CALIFORNIA STATE MINING BUREAU
FERRY BUILDING, SAN FRANCISCO
FLETCHER HAMILTON — State Mineralogist

San Francisco — December, 1916

Mines and Mineral Resources

OF THE COUNTIES OF

Butte, Lassen, Modoc, Sutter and Tehama

CHAPTERS OF STATE MINERALOGIST'S REPORT
BIENNIAL PERIOD 1915-1916

CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO
1917

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BY
W. BURLING TUCKER and CLARENCE A. WARING
Field Assistants

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PREFACE.

The counties presented in the grouping herewith, really comprise two groups, geographically; one, Butte, Sutter and Tehama in the central and upper Sacramento Valley; and the second, Lassen and Modoc, on the eastern side of the Sierra Nevada Mountains, at the northeast corner of California. The first three are important agricultural counties, with Butte County also an important producer of gold and timber. The last two counties, being more mountainous, their principal industries are cattle raising and mining. Being east of the Sierra Nevada divide, Lassen and Modoc belong in part to the Great Basin Region which covers the State of Nevada.

We have endeavored to list all mineral properties, both active and prospective, and desire to here express our appreciation to the many owners and operators, whose cooperation and courtesy have assisted in the preparation of this report.

BUTTE COUNTY.

By CLARENCE A. WARING, Field Assistant.

INTRODUCTION.

The field work in Butte County was completed in December, 1916. About three weeks were spent along a route including Chico, Centerville, Nimshew, Hupps, Magalia, Stirling, Cherokee, Oroville and Forbestown. Many of the mines were visited and information was obtained concerning many of the old mines and prospects. Mention is made of all mines both operative and inoperative with a hope that a word about the development of old properties may enlighten new prospectors.

Appreciation is here expressed to the owners, superintendents and miners for their kindly assistance and cooperation in helping to bring this report up to date.

DESCRIPTION.

Butte County is located in the north-central part of the state. It is bounded on the north by Tehama and Plumas counties, on the south by Sutter and Yuba counties, on the east by Plumas and Yuba counties, and on the west by Glenn and Colusa counties. It has an area of 1764 square miles supporting a population, in 1910, of 27,301. Oroville, the county seat, originally incorporated in 1857, has a population of 3859, while Chico, originally incorporated in 1872, has a population of 3750.

The county includes a considerable area of flat low valley land, east of the Sacramento River and northwest of the Feather River, which produces grain, rice, hops, alfalfa, and citrus and deciduous fruits. Clays in this portion of the county are available for the manufacture of brick, and certain gravels are being dredged for gold. The northeastern portion of the county extends into the Sierras and in places reaches an elevation of 7000 feet. In this upper portion of the county mining and timbering are the principal industries, although a few apples, berries, etc., are grown.

Power.

The greater part of Butte County is well provided with electric power, since four companies are in the field.

The Northern California Power Company has a line entering the northwestern part of the county and extending to Chico and westward into Glenn County. Their generating plant is in Shasta County, on a branch of Battle Creek, near Manton.

The Oro Electric Corporation, with generating plants on the upper Feather River, has lines extending southward through Yankee Hill and Oroville to a point northwest of Honcut, where they turn westward across the county with branches to Gridley and Biggs.

The Pacific Gas and Electric Company has generating plants at De Sabla and Centerville on Big Butte Creek supplied by water from Round Valley, Concow and Hutchinson reservoirs. Power lines extend from Centerville to Oroville and southwestward into Yuba County; also from Centerville southward into Sutter County with branch lines to Biggs and Gridley.

The Great Western Power Company with generating plant at Las Plumas on the Big Bend of the North Fork of the Feather River has a trunk line southward, along a line 4 miles east of Oroville, to Sacramento. No power is at present distributed in Butte County from this line.

Transportation.

The county is well served by railroads and roads.

The Northern Electric Railroad enters the county from the south, passing through Rio Bonito, Tres Vias and Durham to Chico, with a branch from Tres Vias to Oroville.

The Southern Pacific enters the county from the south through Gridley, and crosses the western side of the county through Biggs, Nelson, Chico, Nord and Cana with a branch line from Chico, up Big Butte Creek, to the Diamond Lumber Mill at Stirling. This company also has a line entering the county through Honcut, running northward to Oroville and extending up the east side of Feather River, into the timber lands, with terminal at Brush Creek.

The Western Pacific Feather River route enters the county from the south, passes through Oroville, and follows the Feather River and its North Fork into Plumas County.

The main state highway has been ordered surveyed paralleling the Southern Pacific Railroad through Gridley, Biggs and Chico, while the portion northwest of Chico has been laid out. Good macadam roads have been built in the western portion of the county, while fair mountain roads have been graded in the eastern, more mountainous portion.

GEOLOGY.

The bedrock series of the higher portion of Butte County is made up principally of granite and granodiorite, which have intruded the older diabase and amphibolite with their overlying slates, quartzites and limestones of Carboniferous age. The amphibolite lies in a belt generally with NW.–SE. trend along the west side of the granitic area.

The series has in places been intruded by basic serpentine and acid quartz veins. Considerable areas are covered by sediments, including auriferous gravels, and volcanic rocks. The volcanic series consists of an older basalt overlain by andesite conglomerate, tuff and breccia, all of Tertiary age and in places overlain by a later basalt or dolerite of probable Pleistocene age.

The western portion of the county consists largely of alluvial gravels, sands and clays sloping gently from the foothills towards the Sacramento River to the west.

MINERAL PRODUCTION.

Since 1880 Butte County has produced brick, chrome, copper, diamonds, gold, lead, limestone, mineral paint, mineral water, platinum, silver and stone.

The production of chrome increased very decidedly in 1916, but several of the properties have since been worked out. The copper, lead and silver were recovered by the smelter, from gold ores. The diamonds are found in the cleanups from placer gold gravel.

The dredgers in the region about Oroville have kept up the gold production for several years. Gold production apparently reached its height in 1908, when gold to the value of $3,139,398 was produced. Since then the production has gradually diminished until now it is slightly more than half what it was in 1908. Platinum is recovered from the dredger gold in the process of refining.

The following table of mineral production in Butte County covers the industry since 1880, the earliest time for which production figures are available:

TABLE OF MINERAL PRODUCTION OF BUTTE COUNTY.

Year	Copper		Diamonds, value	Gold, value	Lead		Mineral water		Platinum		Silver, value	Stone industry		Unapportioned		
	Pounds	Value			Pounds	Value	Gallons	Value	Ounces	Value		Material and amount	Value	Mineral	Amount, tons	Value
1880																
1881				$430,501												
1882				650,000							$1,247					
1883				650,000							1,000					
1884				630,000												
1885				680,000												
1886				672,569												
1887				728,160							3,700					
1888				632,902							13					
1889				550,000							6					
1890				696,628							500					
1891				268,977							518					
1892				304,765							5,815					
1893				316,999							229					
1894				307,351							610					
1895				473,673							5,504					
1896				697,261							8,986					
1897				749,316			1,900	$775			5,390					
1898				667,025			2,160	900			7,885	Brick, 700 M	$4,200			
1899				514,508			2,685	900			9,317	Brick, 250 M	1,500	Mineral paint	150	$3,000
1900				486,846			2,480	1,240			5,009	Brick, 300 M	1,800	Mineral paint	900	9,900
1901				485,589			15,000	1,515			13,082	Lime, 600 bbls	600			
				864,978			10,400	1,455			4,634	Brick, 900 M Lime, 1,500 bbls	7,200 1,500			
1902				916,782			14,000	1,500			2,219	Brick, 800 M Lime, 400 bbls	5,000 750			
1903				1,571,507			13,000	1,550		$210	358	Brick, 1,200 M Lime, 250 bbls	7,200 250	Limestone	190	250
1904				1,982,552			12,600	1,512		1,000	2,302	Brick, 670 M	4,020			
1905				2,607,500			15,000	1,500	110	1,770	7,134	Brick, 400 M	3,200			
1906				3,016,747			19,500	1,950	26.4	475	10,853	Brick, 130 M	1,300			
1907				2,786,840			21,400	2,140			8,967					
1908				3,139,398			22,450	2,450			12,708	Macadam, 18,176 tons	7,916			
1909				2,967,079			25,400	1,400			7,205	Brick, 200 M Macad., 117,338 tons	1,200 32,140	Unapp. 1900–1909		107,170
1910				2,487,791	645	$27					6,429	Macadam, 131,889 tons	84,932			
1911			$150	2,323,396							5,102	Macadam, 231,338 tons	78,208			
1912				2,346,229							5,567	Miscellaneous	51,879			
1913			175	2,269,849			1,000	250			5,163	Miscellaneous	258,503			
1914			100	1,700,000	513	20	1,200	300			4,000	Miscellaneous	50,895			
1915	11	$2	300	1,545,976	90	4	5,000	850	126	3,997	3,433	Miscellaneous	67,143	Chrome		540
Totals	11	$2	$725	$24,089,604	1,248	$51	296,275	$22,187		$7,452	$154,835		$621,336			$120,860

TABLE OF MINERAL PRODUCTION OF BUTTE COUNTY—Continued.

	Totals.
Copper	$2
Diamonds	725
Gold	24,089,694
Lead	51
Mineral water	22,187
Platinum	7,452
Silver	154,835
Stone industry	621,336
Unapportioned	120,860
Total (1880-1915, inclusive)	$25,017,142

MINERALS AND MINES.

ASBESTOS.

Asbestos is reported to have been found near Blinzig, north of the big bend in the North Fork of Feather River, by J. C. Martin. The asbestos is of the amphibole variety and occurs in serpentine. The extent of the deposit has not been determined since no development work has been done.

Serpentine areas of considerable extent occur in the amphibolite and slate areas along a line drawn southeastward from Big Bar to Clipper Mills. Small veins of asbestos are in places found along fracture planes in the serpentine.

CHROMITE.

The demand for chrome during the last two years created considerable interest and old prospects which had lain idle for years were opened up and ore was shipped from some of the better ones.

The **Clipper Queen** prospect near Clipper Mills is owned by Geo. Woolley who has a 24-ft. prospect shaft on a chimney of chrome said to be from 2 ft.–8 ft. wide and 30 ft. long. Idle.

Curtis Bros. have developed a deposit of chrome near Pentz from which some ore is reported to have been shipped from Oroville and Durham in April, 1916. It has been operated by John Marchant of San Francisco.

Mr. **N. Lambert** of Nimshew is reported to have deposits of 48% chrome near Magalia in the SW. ¼ of Sec. 2, T. 22 N., R. 3 E., M. D. M. It is 4 miles from the Butte County Railroad. Two or three lenses of chrome are said to have been prospected but no ore has been shipped.

The **Zenith Mine** is in Sec. 6, T. 19 N., R. 7 E., M. D. M., about 2½ miles northeast of Forbestown at an elevation of 2940 ft. Chrome occurs as kidneys in serpentine with talc. The ore was taken out by an open cut along an old shallow tunnel, and some was also grubbed

from the soil near the surface. Apparently most of the shipping ore was taken from a kidney from 6 ft.–20 ft. wide, 12 ft. deep and 75 ft. long, having a course N. 30° E.

The property was closed down when visited in September, 1916, but it was learned that 25 cars of ore were carried, by motor trucks, to Oroville and shipped to the United States Steel Corporation. Owned by the California Manganese Company and leased by E. A. Dickey and F. M. Driesbach of Oakland, under the name of Zenith Chrome Mining Company.

CRUSHED ROCK.

Crusher No. 2 of the **Natomas Consolidated of California** is operating at Oroville. It crushes cobbles from the old dredge tailings, converting them into rock suitable for building purposes.

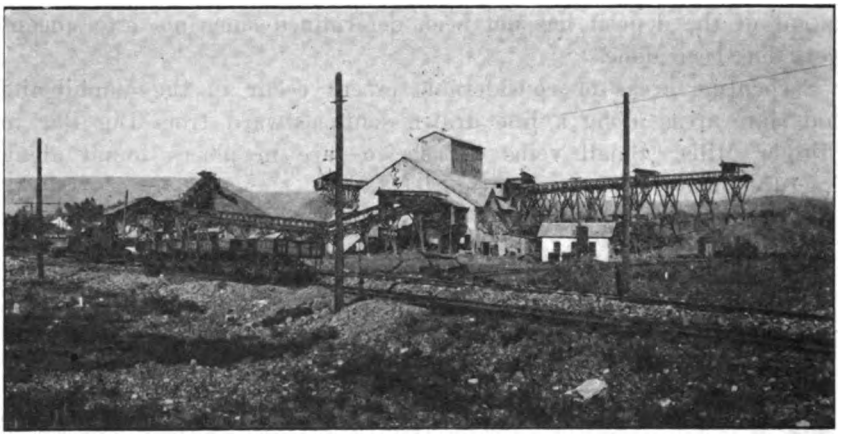

Photo No. 1.—Rock crushing plant of the Natomas Consolidated of California at Oroville. Capacity 1000 tons of crushed rock per day.

The dredge tailings are loaded into dump cars by a Bucyrus No. 40 steam shovel and hauled 1½ miles to the crushing plant. The gravel is crushed and then screened to four sizes as follows: 2½″–1½″, 1¼″–1″, ¾″–½, ⅜″ to dust. The crusher equipment consists of: One 18″ x 36″, one 24″ x 36″ and two 10″ x 36″ jaw crushers. Electricity is used for power.

The plant has a capacity of about 1000 tons of crushed rock per day and employs 23 men. The production of this plant is gradually being cut down, since the company's plant at Fair Oaks, Sacramento County, is large enough to supply the demand and is nearer to the market.

Owned and operated by the Natomas Consolidated of California, Rock Crushing Department, Forum Building, Sacramento; H. W. Thorne, manager, at Oroville.

DIAMONDS.

Diamonds have been found in the placer diggings at Thompson Flat two miles north of Oroville and in the old Cherokee hydraulic mine. The diamonds have been found mostly by "fossickers." In 1915 three white diamonds of first quality, weighing 1 carat each, and six small diamonds some of which were of gem quality, were found at Cherokee. In 1916 a diamond, which when cut was valued at $125.00, was found in the old Cherokee mine by John Hufford, while another valued at $52.00 was found by Ben Jutz.

GOLD—DREDGING.

Gold dredging in California was first carried on in the Oroville district, where W. P. Hammon and Warren Treat in 1898 sank test pits in the gravels. The results of their findings was brought to the attention of Thomas Couch, a Montana mining man, by Frank T. Southerland, and the Couch No. 1 dredge was built. Soon after this the Feather River Exploration Company was organized, the stock of which was held by Lewisohn Bros. of New York, Thos. Couch, W. P. Hammon and Frank T. Southerland.

Dredging in the Oroville field has been a great financial success. The greater part of the field has already been dredged and it is estimated that it will be worked out in about five years. At the end of the year 1916, eleven dredgers were being operated by the following seven companies, or parties:

Gardella	1
Kentucky Ranch	1
Natomas Consolidated	3
Oroville Dredging, Ltd.	2
Oro Water, Light and Power Company	1
Oroville Union	1
Pacific	2

The following table gives a condensed history of dredging in Butte County since its inception.

TABULAR HISTORY OF

Company	Dredge number	Type of construction	Year commissioned	Number and type of buckets	Bucket capacity, cubic feet.	Rated capacity, horsepower.
1898—W. P. Hammon and Thos. Couch.	Couch No. 1	Risdon	Mar. 1,'98		3	
	Couch No. 2	Risdon	June 8,'00		5	
	Couch No. 3	Risdon	June 8,'00		5	
1898—Feather River Exploration Co. Taken over in Jan., 1906, by the Feather River Development Co. and in Jan., 1909, by the Natomas Consolidated of Cal.	Feather R. No. 1	Couch No. 1	Mar. 1,'98		3	
	Feather R. No. 2	Couch No. 2	June 8,'00		5	63
	Feather R. No. 3	Couch No. 3	June 8,'00		5	63
	Feather R. No. 4	Risdon Couch No. 4	Dec. 10,'02		5	63
	Feather R. No. 5	Risdon	Jan., 1903		5	63
1899—Kia Oro Gold Dredging Co.	Kia Oro No.1	Risdon	May, 1899		2½	
1900—Marigold	No. 1	Risdon	Jan., 1900		3	
	No. 2	Risdon			5	
1900—Lava Beds Dredging Co. Taken over by the Oro Water, Light and Power Co.	Lava Bed No. 1		1900		5	
	Lava Bed No. 2	West. Eng. Const. Bucyrus	July, 1903	Close conn.	5	208
	Lava Bed No. 3	West. Eng. Const. Bucyrus	Dec. 4,'04	Close conn.	5	208
1901—Oroville Gold Dredging Co.	No. 1	Marion	Feb., 1901			40
1901—Indiana Gold Dredging and Mining Company. Reincorporat d in 1907 as the Indiana Gold Dredging Co.	Indiana No. 1	Company and Bucyrus	July 4,'01	79 close c.	3½	160
	Indiana No. 2	West. Eng. Const. Co. Bucyrus machinery	Feb., 1903	80 close c.	4	150
	Indiana No. 3	Bucyrus	Dec., 1907	Close conn.	4	150
1901—Boston and Oroville Mining Co. Taken over by the Oroville Dredging Ltd.	Boston No. 1	Risdon	July, 1901	Close conn.	3	
	Boston No. 2	Risdon	July, 1902	Close conn.	3	
	Continental	Bucyrus	1901	Close conn.	4	
	Boston No. 4	Boston Machine Shop Marion	May, 1906	68 close c.	7	360
Garden Ranch Dredging Co.		Marion machine		Dippers		
1902—Boston and California Dredging Co. Took over holdings of the Leggett & Wilcox Co. Taken over by Oroville Dredging Ltd.	Cal. or Leggett No. 1	Risdon	Mar., 1902	Close conn.	3½	
	Cal. or Leggett No. 2	West. Eng. Const. and Bucyrus	Dec., 1902	Close conn.	5	195
	Cal. No. 3	Boston Machine Shop and Marion	Oct., 1904	Close conn.	7	

BUTTE COUNTY DREDGERS.

Type of screens	Type and area of riffles	Dredge capacity, cu. yds. in 30 days. Based on actual operation	Depth dredged below water line, feet	Acres dredged	Total cu. yds. dredged, bank measurement	Total cost per cu. yd. in cts.	Remarks
Revolving	Cocoa matting	40,000				6.0	
Revolving	Cocoa matting	40,000				6.0	
Revolving	Cocoa matting	40,000				6.0	
Revolving	Cocoa matting	40,000				6.0	Wrecked by floods in 1907 and dismantled.
		31,800	28			4.0	Taken over by the Pacific Gold Dredging Co.
							Elevator dredge.
							Elevator dredge.
Shaking			36			8.0	
Shaking			40			8.0	
		20,000					
	528 square feet		35	48.82	2,645,330		Wrecked by flood March 17, 1907. Dismantled.
Shaking		21,000	36			7.5	Wrecked by flood March 17, 1907. Machinery used in construction of Indiana No. 3.
Shaking		21,000	36			7.5	Partly destroyed by floods of January 15, 1909. Reconstructed in July, 1909.
Revolving	Hungarian riffles	39,956	32			6.58	Put out of commission in 1908 because gravel became too tight to handle economically. First had 5 cu. ft. open link buckets.
Revolving	Hungarian riffles						First had 5 cu. ft. open link buckets. Put out of commission in 1908.
Shaking	Hungarian riffles						Worked out the property November, 1909. First built in 1899 with open link buckets.
Revolving		93,000	28				
		30,000					In Wyman Ravine District. Worked out property in 1909.
		39,415				6.23	First had 5 cu. ft. open link buckets. Sold to L. and J. Gardella.
Shaking	Hungarian riffles	60,000	36				
Revolving	894 square feet	92,000					Dredged its way to the Viloro property in 1909. Formerly had 4 cu. ft. open link buckets.

TABULAR HISTORY OF BUTTE

Company	Dredge number	Type of construction	Year commissioned	Number and type of buckets	Bucket capacity, cubic feet.	Rated capacity, horsepower.
1902—Oroville Gold Dredging and Exploration Co. Taken over by the Oroville Dredging Ltd.	Exploration or Biggs No. 1	Risdon	April, 1902	78 close c.	3	-----
	Exploration or Biggs No. 2	West. Eng. Const. and Bucyrus	1905	Close conn.	5	238
	Explor. No. 3	Boston Machine Shop and Marion	Oct. 20,'06	Close conn.	7	-----
1902—Gardella, L.	Gardella or Honcut	Risdon	May 1,'02	28 open link	5	165
Gardella, L. and J.	Gardella	Risdon	Oct. 12,'07	Open link	5½	-----
1902—Cherokee Gold Dredging Co.	Cherokee No. 1	Bucyrus	Oct., 1902	Close conn.	5	120
1902—American Gold Dredging Co. Taken over by Pacific Gold Dredging Co.	American No. 1	Bucyrus	Nov., 1902	-----	3	-----
	American No. 2	Bucyrus	-----	-----	5	100
1902—Pennsylvania Dredging Co.	Pennsylvania	Golden State Miners Iron Works, S. F.	Nov. 1,'02	54 close c.	6	220
1902—Butte Gold Dredging Co.	Butte No. 1	West. Eng. and Const. Co. Bucyrus	Nov. 26,'02	90 close c.	3½	165
1903—El Oro	El Oro No. 1	Link Belt Machinery Co., Chicago	Dec. 26,'03	90 close c.	5	290
	El Oro No. 2	Link Belt Machinery Co.	Jan. 22,'08	Close conn.	5	390
1904—Leggett (Jas. H.) Gold Dredging Co. Later—Leggett Gold Mining Co.	Leggett No. 3	Risdon	Mar. 31,'04	35 open link	5	175
	Leggett No. 4	Risdon	Sept., 1909	Open link	5	-----
1904—Central Gold Dredging Co.	Central No. 1	West. Eng. Const. and Bucyrus	May, 1904	-----	3	-----
1904—Ophir Gold Dredging Co. Consolidated with the Central or Nevada Gold Dredging Co.	Nevada	Central No. 1	May 15,'04	92 close c.	4	168
	Ophir	West. Eng. Const. and Bucyrus	Aug. 4,'06	77 close c.	5	262½
1904—Viloro Syndicate Ltd.	Viloro No. 1	West. Eng. Const. and Bucyrus	Oct. 30,'04	72 close c.	5	242½
	Viloro No. 2 or Cal. No. 3	Marion	Oct. 30,'04	-----	7	-----

[6]Record in April, 1908.
[1]Average in 1908.
[2]Capacity said to be 75,000 cubic yards.
[3]Average for 5½ years.
[4]Average in 1908.
[7]Acres monthly.
[8]3,500,000 cubic yards to January 1, 1909.

COUNTY DREDGERS—Continued.

Type of screens	Type and area of riffles	Dredge capacity, cu. yds. in 30 days. Based on actual operation	Depth dredged below water line, feet	Acres dredged	Total cu. yds. dredged. Bank measurement.	Total cost per cu. yd. in cts.	Remarks
evolving							
d shak'g	Hungarian riffles	[9]109,620	30				
		90,000	35.5				
volving	Risdon return sluices, 350 sq. ft.		10			[12]	Dismantled in August, 1909, and moved to Honcut Creek, where it began dredging in February, 1910. Formerly California No. 1 dredge.
							In Wyman's Ravine.
						7.0	Taken over in 1909 by the Natomas Consolidated.
		60,000				8.0	Taken over by the Pacific Gold Dredging Co.
		90,000				8.0	
o shak-g screns.	800 square feet	43,830	28		8	8.5	
shak'g	750 square feet	47,640	36	40	9	7.0	Dismantled in July, 1910.
shak'g	420.7 square feet	[10]45,590	30	34	10		
king volving	Longitudinal angle irons and cobbles	[11]75,000	30	34	10		
		[8]68,166	30	[7]1.13	11	5.0	Worked out the property and dismantled in June, 1909.
			10			[14]	In Wyman's Ravine. Leggett No. 3 reconstructed.
		40,000	30				Reincorporated as the Nevada Gold Dredging Co.
olving	Hungarian	[4]44,334	36				Ophir and Nevada Gold Dredging Co., Consolidated.
king	832 square feet	[4]44,334	36		12		
king	Hungarian 1,000 square feet		36				Viloro No. 1 destroyed by fire October 18, 1909.
olving							Purchased from California Oroville Dredging Ltd.

[4] 2,655,000 cubic yards to January 1, 1909.
[7] 1,655,000 cubic yards to January 1, 1909.
[8] 4,500,000 cubic yards to January 1, 1909.

[10] 1,800,000 cubic yards during first three years.
[12] Gravel said to average 16 cents per cu. yd.
[14] Gravel said to average 15 cents per cu. yd.

TABULAR HISTORY OF BUTTE

Company	Dredge number	Type of construction	Year commissioned	Number and type of buckets	Bucket capacity, cubic feet	Rated capacity, horsepower
1906—Oro Water, Light and Power Co. Took over the Lava Bed Dredging Co. and the Marigold Gold Dredging Co.	Lava Bed No. 2	West. Eng. Const. and Bucyrus	July, 1908	Close conn.	5	208
	Lava Bed No. 3	West. Eng. Const. and Bucyrus	Dec. 4,'04	Close conn.	5	208
	Empire	West. Eng. Const. and Bucyrus	April 22,'06	82 close c.	5	225
	Victor	West. Eng. Const. and Bucyrus	Sept. 4,'07	Close conn.	5	225
	Hunter	West. Eng. Const. and Bucyrus	Aug. 13,'07	82 close c.	5	225
1906—Pacific Gold Dredging Co. A subsidiary of the Yukon Gold Dredging Co. Took over the American Gold Dredging Co. and the Kia Oro Gold Dredging Co.	Pacific or Perry No. 1	West. Eng. Const. and Bucyrus	May 1,'06	84 close c.	7½	300
	Pacific or American No. 1		Oct., 1902	Close conn.	4	-----
	Pacific or American No. 2	West. Eng. Const. and Bucyrus	April, 1904	Close conn.	5	208
	Pacific No. 4	West. Eng. Const. and Bucyrus	Jan. 26,'08	80 close c.	7	300
1906—Gold Run Dredging Co.	Baggett No. 1	Risdon Iron Works	May 26,'06	37 open link	7	215
1906—Oroville Dredging Limited. Took over the Boston and California, Boston and Oroville, Oroville Gold Dredging and Exploration Co.	California No. 2		Jan. 1,'03	Close conn.	5	-----
	California No. 3		Oct., 1904	Close conn.	7	-----
	Explor. No. 1		April, 1902	Open link	3	-----
	Explor. No. 2		Feb. 17,'05	Close conn.	5	-----
	Explor. No. 3		Oct. 20,'06	Close conn.	7	-----
	Boston No. 4		May 2,'06	Close conn.	7	-----
	Continental		June, 1899	Close conn.	4	-----
1909—Natomas Consolidated of California. (Feather River Division.) Took over the Cherokee and Feather River Exporation Cos. on January 1, 1909.	Cherokee or Feather No. 1	Bucyrus	July, 1902	Close conn.	5	205
	Feather No. 1 (formerly Feather No. 2)	Yuba Const. Co. Marion	Dec. 22,'06	68 close c.	7½	460
	Feather No. 2 (formerly Feather No. 3)	Yuba Const. Co. Marion	Mar. 26,'08	80 close c.	7½	460
	Feather No. 3	Yuba Const.	Sept. 10,'11	79 close c.	15	735
	Feather No. 4	Risdon Feather R. No. 4	Mar. 10,'02	Open link	3½	-----
1909—Kentucky Ranch Gold Dredging Co.	Kentucky No. 1	Risdon	May 1,'09	32 open link	5	175
1909—Butte Creek Cons. Dredging Co.	Butte Creek	Ed L. Smith design and Taylor Iron and Steel Co. machinery	May 1,'09	39 open link	11	375

[5]Acres per month.

[16]Gravel averages 9 cents per cubic yard.

OUNTY DREDGERS—Continued.

Type of screens	Type and area of riffles	Dredge capacity, cu. yds. in 30 days. Based on actual operation	Depth dredged below water line, feet	Acres dredged	Total cu. yds. dredged, bank measurement	Total cost per cu. yd. in cts.	Remarks
aking			36				
aking			40				
volving	Holmes		38				Leak in hull and turned over in pond, 1909.
volving			38				
volving			38				
ng shak'g	Holmes	117,205	[9]34½	[9]2	16	4.44	
						16	
	Holmes		[9]36			16	
ndshak'g		11,000	[9]29			[16]5.0	
volving	360		35 av. 38	28	15	17	Gravel averages 12½ cents per cubic yard. Gross output per cubic yard in 1906–1907 was 11.23 cents.
							Worked out the property and closed down November, 1909.
aking	Hungarian		45				Formerly the Cherokee dredge. Closed down December 31, 1909.
volving			25–40	[18]246	9,766,000	4.41	Gravels average from 9 cents to 14 cents per cubic yard.
volving			25–40	[18]210	10,560,000	3.69	Gravels average from 9 cents to 14 cents per cubic yard.
volving			40	[18]246	13,714,000	3.60	Gravels average from 9 cents to 14 cents per cubic yard.
				[19]10	[18]445,000	7.64	Gravels average from 9 cents to 14 cents per cubic yard. Closed down December 31, 1909.
volving	Risdon double return 264 sq. ft.		18			20	On Honcut Creek.
volving	Manganese steel riffles 624 sq. ft.	30,000	37	[21]4			Sold to Trinity Star Gold Dredging Co. in 1916.

[18]To June 30, 1916.
[19]To 1910.
[20]Gravel said to aver. 11 to 12 cents per cu. yd.
[21]Acres per month.

The **Butte Creek Consolidated** dredge was located on Butte Creek in 1916. It originally had 39–11 cu.-ft. open-link buckets with a capacity of 30,000 cu. yds. of gravel per month. It was sold to the Trinity Star Gold Dredging Company, who dismantled it in 1916 for shipment to Lewiston, Trinity County. C. E. Mason, superintendent, Chico.

The **Honcut** dredge, operating on Honcut Creek, is owned by Lawrence Gardella of Oroville. It is a Risdon dredge with 5 cubic-foot buckets, revolving screen, pumps and 50-ft. bucket elevator run

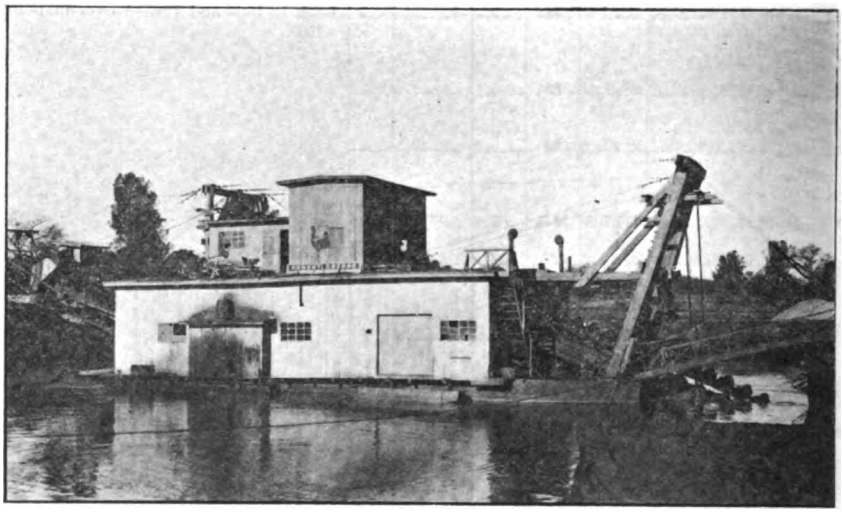

Photo No. 2.—Honcut dredge on Honcut Creek, southeast of Oroville, Butte County.

by electric motors. Power is taken from the line of the Oro Light and Power Company. The dredge is provided with about 600 sq. ft. of riffles. When visited in December, 1916, it was expected to finish the ground in about three months after which the dredge was to be dismantled and moved to Trinity County.

The **Hunter** dredge is operating on the east side of Feather River below Oroville. It is a Bucyrus dredge with 76–6 cu.-ft. close-connected buckets which will dig 37 feet below the water line. Nine men were employed in 3 shifts of 8 hours each. When visited in December, 1916, the dredger was digging from 26′–30′ below the water line and handling from 163 to 200 cu. yds. per hour. Owned by the Oro Water, Light and Power Company of Oroville; C. G. Leeson, manager.

Photo No. 3.—Hunter dredge of the Oro Water, Light and Power Company, on the east side of the Feather River below Oroville.

The **Kentucky Ranch** dredge is operating on Honcut Creek in Sec. 18, T. 18 N., R. 5 E., M. D. M., 10 miles southeast of Palermo. It is a Risdon dredge equipped with 54–5 cu.-ft. close-connected buckets, revolving screen, conveyor belt stacker, and head lines. The winch room is on the main deck. The ground is difficult to work on account of large boulders. The dredge is getting old and it is expected to work only until it goes to pieces. Owned by the Kentucky Ranch Gold Dredging Company, Lawrence Gardella, manager; D. P. Roderic, dredgemaster, Oroville.

