AX - I - DENT - AX

EMPLOYEES' MAGAZINE

United States Smelting, Refining and Mining Company
and Subsidiaries

MIDVALE

IN THIS NUMBER

MISS DOROTHY MENSEL - - - Champion High School Orator of Utah

EARLY HISTORY OF LEAD SMELTING - - - - - - Robert Wallace

DEVELOPMENT OF ORE DRESSING - - - - - - - - C. A. Lemke

ROASTING AND SINTERING LEAD ORES - - - C. A. Greenwood

LEAD BLAST FURNACES - - - - - - - - - J. Lawrence Myers

THE BAG HOUSE AND LEAD SMELTING - - - - - L. D. Anderson

SAFETY FIRST AT MIDVALE - - - - - - - - - J. A. Cotter

REMINISCENCES - - - - - - - - - - - - - David Smart

RURAL MISCELLANY - - - - - - - - - - - - Edgar M. Ledyard

NOTES FROM OTHER PLANTS

Volume 14 MAY - 1929 Number 5

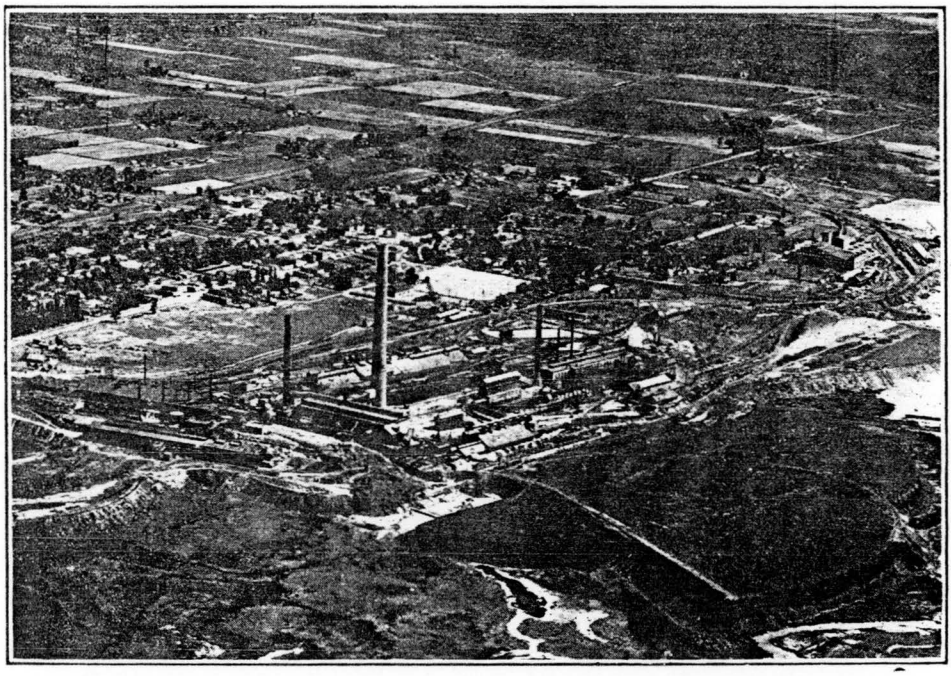
AX - I - DENT - AX

VOLUME FOURTEEN SALT LAKE CITY, UTAH, MAY 1929 NUMBER FIVE

Early History of Lead Smelting in the West

By ROBERT WALLACE, Superintendent, Midvale Plant

The first lead mining and smelting in Utah was carried on about four miles northeast of Minersville, Beaver County. Isaac Grundy, Jesse N. Smith, Tarleton Lewis and William Barton discovered lead in this section in the fall of 1858. Later in the same year, specimens were shown to President Brigham Young who immediately became interested in the discovery. Beaver County was settled in 1856; the first colony was established on the Beaver River at the present site of Beaver. President Young directed Isaac Grundy and others to proceed to the site of their discovery, begin mining and also establish an agricultural colony nearby. Minersville was formally settled on May 17, 1859; Isaac Grundy was the first bishop and in charge of mining operations



Slag Dump in Foreground; Lead Smelter Center; Farms in Background; Midvale, Utah Main Stack is 451 feet 4 1-4 inches high, with an inside diameter of 24 feet at the Top. Total Weight of this Stack is 16,654,000 Pounds

as well. To most of the old settlers, the mine is known as the Rollin's Mine, named for James Henry Rollins, the second bishop of Minersville, appointed on April 2, 1860. The Lincoln District, embracing the Rollins mine, was organized in 1861 and named in honor of President Abraham Lincoln. A device for smelting ore was built and some lead was produced. This was the first production of lead by whitemen, in United States territory, west of the Rocky Mountains.

Camp Douglas Located October 22, 1862

General Patrick E. Connor and his California volunteers arrived in Great Salt Lake City on October 20, 1862, and located Camp Douglas, now Fort Douglas, Utah, two days later. General Connor and his troops spent most of 1863 in various Indian campaigns. During that year lead ore was discovered in Bingham Canyon, so named from

a man who herded livestock at its mouth. At least two accounts of the discovery have been given. One is that a logger, G. B. Ogilvie, discovered the ore and took specimens to General Connor; another that a woman who was a member of a picnic party in the canyon, found the ore. In any event, General Connor, Ogilvie and others located the Jordan claim and filed on it September 17, 1863. A facsimile of this notice appeared in the Salt Lake City Chamber of Commerce Mining Booklet for 1929. This was the first mining claim of record in Utah; now owned by the United States Smelting Refining and Mining Company.

