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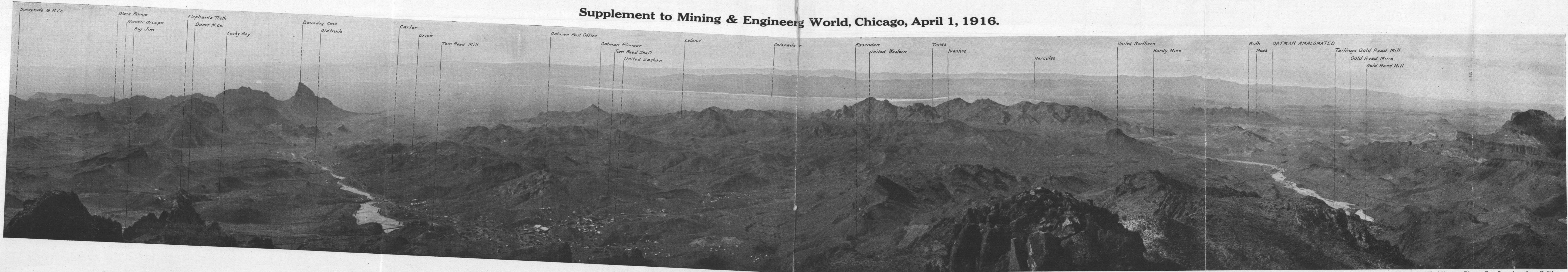
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Supplement to Mining & Engineering World, Chicago, April 1, 1916.



Panoramic View of the Oatman Mining District, Arizona.

Photo by Huddleston Photo Co., Los Angeles, Calif.

The Oatman District, Arizona

BY LEROY A. PALMER*

SYNOPSIS—A description of the mines and development of this new low-grade gold camp in Arizona, which it is believed will develop several steadily producing mines. A well-equipped town of several thousand inhabitants has resulted from these unusual and interesting developments.

The Oatman district is situated in Mohave County, Arizona, about 12 mi. east of the point where California, Nevada and Arizona come together. It is reached by stage from Kingman, Ariz., 27 mi., or Needles, Calif., 20 mi. distant. The early history and geology of the region were described by J. D. Speer in the *Journal* of Jan. 1, 1916, and so will be omitted here except to state that low-grade free-milling gold is found in shoots in fissure veins

backing of such men as D. C. Jackling, Philip Wiseman, Seeley W. Mudd and Frank Keith and others.

Broadly speaking, the veins of the district might be divided into four zones from north to south as follows: The Gold Road, Tom Reed, Vivian and Black Range. These exhibit distinct fissure systems, but appear to converge toward the southeast. Another zone might be distinguished toward the northwest in the vicinity of the Times, Hercules and Pittsburg. The veins in this locality have nearly east-west strikes, but it is probable that they properly belong to the other zones and have locally been deflected from their normal courses. The Gold Road and Tom Reed zones have been traced northwesterly for several miles, as far as Union and Secret Passes.

The low grade of the veins, many of which are concealed by detritus or flows, and the lack of bonanza ore have



THE CAMPS OF OATMAN AND OLD TRAILS, ARIZONA, AND THE SURROUNDING DISTRICT

under a capping 300 to 400 ft. thick. The real revival of the district occurred in the spring of 1915. The Tom Reed mine sunk a new shaft, crosscut and missed the vein. Two practical miners, George W. Long and T. L. McIver, formed a theory regarding the location of the vein, substantiated their theory by underground observations at the Tom Reed, and bought what they felt were the proper claims on which to find the vein. They were able to raise sufficient funds for the necessary development work, which revealed a vein of good ore 30 ft. wide at the 300-ft. level. This is the nucleus of the present United Eastern, which was placed on a firm basis by the

demonstrated the necessity of deep work and the development of sufficient backs to guarantee continuous milling operations before any attempt at output can be made. Because of the comparatively gentle topography, the hills not rising to any great heights above the surrounding country, there are few instances in which tunnels can be used. The customary procedure is to sink in proximity to the vein and crosscut at from 300 to 500 ft. depth. The andesite is not hard, breaks well and stands without heavy timbering, 8-in. sawed timbers being used in most of the shafts. Naturally timbers are expensive but with good superintendence a two-compartment and manway shaft can be sunk and timbered for \$30 to \$40 a foot.

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The first indications of the vein are small stringers of quartz and calcite scattered through the andesite and exuding water. At about the time these veinlets appear, the andesite walls show slight pyritization and will yield a little free gold in the pan. In the oreshoots the vein matter shows pronounced hematite and manganese stains.

Many of the veins show considerable width. The United Eastern averages 25 ft. across; the Big Jim was cut at an angle giving a width of 46 ft. and is estimated to have a width of 40 ft. The United Western went 15 ft. through the vein to a horse, and had just cut through the horse when water was encountered in such quantity as to make a temporary cessation of work necessary, so the width of the vein is not known. The oreshoots usually carry gold for the full width of the vein and may be anywhere from 50 to 350 ft. in length with about the same amount of barren ground.

Water is invariably encountered in the veins at depth, and although the flow is small, the handling of it has been the cause of some embarrassment. The supply of commercial electric power is limited, and consequently the rate is high. For this reason most of the mines have installed gasoline plants, which are obviously unsuited to underground pumping operations. At least one mine has installed a steam pump, but fuel is high and steam is always a disadvantage underground.

All the developing mines are equipped with gasoline power. Almost without exception the plants appear well-chosen and well-installed, and amply but not over equipped. Hoisting is entirely by buckets, which in many instances are equipped with the platform crosshead for the use of the men.

In the two producing mines three systems of stoping are in use. Some of the Tom Reed stopes are square-set, while the Gold Road is using the shrinkage system where possible, but has resorted to filling in some of its stopes, the condition of whose walls does not suit them to shrinkage. In general the andesite walls of the district, although brecciated to some extent, stand well, and this, in connection with the wide veins, some averaging 30 ft. for considerable distances, offers an ideal condition for shrinkage stoping methods to be used.

CONTINUOUS COUNTER-CURRENT DECANTATION USED

There seems to be no choice in the matter of milling practice. The gold is all free, but so fine that efforts to recover it by amalgamation have been wholly unsatisfactory, a saving of only 35% on the plates being realized in the early mills. The ore is, however, readily amenable to cyanidation at a reasonable cost and an extraction of 90% or better is obtained.

It is probable that the Colorado River, 2,000 ft. lower than Oatman, has established a permanent water level for this country. If such proves to be the case, the oxidized ores may reasonably be expected to extend to that depth, so that present milling practice will be standard for years to come with the exception of minor changes such as at present exemplified by the United Eastern, which will use ball mills for primary crushing instead of stamps, the old regulation standby.

While the Gold Road mill has been described heretofore, a brief outline of the practice at this plant will be given as exemplifying the milling system that will undoubtedly be generally adopted for the treatment of these ores. The ore is hauled about 1,000 ft. from the crusher bins at the

shaft in mule-drawn trains and dumped to the battery bins. From these it is fed by swinging feeders actuated by a stamp tappet to eight 5-stamp batteries of 1,050-lb. stamps, where it is crushed in solution. The pulp from the batteries goes to five duplex Dorr classifiers, the sands from which go to four 4x22-ft. tube mills using Danish pebbles. From this point on the process is a continuous counter-current decantation using Dorr thickeners and Pachuca tanks.

Instead of using filter presses for the separation of the tailings, the solution is displaced in the last series of tanks by water from the mine and the tailings discharged continuously from the bottoms of the tanks. The pregnant solution is clarified, mixed with zinc dust and passed through a Merrill press. The precipitate is roasted and run down in a tilting furnace. Extraction by this process is 92% with a consumption of one pound of zinc and six-tenths of a pound of cyanide per ton of ore treated. Costs are from \$2.50 to \$2.75 per ton, but it should be borne in mind that present costs of any chemical treatment can hardly be taken as a fair criterion. The mill is treating 260 tons per day.

TYPICAL MINES OF THE VARIOUS ZONES

Obviously even a brief description of all of the operating properties in the district would be out of the question. Very brief mention will be made of one or more of the mines on the different zones, but it should not be assumed that the property chosen is necessarily any more representative than some other might be.

The most important mine on the Gold Road zone is the mine of that name. The geologic formation at Gold Road is the same as that throughout the district, but with the peculiarity that here veins are found in the rhyolite dikes as well as in the andesite. The mine is opened by two shafts, No. 1 and No. 3, which are 800 and 1,100 ft. deep respectively, the 1,100 level at No. 3 being equal to the 900 level at No. 1. The main workings are on the 700 level of the No. 1 shaft. The vein is from 8 to 10 ft. thick and is mined by shrinkage stoping and filling. In the earlier days of the mine an open stope was carried from the 800 level clear to the surface.

The ore is hoisted at the No. 1 shaft by a 15-hp. variable-speed electric hoist with double drum, operating one automatic dump skip and a counterbalance. It is dumped to a bin from which it goes over a grizzly to a 5K Gates gyratory crusher and thence through a raise to a bin gate in a tunnel 50 ft. below. The tunnel is on a level with the bin track at the mill, and transportation is effected by mule-drawn trains.

A central power plant with 200-kw. motor drives a 15x25x20 Ingersoll-Rand two-stage compressor and a dynamo for the lighting system. The compressor supplies air at 100 lb. to both shafts and the mill.

Gold Road is producing approximately \$700,000 per annum. It is paying dividends, but the amount is not given out, all of the stock being owned by the United States Smelting Co.

Just at present the Gold Ore mine, joining the Gold Road on the north, is attracting considerable attention from the fact that it has become a producer on a small scale. The company, operating to the 550-ft. level, has opened some rich shoots in a 6-ft. vein, but is taking out only its low-grade ore and sending it to the Gold Road mill, mainly to dispose of ore taken out in development

and to determine if Gold Road milling practice is suitable to its ore.

A new property, on which the only development is a 50-ft. shaft sunk by hand, is the Midas. It is on the Gold Road zone some distance beyond the Moss and is of interest in proving the continuity of the vein system. In its present stage of development nothing can be said of the Midas further than that surface conditions are as favorable as those usually found in the district.

The Tom Reed is operating from one main shaft which is 900 ft. deep with about 4,000 ft. of drifts. Milling practice is similar to that at the Gold Road, but the mill is smaller, having a capacity of 125 tons a day. Dividends to date are in excess of \$2,500,000.

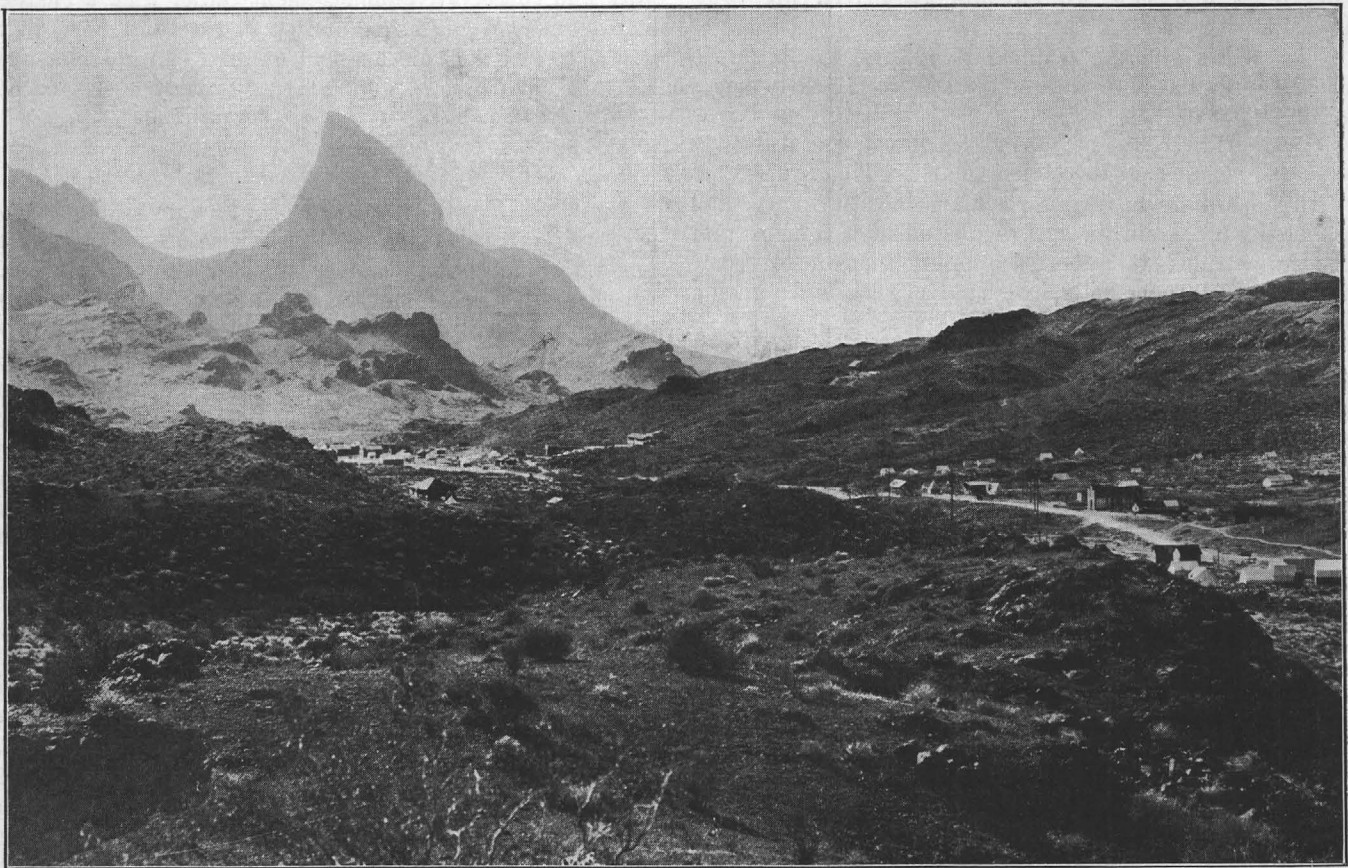
It was the loss of the main Tom Reed vein that led Long and McIver to start the work that resulted in mak-

Grading for a mill is in progress near the shaft. It will follow the general practice of the district, but will use ball mills for primary crushing instead of stamps.

Of the new mines, next to United Eastern, Big Jim is probably the most developed. This mine has crosscut a 40-ft. vein on the 400 level and, at the time these notes were made, was expecting to reach the vein on the 500 any day. The average of the vein from wall to wall is \$7.44, but it is expected that the average of the ore handled will be increased by careful mining.

Big Jim is one of the best financed companies in the camp and, now that ore seems to be assured, is preparing to equip with larger compressors and 150-hp. electric hoist, steel gallows frame and mill.

Another mine on the Tom Reed zone is the Oatman Gold on a vein system paralleling the main Tom Reed



THE CAMP OF OLD TRAILS, WITH BOUNDARY CONE PEAK IN THE DISTANCE

ing a mine of the United Eastern. The old shaft has been carried down 700 ft. with levels at 307, 463, 565 and 665 ft. All these levels have found ore and about 2,000 ft. of drifting has been done. Various statements have been made as to the value of the ore blocked out. Inasmuch as the most conservative, \$10,000,000, comes from the management, it is safe to regard these figures as authoritative. The average value is from \$24 to \$25 a ton; all samples running over \$100 a ton being disregarded.

The shaft is equipped with a 30-hp. gasoline hoist and a 12x7½-in. straight-line compressor. A new two-compartment shaft is being sunk about 1,000 ft. from the old one, and the machinery has just been installed. This consists of a double-drum hoist geared to a 150-hp. variable-speed induction motor and a 150-hp. motor belted to a 12x19x16-in. two-stage Ingersoll-Rand compressor.

vein and extending northwesterly through the Fessenden. The Oatman Gold has sunk to the 500 level and extended a 15-ft. sump on its Kokomo vein, which appears for 4,500 ft. within its lines. At the Kokomo shaft two small feeders intersect the main vein, and these feeders show rich ore. The shaft is equipped with a 20-hp. gasoline hoist and a 14x8¾-in. 300-cu.ft. compressor.

As previously mentioned, the United Western has cut a 15-ft. vein, but has been delayed from proving it on account of water. The 15 ft. gave assays running from \$8 to \$16. This vein outcrops noticeably on the surface and at a depth of 65 ft. ran \$2.50 to \$3 a ton. It is equipped with a 50-hp. hoist and a 14x15-in. three-drill compressor belted to a 60-hp. gasoline engine.

The Tom Reed zone is the most developed and the one on which the most interesting discoveries have been made.

The Vivian zone is so-called from the Vivian mine, which, in times past, had a production estimated at \$100,000, but which has been idle for several years. In this zone are the Gilt Edge, Boundary Cone, Dome and several others. These properties are in the prospecting stage.

The principal mines of the Black Range, the most southerly zone of the district, are on a very prominent quartz outcrop, locally called the Nellie vein, which can be traced across the country through the Black Range and Nellie groups for several thousand feet and which, having resisted erosion more than the inclosing andesite, stands up boldly to a height of 25 ft. or more.

The Black Range has sunk a shaft to a depth of 300 ft., which cut the vein at 150 ft. At the 300 a crosscut was started and run 120 ft., when it was found necessary to stop work until equipment could be installed for handling the water. The equipment consists of a 60-hp. gasoline hoist and two straight-line gas-driven air compressors.

The Nellie and the Oatman Syndicate, the latter in control of J. Parke Channing, are still in the early stages of development.

South of the Nellie and the Black Range operations are just commencing on the Green Quartz. This property is distinguished by having a peculiar chloritic quartz and producing ore, from the surface, of sufficient value so that the former owner supported himself thereon for some years by the crude method of hand mining and working his ore in an arrastre.

What is sometimes called the Northwest zone embraces the Times, Pittsburg, Hercules and a number of neighboring properties, in which the veins have a general easterly and westerly strike and a northerly dip. It is probable that development will demonstrate that these veins are continuations or offshoots of the main fissures which, locally, have taken a different course.