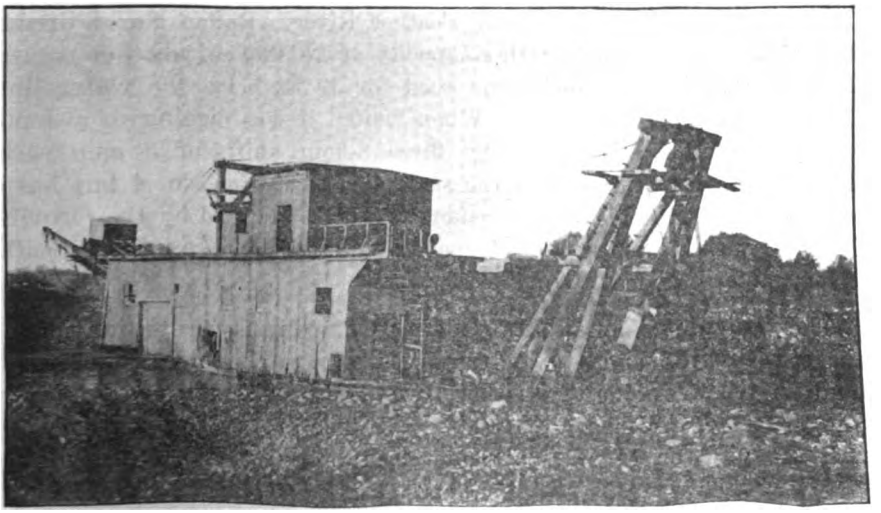

Photo No. 4.—Kentucky Ranch dredge on Honcut Creek, southeast of Oroville.

The **Natomas Consolidated** of California has three dredges on the Feather River southwest of Oroville. Two of these have 7½ cu.-ft. close-connected buckets, while a third has 15 cu.-ft. buckets. Electricity is obtained from the Pacific Gas and Electric Company.

The depth to bedrock is about 40 ft., the pay gravel being covered with hydraulic tailings. The bedrock is soft and the dredgers dig into it about 18 inches. Natomas Consolidated of California, Forum Building, Sacramento. Emery Oliver, general manager.

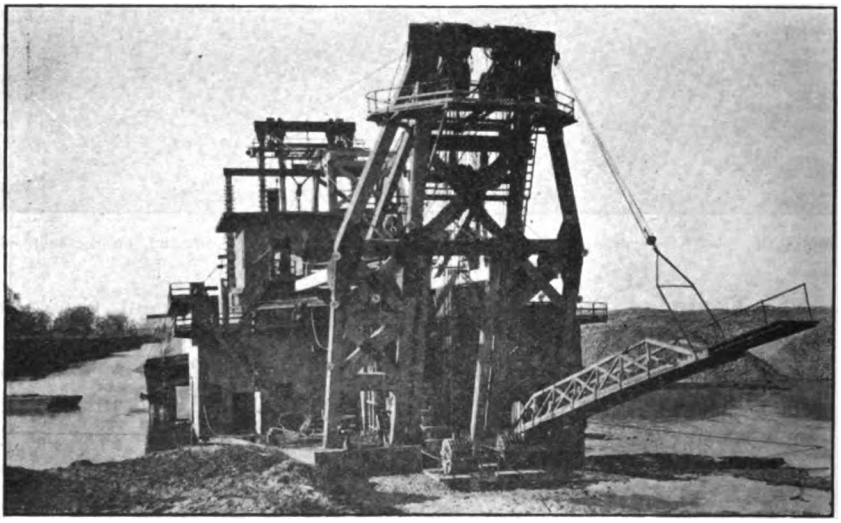

Photo No. 5.—Natoma No. 3 dredge on the east side of Feather River below Oroville.

The **Oroville Dredging Limited** is operating two dredgers near Thermalito on the west side of Feather River. Boston No. 4 dredge has 65–7¾ cu.-ft. buckets with a capacity of 120,000 cu. yds. per month. It is of the Marion winch type good for 32 ft. below the water line, and has 400 sq. ft. of riffles. When visited it was digging to a depth of 25 ft. and was operated by three 8-hour shifts of 3 men each. Exploration No. 3 dredge is the same size as Boston No. 4 but has a crown deck 4 ft. wider, and a Bucyrus winch. Owned by the Oroville Dredging, Ltd., James Osgood, manager, San Francisco. Geo. Featherton, superintendent, Oroville.

The **Oroville Union Gold Dredging Company** is a combination of the old Oroville and Pennsylvania companies. It holds 40 acres of land on the west side of Feather River south of Oroville and is operating the old California No. 3 dredge. The dredge has been in commission for over 14 years and now handles about 75,000 cu. yds. of

gravel per month. The gravels average over 11¢ per cu. yd. and it costs less than 4½¢ per cu. yd. to handle it. W. H. James, president; J. G. Nisbet, manager, Oroville.

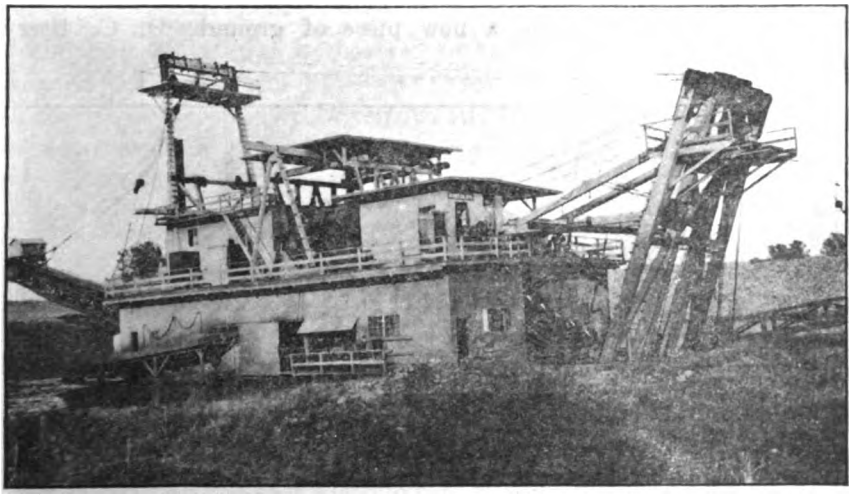

Photo No. 6.—Boston No. 4 dredge, of the Oroville Dredging Company, operating on the west side of Feather River below Oroville.

The **Pacific Gold Dredging Company** has two Bucyrus dredgers in the county. Pacific No. 3 has been operating in Sec. 3, T. 21 N., R. 2 E., on Big Butte Creek, for about two years. The channel is about ¼ mile wide and 20 ft. deep. The dredge is equipped with 6 cu.-ft. buckets and shaker screen and has a capacity of about 120,000 cu. yds. per month. It is expected that the ground will be worked out in another year.

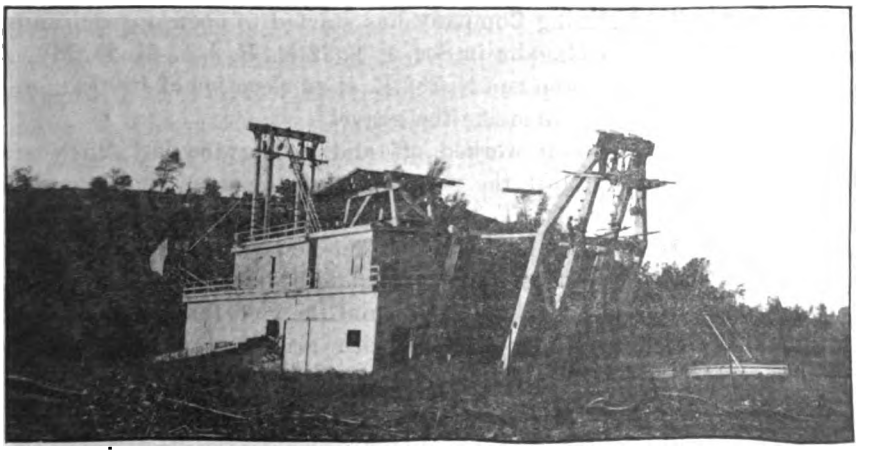

Photo No. 7.—Pacific No. 3 dredge on Big Butte Creek, eight miles east of Chico.

Pacific No. 4 is operating on the west side of Feather River southwest of Oroville. It is equipped with 78–7 cu.-ft. close-connected buckets and shaker screen and handles about 4500 cu. yds. of gravel per day. When visited in December, 1916, it was digging through tailings in order to reach a new piece of ground. O. C. Perry, manager, Oroville.

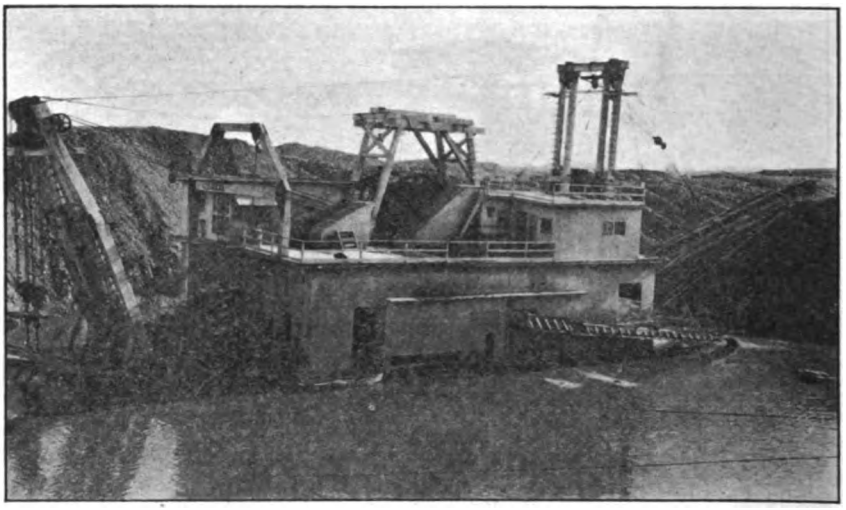

Photo No. 8.—Pacific No. 4 dredge on the west side of Feather River, southwest of Oroville.

GOLD—DRIFT MINES.

Drift mining in Butte County has been more active during the last year. Several properties were being opened up when visited but few were as yet on a producing basis.

The **Bader Gold Mining Company** has started to open up a channel 1½ miles southwest of Magalia in Sec. 1, T. 22 N., R. 3 E., M. D. M. A new 150-ft. tunnel has been run N. 75° E. at an elevation of 1900 ft., and a 70-ft. raise run north to strike the gravel.

The property has been worked off and on for the last 25 years. It was hydraulicked until the soft shale of the west rim began to slide, after which a 1000 ft. tunnel was driven. Attempts to drift met with failure on account of slides. The new work has been carried on along the west rim in porphyry and slate bedrock.

The gravel consists of granite wash and the gold found in it is said to have been oxidized but coarse, with grains about the size of cucumber seeds. Geo. B. Mowry, superintendent, Magalia.

Bibl.: Rept. XIII, p. 82, 1895–6.

The **Bader Bros.** drift property is in the E. ½ of Sec. 36, T. 23 N., R. 3 E., M. D. M., ½ mile southwest of Magalia. A 1000-ft. tunnel in slate is said to have crossed a channel which is said to be 30 ft. wide. Idle. Owned by H. F. Bader of Magalia.

The **Bay State** mine is reported to be 1¼ miles southwest of Nimshew on the east side of Big Butte Creek. Elevation 2000 ft.; 100 A.; channel course NE.-SW.. A 300-ft. tunnel in slate and 200-ft. tunnel in granite. Gravel free. Idle.

Bibl.: Rept. VIII, p. 117, 1888.

The **Bangor** drift mine is reported to be 1 mile east of Bangor. A 2400-ft. channel. Idle.

Bibl.: Repts. XI, p. 164, 1892; XII, p. 80, 1894; XIII, p. 82, 1896.

The **Burgstrasser** or **Kickapoo** drift mine is 6 miles west of Strawberry Valley, elevation 3500 ft.; 100 A.; 300-ft. bedrock tunnel, 12 ft. raise; 300 ft. gangway, 6 ft. of gravel, no breasting. Idle.

Bibl.: Rept. XIII, p. 83, 1895–6.

The **Bushness** drift mine is reported to be located on Blackhawk Creek. Development work is reported to consist of sinking and drifting on a gravel channel. Leased by Messrs. Poung, Hughes and Hogan of Oroville.

The **Butte Belle** drift mine is 2½ miles southwest of Lovelock in Sec. 3, T. 23 N., R. 3 E., M. D. M. It includes 159 A. in the Butte Mining District. Development consists of a bedrock tunnel in serpentine run 550 ft. to intersect a channel N. 10° W. along Big Butte Creek. A well-defined gold-bearing vein crosses the property. Idle.

Bibl.: Rept. XII, p. 81, 1894.

The **Butte King** mine adjoining, was abandoned in 1894. The Brown Ravine mine adjoining, with 160 A. had a 105-ft. bedrock tunnel in granite with an 8-ft shaft, but these were abandoned on account of water. A lower 260-ft. tunnel was being run in 1890. Idle. Owned by Graham and Braden of Stirling.

Bibl.: Rept. X, p. 146, 1890; XII, p. 81, 1894; XIII, p. 83, 1895–6.

The **Butte Queen** drift mine in Sec. 20, T. 25 N., R. 5 E., M. D. M., is 4 miles west of Philbrook, at an elevation of 6225 ft. Coarse gold is reported to have been taken from a tunnel which encountered 5 ft. of gravel under a 150-ft. lava cap. The bedrock is granite and schist.

The **Carr** prospect is 1 mile northeast of Philbrook in the SE. ¼ of Sec. 7, T. 25 N., R. 5 E., M. D. M. A new 60-ft. incline shaft was reported as being run by 5 men who expected to strike gravel at

150 ft. Owned by Mr. Stone of San Francisco; J. B. Carr, superintendent.

The **Catskill** drift property lies 1 mile northwest of Bangor. Elevation 750 ft.; 800 A. It is reported that a channel running E.-W. had 12′-14′ of gravel on the bedrock which ran $2.50 per cu. yd. Sand and gravel from 3′ to 6′ thick overlie the gravel. Development work consists of a 210-ft. double compartment shaft with the main gangway 900′ E. and 300′ W. Breasting has been carried on from 8′ to 18′ high and 40′ wide. An 85 h.p. engine ran a 6″ jackhead pump, hoist and two 10-ft. arrastras. Water was obtained from the Forbestown ditch. Idle.

Bibl.: Rept. XII, p. 82, 1894; XIII, p. 84, 1895–6.

The **Cole** or **Butte Star** drift mine is 1½ miles west of Nimshew in Sec. 22, T. 23 N., R. 3 E. Elevation 2470 ft. A channel capped with lava is reported to run N. 10° E. A 606-ft bedrock tunnel in slate has been run and the gravel channel followed for 2400 ft. Water was obtained from Centerville. Idle.

Bibl.: Rept. X, p. 144, 1890.

The **Contention** drift mine is reported to be ¾ mile southwest of Lovelock in Sec. 36, T. 23 N., R. 3 E., M. D. M. Elevation 2800 ft.; 60 A. A lava-capped channel 30 ft. wide runs E.-W. and is opened up by a 190-ft. bedrock tunnel which continues 65 ft. across the channel. The gravel is reported to be 4 ft. deep along 30 ft. of the tunnel and to have yielded coarse gold. The channel has been followed down stream. Water was obtained from Little Butte Creek. Idle.

Bibl.: Rept. XIII, p. 84, 1895–6.

The **Dog Hill** drift mine is 1½ miles west of Chaparral. Elevation 5800 ft.; 80 A. A 200 ft. channel is reported to have a NE.-SW. course and to have a 150-ft. capping of lava. Two tunnels have been run but are said to have been too high. A third tunnel was run in bedrock. Idle.

Bibl.: Rept. XII, p. 82, 1894; XIII, p. 84, 1895–6.

The **Emma** drift mine is reported to be near Nimshew. A tunnel was driven by the Nimshew Gold Mining Company, but the channel was lost and thought to have been faulted. The property was leased to A. H. Rugh who is reported to have taken out a nugget valued at $726 in November, 1915.

The **Feather River** or **Blue Hog** mine near Magalia has been worked intermittently ever since 1882. Coarse, rounded gold was taken from a channel which had 50 ft. of gravel capped with lava, through an 800-ft. bedrock tunnel in serpentine. A crosscut was made at the

south end of the old workings in 1916 by 4 men superintended by E. F. Woodworth. The channel exposed is said to be 100 ft. wide. Owned by J. A. Fairchild, W. R. Rowland and J. Coin of Los Angeles, who compose the Feather River Land and Mining Company.

The **Gold Hill** mine on the west branch of Feather River about 3 miles from Magalia is reported to have been reopened by Oakland parties who held an option from M. A. Glover. The leasing company consists of H. C. Hanson, G. H. Bibb, J. W. Thatcher and Henry M. Thatcher.

The **Golden Summit Blue Gravel** mine is reported to be 7 miles east of Inskip at an elevation of 6300 ft.; 159 A. The channel course is SW. and carries coarse gold. Development work consists of a 900-ft. tunnel.

Bibl.: Rept. XIII, p. 86, 1895–6.

The **Gregory** property is 9 miles east of Chaparral on the same channel as the Butte King and Butte Queen mines to the south. Five feet of lava-capped gravel is reported to be opened up by a 530-ft. tunnel, 12 ft. shaft on the pitch of the rimrock and a 200 ft. drift across the channel.

Bibl.: Rept. XII, p. 84, 1894.

The **Index** or **Wylie** drift mine is in Sec. 3, T. 22 N., R. 3 E., M. D. M., 3½ miles southeast of Nimshew on Middle Butte Creek; 380 A. Elevation 1250 ft. The channel courses NE. and carries from 3′-4′ of blue gravel on bedrock of slate and serpentine. Old workings in 1890 consisted of a 300-ft. main tunnel with branches of 40′, 60′ and 35′; also 80′ of drifts. Development in 1895 consisted of a 300-ft. incline and a 100-ft. bedrock tunnel. Water was obtainable for 9 months of the year from Middle Butte Creek.

Bibl.: Rept. X, p. 138, 1890; XIII, p. 86, 1895–6.

The **Irwin** mine is ½ mile northeast of Centerville at an elevation of 500 ft. and includes a 240 acre patent. A channel ¾ mile long is said to have a course NE.-SW. Gravels are said to be exposed 700 ft. deep and overlain by 700 ft. of lava. Two tunnels are said to have been run 200 ft. and 240 ft. long. The Pacific Gas & Electric Company ditch passes within ½ mile of the property. Idle for 20 years. Owned by T. R. Bennington, of Halleck, San Bernardino County; A. C. Smith, of Portland, Oregon, and J. M. Irwin, of Chico, c/o De Sabla stage.

The **John Dix** mine is 6 miles northwest of Lovelock on the North Fork of Big Butte Creek at an elevation of 2000 ft. The property is reported to have had 200 acres, on the Portuguese Point Channel, developed by a 2800-ft. incline. In 1895 about 2800 ft. of channel had been

worked through an incline and the gravel breasted out 300 ft. wide and from 4′ to 5′ high. The course of the channel is NE.-SW. A hoist was run by 400 inches of water from the west branch of Butte Creek. The gold was caught in 200 ft. of 18″ flume lined with slat riffles. Idle.

Bibl.: Rept. XII, p. 85; XIII, p. 87.

John's prospect is in Sec. 7, T. 25 N., R. 5 E., M. D. M., near Stirling. Coarse gold occurs in a gravel channel which is being opened up by Mr. Johns of Stirling.

Jones Brothers and **Reese** mine is reported to be 10 miles east of Chaparral House in Sec. 29, T. 25 N., R. 5 E., M. D. M. It was thought to be a southerly extension of the Butte King and Butte Queen mines. Where the channel breaks out the bedrock is slate and has an elevation of 6140 ft. A 450-ft. tunnel in gravel near the west rim connects with an old tunnel on the east rim by a crosscut drift. In 1894 the gravel was washed in 120 ft. of riffled flume with water from the tunnel.

Bibl.: Rept. XII, p. 85, 1894.

The **Kelly Hill** prospect is in the W. ½ of Sec. 27 and SE. ¼ of Sec. 28 of T. 23 N., R. 3 E., M. D. M., 2 miles southeast of Nimshew. It includes a 430-acre patent and a 1.4 acre claim. A channel coursing NE.-SW. carries coarse gold. The gravel is said to be 176 ft. deep and capped with 700 ft. of lava. Four bedrock tunnels have been run 700′, 600′, 500′ and 250′ long and the gravel in places is said to have paid well. In the 250-ft. tunnel the gravel prospects but a channel has not been encountered. Owned by Eugene J. de Sabla of Burlingame, Anna Pierson of San Francisco and A. C. Hanson of Chico, c/o de Sabla stage.

The **Kidd** mine near Nimshew has been opened up during the last year by 4 men who ran a tunnel in slate. The bedrock pitched off and the owners think they were on a bar and have now found the main channel. Owned by Nimshew Exploration Company, consisting of Fred Walker et al., of Nimshew. Geo. Slimer, superintendent.

The **Kirby** or **Indian Springs** mine is in the SE. ¼ of the NE. ¼ and the SE. ¼ of Sec. 34, T. 24 N., R. 3 E., M. D. M., 1½ miles northwest of Hupps. Elevation 2400 ft. The holdings include 6 claims of which 5 are patented. The channel is said to run NE.-SW. and to carry smooth, coarse-wash gold. An old shaft was sunk 150 ft. deep but after about 40 ft. of drifting was done, it caved and was lost. A new shaft 103 ft. deep was being sunk 90 ft. north of the old one and it was expected to strike the channel at 160 ft. in depth. About 100 gallons of water per minute were encountered and it was being handled by 1 centrifugal and 1 jackhead pump. Sawed timber was being

used which cost $24.00 per M. delivered at the mine. Electricity is secured from the Pacific Gas and Electric Company by a 2-mile line owned by the Kirbys. Owned by G. W. Kirby of De Sabla. Option held by E. S. Armstrong, et al., of Los Angeles. N. Touroff, superintendent.

The **Lucky John** mine in Sec. 11, T. 22 N., R. 3 E., M. D. M., is 2 miles north of Paradise and adjoins the Mineral Slide mine to the east. Some 1100 ft. of the old tunnel has been opened up and a 100 ft. incline raise retimbered to reach the gravel. About 320 ft. of tunnel have been run along the lower gravel which is being washed.

Photo No. 9.—Tunnel entrance to Lucky John drift mine near Paradise.

The pay gravel of the channel has not yet been reached. Three men were employed by John D. Hubbard of Paradise, superintendent and part owner. Owned by Jno. D. Hubbard and Jas. Spears, Mills Building, San Francisco, and P. J. Dunn of San Jose.

The **Lynch** and **Brown** prospect is on unsurveyed land 2 miles east of Inskip at the junction of Fish Creek and Brown's Ravine. Gravel is being taken from a 180-ft. incline shaft. Owned by Lynch and Brown of Inskip.

The **Magalia, Perschbaker** or **Lucretia** drift mine is on Little Butte Creek, 3 miles northeast of Magalia at an elevation of 2800 ft. The channel was worked through a 502-ft. perpendicular shaft to bedrock which had a grade of 12′ in 100′. The channel from 4′-20′ wide was supposed to be a branch of the deep channel under Magalia Ridge. The channel was worked out.

Bibl.: Repts. XII, p. 87, 1894; XIII, p. 89, 1895–6.

The **Mesilla Valley Blue Gravel** or **Welch** mine is 1 mile north of Pentz at an elevation of 1020 ft. The property includes 240 acres and is reported to include a blue-gravel channel 25 ft. deep capped with lava. A 200-ft. bedrock tunnel in slate was run and a 400-ft. gangway up the channel had been completed in 1895. Water was obtained from the Miocene ditch. Idle.

Bibl.: Rept. XIII, p. 89, 1895–6.

The **Mineral Slide** mine is 3 miles southwest of Magalia in Secs. 3 and 10, T. 22 N., R. 3 E., M. D. M., at an elevation of 1000 ft. The property includes a 390 A. patent and a water right on Butte Creek located in 1881. Coarse gold is reported to occur in a channel 4′-8′ deep, ½ mile wide and 1 mile long and to be capped with from 700′-900′ of lava. The concentrate is said to carry 2½% platinum.

The channel was first worked through an incline and later through a drain tunnel. A new drain tunnel, to be 1500 ft. long when completed, was in 1200 ft. when visited. This new tunnel is driven by blasting and washing the rock from the face of the tunnel with water from a 12″ wood stave pipe reduced to 6″. When gravel is reached it is planned to install electrically driven buckets to carry the gravel to the tunnel sluice boxes from which it will be washed out into a revolving screen and through more sluice boxes.

Six men were employed in driving the tunnel by S. P. Moody, superintendent. Owned by G. M. Gooday (¼), L. Cohn (¼) and S. P. Moody (½), composing the Mineral Slide Gold Mining Company. G. M. Gooday, president, Magalia. Leased to C. H. Hand and J. F. Cowen of Salt Lake.

The **Monitor** mine is on the south fork of Feather River. It is reported that a shaft is being sunk to the bottom of a gravel deposit. Equipment consists of a 20 h. p. boiler, steam pump and hoist.

The **Morris Ravine** or **Butterfly** mining property includes a 1200-acre patent in Morris Ravine 3 miles northeast of Oroville. The mine was abandoned in 1909 after the Goodall Company had run a 1400-ft. tunnel into the side of the hill. New development work consists of a 500-ft. tunnel run N. 20° E. and 500 ft. of drifts. Work was being carried on, in December, drifting and crosscutting looking for gravel.

The tunnel has been run in slide material brought down by undercutting Table Mountain by hydraulicking in the early days. The face of the tunnel is only a short distance beyond the plane of slipping and is 7 ft. above the bedrock in soft white sands of the Ione formation. The white sands carry no value but gravels on the bedrock carry rough rusty gold.

Owned by the Goodall Estate Company, San Francisco. Leased by the Morris Ravine Leasing Company, W. T. Baldwin, president; R. S. Kitrick, secretary; C. L. Bills, treasurer; and H. W. Te Grunde, manager, Oroville.

The **Napa and Solano Counties Company** or **Best** mine is reported to be 3 miles west of Lovelock in Sec. 27, T. 24 N., R. 3 E., M. D. M., at an elevation of 2100 ft. The property includes 40 acres which is

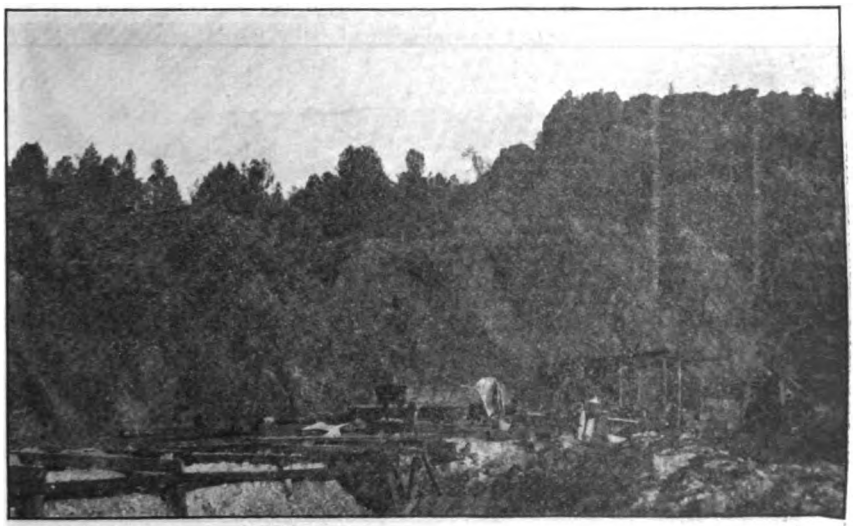

Photo No. 10.—Tunnel of the Morris Ravine Leasing Company near Table Mountain, four miles north of Oroville.

reported to have a channel running NE.-SW. Development consists of a 650-ft. bedrock tunnel in slate and serpentine and a 30-ft. raise. Breasting has been carried on from 50′-100′ wide, 5′-6′ deep and 600′ long. Water was obtained from the mine. Idle.

Bibl.: Rept. XIII, pp. 82–89, 1895–6.

The **Nimshew** or **Pewperfngtuno** mine is ½ mile west of Nimshew at an elevation of 1625 ft. It includes 400 acres on which five channels are reported. These are said to be, from 10′-40′ wide, 2′ deep with a general course of N. 47° E. In 1895–6 three tunnels had been run 1300′, 1600′ and 1100′ long. Idle.

Bibl.: Rept. XIII, p. 89, 1895–6.

The **Old Glory** mine in Morris Ravine, 3 miles northeast of Oroville, includes 60 acres. Development work in December, 1916, consisted of a 400-ft. tunnel run west at an incline of 30°. It is expected to strike the main pay channel at about 600 ft. but it is planned to extend the tunnel to 1000 ft. in length, under South Table Mountain.

The tunnel is being driven by hand drilling. A 4-ft. undershot wheel runs the hoist and a No. 3 air blower. The gravel is dumped into a bin and washed through 250 ft. of sluice boxes by water from the water wheel. Water is obtained from Morris Ravine. Owned by Richard Phillips of Oroville.

The **Palace** mine is 2 miles west of Lovelocks at an elevation of 2100 feet. The property includes 260 acres on which a lava capped channel is reported to have a NE.-SW. course. The gravels are

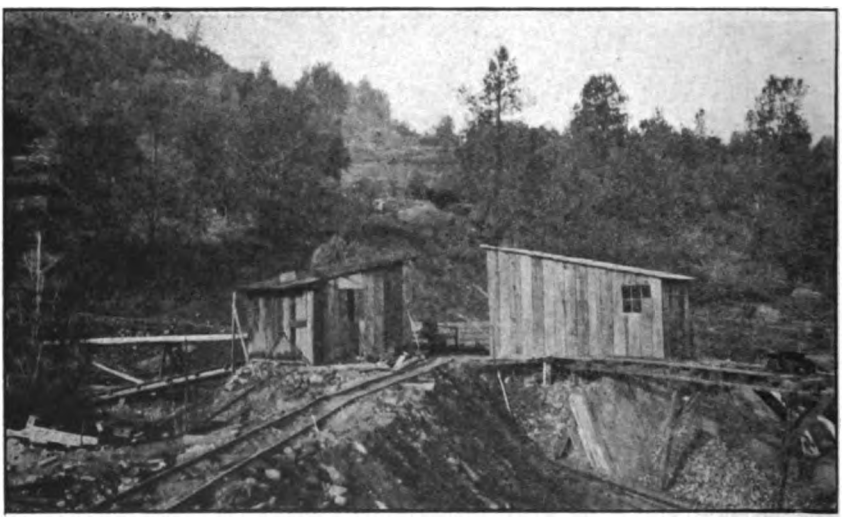

Photo No. 11.—Gravel bin and dump, showing new work being carried on just south of the Old Glory mine in Morris Ravine near the base of South Table Mountain.

reached by a 300-ft. bedrock tunnel in slate and are from 2′-4′ deep and 80′ wide. In 1895 a 1250-ft. gangway followed up the channel of which 800 ft. was breasted. The gravel was washed through the tunnel with water from Cherokee ditch. Idle.

Bibl.: Repts. XII, p. 87, 1894; XIII, p. 90, 1895–6.

The **Parry** or **Alki** mine is 4 miles northeast of Magalia at an elevation of 1700 ft. The property is reported as consisting of 320 acres with a 12-mile water ditch from the west branch of Feather River. A 30-foot overshot wheel ran 4 pumps since the gravels were worked through a 1000 ft. incline shaft. Idle.

Bibl.: Rept. XIII, p. 82, 1895–6.

The **Porphyry Point** mine is reported 3½ miles north of Magalia including 30 acres. A channel is thought to run NE.-SW. Development work consists of a 75-ft. bedrock tunnel in porphyry and a 90-ft. incline shaft. Idle.

Bibl.: Rept. XII, p. 88, 1894; XIII, p. 91, 1895–6.

The **Princess, Aurora,** or **Church** property consists of 320 A., 2½ miles northeast of Magalia at an elevation of 2400 ft. A channel coursing N. 30° E. is reported to be 70 ft. wide with 3 ft. of blue gravel opened up by a 330-ft. incline shaft. The bedrock is serpentine.

Bibl.: Rept. XIII, pp. 82, 91, 1895–6.

The **Republican** mine is reported as 4 miles northwest of Lovelocks at the forks of Butte Creek. A channel coursing south of east has a bedrock of slate and granite. Worked through a 400-ft. tunnel with 160 ft. of sluices lined with hungarian and slat riffles. Idle.

Bibl.: Rept. XII, p. 88, 1894.

The **Robbers' Roost** or **Oro Fino** mine is in Sec. 10, T. 23 N., R. 3 E., M. D. M., 2 miles north of Nimshew at an elevation of 2100 ft. The property includes 270 A. on which a channel courses NW.-SE. Development consists of a 2700-ft. bedrock tunnel in slate run due south with a crosscut run east which struck another channel. The width of the main channel is from 25′ to 140′ and it has been breasted 40 ft. wide. The gravel was run through sluice boxes. New work on the Robbers' Roost was carried on just south of the old Oro Fino for a few weeks during the fall of 1916, but this ceased in October. Owned by Mr. Scribner of San Francisco. W. F. Anderson, superintendent, Nimshew or 302 El Nido Apts., Oakland.

Bibl.: Repts. XI, p. 160, 1892; XII, p. 86, 1894; XIII, p. 89, 1895–6.

The **Royal Drift Mining Company** is reported to have several claims on the west branch of Butte Creek among which are the Straughn Channel, Royal Drift and Clarke. J. H. Durst of Wheatland interested. Allan Veatch, engineer.

The **South Fillbrook** property is reported in Sec. 20, T. 25 N., R. 5 E., M. D. M., at an elevation of 6000 ft. In 1890 a 180-ft. bedrock tunnel was being run SE., in granite and conglomerate, to strike a gravel channel. Idle.

Bibl.: Rept. X, p. 146, 1890.

The **Steifer** or **P. B. Steifer** mine in Sec. 13, T. 23 N., R. 3 E., M. D. M., is 3½ miles north of Magalia near Coutolenc at an elevation of 2600 ft. The property consists of 80 acres of patented railroad land on which a channel is said to have been discovered in 1855.