Utah's First Daily "The Union Vedette" Appeared on November 20, 1863

Isaac Grundy and his associates may properly claim the right to be called the first lead miners and smeltermen in Utah. The first widespread publicity on Utah's mineral wealth, however, belongs to General Connor. "The Union Vedette" made its first appearance on November 20, 1865, estabished by General Connor and his associates as a publicity organ on mining. The first issue of "The Union Vedette" contained a letter written by Captain Charles H. Hempstead, who was General Conner's adjutant at the time, also editor of the "Vedette", the first daily paper published in Utah. The letter, written on November 14, 1863, stated that, in the opinion of General Conner, the territory of Utah was rich in gold, silver, copper, and other minerals, and he invited those interested in mining to come to Utah and engage in that industry. Likewise he directed that soldiers at the various posts in his department be allowed to prospect whenever such work did not interfere with their duties. As a result of this encouragement, soldiers discovered other ore bodies in Bingham, Little Cottonwood Canyon, Ophir, Stockton and other places in Utah the next year.

Soon after the discovery of ore deposits near Stockton in 1864, an attempt was made to smelt the newly found ore. General Connor induced a number of his California friends to furnish money for the enterprise, and a smelting furnace was built. The Rush Valley Smelting Company was also organized at the same time by the officers at Camp Douglas and a furnace was built by them at Stockton.

Lieutenant James Finnerty built a small trial furnace to test ore and General Connor followed with his second larger furnace. Both were only partially successful, owing to the poor quality of fire brick used. Subsequently Lieutenant Finnerty built a second furnace and ran it with good results for several weeks, turning out a quantity of metal.

During the summer and fall of 1864, smelting furnaces were built by six others, in and around Stockton. One built by J. W. Gibson, had a capacity of 600 pounds of ore per day. A cupelling furnace was also built, the same year, by Stock & Weberling.

The Art of Smelting Ores Was a Task New to the Californians

The art of smelting ores was a task new to Connor and his Californians, whose experiences were confined to mining and milling gold ores. This disadvantage was increased by the fact that charcoal was not abundant, and rates of transportation were high. These are circumstances which would have taxed the ability of the most experienced, and the Californians, unused to the work, failed entirely. In September, 1865, after two years of steady, hopeful toil from the time of the first discovery at Bingham, the business of smelting at Stockton was suspended.

In 1866 two small furnaces were built at Little Cottonwood Canyon. About three tons of bullion were produced; most of the lead was lost in the slag but afterwards recovered in 1867, by Reese, a German metallurgist who rebuilt the furnaces to treat North Star ores.

These early attempts complete the smelting history of Utah until after the construction of railways in 1870; in other Western territories, more progress in smelting had been made in the meantime and the experience gained elsewhere was a help in operating the furnaces later built in Utah.

Smelting Works Built At Oreana, Nevada, in 1863

In Nevada, at Oreana, on the banks of the Humbolt River, the Trinity and Sacramento Company built smelting works for reduction of ore from the Montezuma Mine in the Trinity District, organized in 1863. This was before the construction of the Central Pacific Railway and supplies for building and operating the smelter were freighted by mule and ox trains, from Sacramento. Special interest attaches to this smelter, as it was the first in Nevada, from which lead was shipped in commercial quantities, and it contests with Argenta, Montana, the honor of being the birthplace of the silver-lead smelting industry of the United States.

The drawing, from the Fortieth Parallel Survey, of one of the Oreana blast furnaces, is reproduced to show the construction of this early furnace; built with open crucible, exterior forehearth, water-cooled tuyere nozzles for the blast, and solid brick walls around the smelting zone. The blast was supplied by a fan blower driven by a steam engine.

When the furnace was in regular operation, the slag was discharged continuously, while the metal was tapped off at intervals of an hour or two into an iron receiver, from which it was dipped out and cast into pigs for further treatment in separating the silver. The plant consisted of two shaft furnaces with a capacity of 12 to 13 tons of ore, each, per day, four sublimation furnaces, and one English cupelling furnace.

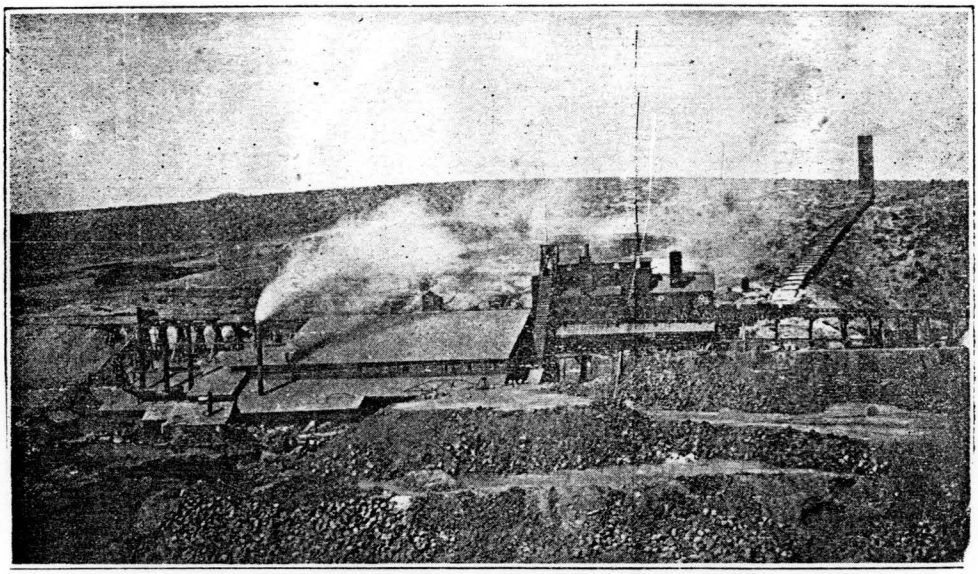
The general cost of the reduction of the ore and separation of the silver is given in the following statement:

Expenses of Smelting Furnace Per Day

Two smelters and two helpers	$16.00
Two breakers	7.50
Two feeders	8.00
Two engineers	8.00
Fuel for engine—furnished on contract	16.00
Chinaman—general laborer	2.00
General expense	2.00
Smelting 13 tons per day costing	$59.50
Cost of smelting, as given above, per ton	$ 4.57
Charcoal, 18 bushels per ton, at 50 cents per bushel	9.00
Estimated repairs per ton	.50
Mining and hauling per ton	4.50
Superintendence and general account per ton	3.00
	$21.57
For sublimation, per ton of ore	8.00
For cupelling, per ton of ore	5.00
Making total cost of treatment per ton of ore	$34.57

The average yield in silver alone, without taking into account the base metals, was about $70.00 per ton of ore.