The Times, considering the stage of its development, is one of the best-equipped mines in the district. A 22-ft. vein, supposedly a continuation of the Tom Reed, was found on the surface, and assays from a general sample taken out while excavating for the hoist returned \$27 a ton. A shaft has been sunk 150 ft., and cross-cuts are being driven to the vein, and at another point it has been reached by a 300-ft. tunnel. Equipment consists of a 25-hp. gasoline hoist and a 14x8 $\frac{3}{4}$ x10-in. angle compound compressor belted to an 80-hp. engine.

BOOM BASED ON QUANTITY MEANS STABILITY

While it is no doubt proper to designate Oatman as a boom camp, it is different from other boom camps of recent years. Strikes have been sensational from the standpoint of quantity rather than quality, and from the start it has been recognized as no poor man's camp. This has brought home the fact that while the district has great possibilities, it is going to take money to realize them. Everywhere there is a spirit of optimism and enthusiasm, but the hysteria that accompanies the possibility of getting rich over night is lacking.

All transportation of passengers is by automobiles, and motor trucks are used for all the freight except that destined to be hauled over the steepest roads, in which case string teams of ten, twelve or even more horses or mules are used. Freight rates are rather high—\$12 to \$15 a ton from Needles or Kingman—but the necessities of life are very reasonable in comparison with other districts

similarly situated. With the exception of certain commodities, particularly hard to get, such, for instance, as fresh milk, it is probably a fair estimate to say that ordinary living expenses are not more than 20 to 25% higher than in the Coast cities. Rooms can be had for a dollar a day and upward, and a good meal can be bought for from 50 to 75c.

A stock exchange has been formed recently with a membership of 47, of whom it is expected that 15 to 18 will engage in active trading. The first session was held Apr. 10 and 28,100 shares were sold at an average price of 38c. per share. This move has been looked at askance by many who have seen the baneful effects of stock manipulation in some of the Nevada camps. It is hardly likely, however, that it will have a serious effect on legitimate operations in Oatman. For one thing the fact that the actual value of the mines will depend on systematic development work and conservative management rather than a chance lucky strike will limit speculation in the stock. Another reason is that Arizona has and enforces a rigid blue-sky law. A repetition of the Sullivan Trust Co. or Nat C. Goodwin & Co. is not possible in Arizona.

ARIZONA LAWS CHECK WILDCATTING

Many will recall the incident of a certain Nevada "copper" whose treasury stock sold up to about a dollar a share under the manipulation of a famous operator, only 20c. per share of which found its way into the treasury. This could not occur in Arizona, as the law specifies that a certain percentage (85, I believe) of the money derived from the sale of treasury stock must actually be paid into the treasury. Further, it is provided that promotion stock must be pooled and not thrown on the market until the company is properly financed, so that the money paid for stock in the financing stages of a mining venture actually goes to the development of the mine and not to enrich some promoter.

Operating under these restrictions there has been more money actually paid into the treasuries of the various mines than in any other camp of recent years at the same period in its history. It is also true that development and operation have been on a more systematic scale and under more practical mining men than has been the general rule.

As a matter of uniformity the managers recently got together and adopted the following scale of wages, which was accepted by the miners. There is a union in the camp, but membership is not compulsory and the district is open. Following is the scale that went into effect Apr. 16:

Hand miners	\$4.00
Hand miners in shaft.....	4.50
Machine miners	4.50
Machine miners in shaft.....	5.00
Timbermen	4.50
Muckers, trammers, nippers and topmen.....	4.00
Millmen	\$4.00-4.50
Minimum for unclassified labor.....	\$3.50

Power for operating is one of the problems of the district. There is no hydro-electric power available and only one commercial power company—the Desert Light and Power Co., of Kingman. Consequently most of the companies have installed their own gasoline plants. Power from either source costs about \$15 a horsepower-month.

Costs of mining and milling should be fairly uniform throughout the district. Total costs at the Tom Reed are in excess of \$8 a ton, but it is the general opinion that this is too high. One engineer has submitted tentative

costs on cyaniding at a maximum of \$2.30 per ton under normal conditions and it is generally considered that on a basis of moderate production total costs should not exceed \$5 a ton.

A WELL-EQUIPPED AND SUBSTANTIAL TOWN

Oatman has gathered its population from all the mining districts of the West. The man who went over the Skagway trail in '97 rubs elbows with the old timer from Gilpin County or the man who shipped the bonanza car from the Hayes Monette lease, all brought there by the same attraction.

The influx has been greater than there were permanent accommodations for, and the whole district is dotted with tents and small shacks. But for so young a town Oatman is unusually well equipped to supply the necessities and comforts of life. There are churches and schools and, except the saloon, every conceivable business, even to a hairdresser and manicure. There are several large stores carrying good stocks; business is good and collections prompt. There are three banks, one strictly local and two branches of larger institutions at Phoenix and Kingman. Oatman has electric lights, Postal and Western Union telegraph, local and long-distance telephone service, three hotels, numerous rooming houses, two weekly newspapers, two first-class picture shows, several restaurants, one with an orchestra, dance floor and near-cabaret, a roof garden and men's social club.

The residents have been too busy to get together and incorporate a city, but the business and social welfare is overseen by the Oatman District Chamber of Commerce, which has 150 members and a very much on-the-job secretary. Through its efforts the town has been equipped by means of private subscription with a water system with fire plugs and a volunteer fire department with hose cart and chemical engine. The locality is naturally healthy, and to keep it so, the Chamber of Commerce has distributed garbage cans and disinfectants to the residents, calling their attention to a state law enjoining the use of such preventatives of disease.

As soon as Oatman realized it was shooting out of its knickerbockers, it took steps to make a city of itself. Jan. 1 Main St. was a wagon trail in a gully with buildings every which way. Now it is a four-rod surfaced street with the buildings bearing at least a semblance of alignment. There are several three-story buildings, and some of the office buildings have a neat stucco finish.

The town is supplied with good water from springs, which is pumped to large tanks at an elevation sufficient to give ample pressure for fire protection. The supply is sufficient for a town of 8,000, and other sources are available from which the total supply obtained would answer for twice that number.

A BOOZELESS BOOM

Oatman is dry and glad of it. Notwithstanding a recent Supreme Court decision holding that one could bring liquor into the state provided he did not sell it, Arizona has started out to prove that prohibition can be made to prohibit. Needles, Calif., is only 20 mi. distant, with liquor galore, but in four days in a real live mining camp I saw only two cases of intoxication, both slight, and I know that one of them came from Needles.

There are two police officers in camp, a deputy sheriff and a night watchman. The deputy has about the easiest

job of anyone in the district, his most strenuous duties being to keep the traffic moving, and the night watchman was engaged only Apr. 1 as a precaution against fires.

I learned of only one case of claim jumping, which was settled amicably. There have been only two public fights in the last four months and not a shooting scrape since the newcomers came in. One of the most peaceable men in the place has been known as a notorious gunman through many of the boom camps of recent years. Not feeling properly dressed without his favorite Colts and learning that he could not pack them without a permit, he applied to the sheriff only to be told that there was strictly nothing doing. So, like all of the rest, he goes about his business without his "irons" and finds that he has no use for them in this model community.

An attempt has been made to inject a touch of high life into the district at the "49 Camp," about half a mile from Oatman proper. Here there is a dance hall with the usual appurtenances, but it is a pretty tame affair and the strongest you can buy your lady is "Tally—Guaranteed no alcohol." If there is a game of stud, a faro layout or a roulette wheel in the camp, only the initiated know the trail and they are not telling it. The streets are alive in the early evening, but about the time the movie show lets out the lights are dimmed and there is a general movement toward bed, to be ready for another day.

All these restrictions have a very important bearing on the great industrial problem. This was sized up very tersely by one of the older residents of the camp. The conversation had turned toward the possibility of labor trouble, when he said: "Well, you know a miner is a natural-born spender. He has to spend his money for something. Up here he can't put it into booze or over the table so he is investing in stocks in these mines, and these fellows aren't going to be in a hurry to start anything that will hit their own pocketbooks unless they have a real grievance."

I learned by inquiry that this statement is true and that an unusually large number of the men, especially the older residents of the camp, have invested in local stocks. Sentiment as to prohibition is unanimous. Miners, operators and business men declare that business is better than with liquor and gambling and that their absence is directly responsible for the orderly condition of the district

WILL BE A LARGE LOW-GRADE CAMP

The "expert" has been fooled so many times that the engineer who has the temerity to predict the future of a new camp is generally regarded by his colleagues as rushing in where angels fear to tread. However, developments at Oatman are now sufficiently well advanced to allow of some prediction of the possibilities of the district. The Gold Road and Tom Reed are proven mines. The United Eastern, with its \$10,000,000 of probable ore, can certainly be called a mine. The Big Jim will soon have done sufficient work to entitle it to this dignity. Possibly United Western will soon be in that class also, as well as some of the others.

The veins are traced for great distances along the surface, they are wide and are unquestionably true fissures. The natural conclusion is that they have depth. Whether the ore persists, to depth, development alone can demonstrate, but even if they do not extend beyond the proven limits of the Gold Road and Tom Reed, there will be ore in the district for a generation to come.

It must not be assumed that all the mines now developing are to become dividend payers or even producers. Inevitably, some of them, especially the later ones, which took the ground left between the pronounced mineral zones, will draw blanks. But I believe that from the production standpoint the Oatman district will be comparable with the Tintic district of Utah. Tintic has produced steadily for the past 45 years. The ore is in shoots, and from time to time a mine lacking development drops out, but there is always a steady output from a large number of mines and a goodly portion of them are paying dividends.

As yet the geology of the district is little understood, and it may be that future developments will reveal possibilities not now recognized. The orebodies of Goldfield were twice delimited before Jumbo Extension drove into the shale-latite contact and made a bigger mine of itself than it had ever been before.

It is hardly to be expected that Oatman will produce another "Big Bonanza" or another Homestake, but I believe that the conservative attitude of the people and the investors, the employment of practical mining men to handle the mines and the money available for development work give reason to believe that it will eventually become a large low-grade gold camp with several productive properties of moderate size which can be depended on for production and dividends for some years to come.

Utah Copper Quarterly Report

The report of the Utah Copper Co. for the first quarter of 1916 shows a production of 36,564,533 lb. of copper—11,999,910 lb. in January, 11,849,972 lb. in February and 12,714,651 lb. in March. The total ore treated was 1,984,600 tons of average grade of 1.4333% copper. Average extraction was 64.27%.

After making allowances for smelter deductions and crediting miscellaneous income, including Bingham & Garfield Ry. earnings, the average cost of copper was 7.19c. per lb. Total net profit was \$7,079,830; dividends paid, \$4,061,225; and net surplus, \$3,018,605. Earnings are computed on a basis of 26.131c. per lb. for copper. Dividend paid on Mar. 31 was at the rate of \$6 per year, plus an extra dividend of \$1 per share.

Ray Con. Quarterly Report

The report of the Ray Consolidated Copper Co. for the first quarter of 1916 shows a production of \$15,801,568 lb. of copper—4,164,043 lb. in January, 5,539,408 lb. in February and 6,098,117 lb. in March. In addition to the copper from concentrating ores, 608,540 lb. was contained in ore smelted directly, making the total copper output 16,410,108 lb. Total ore milled was 745,940 dry tons, an average of 8,197 tons daily, assaying 1.631% copper. Milling cost was 57.59c. per ton, and mining and coarse-crushing cost was 69.23c. per ton, 5.02c. of which was for coarse-crushing.

Average net cost of copper per pound was 10.579c., including 12½c. per ton for mine-development cost, and after crediting dividends of the Ray & Gila Valley R.R., revenues from gold and silver and all other miscellaneous income. Total of profit and income was \$2,205,547, leaving a net surplus of \$1,416,245 after paying dividends of \$789,302. Earnings are based on 24.598c. per lb. for cop-

per. All unsold copper was carried at 13.5c. per lb. The ninth quarterly dividend of 50c. per share was paid on Mar. 31, a total of \$788,564.50, and \$737.50 was paid as part of the eighth dividend on 1,475 shares, the result of conversion of bonds delayed in transit on account of European conditions.

Nevada Con. Quarterly Report

The report of the Nevada Consolidated Copper Co. for the first quarter of 1916 shows a production of 6,157,862 lb. of copper in January, 6,436,853 lb. in February and 6,565,559 lb. in March, a total of 19,160,274 lb. The tonnage of ore treated was 827,880, averaging 1.66% copper. The cost of copper, including Steptoe plant depreciation and all charges except ore extinguishment, and after crediting miscellaneous income, was 9.65c. per lb. Earnings are computed on a basis of 23.478c. per lb. for copper, and all unsold copper is inventoried at 13.5c. per pound.

The surplus for the quarter was \$1,782,083, after paying the twenty-fifth dividend of 37½c. per share and extra dividend No. 4 of 12½c. per share; \$142,360 was set aside for plant and equipment depreciation and \$83,498 for ore extinguishment, leaving a net credit to earned surplus for the quarter of \$1,556,224 and a balance of \$6,405,780 in earned surplus.

Chino Quarterly Report

The report of the Chino Copper Co. for the first quarter of 1916 shows a production of 5,316,975 lb. of copper in January, 4,617,220 lb. in February and 6,333,255 lb. in March, a total of 16,267,450 lb. The total amount of ore treated was 714,400 tons, containing an average of 1.8719% copper. Average extraction was 60.82%, or 22.77 lb. of copper per ton milled. Of concentrates, 58,073 dry tons was produced, averaging 14% copper. From shipping ore 47,014 lb. of copper was produced.

The cost per pound of net copper produced was 8.95c., an increase of previous cost due to the lower grade of the ore treated. The total net income was \$2,746,987, leaving a surplus of \$1,659,512 after paying \$1,087,475 in dividends. Earnings were based on 26.566c. per lb. for copper and all unsold copper on hand and in transit at the end of the period is inventoried at 13.5c. per lb. The dividend for the quarter was \$1.25 per share—at the rate of \$5 yearly.

Potash in Lake Muds of Western Utah

Potash in large proportions is present in the brines and muds of the Salduro Marsh, a sink in the Salt Lake Desert, about 60 mi. west of the southwest edge of Great Salt Lake. From the clays underlying the salt body which covers the marsh, the United States Geological Survey collected samples at depth of 8 to 12 ft., in which the dissolved salts were found to contain from 2 to about 3½% of potash, and 2¼% was found in the soluble salts at a depth of about 4 ft. According to analyses made by the Survey, the brines and muds from the Salduro Marsh contain considerable magnesium chloride as well as chlorides of potassium and sodium, and so are similar to the German potash deposits.

Arizona
Walter Harvey Weed

Mining Engineers' Opinions on the Oatman District, Arizona

C. H. James, London, Engineer.—

"After considerable inspection I have reached the conclusion that the future of the Tom Reed-Gold Road mining district is greater than any other mining camp in America. The present prospective stage will be followed by a great amount of development at depth and the opening of large ore reserves. The great extent of the district is one of its striking features. It is not confined to one belt. Neither is it a camp for small operators, although as in all other gold camps of note the initial work of the small operator is proving an incentive for activity on the part of the larger operators.

"Another striking feature of the local field is that the ores so far found are very easily treated by the cyanide process and so far there is nothing to fear in the way of expensive or complicated treatment methods. With the complex system of dikes and cross fractures which constitute the main structure feature of the field, it will no doubt take a great deal of development at depth to give a general working knowledge of the many vein systems of this field. But as each of the operating mines continues development it will be an easy matter to locate and determine the several forms of ore shoots.

"The fact that very few of the ore shoots now being worked showed pay values at or near surface has demanded of the operators a more than ordinary degree of enterprise in opening up properties. This, no doubt, will still be demanded in the future, but the excellent results of practically all deep development in this field, coupled with similar surface indications, amply justifies great mining activity in the district."

Allen G. Burris, Cripple Creek, Colo.—

"I am convinced that the Tom Reed-Gold Road mining district will in future years record a production of gold in excess of Cripple Creek's enviable record. This district is a marvel and holds one of the most marvelous gold mines ever discovered—I refer to the United Eastern. It has a most remarkable ore body and is unquestionably one of the greatest gold mines in the United States. I believe, however, there are other ore bodies here the equal of that opened in the United Eastern. On the 70 acres we recently bought from the Pioneer people, for instance, we have approximately \$250,000 worth of ore in sight at surface, the shoot in question being one of the few in the local field to outcrop. The Lilah ore shoot on the property of the Arizona-Tom Reed Co.'s ground, adjoining, can be traced at surface for a length of 3000 ft. It is well-defined and well-mineralized. The mineralogical and geological conditions of the entire district demonstrate a wide distribution of precious

metal values and warrant extensive mining operations."

J. Parke Channing, New York.—

"I am inclined to think that there are a great many ore bodies in the Tom Reed-Gold Road district which do not outcrop. Peculiar mineralogical conditions have probably brought about pronounced leaching near the surface and the redistribution of values at greater depth. After making a trip through the underground workings of the United Eastern mine, I am of the opinion that it has the greatest ore showing to be found in Arizona, and is entitled to rank among the greatest gold mines on this continent. There are similar conditions obtaining in other localities of the district, and there is undoubtedly a strong probability that those at present in the outlying areas will produce mines of substantial importance. The entire district is very pleasing to me and unquestionably has a great future."

E. W. Brooks, Arizona.—

"The mineralized area of the Tom Reed-Gold Road mining district appears to be exceptionally large, extending something like 25 miles along the axis of the range with a width varying from 2 to 5 miles. Mineral veins are numerous and their outcrops can often be traced for several thousands of feet, due to the silicification of the vein matter and its consequent resistance to weathering, which has worn down the softer wall rocks on either side, leaving the veins outcropping above the general level. In other cases the outcropping of some of the large veins are not easily distinguished, owing to the vein filling being softer than the inclosing walls. They all appear to carry small values in gold at and near surface. The true ore shoots, however, have thus far been found at a depth of from 100 to 300 ft. I have noted many veins striking in all directions, many of them appearing to converge to a common point. Those which have thus far been found productive have a northwest-southeast trend. It is not my intention, however, to convey the impression that veins having a different strike will, for that reason, be found unproductive."