The channel is said to have a course NW.-SE. and to carry from 2′-4′ of uncemented gravel with a few large boulders. It is about 80 ft. wide and capped with two flows of lava. It is opened up by a 500-ft., 2-compartment shaft 4′ x 10½′ with 250′ of drifts. The gravels

thus far taken out have been sluiced but are said not to have paid for mining.

Equipment consists of one double-drum hoist with both steam and electric connection; one 120 h.p. steam duplex compressor; one 75 h.p. electric compressor; one 35 h.p. electric compressor and four 4-stage turbine pumps, each with a capacity of 700 gallons per minute. Two power houses have recently been built on the west branch of Feather River, each capable, it is said, of generating 350 volts.

When operating, about 26 men are employed, who take out about 70 cars of material. Miners receive $3.00 per shift and muckers $2.50 per shift. Owned and operated at intervals during the last 13 years by the P. B. Steifer Mining Company of Coutolenc, a stock company with P. B. Steifer, president; M. V. Steifer, secretary; and S. M. Steifer, treasurer.

The **Strang** prospect is ¼ mile west of Oregon City at an elevation of 1375 ft. and includes 240 acres. A 100-ft. tunnel on the property was run too high. In 1895 a 50-ft. shaft was being sunk below the tunnel level. Idle.

Bibl.: Rept. XIII, p. 93, 1895–6.

The **Tabbe** prospect in T. 22 N., R. 5 E., is near Rock Creek about 6 miles SE. of Concow. The property includes 4 claims and 1 extension consisting of 520 acres unsurveyed. Water is ditched ½ mile from Little Rock Creek. A channel is said to occur, on the property, with granite bedrock. A 200-ft. tunnel is said to have been run in bedrock but struck the channel too high. It is planned to run another tunnel. Owned by J. N. Stanley, Wm. Delaney of French Gulch, W. H. King of Pulga or Flea Valley, and G. A. Stanley of Magalia.

The **Taylor** prospect is near Pentz and nuggets are reported to have been taken out by a Mr. Clark of Chico.

The **Turner** mine is 1 mile east of Bangor on a channel reported to be 40 ft. wide with a course NW.-SE. Pay gravel is reported to have averaged 8 ft. deep on a bedrock of slate. The channel was opened up by two 50-ft. shafts on either side of the channel with drifts run from each across the channel. The gravel was run through an arrastra which loosened up the gold from the cement gravel. Idle.

Bibl.: Rept. XII, p. 89, 1894; XIII, p. 93, 1895–6.

The **Undine** property on Butte Creek, 15 miles from Chico is under lease to Geo. F. Dyer and the Undine Operative and Mining Company of Chico.

The **Wescott** mine is on the south edge of Philbrook Valley at an elevation of 6000 ft. It consists of 1 claim adjoining the Butte King and Butte Queen claims. A 600-ft. bedrock tunnel was run under the west rim and coarse gold in cement gravel taken out. Idle.

Bibl.: Rept. X, p. 140, 1890.

The **Willard** claim is 1 mile northeast of Magalia and consists of 5 claims located in 1852. The property has yielded to date seven large nuggets valued at from $2000 to $10,690 apiece. A quartz ledge is reported near a slide from Sawmill hill. Owned by F. H. Dakin, No. 110 Sutter st., San Francisco.

The **Wilson** mine is 3½ miles north of Magalia at an elevation of 2500 ft. It consists of 1200 acres on which are a 200-ft. shaft to bedrock and a 300-ft. bedrock tunnel but as yet no channel has been opened up. Idle.

Bibl.: Rept. XIII, p. 94, 1895–6.

The **Woods** property is in Sec. 26, T. 24 N., R. 3 E., M. D. M., 4 miles north of Lovelocks. It consists of 160 acres on which three bedrock tunnels in slate 800′, 700′ and 200′ have been run in an easterly direction. Some stoping has been done in the 70-ft. tunnel and coarse gold in blue gravel taken out. Water is ditched 1½ miles from Little Butte Creek. Idle.

Bibl.: Rept. X, p. 140, 1890.

GOLD—HYDRAULIC MINES.

Hydraulic mining has not been carried on in Butte County in recent years. Present laws would demand the construction of debris dams before active work could be undertaken.

The **Spring Valley** or **Cherokee** hydraulic mine, ¼ mile east of Cherokee, was located in 1854 and consists of 1500 acres in Secs. 4, 5, 28, 29, 32 and 33 of Tps. 20 and 21 N., R. 4 E., M. D. M. Hydraulicking at this property was stopped by the anti-debris laws in October, 1890. Working the property by drifting has not been considered feasible. Water for hydraulicking was taken from the headwaters of Big Butte Creek and the west branch of Feather River and the mine tailings were dumped into Sawmill Ravine from which they were conveyed into Dry Creek.

During the 36 years in which hydraulicking was carried on about 150 acres were worked to bedrock, with a 500-ft. face and nearly as much was worked to within 15 ft. of bedrock. The latter, lower,

cement gravel required blasting. In 1895 several small companies had leased portions of the bedrock and were cleaning it up. Since then "fossickers" have done some work. Idle. Owned by the Spring Valley Gold Mining Company. J. B. Whitcombe of Cherokee, receiver.

Bibl.: Repts. X, p. 124, 1890; XIII, p. 92, 1895–6.

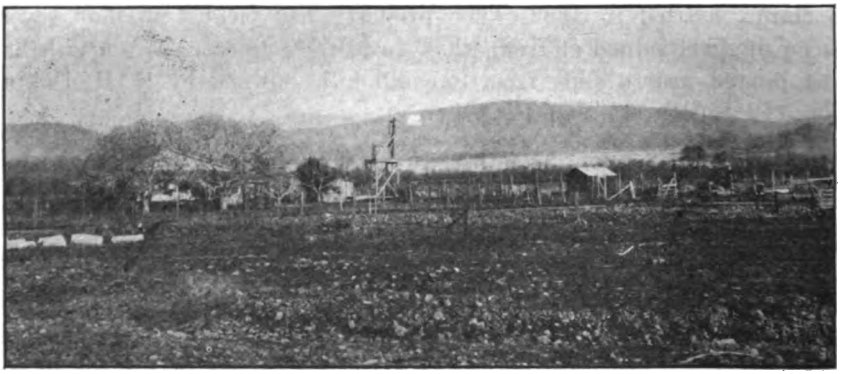

Photo No. 12.—View northeastward from a bridge two miles south of Pentz showing hydraulic tailings from the old Cherokee hydraulic mine.

GOLD—PLACER MINES.

(Surficial or Sluicing.)

Gold is being recovered by small parties of miners in many of the creeks and ravines throughout Butte County. Nuggets of considerable size are sometimes found and in some localities platinum is associated.

In **Bald Rock Cañon** the **Middle Fork Mining Company** has been taking gold from the loose gravels in the rough creek bed. Their equipment consisted of an electric blasting outfit, 5-ton hoist, and barge on which was mounted a Corliss engine which ran an air pump supplying a diving suit. The gravel taken out is reported to have averaged $7.00 per yard. The method of working does not permit of many yards per day and the values contained are necessarily uncertain.

The company consists of S. Hansen, J. Martin Sivertsen and John Schmitt, all of Oroville, and is reported to have been organized for the purpose of raising money to buy a gravel pump and other equipment. The permit allows the company to issue 28,000 shares of stock to the members of the company in exchange for their claim and all equipment, and to sell 22,000 shares at $1.00 per share to net not less than $.90 per share to carry out their purpose.

GOLD—QUARTZ MINES.

Considerable activity has been manifested by the quartz mines in Butte County the past year. Several of the old mines and prospects are being re-equipped for operations on a larger scale. Among the more noteworthy are the Banner, Bumblebee, Gold Bank, Kinkaid, Mascot, Oklahoma Wonder and Springer.

The **American Eagle** property is 4½ miles west of Merrimac. In 1890 it was reported to have a 5-ft. quartz vein in granite striking NE.-SW. and dipping 45° E. Development consisted of a 600-ft. tunnel and a 1700-ft. tunnel with three raises to the surface. A small amount of stoping was done and the ore was run through a Dodge rock breaker, a 5-ft. Huntington roller mill and over two Triumph concentrators. Idle.

Bibl.: Rept. X, p. 128, 1890.

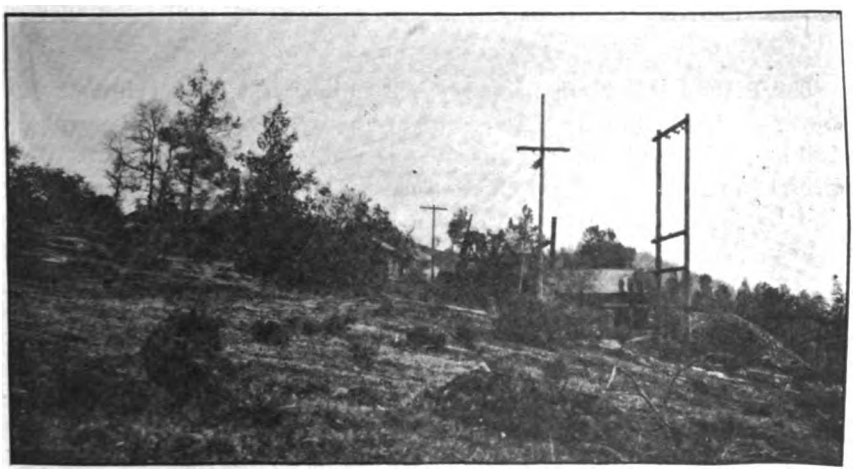

Photo No. 13.—Hoist and transformers at the Banner quartz mine south of Monte de Oro and four miles northeast of Oroville.

The **Banner** mine is 5 miles northeast of Oroville at an elevation of 580 ft. The property consists of 220 acres including 4 patented claims, the Old Banner, South Banner, Amosky and Clark. Early work was mostly done on the Little Banner vein which was about 18″ wide and dipped NE. This vein connected with the Big Banner vein at a depth of 200 ft. The Amosky vein is reported to parallel the two Banner veins although it is probable that it is the same vein that is being exploited at the present workings of the Banner. The vein in the Banner mine averages 4 ft. wide while in the Amosky it is said to be 7 ft. wide on the 200-ft. level. The veins strike N. 15° E. The Banner vein dips 75° E. in a footwall of slate and a hanging wall of metamorphic sandstone.

Development work at the Banner consists of a 2-compartment shaft to 400 ft. but open only to the 200-ft. level on which drifts are being run N. 15° W. by 6 men in 2 shifts. Equipment consists of a 20 h.p. electric motor to run the hoist and a 75 h.p. electric motor to run a compressor. A 20 h.p. motor runs a 2-stamp Joshua Hendy mill equipped with one 4′ x 5′ and one 4′ x 7′ amalgamation table. The plant receives power from a new 4-mile line, built by the company, from the Pacific Gas & Electric Company.

Development work at the Amosky consists of a 600-ft. 2-compartment shaft, open and timbered to the 200-ft. level. The shaft runs N. 20° E. at an incline of 35°. Equipment consists of a Lambert steam hoist with Nagle boiler. The ore is trammed about 50 ft. to a bin.

It is planned to install a larger mill and concentrating equipment. Owned by the South Banner Mining Company. Geo. E. Gardner, president; Richard Phillips, secretary-treasurer and manager at Oroville.

The **Bishop and Wells** property is 3½ miles west of Merrimac. It is reported that a 3-ft. quartz vein occurs between granite and porphyry, striking N.-S. and dipping 45° W. Development consists of a 100-ft. tunnel on the vein. Equipment consisted of five 300-lb. stamps operated by an 8-ft. hurdy wheel driven by water from Clear Creek under a 40-ft. head. Idle.

Bibl.: Rept. XIII, p. 83, 1895–6.

The **Bluebird** mine is reported as 2½ miles north of Inskip at an elevation of 3850 ft. A 4″ vein in decomposed porphyry strikes NE.-SW. and dips NW. Development consisted of a 30-ft. shaft and open cuts.

Bibl.: Rept. XIII, p. 83, 1895–6.

The **Bootjack** group consists of 5 claims in Sec. 10, T. 19 N., R. 6 E., M. D. M., near Forbestown. A quartz vein carrying free gold and pyrite is said to be 7 ft. wide at the surface and 15 ft. wide on the 100-ft. level. The ore is said to assay about $6.00 per ton. Development consists of a 120-ft. shaft and a 15-ft. drift on the 100-ft. level. Equipment consists of a 60 h.p. steam boiler, hoist, 1-ton skip, a 3-drill compressor, 1 machine drill and 500 ft. of cable. Idle. Owned by Manuel Fernandez of Forbestown.

The **Bullion** mine is 1½ miles from Forbestown in Sec. 3, T. 20 N., R. 6 E., M. D. M. It consists of 1 claim adjoining the Keystone property to the west. Development consists of a 60-ft. tunnel in greenstone. The ore was milled in an arrastra in 1890. Idle.

Bibl.: Rept. X, p. 128, 1890.

The **Bumblebee** mine is in the NW. ¼ of Sec. 27, T. 20 N., R. 4 E., M. D. M., 4 miles northeast of Oroville at an elevation of 1090 ft. It consists of 2 claims, the Josephine and Bumblebee, including 36 acres. A quartz vein strikes E.-W. and dips S. 33° between a limestone footwall and slate hanging-wall. It outcrops at the surface about 200 ft. below the mine in a ravine which was placered in the early days.

Development consists of a 180-ft. incline shaft and 400 ft. of old stopes. Mine equipment includes a 40 h.p. International kerosene engine, Gardner, 10″ x 10″ compressor, and air drills; an 800-ft. steam

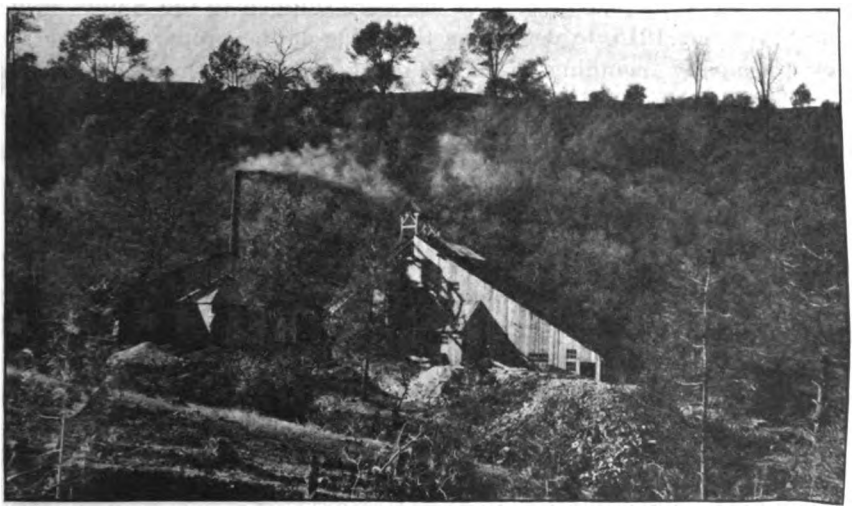

Photo No. 14.—Hoist and mill at the Bumble Bee quartz mine on the west side of Oregon Gulch, six miles northeast of Oroville.

auxiliary hoist and 40 h.p. boiler with a 3000-gallon supply tank 250 ft. above the plant.

The mill equipment consists of an 8″ x 10″ Blake jaw crusher, a 38″ x 4′ ball mill and Eckleson concentrating table run by a 15 h.p. International kerosene engine, and ball mill with worm feed guaranteed for 36 tons in 24 hours, through 40-mesh screen. The mill equipment and kerosene engine are all new. Water for the mill is obtained from the Pacific Gas and Electric Company's ditch 75 ft. above the mill. Four men were employed in the mine. Owned by the Butte Gold Mining Company, No. 505 Consolidated Realty Building, Los Angeles. C. B. Ford, president; C. D. Falstead, secretary and treasurer; W. M. Ford, general manager at Oroville.

The **Burlington** group near Forbestown is reported to have been taken over by the Ralston Development Company, organized by W. C. Ralston of San Francisco, with an authorized capital of $3,000,000 for the purpose of acquiring and operating the Burlington claims,

the option for which calls for $130,000. The company has been permitted to sell 20,000 shares at par, $3.00 per share, to net not less than $2.50 per share.

The **Butte Creek** property is on Big Butte Creek, 1 mile east of Nimshew. An 18″ quartz vein strikes NW.-SE. and dips 45° E. between a footwall of slate and a hanging wall of limestone. Two tunnels 160′ and 80′ long and 70′ apart were run on the vein and the ore blocked out was stoped. The mill consisted of ten 750-lb. stamps and two Frue concentrators run by water-power.

It is reported that 22 tons of ore were shipped to the Selby smelter in November, 1915, to determine the value of the property. Operated by a company including Frank Whittock and K. D. Crowder of Chico.

Bibl.: Repts. XII, p. 82, 1894; XIII, p. 83, 1895–6.

The **Cain** prospect is ⅛ mile south of Inskip at an elevation of 4250 ft. A quartz vein in slate strikes E.-W. and dips north. A tunnel has been driven on the vein. Idle.

Bibl.: Rept. XIII, p. 83, 1895–6.

The **Carlisle** property includes 640 acres 2½ miles southeast of Forbestown, on the south fork of the Feather River, at an elevation of 1275 ft. A 9-ft. vein of ribbon quartz is reported to carry free gold with galena, pyrite and chalcopyrite. It strikes NE.-SW. and dips 50° NW. between slate and porphyry. The vein has been prospected by a shaft and two crosscut tunnels. Water power is available. The tunnels are reported to have recently been opened.

Bibl.: Rept. XIII, p. 83, 1895–6.

The **Clark Brothers** mine is 10 miles east of Yankee Hill in the Concow district at an elevation of 2300 ft. A 135-ft. tunnel is reported to have been run along the vein and the ore milled in a 12-ft. arrastra. Idle.

Bibl.: Rept. XIII, p. 84, 1895–6.

The **Crystal Hill** property is reported as 3 miles northwest of Enterprise at an elevation of 1100 ft. An 18″ vein in granite strikes E.-W. and dips vertical. Development consists of a 100-ft. tunnel and a raise to the surface. The ore was milled by four 750-lb. stamps run by water power.

Bibl.: Rept. XIII, p. 84, 1895–6.

The **Crystal Peak** property is reported to be 3 miles north of Enterprise at an elevation of 1100 ft. A 50-ft. quartz vein in granite strikes E.-W. and dips vertical. Ore from a 150-ft. tunnel on the vein was milled by two 750-lb. stamps operated by water power. Idle.

Bibl.: Rept. XIII, p. 84, 1895–6.

The **Defiance** property is reported to be 9 miles north of Oregon City. Two parallel veins between slate and porphyry were developed by a 90-ft. shaft.

Bibl.: Rept. XII, p. 82, 1894.

The **Dutch Ravine** property is reported to be 3 miles south of Hurleton. A quartz vein from 2′-5′ wide strikes N.-S. and dips W. in slate. A 135-ft. shaft was sunk on the vein.

Bibl.: Rept. XII, p. 82, 1894.

The **Edna M.** or **Buzzard** property is reported to be 2½ miles west of Inskip at an elevation of 3850 ft. A 3″ seam of quartz strikes NE.-SW. and dips SE. Two tunnels 80 ft. and 200 ft. long connected by a raise followed the seam which carried high values. A 400-ft. crosscut tunnel was also run. The quartz was panned and the tailings were run through an 8-ft. arrastra operated by a 9-ft. undershot wheel run by water from Cherokee ditch. Idle.

Bibl.: Rept. XIII, p. 85, 1895–6.

The **Eureka** quartz mine is on the property of the old Mugford drift mine in Sec. 3, T. 22 N., R. 3 E., M. D. M., 2½ miles SW. of Magalia. It consists of a 240-acre patent on which a dike of porphyry from 40′ to 60′ wide is said to be enriched by cross stringers of quartz and to assay from $0.40 to $123.00 per ton. The gold occurs free and with sulphides. The dike is said to be exposed along the surface for about ¼ mile.

A 290-ft. tunnel with entrance 75 ft. below the outcrop of the dike has not yet crosscut it since it is said to dip away from the direction in which the tunnel has been run. Equipment consists of a 6 h.p. gas engine, jackhead pump and 2 mine cars. Owned by Chas. Crowder (½) and H. W. Whitten (½) of Chico.

The **Excelsior** or **Mammoth** mine is 4 miles northwest of Inskip at an elevation of 3925 ft. It is reported that a 3-inch seam of quartz in slate strikes N.-S. and dips vertically. Development work consists of a 240-ft. tunnel and a 100-ft. shaft on the vein. The mill consisted of four 350-lb. double-stem stamps with square shoes and dies. Idle.

Bibl.: Rept. XIII, p. 85, 1895–6.

The **Exposition 1915** mine at Lumpkin is reported to be developing an 18-inch quartz vein. Development consists of a 125-ft. tunnel on the ledge with 200 tons of ore blocked out. The ore is reported to mill $12.00 per ton, while the concentrated sulphurets are reported to assay up to $80.00 per ton. A stamp mill on the property is run by water power. Owned by Frank C. Burroughs and A. F. Thorselius of Lumpkin.

The **Fitzpatrick** property is ¾ mile from Inskip at an elevation of 4250 ft. A quartz vein in granite is reported to strike N.-S. and dip 60° E. A 495-ft. tunnel has been run. Idle.

Bibl.: Rept. XIII, p. 85, 1895–6.

The **Gallagher** and **Perkins** property is in Secs. 10 and 15, T. 24 N., R. 4 E., M. D. M., near Kimshew. An 18-inch quartz vein, reported to occur along a contact of granite and porphyry, strikes N. 30° E. and dips 30° W. Development work consists of a 130-ft. tunnel on the vein and a 60-ft. crosscut tunnel. A 10-stamp mill stood on the property in 1890. Water was obtained from the mine. Idle.

Bibl.: Rept. X, pp. 133–4, 1890.

The **Gold** or **Rees Ledge** property is in Sec. 21, T. 25 N., R. 5 E., M. D. M., at an elevation of 6050 ft. A quartz vein in slate strikes NW.-SE. and dips W. The free-milling ribbon quartz is reported to have averaged $20.00 per ton. A tunnel was started in 1890 to tap the vein at a depth of 300 ft. below the surface. Idle.

Bibl.: Rept. X, p. 133, 1890.

The **Gold Bank** group of mines is located ¼ mile northeast of Forbestown at an elevation of 2820 ft. The property as consolidated includes the Gold Bank Group, Golden Queen, Shakespeare and Miller, consisting of 1035 acres with timber lands; also the "R. R.," Gold Quartz, Conjunction Gold Quartz, Oroville No. 1 (Placer) and Oroville No. 2 (Placer) consisting of 255 acres. A patent was applied for in 1916.

Development consists of an 8′x8′ lower tunnel driven 1600 ft. to intersect a vein of quartz 500 ft. vertically below the mine workings. Mining equipment consists of a 4-drill Rand compressor and power drills. Mill equipment consists of an old 40-stamp mill with amalgamation plates and 16 Frue concentrators. Water is obtained from the Forbestown ditch.

At the old Gold Bank mine 5 stamps were reported to be operating in November, 1915, and 10 stamps in December, 1915, during which time $8000.00 in gold was produced. The concentrates were shipped to a Utah smelter.

Owned by the Forbestown Consolidated Gold Mines Company, M. J. Cooney of Forbestown, manager; Fred J. Stoer, secretary and treasurer. Under bond and lease to the California Gold Mines Company of Salt Lake City, Chas. W. Reese of Salt Lake, general manager.

The **Golden Eagle** property is 3 miles north of Paradise in Sec. 3, T. 22 N., R. 3 E., M. D. M., on the SE. portion of the Mineral Slide drift property. An 8-ft. vein, cut by Little Butte Creek, strikes NW.-SE. and dips 45° NE. Development work consists of a 500-ft. tunnel

and an 86-ft. shaft on the vein, while south of it are two tunnels 150′ and 400′ long. A mill, in 1890, was equipped with a rock breaker, Hendy self-feeder, 20 stamps, 6 concentrators and a reverberatory roasting furnace. Idle.

Bibl.: Rept. X, p. 135, 1890.

The **Golden Fissure** property is 3½ miles west of Enterprise at an elevation of 1500 feet. A 4-ft. quartz vein strikes E.-W. and dips vertically in granite. Development work in 1895 consists of a 100-ft. tunnel.

Bibl.: Rept. XIII, p. 86, 1895–6.

The **Golden Queen** property is ½ mile north of Forbestown. A 20-ft. quartz vein strikes NE.-SW. and dips N. 20°. The ore was sorted in the mine and the low grade used for filling. The picked ore averaged $5.00 per ton in free gold and 1½% sulphurets. The ore is reported to carry pyrite, galena and some telluride.

Equipment in 1892 consisted of a No. 2 Gates crusher and ten 750-lb. stamps operated by water power. Apron, sluice plates, blankets, sluices and 16-ft. buddle were used to save the gold.

Bibl.: Rept. XI, p. 162, 1893.

The **Golden Summit** property is 18 miles east of Powellton in Sec. 21, T. 25 N., R. 5 E., M. D. M., at an elevation of 6600 ft. It consists of a 320-acre patent on which an 8-ft. quartz vein strikes N. 66° E. and dips vertically between syenite and greenstone.

Development in 1895 consisted of a 250-ft. incline shaft tapped at 100-ft. depth by a 400-ft. drain tunnel. Drifts were run 400′ east and 400′ west on the 100-ft. level, and 300′ east and 250′ west on the 200-ft. level. Equipment consisted of ten 800-lb. stamps and two Woodbury concentrators run by steam power.

Bibl.: Rept. XIII, p. 86, 1895–6.

The **Golden Thread** property is on Secret Creek 2½ miles northwest of Inskip, at an elevation of 3550 ft. A 2-inch seam of quartz carrying coarse gold strikes NE. and dips W. in decomposed rock. Development work in 1895 consisted of open cuts and tunnels with stoping to the surface. Idle.

Bibl.: Rept. XIII, p. 86, 1895–6.

The **Inskip** property is ½ mile southwest of Inskip in Sec. 29, T. 25 N., R. 4 E., M. D. M. Two parallel veins, one of which is from 6″-3′ and another 2½′ wide are about 20 ft. apart. A 100-ft. drift run between the two veins is reported to have developed 125 ft. of backs. Crosscuts were run to the vein. The ore was hand sorted and

run through an 8-ft. arrastra operated by a 16-ft. overshot wheel with water from the Cherokee ditch.

Bibl.: Rept. XII, p. 84, 1894.

The **Keystone** property is reported to consist of one claim ½ mile northwest of Forbestown in Sec. 3, T. 20 N., R. 6 E., M. D. M. Development work consisted of a 120-ft. incline shaft on the vein at an angle of 45°, an 80-ft. perpendicular shaft and a tunnel in greenstone. Idle.

Bibl.: Rept. X, p. 127, 1890.

The **Kinkaid** mine is in Sec. 7, T. 21 N., R. 5 E., M. D. M., near Shields Gulch, 6 miles northwest of Berry Creek. The property includes 157 acres of patented land purchased from the railroad.

A 10-ft. quartz vein in porphyry strikes NW.-SE. and dips 15° NE. The ore is said to mill $7.00 per ton in free gold; $6.00 in gold per ton is recovered by cyaniding and the tailings assay $6.00 per ton. The sulphides are concentrated.

Development consists of a 100-ft. tunnel and 50-ft. winze. Experimental equipment consists of a Kendall 1-stamp mill and a Chilean rotary mill run by two 6 h.p. gasoline engines; a jaw crusher run by an 8 h.p. gasoline engine; and a concentrator run by a 2 h.p. gasoline engine. Three men were employed in December, 1916. Owned by M. P. Kinkaid of Oroville and Mr. O'Neill of Nebraska. Jack H. Kinkaid, superintendent.

The **Lost Treasure** consists of one claim on Dutch Gulch, ¾ mile north of Inskip, in Sec. 28, T. 26 N., R. 4 E., M. D. M. Pockets of gold were found in quartz stringers, some of which were 12 inches wide in altered syenite. In 1894, a 150-ft. tunnel was reported to have been driven NE. along the strike of the quartz veins.

Bibl.: Rept. XII, p. 86, 1894.

The **Lucky Bob** prospect is 4 miles north of Oroville. A 2-ft. quartz vein in slate and greenstone is reported to strike W. of N. and dip 55° W. A 550-ft. tunnel was driven along the vein.

Bibl.: Repts. XII, p. 86, 1894; XIII, p. 87, 1895–6.

The **Mascot** property is in the SW. ¼ of Sec. 27, T. 20 N., R. 4 E., M. D. M., 5 miles northeast of Oroville, at an elevation of 980 ft. It consists of a 40-acre patent on which two veins are being worked. A 6″-18″ sugary quartz vein exposed in a 75-ft. upper tunnel strikes N. 10° W. and dips 40° NE. A vein striking N. 35° E. is being worked in a tunnel 75 ft. in elevation below the upper tunnel. Stoping has been carried nearly 30 ft., to the surface, for a distance of 30 ft. along the vein in the upper tunnel.

Mine equipment consists of a bunk house, shop, car, etc. A Joshua Hendy triple-discharge 3-stamp mill was being installed in December, 1916.

Owned by Wm. Ford and C. A. Grummet of Oroville, and Jas. Wykoff of Woodleaf. Option held by W. T. Baldwin, manager, of Oroville, and John Upton, superintendent.

The **Matheson** or **Meredith** property is 4½ miles north of Nimshew on the south side of Big Butte Creek, in Sec. 2, T. 23 N., R. 3 E., M. D. M., at an elevation of 2000 ft. A 10-inch quartz vein is reported to strike NW.-SE. and dip 30° E. between a footwall of slate and a hanging wall of serpentine. Mill equipment consisted of eight 850-lb. stamps and a 4-ft. Huntington roller mill. Water was ditched 1 mile. Idle.

Bibl.: Repts. XIII, p. 88, 1895–6; X, p. 135, 1890.

The **Mattie** property is 8 miles east of Oroville, near Miner's Ranch, at an elevation of 1100 ft. An 8″-30″ quartz vein strikes E.-W. and dips 40° S. between greenstone and slate. Two prospect shafts 400′ apart were 10′ and 50′ deep. Idle.

Bibl.: Rept. XIII, p. 88, 1895–6.

The **Mosquito Creek** property is reported to be ½ mile east of Coutolenc, at an elevation of 2750 ft. Three parallel quartz veins are reported to occur in slate, one of which strikes N.-S. and dips 60° E. Idle.

Bibl.: Rept. XIII, p. 89, 1895–6.

The **Mount Ida** property is 2½ miles northeast of Hurleton at an elevation of 1430 ft. An 18-inch quartz vein in diorite strikes N.-S. and dips 54° W. Development work consists of a 25-ft. shaft, tunnel and open cuts. Idle.

Bibl.: Rept. XIII, p. 89, 1895–6.

The **New Oregon, Forty-nine** or **Red Point** mine is 1½ miles east of Enterprise at an elevation of 1625 ft. It consists of a 160-acre patent on which a 12-ft. quartz vein strikes E.-W. and dips 60° S. between slate and porphyry. Development work in 1895 consisted of 2 cross-cut tunnels with short drifts. Idle.

Bibl.: Rept. XIII, p. 89, 1895–6.

The **Oklahoma Wonder** property is 5 miles northeast of Oroville in Sec. 27, T. 20 N., R. 4 E., M. D. M., adjoining the Mascot mine. An 18″ sugary quartz vein carrying free gold strikes N. 75° W. and dips 35° S. Development consists of a 10-ft. incline shaft just started.

An old mill with five 250-lb. stamps has been installed, with 3′ x 4′ plate and Challenge feed, to work the upper oxidized ore. The decomposed vein material near the surface pans very well and the surface thereabouts has been ground sluiced in the early days. Owned by Mary I. Hedge of Oroville. Option held by W. T. Baldwin and John Upton of Oroville.

The **Owl** property is 2 miles northwest of Inskip at an elevation of 3925 ft. A rich seam of quartz in porphyry strikes N. and dips W. The ore was milled in an 8-ft. arrastra. Idle.

Bibl.: Rept. XIII, p. 90, 1895–6.

The **Pactolian** property is 2 miles north of Hurleton at an elevation of 1600 ft. A 2′-8′ quartz vein strikes NE.-SW. and dips SE. between diorite and slate. Development work consisted of a tunnel.

Bibl.: Rept. XIII, p. 90, 1895–6.

The **Palo Alto** property is 3 miles north of Merrimac. It is reported to include a 3-ft. quartz vein striking N.-S. and dipping 75° E. between granite and porphyry. The vein has been opened up by five tunnels. Equipment consisted of a 12 and a 10-stamp mill operated by water power, a Blake rock crusher and 2 Frue concentrators. Idle.

Bibl.: Repts. X, pp. 129-130, 1890; XIII, p. 90, 1895.

The **Phoenix** property includes three claims 3 miles south of Hurleton in Sec. 28, T. 19 N., R. 5 W., M. D. M., at an elevation of 1600 ft. A 2′-8′ quartz vein strikes N.-S. and dips vertically. Development consists of a 105-ft. shaft, short drifts along the vein and some stoping.

In 1894 the mine was equipped with a horse-whim hoist and the mill with a Dodge rock breaker, with Stanford self-feeder and a Bryan roller.

Bibl.: Repts. XIII, p. 90, 1895–6; XII, p. 87, 1894.

The **Pinkston** property is 10 miles east of Yankee Hill, at an elevation of 2300 ft. A 2′-4′ quartz vein is reported to strike N.-S. and dip vertically. Development consists of a 60-ft. shaft and 80 ft. of drifting on the vein. The stamp mill has been removed. Idle.

Bibl.: Rept. XIII, p. 90, 1895–6.