In 1867, the result of smelting 1800 tons of ore showed a production of 983 pounds of metal per ton of ore smelted. One of the products of the sublimation furnace was an



Eureka Consolidated Mining Company's Lead Smelter, Eureka, Nevada
In Operation from 1870 to 1891

alloy of lead and antimony sold in San Francisco for the manufacture of type-metal.

At Eureka, Nevada, silver-lead ore had been discovered in 1864, but the deposits were not considered of much value, and the district was deserted until the beginning of 1869.

In the early part of 1870, Major W. W. McCoy and Col. G. Collier Robbins, after several unsuccessful attempts by others, succeeded in smelting the ore with satisfactory metallurgical results. This induced Messrs. Buel and Bateman to bond the mines and sell them, the same year, to the Eureka Consolidated Mining Company of San Francisco.

The first annual report of this Company, covering the period from July 7, 1870, to September 30, 1871, is of interest in showing the rapid progress made after the first problem of smelting had been solved.

The smelting plant consisted of five furnaces, Nos. 1 and 2, with a capacity of 16 to 18 tons, each, per day; No. 3, 18 to 22 tons; and Nos. 4 and 5, 35 to 45 tons each, making a total capacity of 120 to 148 tons per day according to the "Smeltability" of the ore charged.

For the first fifteen months, operations ending September 30, 1871, 18,847 tons of ore were mined at a cost of $5.52 per ton and 18,825 tons of ore were smelted at a cost of $19.60 per ton. Bullion production was 3,468 tons, which yielded $1,124,075.67 after refining at Newark, New Jersey. Balance of net earnings over expenditures was $130,131.29, after dividends Nos. 1 to 5, inclusive, amounting to $225,500.00 had been paid to the stockholders.

Under "smelting account" is the item of $255,761.50 for charcoal. The consumption of charcoal in smelting operations was from 30 to 45 bushels per ton of ore—on the average say 35 bushels—and the price varied between 28 and 30 cents per bushel. On the question of charcoal supply, Superintendent W. S. Keys says:

"In all smelting operations, the question of fuel is one of vital importance, the cost of charcoal alone consumed in the Company's works being the largest single item of expense incurred in the production of the metal. Already the nut pine, the only wood suitable for coaling, has been cut off within a radius of ten miles of Eureka. With every year the price per bushel of charcoal must increase, and in view of the probably increased consumption in the immediate future, your Superintendent has the honor respectfully to suggest that steps be taken to test the feasibility of obtaining coke from some of the mines of the Rocky Mountains.

"An attempt to use gas coke in one of the Company's furnaces failed for the reason that the blast used was not of sufficient force to penetrate the heavy mass of compact coke and ore. To enable us to do this, there will be required a powerful engine of upwards of 100 H. P. and a double cylinder blast.* Experiments on a small scale have shown that some at least of the Rocky Mountain lignites may be coked.

"Charcoal now costs $40 per ton. Coke, your Superintendent believes, can be made and delivered at the works at Eureka for $32 per ton; the smelting power of coke compared to charcoal is as 8 to 5, and therefore, could coke be employed, there will result a saving to the Company of over one-third of the present outlay for fuel.

"This question may possibly be left in abeyance until the succeeding spring and summer, at which time the enhanced price of charcoal will necessitate its solution."

Many Years Passed Before Coke Was Used In Nevada Furnaces

But the next summer and many more passed, and charcoal was still used and hauled from places more than ten miles from Eureka. On August 18, 1879, the charcoal burners riot, in which five burners were killed and six wounded, occurred in a camp at Fish Creek, 30 miles from Eureka.

Coke was produced at Castle Gate, Utah, in 1890, but long before that, coke for the early furnaces in the West, was brought from Pennsylvania.

In regard to the relative merits of coke and charcoal in lead smelting, it may be said that coke, on account of its greater density and strength, will bear a heavier burden in the stack of the furnace without crumbling, and on account of its higher igniting point, the smelting zone is more easily held down in the lower part of the furnace where it should be, and "hot tops", are more easily avoided.