Walter Harvey Weed, New York.—

"A prominent feature of the Tom Reed-Gold Road mining district is the occurrence of many dikes whose wall-like outcrops are traceable uphill and down, often for many miles across the country. These dikes are the veins along which most of the mines are located. Some of them are doubtless true dikes, fissured and mineralized by vein forming agencies. Others are true fissure veins along which mineral solutions have soaked into the wall rocks, altering and silicifying

them, so that their hardened quartzose texture has resisted erosion and the vein and its silicious wall rock have weathered out in relief. Almost all of the better known properties of the district have been located along such veins. Other veins occur, but are less readily found, and until recently, since the discovery of rich ore in a vein of this nature in the United Eastern mine, were unfavorably regarded. In my opinion both types of veins are worthy of exploration."

Primary Mercurial Resistance Standards.

Although electric light and power are today in almost universal use, the average consumer pays little attention to the manner in which the amount of his bill is determined.

He knows that his consumption of current is reckoned from his meter, but he does not know how his meter was originally adjusted or how it is checked from time to time to determine if its indications are correct. Only in rare instances does he know very much about the electrical units in terms of which his measurements are expressed and still less concerning the fundamental electrical units to which these measurements are referred.

These fundamental units, the ohm (the unit of resistance) the ampere (the unit of current) and the volt (the unit of electromotive force) were defined by the International Congress on Electrical Units and Standards (London, 1908) and have since been internationally adopted.

The Bureau of Standards, of the Department of Commerce, has just issued a publication, Scientific Paper No. 256, dealing with the construction of four standard ohms.

This unit was defined by the London Congress as the electrical resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.4521 grams in mass, of a constant cross-sectional area and of a length of 106.300 centimeters. The work done at the Bureau of Standards consisted in the construction of material standards representing the unit realized in the form of mercury columns in glass tubes, and the work involved measurements of the highest accuracy of the length, the departure from uniformity of the cross-section and the mercury content of each tube, as well as their comparison with working standard. All measurements had to be made at the melting temperature of ice prepared from specially purified water which was used in order to avoid any temperature uncertainty due to possible impurities in the ice.

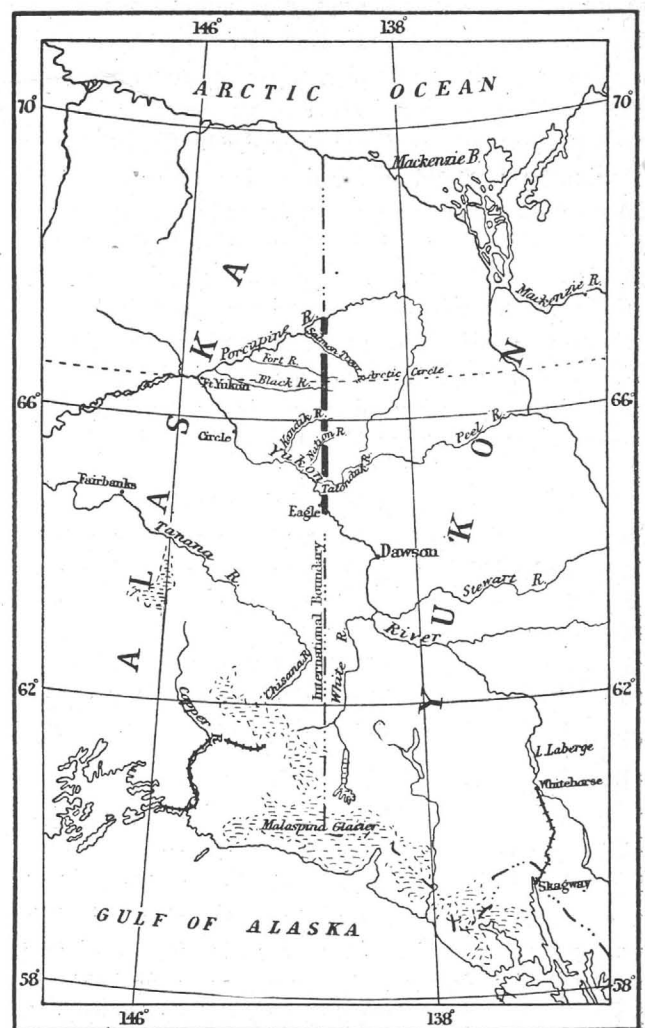
Electrical comparisons of the four standards showed the average deviation of their individual values from their mean value to be less than one one-hundred thousandth of an ohm.

England, Germany, France, Russia, Japan and the United States now have mercury standards of resistance which all agree to a high accuracy.

Similarly accurate work has been done at the Bureau with regards to the ampere and the standard volt, so that the public can be assured that the electrical standards maintained at their national standardizing laboratory are of an accuracy far exceeding any commercial requirements.

Copies of the publication referred to may be obtained without charge from the Bureau of Standards, Washington, D. C.

From figures furnished by express companies engaged in forwarding bullion from Alaska to the United States, the Fairbanks region has shipped this year more than \$200,000 worth of antimony.



YUKON-ALASKA INTERNATIONAL BOUNDARY BETWEEN PORCUPINE AND YUKON RIVERS.

The mineral resources of the district include deposits of iron-containing minerals, coal, marble, lithographic limestone, and magnesite. Iron-containing minerals, chiefly hematite, magnetite, and their oxidation products, comprise a considerable percentage of certain beds occurring in the southern part of the district, and portions of some of these deposits contain up to 30% or even possibly 40% of metallic iron. On Tatonduk river, also, a few coal seams not, however, exceeding 2 ins. in thickness, are noted in carboniferous shales. In addition, marble, lithographic limestone and magnesite are somewhat extensively developed in certain localities. Owing to the remoteness of their occurrence, however, none of these deposits are of present economic importance.

NOTE BY G. M. COLVOCORESSES
re Visit to OATMAN AMALGAMATED
CLAIMS in May, 1930.

The shaft is caved in a short distance below the collar and would have to be cleaned out and timbers repaired before any underground inspection could be made. Moreover, I assume that the water has risen above the lower levels.

Most of the buildings have been wholly or partially wrecked and the mining equipment has been removed, with the exception of a gas engine hoist equipped with cable. I noted also a considerable amount of pipe in place, some ore buckets and tram bars.

The head-frame is still standing and the hoist house is in fairly good condition and some lumber in bad shape has been left in the other camp buildings.

I had opportunity to discuss this property with two engineers who were familiar with same while it was operating and understand that at various points in the mine some pockets or seams of fairly good ore were found but no large ore body developed. Also I was told that at depth the property ran into a zone of soft broken ground in which there was a heavy flow of water and progress thru which involved heavy timbering and pumping.

The surface exposures on the property appear rather attractive, altho I did not take occasion to visit them in detail and the location and general geology would indicate that it is in line with some of the larger ore bodies in the Oatman District and would constitute favorable prospecting ground.

A more thorough investigation of this mine would seem to be in order, altho the action of the owners in discontinuing all developments does not argue in favor of its having any value.

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Arizona

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Oatman and the Tom Reed-Gold Road Mining District, Arizona

By ETIENNE A. RITTER.*

Oatman is experiencing a genuine mining boom, and many old-timers from the early days of Cripple Creek, Tonopah and Goldfield mix there again together and with the throng of the newcomers.

In a way, the district is an old one, the Moss mine in the northern part of the area having been discovered in 1863 or 1864, and a number of other properties having been located from time to time since then.

The two main producers of the district, the Gold Road mine and the Tom Reed, were located in 1900, and have been worked continuously since. Both have their shafts 900 ft. deep, with the ore going down deeper, and have explored the lodes for distances of several thousand feet on their strikes. The Gold Road has one continuous ore shoot 1200 ft. long, and has mined ore in quantities for a distance of 4000 ft. on the vein. The Tom Reed mine has mined for similar distances.

The Gold Road mill treats about 9000 tons per month, which is said to average about \$8 to \$9. The gross past production of the mine is estimated at over \$6,000,000.

The Tom Reed mill treats 4000 tons per month of quite high grade for milling ore. The value of the ore treated averaged from \$20 to \$40 during the last few years.

The total production to date exceeds \$6,000,000. The cost of mining and milling is between \$8 and \$9.

Yet what has attracted the attention of the outside world has been the development last year of remarkable ore bodies in the United Eastern and Big Jim mines, below outcrops which hardly show on the surface of the ground. Since then, development has been carried actively on a score of properties, and the results obtained have kept the enthusiasm and have increased the confidence in the future of the district.

Peculiar Geological Conditions.

Due to peculiar geological conditions, several ore

*Mining Engineer, Colorado Springs, Colo.

bodies, which have proven of great value at depths ranging from 200 to 600 ft., do not show up on the surface, and the veins themselves are quite inconspicuous. This forces the mine operators to thorough, and, of course, rather expensive prospecting by shaft sinking, to a depth of several hundred feet before starting any crosscutting or drifting. Yet more than 100 companies have been formed; about 40 of them have started work or are carrying on actively extensive mining operations, and a dozen of them have opened up bodies of milling grade ore.

Oatman is no poor man's camp, on account of the expensive work required for prospecting at depth, and because of the fact that, so far, the ore bodies when found have to be milled on the ground. This calls for another heavy outlay of capital. Yet it must be said that the companies which are operating have gone into the work in the right way, and that all the mining done is done through first-class shafts, well timbered, with good headframes and equipped by modern and substantial plants of machinery.

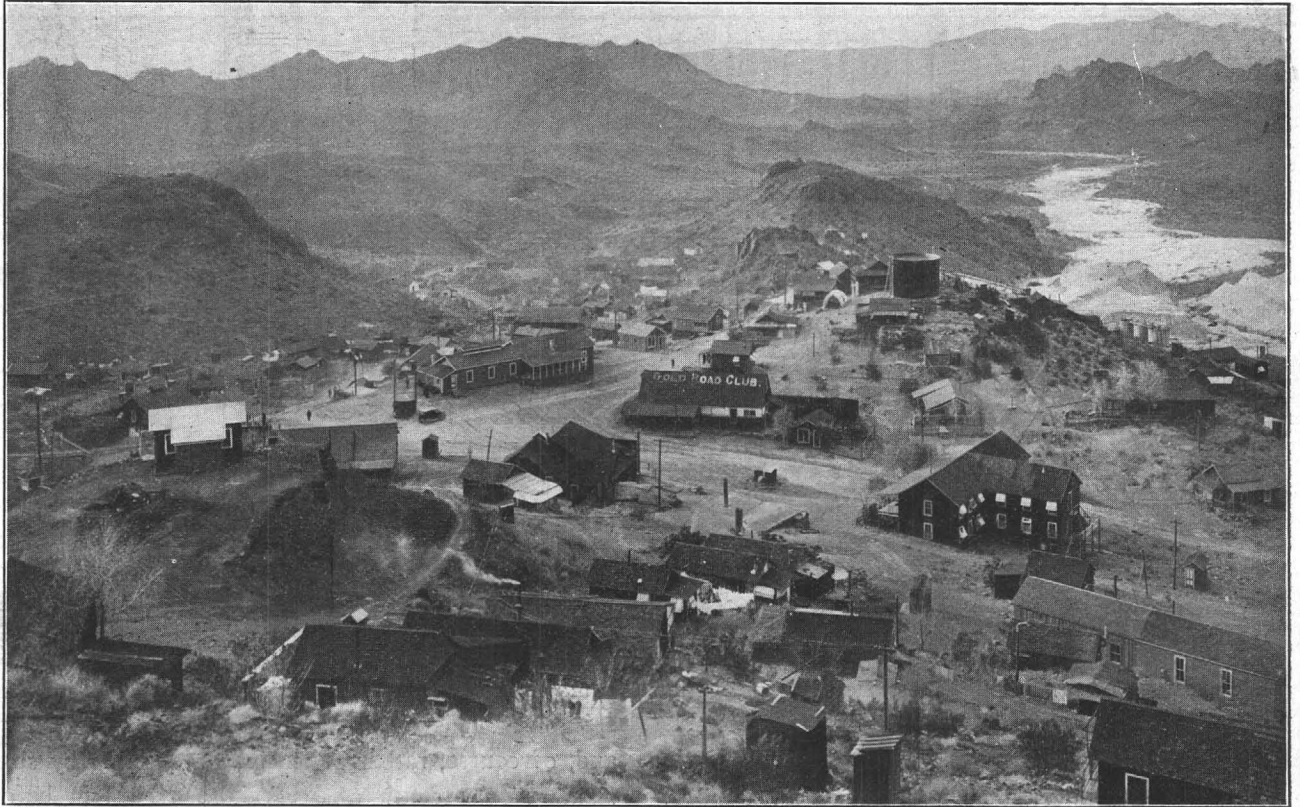
Importance of the Automobile.

Here gasoline is king. All the passenger travel is done by automobiles. Ever so often a barker walks up and down the main street of Oatman calling through the megaphone, "passengers for automobile stage to Needles," or "passengers for automobile stage to Kingman." All the freight, but the heaviest, is done by automobile trucks, which can carry 10,000 lbs. each trip.

Only once in a great while a prospector can be seen going out into the hills walking behind two or three packed burros—reminders of an almost prehistoric age—and who looks quite strange in the midst of his new surroundings.

However, the heaviest freighting is done by teams of 8 or 10 mules, which have grown contemptuous of the "chuck, chuck, chuck," of their modern competitors, the gasoline trucks.

Mohave county has voted a sum of \$100,000 to



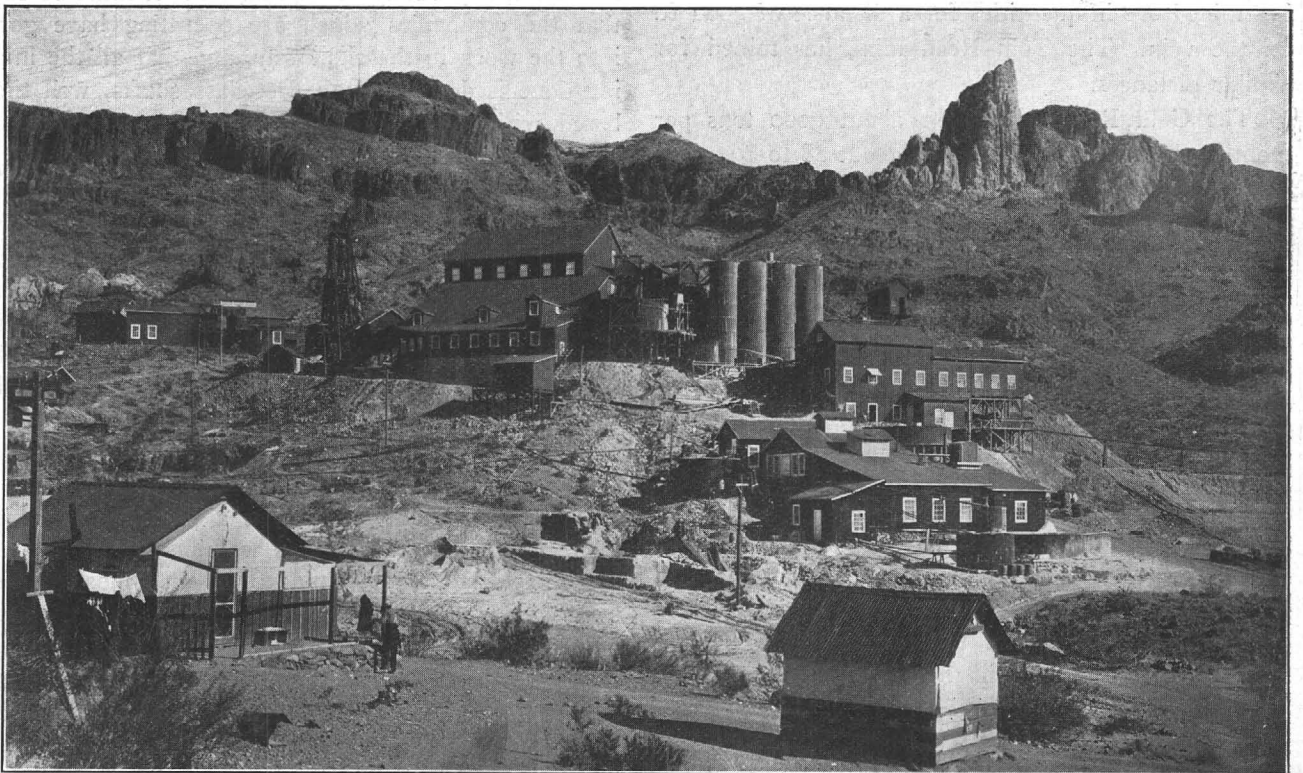
THE TOWN OF GOLD ROAD, ARIZONA.

improve the county roads, and this will make for greater facilities of travel.

Oatman is building all the time and several two and three-story stucco business blocks have been erected during the last few weeks, or are in process of construction right now. The town is the center of activities for the district, the town of Gold Road hav-

ing hardly increased at all in population, while that of Oatman has doubled every few weeks since last summer.

Oatman is reached from two main points, both on the transcontinental line of the Santa Fe railroad. One of these is Kingman, the county seat of Mohave county, in Arizona, and the other is Needles, just



MILLING PLANT OF THE TOM REED GOLD MINES CO.

across the Colorado river and in California. The passenger automobiles make the trip from Kingman or Needles to Oatman easily in 2 hours.