The **Poumarat** property is on Little Butte Creek, 1½ miles northwest of Lovelocks, at an elevation of 2600 ft. A 2-ft. vein in slate strikes N.-S. and dips 45° E. Development consists of a 100-ft. two-compartment shaft with a 100-ft. drift N. on the 70-ft. level.

Bibl.: Rept. XIII, p. 91, 1895–6.

The **Rainbow** property consists of a 40-acre patent on Jordan Hill, 4 miles northwest of Yankee Hill in Sec. 29, T. 22 N., R. 4 E., M. D. M. A 2½-ft. quartz vein strikes E.-W. and dips 50° N. between slate and serpentine. Development consists of an incline shaft with drifts east and west. A 5-stamp mill stood on the property in 1895–6.

Bibl.: Repts. XI, p. 58, 1892; X, p. 131, 1890.

The **Ramona** or **Skipper** property includes 40 acres 1½ miles south of Magalia, at an elevation of 1900 ft. Two quartz veins, from 3′-10′ wide, in syenite are reported to strike N. 65° E. and dip 75° SE. Development in 1895 consisted of a 46-ft. tunnel on the vein; and the equipment included ten 850-lb. stamps. Water was obtained from the Cherokee and Miocene ditches.

Bibl.: Rept. XIII, p. 91, 1895–6.

The **Rawhide** property consists of 1 claim, 2 miles north of Inskip, at an elevation of 4300 ft. A quartz vein from 4′-30′ wide strikes N.-S. and dips 75° E. in slate. Development consisted of a 25-ft. incline shaft and a 25-ft. tunnel on a stringer of the main vein.

Bibl.: Rept. XIII, p. 91, 1895–6.

The **Resumption** property is 3½ miles east of Hurleton at an elevation of 1800 ft. A 3-ft. vein, reported to strike NE. and dip NW., has been opened up by a tunnel. The ore was run through a Phoenix mill.

Bibl.: Rept. XIII, p. 92, 1895–6.

The **Rock River** property consists of 3 claims located 9 miles north of Oroville, in Secs. 4 and 9, T. 20 N., R. 4 E., M. D. M., at an elevation of 1200 ft. A quartz vein from 20″ to 3′ wide strikes N. 48° W. and dips 45° SW. along a contact of slate and diabase. Development work consists of a 300-ft. incline shaft on the vein with three levels. Three drifts have been run north 300′, 275′ and 160′, while two 100-ft. drifts have been run south. A 15 h.p. engine ran a hoist and No. 4 Dow pump.

Bibl.: Rept. XIII, p. 92, 1895–6.

The **Roeper** or **Midas** property is 1½ miles west of Inskip. Three quartz veins strike NE.-SW. along a contact of slate and porphyry. It is said that one vein is low grade, another carries sulphides and a third carries free gold. The latter vein is said to vary from 4″ to 12″ wide. Development work done during the last 5 years consists of a 1500-ft. tunnel and considerable crosscutting.

Owned by the Chico Consolidated Gold Mining Company. John Roeper, manager, 416 Second st., Chico. Reported sold to J. H. Sharp of San Francisco.

The **Southern Cross** mine in Sec. 32, T. 20 N., R. 6 E., M. D. M., near Enterprise, is reported to have opened up a quartz vein in granite which varies in width from a seam up to 6 ft. It strikes NE.-SW., dips 60° NW. and is developed by a 200-ft. tunnel. Mill equipment consisted of four 850-lb. stamps, 2 Banner mills, a ball mill and a Woodbury concentrator. Owned by L. Rosenthal of San Francisco.

Bibl.: Register of Mines and Minerals, Butte County, pp. 8 and 9, 1903.

The **Spring Valley** property consists of 42 acres located 2 miles southeast of Cherokee, at an elevation of 1600 ft. A 5-ft. quartz vein is reported to strike N. 80° W. and to dip 40° E. Development consists of a 400-ft. tunnel on the ledge and an 800-ft. crosscut tunnel with a 28-ft. raise to the vein. Mill equipment consisted of ten 850-lb. stamps. Idle.

Bibl.: Rept. XIII, p. 92, 1895–6.

The **Springer** or **Gold Dike** property is 2 miles north of De Sabla and 8 miles northwest of Magalia in the E. ½ of Sec. 34, T. 24 N., R. 3 E., M. D. M., at an elevation of 2350 ft. The roads are good during the dry season. The property includes 6 claims, the Paul Jones Placer, American Ravine Placer, Trenton Placer, Tiger Lily Quartz, Twilight Quartz, and D. A. Matheson Quartz.

The porphyritic dike from 200′–400′ wide and 1 mile long has been prospected by sluicing and found to carry rough coarse gold associated with quartz stringers. It is estimated that the ore will average about $1.00 per ton milled while the cost of mining and milling will not exceed $0.50 per ton. The recovery of gold by milling is expected to be about four times greater than by sluicing.

The ore is blasted and handled by a steam shovel, on benches and in open cuts, which dump it in chutes which lead to receiving bins. Equipment consists of a churn drill, an American No. 28 steam shovel with ¾ cu. yd. bucket, 200-ton receiving bin, grizzly, 16″ x 30″ jaw crusher, ball mills (two 6′ x 5′, one 5′ x 3′, one 4′ x 3′), 6 Deister Simplex concentrating tables, amalgamation tables. Plans call for a 700-ton mill bin with conveyor belt from the receiving bins, a 50 h.p. electric motor to run the crusher and a 5 h.p. motor to run 3 Challenge feeders.

Electricity will be obtained from the Pacific Gas and Electric Company. Water is secured from American Ravine. The tailings will be turned into the west branch of Butte Creek.

Twelve men were employed in December, 1916, during the installation of equipment, buildings, etc., by H. M. Thompson, superintendent. Owned by the Springer Consolidated Mining Company of New York.

The **Shakespeare** property is at Forbestown. A 4-ft. quartz vein in syenite and greenstone is reported to strike N.–S. and dip 80° W. Development consists of a 250-ft. shaft with some drifting. In 1894 the mill was equipped with thirty 1000-lb. stamps, 12 Frue concentrators and a chlorination plant. Idle.

Bibl.: Repts. XII, p. 88, 1894; XIII, p. 92, 1895–6.

The **Slater** property is 2½ miles east of Enterprise at an elevation of 1100 ft. A 7″–4′ quartz vein in granite strikes E.–W. and dips N. Development consists of a 190-ft. crosscut tunnel and a 200-ft shaft on the vein with some stoping. Equipment in 1895 consisted of a 10-ft. arrastra run by steam power. A 2½-mile ditch carried water from Slater ravine. Idle.

Bibl.: Rept. XIII, p. 92, 1895–6.

The **Standard Gold and Silver Companies** mine is at Oregon City, 8 miles northwest of Oroville at an elevation of 1425 ft. It consists of two claims on which four 18″ parallel quartz veins occur in greenstone and syenite. The veins strike NW.–SE. and dip 35° SW.

Development work consists of a 487-ft. single-compartment incline shaft with 4 levels. Drifts in 1895 were as follows: 135-ft. level drifts N. 219′ and S. 227′; 239-ft. level, drifts N. 197′ and S. 200′; 387-ft. level, drifts N. 48′ and S. 105′. Ore is reported to have been stoped from the second level to the surface. The mine made considerable water.

Equipment in 1895 consisted of a 20 h.p. engine which ran 3 Knowles pumps and several Hooker pumps, a 4-ft. Bryan roller-mill, Midas amalgamator and 2 Frue vanners. Idle.

Bibl.: Rept. XIII, p. 93, 1895–6.

The **St. Lawrence** property is 2 miles north of Inskip at an elevation of 4325 ft. A quartz vein in slate strikes NW. and dips E. Developed by open cuts and shallow pits. Idle.

Bibl.: Rept. XIII, p. 93, 1895–6.

The **Sunbeam** property near Yankee Hill has a 3½-ft. quartz ledge reported as being developed by J. L. Charles, Wm. and Ray Develter, Gus Forthous and L. H. Fields of Oroville. A 5-stamp mill was reported to be under construction in February, 1916.

The **Triumph** prospect is near Lumpkin. A quartz vein is being prospected by open cuts. Water is available. Owned by F. A. Thompson of Goldfield, Nevada.

The **Wild Yankee** or **Bessie** property is 3¾ miles northwest of Inskip at an elevation of 3925 ft. Three veins are reported to strike NE.–SW. and dip nearly vertical. The principal vein is 4 ft. wide, in syenite, and prospected by a tunnel and open cuts. There are two tunnels and an incline on the other veins. The ore was milled by an 8-ft. arrastra run by water power.

Bibl.: Rept. XIII, pp. 82 and 94, 1895–6.

MANGANESE.

Considerable manganese ore was shipped from Butte County in 1916. The large ore bodies, so far as development work has shown, were taken out, but it is possible that other deposits would bear more detailed investigation.

The **Binet** prospect is west of Clipper Mills. Insufficient work has been done to determine the size of the deposit. An option is held by J. A. Knox of Oakland. Owned by E. C. Binet of Clipper Mills.

The **Powell** property consists of a 120-acre patent in Sec. 35, T. 20 N., R. 7 E., M. D. M., 1 mile north of Clipper Mills. The manganese deposit is 8 inches wide and strikes N. 65° E. A 30-ft. shaft has exposed the ledge at its bottom. A 50-ft. open cut exposes 30 ft. of ledge matter carrying more or less manganese. This ledge strikes E.-W. and dips 30° N.

Small kidneys of chrome ore in serpentine have also been found on the property but no deposit of any size has been opened up.

Owned by E. V. Powell. Leased by Davis and Horning of Oroville who had not begun work when the property was visited.

The **Woolley** or **Bear Cañon** mine is in Sec. 35, T. 20 N., R. 7 E., M. D. M., 1½ miles northwest of Clipper Mills. A ledge of manganese ore strikes E.-W. and dips N. in amphibolite near an area of serpentine. A body of ore from 4′-20′ wide and 50′ long was opened up by a tunnel and stoped out in 1916. About 220 tons of 40% ore was shipped by the Noble Electric Steel Corporation who leased the property. The ore was hauled from the mine to Oroville by motor trucks for $6.00 per ton. Owned by Geo. W. Woolley of Clipper Mills.

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LASSEN COUNTY.

By W. Burling Tucker, Field Assistant.

Field Work in September, 1915.

DESCRIPTION.

Lassen County, in the northern part of the state, is bounded on the south by Plumas and Sierra counties, on the west by Shasta, on the north by Modoc, and on the east by the state of Nevada.

The county has an area of 4680 square miles. It is a succession of mountain ranges, those in the western half being heavily timbered, and interspersed with valleys, both large and small, wherein are located numerous lakes, of which there are twenty-two. The most prominent of these is Eagle Lake, which lies twelve miles north of Susanville, near the center of the county, among the eastern spurs of the Sierra Nevada range. It is fourteen miles long by six miles wide, having an area of 28,000 acres, and an elevation of over 5000 feet. Apparently, it has no outlet, but Willow Creek, which takes its rise immediately below the lake from several large springs, is supposed to be fed by the lake.

It is surrounded by mountains, some of them clothed with heavy pine timber that reaches to the water's edge. To the northeast, Fredonyer's Peak rises to an altitude of 8,000 feet. Honey Lake Valley is situated in the southeastern part of Lassen County, and comprises some 225,000 acres of agricultural land. About the center of the valley is located Honey Lake, a vast expanse of water, with a surface of 64,000 acres, at an elevation of 3949 feet above sea level. It is fifteen miles long from east to west, and four to twelve miles wide at its highest stage, when it attains a depth of ten feet; the water is alkaline. Two streams empty into this lake, Susan River from the west, and Long Valley Creek from the south. Surrounding this fertile valley on all sides are wonderful mountain ranges varying in elevation to almost 8000 feet above the sea. In the northern part of the county, sending their waters into the Pacific, we have a second Willow Creek and the Pit River. The mountains, too rough and high for agricultural purposes, afford excellent grazing, and therefore are devoted entirely to stock raising. Due to the recent volcanic activity of Lassen Peak, it is interesting to note that the Cinder Cone, which lies ten miles northeast of Lassen Peak, is situated in the southwestern part of the county, between Snag Lake and Lake Bidwell. The slopes of this cinder cone are covered with a loose material of scoria, lapilli, and a dull black volcanic sand.

This cinder cone is regular in form, with a smooth, dark surface. It rises to an elevation of 640 feet above the lowest point of its base

(6907 feet above the sea) with an average diameter of 2000 feet below and 750 feet across the top.[1]

The pit has a depth of 240 feet, with a narrow bottom and partially slaggy slopes. The greater part of this country is covered with sheets of basaltic lava, volcanic ash and scoria; only occasionally do we find exposures of sandstones and shales, and some marl and clays.

The principal industries of the county are stock raising, dairying, mining, and lumbering.

RAILROAD FACILITIES.

Lassen County is reached and traversed by three different railroads: The Western Pacific crosses the county east and west in the southern part; the Southern Pacific Railroad comes in from the east, starting at Fernley, on the Central Pacific about thirty miles east of Reno, Nevada, and continues through Honey Lake Valley as far as Westwood, where the headquarters of the Red River Lumber Company are located; the Nevada-California-Oregon Railroad, commencing at Reno, Nevada, and ending at Lakeview, Oregon, traverses the entire length of the east side of the county.

MINING CONDITIONS.

Owing to the larger part of the country being covered by eruptive overflows, which obscure all indications of the presence of valuable mineral, there are only two places in the county where mining has been carried on, resulting in bullion shipments, the most prominent of which is the Hayden Hill mining district.

In the neighborhood of Susanville in the granite on the Diamond Mountain range, there has been some prospecting and development in the past, but at present there is only a small amount of activity in this district.

South of Coopervale in Secs. 29 and 32, T. 28 N., R. 10 E., some good copper prospects have been developed, showing values in gold and silver. Among the mineral resources of this county are copper, gems, gypsum, gold, silver and sulphur.

[1] J. S. Diller, U. S. G. S., An. Rep. VIII, 395-432.

LASSEN COUNTY—Table of Mineral Production.

Year	Gold, value	Silver, value	Copper		Stone industry, value	Unapportioned
			Pounds	Value		
1880	$25,000					
1881	71,000	$1,000				
1882	100,000	20,000				
1883	20,000	5,000				
1884	50,000					
1885	15,000	150				
1886	25,812	135				
1887	24,168	304				
1888	50,000	200				
1889	97,503	215				
1890	14,890	300				
1891	3,676					
1892	15,400					
1893						
1894	35,283					
1895	25,000					
1896	40,300					
1897	49,100	850				
1898	37,460	300				
1899	28,898					
1900	19,807	676				
1901	5,900	200				
1902	23,410	244				
1903	91,102	1,203				
1904	116,993	1,515				
1905	[4]					
1906	[4]					
1907						
1908	7,284	783				
1909	[1]116,327	[1]1,463				[3]$217,521
1910	[1]82,180	[1]972				
1911						1,522
1912						
1913		2	2,259	[2]$350	$2,030	
1914		10	19,089	[2]2,539	775	
1915					870	
Totals	$1,193,333	$35,522	21,348	$2,889	$3,675	$219,043

Total Mineral Production of Lassen County, 1880–1915 (Inclusive).

Copper[2]	$2,889
Gold	1,193,333
Silver	35,522
Stone industry	3,675
Miscellaneous and unapportioned	219,043
Total	$1,454,462

[1]Includes gold and silver in Lassen, Modoc and Colusa.
[1]Includes precious metals of Lassen and Colusa.
[2]Copper production erroneously reported from Lassen County in the years 1913 and 1914, on account of shipping point being Doyle, while producing copper mines were located in Plumas County.
[3]Unapportioned, 1900–1909.
[4]Combined with figures of other counties.

COPPER.

Mountain Meadows Copper Mine. This property is situated 6 miles south of Coopervale, in Secs. 29–32, T. 28 N., R. 10 E. The holdings consist of ten claims: 5 patented are, Copper Queen, Copper King, Native Copper No. 1, No. 2, and No. 4, and five locations, giving 7500 feet along the lode. The veins occur in a meta-andesite conglomerate,

strike N. 29° W. and dip N. 61° E. The copper ores carry gold and silver values. Developments consist of shaft 100 feet deep and a tunnel 900 feet long, besides numerous open cuts on the veins. Idle. Mountain Meadows Copper Co., 316 Mars Bldg., Sioux City, Iowa, owners.

GOLD.

The Hayden Hill mining district has been described in Bulletin 594 of the United States Geological Survey by James M. Hill, and we have drawn freely from that paper in what follows:

HAYDEN HILL MINING DISTRICT.

This district is in the north central part of the county. The town of Hayden Hill is near the head of the west fork of Willow Creek, 16 miles south of Adin, at the west base of the low, rounded knob from which it is named. The nearest point on the Nevada-California-Oregon Railroad is Likely, about 30 miles east-northeast of Hayden Hill.

Topography.

The town of Hayden Hill lies at an elevation of 5400 feet, at the west base of the hill of that name, which attains an elevation of 6357 feet. This hill rises about 900 feet above the relatively level basalt-covered plains. On the south and west it has gentle even slopes to a point within 75 feet of the summit, which takes the form of a sharp peak. On the north and west it is very different as branches of Willow Creek have cut in close to the hill. On the north, there is an abrupt rise of 150 to 300 feet near the summit, below which the slopes are very steep for another 300 feet. On the east the hill rises 1200 feet in a little over a mile with a rather flat bench 1000 feet wide, 500 feet below the summit.

Geology.

Hayden Hill is composed of buff-colored to yellowish rhyolite tuffs. The bedding is distinct, being in some places horizontal and in others dipping very low to west-southwest. These beds differ in appearance, some of them being composed of rather coarse conglomeratic material, and others being fine-grained consolidated muds. At the summit of the hill these tuffs have been brecciated and silicified and cemented by white quartz. This hard rock forms the peak at the top of the hill, and the scarp along the north side.

The silicification and brecciation appear to have occurred in a fault that was slightly concave to the south-southeast, and which has raised the beds to the southeast forming Hayden Hill. This fault zone strikes about N. 50° E., and the amount of vertical displacement seems to have been greater to the east-northeast near the summit of the hill than in the vicinity of the town of Hayden Hill. The low flat to the south and

southwest of the hill is underlain by a soft, partly consolidated dirty buff-colored rhyolite tuff. The tuffs are probably of Tertiary age.

Ore deposits.

The veins of Hayden Hill are confined to the area west of the summit, and the richest of them occur in the long even-sloping southwest side.

The most productive veins were the Providence, Golden Eagle, Juniper, Brush Hill, and Hayden Gulch. There are two distinct sets of veins, one striking about N. 68° W. and the other N. 38° E. The northeast veins appear to be younger than the northwest veins, and movement along the Providence vein has displaced the Golden Eagle, as at the northwest end of all the levels the Golden Eagle swings to the north on approaching the Providence. The two northeast veins, near the main shaft of the Golden Eagle, clearly cut that vein.

Structure of the veins.

As a rule the veins of Hayden Hill have steep dips. In general the northwesterly fissures dip 60°–70° NE., though in many places in the Golden Eagle Mine the vein is vertical.

The northwesterly fissures are as a rule nearly vertical, but at the junction of the Providence and Golden Eagle veins the Providence has a dip of 45° SE. Most of the fractures are 1 foot to 10 feet wide, but some are as wide as 25 feet. The filling of all the veins is a soft, consolidated fault breccia of the adjacent wall rock, much of the material being as small as sand grains. Both the country rock and the ore are more or less iron-stained and the richest ore contains a large amount of pyrolusite. This rich ore occurs in irregular pockets throughout the main vein. The rich veins are remarkable for the small amount of quartz they contain. The gold in these veins occurs as small nuggets. It is not flattened, but is so fine that some particles will float when dried. It is never found in the fragments of rock, but always in the fine sandy and claylike material. This metal is a combination of gold and silver, worth about $14.00 an ounce.

Origin of the shoots.*

The concentration of gold with manganese in certain well-defined shoots in the productive veins, and the fact that almost no sulphide minerals are present in them, lead one to conclude that the valuable ores are all secondary, due to concentration by oxidizing waters with a general downward movement. The present ground-water level, as shown by the Golden Eagle shaft, is about 625 feet below the surface, which is in the oxidized zone to present depth of shaft, 835 feet. The veins are certainly younger than the rhyolite tuffs, which are of Tertiary age.

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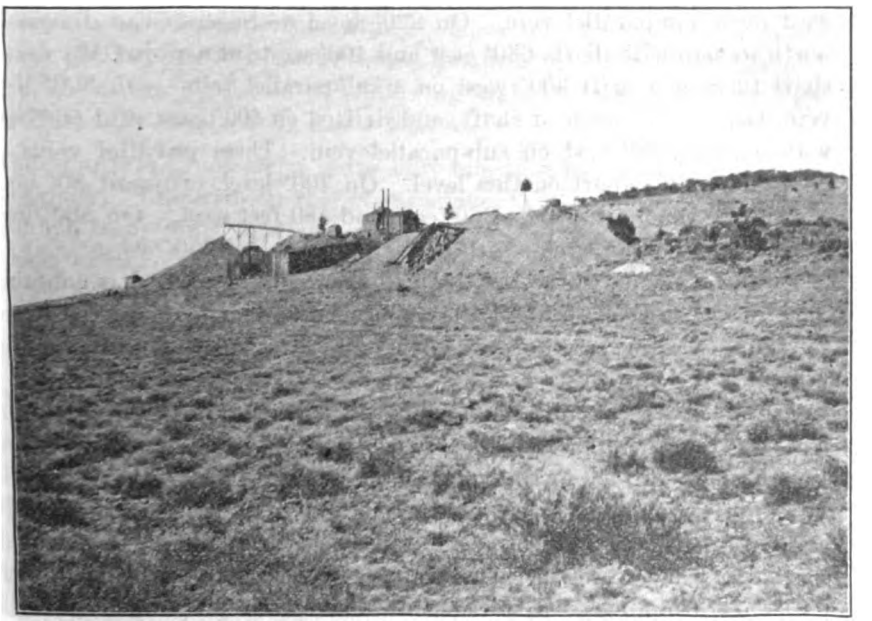
*J. M. Hill, op. cit.

MINES.

Blue Bell Mine. See our Rep. IX, p. 213; XII, p. 148; and XIII, p. 200; Bulletin 594, U. S. G. S. This mine is situated on southwest slope of Hayden Hill, at an elevation of 5400 feet. Development consists of vertical shaft having a depth of 160 feet. Idle. H. P. Anderson and Albert Chittock of Hayden Hill, owners.

Brush Hill Mine. See our Rep. X, p. 276; XI, p. 241; XII, p. 148; XIII, p. 200; Bulletin 594, U. S. G. S. It is situated on Hayden Hill, at 6500 feet elevation. Developments: vertical shaft 500 feet deep; shaft 270 feet vertical and then 130 feet on incline. Idle. George A. Keller of Buffalo, N. Y., owner.



Golden Eagle Mine and Mill. Hayden Mining District.

Daisy Dean Mine. It is situated one mile southeast of Hayden Hill, on the north slope of Buckskin Hill. Shaft sunk to a vertical depth of 200 feet, on vein striking N. 35° W. in a rhyolite tuff. Levels were driven on the vein at 50′, 100′ and 200′. Idle. H. C. Watson of Bieber, Cal., owner.

Golden Eagle Mine. See our Rep. X, p. 275; XII, p. 149; and XIII, p. 200; Bulletin 594, U. S. G. S., pp. 30 to 38. It lies on the southwest slope of Hayden Hill. Holdings consist of 160 acres, including the following claims: Golden Eagle, Providence, Evening Star, Aileen, White Swan, Vincuna, and Tailings Placer claim. Two veins have been developed on this property; the Golden Eagle vein strikes N. 45°

W., dipping 75° NE., while Evening Star or Providence vein has a course of N. 38° E. with a vertical dip.

The Golden Eagle vein varies in width from 1′ to 25′. The length along the lode on Golden Eagle vein is 3100 ft., while on Evening Star vein it is 4500 feet. Southwest of Golden Eagle vein, a 6′ x 10′ 2-compartment shaft has been sunk to a vertical depth of 835 feet. Levels have been driven on the vein at 150′, 200′, 300′, 400′ and 500′ to the end lines of the Golden Eagle claim. The vein has been stoped out from 400′ level for a distance of 400 feet east of shaft. West of shaft for about 300 feet the vein has been stoped from 400′ to 220′ level. On 150′ level, crosscut from shaft 40′ north to vein, with a drift 500′ east, and 560′ west on main vein; at 60′ west of shaft there is a drift 240′ west on a sub-parallel vein. On 220′ level a crosscut was driven 20′ north to vein with drifts 680′ east and 400′ west; at a point 40′ west of shaft there is a drift 300′ west on a sub-parallel vein. On 300′ level, vein was cut 75′ north of shaft, and drifted on 600′ east and 600′ west with a drift 300′ east on sub-parallel vein. These parallel veins are from 20′ to 40′ apart on this level. On 400′ level, crosscut 80′ north of shaft to vein, with drifts 360′ east and 580 feet west. On 500′ level, crosscut 85′ north to vein, with drifts 140′ east and 250′ west.

Milling. Owing to the fact that all the gold is free and is contained only in the fine material in the veins, crushing was early discovered to be unnecessary, so all ore was dried and screened, and only the fines milled.

There is a 150-ton mill and cyanide plant on the Golden Eagle claim. The ore from the mine was dried in a 10′ x 20′ Benjamin furnace, then put through a 1-inch mesh trommel, the oversize from which went onto dump. The undersize from the trommel was again dried in two 3′ x 10′ revolving furnaces and crushed to 4-mesh between rolls. It was again sized in a 4-mesh trommel, the oversize returning to the rolls, and the undersize dropping to a storage bin. The sized pulp was leached in twelve 50-ton cyanide tanks.

From the amount of fines contained in the dumps it appears that the drying had not been complete. It is reported that, owing to the large amount of slimes that was mixed with the coarse ore in the leaching tanks, which prevented proper percolation of the solutions, probably only about 50% extraction was made on the ores treated by this plant. Six men are employed retimbering shaft. Lassen Mining Company, 1004 Alaska Commercial Building, San Francisco, Cal., owners.

Gray Goose and Sunrise Mines (Hayseed and Hayden Gouge). They are situated on Hayden Hill to the northeast of the Golden Eagle claim, at an elevation of 6300 feet. Two veins have been developed on this property; the Hayseed vein has a course of N. 68° W. while Hayden Gouge vein strikes N. 45° E., both veins having a vertical dip.

There are three shafts on the property with depths of 300 feet and a tunnel on the Sunrise claim 400 feet long. Idle. Barney Fillingin of Hayden Hill, owner.

Idaho and Leora Mines. These mines are situated on the plain ying southwest of Hayden Hill. The vein on the Idaho claim strikes N. 35° W. and has a vertical dip. A shaft has been sunk on this vein to a vertical depth of 100 feet, developing a vein having an average width of 2 feet. The course of the vein on the Leora claim is E.-W., dipping 65° N. Two shafts have been sunk on this property, one being an incline on the vein 60 feet deep, the other shaft is sunk north of vein to a vertical depth of 100 feet. Idle. W. Snyder, John Bowden and O. L. Nave of Hayden Hill, owners.

Jumper and Mount Vernon Mines. These mines are situated on the summit of Hayden Hill, about a mile northeast of the town of Hayden Hill. Holdings consist of the following claims: Jumper, Mount Vernon, Burbank, Early Rose, Snow Flake.

The Mount Vernon claim is the only one that has been developed to any extent. The vein on this claim strikes N.-S., dipping 70° E. A shaft has been sunk to a vertical depth of 120′; at the 120′ level, a crosscut has been driven 30′ east to vein, at which point, a winze has been sunk 100′ on the vein. The vein is a quartz-filled fissure, having an average width of 8 inches, and shows some pyrite. The formation is a rhyolite tuff. Idle. O. L. Nave of Hayden Hill, owner.

Juniper Mine. See our Rep. IX, p. 212; XII, p. 150; and XIII, p. 201. It is situated on the west side of Hayden Hill, at 6325′ elevation. There are two veins on the claim; a N.-S. and an E.-W. vein; the developments have been confined to the latter near the crossing with the former. The workings consist of two shafts, one 300 feet deep, and the other 126 feet. Both workings are caved. Idle. G. H. Knight; J. Harvey Estate, of Adin, California; T. A. Roseberry Estate, of Susanville, California; John McFarling Estate, of Calistoga, California, owners.

Lucky Star (North Star) Mine. It is situated north of the town of Hayden Hill, at an elevation of 6100 feet. The vein is 2½ feet wide, course nearly N.-S., dips about 45° W. between brecciated rhyolite walls. Developments consist of vertical shaft on south end of claim 100 feet deep. Crosscut tunnel 210 feet long. At a point 45 feet east of portal a brecciated, rhyolite dike was cut 30 feet in width, with ore occurring on both sides of this dike. A drift has been driven on the west side of this dyke 175 feet south, also on east side a distance of 125 feet south, developing good ore on both walls of the dike. The ore from the mine is screened over 1″ screen, the through size going to storage bin, while oversize material goes to waste dump. The sized material is

treated in two 10-ton leaching vats, the sands being given a six days treatment. Capacity of cyanide plant is three tons per day. Two men are employed. Under lease to G. J. Steel et al. of Alturas, California. Mrs. B. Arnett of Hayden Hill, owner.

PRODUCTION OF HAYDEN HILL.

There are no accurate figures of the production of Hayden Hill. Approximate estimates of the gold and silver output for certain mines furnished by residents of Hayden Hill to James M. Hill of U. S. Geological Survey, are as follows:

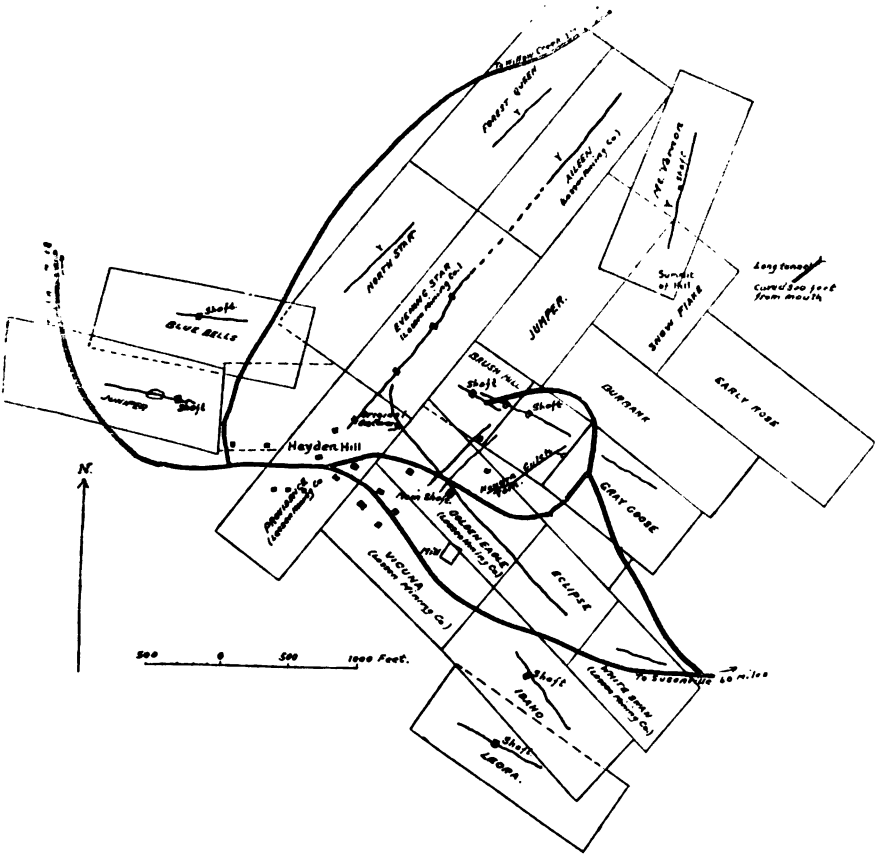
Juniper	$600,000
Brush Hill	400,000
Evening Star	200,000
Hayden Gouge	20,000
Blue Bell	100,000
Providence	78,000
Hayseed	150,000
North Star	20,000
Golden Eagle	*25,000
Golden Eagle	†1,000,000
Total	$2,593,000

The following figures from 1880 to 1911 are taken from the reports of the Director of the Mint, and those for some years include the whole of Lassen County, during which time there were few producing mines outside of Hayden Hill.

Production of Hayden Hill District, Lassen County.

Year	Gold	Silver
1880 to 1886	$307,712	$26,285
1887	39,109	303
1888	50,000	200
1889		
1890	14,890	200
1801	3,676	
1892	15,400	
1893		
1894	35,283	
1895	25,000	
1896	40,300	
1897	49,100	850
1898	37,460	300
1899	28,898	
1900	19,807	676
1901	5,900	200
1902	19,810	247
1903	93,599	1,203
1904	115,993	1,514
1905	142,000	2,020
1906	397,105	1,169
1907		
1908	6,724	121
1909	115,475	1,450
1910	81,060	968
1911	2,500	277
	$1,646,801	$37,973

*Previous to 1901.
†Under Lassen Mining Co.



SKETCH MAP OF HAYDEN HILL, LASSEN COUNTY, CAL., SHOWING LOCATION OF THE PRINCIPAL CLAIMS AND VI

As will be seen, there is a discrepancy of about $600,000 between the two sets of figures. This is due probably to the method of collecting statistics in the early days, and the larger figures are considered more nearly correct.

DIAMOND MOUNTAIN MINING DISTRICT.

This district lies seven miles to the southwest of Susanville, on the eastern flank of the Diamond Mountain Divide. During the past years spasmodic attempts have been made to develop the quartz veins that occur in the granite of this main divide.