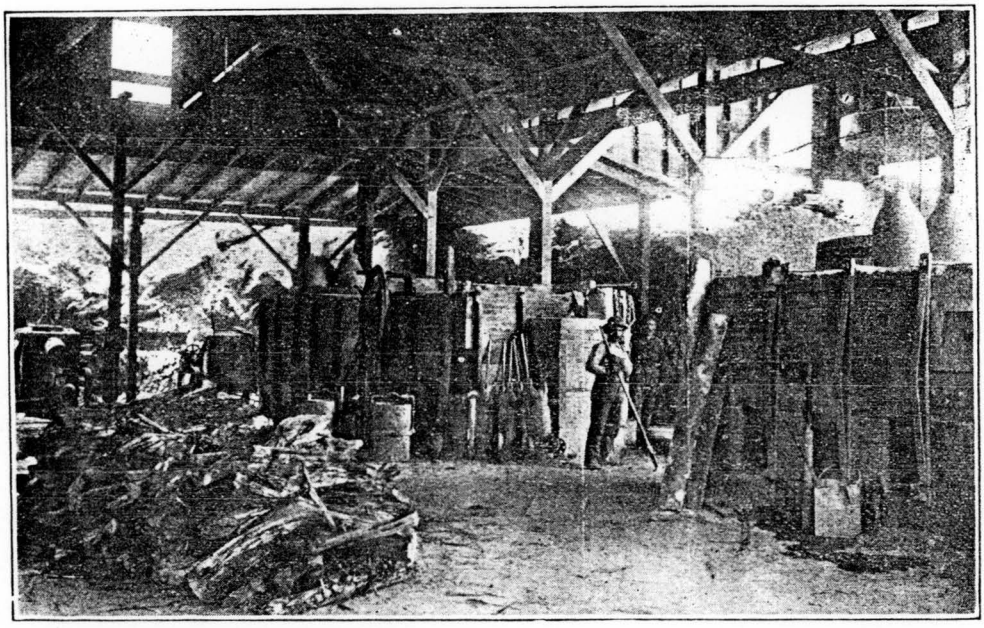
On the other hand, charcoal is more porous, and weight for weight, its bulk is three times greater than that of coke, which is an advantage in holding the charge more open in the stack, but when used alone, its disadvantages are that it crumbles in the furnace, and fine charcoal is not only worthless as a fuel, but it is a bad conductor of heat and makes dirty slags.

Coke and Charcoal Were Combined At Sandy Furnaces

An ideal fuel would combine the strength of coke and porosity of charcoal, and in the 80's a combination of both was used, (at Sandy, Utah, five scoops of coke and two of charcoal) the coke supporting the charge, while the charcoal igniting first, burned away quickly, leaving hollow spaces for the blast to penetrate.

*** The Superintendent's comments on blast pressure have a familiar ring today, when blast furnace charges are tightening on account of increasing proportions of fine flotation concentrates. —(R. W.)**

The smelting operations of the early 70's at Eureka, properties in which the United States Smelting, Refining and Mining Company was later interested, are of special interest in the metallurgical history of lead smelting, because they brought about the invention of the Arents siphon tap, one of the two most important changes in furnace construction, which make radical differences between the furnaces of today



Furnaces in Lead & Silver Refinery of Eureka Consolidated Mining Co., Eureka, Nev.

and the early ones. The other important change in furnace construction was the application of water jackets to lead blast furnaces at Bingham Canyon, Utah, made by Ellsworth Daggett, at the Winamuck Smelter.

The operations of the 80's at Eureka are a milestone in the history of the world's lead production because after the Eureka smelters had built their own silver and lead refineries and could ship their silver, and hold their refined lead, which at one time was stacked like cord wood covering acres, Eureka controlled the price of lead in the markets of the world.

In 1877, the Richmond Company, added a refinery to their smelting plant, using the Luce and Rozan process, a modification of the Pattinson method which enabled them to desilverize their base bullion, and hold their market lead for the highest price. In 1866, the Eureka Consolidated Company built a refinery with the same object in view, using the Parkes process. These plants continued in operation until the Richmond Company suspended operations in 1890, and the Eureka Consolidated suspended operation of their reduction works in the fall of 1891.

The application and use of the siphon tap or "automatic tap", for continuous discharge of lead from the crucible, spread to furnaces in every lead smelting district of the world, after its invention at Eureka, by Arents, a Clausthal metallurgist.

The Siphon Tap Is Universally Adopted

Before the invention of the siphon tap, furnaces built with closed crucible were called "sump furnaces", and the bullion was tapped from the bottom of the crucible or sump. Another style of construction was to leave the crucible open, and build an exterior forehearth, it being remembered that these early furnaces used charcoal for fuel and ran on very light blast, supplied by fans, or on blast of not over six to eight ounces pressure, if supplied by blowers.

With either kind of construction, whenever bullion was tapped from the furnace, it was necessary to take off the blast. As the bullion was tapped out, half smelted charge sank down into the crucible and this had to be cleared from the bottom of the crucible by running a curved iron bar through the forehearth and all tuyeres had to be cleaned, before the blast could be turned on again, slowly, and smelting resumed.

The siphon tap for continuous discharge of lead from the bottom of the crucible changed all this, and today all furnaces are built with closed crucibles and siphon taps.

Open Crucible Was Thought To Have Certain Advantages

At Eureka, however, even after adoption of the siphon tap, the open crucible was thought to have certain advantages for which it must be retained, for in a description of smelting operations of the early 80's, we find:

"The furnace has an open hearth at one end with a slag spout as well as one for speiss. The latter is placed one and one-half inches below the former. The lead is allowed to run out of an opening on the side of the lead well, which is a very short distance below the speiss spout. When one of the large furnaces is working properly there is a continuous flow of all the three smelting products, slag, speiss, and lead, from the crucible. The furnaces are barred out regularly once every twelve hours, the front 'bache' being removed for the purpose. It is said to have been proven by repeated experiments that the nature of the Eureka ores renders their advantageous smelting in a furnace with a closed hearth impossible, as the large quantity of iron in the ore makes a continual barring out necessary in order to prevent the formation of 'sows'. The separation of the different smelting products, slag, speiss, and lead is tolerably complete."

In Utah, after completion of the railways in 1870, mining and smelting became a permanently established business. Completion of the railways made mining practicable, and the new discoveries of ore in Little Cottonwood Canyon in 1868, gave a new impetus to mining which had been nearly at a standstill since the first activities of General Conner and others at Stockton in 1864.

First Recorded Shipment of Ore to Leave the Utah Territory

In 1865-1866, General Conners' command at Camp Douglas was relieved and many of his men who had been most interested in mining activities, returned to California, which further lessened interest in Utah mining. Nearly all the first ore from Little Cottonwood Canyon was shipped to Swansea, Wales, which at that time was one of the great smelting and refining centers of the world. However, what is said to have been the first shipment of Utah ore to a smelting plant outside this state was one of ten tons, on July 25, 1869, by Woodhull Bros., from the Monitor and Magnet mine in Little Cottonwood to T. H. Selby, San Francisco. The charge for freighting this ore to Uintah on the Union Pacific Railroad was $32.50 per ton.