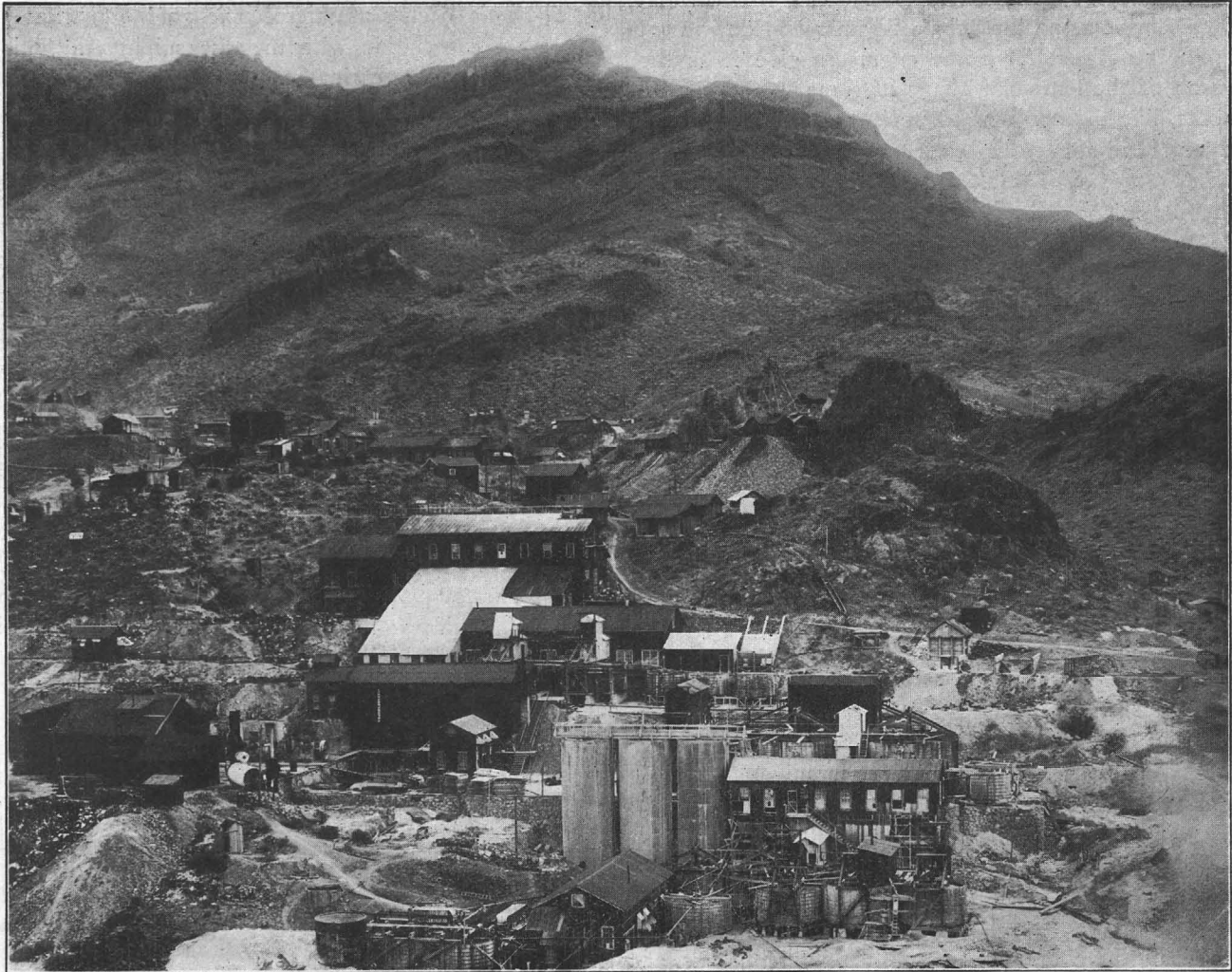
Climature.

The climate of the region is arid, the annual precipitation being only 5 ins., that is to say, much less than the evaporation. The winters are mild and the summers, while hot during the day, have yet fairly cool nights. The vegetation consists of cacti, greasewood, yuccas and sagebrush, and does not interfere in any way with prospecting. Prospecting is made easy

Geologically, the range is formed by the pre-Cambrian granitoid complex, flanked, overlain and in the southern part deeply buried by extensive areas of Tertiary volcanics.

The volcanic rocks consist mainly of an older andesite, supporting a green chloritic andesite, in which many of the main ore bodies are formed, overlain by a series of flows of trachytic, rhyolitic and andesitic lavas, tuffs and breccias, and capped in many places by a basaltic flow.

The Tom Reed-Gold Road district is characterized by two sets of veins and dikes running at a more or



THE GOLD ROAD MILL AND MAIN HOISTING SHAFT.

by the bareness of the rocks, except where they are covered by recent surface wash.

Geology of the District.

The country belongs to the geologic province of the Basin ranges of which it forms the southern part, and which is so characteristic of the many mining districts of Nevada.

Oatman is located on the western slope of the Black range, which comprises an important range of mountains about 10 miles in width, running north and south between the Sacramento valley, where Kingman is situated, to the east and the Mohave valley, through which flows the Colorado river to the west.

less acute angle to each other. One set of veins run N. 10° W. like the Pasadena vein to N. 50° W. like the Tom Reed and Gold Road veins. The other set runs almost east and west, or N. 75° to 80° W. like the Times, the Hardy and the Gaddis and Perry veins.

The Veins of the District.

The veins are really large lodes made of sheeted fracture zones, very persistent for lengths of several thousand feet, and in some cases for distances of several miles. In many cases they form some outcrops very prominent in the landscape.

The prominence of the vein outcrops depends to a

great extent on the country rock in which they occur. In the trachytes or rhyolites, what Schrader has called the Undifferentiated Tertiary volcanics, or in the microgranite they are quite conspicuous. On the contrary, when the lodes outcrop in the green chloritic andesite they are inconspicuous and difficult to trace in an astonishing degree. I am inclined to think that the cross lodes of the nearly east and west system have had a very important genetic influence in the location and the emplacement of the ore bodies in the lodes of the more nearly north and south system, such as in the Tom Reed, Gold Road, United Eastern and Big Jim mines, for instance. Faulting and horizontal displacement along the vein, without much downward throw is noticeable. Some engineers give it as the reason of the lenticular shape of some important ore shoots, like the one opened up in the United Eastern mine. I did not see any clear evidence to support that theory there, and I think that it can be well questioned whether or not such is the case.

The Ore Deposition.

I believe also that the special feature of the district, namely, the fact that several of the most important ore bodies do not come to the surface, is the consequence of the chemical composition of the ascending hot waters which have formed them. The veins contain a large percentage of calcite mixed with the quartz. This feature is connected with the lack of metasomatic replacement which is quite characteristic of the ore deposits of the district. It is remarkable to see in the best ore of the United Eastern, Big Jim or Gold Road mines, pieces of andesite or other country rock surrounded by quartz or calcite, and not altered at all. In the veins of the Cripple Creek or Goldfield districts, such pieces would have been completely altered. But in the Oatman district this is not the case. I think that the hot ascending waters were already saturated with lime. When they deposited their gold they were unable to dissolve and to silicify the feldspars and the ferromagnesian minerals of the country rock between the fissures, even microscopic in size, of the sheared zone forming the lode. While they were depositing the gold values, in all these small cracks, at the same time they left the wall rock of these cracks almost unaltered. Later the large amount of calcite in all the fractures was much more easily dissolved and carried to a lower level by the surface waters in their downward migration, without leaving as much traces behind as would have been the case if this phase of vein transformation had reacted on a strong vein formed of metasomatic quartz.

This seems to me the reason why the veins show only such inconspicuous outcrops at the surface today, and why they show also an unusual amount of surface leaching, which has penetrated rather deeply, and which has taken with it all the values in the fairly well-opened veins.

Of course, these opened veins were formerly the

best channels for the deposition of the largest ore bodies.

The nearness of the very low and large Colorado river, which must have created a very low permanent water level, must also have had an important influence in helping to create a thoroughly leached zone of several hundred feet in depth, in the veins of the Gold Road and Tom Reed mining district.

It is admitted generally that there is some relationship between the high-grade ore and the secondary quartz. A prominent mineralogical feature of the ores is the splendid specimens of pseudomorphic quartz replacing calcite.

The gold occurs as microscopic gold, remarkably free from association with metallic sulphides. This condition prevails yet in the lowest workings of the two deepest mines, the Gold Road and the Tom Reed, more than 1000 ft. below the surface.

Whether the sulphides will be formed in quantities large enough to have an important bearing on the milling operations at greater depths remain yet to be seen.

The Milling Operations.

The Gold Road and the Tom Reed mill their ores on the ground by the cyanide process, and both have installed the counter-current decantation system.

Both mills pass the ore through a crusher, then use stamps. Dorr classifiers and tube mills are employed for regrinding. In both cases the ore is slimed to 100 mesh, and the zinc dust is used for the precipitation of the gold.

The United Eastern intends to crush in ball mills instead of stamps, but otherwise will follow a flow sheet very similar to the one which has proved so successful at the Gold Road and Tom Reed mills. So far as I know, no testing whatever has been made, to find out whether or not the ores of the Oatman district would be amenable to the flotation process.

Conclusions.

Arizona is in the list of the prohibition states, and the town of Oatman has no saloons, dance halls, or gambling places. The wages paid are about the usual in the mining camps of the west. Lumber is \$50 per thousand.

A number of new hotels and boarding houses have just been opened and there is no difficulty in securing good accommodations. Oatman is fast becoming the outfitting center of a very large territory and many new districts for a distance of 100 miles north and south along the range are receiving a great deal of attention.

If only part of the stories told prove true, Oatman will not only become the capital of an important local mining district, having an area of 6 miles wide by 10 miles long, but will become the main center of a mining area 20 times larger. This will be the result of the advent of the automobile, which has made a 100-mile trip today easier than a trip 20 miles long was 15 years ago.

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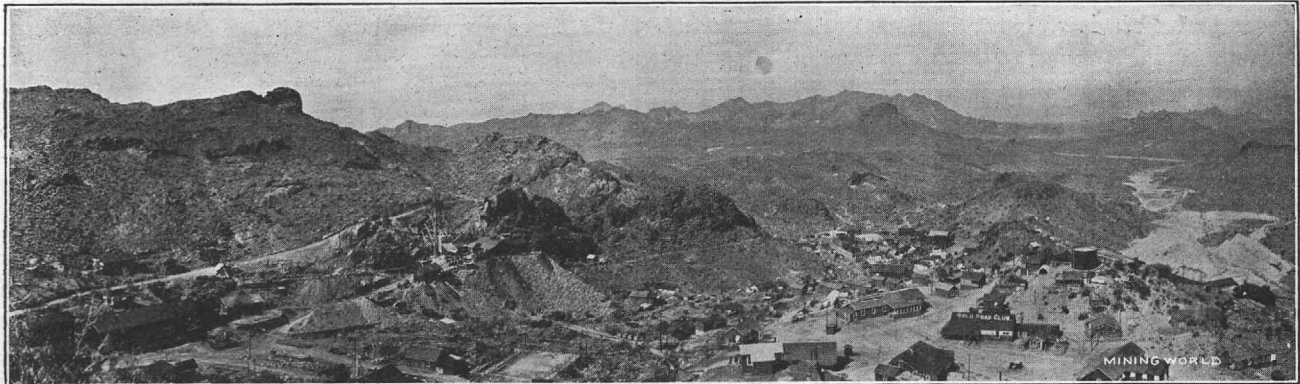
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GENERAL PANORAMIC VIEW OF THE OATMAN DISTRICT.

Present Development of the Oatman District of Arizona

By W. A. SCOTT.

[In order to give our readers the exact status of conditions as they exist in the Oatman gold camp of Arizona, Mr. Scott, associate editor and western field representative, made a special trip to the district. The result of his investigations will be found interesting.—ED.]

A mining map of the Oatman, Ariz., mining district prepared by Haff & Colwell, engineers, shows there are 120 sq. miles in Oatman district, there being 50 sq. miles of surveyed claims. About 20% of the latter area is surveyed for patent.

There are 105 new headframes and hoisting plants in the district, and the most of them are active. There are 8 or 10 electric plants, a number of semi-Deisel oil engines, all the others being gasoline engines, in which the lighter distillate, called "tops," is used. As shafts reach a depth of 600 to 1000 ft., the electric power is likely to increase.

In giving an account of new development the various new undertakings will be taken in order of their importance.

The United Eastern Mining Co. opened the ore body at a depth of 365 ft., from No. 1 shaft, and now has working levels from the 300, 400 and 500-ft. stations. This development discloses a width of vein 3 to 40 ft., the ore body being a continuous ore shoot.

The vein has a dip to the northeast, the original shaft, No. 1, having been sunk in the hanging wall. Water was struck at the 500-ft. level, and about 10,000 gals. are being baled out per day through No. 1 shaft. The new 3-compartment shaft being sunk farther out in hanging wall, now at a depth of 140 ft., is expected to cut the vein at about 1000 ft., and is being timbered with 10 by 10 timbers. This is to be the main working shaft, and is equipped with an Allis-Chalmers double-drum, electric hoist, operated by a 150-hp. motor, and has a Cutler-Hammer solenoid brake. Other equipment here consists of a 900-cu. ft. Ingersoll-Rand air compressor, driven by another 150-hp. electric motor; this will be good for 12 drills of the kind and capacity to be used. Power is secured from the Desert Light & Power Co., Kingman. The new plant also includes a Leyner drill sharpener. The intention is, when the new shaft reaches sufficient depth, to make connections with the old workings at the 400, 500 and 600-ft. levels. In the vein, the gangue consists of a mixture of quartz and calcite, with no sulphides. The value of the ore runs \$20 to \$25, the ratio of gold and silver being about 2 ozs. gold to 1 oz. silver. The gold occurs as finely-divided, free particles, disseminated through the quartz and calcite, and is considered an ideal cyaniding ore. The site for the mill, which is under construction, is

on the sidehill sloping northwesterly from the new shaft. Data concerning the mill equipment have been previously published in *Mining & Engineering World*. A new pumping plant, to bring in a water supply to the property, is practically completed. It consists of a Dow triplex plunger pump, operated by a 30-hp. electric motor, installed at springs on the opposite side of the range. This requires a lift of 700 ft., through a $3\frac{1}{2}$ -mile line of 4-in. steel pipe, to tanks at the summit. J. A. Burgess, formerly of Tonopah and Fairview, Nev., is now general superintendent of the property; Philip Wiseman, Los Angeles, is president of the company. The directors are: Seeley W. Mudd, Frank A. Keith, Philip Wiseman, J. L. McIver, W. K. Ridenour, D. C. Jackling, R. C. Nowland, R. I. Rogers, and Geo. W. Long.

The Big Jim Gold Mining Co. has a well-developed property on the same ore zone as the Tom Reed and United Eastern. Work was begun Aug. 1, 1915, and there is now a 500-ft. shaft, with working levels extending from the 400 and 500-ft. stations. The ore body was opened by a crosscut on the 400-ft. level, showing a vein of ore 38 ft. wide; it was opened by another crosscut on the 485-ft. level, where the same width of vein was found. Ore on the 400-ft. level assayed an average of \$7.44; other samples taken after drifting some distance ran \$60. Assays taken from the drift at 480-ft. level averaged 35% higher than those at 400. The shaft has two compartments from the collar to the 400-ft. station; below that it is a 3-compartment shaft. New equipment lately installed consists of an Ingersoll-Rand 700-cu. ft. air compressor, electric driven; this will operate 7 Ingersoll-Leyner drills. There is also a new drill sharpener. The hoist is operated by a 25-hp. Fairbanks-Morse gasoline engine; but it is stated that heavier hoisting equipment will soon be required. Water was struck at 400-ft. level, and about 85 gals. per minute are being pumped by compressed air. A 4-stage Cameron centrifugal pump is being put in position. The Big Jim is under the management of A. G. Keating, who states that the company is securing data and estimates on milling equipment, as it is evident the mine soon will require such a plant. The ore characteristics of this mine are similar to those of Tom Reed and United Eastern. A force of 40 men is employed, and the property has four buildings for hoist, air compressor, blacksmith shop and change room for the miners.

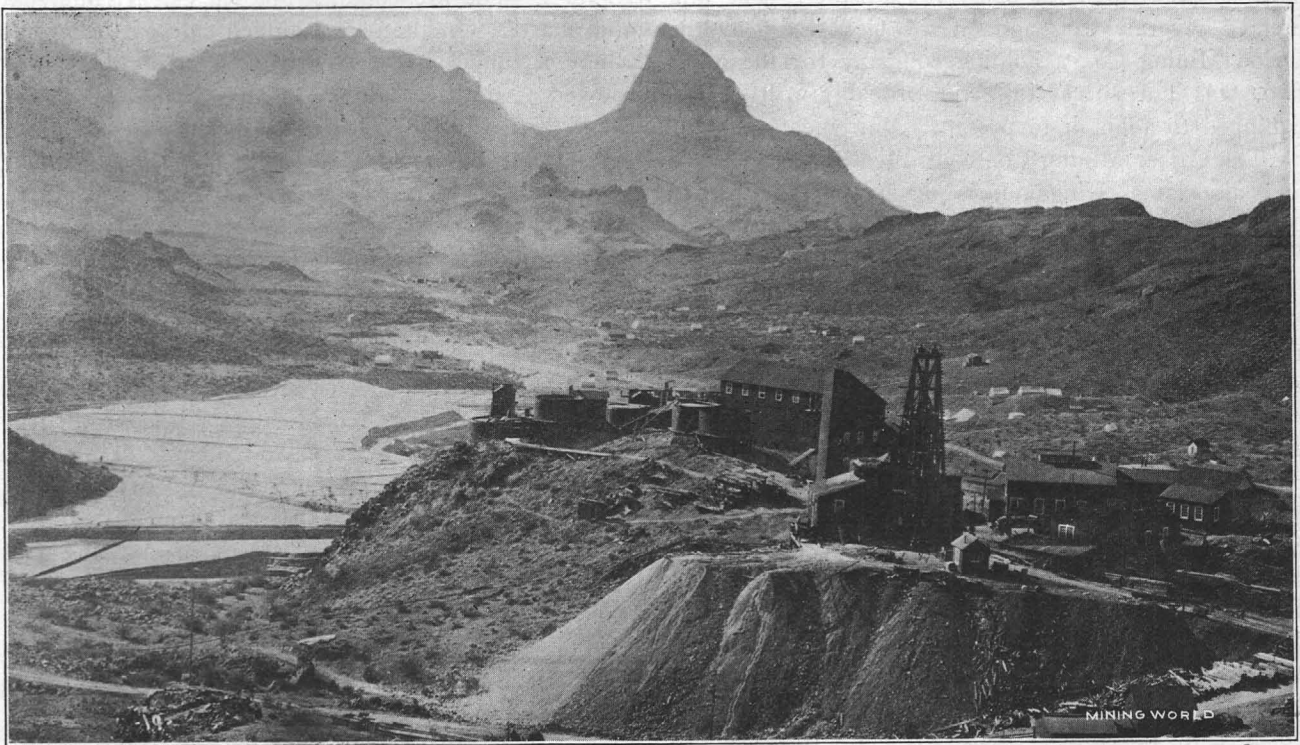
The Pittsburgh, Murdock and Oatman Southern are all being developed under the management of S. R. Porter, who has been in the district 12 years. These properties are financed by parties in the east, for whom R. B. Lamb is consulting engineer. The Pittsburgh, having a 300-ft. shaft and 800 ft. of drifts, is being equipped with a 1000-cu. ft. air compressor and a 60-hp. gas engine for hoisting, and a boarding house and several cottages are being built. Considerable amount of ore has been exposed on a vein believed to

be parallel to that of United Eastern. The Oatman Southern, situated south of Boundary Cone, is being equipped with a new gasoline hoist and air compressor, over the shaft. Development has opened high-grade gold ore. A force of 20 men is employed. The Murdock, on the Black range lode, has a 150-ft. shaft in the hanging wall. It has a gasoline hoist, air compressor and other equipment. The plan is to sink to 500 ft. depth. Supt. Porter states that \$6000 per month will be spent in developing each of these three groups, which means a combined force of about 100 men.