The only property in this district that has any recent developments is the Gold Belt Mine. The others are either abandoned, or only a small amount of surface prospecting has been done on them to hold the claims.

Gold Belt Mine. See our Rep. X, p. 274; and XII, p. 149. It is 7½ miles southwest from Susanville and comprises 1500 by 600 feet. The vein strikes N. 45° E. and has a vertical dip, in granite, averaging 4 feet in width. Developments consist of two tunnels. The lower tunnel crosscuts the vein at a distance of 185 feet from portal; a drift has been driven 185 feet southwest on the vein. Fifty feet above the lower tunnel, a tunnel has been driven on the vein southwest 150 feet, and all ore stoped out to the surface. The quartz is pockety—the general run of the ore not being over $3.00 per ton. The gold runs about $12.00 to the ounce. Idle. George N. McDow of Susanville, California, owner.

MINERAL SPRINGS.

A large number of warm and hot springs issue from the lava-covered region of Lassen County. In a few places there are lake bed deposits of partly consolidated sands and clays. Areas of alluvium form occasional patches of meadow and valley land while in the neighborhood of Eagle and Honey lakes are found a number of warm and hot springs. The water from these springs is mostly saline in character.

Amedee Hot Springs. (See Water Supply Paper 338, by G. A. Waring, U. S. G. S.) These springs are situated at Amedee in Honey Lake Valley. In the alluvial land which slopes westward toward Honey Lake, scalding water forms several groups of shallow pools, mainly at six places in a belt about 600 yards long that trends nearly southward. About ½ mile S. 30° W. from the southernmost of these main groups another hot spring forms a pool in the salt grass land. Temperature of springs is 172° to 204° F. The water is saline.

Analysis by F. M. Eaton, 1909.

Constituents	Parts per million	
	By weight	Reacting values
Sodium (Na)	232	10.18
Potassium (K)	4.9	.13
Calcium (Ca)	18	.90
Magnesium (Mg)	Trace	Trace
Iron (Fe) } Aluminum (Al)	1.8	.06
Sulphate (SO_4)	269	5.60
Chloride (Cl)	164	4.62
Carbonate (CO_3)	27	.91
Silica (SiO_2)	94	3.12
Carbon dioxide (CO_2)	Present	Present
	810.7	

Bassett Hot Spring. (See Water Supply Paper 338, by G. A. Waring, U. S. G. S.). It is situated 2½ miles east of Bieber, in Big Valley. The water rises with a temperature of 173° F. from a fissure in tuffaceous sandstone. Total flow of the spring is approximately 175 gallons per minute. The water has no distinct odor or taste, but the analysis shows the water to be moderately mineralized primary saline water of the sulphate type.

Analysis by F. M. Eaton, 1909.

Constituents	Parts per million	
	By weight	Reacting values
Sodium (Na)	224	9.74
Potassium (K)		
Calcium (Ca)	31	1.68
Magnesium (Mg)	Trace	Trace
Sulphate (SO_4)	377	7.85
Chloride (Cl)	101	2.85
Carbonate (CO_3)	21	.70
	757	

Highrock Spring. Situated 10 miles southeast of Amedee, on the Highrock ranch. A large thermal spring rises at the edge of Honey Lake Valley from basaltic lava that forms the hills to the east. This spring has a flow of 525 gallons per minute. Temperature 86° F., alkaline. The water is used for domestic supply and irrigation.

Shaffer Hot Springs (Braubecks). (See Water Supply Paper, 338, by G. A. Waring, U. S. G. S.) These springs are situated at Hot Springs Station on the Nevada-California-Oregon Railroad.

The principal spring rises with vigorous ebullition in a pool about ten yards in diameter, and is from one to two feet deep. Temperature 204° F. The flow of main spring is about 175 gallons per minute. Two other hot springs that discharge about 65 and 10 gallons per minute, respectively, also six or more hot pools that have no surface overflow, are formed in the nearly level salt grass area in a distance of about 125 yards southwest of the main spring.

Analysis of water from main spring by G. E. Colby of U. S. G. S.

Constituents	Parts per million	
	By weight	Reacting values
Sodium (Na)	304	13.22
Potassium (K)	9.4	.24
Calcium (Ca)	12	.60
Magnesium (Mg)	0.4	.03
Sulphate (SO_4)	349	7.27
Chloride (Cl)	207	5.84
Carbonate (CO_3)		
Silica (SiO_2)	131	4.34
	1,012.8	

Stone Breaker Hot Springs. These springs are 8 miles southeast of Bieber, in Big Valley. There are six pools and springs in a belt extending 275 yards in a southerly direction; about 250 yards east there are four other hot pools. The highest temperature recorded was 165° F. Flow from the hottest spring is 125 gallons per minute. The hot water rises from a tuffaceous sandstone.

Mud Springs. There are extensive hot mud springs situated about 15 miles northeast of Honey Lake.

MODOC COUNTY.

By W. BURLING TUCKER, Field Assistant.

Field Work in August, 1915.

DESCRIPTION.

Modoc County, situated in the northeastern part of the state, is bounded on the south by Lassen County, on the west by Siskiyou. on the north by the state of Oregon, and on the east by the state of Nevada.

Modoc County has an area of 3823 square miles. It is a succession of valleys, that in the past were inland lakes, and which follow one another through the country from north to south. In the northern end of the county are notable Goose Lake, Tule Lake, and the three lakes of Surprise Valley. These valleys are separated by low volcanic ridges, being bordered by bluffs of volcanic rocks.

The lava flows, with which the county is to a large extent covered, evidently had their source from Lassen Butte in the southern part of the county, and the peaks in the Warner Range for the northern flows. Probably some of the flows emanated from Mount Shasta to the west.

The Warner Range of mountains which divides the Goose Lake country from the Surprise Valley section, attains in several places a height of over eight thousand feet. This range is a branch of the Sierra Nevada Mountains.

Pit River, one of the main sources of the Upper Sacramento River, takes its rise in this county and, with its tributaries, supplies the county fairly well with water. It starts from some large springs below the south end of Goose Lake. This river drains all the country west of the Warner Range of mountains. The most productive areas agriculturally are Round, Stone Coal, Hot Springs, Goose Lake and Surprise valleys. Round Valley has a diameter of eight miles, surrounded by eruptive hills, and is largely devoted to grain raising. This valley gets its water supply from Rush Creek. Stone Coal Valley is twelve miles long by one mile wide. This valley, surrounded with low-lying, well-timbered hills covered with good pine timber, is named from a strata of coal which occurs along Stone Coal Creek in exposures of shale. Hot Springs Valley is twenty-five miles long and four miles wide, deriving its name from a number of hot springs that rise in the valley. Alturas, the county seat, is at the junction of the three valleys—Goose Lake, South Fork and Hot Springs. Surprise Valley lies to the east of Warner Range and is sixty miles long and about six miles wide. It has, at one time, been

an inland sea. At present it contains three lakes—the Upper, Middle and Lower lakes, the waters of which are strongly alkaline. On the east side of these lakes to the state line the country is all desert. The town of Cedarville lies east of Middle Lake. At the head of Upper Lake, Mount Bidwell rises to a height of 8450 feet; at its foot is the town of Fort Bidwell. The largest sheet of water is Goose Lake, which is 45 miles long and eight miles wide and has a depth of about twenty feet.

The principal industry of the county is stock raising. Owing to the heavy flow of lava over a large part of its area, only two mineral belts have been developed in the county; the High Grade District, located in the Warner Range of mountains in the northeastern part of the county, near the state of Oregon boundary line, and the Winters District, situated in the southern part of the county, a few miles north of the Lassen County line.

RAILROAD FACILITIES.

The Nevada-California-Oregon Railroad traverses the entire length of the east side of the county, commencing at Reno, Nevada, and ending at Lakeview, Oregon. From the principal stations on this railroad the remote parts of the county are reached over good wagon roads.

Among the known mineral resources of Modoc County are: clay, coal, copper, gold, iron, quicksilver, salt and silver.

MODOC COUNTY—Table of Mineral Production.

Year	Gold, value	Silver, value	Salt		Stone industry, value	Other minerals, value
			Tons	Value		
1880	$10,000					
1881	20,000	$1,500				
1882						
1883	50,000					
1884	60,000					
1885	60,000					
1886*						
1910	5,438	75				
1911	19,875	363				
1912	27,893	494	50	$800		
1913	6,061	94	40	720		
1914	1,000	10	40	720		
1915	7,557	104	†	†	$300	$720
Totals	$267,824	$2,640	130	$2,240	$300	$720

Total mineral production, Modoc County, 1880-1915 (incl.)

Gold	$267,824
Silver	2,640
Salt	2,240
Stone industry	300
Other minerals	720
Total	$273,724

*1886 to 1910 no mineral production.

COAL.

In Stone Coal Valley along the creek of that name in the exposure of shales there is a stratum of lignite coal which has a strike of N. 65° W., and a dip of 25° N. Only a small amount of development has been done on this coal.

COPPER.

On the east slope of a spur of the Warner Range, about seven miles south of Fort Bidwell, some very promising indications of copper have been discovered, but owing to the remoteness of the district from railway transportation, only a small amount of development and prospecting has been done on the properties.

Seitz Copper Mine. It is situated seven miles south of Fort Bidwell, and 25 miles SE. of Willow Ranch Station on the Nevada-California-Oregon Railroad. The claims are located on the east slope of a spur of the Warner Range, at an elevation of 5860 feet. Holdings consist of six claims: Little Ben, Josiah, Christy, Dream, Charity, and Blue Jay, giving 3000 feet on the lode. A series of narrow veins occur in a porphyritic andesite, and have a general strike of N. 65° E., dipping 60° SE. Developments consist of shaft 90 feet deep and a tunnel 336 feet long, which connects with bottom of the shaft. The ores developed carry cuprite, malachite, azurite, and some native copper. A large number of shallow open cuts have been made on the different veins which have a width of two inches to eight inches—some high grade ore has been shipped from this property. Two men are employed. Mrs. W. B. Yonkin and W. B. Seitz of Fort Bidwell, owners.

GOLD.

HIGH GRADE MINING DISTRICT.

In the following description the writer has drawn freely on a report of this district by James M. Hill of the United States Geological Survey.

Location.

The High Grade District is located in the extreme northeast corner of the county, in the Warner Mountains. Its northern boundary is the Oregon line; its eastern boundary is about seven miles west of the Nevada-California line, and its western boundary is Goose Lake Valley.

History of Mining in this District.

The discovery of gold in the High Grade camp was made on the Oregon claim at the south end of the district in 1905 by a sheep herder, who sold to J. O. Kafader, of Fort Bidwell. The first real boom took place in the summer of 1905, but the autumn of 1909 and the spring of 1910 witnessed the big rush to the district.

Accessibility.

Fairport, on the Nevada-California-Oregon Railway, is ten miles west of the district, and it, with the town of New Pine Creek, Oregon, which is a mile off this road, is the supply point for the mines. The roads from Fairport to High Grade are steep but good.

Timber and Water.

High Grade is plentifully supplied with timber and water for mining purposes.

Topography.

The Warner Mountains in the vicinity of High Grade are rugged, but have a fairly even crest at an elevation of 7500 feet. Mount Bidwell, about three miles southeast of the camp, attains an elevation of 8550 feet. The west front of the range has an abrupt rise of 1000 feet above the level floor of Goose Lake Valley, which is about 5000 feet above sea level. This rise is along a fault which follows the east side of the valley for some distance. The cañon cut by Pine Creek, which is followed by the High Grade road, has very steep sides. The east front of the Warner Mountains has also a very abrupt rise. The mines in the High Grade district are located along the summit of the range at the headwaters of New Pine Creek. The most prominent peak on this divide is Yellow Mountain, which has an elevation of 8000 feet.

Geology.

In the High Grade district there are four distinct types of extrusive lavas. The oldest rock exposed along the lower western side of the district is a dark grained andesite; above this is a white to yellow rhyolite. Above this rhyolite on the flat eastward slope of Alturas ridge there is a purplish flow rhyolite with very fine lamellae. A fresh porphyritic augite basalt is exposed on the west flanks of Mount Bidwell.

The andesite which covers the western part of the district is composed of dark-gray to green flows, dipping east at low angles. On the ridge about two miles west-northwest of High Grade the yellowish rhyolite overlies the andesite. This contact is again seen about 400 feet below the summit of Discovery Hill, at an elevation of 7700 feet. The rhyolite that forms all of Yellow Mountain and High Grade Hill, and the northern part of Discovery Hill, is white, but weathers yellow.

On Alturas Ridge there is a small area of thinly laminated purple rhyolite. The augite basalt on the west flank of Mount Bidwell is perfectly fresh greenish-black porphyry that weathers dull brown.

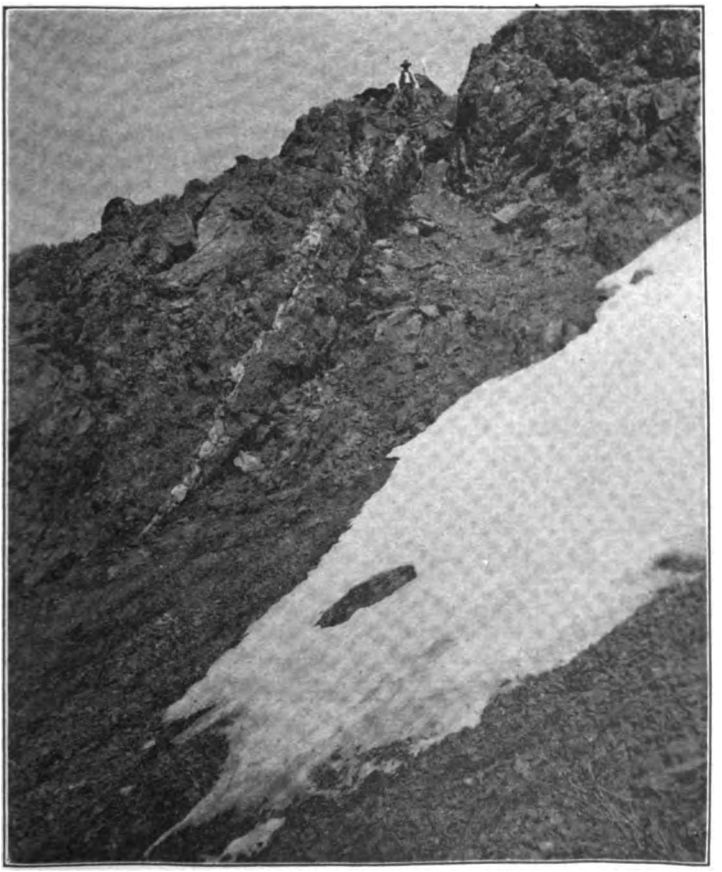
Ore Deposits.

There are three distinct types of ore deposits in the High Grade district. (1) Veins in granular rhyolite with some replacements of the walls. (2) Veins in andesite. (3) Veins and replacements in

glassy rhyolite. The veins in the granular rhyolite yield the largest amount of ore.

The principal veins occur in nearly east-west vertical fissures, and also to some extent in north-south and northwest-southeast fractures.

In practically all the veins post mineral movements have in places crushed the ore and produced gouge, which, though seen in places between the walls and vein quartz, is commonly found in the quartz where the wall rock was too tough to fracture. The clay gouge of almost every vein constitutes the richest ore.

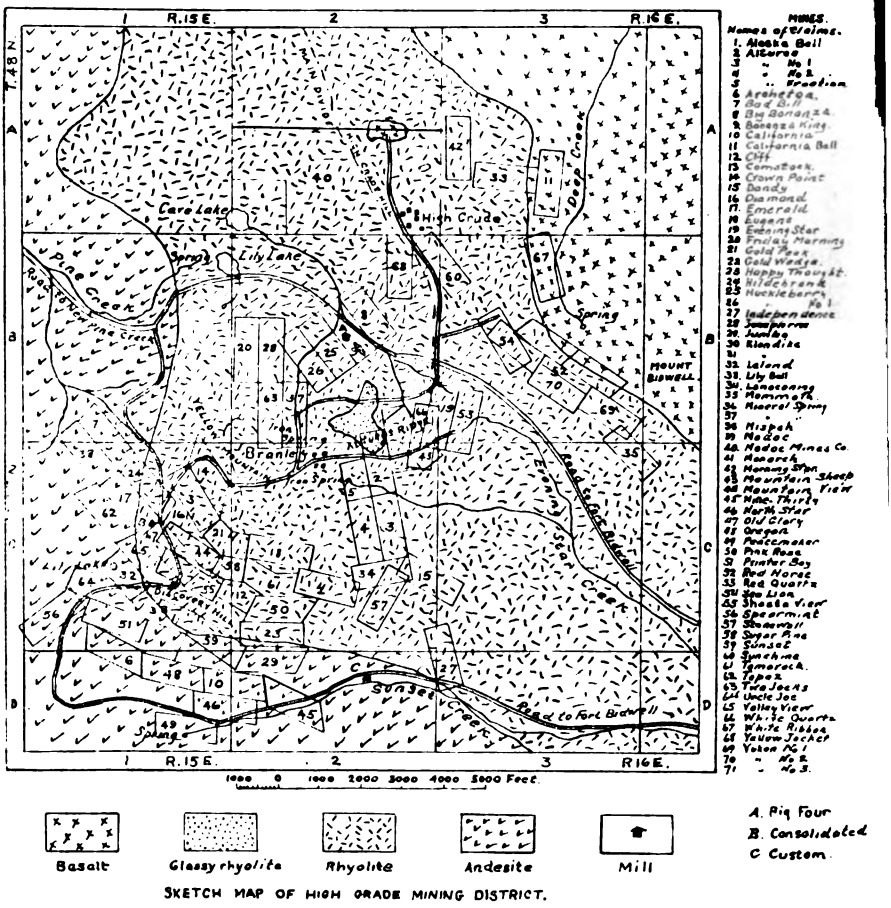


Outcrop of discovery vein on Oregon Claim, High Grade.

The veins in granular rhyolite are found on High Grade Hill, on Alturas Ridge, and the north side of Discovery Hill. In all these places the granular rhyolite has been more or less silicified, particularly along zones of brecciation, the result being that the rock has become particularly hard.

On High Grade and Discovery Hills this hard altered rhyolite has weathered into so-called "rock piles." In these veins the best ore occurs in shoots which pitch east or southeast on the veins at medium angles.

The veins in andesite are confined mostly to the south side of Discovery Hill. The andesite is cut by a number of small white



quartz stringers, which strike west-northwest and east-northeast, and which in some places unite to form fair sized veins, as on the North Star, Oregon and Sunset claims. Most of the larger veins strike about N. 60° W. and dip 70° to 75° S. Post mineral movement has formed gouge along the walls, and in some places has crushed the veins.

The veins in the glassy rhyolite occur on Alturas Ridge, where the Alturas shaft has been sunk on a north and south fracture in glassy rhyolite; the fissure is quite tight and shows some pyrite.

MINES.

Alturas Mines (quartz). See Bulletin 594, U. S. G. S., p. 47. They are situated on the north slope of Alturas Ridge, nine miles east of New Pine Creek, Oregon. Holdings consist of the following claims: Alturas No. 1, No. 2, No. 4, Little Fawn, and Alturas Triangle. A vertical shaft has been sunk on a north and south fracture to a depth of 125 feet. This fracture cuts a glassy flow rhyolite. Pyrite has been deposited as the matrix of the breccia together with bluish, white and amethystine quartz. Idle. Alturas Gold Mining Company, owner. C. W. Canfield, Oakland, Cal., manager.

Bidwell Discovery Mines. See Bulletin 594, U. S. G. S., p. 46. These mines are situated on the south slope of Discovery Hill, about eight miles NW. of Fort Bidwell. Claims are as follows: Oregon, California, Gold Wedge, Archerton, Hardtack and Nine-thirty, with 4400 feet on the lode. The veins on these claims occur in the andesite. The Oregon-California vein strikes N. 60° W. and dips 20° S. Width of four inches to one foot. It consists of white quartz stained with limonite, and in some places stained with a green copper silicate. The vein stands out distinctly against the dark andesite walls. Developments consist of a tunnel which crosscuts the vein 150 feet from portal, with a drift west on the vein 150 feet, and east 170 feet.

In the west drift, a crosscut was driven south 80 feet cutting a parallel vein which was drifted on forty feet west, showing four to eight inches of quartz. The occurrence of the gold is very fine and can not be seen in the quartz. There is a Kendall 1-stamp mill on the property. Two men are employed. Bidwell Discovery Gold Mining Co., Fort Bidwell, Cal., owner. C. D. Kafader, president. J. O. Kafader, secretary and manager.

Big Four Mine. It is situated eight miles east of New Pine Creek, Oregon, on the Fairport and High Grade road. Claims: Big Bonanza, Bonanza King, Golden Treasure, and Golden Knight, with 3000 feet on the lode.

On the property there is a massive outcrop of highly silicified rhyolite, which strikes N. 60° E. This outcrop carries values for a width of 150 feet. An incline shaft has been sunk 100 feet on a N. 30° W. vein, which dips 70° NE. This vein varies in width from two inches to two feet, and cuts granular rhyolite. The ore consists of rhyolite and quartz in a clay matrix. The vein was drifted on both north and south on the 30′ and 40′ levels. Ore is being mined from the silicified outcrop by means of a surface open cut. The ore is hauled from open cut in dump carts to mill, where it is crushed by five stamps, weighing 1000 lbs. dropping 105 per minute, and crushing two tons per stamp through a 60-mesh screen. The pulp from

battery flows over amalgamating plates 18 feet long by 5 feet wide and which have a slope of 2½ inches per foot. The mill is driven by steam power. Six men are employed. The property is under lease to C. W. Tyler and Carl Monsees. Big Four Mining Company, Alturas, Cal., owner.

Eugene Mine. This mine is situated on the east slope of Discovery Hill, nine miles east of New Pine Creek, Oregon. Here is a series of east and west fractures in rhyolite. Developments consist of a tunnel 270 feet in length and a series of shallow open cuts. Idle. Richard Mason et al., of High Grade, owners.

Fern Mine. It is situated on the east slope of Alturas Ridge, nine miles east of New Pine Creek, Ore. Holdings: Fern Fraction, Fairport No. 1, No. 2 and No. 3. The vein has a course of N. 70° W., dips 80° S. It varies in width from 2″ to 12″. The fracture is filled with brecciated country rock cemented with quartz. Developments consist of shaft 40 feet deep and a series of shallow open cuts. Idle. Fairport Merger Gold Mining Co., New Pine Creek, Ore., owners.

Fort Bidwell Consolidated Mines. See U. S. G. S. Bulletin 594, p. 46. These mines are situated on the north side of Discovery Hill, about eight miles east of New Pine Creek, Oregon. Holdings consist of the following claims: Mountain View, Sugar Pine, Missing Link, Diamond Fraction, Old Glory and Valley View, with 2650 feet on the lode. The developments have been on the Mountain View and Sugar Pine claims. The vein on the Mountain View strikes N. 70° W. and dips 75° S. This vein cuts the rhyolite and the underlying andesite. Some very high grade ore is reported to have been extracted from a winze, where the ore occurred on the hanging wall in a heavy iron-stained gouge. Some of the vein quartz shows a copper silicate stain. On the Mountain View claim, a crosscut tunnel has been driven 150 feet to vein, with a drift east 250 feet on the vein.

Two shoots of ore were developed, one being 40 feet in length, and the other 50 feet long. At intersection of crosscut tunnel, and drift, a winze was sunk on the vein to a depth of 75 feet. About 100 feet east of this winze, a second winze was sunk to a depth of 35 feet. The vein on the Sugar Pine strikes N. 80° W., and dips 60° to 70° S. The vein ranges in width from 4″ to 5′, and consists of partly brecciated rhyolite. Throughout the vein there is considerable iron-stained clay that is reported to carry gold values. The walls of this vein are stained with a heavy coating of limonite and some hematite. The wall rock for two feet on either side of the vein is a low grade ore. The Sugar Pine vein has been developed and worked from three tunnels driven on the vein: No. 1 Tunnel (lower) 350′ long; No. 2 Tunnel, which is 70′ above No. 1, has a length of 200′; No. 3 Tunnel is

40′ above No. 2 and is 90′ long. The ore has been stoped out from No. 1 to No. 3 Tunnel for a length of 75 feet. It was trammed from No. 1 Tunnel to bins, from which it was transported by an aerial tramway over ridge to ten-stamp mill on the Mountain View claim, a distance of 3200 feet. Idle. Fort Bidwell Consolidated Mining Company, Hodges Building, Detroit, Mich., owner.

Gold Peak and Klondike Mines. They are situated nine miles east of New Pine Creek, Oregon, on the north slope of Discovery Hill. The vein varies in width from 2″ to 12″; strikes N. 70° W. and dips 30° S. The developments consist of a series of shallow shafts and tunnels. Idle. J. T. Maupin, E. Coshes et al., Fort Bidwell, Cal., owners.

Gold Shore Mine. This mine is situated nine miles E. of New Pine Creek, Oregon, on High Grade Ridge. Holdings consist of four claims—Daisy, Inner Fraction, New Year and Gold Shore. The main fissure strikes N. 60° W. and dips 80° S.; and varies in width from 2″ to 5′. Developments: shaft 26 feet deep sunk on the vein, which shows five feet of vein material. A crosscut tunnel 250 feet long was driven to cut the above vein, but owing to displacement of the vein, it was not found on the tunnel level. Idle. Gold Shore Mining Co., New Pine Creek, Ore., owner.

Last Dollar Mine. It is situated nine miles E. of New Pine Creek, Oregon, on the west slope of High Grade Hill. Vein strikes N. 75° E. and dips 80° S. Width twelve inches. Shaft 45 feet deep sunk on the vein. Idle. E. T. Weisendanger of Los Angeles, owner.

Modoc Mine. See U. S. G. S. Bulletin 594, p. 45, by James M. Hill. It is situated nine miles E. of New Pine Creek, Oregon, on the crest of High Grade Hill. Holdings consist of 259 acres of patented land in Sec. 36, T. 48 N., R. 15 E. The main shaft was sunk to 50 ft. level on a vertical fracture that strikes N. 70° E. in a silicified fault breccia. The fissure is three inches to fifteen inches in width, with a clay gouge on both walls. The highest grade ore developed in this property is a soft heavily iron-stained breccia of wall rock and quartz with a clay gouge between the central band of quartz and the walls of the vein. In this ore the matrix of the breccia has been partly leached. The wall rock is somewhat iron-stained for several feet from the vein, with numerous quartz stringers running through it in all directions. Developments: The east shaft which is the main vertical shaft, has been sunk to a vertical depth of 212 feet. At a point 180 feet west of main shaft, an air shaft was sunk to a vertical depth of 125 feet, intersecting the workings from main shaft on the 50′ and 100′ levels. Drifts have been driven east and west on the vein on the 50′,

100′ and 200′ levels. On the 50′ level there is a drift west 240′, and 79′ east. On the 100′ level, drift 365′ west and 15′ east. On the 200′ level, drift 275′ west and 66′ east. The 200′ level was driven on a mud seam, and at a point 230′ SW. of shaft a vein having a strike of N. 70° E. and dipping 80° S was cut. About 90′ SW. of west shaft a winze was sunk to a depth of 50′ on an intersection of three fractures, and a vein having a course of N. 70° E. and dipping 85° S. This vein varies in a width from 6″ to 18″. The vein filling is a white quartz with clay gouge on both walls. In a crosscut south of winze on the 100 ft. level a crushed zone 25 ft. in width was cut, which is highly mineralized with pyrite, and strikes N. 25° W. Twenty men

Shaft house and ore bins, Modoc Mines Company. High Grade mining district.

are employed. Modoc Mines Company, Kestner Bldg., Chicago, Ill., owner. William Wrigley, Jr., president. N. E. Guyot, manager.

Morning Star Mine. It is nine miles east of New Pine Creek, Oregon, on the east slope of High Grade Hill. Claims: Morning Star and Snowdrift. Two veins have been developed—the Morning Star vein strikes N. 30° E. and dips 70° W.; the Snowdrift vein has a N.-S. course with a dip of 80° W. Developments: Shaft 60 ft. deep and a tunnel 200 ft. in length. Two men employed. J. E. Dunnavin and Frakes Brothers, owners.

Mountain Summit and Quartzite Mines. They are situated eight miles east of New Pine Creek, Oregon. On Mountain Summit claim there is a shaft 50 feet deep, sunk on N. 70° W. fissure. Two shafts have been sunk on the Quartzite claim to the depth of 50 feet, with a

small amount of drifting from each shaft. Idle. J. O. Kafader et al., of Fort Bidwell, owners.

Mountain Sheep Mine. It is situated nine miles east of New Pine Creek, Oregon, on the east slope of Alturas Ridge. The vein strikes N. 70° W. and dips 75° S. It varies in width from 2″ to 2′. Developments: Tunnel 90′ long, and a series of shallow shafts from 25′ to 50′ deep. Idle. Fleming Bros. of New Pine Creek, Oregon, and Jamison and Wylie, of Alturas, Cal., owners.

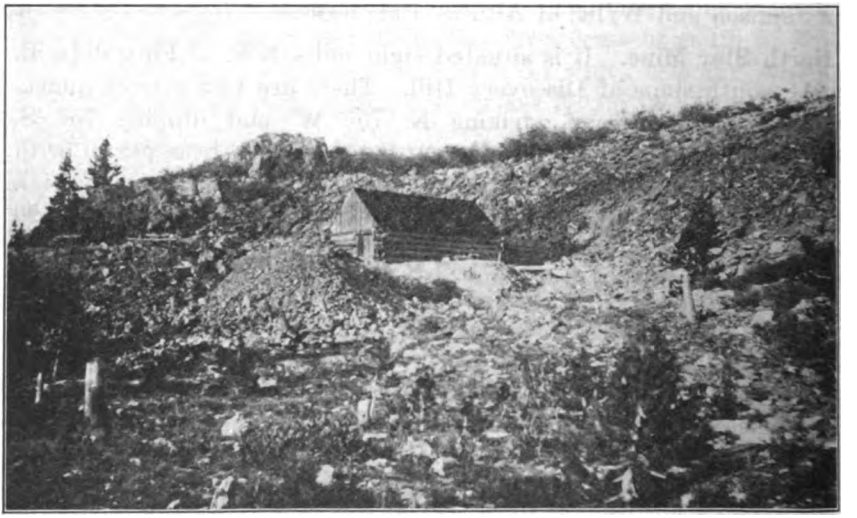
North Star Mine. It is situated eight miles NW. of Fort Bidwell, on the south slope of Discovery Hill. There are two narrow quartz veins on this property, striking N. 70° W. and dipping 75° S. Developments: Upper tunnel crosscut the vein 78 ft. from portal, with a drift 30 ft. west on vein. About 200 feet below this crosscut a tunnel has been driven 42 feet to vein, which has been drifted on 190 feet west. One man employed. J. T. Maupin and G. F. Maupin of Fort Bidwell, Cal., owners.

Shasta View Mine. It is situated 8 miles east of New Pine Creek, Oregon, on the west slope of Discovery Hill. This property has been worked through the Mountain View tunnel. At a point 90 feet east of the crosscut tunnel on the Mountain View claim, a crosscut has been driven southwest 138 feet to the Shasta View vein, that strikes N. 80° W., with a dip of 80° S., and a drift has been driven east on the vein 75 feet. This vein cuts both the granular rhyolite and the underlying andesite, and varies in width from 2″ to 15″. The vein shows crystallized quartz and clay gouge; at places it is copper stained. Idle. Richard Mason and G. F. Maupin of Fort Bidwell, Cal., owners.

Sunset Mine. It is situated 8 miles northwest of Fort Bidwell on the south slope of Discovery Hill. The Sunset vein cuts both the granular rhyolite and the underlying andesite. The vein has a strike of N. 60° W. and dips 75° S. It varies in width from 2″ to 2′. In the rhyolite it contains the typical brecciated quartz cemented ore, but in the andesite it consists of white quartz. It is developed by a series of open cuts, and a shaft 65 feet deep, also by a long tunnel lower down on the hill, which has over 800 feet of crosscuts and drifts. This tunnel, which has been driven in the andesite, has not developed any pay ore. Two men are employed sinking a shaft on the crest of Discovery Hill. J. N. Van Coughnet, E. McCoughrey et al., of Fort Bidwell, Cal., owners.

Sunshine-High Grade Gold Mines. They are situated on High Grade Hill, about 9 miles east of New Pine Creek, Oregon. Claims: Sunshine, Yellow Jacket, and Gascow Fraction. On the Sunshine

claim a shaft has been sunk to a depth of 60 feet on a narrow open fissure which strikes N. 75° W. and dips 85° S. The vein varies from 2″ to 8″ in width, and cuts a silicified rhyolite, which shows only slight brecciation. The richest ore from this vein is a mixture of brownish-colored clay gouge and quartz. A tunnel 300 feet long has been driven on this vein, connecting with the shaft about 150 feet from portal. From the tunnel level two winzes have been sunk to a



Sunshine tunnel, High Grade mining district, showing typical "rock piles" of High Grade Hill.

depth of 50 feet on the vein. The north end of the Yellow Jacket claim is underlain by a silicified rhyolite breccia, in which there are a number of fractures that strike N. 75° W. The ore on this claim consists of a hard, silicified breccia. A shaft has been sunk to a depth of 70 feet on one of these fractures. Idle. Sunshine-High Grade Gold Mining Co., owner; Felix Green, president; J. S. Taylor, secretary, New Pine Creek, Ore.

Tamarack Mine. It is situated on the east slope of Discovery Hill, about 8 miles northwest of Fort Bidwell. Developments consist of a crosscut tunnel 130 feet in length, and a series of shallow shafts and open cuts. Idle. A. C. Lowell of Fort Bidwell, owner.