In the autumn of 1869 the first bonanza ore body was struck at the Emma mine, in Little Cottonwood. In June, 1870, Walker Bros. began shipping the Emma ore to Swansea, and by August, 1871, had shipped 10,000 tons, which was sold in Liverpool, England, at a cash price of 36 pounds Sterling per ton of ore. Shipments of Emma ore continued to Swansea until the autumn of 1873.

Sixty years ago, on May 17, 1869, construction of the Utah Central, the pioneer railway line of Utah, was begun at Ogden, just a week after the Union and Central Pacific Railways had been joined at Promontory. The Utah Central's last rail was laid at Salt Lake City on January 10, 1870. The completion of this railroad brought men interested in mining and the successful mining operations in Little Cottonwood drew the attention of men with capital and of men with experience and ability in carrying on the business of mining and smelting.

Railroads Built Many Branches From Salt Lake City

The first years of the decade from 1870 to 1880 saw great activity in the construction of smelting furnaces at numerous sites near the mines, as railway lines reached out from Salt Lake City. Construction of the Utah Southern, a continuation of the Utah Central, was commenced at Salt Lake City, May 1, 1871, and the road was completed to Sandy on September 23, 1871, the new town being named for the Scotch Engineer on the first locomotive. On September 23, 1872, the Utah Southern was completed to Lehi, and on September 21, 1873, to Provo. Construction work on the American Fork Railroad, a narrow guage, was commenced at American Fork, in May, 1872, and the road completed to Deer Creek, a distance of 12 miles, in November of the same year. From Sandy, the central point between the Bingham and Cottonwood mining districts, narrow guage roads were built both east and west. Work was begun on the Wasatch and Jordan Valley Railroad at Sandy in January, 1873, and completed to Fairfield, Utah, in Little Cottonwood Canyon, eleven miles from Sandy, on Sept. 28th.

The Bingham Canyon and Camp Floyd Railroad, the narrow guage from Sandy to Bingham, was incorporated September 10, 1872, and completed to Bingham, December 1, 1873, construction work being delayed on account of having to wait for the rails to be manufactured. An extra rail was laid from Sandy to the West Jordan Smelting Works (site of our present Midvale Smelter). Consequently, Midvale has always been served by standard guage railroads.

The activity in building smelting plants went forward with the construction of the railways. The first shipment of bullion from a Utah Smelter was from the plant owned by Woodhull Bros. situated about six miles south of Salt Lake City, on the State Road, near its crossing over Big Cottonwood Creek. The first production of bullion at this plant is said to have been on September 20, 1870, from ores obtained from the Monitor and Magnet claims in Little Cottonwood. The equipment consisted of one cupola blast furnace and one reverberatory furnace.

On the north side of Little Cottonwood Canyon, Buel and Bateman built a plant in 1870 for treating ore from the Flagstaff mine. The product of the Flagstaff furnaces

Group of Employees at Eureka Consolidated Mining Company's Lead Smelter At Eureka, Nevada, About 1875

during 1872 was 3,000 tons of metal valued at $750,000. In 1873 the Flagstaff Smelter consisted of three stacks. The Flagstaff was owned by an English company, who shut it down soon after and shipped ore to Sandy. On the south side of Little Cottonwood Canyon, just above Beaver Springs, the Davenport Smelter was built in 1872 or 1873 and operated until 1875 when it was shut down. At Union Fort, the Monitor Furnace was built by T. R. Scheuner in 1871. This furnace had a capacity of 10 to 15 tons per day. North of Salt Lake City, the Warm Springs Smelting Works was built in 1870 by F. T. P. Pascoe. This plant consisted of one blast furnace and one reverberatory and treated ores from Cottonwood and Bingham. About four miles south of Salt Lake City, the Badger State Works was built in the spring of 1871. This plant consisting of one blast furnace with a capacity of 15 tons per day was leased to Robins, Mackinson and Jones. Construction of the W. and M. Robins Smelting Works, seven and one-half miles south of Salt Lake City, at Little Cottonwood Creek, was completed in May, 1871. In 1871, also, the Wasatch Silver-Lead Works was built at South Cottonwood, seven miles from Salt Lake City, on the Utah Southern Railroad. Equipment, one reverberatory and two blast furnaces, with capacity of 50 tons per day.

Winamuck Smelter Operates Successfully in Bingham Canyon

In 1871 the first smelter in Bingham Canyon was erected at the Utah Mine. By 1873 it had been demonstrated that the ore could be transported to the valley furnaces at less expense than the fluxes and charcoal used in smelting could be freighted up the canyon, and the smelter was torn down. On the other hand, the Winamuck Smelter, built at Bingham Canyon in 1871, by Bristol & Daggett, was most successfully operated. Costs were very high, but metal losses were correspondingly low. Mr. Eilers has stated that metal losses at the Winamuck were less than at any of the other early smelters in the West, except at Eureka, Nevada. The plant consisted of two blast furnaces with a daily capacity of fifteen tons each. Up to January 1, 1874, 12,000 tons of ore had been mined and smelted from which bullion valued at $876,000. had been produced yielding a profit of $336,000., but by that time the easily smelted

carbonate ores had been worked out. Heap roasting of the sulphide ores was insufficient and complete roasting in reverberatory furnaces too expensive, and the lower lead content of the sulphide ores made smelting unprofitable.