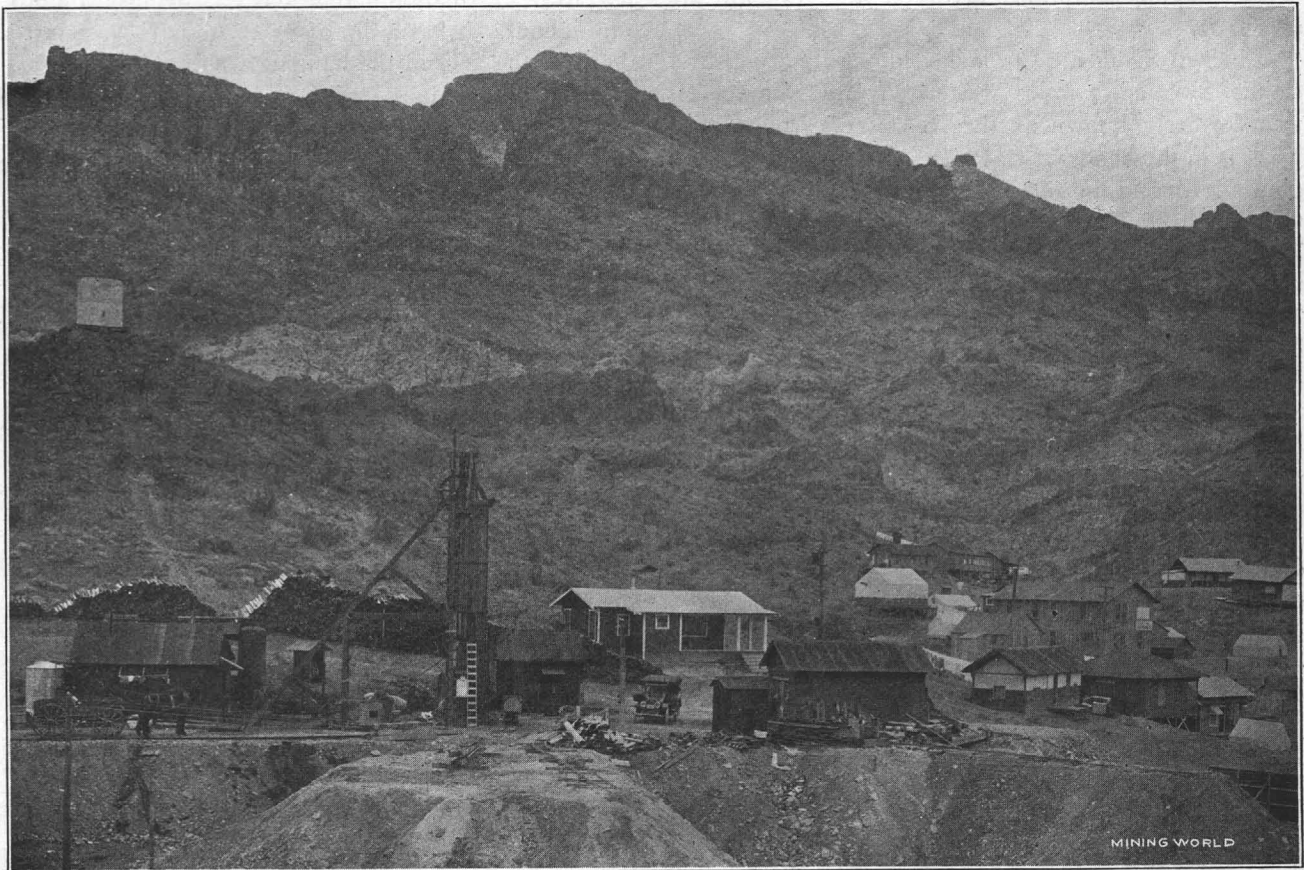
The San Francisco Gold Mines Co., controlled by Capt. Jno. A. Hassell, C. E. Miller, Jno. O. Knight, F. M. Sayre, Los Angeles, and L. P. Morel, Oatman, has three claims, on which is a vein considered the same as that on the Fessenden and South Merit of Oatman United. Development is proceeding under direction of Fred. W. Crosley, E. M. Sinking is in progress, the equipment consisting of a 30-hp. West Coast gasoline hoist and an Ingersoll-Rand air compressor. The idea is to sink to a depth of 600 ft. Samples taken by trenching on the surface showed low assays in gold. The sinking here is in the hanging wall, and at a depth of 300 to 400 ft. crosscuts will be driven to the vein.

Boundary Cone Mines Co., Los Angeles, has a well-developed, well-equipped property, situated about 2 miles southwest of Oatman. The shaft has a depth of 785 ft., from which there are drifts in ore on the 250, 550 and 750-ft. levels. The vein, which is irregular in dip, stands between andesite walls, except at the 550 level, where one wall is rhyolite. The ore assays from \$1 to \$40 gold on the 450 and 550 levels; many nuggets of gold have been found in the quartz. Ore from the 750 level assays from a trace to \$10 and \$12 in gold. A considerable tonnage of ore has been blocked out. Equipment includes a 40-hp. gasoline hoist and a 340-cu. ft. air compressor. A new drill sharpener is to be put in.

The Gold Dust Mines Co., and Gold Key Mines Co., having adjoining groups lying west of Old Trails, are being developed under direction of J. C. Denton, manager and F. F. Brush, mining engineer, and Richard Lloyd, superintendent. Several years ago the Gold Dust was equipped and partly developed. There is a 500-ft. shaft in the hanging wall, crosscuts from which have been driven to the vein from each 100-ft. station, except at the 400. On the 200 there is 1135 ft. of drifting, and a like amount on the 500. The vein varies in width from 8 to 12 ft., the free-milling ore occurring in a system of lenses. A second shaft, sunk at a higher point, is on same vein, and has a depth of 270 ft. There is a parallel vein on the Gold Key, in which there is higher grade ore, containing coarser gold; this is considered the same as the vein of Boundary Cone mine. Development is by means of an inclined shaft, corresponding to the dip of the vein. A new gasoline hoist and air compressor have



TOM REED GOLD MINE AT OATMAN.



SURFACE PLANT OF UNITED EASTERN AT OATMAN.

been put in place; also, a new headframe. A steel skip is operated in the shaft for hoisting. The mill erected several years ago on the Gold Dust by the Orion Mining Co., a holding company for the other two, was not successful, and probably will be re-equipped to adapt it to present requirements.

The Carter Mining Co., controlled by J. L. Munds and associates, Kingman, is developing the Carter property near Old Trails, the work being in charge of W. H. Munds, superintendent. An inclined shaft has been sunk to a depth of 350 ft. in the hanging wall of vein. Stations have been cut out at depths of 50, 150, 250 and 350 ft., and from these there is about 1000 ft. of lateral development. The foot wall is said to be trachyte, the hanging wall being the characteristic andesite of the district. The vein width ranges from 6 ins. to 19 ft., averaging, perhaps, 3 ft. The silicious gold ore, typical of the district, is found here, assaying about \$8. Equipment consists of a 20-hp. Witte gasoline hoist, Sullivan air compressor, and a 4-hp. Buffalo blower.

The Sun Dial Gold Mining Co., A. F. Carper, superintendent, is developing a group of claims 3 miles northwest of Oatman. This property is provided with the typical plant of equipment for exploration and initial development. A shaft is being sunk at the junction of cross veins. Interested in this are Donald Barker, Geo. Nolan, Harry Andrews and A. F. Carper. The surface here is 300 ft. lower than at Oatman, and water has been found at 50 ft. depth, making conditions favorable for reaching ore at 200 ft.

Chicago Syndicate Co. is developing its group of 7 claims, situated 5 miles westerly from Oatman. It was formerly known as the Red Reef group. The work is in the hands of C. R. McCollom, managing engineer. Among the interested parties are D. E. Hunter, David Blankenhorn and B. M. Wotkyns, all of Pasadena; and J. J. Mitchell, of Illinois Trust Co., Chicago, and Edward Swift of Swift Packing Co. The fissure vein, having a strike northwest, and a dip of 72°, has a calcite-quartz filling, the vein outcrop showing a width of 15 ft. on one branch and 12 ft. on another. A 2-compartment, vertical shaft, 4 by 4½ ft., is being sunk on the hanging-wall side, expecting to cut the vein at a depth of 225 ft. The shaft, now down 40 ft., is being timbered with 8 by 8 timbers. A 15-hp. West Coast gas hoisting engine has been put up, also a Sullivan air compressor to be belt driven from the hoist. A heavier plant will be required as soon as water level is reached. This camp is 1000 ft. lower than Oatman, and a wet shaft is anticipated. This work is essentially for exploration purposes, but ore may be reached at 200 ft.

The Times Mining Co. operations are under direction of Z. J. Bergeron, president; W. F. Gray, vice-president and manager; Frank H. Lathrop, secretary-treasurer. This group of 240 acres covers three parallel veins 6300 ft. on their strike. One shaft has reached a depth of 180 ft., and two others are being

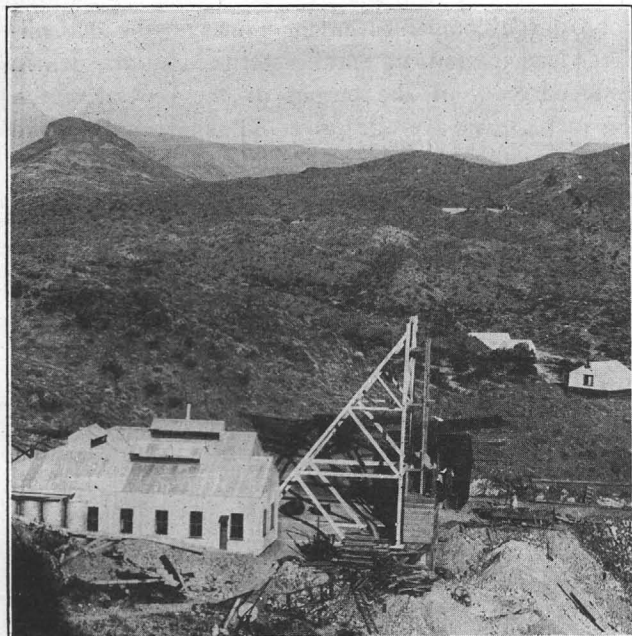
sunk. The main vein is about 40 ft. wide at the 150-ft. level. The ore contains gold in calcite, fluorspar and quartz. On the Martin gulch side of the group, where a tunnel is being driven, a crosscut of vein showed a width of 124 ft., and this contained an ore shoot 18 ft. wide. The ore is of excellent grade. The property is equipped with 25-hp. gasoline hoist, a 15-hp. gas engine for operating a 12-kw. generator, and still another to operate an air compressor. The company is laying a 4-mile line of 4-in. pipe to convey water from springs by gravity to the camp. This company employs 40 men and has a townsite situated 5 miles northwest of Oatman.

The Black Range mine, situated in the Boundary Cone section, 6 miles from Oatman, is controlled by D. P. Wright, L. P. Morel and others. They have opened a contact lode, between andesite and an altered rock. Between walls are segments of clay, altered rhyolite and a vein of quartz, bearing free gold, averaging high grade. A 300-ft. shaft has been sunk on the hanging wall, the hoisting being done with a gasoline engine. They operate two air compressors, one for drill power and the other for pumping. Water level was found at 300 ft., where ore was struck. Mr. Wright will soon be figuring on milling facilities.

Midway Mining & Milling Co., Los Angeles, is developing a group of claims covering one mile on the strike of the old Moss vein. These holdings lie between the Moss and Mossback groups. The Moss was operated in early days. The vein is a fissure in a porphyry formation, and has a defined outcrop throughout. It has a dip of 85°. A shaft was started 6 ft. off the vein in the hanging wall, and quartz containing small values was found at 30 ft. The vein proper, it is figured, will be opened in the course of this sinking at 80 to 100 ft. depth. A 25-hp. gasoline engine and a 3-drill air compressor have been put in. The shaft has two compartments and is being timbered. Suitable buildings have been erected, and 16 men are employed. Part of the work consists of laying 2½ miles of 1½-in. pipe to convey a water supply by gravity from springs situated 400 ft. higher than the camp. The Moss-Midway fissure is a gold-bearing vein, as has been demonstrated by workings in the Moss and Mossback groups. The purpose is to sink 500 ft. on the Midway. The officers are as follows: Erasmus Hoff, president; A. J. Mead, vice-president; W. D. Palmer, secretary; J. E. Eichelberger, manager.

Oatman Queen group, a mile west of United Eastern, is being developed under direction of Lewis Hind. Over a 170-ft. incline shaft is a 25-hp. gasoline hoist and a 340-cu. ft. air compressor. The vein is 30 ft. wide, a general average value of the ore is said to be close to \$12. The plan is to sink to 300 ft. depth and then crosscut and drift. The No. 5 Cameron pump in use here raises 2500 gals. of water per 24 hours. W. E. Moore is in charge of the work.

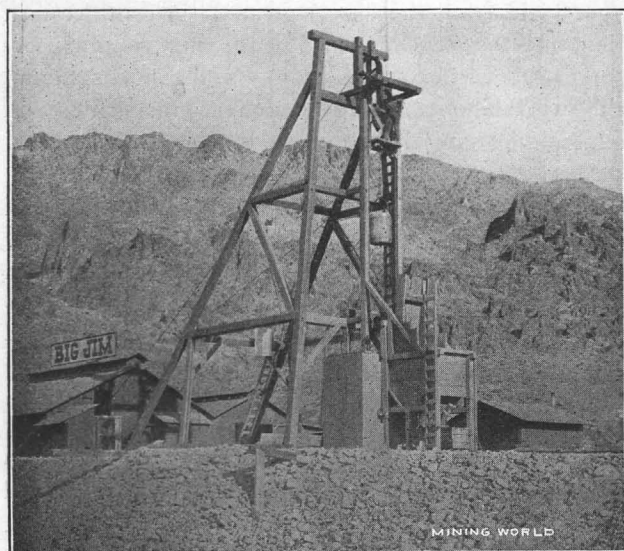
Combination Mines Co., R. L. Johns, manager, and W. P. Mahoney, superintendent, has sunk a 250-ft.



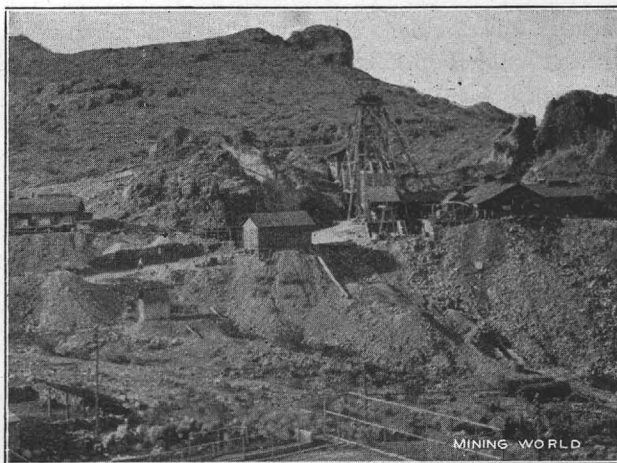
TIMES GROUP LOOKING EAST.

shaft on a group of claims lying 800 ft. east of the Big Jim. It is equipped with hoist and air compressor. Sinking is going on at the rate of 6 ft. per day, the plan being to go down to a depth of 500 ft. before crosscutting to the vein.

Oatman Amalgamated Gold Mining Co. is controlled by the following: G. W. Long, president; Chas. Prochnow, vice-president; J. T. Burns, secretary-treasurer and manager; Del Sherer, W. D. Rodin, D. A. Byrne, Geo. Babbit, C. A. Jones and J. L. McIver. Their group of 34 claims lies in the northern part of the district, northwest of Gold Road group. The 150-ft., 2-compartment shaft is to be continued to a depth of 500 or 600 ft., then a crosscut will be driven to the vein. Thus far about \$30,000 have been spent on equipment, buildings and underground work. This includes hoist, compressor, pumping plant, tanks and a 1600-ft. pipe line for water



BIG JIM HEADFRAME AT OATMAN.



THE GOLD ROAD PROPERTY.

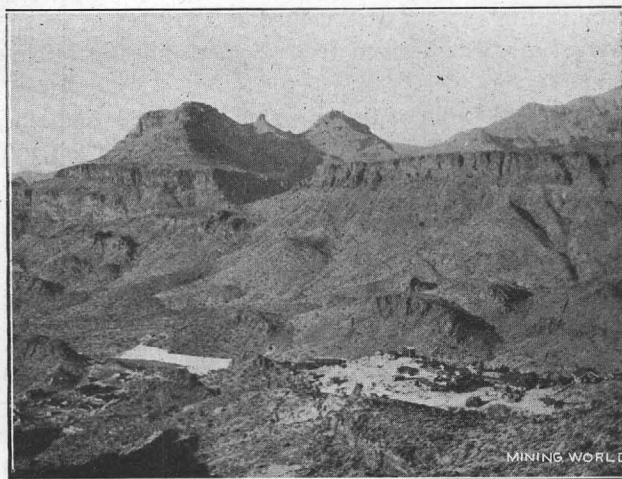
supply. A report on the property was recently made by Etienne A. Ritter, mining engineer.

