripes Claim Elev. Collar 5258 <sup>2</sup> Depth 1795' Concrete Size Compartments 4'-4'-6" x 5'-6" 1'-5'-5'-6"	On Silver Bear Claim Elev. Collar 5356 <sup>2</sup> Depth 1051' Timbered Size Compartments 2'-4'-6" x 5'
SUNRISE	SOUTHWEST	SPRAY	UNCLE SAM	WADE HAMPTON	WARREN	WHITE TAILED DEER	BRIGGS	CAMPBELL	COLE	CONGDON	HOATSON
On Golden Gate Claim Elev. Collar 6032 <sup>2</sup> Depth 734' Timbered Size Compartments 1'-10'-6" x 5' 1'-3'-5"	On Atlanta Claim Elev. Collar 5577 <sup>2</sup> Depth 493' Timbered Size Compartments 2'-4'-4" x 5'-4"	On Silver Spray Claim Elev. Collar 5435 <sup>2</sup> Depth 1060' Timbered Size Compartments 2'-4'-6" x 5' 1'-3'-4" x 5'	On Uncle Sam Claim Elev. Collar 5817 <sup>2</sup> Depth 923' Timbered Size Compartments 2'-4'-4" x 5'	On Black Hawk Claim Elev. Collar Depth 424' Timbered Size Compartments 2'-4'-6" x 5'-6"	On Early Morning Claim Elev. Collar 4999 <sup>2</sup> Depth 2147' Timbered except 32' concrete at collar Size Compartments 2'-4'-6" x 5'-6" 1'-5'-6" x 5'-6"	On White Tailed Deer Claim Elev. Collar 5394 <sup>2</sup> Depth 602' Timbered Size Compartments 2'-4'-8" x 5'	On Hard Cash Claim Elev. Collar 5225 <sup>2</sup> Depth 1630' Timbered Size Compartments 1'-11'-5" 1'-5'-5" 2'-4'-6" x 5'	To 1800 Level 1800 To 2350 2350 To 2700 On Regular Claim Elev. Collar 5060 Depth 2938' Concrete Size Compartments 2'-4'-10" x 5' 1'-5'-3" x 10'-8" 2700 to 2966 12 inch Curtain Wall & Wood Dividers	On Triangle, Magnate & John P. Jr. Claims Elev. Collar 5329 <sup>2</sup> Depth 1563' Timbered Size Compartments 1'-6'-6" x 5' 3'-6'-6" x 5'	On Black Bear Claim Elev. Collar 5717 <sup>2</sup> Depth 1244' Timbered Size Compartments 1'-2'-4'-6" 2'-4'-4'-6"	On Del Norte Claim Elev. Collar 5251 <sup>2</sup> Depth 1680' Timbered Size Compartments 3'-4'-6" x 5' 1'-4'-8" x 5'
IRISH MAG	JUNCTION	Nº 3	OAKLAND	OLIVER	POWELL	SAGINAW	GALENA	DENN			
On Irish Mag Claim Elev. Collar 5159 <sup>2</sup> Depth 1358' Timbered Size Compartments 1'-2'-x 5' 1'-3'-6" x 5' 2'-5'-5"	On Waddell Claim Elev. Collar 5101 Depth 2727' Concrete Size Compartments 1'-7'-1" x 6" 2'-4'-6" x 6" 1'-4'-x 6" 1'-4'-2" x 6"	To 600 Level 400 To 1000 On Uncle Sam Claim Elev. Collar 5233 <sup>2</sup> Depth 914' Timbered Size Compartments To 600 1'-2'-6" x 4'-6" 1'-4'-x 6" Below 2'-4'-4'-6"	On Oakland Claim Elev. Collar Depth 827' Timbered Size Compartments 1'-2'-x 4'-6" 1'-4'-6" x 4'-6" Ventilation Shaft	On Senator Claim Elev. Collar 5372 <sup>2</sup> Depth 1477' Timbered Size Compartments 1'-3'-x 4'-6" 3'-4'-x 4'-6" Open to 1150 level	On Wagner Claim Elev. Collar 5803 <sup>2</sup> Depth 605' Timbered Size Compartments 1'-2'-6" x 5' 2'-4'-6" x 5'	On Leland Stanford Claim Elev. Collar 5042 <sup>2</sup> Depth 1752' Timbered Size Compartments 1'-5'-x 4'-6" 2'-4'-x 4'-6"	On Copper Glance Claim Elev. Collar 5213 <sup>2</sup> Depth 1407' Timbered-Womanized Size Compartments 3'-4'-6" x 5'-6"	On Robert E. Lee Claim Elev. Collar 5083 <sup>2</sup> Depth 3152' Concrete to 2166' Size Compartments 1'-4'-7" x 6'-0" 2'-4'-8" x 6'-0" 1'-2'-11" x 6'-0"			
* Inaccessible or in bad state of repair											

3/16/45  
Revised 11/24/41  
6/7/50

**PHELPS DODGE CORP.**  
COPPER QUEEN BRANCH  
**SHAFT DATA**  
BISBEE, ARIZ. AUGUST 1932

Data sheet on the principle shafts at Bisbee to 1950. Those mines not owned by Phelps Dodge at the date of the chart have been excluded. Graeme Larkin collection