Ellsworth Daggett Equips Blast Furnaces With Water Jackets

Among the items in the cost of $45 per ton for mining and smelting, were charcoal at 30 cents per bushel; limestone at $7 per ton; and red hematite iron ore for flux, brought from Rawlins, Wyoming, at $25 per ton. Fire bricks were brought from Golden City, Colorado, and even from Illinois. The operations at the Winamuck are of special interest because of the first application of water jackets to a lead blast furnace by Ellsworth Daggett, graduate of Yale and Freiberg. Before that time all lead blast furnaces had been built with solid walls of brick or stone around the smelting zone. The furnaces were equipped with sprays for cooling the brick work and with troughs above the smelting zone for dripping water down the sides of the walls; but after a campaign of a day or two fire would show through the brick work. The burned places were repaired with clay. Sometimes a furnace campaign would last only a few days and a week's run was considered good. The only water jacket was a small one around the tuyeres until Mr. Daggett built water jackets to replace the brick walls around the smelting zone. At the end of a week's run the water jacketed furnace was running as well as it had on the day it was blown in, and it kept on week after week and there were no more troubles from burnt out brick work.

The modern furnaces are many times larger than the early ones, the canvas sleeves for tuyere connections have been replaced by cast iron, and the old clay breasts have been replaced by water cooled tapping blocks, but the two important changes in furnace construction which make furnaces of today differ from the early furnaces are the invention of the siphon tap at Eureka, Nevada, by Arents, and the application of the water jacket at Bingham by Ellsworth Daggett.

Smelters With Furnaces of Many Kinds Built Near Midvale and Sandy

At West Jordan, the Sheridan Hill Smelter, equipped with four blast furnaces, was built in 1873, to treat ores from the Neptune Mine at Bingham. It's site was on the right bank of the Jordan River, directly south of our present Midvale smelting plant. The Galena Smelter, built in 1873, was equipped with three blast furnaces and four reverberatories to treat ore from the Galena and Old Jordan Mines at Bingham. The plant was afterward enlarged to treat ore from the Telegraph Mine and was known as the Old Jordan Smelting Works. In 1899, at the time of the organization of the United States Smelting Company, it was referred to as the Old Telegraph. It's site was on ground now occupied by our Midvale plant.

In the early 80's the Jordan Smelting Works consisted of two reverberatory and six shaft furnaces. The stacks of five of the blast furnaces were elliptical, sixty by thirty inches interior dimensions, ten feet six inches from tuyeres to feed floor, fourteen inches from tuyeres to slag tap, and twenty-four inches from tap to sole. The elliptical shape in construction of the stacks is interesting, as it is the shape that a furnace naturally tends to assume after it has been in blast for sometime.

In our furnaces to-day, when a hang starts to form in the stack, the furnacemen say that they don't see why the stacks are not built with rounded corners in the first place. The sixth furnace at the Old Jordan Works was octagonal, forty-two inches in diameter and twelve feet six inches in heighth. The jackets on all the furnaces were riveted boiler plate with an inside space of three inches for water, and they were made in separate segments, held in place by a strip of thin band iron. When the furnace was run down and had to be cleaned out, the band was loosened and the front jacket was taken out. This arrangement was said to be "unsurpassed for convenience".

The Saturn Mining Company built a plant with three blast furnaces of total capacity of sixty tons per day at Sandy in 1872. The Wellington Mining and Smelting Company also built a furnace just east of Sandy,, in 1872. This was afterward called the "Last Chance" and in 1873 was leased by the Flagstaff company, who ran the plant on their own ore until April, 1876, when they closed it down and began selling their ore on the Salt Lake market, having found that smelting was not as profitable as selling the ore to custom smelters.

Many Smelters Spring Up To Smelt a Particular Kind of Ore

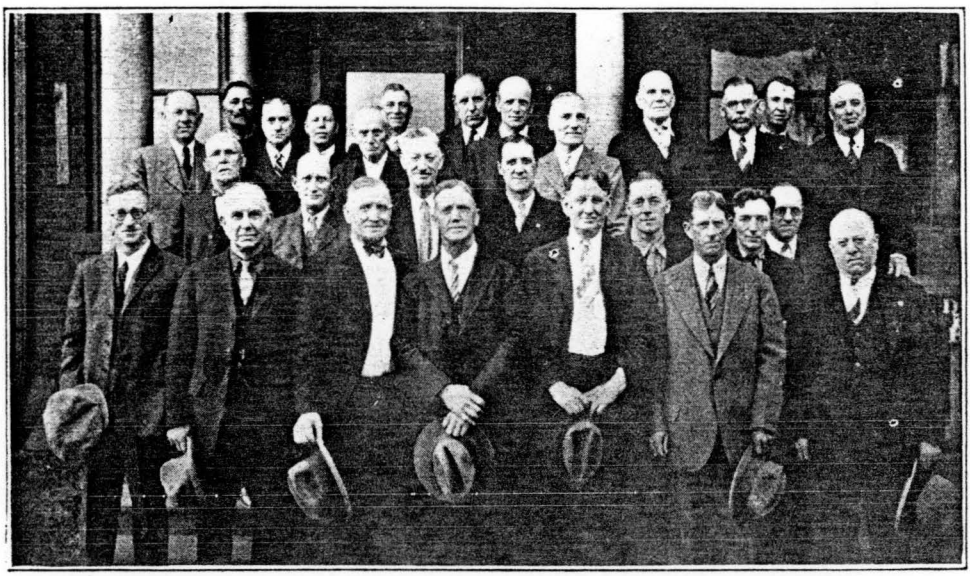
The first plant of the Mingo Furnace Company was built at Sandy, in 1878. The Mingo, also called the Pennsylvania Smelting Company's plant, was rebuilt three times and continued in operation until it was bought by the American Smelting and Refining Company and closed down in April, 1901. The plant was later dismantled.