Oatman Leader group of 3 claims covers a vein on which considerable work has been done. In this, surface ore assays show gold values. Hoisting and compressor equipment have been installed. Among those interested are W. F. Gray, J. C. McCormack, H. D. MacMaster, E. Bollinger and E. Shotmiller.

Oatman-Crescent, near Black Range mine, is controlled by Geo. W. Pierce and associates. It has been financed in New York. An engine and air compressor are being set up for exploration work. A depth of 300 ft. is to be attained by driving a 450-ft. crosscut tunnel to the vein. Pierce has 15 men at work.

Esperanze Exploration Co., controlled by Geo. W. Long, J. P. Loftus, J. L. McIver, F. H. Lathrop and others, has equipped for sinking 400 ft. before crosscutting to the two veins on the group, situated in Crouse canyon, east of Boundary Cone.

Oatman Syndicate, owned by J. Parke Channing and associates, New York, has a 400-ft. shaft, from the base of which crosscuts have been driven south to the lode. The outcrop of the vein here is perceptible for some distance, there being other locations farther east of that of Oatman Syndicate, one of



COUNTRY SURROUNDING GOLD ROAD CAMP.

which is the Nellie. This vein strikes northwest-southeast, and is southeast of Boundary Cone peak.

Wrigley Exploration Co. has extensive locations covering Highland Chief and Crown Point lodes, having an east-west strike through Boundary Cone spur. Under direction of C. H. James, E. M., equipment is being put in position for driving a crosscut tunnel to open these and other parallel lodes at a depth of 600 ft. The equipment consists of a 75-hp. semi-Deisel oil engine and an Ingersoll-Rand air compressor. J. M. Heck, who located the claims and sold them to the Wrigley Exploration Co., says there are four east and west veins cutting through this mountain spur. The tunnel is to be 6 by 7 ft., and only a little timbering may be required. A well-equipped camp is being established, and water is being piped there from Black Range mine.

"Jack" is the New Monarch Among Minerals in the Central States.

For many years the value of the copper mined in the central states has exceeded that of zinc, frequently by millions of dollars, owing entirely to the greater value of the copper, for the quantity of zinc produced has been larger. Under the stimulus of extraordinary prices for both copper and zinc in 1915 the mine output of copper in the central states increased 50,650 tons and that of zinc 47,857 tons. The value of the copper produced increased from \$21,865,043 to \$46,494,969, an unusual increase, but not sufficient to retain its pre-eminence, for the value of the recoverable zinc jumped from \$17,139,264 in 1914 to \$53,540,472 in 1915, "jack" thus running \$7,000,000 ahead of copper. Under ordinary conditions the production of 222,548 tons of lead, valued at \$20,919,512, an increase of 18,703 tons in quantity and of \$5,000,000 in value, would have attracted considerable attention. An increase in value of one-third is unusual, but it appears small compared with that of either zinc or copper.

The production of silver in the central states is always relatively unimportant. The output in 1915 amounted to 647,553 ozs., valued at \$328,309, of which 585,933 ozs. was derived from copper mines in Michigan.

The total value of the silver, copper, lead, and zinc mined in the central states increased from \$55,171,306 in 1914 to \$121,283,262 in 1915, or about 120%.

The high price of copper in 1915 benefited few companies or individuals except those interested in the comparatively small number of mines in the Lake Superior district in Michigan, for that state produced nearly all the copper credited to the central states. Missouri reported 402,160 lbs. of copper, which was derived mainly from the dressing of lead concentrates.

The average selling price of lead was less than a cent a pound more in 1915 than it was in 1914, so that lead mining was more profitable chiefly for the

5 or 6 large companies having mines in the disseminated lead region in southeastern Missouri, which produced 83% of the output of the central states. The increase in average price did not stimulate lead mining in other regions, as the only other notably increased output was due to more extensive mining of the "sheet ground" in the Joplin region, which carries considerable lead. In 1915, however, the smelters desired high-grade zinc concentrates free or nearly free from lead. Such concentrates were purchased at a base price much higher than that paid for concentrates containing over 1% of lead. Moreover, high-grade zinc concentrates frequently sold for more than double the price paid for galena concentrates, so that owners of "sheet ground" and "soft ground" had no reason to rejoice over the lead content of their ore.

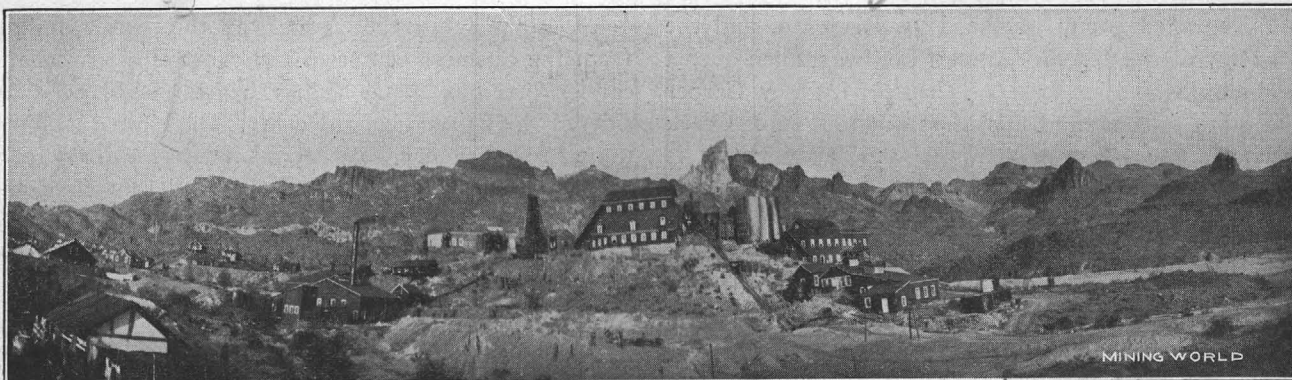
The largely increased and high price of zinc concentrates created a healthy boom in nearly all districts. The profits of the big operators were abnormal, but hundreds of mines worked by small companies or individuals shared in the general prosperity. Miners' wages were raised and mining machinery and supplies were liberally purchased at advanced prices. With zinc concentrates doubled and more than doubled in value any mine that would not yield a profit was indeed worthless. Producing properties or old mines with shafts and drifts that could be unwatered, where old concentrating plants could be repaired or new ones quickly built, were eagerly sought. Old dumps at abandoned mines attracted men and boys who made good wages by culling the waste rock. Tailing mills were run profitably on material that would not yield any profit when zinc concentrates sold for less than \$50 a ton.

The salient facts relating to zinc and lead mining in the central states in 1915 were the building of new mills and roasting and separating plants in the Wisconsin-Illinois region; the increased output and the better recovery made by "flotation" in the disseminated lead district in Missouri; the more general use of thickeners, classifiers, and tables and the vastly larger yield from the "sheet ground" in southwestern Missouri; the development of the new mining territory near Picher and Cardin, in the north Miami field in Oklahoma; and the active prospecting and mill building and the large increase in shipments of zinc carbonate in Arkansas.

The final figures showing silver, copper, lead, and zinc mined in the central states in 1915 are given by states and by regions in a report prepared by J. P. Dunlop, a copy of which can be obtained upon request addressed to the Director, U. S. Geological Survey, Washington, D. C.

The Manganese Products Co., 35 Wall street, New York, incorporated in Delaware, April 1, 1916, has taken over the Kennedy manganese ore mines, located about 5 miles from Lipscomb, Augusta county, Va., formerly owned and operated by the Steel Ores Co. of Virginia.

Gold Mines



THE PROPERTY OF THE TOM REED GOLD MINING CO., OATMAN, ARIZ.

The Oatman, Arizona, Mining District

STAFF CORRESPONDENCE.

Many people hold the opinion that Oatman, Ariz., is a low-grade camp. This may, or may not be the case. Time and development will prove, or disapprove the theory. During the period of "watchful waiting," however, it is not amiss to give the data now available on this interesting subject. The facts and figures gathered during a 7-months sojourn here do not corroborate the contention that Oatman is a low-grade camp. It is my purpose to submit them herewith unadorned and unbiased.

Ore having an average gold content of \$40 per ton is being mined in the Tom Reed workings at a depth of 1075 ft., while from a short distance below surface to that depth ore has at times been opened that averaged upward of \$300. The average value of all the ore extracted from the Tom Reed mine during the 1914-15 fiscal year was \$21. Low-grade ore, as commercially recognized, is ore having a precious metal value of \$10 per ton, or less—generally, less. The average value of the Tom Reed ore is therefore more than double that commercially known as "low grade."

An especially noteworthy feature is the broad area here over which ore carrying a gold content much higher than "low grade" is distributed. On the 200-ft. level of the Moss mine, for instance, \$60 ore is being mined. The Moss is located 6 miles north of the Tom Reed, and between the two are located a number of properties where the average grade of the ore is considerably higher than "low grade." The Moss mine is being operated by the U. S. Smelting, Refining & Mining Co., owner of the Gold Road mine. The latter was purchased from a French syndicate for \$1,500,000. It has produced ore having a value as high as \$300 per ton, and is shipping monthly to mint \$65,000 worth of gold bullion. Adjoining the Gold Road on the south is the Gold Road Bonanza Co. where \$30 ore was recently opened at a depth of 50 ft.

Half a mile north and east of the Gold Road mine is the property of the Gold Ore Mining Co. where a 6-ft. face of \$100 ore is exposed in the west drift on

the 500-level. Four miles to the north and west of the Gold Ore, and about 2 miles from the Moss mine, is located the Mossback mine, owned by Burlock, Garrison and associates of San Diego. Burlock has mined and shipped a considerable tonnage of \$300 ore. A deal for the transfer of the property is being negotiated at a price running into six figures. Nearby the Moss and Mossback mines are the extensive Gaddis and Perry mineral holdings and the Oofy Goofty group of the United Western Co. The ledges on both yield high values at surface. Kenneth Donnellan, one of the Pioneer mining men in the Goldfield country, has with San Francisco associates taken over the Gaddis and Perry group.

Five miles south of the Tom Reed mine and 10 miles south of the Moss and Mossback properties, the Black Range and the Nellie companies are developing extensive acreages. Ore carrying gold in the free and sampling upwards of \$100, has been found at surface and shallow depth on both of these properties. D. C. Wright, president of the Black Range Co. and formerly a lessee in the Cripple Creek district, expended \$15,000 in developing the Black Range ground before asking for outside financial aid. Recently he refused an offer of \$100,000 for his holdings in the Black Range Co.

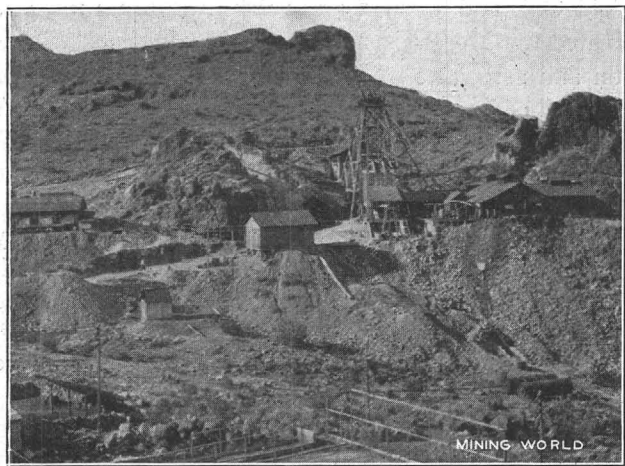
Two feet of ore sampling \$600 were recently opened at a depth of 50 ft. on the Green Quartz group. The acreage is adjacent to the Black Range and the Nellie on the south and west, and was formerly owned by Louis Armil. For a number of years Armil worked the ore with financial success by means of a rude arrastra. Long and McIver, the men who developed the United Eastern into a bonanza, now control the property. High values have also been obtained on the Murdock group, formerly owned by Murdock and Porter and now called the Black Hawk, Curry & Alexander, Lazy Boy, Esperanza and other properties located in the extreme south end of the camp.

The Hardy mine, located north of and adjoining

the Neglected group of the Tom Reed Co. and the property of the Jerome-Oatman Co., was taken over a few months ago by Fred W. Crosley, J. O. A. Carper and other former mine operators of the Cripple Creek district. The Buckeye vein on the Hardy group is one of the richest in the camp. In former years this vein produced a considerable tonnage of high-grade ore that was freighted by team to Needles and from there shipped to San Bernardino and reduced at a good profit. A lateral is being driven to tap the Buckeye vein at depth. The Jerome-Oatman Co. is driving its shaft to depth with the object of opening the extension of the Hardy vein system. The new machinery went into commission a short time ago and is proving an efficient factor in hastening mining operations. The Hardy and the Jerome-Oatman are located 4 miles north of the Tom Reed, and about 7 miles north of the Black Range and the Nellie.

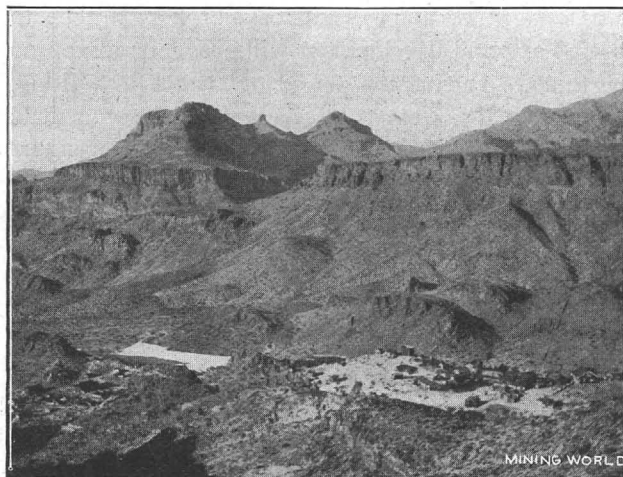
Within a mile of the Jerome-Oatman and the

"Oatman's heart of gold," as the 3-mile radius from the business center of the camp is often called, carries precious metal values which would be considered "high grade" in any camp. The United Eastern mine, for instance, has approximately \$10,000,000 worth of ore in sight on and above the 565-ft. level. Values range as high as \$1200, and hold strong across a width of 30 ft. at \$40. The northwest drift on the 565-ft. level has sampled an average of \$300 for the last 50 ft. At a depth of 83 ft. the shaft on the Oatman Mining & Milling Co. entered \$85 ore. The shaft is nearing the 300-ft. point where a crosscut will be sent out to tap the ore body encountered above. Vein material having a value of \$35 was found at a depth of 135 ft. in the United Western workings. This ore is to be cross-cut at a depth of 500 ft. A station is now being cut at that level. The current week the United Western paid off all indebtedness against its Horseshoe Reed group of claims and was given a deed



THE GOLD ROAD PROPERTY.

Hardy are located the Times group, the Grey Eagle group and the holdings of the Ivanhoe Con. Mines Co. The Times was recently taken over by W. F. Gray, formerly a successful leaser at Goldfield. Associated with Gray in the venture are B. J. Berceron and other Ohio capitalists. Free gold features the ore on the Times group and at a depth of 50 ft. samples better than \$50. The Grey Eagle group, formerly owned by Thornton, Dunbar and associates, has been taken over by the Gold Stone Mining Co. W. B. Gordon, a well-known Goldfield and Manhattan mining man, is the moving spirit in the enterprise. By check assay it has been demonstrated that 3 ft. of manganese ore on the Gold Stone property has an average value of \$33. At other points pannings of the ore indicate values of at least \$100. A camp has been established and development work started. The Ivanhoe is showing 40 ft. of vein material carrying good values at a depth of 200 ft. The objective of the shaft is a depth of 500 ft. where the ore body will again be crosscut. From shallow workings on the Ivanhoe ore has been mined and saved for shipment that has an average value of \$45 per ton.



COUNTRY SURROUNDING GOLD ROAD CAMP.

thereto by William Berg and Sam Frolley, the former owners.

The Leland-Vivian mine has produced a large tonnage of high-grade ore, as have likewise the Orion, Pioneer and Ruth mines. The latter lies beyond the boundaries of "Oatman's heart of gold," but will in due course add materially to the precious metal output of the camp. Ore having an average of \$100 was stoped to surface from a depth of 150 ft. on the Orion during the period when it was called the "Gold Dust." The property is being aggressively developed. From surface to a depth of 60 ft. on the Pioneer property, recently purchased by Allen G. Burris and associates, ore was mined some years ago and shipped to sampler at Kingman that gave returns of \$200. The Lilah vein on the Arizona-Tom Reed Co., adjoining the Pioneer mine, samples as high as \$50 at surface and shallow depth.