White Quartz (Red Quartz, Evening Star and Klondike) **Group of Mines.** These properties are situated on east slope of Alturas ridge, about 9 miles east of New Pine Creek, Oregon. On these claims there are a series of parallel north and south fractures cutting a granular rhyolite. Developments consist of a series of shallow shafts and open cuts. Idle. W. D. Broaddus and J. E. Dunnavin of Fort Bidwell, owners.

WINTERS MINING DISTRICT.

The Winters Mining District is about 35 miles west-southwest of Alturas, 16 miles north of Adin, and 3½ miles south of Pit River. It lies on the southwest of Scheffer Mountain just east of the Adin-Alturas road. The only developed property in this district is the Hess Mine.

Geology.

This district lies in the great area of volcanic rocks which covers so much of northeastern California. The rocks in the vicinity of the mines are porphyritic.

Ore Deposits.

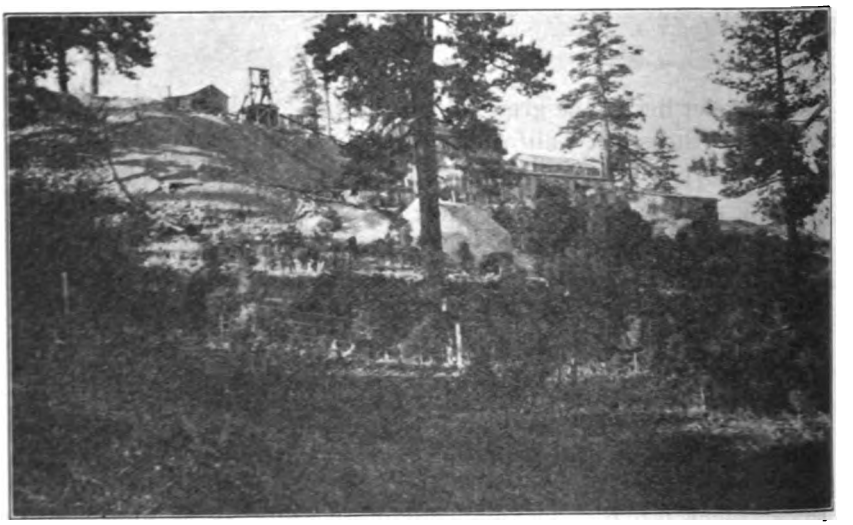
The ore deposits strike west-northwest in a zone of slight displacement along which the flows north of the fault zone have been raised with relation to those south of it. This zone has been traced for about 2 miles east and west and is scarcely more than one-half mile wide. The brecciated country rock is associated with all the ore mined. The vein filling consists of quartz and calcite, the former largely replacing the latter.

MINES.

Dixie Queen Mines. They are 16 miles north of Adin, and lie east of the Hess Mine. Developments consist of a crosscut tunnel 300 ft. long and a series of shallow shafts and open cuts on the vein. The vein has a general E.-W. strike and dips 50° S. Idle. Dixie Queen Mining Co., Los Angeles, Cal., owner.

Hess Mine. It is 16 miles north of Adin on a ridge southwest of Scheffer Mountain, and about one-fourth of a mile east of the Adin-Alturas road, at the head of the south fork of Stone Coal Creek. The Hess vein strikes E. and dips about 50° S. and has a width of 4′ to 6′. It occurs along a zone of faulting, which has produced a breccia of basalt 4′ to 12′ wide, consisting of quartz, calcite and adularia cementing fragments of the wall rock. An incline shaft 300 feet deep has been sunk on the vein, and levels driven on the vein at 120′, 150′, 200′ and 250′. On the 120′ level the vein has been drifted east 100′ and west 65′. On the 150′ level there is a drift 25′ west and 140′ east. The 200′ level has been extended 150′ east. There is a drift 250′ west and 170′ east on the 250′ level. The ore shoot developed was 80′ long at the surface; at the 120′ level 150′ long, and at the 150′ level it is 65′ long. On the 200′ and 250′ levels this ore shoot is about 100′ long. The richest ore occurred along footwall of vein. The incline shaft cuts a fault on the 200′ level, the vein being faulted to the south. The length of throw has not been determined. The strike of this fault is N. 15° W. with a dip to the east. On the 250′ level this fault was

picked up 40′ east of shaft. No ore has been developed west of fault. About 550′ east of main incline a vertical shaft has been sunk to a depth of 110′. This shaft was sunk for main working shaft, but operations were suspended before its completion.



Hess mine and mill, Winters Mining District, Modoc County.

Mill: A 6″ x 8″ Dodge crusher. Ten stamps weighing 500 lbs. each. A 20-ton cyanide plant. The gold which occurs in very fine particles is said to be hard to save by amalgamation, but good results were obtained by cyanidation. Two men employed on development work. Hess Gold Mines Co., owner; F. M. Jamison, president; A. K. Wylie, secretary. Alturas, Cal.

Modoc-Mammoth Mines. They are situated 16 miles north of Adin, on ridge east of Stone Coal Valley. Several shafts were sunk on these claims but no ore was developed. Idle. Modoc-Mammoth Gold Mining and Milling Co., owner; F. M. Jamison, president; Dennis Kane, secretary. Alturas, Cal.

MINERAL SPRINGS.

Throughout Modoc County there are a number of hot and warm springs which are of deep-seated origin. The waters of these springs are used extensively for domestic and irrigation purposes. As a rule the waters from these springs have no distinct odor or taste, and are only slightly mineralized of an alkaline type. The following enumerated springs have been described in the "Water Supply Paper 338, on Springs of California," by Gerald A. Waring of the United States Geological Survey:

Allen Warm Springs. These springs are situated 9 miles west of Alturas on the Alturas and Adin road. The water is only slightly mineralized, of an alkaline type. The flow is approximately at the rate of 275 gallons per minute. Temperature being about 81° F. The water is employed for domestic uses as well as for irrigation.

Bottle Spring. It is about 10 miles south of Pothole Spring, and near the northern end of Fairchild Meadow. It yields cold water, and the amount is said to vary greatly with the season.

Boyd Spring. It is situated near the eastern side of Upper Lake in Surprise Valley. Temperature of water is about 67° F. Used for irrigation purposes.

Kelley's Hot Spring. It is located on the Alturas and Adin road about 20 miles west of Alturas, or 4 miles northwest of Canby. A pool about 12 yards in diameter has been formed in a semicircular depression in the alluvium of the northern side of Pit River Valley. In the center of this pool the water boils up with such force as to dome up about one foot high. It discharges about 325 gallons per minute. Temperature of 204° F. The water has no distinctly mineralized taste, though it is said to stimulate the action of the kidneys.

Pothole Spring. This spring is situated in a small marshy area at the western base of Blue Mountain, about 35 miles northwest of Alturas. The water rises in a deep clear pool a few feet in diameter, and is noticeably above normal temperature, but probably less than 70° F. The flow from this spring is small.

A **number of springs** occur in this county that have no designated names, and their locations will be herewith described as follows:

About 8 miles north of east from Kelley's Hot Spring a stream named **Hot Creek** is formed by a number of hot springs that rise on the north side of the valley that borders Pit River. Near the head of **Cañon Creek**, south of the valley of Pit River, are a number of warm springs. On the west side of the cañon of **Bidwell Creek**, about a mile north of Fort Bidwell, are a number of hot springs whose temperature ranges from 90° to 110° F. At points about 2 and 3 miles, respectively, north of **Lake City**, hot water rises in the meadow land that borders Upper Lake. Between Upper and Middle lakes, on the east side of **Surprise Valley**, are three small hot springs.

SALT.

The **Surprise Valley Salt Works**, S. S. and E. H. Buck, Cedarville, produce a small tonnage of salt annually by solar evaporation of the alkaline lake waters there.

SUTTER COUNTY.

By CLARENCE A. WARING, Field Assistant.

Field Work in December, 1916.

Sutter County lies just north of Sacramento County, California, mainly between the Sacramento and Feather rivers. It is bounded on the east by Yuba and Placer counties, on the west by Colusa and Yolo counties and on the north by Butte County. The county includes an area of 611 square miles, supporting a population in 1910 of 6328 persons. The assessed valuation of the county in 1916 was $13,472,178. It was named in honor of the distinguished pioneer, General John A. Sutter. Yuba City, the county seat and largest town, had a population exceeding 1600 in 1914.

The county is excellently provided with transportation. The Feather and Sacramento rivers are navigable by small craft all the way to

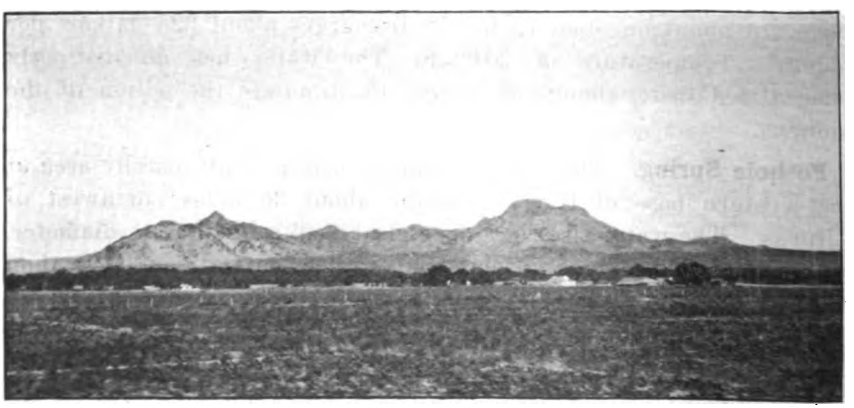


Photo No. 15.—View of Marysville Buttes, Sutter County, from the southeast. Photo by Walter W. Bradley.

Sacramento. The main Southern Pacific Railroad from San Francisco to Portland enters the county near Yuba City and passes northwestward through Lomo and Live Oak. The Northern Electric (Colusa Branch) Railroad crosses the county from east to west through Yuba City and northward from the same place. The Northern California Railway (S. P. Co.), enters the southern end of the county and follows the west side of Feather River northward to Yuba City. The Northern Electric and Western Pacific Railways cross the southeastern portion of the county, from north to south, west of Pleasant Grove. The county is well served by wagon roads.

Power lines of the Pacific Gas and Electric Company and Oro Electric Corporation, practically surround the county and cross its southern end. Electricity is thus available for both power and lighting purposes in practically every part of the county.

The north central portion of the county is marked by the Sutter or Marysville Buttes, the South Butte of which is 2128 ft. in elevation.

The Buttes occupy a circular area about 10 miles in diameter, but strips about 2 miles wide along the more gentle eastern and western slopes are cultivable. The remainder of the county consists of lowland with a gentle southwesterly slope, a great portion of which is capable of producing a wide range of crops. Considerable of the western portion of the county consists of low tule land capable of being reclaimed.

GEOLOGY.

The geology of Sutter County has been covered in considerable detail by H. W. Turner,[1] and W. Lindgren.[1, 2] Paleontological papers describing the Eocene formation of the Marysville Buttes have been written by W. L. Watts,[3] J. G. Cooper,[4] and R. E. Dickerson.[5]

Aside from the Buttes, Sutter County is covered with deep alluvial soil. The Buttes consist of a core of andesite surrounded by upturned Ione sedimentary strata overlain by andesite tuff and breccia. The sedimentary strata have been shown to be of Eocene age and were tilted in all directions from the center of the Buttes when the andesite intrusion took place. The andesite core has later been broken through in places by rhyolite.

MINERAL RESOURCES.

Sutter County has to date been but a slight mineral producer, although a few metals such as gold, silver and quicksilver have occasionally been found in the Marysville Buttes. No systematic work has been undertaken since the results of prospective work have not warranted it. Coal, clay and natural gas have also been found, but little has been done with them. It is reported that rock in the Buttes suitable for road metal is being crushed and used by the road supervisors. The only commercial mineral production in Sutter County, noted in the statistical records of the State Mining Bureau, was: Macadam, $5,000 in 1908. There was some also in 1916, but the amount is not to hand at this writing.

[1] U. S. Geol. Surv. Folio No. 17, Marysville, 1895.
[2] U. S. Geol. Surv. Prof. Paper No. 73, pp. 23–25, 1911.
[3] Calif. State Min. Bur. Bull. 3, pp. 9–10, 1894.
[4] Calif. State Min. Bur. Bull. 4, pp. 36–45, 1894.
[5] Bull. Dept. of Geol., Univ. of Calif., Vol. 7, No. 12, pp. 257–298, pls. 11–14, April, 1913.

CLAY.

Clay beds of considerable extent occur in the sedimentary Eocene strata of the Marysville Buttes. These should be available for the manufacture of brick and pottery.

COAL.

Thin seams of lignite occur in certain of the beds of the Ione formation in the Marysville Buttes. It is reported to have been found in the South Butte Valley and 3 miles south of Pennington and also in a 35-ft. well south of Sutter City. The beds lie above strata of clay and are overlain by gravelly sand. The coal is probably of too poor quality to be of economic importance.

GOLD.

No gold-bearing quartz veins have been found in the Marysville Buttes, but certain coarse gravels occurring in the sedimentary Ione strata have been found to be auriferous. The volcanic mud-flows containing gravel have also been found slightly auriferous. The gravels consist of waterworn pebbles of quartz, metamorphic sedimentary rock, diabase, granite and serpentine, and no doubt were carried from the Sierra Nevada by rivers.

The gulches and ravines in certain localities have been washed during the rainy season and fine, well-rounded gold recovered. An occasional large piece of gold, worth as high as five dollars, is found.

NATURAL GAS.

Small quantities of gas have been encountered in wells, drilled for water, at Yuba City. Since none of the wells penetrated below 200 ft. they probably did not reach any gas-bearing sedimentary strata underlying the alluvium. A 20-ft. well, drilled in 1864 about 1 mile southwest of South Butte, in Ione clay and sandstone is reported to have yielded a small flow of natural gas. A second well reported to have been drilled, in 1892 close to the first one, struck no gas and ran into massive eruptive rock.

The Ione strata appear to carry natural gas throughout the region and in certain localities may be found to yield a commercial supply. Such localities will probably not be found in the immediate vicinity of the buttes but sufficiently remote where undisturbed strata may be penetrated.

LIMESTONE.

An impure gray limestone is reported to occur, just south of South Butte, in beds of the Ione formation which lie in a nearly vertical position. A tufa (spring deposit) consisting principally of calcite is

reported to occur in an area of volcanic tuffs about 1000 ft. south of the South Pass road, 1½ miles south-southeast of the South Butte.

These lime deposits should be valuable as a natural binding material for road metal.

STONE.

A quarry in the rhyolite rock 3 miles northwest of Sutter City, has furnished some building stone which was used locally.

It is reported that the county supervisors are at present using crushed rock from the Buttes for road metal. The volcanic rocks should furnish an excellent material for roads and the supply is easy of access and unlimited.

TEHAMA COUNTY.

By W. Burling Tucker, Field Assistant.
Field Work in September, 1915.

DESCRIPTION.

Tehama County is situated in the upper part of the Sacramento Valley. It extends east to the summit of the Sierras, on the west to the crest of the Coast Range Mountains. The county itself comprises an area of 2893 square miles and is about evenly divided on both sides of the Sacramento River. For nearly 50 miles this river wends its way through the center of the county.

Rising in the Sierra Nevadas and flowing westward into the Sacramento River are Los Molinos River, Deer, Antelope, Paynes, and Battle creeks—all perennial streams, and supplying unlimited water for irrigation purposes.

Starting in the Coast Range Mountains and running eastward into the Sacramento River are Cottonwood, Elder, and Toms creeks. The town of Red Bluff, the county seat, lies at the head of river navigation on the Sacramento. The county comprises valley, foothill, and mountain lands, used principally for agricultural, horticultural, and grazing purposes.

The eastern and western portions of the county are covered with extensive growths of fine timber, the lumber industry being an important source of revenue.

GEOLOGY.

The eastern half of the county is covered with sheets of lava, which had their origin from and around Lassen Peak. The central part of the county shows an extended plateau of gravels, sands and clays, which extend to the serpentines and metamorphic rocks of the Coast Range.

MINING.

Little mining is being done in this county at present. Chromic iron, indications of oil, coal, copper and manganese occur in the western part of the county. Some development work has been done on the chrome deposits which occur in a belt of serpentine, near the western boundary of the county in the Coast Range Mountains.

About 10 miles west of Paskenta some promising prospects of manganese ore are being opened up.

Mineral springs are abundant throughout the county, some of which are widely known for their medical purposes, the most noted being Tuscan Springs, near Red Bluff.

MINERAL RESOURCES.

Among the mineral resources of the county are: brick, chromite, copper, gold, manganese, marble, mineral water, salt, silver, and the stone industry.

TEHAMA COUNTY—Table of Mineral Production.

Year	Gold, value	Chrome		Brick		Mineral water		Salt, value	Stone, value	Other minerals, value
		Tons	Value	M	Value	Gallons	Value			
1880-1884	$22,000									
1894		1,680	$12,680							
1895		950	9,025	500	$2,500					
1896		56	475							
1897						10,000	$2,400			
1898				200	1,400	54,000	8,000			
1899				300	1,800	10,000	18,000			
1900				325	2,200					
1901				300	2,000	20,000	4,000			
1902				500	3,500					
1903				600	4,500	5,000	2,500			
1904				500	3,500					
1905				650	5,000	8,000	4,000			
1906				700	5,600	8,000	4,000			
1907				400	3,200	550,000	75,000			
1908				400	3,000	20,000	2,000	300		
1909						5,000	500	300		
1910				600	3,600	5,000	500	300		
1911						5,000	500			
1912				225	1,300					
1913				300	1,800	75	42		$600	
1914						100	100	200		
1915		*	*	400	2,700	1,000	500	*	750	$752
Totals	$22,000		$22,180		$47,600		$102,042	$1,100	$1,350	$752

*Included under "Other Minerals."

Total mineral production, 1880-1915 (incl.).

Gold	$22,000
Chrome	22,180
Brick	47,600
Mineral water	102,042
Salt	1,100
Stone industry	1,350
Other minerals	752
Total	$197,024

CHROMITE.

A belt of serpentine having a general north and south trend runs through the southwestern part of the county. This belt is on the lower eastern slope of the Coast Range Mountains. In this serpentine, float of chromite is found in a great number of places. Most of the mining operations on these deposits have been conducted in the neighborhood of the north fork of Elder Creek.

Basler Mining and Development Company's chrome deposits are situated in Secs. 4 and 8, T. 25 N., R. 7 W., about 28 miles southwest of Red Bluff.

The chromite occurs in lenses in the serpentine. This company controls 11 claims along a belt of serpentine striking north and south. Owing to their remoteness from railway transportation, only a small amount of development has been done on these claims.

M. J. Cheatham of Red Bluff, owns deposits of chromite in Sec. 16, T. 24 N., R. 7 W. They were formerly worked by the Tehama Consolidated Chrome Company of Red Bluff. (See Reports, X, p. 692; XII, p. 38; XIII, p. 50; also Bulletin No. 38, p. 272, of the California State Mining Bureau.) These deposits have been mined in 3 places and ore was shipped from the property in 1898. The ore was hauled a distance of 30 miles to Red Bluff, which was the nearest shipping point.

Noble Electric Steel Company's chrome mine. See our Reports, X, p. 692; XII, p. 38; XIII, p. 50. This property is situated on the north fork of Elder Creek, in Sec. 16, T. 25 N., R. 7 W., about 28 miles west of Red Bluff at an elevation of 2000 feet. The ground has been taken up as a surface claim covering 640 acres. The deposits consist of a series of separate lenses inclosed in the serpentine, and 10 to 12 of such lenses have been developed. The largest of these lenses is about 60′ in length by 60′ in width, located in a gulch which runs into Elder Creek. They have been worked in the past by a system of open cuts. The serpentine belt in which these deposits occur is about 3 miles in width, and can be traced through the county. It has a general north and south trend. To the east of this belt the country rock is slate, while on the west the formation is a syenite. Chrome iron has been proved to occur for at least 10 miles along this belt. In all the gulches running into Elder Creek are also noticed quantities of magnesite.

On the opposite side of the creek from where the chrome ore was mined there is a vein of pectolite about 20′ wide, which courses north and south and dips west in the serpentine. In this vicinity along the banks of Elder Creek are several saline springs.

Fifteen men were employed building a wagon road up Elder Creek to these deposits, with the plan of mining and shipping the ore to the Noble Electric Steel Company's electric smelter at Heroult, Shasta County.

CLAYS.

There are undoubtedly several clay deposits in the Sacramento River bottom lands of Tehama County, but very few have been used for the manufacture of brick.

O'Conner Brothers of Red Bluff, own a clay deposit on the Reed Tract, in Sec. 29, T. 27 N., R. 3 W. The deposit covers an area of

over 19 acres, about 5 of which have been worked by pits, showing a good quality of brick clay for a depth of from 8′ to 11′, underlaid by gravel. The bricks are made in a soft-mud machine worked by horse power. They are sun dried and burned in open kilns. The full capacity of brick yard, when running, is about 16,000 bricks per day. The bricks are used locally.

COPPER.

California and Massachusetts Copper Mines. These properties are situated on the north slope of Tom Head Mountain, about 40 miles west of Red Bluff. The holdings consist of 3 claims, namely: Sulphide, Uncle Sam, and Spring. The deposit occurs in the form of a vein striking N. 75° W. and dipping 65° N. in diabase. This vein is capped on the surface by iron gossan. The ore is chalcopyrite, associated with pyrite. Developments consist of two tunnels, at an elevation of 4150′; a crosscut tunnel has been driven south into the mountain 420′, cutting the vein at a distance of 150′ from the portal, then drifts run east and west for a distance of 200′.

The width of ore developed on this level was about 5′. Several winzes have been sunk from this level on the vein to depths of 30′. About 150′ above this tunnel there is another tunnel 366′ long, which intersected the vein at 66′ south of portal, with drifts east 150 feet and west 100′ on the vein. The ore developed on this level varies in width from 4′ to 20′. The ore so far developed has a very low copper content. The equipment on the property consists of an 80 h.p. boiler, 12″ x 14″ x 14″ Sullivan air compressor, cars and track, with tool and blacksmith shops. Idle. California and Massachusetts Copper Mines Co., owner, William Wrigley, Jr., president; J. C. Cox, secretary. Kestner Bldg., Chicago, Ill.

GOLD.

In former days some placer mining was carried on in the upper reaches of the Sacramento River, but this has entirely ceased.

Gold bearing quartz veins have been discovered on Tom Head Mountain, in the Coast Range Mountains, and also in the neighborhood of Paskenta. Due to their remoteness from railroad transportation, only a small amount of prospecting has been done on the veins in these districts.

Bowers Creek Mine is a prospect 10 miles west of Paskenta, situated on the east slope of Beauty View Butte. The vein strikes N. 50° W. and dips 60° in the diabase. A tunnel has been driven 30′ on the vein, which averages 18″ in width. Idle. D. H. Thurston, E. P. Logan et al., of Paskenta, owners.

MANGANESE.

Some very promising deposits of manganese ore have been found on Beauty View Butte, about 10 miles west of Paskenta. Only superficial work has been done on these deposits, on account of their distance from railway transportation. The nearest shipping point is the town of Corning, on the Southern Pacific Railroad—a distance of 30 miles. These deposits are located in a belt of serpentine which strikes north and south. The manganese occurs in a lenticular bed interstratified with red and gray jasper. The ore, when fresh, is a hard, black, massive variety, steel blue in color, with a well developed conchoidal fracture. On an exposed surface it becomes soft and breaks up into fine black powder. The ore contains a large amount of silica in the form of quartz veins and unaltered chert. The deposits are made up of a series of irregular lenticular bodies, more or less isolated and separated by many feet of barren rock. The general strike of these deposits is N. 20° W. Five to six outcrops of manganese ore were noticed, varying in width from 10′ to 30′.

Elva Manganese Mine is a prospect 10 miles west of Paskenta, situated on south slope of Beauty View Butte. It lies in Sec. 20, T. 23 N., R. 7 W. C. S. Benner of Paskenta, owner.

Manganese Peak Mine. This prospect is situated on Beauty View Butte, north of Bowers Creek. Two claims have been taken up, called Manganese Peak and Success. The deposits of manganese ore on these claims from the outcrops, appear to be quite extensive, and in places show a width of 10′ to 30′. The only work on these outcrops are a few shallow open cuts. Idle. Alonzo Luce, Virgil Apperson et al., of Willows, Cal., owners.

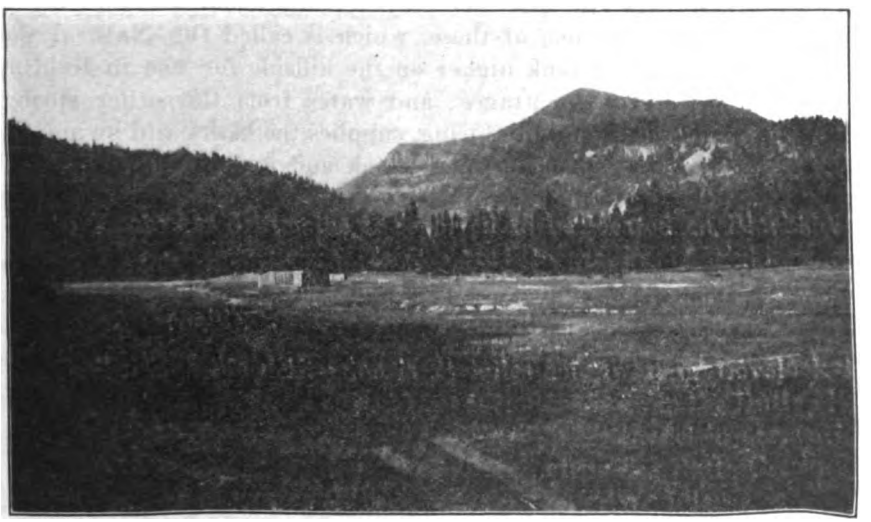
Rosy and Sophie Manganese Mines. Situated in Sec. 14, T. 24 N., R. 7 W., M. D. M., on ridge south of Elder Creek. C. S. Benner and D. H. Thurston, of Paskenta, Cal., owners.

MINERAL SPRINGS.

(See Water Supply Paper No. 338 on Springs of California, by G. A. Waring, of United States Geological Survey.)

Colyear Springs. These springs are situated high on the mountain side north of the North Fork of Elder Creek, 35 miles west of Red Bluff. Six springs here rise in a cemented place 5 yards in diameter, among the pine trees, on a moderate slope. One of the largest yields cold sulphur water, while the others are only slightly sulphuretted. On the slope about 8 yards above these springs, there is a clear water spring that yields 4 to 5 gallons a minute. Dr. J. A. Owen of Red Bluff, owner.

Morgan Springs. They are situated on the Morgan Ranch, about 50 miles northeast of Red Bluff. There are a group of 25 springs and pools scattered for a distance of ¼ mile in a meadow along Mill Creek; this meadow is termed Big Hot Spring Valley. Most of them are quiet pools of small flow, as a rule less than 5 feet in diameter and relatively shallow. A number of them contain thick algous growths, and several deposit native sulphur. A number of springs steam and sputter from vents in a hard conglomerate along the banks of the creek. One of the northernmost of these springs seems to have a true geyser action, for it issues from a shallow basin 3 feet in diameter, in which the water comes to a state of vigorous ebullition and



View of Big Hot Springs Valley. Morgan Springs.

then subsides. The place is used as a summer resort, there being a number of houses and tents which are rented by the owner during the summer months. Along the creek are a number of bathhouses and a swimming pool. There are also several vapor bathhouses built over vents at the creek edge. W. E. Hamlin of Mineral, Cal., owner.

Tuscan Springs. These springs are situated 10 miles northeast of Red Bluff, near the head of the cañon of Salt Creek. Tuscan Springs were discovered in 1856 by Dr. John A. Veatch, who, in a chemical examination of the waters, discovered crystals of borax, said to be the first borax found in the state. The springs are situated at an elevation of 1000 feet above sea level. The cañon of Salt Creek widens at its head to a small valley surrounded by rugged cliffs, and the springs issue along the main creek and its branches in this open area.

The springs rise in a dark shale and sandstone, the latter material being veined in places by calcite. The structure shows that the beds have been folded into a small arch or anticline. Dips of 50° on the western side of the fold are observed.

The occurrence of usable quantities of illuminating gas is worthy of mention in connection with this anticlinal structure. The sediments are overlain by volcanic tuff, which forms the cliffs of the cañon walls. As many as 50 springs are claimed for the locality. Spring houses protect some of those that are most used for drinking purposes. Water from another spring supplies evaporating trays, in which occasional amounts of medicinal salts are prepared for sale. Two other springs rise in cemented reservoirs about 15′ and 20′ in diameter. Gas from one of these, which is called the Natural Gas Spring, is piped to a tank higher on the hillside for use in lighting purposes in hotel and cottages; and water from the other spring, which is called the Fountain Spring, supplies the baths and swimming pool. Most of the springs rise in brick and cemented basins. All springs are within 250 yards southeast of the hotel, which is on higher ground overlooking them. Most of the springs have a small flow, but all are strongly mineralized. Some are strongly sulphuretted as well as saline. The following analyses indicate that they are primary saline waters, remarkably uniform in composition for springs of such high mineral content, the chief difference being in the high sulphate content of Spring No. 1. There is a remarkably high potassium content in all but the Natural Gas Spring.

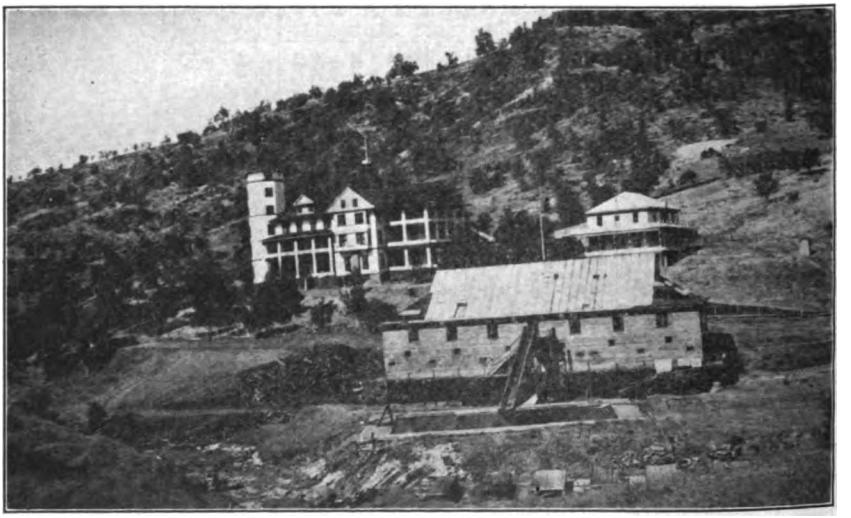
Analyses of Water From Five of the Tuscan Springs.*

Constituents are in parts per million.

Constituents	No. 1		No. 2		No. 3		No. 4		No. 5	
	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values
Sodium (Na)	8,096	352	8,349	363	8,241	358.3	7,944	345.4	8,386	364.6
Potassium (K)	29	.75	2,448	82.6	3,353	85.8	2,705	69.2	2,851	72.9
Lithium (Li)	.3	.05	1.7	.24	2.0	.29	1.9	.27	1.9	.2
Barium (Ba)	3.7	.05								
Calcium (Ca)	144	7.20	67	3.34	66	3.28	68	3.37	68	3.41
Magnesium (Mg)	92	7.59	23	1.86	28	2.27	27	2.21	21	1.71
Iron (Fe)	13	.47	.9	.08	Trace	Trace	Trace	Trace	0	0
Sulphate (SO_4)	351	7.30	2,108	43.9	420	8.76	448	9.33	680	14.15
Chloride (Cl)	12,460	351.40	13,540	381.9	15,440	435.6	14,380	405.6	15,020	423.6
Carbonate (CO_3)	281	9.38	156	5.20	166	5.55	167	5.58	154	5.12
Silica (SiO_2)	35	1.17	13	.43	13	.43	5.6	.19	5	.02
Totals	21,505		26,706.6		27,729		25,746.5		27,182.4	
Hydrogen sulphide	383	22.54	320	18.77	122	7.16	84	4.94	294	17.23

*U. S. G. S., Water Supply Paper No. 338, p. 290.

Tuscan Springs are open all the year round. The waters are reported to be especially beneficial for blood and skin diseases, also for malaria, kidney, liver and rheumatism. E. B. Walbridge Estate, Red Bluff, owner. Mrs. E. B. Walbridge, manager.



View of hotel and bath-houses, Tuscan Springs, Tehama County.

White Sulphur Spring. There is a small, cool sulphur spring about 1½ miles northeast of Mineral post office, which is near the southern base of Lassen Peak. It issues in a ravine 15 yards from the eastern bank of Summit Creek, and about 150 yards east of the stage road. The spring issues from basaltic lava, at the rate of 8 gallons per minute, of cold, noticeably sulphuretted water, which deposits small amounts of sulphur. It is the only cold spring seen in the Lassen Peak region. the other sulphur springs being of a notably thermal character. A. L. Conrad of Red Bluff, owner.

SALT.

See Tuscan Springs, under Mineral Water.

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CALIFORNIA STATE MINING BUREAU

FERRY BUILDING, SAN FRANCISCO

FLETCHER HAMILTON State Mineralogist

San Francisco December, 1916

Mines and Mineral Resources

OF THE COUNTIES OF

El Dorado, Placer
Sacramento, Yuba

CHAPTERS OF STATE MINERALOGIST'S REPORT
BIENNIAL PERIOD 1915-1916

CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO
1917

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PREFACE.

The group of counties here presented lies west of Lake Tahoe and includes the northern end of the Mother Lode of California. It includes a strip across the Sierra Nevada Mountains east of Sacramento as well as a strip along the foothills of the same range and a portion of the Sacramento Valley.