At Murray, then known as South Cottonwood, seven miles south of Salt Lake City, on the Utah Southern Railroad, the Germania Separating and Refining Works com-

menced operations on November 26, 1872. It started as a lead refinery and was the only works of its kind in Utah. In 1873 the Germania plant treated 4,100 tons of lead bullion (1,670 tons coming from Nevada) and produced 560,580 ounces of silver, 6,710 ounces of gold, and refined lead of the best quality. Two years later, blast furnaces and reverberatories were added for smelting ores. The plant gradually grew and continued in operation, under many ownerships, until it was purchased by the American Smelting and Refining Company and dismantled in 1902 after construction of their Murray plant had been completed.

F. Anton Eilers, Noted Metallurgist, Familiar With Western Country

In 1876, Anton Eilers, who had received his technical training at the University of Gottingen, and the mining school of Clausthal, came to the Germania in charge of metallurgical operations. Besides his technical training, Mr. Eilers had a great ad-



Left to Right, Back Row: Hilmer J. Jensen, Nick Dokas, R. F. Middleton, Carl C. Jensen, Harry Stagg, John Lancaster, Frank W. Richardson, Chas. Webber, Niel Olson, Matt Bishop, Frank Lenberg, Chas. Greenwood, W. W. O'Brien; Middle Row: David Beynon, Jake Francom, Robert Lancaster, James M. Brady; Front Row: Sam Lancaster, John Holden, John Jackson, Alma Harrison, David Smart, Ray Alsop, Walter Dumas, W. R. Wagstaff, N. L. Jensen and J. M. Hughes. Combining this group with those shown with Mr. Lemke's article makes a total of thirty-six men employed at present with a record of twenty-five years or more at the Midvale Plant; over 800 years of service.

vantage in undertaking this task on account of his previous seven years experience as deputy United States Commissioner of Mining Statistics for the States and Territories in and west of the Rocky Mountains. As assistant to Dr. R. W. Raymond in this work, his visits to the mining districts had made him familiar with the natural resources, industries, prospects and people of this entire western country.

Mr. Eilers has been called the "father of modern silver lead smelting". He was the first to apply chemistry to metallurgy and to work out the theory of slag formation on an accurate chemical basis. His tables of typical slags of definite combinations of silica, iron and lime are known to every metallurgist in lead smelting. Yet his table of "type slags" was intended only as a guide for the metallurgist, and, if a furnace was running smoothly on a slag whose composition did not correspond exactly to a type in the table, he would not change the slag to make it correspond. His definition of the requirements of a good slag was that it should not contain over three-quarters of one percent of lead or one-half ounce of silver to the ton, (provided that the base bullion did not run higher than 300 ounces); that it should not have a density of over 3.6; that it should not cause accretions in the hearth, thus keeping the lead red-hot, and that it should not cause any creeping up of over-fire.

At the time Mr. Eilers came to the Germania, the valley contained many small shaft furnaces which froze up quite regularly once a week or oftener. Eight days run, without digging out and blowing in again, was considered rare practice. The Germania furnaces, running smoothly without such interruption, were a revelation in metallurgy and when larger and better furnaces were built, Mr. Eilers' fame spread far and wide and presently Clausthal and Freiberg and Swansea began to "sit up" and take notice of the new practice in lead smelting in the Salt Lake Valley.

In 1879 he was taken into partnership by Gustav Billing and as the firm of Billing & Eilers, they built the Arkansas Valley Smelting Works at Leadville, Colorado. At the Eilers' Plant in Pueblo, Colorado, built later, many young metallurgists, who afterward distinguished themselves in the smelting industry, received their early training under Mr. Eilers' direction. Among them was Col. Arthur S. Dwight, who perfected the Dwight-Lloyd sintering process. Mr. Eilers' active connection with lead smelting continued until 1909, thirty-three years from the time of his first success in lead smelting at the Germania.

The other early smelting plants at Murray were the Horn Silver or Francklyn smelter, built in 1881 and operated until 1885; and the Hanauer Smelting Works. The Hanauer was originally known as the Morgan Smelting Works, but ownership changed in 1883 and it's name was changed at the same time. It was bought by the American Smelting and Refining Company and closed down early in 1899. This completes a summary of the early smelting plants in Salt Lake County.

Smelters Were Built In Other Parts Of The State

Outside Salt Lake County, in American Fork Canyon, the Sultana smelter, (three stacks) was erected in 1871-72 and operated until the spring of 1875, on ores from the Miller mine. The furnaces at the Sultana were equipped with automatic siphon taps at a very early date. After smelting operations were suspended the furnaces were torn down to recover the lead contained in them and the slag dumps were profitably picked over four times before 1880. The charcoal kilns, which were of the beehive pattern and held about 25 cords, each, ran until 1877, making charcoal for the Salt Lake valley furnaces.

In the Rush Valley Mining District, activity in mining was renewed after completion of the transcontinental railways. The first carload of galena ore shipped from Utah is said to have come from the Silver King mine; it was shipped on schooner from Clinton's landing, across Salt Lake to Corinne; thence on the Central Pacific Railroad to Selby's Works, at San Francisco.

The first furnace built at Stockton in 1864, by General Connor, was bought in 1871-72 by I. S. Waterman. On this site the Waterman Company ran quite steadily for several years. During the four years, ending April 1, 1878, 26,270 tons of ore were smelted and yielded 8,312 tons of base bullion which sold for $109.64 per ton or $911,327. During this time, 3,300 tons of flue dust were caught which assayed from 36 to 57 percent lead and from 13 to 35 ounces silver. Other smelting plants in the district were: the one built in 1872, by Lilly, Leisenring, of Philadelphia, equipped with three furnaces; the Chicago smelter, built in 1873, at Slagtown, on the eastern slope of Rush Lake, about two miles from Stockton and finally shut down in 1880, and the Carson and Buzzo Works, half a mile south of the Chicago, built in March, 1873, just before Carson & Buzzo became interested in the Galena Smelter at West Jordan, built for smelting ore from the Old Jordan at Bingham.