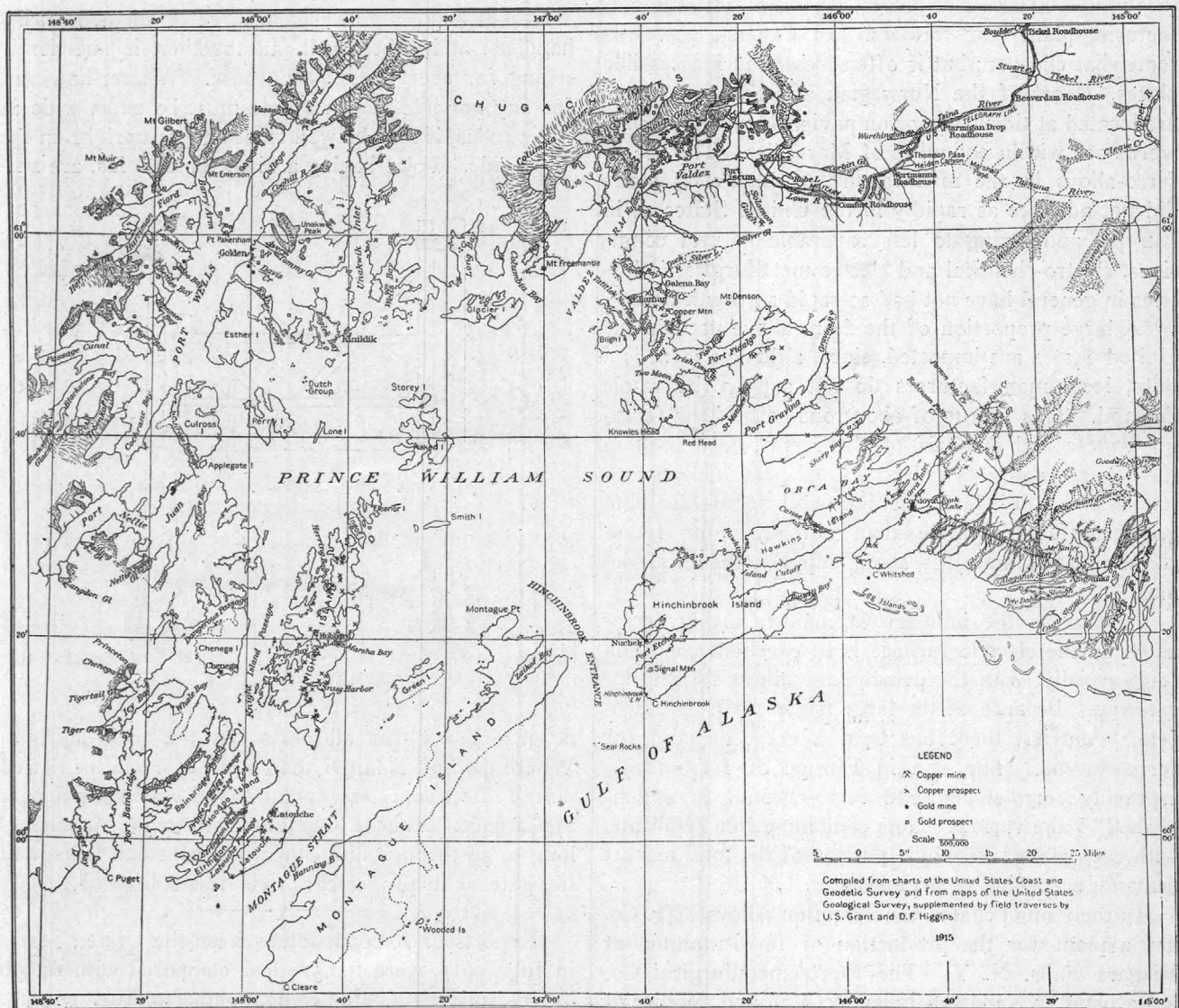
Assays as high as \$60 gold have been obtained on the ledge outcrop on the property of the White Chief Co., adjoining the townsite of Old Trails. High-grade ore showing much gold in the free, was found last

spring by J. J. Casey on the property of the Casey-Jones Mining Co., a corporation in which Dr. J. C. Francis, V. S. Rowley, J. J. Casey and others are financially interested. A shaft is to be sunk to a depth of 500 ft. before attempting to prove up the ore body that samples so encouragingly at surface. The Big Jim Co. is in line for the same character of value on that portion of its estate adjoining the Tom Reed property on the southeast, as obtain in the Tom Reed mine. The shaft is nearing a depth of 300 ft. where a crosscut is to be run to and through the extension of the Tom Reed ledge.

One hundred dollar ore is being mined at a depth of 200 ft. in the Boundary Cone mine, producer of rich crystallized gold ore. The Carter mine, nearby,

has 4 ft. of ore on the 400-level that samples from \$28 to \$35. The Treasure Key property, recently taken over by W. S. Wise and other Los Angeles people who dominate the affairs of the Orion, has \$30 ore at a depth of 50 ft. Development of the property was started about 10 days ago. The Gold Reed mine, located near the center of the camp's most productive area, is showing 4 ft. of \$32 ore at a depth of 375 ft. In the upper levels ore was mined having a value of \$80. Specimen ore, showing gold in the free and assaying as high as \$45, was recently found at shallow depth on the Gilt Edge group adjoining the Leland-Vivian mine.

From the foregoing facts and figures the reader may draw the deduction that the assertion that Oatman is a "low-grade" camp is at least debatable.



MAP OF PRINCE WILLIAM SOUND, ALASKA, SHOWING MINERAL LOCATIONS.

The producing copper properties on Prince William sound, appear to have been only slightly affected by the confusion in the financial and copper markets resulting from the European war. An increased quantity of copper ore was mined last year, but the average grade of the ore mined was much lower than in the preceding year. The value of the metals recovered from these copper ores in 1914 was also less than in 1913. This decrease was due largely to the lower grade of the ore mined, although the lower price received for the copper content of the ores contributed slightly to the decline in the total value of production. The productive mines of the Prince William Sound region in 1914 included two copper mines and eight gold mines. These are described in detail in Bulletin 622-E, "Mining on Prince William Sound," by B. L. Johnson, recently issued by the Survey. A copy may be obtained free on application to the Director of the Survey, Washington, D. C.

The Ferro-Alloy Industry.

The growth of the ferro-alloy industry in Europe has been rapid, but comparatively slow in the United States. Previous to the war there were about 25 European plants engaged in the manufacture of ferro-alloys by the electric-furnace method, as compared with two in the United States. There is, however, an electric-furnace ferro-silicon plant in Canada, at Welland, Ont.

There are several reasons why the growth of this industry has been slower in America than in Europe. Hydro-electric power is not so cheap here, and not so favorably located for the receipt of raw material and the sale of product. The water-power sites cannot be developed as cheaply as many of the foreign sites, where the cost of electric power per horsepower-year varies from \$7 to \$15 as compared with \$15 to \$30 in the United States, for power delivered at the manufacturing-plant transformers. In Canada, power is somewhat cheaper; but is often located in inaccessible places. Most of the Norwegian and Swedish plants are located at tidewater, or on navigable rivers. French works are within 200 miles of Marseilles. The use of ferro-alloys in the manufacture of high-class steels did not advance as rapidly in the United States as in Europe, and owing to less favorable natural conditions, electro-chemical and electro-metallurgical industries in general have not had so rapid a growth here.

A large proportion of the ferro-alloys used in the United States are imported, since, although there is a duty, local manufacturers do not supply the whole demand. This is true of about one-half of the ferro-manganese and one-half of the ferro-silicon used in the United States, as well as a large part of the ferro-tungsten. More ferro-titanium and ferro-vanadium are manufactured here than abroad. Our ferro-chrome production just about supplies the local demand.

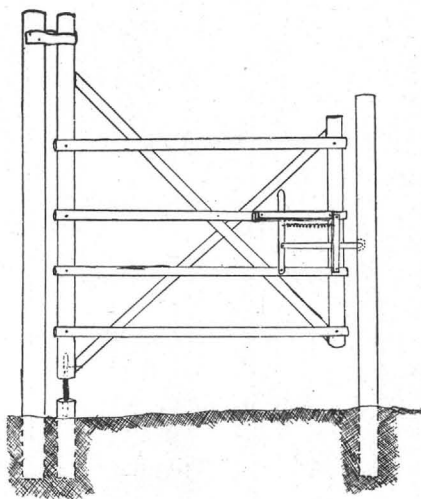
In Europe the industry of manufacturing ferro-alloys in the electric furnace is in excellent condition commercially, with the demand for alloys steadily increasing. Because of the large navies built by European countries, there has been a great demand for ferro-chrome. The sale in Europe of ferro-alloys, especially ferro-silicon and ferro-chrome, is accomplished by the various plants combining in a syndicate, with each plant receiving a portion of the total market demand, according to arrangement.

In the United States, the Titanium Alloys Mfg. Co. has a plant for the production of ferro-titanium at Niagara Falls, N. Y. The Electrometallurgical Co. has a plant at Kanawha Falls, W. Va., and another at Niagara Falls, N. Y. This company makes ferro-silicon, ferro-chrome, ferro-tungsten, ferro-vanadium, ferro-molybdenum, and ferro-phosphorus. The Primos Chemical Co., Primos, Pa., manufactures metals and ferro-alloys by chemical methods or in combustion furnaces. Among its products are ferro-tungsten,

ferro-vanadium, tungsten metal, ferro-molybdenum, ferro-chrome, ferro-nickel, and ferro-boron. The American Vanadium Co., Bridgewater, Pa., manufactures ferro-vanadium by a method similar to the thermit process. The Goldschmidt Thermit Co. has a plant for the manufacture of metals and ferro-alloys by the thermit process at Newark, N. Y., but imports most of its products from its foreign works. This company produces ferro-titanium, ferro-vanadium, ferro-molybdenum, ferro-silicon, ferro-chrome, and chromium, as well as other metals and alloys. The Noble Electric Steel Co., Heroult, Cal., is manufacturing ferro-manganese at its electric-furnace plant.

An Inexpensive Gate Made of Poles.

The sketch herewith shows a very simple gate made of light poles. If lumber is plentiful, 2x4's may be used for uprights and 1x4's for the cross pieces. This will make a gate which, large or small, is easily handled; and, when well put together, is sufficiently strong for every possible purpose. Where, however, for any possible reason a gate must be extra wide as for wagons, it may be well to use a 4x4 upright on the hinge side. Poles having a diameter of 2 ins. are suf-



A GATE MADE OF SMALL POLES.

ficiently heavy for all parts but the main upright. Where the butt is larger than 2 ins. it should be hewed down. Peel the poles and the gate will make a neat appearance. Put it together with nails sufficiently long to go through and clinch or with small bolts, and the gate, with proper care, will last a lifetime.

Exports of ferrovanadium from the United States in July, 1915, were 190,576 lbs., compared with 14,696 lbs. in July, 1914. For eight months to Aug. 1, 1915, they were 559,143 lbs. against 397,437 lbs. and 383,700 lbs. to Aug. 1, 1914, and Aug. 1, 1913, respectively.

Pennsylvania was the chief coke-producing state in 1914 with an output of 28,753,444 short tons valued at \$67,929,864.



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The Tom Reed-Gold Road Mining District, Arizona

By J. D. SPERR*

SYNOPSIS—District lies on Colorado side of Black Mountain Range, near western boundary of state, and borders on California and Nevada. It is characterized by lack of sedimentary rocks. Profound fissuring has resulted in veins not yet bottomed by deepest workings. Oatman experiencing big boom; has about 100 incorporated mining companies, about 40 of which are operating; 10 having good milling ore and 3 having large producing mines of proven merit.

This district was formerly known as the San Francisco mining district of Arizona, but it is now commonly called the Tom Reed-Gold Road district, after the two oldest and best-known mines.

In the early history of Mohave County, little is written of the Black Range mountains along the western

*Mining engineer, Tom Reed Gold Mines Co., Oatman, Ariz.

part of the county, except the records of a few Indian fights. Prospectors thought the range worthless because there were no high-grade ores to be found on the surface; and silver in other parts of the county was then attracting more attention. Shortly after the slump in silver, gold was struck where the Gold Road mine is now located. This was followed by the usual rush, and some work was done in other parts of the district, followed by a long period of comparative quiet. Of late years, no one would believe a boom possible in Mohave County—it seemed too old and well-known. But the unexpected happened. Now the Tom Reed-Gold Road district is growing so fast it is difficult to keep track of developments.

The main portion of the district lies on the west flank, or Colorado River side, of the Black Mountains, or River Range, in the western part of Mohave County. It embraces an area of about 6 mi. east and west by about 10 mi. north and south, with the camp of Oatman as the present center of an activity recalling Goldfield's boom.



SCENES OF ACTIVITY IN AND ABOUT OATMAN, THE LATEST BOOM CAMP

The topography of the district is generally similar to that of the Southwestern desert country. Enormous volcanic action, fissuring and faulting, followed by erosion, have left the country rough and rugged as a whole and marked by deep cañons, steep slopes and high peaks. The general strike of the range is north and south. The west drainage is directly into the Colorado River, and the east drainage is into the Sacramento Valley and thence into the Colorado.

There are three outlets to points on the Santa Fé railroad, the only one into this part of the country. These points are connected by generally good desert roads to Oatman and the surrounding properties.

Needles, Calif., is the nearest railroad center. This is a division point of the Santa Fé, lying on the west side of Colorado River about 20 mi. from Oatman. The fact that all goods via Needles must be ferried across the river makes this town unimportant as a shipping point.

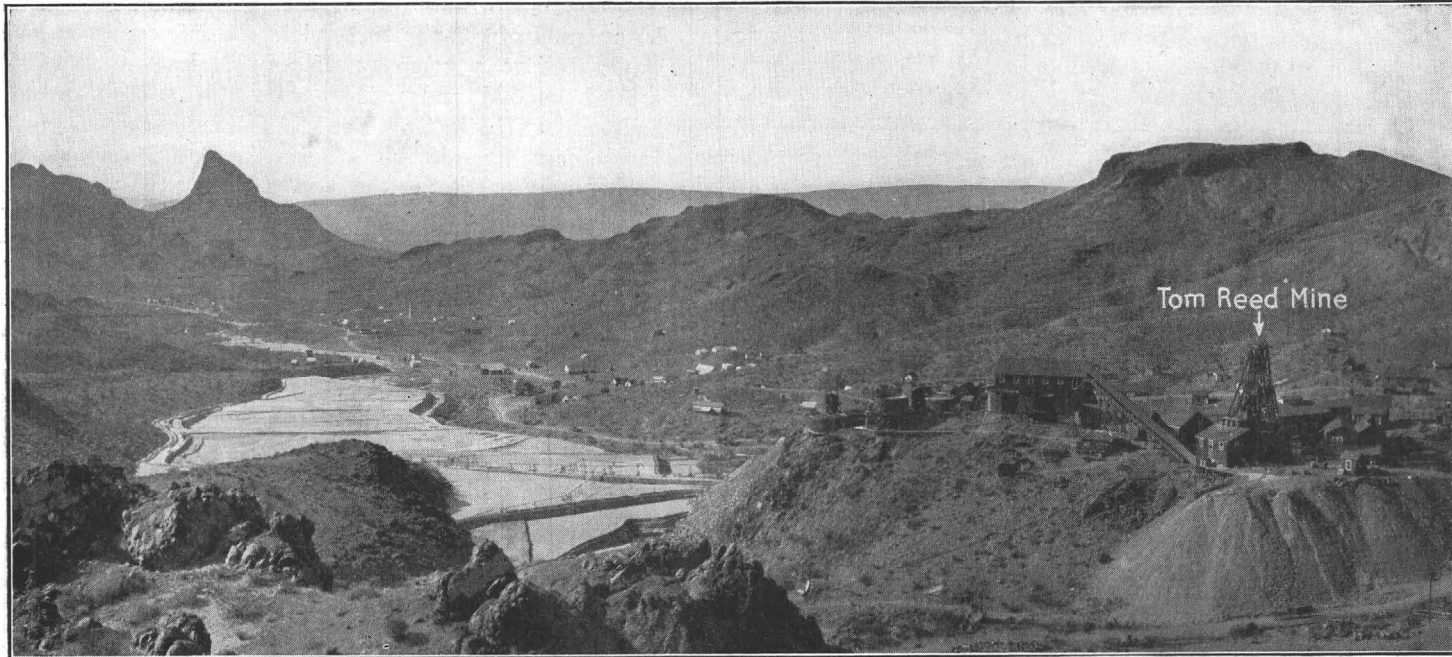
Kingman, the county seat of Mohave County, lies about 27 mi., by road, to the east of Oatman. This is the main shipping point at present. Practically all supplies are hauled by motor trucks or wagons from this town. As

group at about the time this bulletin was written. Well-defined oreshoots have been worked with great profit in this mine, and it is now one of the well-known mines of the country.

Since the writing of Mr. Shrader's report several other prospects have been worked to a greater or less extent, so that at the present time considerable more is known of the economic importance of this district. The present activity, which began a little over a year ago, justifies a summation of these later developments and of the facts proved by them. At this writing between 75 and 100 companies are operating in the district. Of these three have proven mines, about 10 others have some showing of milling ore opened up, and about 25 are carrying on active development.

Complex geologic conditions offer great opportunity for detail study of general conditions which will be briefly summarized here.

A pre-Cambrian complex of schists, gabbros and porphyries underlies and forms the base of the range. Sedimentaries are markedly absent, although occasionally found overlying the granites, notably as black shale, which



PANORAMA OF THE TOM REED-GOLD ROAD MINING DISTRICT AND THE CAMP OF

a supply point for the surrounding country, Kingman is rather an important town. The steep grades over the mountain make freighting difficult, but considering the character of the country, the charges are reasonable. Rates are generally fixed by contract and may range anywhere from 8c. to 25c. per 100 lb., depending on the accessibility of the point of destination. Topock, on the Arizona side of Colorado River, lies about 27 mi. to the southwest of Oatman. A good road is being built to this station to provide a railroad outlet that will avoid hauling over the Gold Road hill from Kingman. This road is held to a maximum grade of 10% on the up haul to allow of advantageous use of motor trucks.

The older history of this district is well outlined in the United States Geological Survey Bulletin No. 340, of 1908, by F. C. Shrader. Later important economic developments began with active work on the Tom Reed

may be seen just to the south of Boundary Cone. Other rocks higher up in the range may possibly be altered sedimentaries.

Overlying the pre-Cambrian base is a series of flows and intrusions, highly altered, difficult to separate and conveniently referred to as the "Undifferentiated Volcanics." It is, however, in these later igneous flows that the mines are found, and their economic importance justifies closer study and a more careful differentiation.

These rocks are everything from rhyolite to basalt. They grade from very acidic to very basic in a most confusing manner, and no one, as yet, has definitely mapped or determined the different flows. Formerly it was supposed that the flows were arranged somewhat as follows: An old andesite overlying the granites, followed by a younger or chloritic andesite, both of which were cut by rhyolites and covered by a basalt.