Generally speaking, the group is fairly well provided with transportation facilities and electric power, especially in the western portion. These factors should lend encouragement to a greater development of the region, for the cost of extensions to the outlying districts is not prohibitive.

The group presents a diversity of mining interests which made the work of especial interest. An endeavor has been made to make this report a directory of all mines in these counties as well as describing those being operated.

Acknowledgment is made of the courtesies extended by the mine owners and operators throughout the region, whose assistance made this report possible.

EL DORADO COUNTY.

By W. BURLING TUCKER, Field Assistant.
Field Work in December, 1914.

INTRODUCTION.

The following report represents only a little over a month's field work in the county, as owing to the season of the year, the north and eastern sections of the county were covered with snow. Hence, it was impossible to investigate the more remote mining districts; but, by combining the writer's personal observations on the principal properties with other data from reliable sources, all deposits of any importance have received attention, and are accurately recorded.

DESCRIPTION.

El Dorado County has the distinction of being the scene of Marshall's discovery of gold at Coloma, and the earliest beginning of the modern era of gold mining.

El Dorado County is bounded on the north by Placer, on the south by Amador, on the east by Alpine County, and the state of Nevada, and on the west by Sacramento and Placer counties. The Middle Fork of the American River separates this county from Placer, while the Cosumnes separates it from Amador County. These rivers, with their numerous branches, constitute the principal streams found in El Dorado County. In the eastern part of the county at an altitude of about six thousand feet, a number of lakes occur; Lake Tahoe, the most important body of fresh water in California, being partly in this county, and is one of the scenic wonders of California.

Three-fourths of this county, including the more mountainous parts, are heavily wooded, the timber consisting of stately forests of pine, spruce and cedar. The balance is covered with a more scattered growth of oak and inferior pine, there being very little timber of any kind in the extreme western portion of the county.

POWER.

Electric power is furnished to the mines by the Western States Power Company, and water by the San Francisco-Oakland Terminal Power Company.

TRANSPORTATION FACILITIES.

From San Francisco and other important trade centers, this county has the benefit of good railroad communication by means of the Southern Pacific Railroad to Sacramento, from which point a branch

line of the same system over the Sacramento and Placerville Railroad to Placerville passes through Shingle Springs, El Dorado and Diamond Springs, with terminus at Placerville.

ROADS.

The main state highway, which is at present under construction, runs from Sacramento via Folsom and Placerville to Lake Tahoe and Carson City, Nevada, the proposed route running directly east through the center of the county. The principal mining districts are in easy communication by means of good wagon roads with different railway points.

GENERAL GEOLOGY.

The western margin of the county is followed by a belt of the Calaveras formation, greatly broken by later intrusions and in part accompanied by greenstone tuffs of the Carboniferous age. The late Jurassic, Mariposa formation, accompanied by large masses of greenstones and greenstone tuffs, traverses the western area in a narrow band from north to south. East of these rocks the Calaveras formation, having a prevailing northerly trend, occupies the greater eastern part of the county. A large area of gabbro-diorite lies near the western margin; numerous serpentine areas of elongated form are found in the same vicinity.

Gabbro, gabbro-diorite and serpentine belts traverse the county along a line from about one mile east of Placerville to a mile east of Georgetown.

The main granitic area of the high Sierra makes up the eastern part of the county. Tertiary auriferous gravels are exposed near Placerville. Rhyolitic tuffs lie in the old stream beds on the Long Cañon divide and especially underneath the Placerville and Newtown divides. Andesitic tuff-breccias cap many of the ridges from the Cosumnes to Long Cañon, but the largest masses are found on the Placerville and Newtown divides.

MINERAL PRODUCTION.

The principal mineral resources of El Dorado County, many of them undeveloped, are: Asbestos, Barytes, Chromite, Clay, Copper, Gems, Gold, Iron, Molybdenum, Limestone, Quartz Crystals, Quicksilver, Glass-sand, Slate, Soapstone, Silver and Miscellaneous Stone.

Year	Gold, value	Silver, value	Copper		Lime		Limestone		Slate		Stone industry, value	Miscellaneous and unapportioned	
			Pounds	Value	Barrels	Value	Tons	Value	Squares	Value		Kind	Amount
1880	$389,383	$208										Unapportioned, 1900-1909	$251,820
1881	550,000	900											
1882	600,000												
1883	530,000												
1884	575,000	16,000											
1885	35,000												
1886	619,992	1,822											
1887	706,871	365											
1888	650,000	500											
1889	427,638	408											
1890	204,583	275											
1891	173,279	359											
1892	198,321												
1893	294,610	1,220											
1894	366,707	356			10,000	$8,000			1,800	$11,700			
1895	700,101	448			28,500	28,500			1,350	9,450			
1896	812,289	534			4,413	4,158			500	2,500			
1897	674,626	886			13,500	6,750	500	$250	400	2,800			
1898	501,966	4,174			3,360	3,360			400	2,800			
1899	404,497	8,414			7,935	7,935			600	4,500			
1900	368,541	25,129	3,125	$500	7,500	6,000			3,500	26,250			
1901	292,086	5,977			11,000	11,000			5,100	38,250			
1902	335,031	52	2,128	319	24,599	16,176			4,000	30,000			
1903	277,304				5,600	7,000							
1904	474,994				12,864	7,075			6,000	50,000		10 tons of asbestos	162
1905	384,735	2,525	160,000	24,960	9,260	6,946	1,050	5,775	4,000	40,000		112 tons of asbestos	2,625
1906	431,746	2,690			19,217	21,138			10,000	100,000		20 tons of asbestos	1,000
1907	319,177	2,301		122		16,198		15,318	7,000	60,000			
1908	342,033	5,504	608	83	15,921	20,192			6,000	50,000	$1,600	200 M. paving blocks	8,000
1909	238,284	1,299			13,828	14,591			6,961	45,660	530	3,763 tons of sand (glass)	5,645
1910	171,304	967			11,300	9,944			1,000	8,000	2,616	1,200 tons of sand (glass)	1,800
1911	133,967	1,010			15,086	12,309	1,000	1,000			5,465	3,701 pounds of lead	167
1912	105,565	843			14,023	11,218					4,375		
1913	62,688	250	693	107							4,678		
1914	135,000	400			14,000	12,082					2,600	90 pounds of lead	4
1915	401,288	1,358	417	73	15,911	12,872					7,500	Other minerals*	5,250
Totals	$13,888,566	$87,377	166,966	$26,164	257,817	$243,444		$22,843	58,611	$481,910	$29,364		$276,473

*Includes slate and soapstone.

Total mineral production of El Dorado County from 1880 to 1915 inclusive:

Copper	$26,164
Gold	13,888,556
Lime	243,444
Limestone	22,343
Stone industry	29,364
Silver	87,377
Slate	481,910
Miscellaneous and unapportioned	276,473
	$15,055,631

CHROME.

Pilliken Chrome Mine. Located 10 miles northeast of Folsom, Sacramento County, and one mile northwest of Flagstaff Hill, in Sec. 28, T. 11 N., R. 8 E., M.D.M. Elevation 1100′–1240′.

The chrome occurs as lenses in serpentine and is in places associated with a fine-grained reddish quartzite carrying small inclusions of chromite.

The lower workings, at an elevation of 1100′, consist of a 100′ tunnel crosscutting the ore body which strikes E.-W. and dips 15° N. The ore has been stoped to the surface and 800 tons are said to have been taken out.

The old upper workings, at an elevation of 1240′, consist of a 60-foot tunnel at the end of which the ore has been glory-holed to the surface. The ore body has a strike N.-S. and dips 35° W.

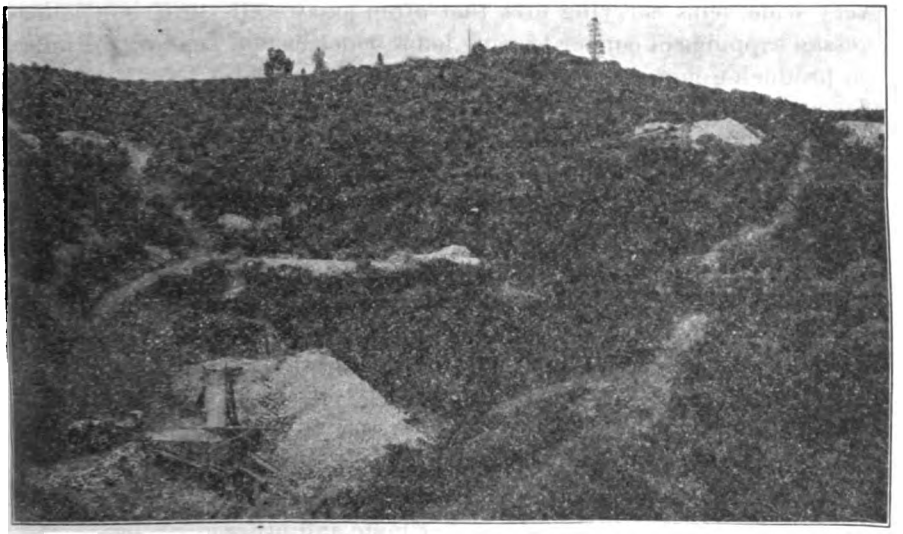
New works to the south of the old upper workings, at an elevation of 1100′, have followed an ore body striking N.-S. and dipping 23° E. A 30-foot open cut and 40′ incline stope show a 12′ face of solid chrome ore. Another lens of ore has been opened up, at an elevation of 1140′, just west of the last described workings. The ore body here strikes N.-S. and dips 35° E. A stope 50′ long and 40′ deep, with a horse of serpentine in the center, shows a 4′ chimney of ore.

Twenty-five men, including nineteen miners, were employed when the deposit was visited in September, 1916. Leased to the Noble Electric Steel Corporation, Heroult, Shasta County, by George Pilliken of Folsom, owner.

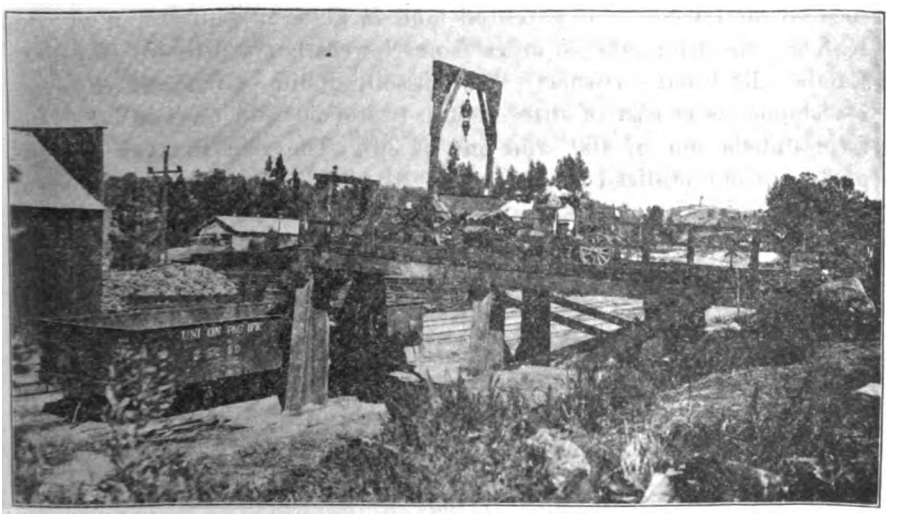
COPPER.

General Geology of the Copper Belt.

The copper belt of El Dorado County passes through the lower western portion, along the edge of the Sacramento Valley, including about 25 miles of the "foothill copper belt." Along this line the belt mentioned displays many copper deposits that have been prospected in a superficial way. They are but a little north of the section of the belt through Amador and Calaveras counties, in which the chief



Chrome mining at the Pilliken property, El Dorado County; 10 miles northeast of Folsom, Sacramento County. Photo by C. A. Waring.



Loading chrome ore, from the Pilliken property, at Folsom. Photo by C. A. Waring.

development and production of this copper belt have occurred. While a number of the best developed copper properties display very wide veins carrying ores that often assay well, and continuous gossan cappings of copper-bearing lodes which can be traced for miles, no producing mines of importance have been developed in El Dorado County. Some of the ore bodies carry good values in gold and silver along with good percentages of copper sulphides.

The copper ores occur as vein deposits along the granodiorite in the zone of contact metamorphics, and one prospect lies south of Deer Creek in the amphibolite schist. Also small masses of copper pyrites occur in the serpentine and amphibolite about two miles west of Greenwood. There is every indication of an east and west belt in the foothill section. The Lilyama and Pioneer mines are on the east belt, while the Alabaster Cave Mine is on the west belt. Another belt might include the Noonday and E. E. mines, east of El Dorado. These two are just at the east line of the Mariposa slates. About three miles north is the Larkin copper mine, on the same belt, as it is along the east edge of the Mother Lode formation. About twelve miles north are the El Dorado copper mine and other properties, that occur just east of the Mother Lode formation.

MINES.

Alabaster Cave Mine. Bull. 50, pp. 211–212. The property is located on 180 acres of patented land in Secs. 10 and 15, T. 11 N., R. 8 E.; elevation 800′; 5 miles from Newcastle station, on Southern Pacific Railroad. Owner, W. Russell, Santa Cruz, California. Developments consist of three shafts, two of 50′ and one of 300′, and two tunnels, one of 100′ and one of 30′. The vein matter consists partly of mineralized diabase, and 8′ to 10′ of ore, composed of oxides, malachite, azurite, and some unaltered sulphides near the surface, and of sulphides, chalcopyrite, bornite, etc., in depth. Reported to average 3% to 4% copper with some values in gold and silver. Idle.

Bob or Iron Crown Mine. Sec. 13, T. 12 N., R. 10 E. Vein 40′± wide between serpentine and slate. Values reported as $7.00 in gold, silver 1.58 oz. and some copper. Developed by shaft in east wall and by shallow cuts. Gossan cap. Owned by S. B. Selkirk and Geo. W. Dent.

Bibl.: Bull. 50, pp. 219–220, 1908.

Cambrian Mine. Sec. 23, T. 11 N., R. 9 E. Ten miles from Placerville. Three veins of talcose schist and limestone between granodiorite and serpentine. Veins from 50′ to 70′ apart and average 6 to 8′ in width. Dip east. Ore consisted of chalcopyrite, malachite, cuprite

and native copper carrying some gold. Reported to average 10% copper. Developed by tunnels. Owned by the Cambrian Mining and Milling Co.

Bibl.: Bull. 50, pp. 213-214, 1908.

Contraband Copper Mine. See our Bull. 50, pp. 214, 216, "The Copper Resources of California." It is situated 2 miles southeast of Georgetown and 20 miles east of Auburn on the Southern Pacific Railroad. Elevation 3550′. Vein about 12′ wide, between hanging wall of micaceous schist and diabase footwall. Strike N. 80° E., dip 45° N. Ore: oxides, native copper and sulphides reported to contain as high as 18% copper, with gold and silver values. There is also an asbestos deposit on the property. Development consists of several tunnels and shallow shafts. Idle. Woodside-Eureka Mining Co., 204 Bacon Bldg., Oakand, Cal., owner.

Cosumnes Copper Mine. See our Bull. 50, p. 214. It is situated 2½ miles northeast of Fairplay. The vein strikes NE.–SW., and is a mineralized limestone and amphibolite schist. The limestone belt is 500′ wide, showing sulphides in limestone near the surface. The ore is sulphide, malachite, azurite and oxide, with reported values of over 4% copper, also some gold and silver. The property has been developed by three tunnels. Idle. Rio Vista Gold & Copper Co., owner.

E. E. Copper Mine. See our Bull 50, pp. 218–219. It is located 4 miles east of El Dorado in Sec. 18, T. 9 N., R. 11 E. The ore occurs in lenses in a meta-diabase. The strike of vein is N. 4° E., dip 85° E. The ore is copper sulphide associated with pyrite, carrying gold and silver values. Developments: a vertical shaft 85′ deep with 300′ of drifts; two tunnels, one 300′ long, the other 100′. Property worked off and on by the owner. Joseph Schuppi of El Dorado, owner.

Larkin Copper Mine. See our Bull. 50, p. 217. This property is situated 4 miles south of Placerville, and 1½ mile west of Diamond Springs, on the Southern Pacific Railroad. The vein is 3′ wide with schist walls, and strikes N. 20° E., dip 80° E. Ore: chalcopyrite, malachite, pyrite, iron oxide, with gold and silver values. Developments: 160′ vertical shaft, with crosscut 45′ east on 150′ level, which cut a vein 15′ east of shaft; drift north 100′ on the vein. Idle. Warren Larkin of Placerville, owner.

Lilyama Mine. See our Bull. 50, p. 212. It is located 11 miles southeast of Auburn on the Southern Pacific Railroad in Sec. 3, T. 11 N., R. 9 E. A belt of limestone between granodiorite and quartz-porphyry walls carries ore in the form of lenses. The croppings are grossan and nearly pure black iron oxide (magnetite). The ore consists of sulphides of copper associated with pyrite. The ore is reported

to run as high as 10% copper with gold and silver values. Developments: Tunnel 350′ long and shaft 25′ deep. Idle. Robert Crocker & Co. of Placerville, owner.

Noonday Copper Mine. See our Bull. 50, p. 220. It is situated 4½ miles east of El Dorado, in Sec. 18, T. 9 N., R. 11 E. The ore occurs as lenses in a meta-diabase. The vein is 7′ wide; strike N. 4° E., dip 85° E. The ore consisting of bornite and chalcopyrite associated with pyrite, is reported to have yielded 5% to 9% copper, with about $3.00 in gold per ton, and a little silver. Developments consist of a vertical shaft 200′ deep with 280′ of drifts on the vein. There is a 60 h.p. boiler and single drum hoist on the property. Idle. Peyton Chemical Co. of San Francisco, owner.

Oest Mine. Sec. 4, T. 13 N., R. 8 E. Vein between diorite and schist carries chalcopyrite, pyrite, native copper and malachite. Developed by shaft. Idle. Owned by H. Oest of Auburn.

Bibl.: Bull. 50, p. 217, 1908.

Pioneer Copper Mine. See our Bull 50, p. 213. Situated 2½ miles east of Pilot Hill, and about 11 miles southeast of Auburn, Placer County. The deposit is in the form of a mineralized limestone 50′ to 60′ wide, with a granodiorite footwall and quartz-porphyry hanging-wall. The mineralized zone strikes north and south, with a dip towards the west. The ore occurs in lenses in the limestone. The developments consist of a tunnel 900′ long, and two shafts, 90′ and 100′ in depth. Idle. William Haker of New York City, owner.

Robert Mine. Sec. 13, T. 9 N., R. 11 E. Three and one-half foot quartz vein between schist and slate. Developed by shaft and tunnel. Owned by W. L. and L. Robert.

Bibl.: Bull. 50, p. 216, 1908.

GOLD.

General Geology of "Mother Lode" and Gold Bearing Belts of El Dorado County.

The most important mines of El Dorado County are located on the Mother Lode in an area of Mariposa slates, traversing the county from north to south. The Mother Lode, which must not be considered a continuous vein, but rather as a belt of parallel, though sometimes interrupted, quartz-filled fissures, can be traced continuously as far north as the St. Lawrence mine on the Georgetown divide. Along it are found many celebrated mines, such as the Nashville, Montezuma, Church Union, Pacific, Poverty Point and Gopher-Boulder. The veins run parallel to the strike of the slates, or cut them at a very acute angle. The dip is nearly always to the east, and usually at a somewhat less steep angle than that of the surrounding slates. Along the veins of

the Mother Lode frequently run narrow streaks of amphibolite-schist and serpentine. The eastward bend in the strata caused by the intrusive granodiorite in the vicinity of Placerville is closely followed by the veins. North of the St. Lawrence mine the Mother Lode is not well defined. The quartz veins are more frequently interrupted and are replaced by a peculiar kind of deposit, the "seam diggings." In these, a certain belt of slate is impregnated with minute irregular quartz veins, frequently very rich in gold. Such seam diggings occur at Georgia Slide, Spanish Dry Diggings, Greenwood and other places. From the St. Lawrence one branch of auriferous quartz deposits runs up towards Georgetown and Georgia Slide. Another belt begins by the Esperanza mine, north of the St. Lawrence, and continues with frequent interruptions to the Sliger vein and Oregon bar, both on the middle fork of the American River. On both sides of the great serpentine belt, running from Volcanoville to the Cosumnes granodiorite area, near the contact are numerous small quartz veins, very rich in scattered bunches and pockets of gold. Few permanent mines are found, however, along these contacts. The only important mining district in the eastern part of the county is that of Grizzly Flat. A long stretch on the contact of slates and granodiorite, from the middle fork of the Cosumnes to the "Buttes," is mineralized and accompanied by a great many auriferous quartz veins, the most prominent of which is that at the Mount Pleasant mine.

This county, which in past years has produced a very large amount of gold, is at present passing through a temporary period of inactivity, due partly to scarcity of water. The county offers abundant legitimate and promising opportunities to those with both capital and experience to handle large low grade mines.

GOLD MINES—QUARTZ.

Adams Gulch Mine. See our Report XII, p. 101. It is 2 miles north of Nashville, at 1200′ elevation, and comprises the following claims: Adams Gulch, White Oak, Sullivan and Stony Point, including a total of 320 acres. The vein strikes N. 10° W., dip 60° E. Width of vein is 4′ in Mariposa slates. Developments consist of two tunnels; upper tunnel is 180′ long, lower crosscut tunnel has a length of 220′. Two men are employed cleaning out and driving lower tunnel. J. C. Heald of Nashville, owner.

Adjuster and Hustler Mines. They are situated 2 miles south of Diamond Springs, on Mathenas Creek. Vein strikes N. 20° E., dip 70° E., in Mariposa slates. Two tunnels on property, one 123′, the other 100′ long. Two men employed. R. B. Seward, of Diamond Springs, owner.

Adjuster Mine. A prospect 3 miles east of El Dorado. Vein strikes north and south in slate. Average width of vein is 5′. Development: crosscut tunnel 250′ to vein, with a drift 50′ north and 75′ south on vein. Idle. O. A. Ingram, of El Dorado, owner.

Alpine (Union Consolidated) Mine. See our Report VIII, pp. 167, 168. Situated 2½ miles southwest of Georgetown, at an elevation of 2550′. Comprises the following claims: Leap Year, Manhattan Placer mine, Alpine, Alpine Jr., with a total area of 180 acres. The formation is amphibolite schist. The strike of the vein is N. 25° W., dip 60° E., with average width of 12′. Shaft sunk on the vein to 100′ level from which point to 400′ level the shaft is in the footwall of vein. The vein has been developed on the 100′, 200′, 300′, 400′ levels. On the 100′ level, drifts N. 150′, S. 400′; on the 200′ level, drifts N. 75′, and S. 400′; on 300′ level, drifts 100′ N. and 450′ S.; on the 400′ level drifts 50′ N. and 450′ S. The ore is free milling with 1½% to 2% pyrite. Idle. Lucero Gold Mining Co., Inc., 530 Wilcox Bldg., Los Angeles, owner.

Argonaut Mine. See our Report X, p. 176. It is one mile east of Greenwood. The vein has an average width of 15′; strikes NW. and SE., dip 60° E. Tunnel 500′ on vein. Idle. Ford & Co., of Auburn, Placer County, owner.

Baldwin (National) Mine. See our Report XII, p. 102. It is two miles east of Nashville. Consists of one claim 3000′ in length by 300′ wide. The vein has an average width of 15′, strikes N. 10° E., dips 60° E. in Mariposa slates. There is a shaft 200′ deep sunk on a 70° incline. The vein has been developed on the 100′ and 170′ levels. On the 100′ level there is a drift 50′ N., and 50′ S.; on the 170′ level, drift 60′ N. and 150′ S. The vein has been stoped from 100′ level to surface. The present workings are confined to a quartz stringer lead in footwall of main vein. The equipment consists of 80 h.p. boiler, single drum hoist, and 6-foot Huntington mill. The property is under lease to O. N. Hirst, of Nashville. Three men are employed. E. J. Baldwin Est., of San Francisco, owner.

Baltic Mine. See our Report XIII, p. 133. Situated 8 miles northwest of Grizzly Flat, at 4250′ elevation, and comprises four claims. A 12″ vein strikes NE. and SW. and dips 50° E. between slate walls. Developments consist of tunnel 500′ long and an incline shaft 130′ deep. Idle. Reeg & Sciarossi, of Placerville, owners.

Balmaceda Mine. It is 1½ miles northeast of Nashville, on ridge east of north fork of Cosumnes River. There are two parallel veins in Mariposa slates, which strike N. 20° E., dip 65° E. The veins have an average width of 4′. A tunnel 500′ long has been driven on west vein. The ore has been stoped out above tunnel level to surface on

ore shoots, which have a length of 40′ to 100′. Two men are employed. J. C. Heald, of Nashville, owner.

Barnes-Eureka (Greenstone) Mine. See our Report XII, pp. 102 and 112. Situated 3 miles northeast of Shingle Springs, on ridge east of Slate Creek. There are two claims: Barnes and Eureka. The vein occurs on contact between serpentine and diabase. The vein has an average width of 2′, and strikes N. and S., with a dip 45° E. It carries free gold with arsenical pyrites and tellurides of gold. Two incline shafts on the property, having depths of 250′ and 350′. Idle. R. K. Berry, J. J. Blair, of Placerville, owners.

Beattie and Parsons Consolidated Mine. (Seam Diggings.). See our Reports XI, p. 203; XII, p. 102; XIII, p. 133. It is 1½ miles north of Georgetown, on the porphyry seam belt. The formation is traversed by slates and schists, and intercepted by numerous gold bearing quartz seams. Idle. Ida Barklage Brown et al., of Georgetown, owners.

Bidstrup Mine. It is 2 miles south of El Dorado. Vein 12″ wide in granodiorite. Strike north and south. Developments: shaft 35′ deep, tunnel 185′ long. Idle. W. I. Bidstrup, of El Dorado, owner.

Big Chunk Mine. It is ½ mile east of Kelsey. Developments: incline shaft 100′ deep, tunnel 150′ in length. Idle. Mrs. Margaret Smith, of Kelsey, owner.

Big Four Mine. It is a prospect one mile south of Garden Valley. Worked as a pocket mine. Idle. Mrs. M. E. Rhodes and John Hurley, of Garden Valley, owners.

Big Sandy Mine. See our Report X, p. 173. It is ¼ mile south from Kelsey, at elevation of 1900′ and comprises the following claims: Grey Eagle, Big Sandy, and Marshall mill site. On Mother Lode belt in Mariposa slates. The vein has an average width of 500′ with a strike of N. 12° W., dips 70° E. Developments consist of a vertical shaft 334′ deep, with levels at 74′, 124′, 227′, and 323′, with crosscuts west to vein from shaft, and drifts north and south on vein. Old 10-stamp mill on property. Idle. Big Sandy Mining Co., care Chas. Breyman, Nasby Bldg., Toledo, O., owner.

Black Hawk Mine. It is a prospect, situated ¾ mile south of Kelsey. Vein 4′ wide in Mariposa slate. Tunnel 250′ long on vein. Idle. Oscar Reeg and Blair Estate, of Placerville, owners.

Blue Bank Mine. See our Report XIII, p. 134. It is 9½ miles northwest of Shingle Springs. The vein is 18″ wide, strikes N. and S., dips 74° W. in amphibolite schist. Tunnel 120′ long on vein, with 100′ incline below tunnel level. Idle. Murphy Bros., of Shingle Springs, owners.

Blue Rock Mine (Seam Diggings). See our Report XI, p. 203. It is 1½ miles north of Georgetown, on porphyry seam belt. There is a zone of schists and slates traversing the formation, which is intersected by numerous gold bearing quartz seams. Idle. Flynn Bros., et al., of Georgetown, owners.

Boneset Mine. See our Report XII, p. 104. It is a prospect 6 miles north of Shingle Springs. Vein 15′ wide in gabbro-diorite. Strike NE. and SW.; dip 70° N. Tunnel 140′ long, crosscuts vein at depth of 40′. Idle. M. E. Gates, of Sacramento, owner.

Bordt Mine. See our Report XII, p. 104. It is a prospect ½ mile east of Greenwood. East and west vein, dip 60° N. in slate. Idle. W. Bordt, of Greenwood, owner.

Boulder Mine. See our Report XIII, pp. 135–136. It is 8 miles northwest of Shingle Springs. Vein 8′ wide in granodiorite; strike NE. and SW., dip 35° NW. Work was carried on through four tunnels. A 20-stamp mill on property. Idle. Boulder Mining Co., care F. W. Williams, 163 Crocker Bldg., San Francisco, owner.

Bower Mine (Seam Diggings). See our Report XI, p. 204. Situated at Greenwood, on the porphyry seam belt. Zone of slates and schists 30′ to 100′ wide, traversing the porphyry with quartz seams carrying gold. Has a reported production of $2,000,000. Idle. California Water Co., owner.

Bright Hope Mine. See our Report XIII, p. 136. Located 1 mile northeast of Georgetown. Vein 6′ wide in Mariposa slate; strike NE. and SW., dip 60° SW. Development: tunnel 400′ long, shaft 80′ deep. Idle. Mrs. Gibbs and W. H. Hulbert, of Georgetown, owners.

California Jack Mine. See our Report XIII, p. 136. It is 3 miles southwest of Georgetown. Vein 12′ wide strikes N. and S., dip 60° E., in Mariposa slates. Developments consist of crosscut tunnel 350′ to vein with drift north 200′ on vein. Shaft 90′ deep. Idle. Mrs. E. M. Potts and A. L. Jeffrey, 527 Citizens National Bank Bldg., Los Angeles, Cal., owners.

Cedarberg Mine. See our Reports XII, p. 106; XIII, p. 137. Located 2½ miles northwest of Greenwood. The formation is an amphibolite schist. Vein 1½′ wide, strikes N. and S. and dips 57° E. Developments consist of a shaft sunk on 57° incline to a depth of 318′, with levels at 100′, 200′, 300′. Idle. J. T. Smith, of Greenwood, owner.

Central Mine. It is situated 3 miles south of El Dorado on the Mother Lode belt. There are three parallel veins cutting the Mariposa slates, which have a general strike of N. 10° E., dipping 60° E. Developments: tunnel 800′ long. Idle. Seymour Hill, of El Dorado, owner.

Chaparral Mine. It is 2 miles southwest of Kelsey. Vein 6′ wide with a diabase footwall and slate hanging wall. Vein strikes NW. and SE., dip 70° E. Shaft 200′ deep. Tunnel 50′ long. Idle. Philip Stingle, of Boston, and Margaret Kelly, of Kelsey, owners.

China Hill Mines. See our Report XII, p. 106. It is a pocket mine situated 3 miles southwest of El Dorado. The vein occurs in a hornblende porphyry, and has average width of 5′. Strike N. and S., dip 70° E. Developments consist of crosscut tunnel 200′ to vein with drifts north and south for a distance of 200′, giving 130′ of backs. There is a 5-stamp mill on property. Idle. China Hill Mining Co., W. M. Langtry, president; J. E. Fox, secretary, Placerville, owner.

Church Mine. See our Reports VIII, p. 191; X, p. 171; and XII, p. 106; also, Bull. 18, p. 92. This property is situated 2 miles southeast of El Dorado. Comprises two claims: Church and Golden Fleece, with 2300′ on the lode. Three veins occur in the Mariposa slates. These veins have a general north and south course, and dip 74° E. The veins have an average width of 5′ to 10′. The shaft has three compartments, and was sunk to a vertical depth of 1350′. The vein has been developed on 100′, 200′, 300′, 350′, 500′, 600′, 700′, 850′, 1000′, and 1200′ levels. The course of the Kidney vein was north and south as far as the 350′ level, on which level the vein is 40′ west of shaft. From the 350′ to 500′ level this vein dips 45° E. Below the 500′ level the vein straightens up to 74° and has a course of NE.–SW. From the 500′ level to surface the ore occurs in kidneys. The ore shoot from the 500′ level to 1200′ level is continuous, but below the 1200′ level the shoot shortened up to a length of 25′. A crosscut was driven from the shaft 1400′ east. On the 1200′ level there is a crosscut from shaft to vein 625′ east, from which point a winze was sunk on the vein to a depth of 150′. This vein showed 4′ of quartz with a gouge on both walls, in the bottom of winze. The vein has been stoped out on ore shoots from 1200′ level to surface. There is a double drum, water-power hoist on the property. Idle. Seymour Hill, of El Dorado, owner.

Collins & Bacchi Mine. It is a prospect near Garden Valley, comprising 126 acres of patented land. Idle. J. G. Hibbs, of Wawa, Pa., owner.

Cousin Jack Mine. See our Reports XII, p. 107; XIII, p. 138. It is situated 5 miles southwest of Grizzly Flat. Vein 12″ wide occurs in the slates, with a course N.–S., dip 60° W. Developments consist of 300′ upper tunnel, 250′ above a lower tunnel which has a length of 400′. Idle. Mrs. M. Jeffrey, of Grizzly Flat, owner.

Crown Point Mine. See our Report XII, p. 107. It is 2 miles southeast of Diamond Springs. Three veins occur in Mariposa slate

and strike N. 27° E., dip 72° E. These veins have an average width of 4′. Developments consist of a shaft 500′ deep, sunk on an angle of 72°, and a tunnel 512′ long. The mine has been developed from the shaft on the 100′, 200′, 300′, and 400′ levels. The tunnel intersects shaft at a depth of 300′. Idle. James Richards, of Placerville, owner.