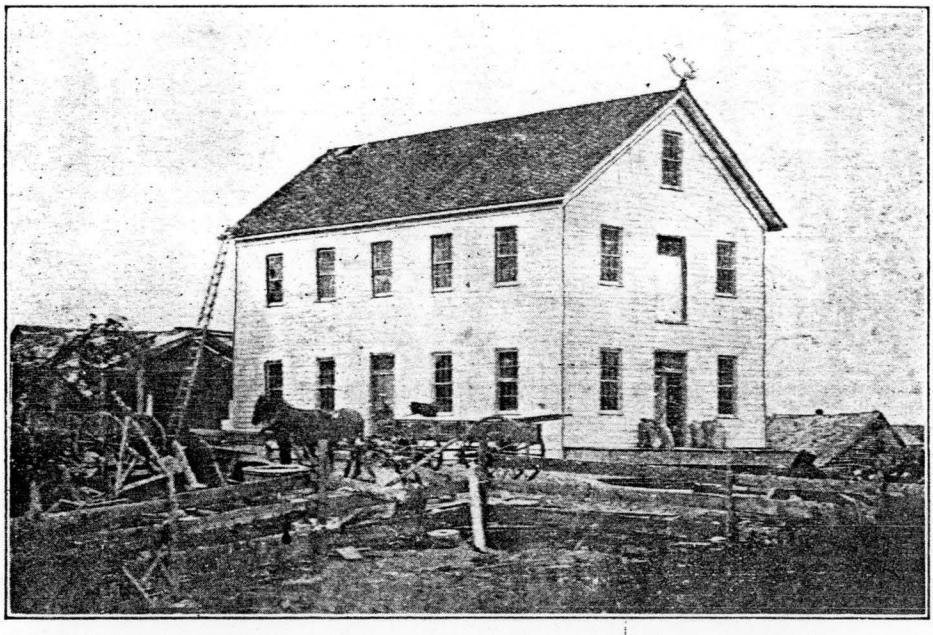
In the Ophir district, there were three smelting plants; the Pioneer smelter, built in 1871, which probably produced 125 tons of bullion, the Ophir smelter, built in 1872, which produced very little bullion, and the Faucett smelter, built in 1872, which made a small production. In the Tintic District, a plant built in 1871, by Homan, Clarkson and others, of Omaha, at Homansville, consisted of two furnaces with a capacity of from 20 to 30 tons of ore per day. It ran for a short time and produced several hundred tons of lead bullion, but was closed down and moved in 1872. Other smelting furnaces were erected in 1871 at Diamond City by a Fond du Lac Company. In 1874, the Germania Smelting Company erected furnaces in Black Dragon Hollow and later moved them to a site a mile and a half north of Millers, on Moore Springs.

In the Star District, in Beaver County, two small furnaces were built at Shaunty Springs in the summer of 1873. The next year these were torn down and replaced by one furnace with a capacity of 20 tons per day. This furnace was shut down in the summer of 1877, after having smelted a total of 12,000 tons of ore and produced 3,000 tons of bullion, containing $325,000 in silver and $10,000 in gold. The Troy furnace was erected in 1875, on the Beaver River, five miles south of Milford, to smelt Mammoth mine ore. It ran a few months. The Latey and Williams plant, a single stack custom smelter, was erected at Milford, in the autumn of 1876.

In the Clifton District a small furnace was built in 1871, and probably 150 tons of bullion were produced. It is said that the hostility of the Utes, Piutes and other marauding bands of Indians retarted the development of mineral resources in that district until the year 1870.

Operations of Mingo Smelter at Sandy, Familiar to Men at Midvale

Of all the smelters in existence before 1900, the operation of the Mingo, at Sandy, under "Sam" James, is most familiar to the older men in our Midvale Plant, many of whom worked there and say that Mr. James could put any kind of rock in a furnace and make it into bullion. Before Mr. James came to the Mingo in 1892, seven furnaces were in blast, smelting 85 tons of charge per furnace day, which made the total capacity of the plant 595 tons of charge per day. All the work of unloading, sampling, bedding the ores, and operating the roasters, was done by hand and 1200 men were employed. After Mr. James took hold of operations, he raised the blast on the furnaces from 12 ounces to 24 ounces pressure, put through 195 tons of charge per furnace day, and ran four furnaces, making a total of 780 tons of charge per day. Improvements for handling the ore were put in and the plant was finally operated by 500 men. The coke was all forked and the fines or "coke breeze", which were not only useless but harmful in furnace operations, were thrown over the dump.



General Patrick E. Connor, Bishop Archibald Gardner, of the L. D. S. Church, and a number of other men met in the building above shown in the fall of 1863, and formulated the first mining laws for Utah. The above picture was made in 1880. The original building has been remodeled by John A. Aylett, and with other buildings, it now houses the West Jordan Milling Company. In early days a pioneer sawmill, a mattress factory, a woollen mill, and a tannery were operated nearby. This building stands on the Salt Lake City - Midvale - Bingham Road, on the left bank of the Jordan River, immediately west of the Midvale Smelter.

Sandy Was At One Time The Greatest Smelting and Sampling Center In Utah

Nothing remains except the Mingo slag dump to suggest that Sandy, now the quiet town of homes and thriving gardens, was once the greatest shipping, smelting and sampling point in Utah. The smelters and sampling works of Sandy are gone forever, but if the oldest resident could bring before our imagination the phantoms of the past, we might see the early English owned furnaces, where all the smeltermen were Welsh and Irish; the long sheds at the sampling works, with a train unloading ore on one side and on the opposite side another train reloading it; and the streets blocked with teams and wagons hauling ore from Cottonwood and Butterfield Canyons, when the "skinners" could wash the dust from their parched throats at nineteen places, with something stronger than the water of Little Cottonwood.