The mineral belt was supposed to be within the chloritic andesite and limited to it. Present developments, however, seem to show an entirely different state of affairs, which is both more complicated and of greater importance to the district as a gold producer. It is now definitely proved that the mineral belt is not limited, especially in depth, to the chloritic andesites. True fissure veins have been traced through the chloritic andesites and over 200 ft. into an underlying rock which has not been definitely classified, but which is certainly not the "older andesite" of local fame. And the oreshoots continue to the deepest workings in the district.

True fissure veins have been found at depths of from 200 to 400 ft. in chloritic andesites, but capped by a basic andesite similar to the rock previously called the "older andesite."

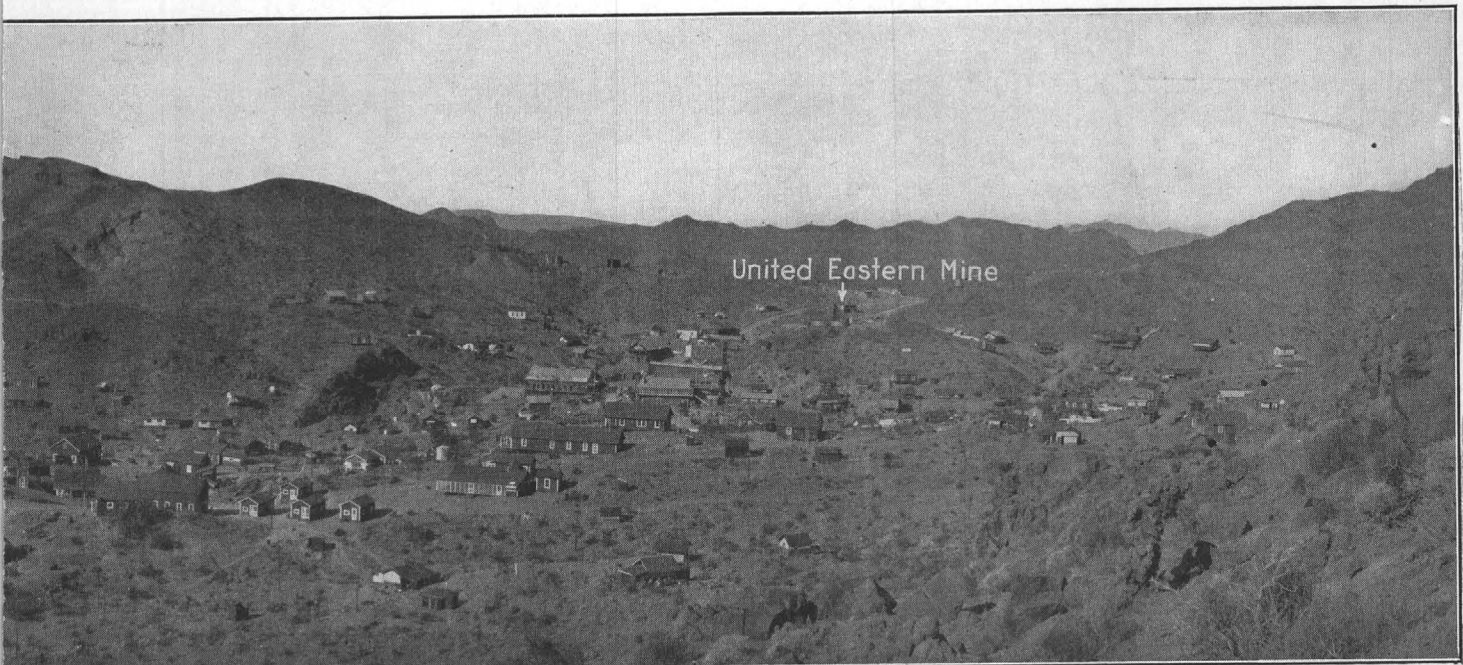
After careful study covering a period of two years, the writer is of the opinion that the flows followed more the following order: A nearly normal andesite, called a biotite andesite or chloritic andesite, follows the pre-Cambrian complex. Following this flow was a period of great fissuring and faulting, during which enormous intru-

were laid down as a series of flows which were afterward tilted to a pitch of from 60 to 80°, but as yet there is not sufficient evidence to justify advancing this theory.

The latites and rhyolites paralleling the main fissure veins are presumably the mineralized feeders from which the hydro-thermal solutions mineralized the fissures in the adjoining rocks. No pay ore has been found yet within these intrusions, but the concentrations seem to occur within the fissures close by, but cutting through the andesites.

The surface is capped and it is necessary to penetrate the capping, sometimes to a depth of 400 or 500 ft., to find the true fissure veins. The ore occurs in shoots within the veins, which shoots are separated by areas of barren or low-grade material. No definite law has been evolved for finding these shoots, but it has been proved that they repeat themselves within the same fissure. There is a vast undeveloped territory within this district, but the work being carried on at present can be counted on to develop at least a part of it into paying mines.

Oatman, as the center of activity and main distributing point of the district, has grown in all directions, in-



OATMAN, SHOWING THE MINE FOR WHICH THE DISTRICT IS NAMED

sions of latite and rhyolite were thrust upward and most of the great fissure veins were formed. Following this period of fissuring came another flow of andesite of a more basic type than the chloritic andesite. This flow probably covered all the chloritic andesite and even spread beyond it. Then, following a period of erosion, came a flow of basalt, which is the last in the series and remains as a capping over most of the Black Mesa part of the range. Since the primary fissuring, there has been little movement of note.

SYSTEM OF FISSURING WELL DEVELOPED

The district shows a remarkable and well developed parallel fissuring, especially in that part within a radius of 3 mi. from Oatman. The main fissuring and general formation strikes about northwest and southeast. This leads to another theory—that the andesites and latites

cluding straight up and straight down. From a one-mine camp of perhaps 300 or 400 inhabitants, it has become the seat of operations of nearly 100 organized companies and has six times its former population. It takes nearly half an hour to drive an auto from one end of the camp to the other.

Since its foundation, Oatman has always been a model camp. Cleanliness has been the watchword. No tin cans or refuse is allowed to litter the streets. The houses and business buildings have always had a well-kept, permanent look, and during these boom times the effect of these early adopted principles is being felt.

Living conditions are such as one expects to find only in large towns. Electricity, furnished from a modern plant in Kingman, adds much to the camp; practically all the houses are electrically lighted. An ice plant has done a good business here for years. One can buy anything from



MAP OF CLAIMS IN TOM REED-GOLD ROAD MINING DISTRICT

a potato to a hoist from the stores, provided they are not "just out." Telephones and telegraphs and uniformed messenger boys are commonplace features. The camp boasts three newspapers and they are enterprising sheets too; extras are put out on the slightest provocation. There is a motion-picture show with pictures changed daily. In fact, there are few modern comforts and conveniences that the camp has not acquired.

As an unusual feature of prospecting, the automobile plays an important part. Everything nowadays is done by machinery, and here traveling and freighting are no exceptions to the rule. As the camp is 20 mi. from the nearest railroad point and 27 mi. from the main shipping point, traveling and freighting are considerable items. But the automobile and truck simplify all that. It is no uncommon sight to see 20 or more automobiles in

roof garden and office purposes. Other enterprises, too numerous to mention, are all to be found here, including "Lou's Trading Post," where you can buy or sell anything from a frying pan to a complete mine equipment.

As an exact representation of a modern camp and as a complete opposite to the early-day camps, the tale of Oatman is well-worth preserving. No gun fights occur here; everything is peaceful and orderly; gambling is not a thriving industry; and, of course, Arizona is dry! All the deputy sheriff has to do is to act as traffic cop, and that is some job in itself. No one will ever speak of a bad man from Oatman, for there "ain't no such animal."

The boom has a solid, and comparatively conservative basis. The camp has gone on record as being against wildcatting and as favoring conservative, legitimate publicity based on actual worth and development, which it is hoped can be lived up to. The district has received the approval of prominent mining engineers, and the prospects of steady development and growth seem unquestionable. No one here is afraid of waking up in the morning to find the boom "busted" and the camp dead, as has occurred so often heretofore. All of the prospects will not make mines, but there is no question of the district making good; it has already done that.

Mining Conditions Around Oatman and Kingman

EDITORIAL CORRESPONDENCE

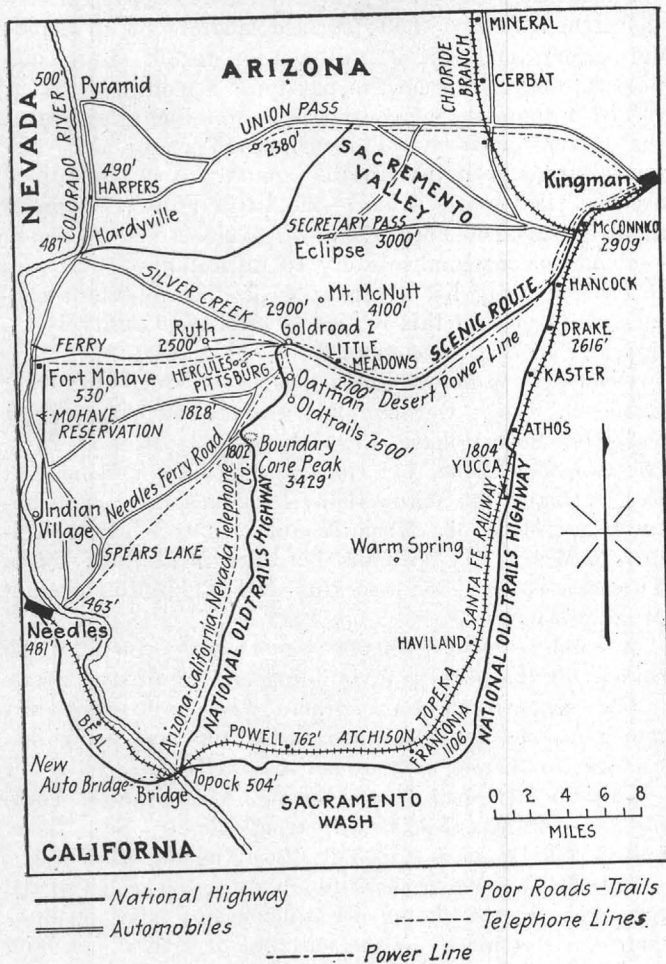
Although the excitement of the Oatman (Arizona) boom is only eight or nine months old, the camp and the surrounding territory have four large producing mines—which of course antedate the boom—yielding together between \$300,000 and \$500,000 per month. These are the Gold Road, the Tom Reed, the Golconda and the Tennessee. At least one other will be added to this list when its 200-ton mill, now under construction, is completed, and there are several small producers at present and there is likelihood of their increasing, both in number and in amount of production, as development work now in hand progresses.

Although there is a new company organized every day—sometimes two—the Arizona Corporation Commission is using more care now in granting permits for the sale of stocks, but there is every reason to believe that many are selling stock who will not engage in actual development.

THE CAMP'S PRODUCING MINES

The Gold Road produced during the year 1914, according to the report of the United States Smelting, Refining and Mining Co., of which it is a subsidiary, 107,846 tons of ore. Other than these the company has not made public its production or dividend figures. The Arizona State Tax Commission fixed a value on this mining property, for the purposes of taxation during the current year, of \$262,670, and the value of improvements at \$166,940.

The Tom Reed made the following production according to its report dated May 20, 1914: 1910, 14,289 tons, average value per ton \$42.46; 1911, 39,447 tons, \$19.53; 1912, 43,478 tons, \$23.22; 1913, 48,110 tons, \$24.09; The gross gold production for 12 months ended March of that year was \$1,158,927. The Arizona State Tax



ROAD MAP OF OATMAN PORTION OF MOHAVE COUNTY
 Figures show elevation above sea level

the center of town at the same time, and probably twice that many arrive and leave every day. Moreover, no driver complains of doing a poor business.

A list of the businesses, besides mining, that are thriving in this camp would read like a buyer's guide. At this time there are four banks either doing business or preparing to do so. Several hotels and rooming houses are open or in process of construction, but it is a difficult matter to find a place to sleep if you have not brought your blankets. Drug stores, grocery stores, hardware stores and all other kinds of stores are to be found. The head of one of the brokerage firms is erecting a 3-story concrete and stucco building to be used for restaurant,

Commission, for the purposes of taxation for the current year, put a value on the mining property of the Tom Reed of \$3,034,060, and on the improvements, \$175,500.

The total net bullion production to Apr. 1, 1914, was \$4,051,215. To and including dividend 46, May, 1914, the total dividends disbursed amounted to \$1,882,864. The operating costs for the year ended Apr. 1, 1914, were as follows: Mining, \$4.153; milling, \$1.664; cyaniding, \$1.557; marketing, \$0.155; total, \$7.529. The indirect cost, composed almost entirely of depreciation charges, was \$1.133, making a total cost per ton of \$8.622.

The Tom Reed is now producing \$100,000 per month from 4,000 tons of ore, which is treated in a 20-stamp mill. The working force is about 150 men. The ore is free-milling and is easily cyanided. No ore was encountered until a depth of 300 ft. was reached. The mine is opened up to a depth of about 1,200 ft.

The Golconda mine at Golconda in the Wallapai district, 20 mi. north of Kingman, owned by the Union Basin Mining Co. and controlled by N. L. Amster, of Boston, has paid two dividends this year, of \$85,000 each. The company is at present expending in the neighborhood of \$100,000 on the construction of a 200-ton oil-flotation plant for the treatment of zinc ores.

The Tennessee mine in the Wallapai district is reported to have made a new find of ore on the 1,200 level. The big shaft is progressing toward the 1,500 level. The mine has increased its regular output from 100 tons per day to 200 tons, 3 carloads per day being shipped to the Needles smeltery.

In the Secret Pass district, 20 mi. west of Kingman, the Orphan mine is being worked under bond and the ore treated in a 2-stamp Tetrault mill. From six weeks' operations three bars of bullion have been shipped, amounting to about \$2,000; the total mill run having been only about 200 hr.

PROMINENT NEW ENTRIES

The United Eastern Mining Co. was organized by two practical miners, George Long and James McIver, who, while working in the Tom Reed mine, figured out the trend of the rich Tom Reed lead and secured control of the adjoining ground under bond. Seeley W. Mudd and Frank A. Keith became interested in the venture, and at a depth of 200 ft. the apex of an ore chute was tapped. The mine is now opened up to a depth of 565 ft., and it is claimed that \$5,000,000 worth of ore is in sight in the mine—developed within a period of eight months. At one place the ore is said to be 43 ft. wide and averages \$32 per ton. D. C. Jackling, representing Hayden-Stone interests, has just been elected to the directorate. The company has recently authorized the construction of a 200-ton cyanide plant, work on which has already begun.

It is not often that a boom camp gets the invested interest of as many prominent men as are already associated with Oatman. The following are some of the more prominent: Senator W. A. Clark, D. C. Jackling, N. L. Amster, Seeley W. Mudd, Frank Keith, J. Parke Channing, A. E. Carlton, United States Smelting and Refining Co., Hayden, Stone & Co.

J. Parke Channing, in connection with G. W. Long and J. L. McIver of the United Eastern, has taken over from H. G. Putney the Putney group of 12 claims and

has organized the Oatman Syndicate Mining Co., a close corporation, for the development of this property. Work has already been started on a 500-ft. working shaft.

About the only approved method of development in this district is sinking from 300 to 500 ft. and then cross-cutting and drifting. Practically no surface work is being carried on. This is an unusual feature of a boom camp. Gas-engine hoists and compressors and Jack-hamer drills are the usual equipment.

SCALE OF WAGES AND TRANSPORTATION

The wages paid are about the usual in the mining camps of the West. The following is the scale: Superintendents, \$250 to \$350 per month; hoist engineers, \$4.50 per day; pump men, \$4; timber men, \$4 to \$4.50; machine drillers, \$4 to \$4.50; hand drillers, \$3.50 to \$4; blacksmiths, \$4 to \$4.50; carpenters, \$4 to \$6; car and shovel men \$3 to \$3.50; surface laborers \$3 to \$3.50; ore sorters, \$3 to \$3.50; millmen, \$4 to \$6. It is compulsory, under state law, to pay twice a month.

The automobile, of course, is a prominent feature of the present activity. Three hundred motor cars and trucks are now in use in the county. About one-third are the poor man's friend—the little Ford. Kingman alone boasts of 60 Fords, 76 of other makes and 20 trucks—about one machine to every 10 inhabitants.

The following list of distances to the important centers of activity in this section of Mohave County is interesting in this connection.

Distances from Kingman by wagon road to: Gold Road, 23 miles; Oatman, 26; Union Pass, 20; Secret Pass, 20; Fort Mohave, 43; Chloride, 23; Mineral Park, 20; Golconda Mine, 17; Golconda Extension Mine, 16; Cerbat Camp, 14; White Hills, 43; Hackberry, 28; Copper Giant Mine, 36; Music Mountain, 39; Wallapai Tellurium Mines, 15; Williams Tungsten Mines, 68; Yucca Tungsten Mines, 35; Stockton Hill, 11; Molybdenum Mines, 35 miles.

A bond issue of \$100,000 was recently voted by the county for the purpose of building and improving roads.

For the information of those wishing to visit this region a list of the railroad fares from various points (subject to change without notice) is given.

Fare to Kingman from: Boston, \$76.75; New York, \$74.75; Chicago, \$56.40; Denver, \$38.50; Salt Lake, \$35.85; San Francisco, \$22.20; Los Angeles, \$13.60.

Oatman is now experiencing a building boom. The call for office rooms, hotel accommodations and business quarters is resulting in the building of several new and modern buildings, besides large additions to buildings already up. The townsite boosters are getting more numerous daily. There are now at least 12 townsites and additions in and around the main camp.

The rest of Mohave County is also experiencing a revival as a result of the interest in the Tom Reed-Gold Road district. A strike of porphyry copper, carrying some native, made a short time ago at Mineral Park, caused quite a rush and everything in that locality has been staked.



Platinum Production in the United States in 1914 amounted to 525 troy oz. of platinum from domestic crude placer material or a total of 3,430 oz. of new refined platinum from platinum sands, gold bullion and copper matte, according to the Geological Survey. In addition there was a production of 64 troy oz. of iridium, 195 oz. of osmiridium and 2,635 oz. of palladium.