Crusader Mine. Situated 3 miles south of Diamond Springs, on Mathenas Creek. Comprises the following claims: The Crusader, Alta, Gibraltar, with 3000′ on the lode. The vein occurs in Mariposa slates, having an average width of 3′; strike N. 20° E., dip 80° W. Shaft 100′ deep sunk on 70° incline. The shaft intersects vein 50′ below collar. On the 100′ level a crosscut was driven west to vein, a distance of 20′, with a drift north 20′ and south 75′. An ore shoot 100′ long with an average width of 300′ was developed. Idle. Seymour Hill, of El Dorado, owner.

Crystal Mine. See our Report XII, p. 107. It is 5 miles south of Grizzly Flat. Idle. L. L. Alexander, of Omo ranch, owner.

Crystal Mine. See our Report XII, pp. 107–108. It is 3½ miles south of Shingle Springs. North and south vein with an amphibolite schist footwall and serpentine hanging wall. The vein has an average width of 3′ and dips 50° E. Developments consist of incline shaft, 250′ deep, and a crosscut tunnel 350′ long. Idle. G. Phelps, Paul Lewis, and Barrett Bros., of Shingle Springs, owners.

Crystal Mine. See our Report XIII, p. 138. It is a prospect ½ mile north of Cool. Idle. E. Terry, C. Ashley, and C. Schulz, of Cool, owners.

Daily and Bishop Mine. See our Report XIII, pp. 138–139. It is 2½ miles south of Grizzly Flat, on Clear Creek. Idle. Bishop, et al., of Grizzly Flat, owners.

Dalmatia Mine. See our Reports X, p. 174; XI, p. 201; and XII, p. 177. Situated ½ mile east of Kelsey; on the porphyry seam belt, with an ore zone from 20′ to 50′ wide, which strikes N. 10° W., dip 25° E. Developments: incline shaft 200′ deep, tunnel 1200′ long; with an open cut 500′ in length. There is a 10-stamp mill on property. Idle. William A. Bell, No. 5, "The Cliff," Black Rock, Brighton, England, owner.

Darling (Chanced Upon) Mine. See our Report XI, p. 202. It is 3 miles northeast of American Flat, in Slate Mountain Range. Vein having an average width of 2′, occurs in Calaveras slate; strike NW. and SE., dip 78° E. Shaft 190′ vertical. Idle. P. G. Gilpin, of San Francisco, owner.

Davidson Mine. See our Report XII, p. 108. Situated 2 miles northwest of El Dorado, at an elevation of 1700′. The vein occurs in Calaveras slates west of Mother Lode belt. The course of vein is N.

10° W., dip 74° E., and average width of 2′. An incline shaft has been sunk to a depth of 280′, with drifts north and south on vein, on 100′ and 200′ levels. Equipment on property consists of 80 h.p. boiler, 2-drill Rix compressor, and 5-stamp mill. Idle. Central El Dorado Mining Co., Paris, France, owner.

Eagle King Mine. See our Reports VIII, p. 178; XII, pp. 108–109; and XIII, p. 139. It is located 1½ miles northwest of Grizzly Flat, on ridge south of north fork of the Cosumnes River. The vein occurs on the contact between the granodiorite and mica schist. Strike N. 20° E., dip vertical. The quartz carries 3% sulphurets, with galena, zinc, and pyrite. Developments consist of a tunnel 1200′ long and a winze from tunnel level 60′ deep. There is a 10-stamp mill on property. Idle. E. W. Witmer and John Melton Estate, of Placerville, owners.

Eagle Mine. See our Report XIII, p. 139. It is 2½ miles north of Grizzly Flat. The vein occurs in granodiorite. Vertical shaft 240′ deep and tunnel 780′ long. Idle. Mrs. Kate Smith and S. Kendrick, of Grizzly Flat, owners.

Edner Mine. See our Reports XII, p. 109; XIII, pp. 139–140. It is a prospect, 7 miles east of Fairplay. The vein occurs in granodiorite; strike N. and S., dip 65° W. Tunnel 150′ in length, shaft 50′ deep. Idle. Charles Edner, of Omo Ranch, owner.

Esperanza Mine (Seam Diggings). Situated ¾ mile east of Greenwood, on the porphyry seam belt. Idle. Paul Rici, et al., of Greenwood, owners.

Esperanza Mine. See our Reports X, p. 175; XII, p. 109. It is 1 mile northwest of Garden Valley, on ridge west of Manhattan Creek. Vein 5′ wide occurs in slate; strike N. 20° W., dip 60° E. Developments consist of vertical shaft 600′ deep and tunnel 260′ in length. Ten-stamp mill on property. Idle. Garden Valley Mining Co., St. Johns Bldg., Chester, England, owner.

Eureka Mine. See our Reports XI, p. 203; XII, p. 109. It is situated in the town of Georgetown. Three parallel veins occur in the Mariposa slates, which strike NE.-SW. and dip 60° E. The veins have an average width of 6′ to 10′. There is an incline shaft 240′ deep with 500′ of drifts on veins. Idle. E. B. Lee, of New York City, owner.

Falls Mine. It is 3 miles south of Diamond Springs, on Mathenas Creek. Crosscut tunnel 200′ long cutting Mariposa slates. One man employed driving crosscut tunnel to intersect vein. Joseph Diechsler, of Diamond Springs, owner.

Fisk Mine. See our Report XIII, p. 140. Situated 1½ miles north of Placerville. Vein occurs between serpentine on west and black

graphitic slate on east. Two tunnels have been driven on vein. Idle. J. H. Skinner, of Placerville, owner.

French Mine (Seam Diggings). See our Report XII, p. 110. It is ¼ mile west of Greenwood, on the porphyry seam belt. Idle. California Water and Mining Co., owner.

French Hill Mine (Seam Diggings). See our Report XII, p. 110. It is 6 miles north of Greenwood, on porphyry seam belt. Shaft 100′ deep, tunnel 100′ long. Idle. A. J. Johnson and E. S. Hadley, of Sacramento, owners.

Frog Pond and **Marigold Cons. Mines.** These properties are situated ½ mile north of Garden Valley. The owners are mining a series of flat seams which occur in porphyry, containing arsenical pyrites which are very rich in gold. Two men employed. S. W. Collins and C. K. Norris, of Garden Valley, owners.

Garden Gate (McNulty) Mine. See our Report XII, p. 117. It is 3 miles south of El Dorado. Shaft 400′ deep, and crosscut tunnel 450′ to vein, with winze from tunnel level 450′ deep sunk on the vein. There is a 10-stamp mill on the property. Idle. J. B. Drury, of St. Louis, Mo., owner.

Gardner Consolidated Mine. It is 1 mile north of Placerville, on ridge east of Big Canyon Creek. The vein has an average width of 5′, with a course of N. 40° E., dip 70° E. The formation is a Mariposa slate. Developments consist of crosscut tunnel 400′ to vein with drifts north and south, for a distance of 500′. Idle. W. H. Myers, of Placerville, owner.

Garfield Mine. See our Report XII, p. 110. It is 1 mile south of Volcanoville. Idle. Garfield Mining Co., owner. W. C. Green, of Georgetown, agent.

Garfield & Excelsior Cons. Gold Mines. See our Report XII, p. 111. It is 1 mile northeast of Greenwood. Idle. F. H. Bilty, et al., of Greenwood, owner.

Georgia Slide Mines (see Beattie & Parsons, Blue Rock, also Mulvey Point and Pacific).

German (Haeger) Mine. See our Report XIII, p. 142, and Bull. 19, p. 90. Situated 4 miles south of El Dorado. The vein occurs in Mariposa slates, on the footwall of the Mother Lode. Strike N. 10° E., dip 60° E. Developments were carried on through a shaft 500′ deep sunk on an angle of 60°. There is a 10-stamp mill on the property. Idle. Seymour Hill, of El Dorado, owner.

Gold Mountain and **Monitor Mines.** These properties are situated 2 miles south of Nashville. Idle. Mrs. B. E. Carter and Mrs. L. S. Santbin, of Nashville, owners.

Golden State Mine. See our Reports XI, p. 204; XII, p. 111. It is 4 miles northeast of Georgetown on the porphyry seam belt. Idle. Ida Barklage Brown, of Georgetown, owner.

Good Luck Mine. It is 2 miles east of Diamond Springs. Vein 18″ wide occurs in the Mariposa slates. Strike N. 20° E., dip 45° E. Developments consist of shaft 250′ deep, and two tunnels, one 200′, the other 300′ in length. There is a 5-stamp mill on property. Idle. Good Luck Mining Co., care Robert Mitchell, 76 Kensington, London, England, owner.

Gopher-Boulder Mine. See our Report VIII, p. 175, also Bull. 18, pp. 98–99. Situated ½ mile north of Kelsey. The vein is 30′ to 100′ wide, but low grade. A shaft has been sunk on the vein 250′ on an angle of 35° and a large open cut has been made in a zone of quartz and greenstone schist. A crosscut tunnel has been driven 300′ to Gopher vein, and over 500′ of drifting and crosscutting has been done on this vein. There is a 20-stamp mill on the property. Idle. W. A. Bell, No. 5 "The Cliff," Black Oak, Brighton, England, owner.

Grand Victory Mine. See our Reports VIII, p. 194; X, p. 178; and XII, p. 112. It is on Squaw Creek, 7 miles southeast of Placerville, at 2100′ elevation, and comprises 160 acres of mineral land on which are quartz locations. The ore body is a black quartzite, lying in slate of the Calaveras formation near the granodiorite contact, striking NW.-SE. and dipping vertically. Two ore bodies developed have widths of 64′ and 125′, with slate intervening. Developments consist of a vertical shaft 500′ deep and a tunnel 500′ in length. There is a 10-stamp mill on the property. Idle. Grand Victory Gold Mining Company, care John C. Wright, of Indianapolis, Ind., owners.

Griffith Mine. See our Report XII, p. 112. It is ½ mile southeast of Diamond Springs. Comprises the following claims: Manzanita King, Manzanita Queen, Potosi, Collar, and 180 acres of mineral land. Two shafts were sunk on the property. The north shaft has a vertical depth of 700′ and the south shaft, 450′. The vein strikes N. 27° E., dip 72° E. Average width of 5′. Idle. Jumper Gold Syndicate Mining Co., Stent, Tuolumne County, owner.

Guilford (Poverty Point) Mine. It is situated 2½ miles north of Placerville, on ridge south of the south fork of the American River. Comprises the following patented claims: Iowa, Hidden Treasure, Bantam, Baltic, Humming Bird, Poverty Point, Brighton, Bell and Fortuna, total holdings amounting to 500 acres, with 5000′ on the lode. Two parallel veins occurring in the Mariposa slates have been developed on this property. These veins strike N. 20° W., with a dip of 70° E. The east vein is 30′ east of west vein. These veins have an average

width of 5′. A diabase dike follows the vein and in places is highly siliceous. Two ore shoots have been developed, 200′ and 400′ in length, with an average width of 5′. The property has been developed through four tunnels: Iowa Tunnel, 500′; Baltic Tunnel, 1500′; Baltic No. 2 Tunnel, 600′; Poverty Point Tunnel, 700′. The ore is free milling with 3% pyrite. Compressor and mill are run by water-power, the water being obtained from the San Francisco-Oakland Terminal Power Company ditch under a head of 560′ at mill.

Mill: 9″x15″ Blake Crusher, 15 stamps weighing 850 lbs. per stamp, dropping 95 per minute, with 6″ drop, crushing 3 tons per stamp through 20-mesh screen. The pulp from batteries after flowing over amalgamating plates, flows to three Wilfrey tables and two 4-foot Frue vanners. An extraction of 85% is made in mill, with a loss of 20¢ per ton in tailings. Concentrates have a value of $80.00 per ton. Twenty-five men are employed. Guilford Gold Mining Co., Placerville, owner. A. Baring-Gould, president and general manager; E. W. Witmer, secretary; William Christian, superintendent.

Grouse Gulch Mine. See our Report XII, p. 113. It is 1½ miles west of Grizzly Flat. Idle. Mrs. K. Smith, of Grizzly Flat, and I. W. Smart, of Placerville, owners.

Hillside Group of Mines. These properties are situated 4 miles south of El Dorado, comprising: Hillside No. 1, Hillside No. 2, Hillside No. 3, Hillside No. 4, Hillside No. 5, Hillside Extension, Tasmania, Chihuahua, O'Campo, Oro Blanco, Santa Fe and Bismark, a total holding of 240 acres with 7500′ on the lode. Series of parallel veins occurring in the Mariposa slates, with a general strike of N. 20° E., dip 70° E. Developments: crosscut tunnel 500′ long and a lower tunnel with a length of 200′. There is a 5-stamp mill on the property. Two men are employed driving lower tunnel. Hillside Mining Co., care E. E. Bender, 64 Fremont st., San Francisco, owner; W. E. Blackmer, of El Dorado, superintendent.

Idaho Mine. It is 3 miles south of El Dorado. Idle. Sidney Pringle, of San Francisco, owner.

Ida Livingston. It is a mile north of Kelsey. Idle. A. W. Craig et al., of San Francisco, owners.

Independence Mine. It is a pocket mine, 2 miles southwest of El Dorado. Idle. Independence Quartz Mining Co., 806 19th st., Des Moines, Iowa, owner.

Inez Central Mine. See our Reports XI, p. 171, and XII, p. 114. Situated 3 miles east of Nashville. Idle. S. H. Maginess, of Placerville, owner.

Isbell & Blue Lead Group. These properties are located 1 mile south of Garden Valley. On Isbell claim there is a shaft 250′ deep;

on Blue Lead the shaft has a depth of 150′. Idle. M. P. Bennett, of Placerville, owner.

Ivanhoe Mine. See our Report X, pp. 175–176. It is ½ mile northwest of Garden Valley. Idle. H. Warren Russell, of Garden Valley, owner.

Josephine Mine. See our Report VIII, pp. 165–166. It is ½ mile east of Volcanoville. Development consists of five tunnels on the vein. Idle. J. A. Shields, of San Francisco, owner.

Kelsey Gold and Silver Mine. Situated 1 mile south of Kelsey, on ridge northwest of south fork of the American River. Lower tunnel 150′, upper tunnel 400′ in length. Idle. Mother Lode Mines Company of California, 32 Hancock St., Jersey City, N. J., owner.

Lady Blanche Mine. See our Report XIII, p. 147. It is 2½ miles east of Fairplay. Idle. J. E. Stratton, of San Francisco, Cal., owner.

Lady Emma Mine. See our Report, XIII, pp. 147–148. It is 1 mile east of Kelsey. Idle. Charles E. Hand, of Placerville, owner.

Larkin Mine. See our Report XIII, p. 148, and Bull. 18, p. 93. Situated ½ mile east of Diamond Springs. The great dolomitic vein passes through this property, in addition to which there are several other less prominent veins. It is upon one of the latter, which occurs in the hanging-wall slates of the dolomitic vein, that past operations have been conducted. This vein is accompanied by a small dike of diabase. The dolomitic veins is 80′ wide, and is altered to a talc schist. West vein has a course of N. 20° E., dip 74° E., while east vein has a vertical dip. The shaft has been sunk to a vertical depth of 800′. Levels were driven north and south on the vein at 100′ intervals. Over 4000′ of drifts have been run in this mine. There is a 10-stamp mill on the property. Idle. Larkin Mining Co., San Francisco, owner.

Last Chance (Sugar Loaf) Mine. See our Report XIII, p. 158. It is 2 miles east of Nashville. Comprises 1427 acres of mineral ground. A shaft has been sunk on the Last Chance vein to a depth of 600′ on 70° incline, also a shaft 260′ deep on the Monarch vein. There is a 10-stamp mill on the property. Idle. Dr. A. C. Smith, of Portland, Oregon, owner.

Lincoln Mine (Seam Diggings). See our Report XIII, p. 148. It is 1¼ miles northwest of Georgetown, on the porphyry seam belt. Idle. M. D. Haskins, of Georgetown, owner.

Log Cabin (Darrow) Mine. See our Report XIII, p. 149. It is 5 miles southeast of Shingle Springs. Tunnel 600′ long. Idle. A. Darrow, of Shingle Springs, owner.

Lone Jack Mine. See our Report X, p. 176. It is 1 mile northwest of Garden Valley. Idle. Campbell & Metson, of San Francisco, owners.

Lone Star Mine. See our Report XII, p. 116. It is 4 miles southeast of El Dorado. Comprises the following claims: Lone Star, Wild Rose, Old Abe, South Star, and Recall. A series of parallel veins in Mariposa slates, which have been developed by a crosscut tunnel 500′ long. Idle. S. H. Maginess, of Placerville, owner.

Lone Star Mine. See our Report XII, p. 116. It is situated 1 mile south of Nashville. Vein 7′ wide occurring in Mariposa slates; strike N. 10° E., dip 60° E. A shaft has been sunk on this vein to a depth of 100′. Idle. J. C. Heald, of Nashville, owner.

Lookout Mine. Worked as a pocket mine, and is 3 miles south of El Dorado. Idle. Seymour Hill and Grant Hill, of El Dorado, owners.

Lookout and K. K. Mines. See our Report XIII, p. 149. They are in Quartz Cañon, 1 mile south of Volcanoville, and comprise two claims. Idle. Wilson Cary, of Georgetown, owner.

Loveless Mine. It is a pocket mine, situated 4 miles south of El Dorado. Vein of quartz 12″ wide occurs in a casing of slate in diabase, and strikes north and south, dip 47° W. Developments consist of a crosscut tunnel 160′ to vein, with drift north and south on the vein for a distance of 300′; also a shaft 90′ deep. Two men employed. L. T. Loveless & Bros., of El Dorado, owners.

Lucinda Mine. See our Report XIII, p. 149. It is 3 miles west of Grizzly Flat. East and west vein in granodiorite. Idle. Mrs. Nail and D. Gallagher, of Grizzly Flat, owners.

Lucky Jack Mine. It is 2 miles south of El Dorado. There is a series of blanket veins which strike north and south in granodiorite. Work is carried on through a series of shallow shafts. Two-stamp mill on the property. Two men employed. Thomas Murphy, of Logtown, owner.

Lucky Marion Mine. See our Report XIII, p. 150. It is ½ mile west of Greenwood. Idle. Lucky Marion Mining Co., of St. Louis, Mo., owner.

Mameluke Hill Mine (Seam Diggings). It is 1 mile north of Georgetown, on ridge south of Cañon Creek. Idle. Mameluke Hill Mining Co., Ira Vaughn & Son, 36th St. and San Pablo Ave., Oakland, Cal., owners.

Mammoth Mine. See our Report XIII, p. 150. It is a prospect, located 8 miles northwest of Shingle Springs. There is a 10-stamp mill on the property. Idle. Jasper Jurgens, of Lotus, owner.

Manhattan-California Mine. Situated 2 miles northeast of Nashville. Comprises 77 acres of mineral land. Shaft 400′ deep. Idle. Manhattan-California Mining Co., W. T. Hyatt, of Sacramento, owner.

Marguerite Mine. It is situated 4 miles south of Placerville. Three parallel veins have been developed in slate of Mariposa formation, which strike north and south and dip 70° E. Developments consist of a vertical shaft 300′ deep, and a tunnel 200′ in length, with 1200′ of drifts on veins. Equipment: 80 h.p. boiler, single drum hoist and Rix compressor. Idle. Marguerite Mining Company, care W. W. Tenney, secretary, 510 Battery St., San Francisco, owner.

Mathenas Creek (Schneider) Mine. See our Reports VIII, p. 190; XI, p. 172; XII, p. 117. It is 2 miles south of Diamond Springs. Idle. Mathenas Quartz Mines and South Co., owner.

Melton Mine. See our Reports VIII, p. 177; XII, p. 117. It is 2½ miles northeast of Grizzly Flat, on ridge south of the north fork of the Cosumnes River. Idle. Isaac P. Lampson, of Cleveland, Ohio, owner.

Miller (Ribbon Rock) Mine. It is a prospect, 2½ miles south of Placerville. Idle. Moses Miller, of Placerville, owner.

Montana Mine. See our Report XIII, p. 151. It is 1 mile south of Volcanoville, on ridge north of Otter Creek. Idle. J. Helmers et al., of Georgetown, owners.

Montezuma Mine. See our Reports XII, p. 118; XIII, p. 151; also Bull. 18, p. 91. Situated ½ mile north of Nashville, on slope of ridge east of the north fork of the Cosumnes River. Comprises the following claims: Mariposa, Montezuma, East Montezuma and North Extension of the Montezuma. The vein occurs in the slates of the Mariposa formation. The vein has an average width of 7′, with a course of N. 20° E., dipping 57° E. A two-compartment 4′x10′ shaft has been sunk on an angle of 57° to a depth of 440′. Three levels have been driven on vein. On 160′ level there is a drift 200′ S. and 90′ N. On 360′ level drift N. 330′ and S. 400′. There is a drift from the Havilah shaft on the 1200′ level, 1285′ N. into the Montezuma claim. Equipment: Giant compressor, single drum hoist, driven by 55 h.p motor, and a 10-stamp mill. This property is under bond to the California Exploration Co., who propose to sink the 2-compartment shaft to the the 1200′ level of Havilah shaft. Electric power is furnished by Western States Power Co. Water is obtained from the north fork of the Cosumnes River by a ditch 1½ miles long, capacity of 1800 miner's inches. Idle. J. C. Heald, of Nashville, owner.

Morey Mine. See our Reports VIII, p. 178; X, p. 178; and XII, p. 118. It is 1 mile west of Grizzly Flat. Idle. E. R. Morey, of Grizzly Flat, owner.

Mount Hope Mine. See our Report XIII, p. 178. It is 3 miles north of Grizzly Flat, on ridge north of north fork of the Cosumnes River. Idle. Sierran Mining Co., care Judge Wildman, of Norwalk, Ohio, owner.

Mount Pleasant Mine. See our Reports VIII, p. 178; X, p. 178; and XII, p. 118. This property is situated ¾ mile west of Grizzly Flat. Controls 259 acres of mineral ground, which gives 5156′ on the lode. The mine is on the east belt, which is well defined by a succession of quartz veins. The belt at the Mount Pleasant is 300′ wide, dips vertical, strikes N. 13° E. The three largest veins strike diagonally through the lode, at small angles of from 2° to 10° from the NE.-SW. strike of the lode. These quartz veins are in the granodiorite or along its contact with the mica schist and in the mica schist northerly from the contact line of the formation. The quartz veins in the mica schist, east of the granodiorite formation, at the southern end of the property have the same strike as the lode. The three principal quartz veins are very nearly parallel in strike, but do not overlap. Each has one or more spurs and lesser parallel veins, and is thus, itself, the center of a small vein system. The quartz bodies of the veins are lenticular masses. The ore is concentrated in shoots. The quartz contains free gold, galena, zinc blende and pyrite. The three principal veins are called the Earl, McKane, and Big Vein. A shaft has been sunk to a depth of 1065′ on the vein, with levels driven on the vein at 100′ intervals. Workings amount to over 9000′ of drifts. On 1000′ level there is a drift 750′ north. This level is being continued north to intersect ore shoots that have been stoped out from 700′ level to surface. Equipment consists of hoist, compressor, and 10-stamp mill. Twelve men are employed. Mount Pleasant Cons. Gold Mining Co., Merchants Exchange Bldg., San Francisco, owner; Larry King, superintendent.

Mulvey Point and **Pacific Mines** (Seam Diggings). These properties are situated 1 mile north of Georgetown, on porphyry seam belt. Idle. Ida Barklage Brown et al., of Georgetown, owners.

Nashville (Havilah) Mine. See our Reports XII, p. 119, and XIII, p. 151. Situated at Nashville on the north fork of the Cosumnes River. Comprises the following claims: Havilah, East Havilah, Northeast Nashville. A vein from 5′ to 20′ wide occurs in the slates of the Mariposa formation. Strike N. 10° E., dip 60° E. A shaft has been sunk on this vein to a depth of 1200′ with levels at 100′ intervals. The 1200′ level was driven north 1500′ into the Montezuma claim, which joins this property on the north. The ore is free milling with 2% pyrite. This property is under bond to the California Exploration Co., of London,

England, who plan to work it in conjunction with the Montezuma Mine. Idle. Joshua Hendy Machine Works, San Francisco, owner.

New El Dorado Mine. See our Report XII, p. 119. It is 2½ miles northeast of Greenwood. Idle. W. N. Martin, of Oakland, owner.

New Garibaldi Mine (Seam Diggings). See our Report XIII, p. 152. It is 2½ miles west of Greenwood on the porphyry seam belt. Idle. J. B. Hayes, of San Francisco, owner.

Oak Mine. See our Report XII, p. 119. It is 5 miles southwest of Grizzly Flat. Idle. J. Ryan, of Grizzly Flat, owner.

Ohio Mine. See our Report XIII, p. 152. It is 1 mile east of Greenwood. Idle. B. W. Katzenstein, of Sacramento, owner.

Omo Mine. See our Report XIII, p. 152. Situated 8 miles east of Fairplay. Idle. G. W. Mock, of Omo ranch, owner.

One to Sixteen and **Vulture Mines.** They are 1 mile north of Placerville. Idle. W. A. Craddock, of Placerville, owner.

Oriflamme Mine. See our Reports VIII, p. 189; XI, p. 172. It is 3 miles east of Diamond Springs. Idle. S. H. Maginess, of Placerville, owner.

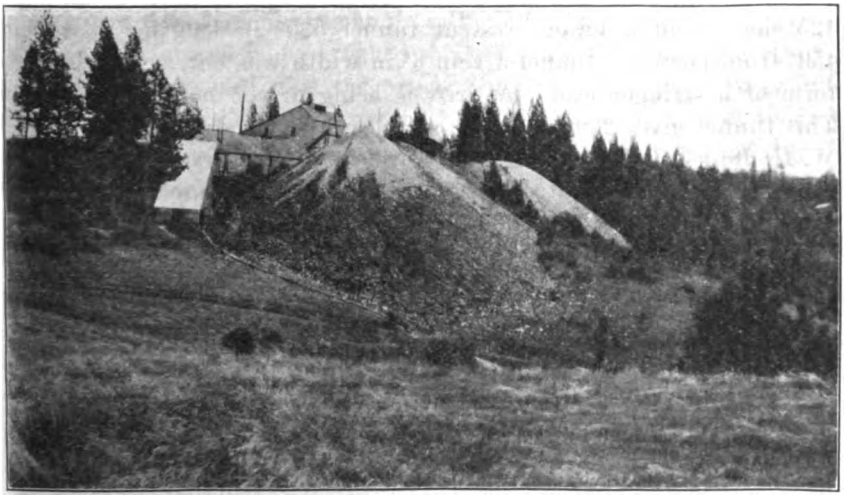
Oro Fino (Big Cañon) Mine. See our Reports VIII, p. 174; XII, pp. 103, 479; and XIII, p. 133; also Bull. 18, p. 96. It is situated 5 miles south of Diamond Springs, in Big Cañon. The vein, which is 40′ wide, consists of a dike-like mass of diabase breccia which has become silicified and impregnated with finely disseminated auriferous pyrite. Many small seams of calcite traverse the rock in every direction. Both hanging and footwall are diabase, but little altered even in close proximity to the vein. A vertical shaft has been sunk to a depth of 200′ where it turns to an incline of 40°, and continues to a depth of 540′ on the vein. The dike strikes north and south and dips 40° E. There are levels on the vein at 100′, 200′, 300′, 500′, and 700′. The ore has been stoped out from the 500′ level to surface for about 200′ north and south of the shaft. The values in the ore are in the sulphides, which contain about 3% auriferous pyrite. The present work is confined to development operations on the 700′ level. A 5-drill Rix compressor driven by water power furnishes air for machine drills and single drum hoist. The property is under option to the Tredwood Syndicate, Ltd., of London, England. Twelve men are employed. Hayward, Hobart and Lane Estates, Merchants Exchange Bldg., San Francisco, owner. C. H. James, general manager; C. C. Marsh, superintendent.

Pacific Mine. See our Reports VIII, p. 183; X, p. 173 and XII, p. 120. This mine which is situated at Placerville, comprises the following claims: Epley, Crescent, Webber, Farraday, Henrietta, Albright

Mill Site, Webber Placer Mine, Excelsior Placer Mine, Albright Placer Mine, Oregon Hill, Pacific, Maryland, Rose, North Atlantic, Climax, Chester, Ida Mitchell, Keegan, Davey, Young, Harmon, Old Harmon, Franklin Placer Mine, Gross, Van Hooker, Eureka, Brown Bear, White Bear, Cinnamon Bear, Grizzly Bear, Spanish Hill Placer, and Texas Hill Placer mines. The quartz mines extend a mile south of the American River to Webber Creek, a distance of three miles. The hydraulic and placer mines are located in Chili Ravine and on Spanish and Nigger Hills. The total holdings of the company amount to 1400 acres, with 4½ miles along the lode. The veins run parallel to the Mariposa slates, or cut them at an acute angle. The Pacific vein occurs in a zone of ankerite and mariposite which zone is 300′ wide on the 700′ level. By a series of diamond drill holes this ankerite zone was shown to have narrowed up to a width of 125′ on the 2000′ level. The Pacific vein strikes N. 25° W., dipping 70° E., and is from 4′ to 12′ wide. This vein was lost on the 700′ level and appears to have been faulted to the east between the 300′ and 400′ levels. The ore is free milling with 2% pyrite. During the past year an extensive prospecting campaign was prosecuted with diamond drills to determine if the ore bodies continued in depth, but the results were unsatisfactory. Over 8000′ of diamond drill holes were driven from the winze at the 1700′ and 2000′ stations. At the 1700′ station, 3 holes were driven at different points, from 600′ to 700′ in length. On the 2000′ station 8 holes were driven in a fan shape from 300′ to 1200′ in length, but results obtained were not very encouraging; therefore this method of prospecting was abandoned. A vertical shaft has been sunk to a depth of 700′. About 200′ north of this shaft a winze was sunk on a 70° incline to a depth of 1365′. The shaft was sunk in the black slate footwall to the 700′ level, cutting the Pacific vein on the 300′ level. The winze from 700′ level is in black slate footwall from 1600′ to 2000′ levels. An extensive amount of drifting has been done on 100′, 200′, 300′, 400′, 500′, 600′, and 700′ levels. Drifts: on 300′ level, N. 200′; on 500′ level, N. 1000′, and S. 1500′; on 700′ level, N. 1200′ and S. 250′. All the above work was on the Pacific vein. On the 700′ level about 220′ north of crosscut from shaft to Pacific vein a crosscut has been driven 85′ east, which encountered a talc ore body, 75′ long and 7′ wide. This crosscut was continued 130′ into black slate hanging wall, but no ore was encountered. All the present work is confined to stoping operations on the talc ore body.

Mine equipment: Double drum flat rope hoist driven by waterpower, 22½″ x 14″ x 18″ Laidlaw-Dunn Gordon compressor. A 5-stamp mill crushes 3 tons per stamp through 30-mesh screen; concentrates are saved on a No. 4 Deister table. Water for power is obtained from the San Francisco-Oakland Terminal Power Co. ditch. The Pacific

mine is at present under lease to P. D. Burdt and J. W. Santa, of Placerville, who are milling the ore from dumps and from the talc ore body developed on the 700′ level. Eight men are employed. Placerville Gold Mining Co., Placerville, owner; president, Alexander Baring; secretary and general manager, A. E. May.



Pacific Mine, Placerville, El Dorado County. A view of hoist and 5-stamp mill.

Philadelphia and **Gold Note Mines.** See our Reports XII, p. 120; XIII, p. 153. They are situated 8 miles south of Grizzly Flat, comprising the following claims: Gold Note, Philadelphia, White Hall, Woolara. There is a 10-stamp mill on the property. Idle. J. B. Polk and Parker Bros., of Omo ranch, owners.

Pocahontas Mine. See our Report XIII, p. 154. It is 4 miles south of El Dorado. All machinery has been dismantled and sold. Shafts are caved. Idle. Quincy I. Chase, of San Francisco, owner.

Polar Bear, White Bear and **Empire Group.** They are situated 3 miles south of Grizzly Flat. Idle. J. Q. Wrenn, G. H. Werntz et al., of Placerville, owners.

Pyramid Mine. See our Reports XII, p. 121; XIII, p. 154. It is 4 miles northwest of Shingle Springs. Idle. Pyramid Mining Co., Auzerais Bldg., San Jose, owner.

Rainbow Mine. It is a prospect, 1¼ miles west of Garden Valley. Idle. J. Ramsdell and C. M. Root, of Garden Valley, owners.

Red Hill Mine. Situated 2 miles northwest of Garden Valley. A vein 10′ wide occurs in the Mariposa slates; strike N. 20° W., dip 70° E. An incline shaft has been sunk on the vein to a depth of 100′ and vein drifted on 350′. The ore is free milling with 2% pyrite. Five

men are employed on development work. There is a 2-stamp mill on the property. Red Hill Mining Co., St. Louis, Mo., owner; W. Gill, superintendent.

Red Wing Mine. Situated 3 miles south of El Dorado. A vein 5′ wide occurs in the slates of the Mariposa formation; strike N. 10° E., dip 70° E. The vein has been developed by two tunnels, an upper 125′ long, and a lower crosscut tunnel 525′ in length; at a point 450′ from portal of tunnel a vein 6′ in width was cut, which is in the form of a stringer lead. A drift is being driven north of this vein. This tunnel gives 260′ of backs on the vein. Five men are employed. W. H. James, J. E. Lawyer, P. J. Loveless, of El Dorado, owners. The property is under bond to W. F. Deaner, of San Francisco, J. I. Noce, superintendent.

Richmond Mine. It is 8 miles east of Fairplay. There is an 8-stamp mill on property. Idle. E. W. Witmer, of Placerville, owner.

Rising Sun (Potter) Mine. It is 1 mile northwest of Kelsey. Idle. R. Filippini Estate and A. Forni, of Placerville, owners.

River Hill (Gentle Annie) Mine. (For Gentle Annie Mine see our Reports X, p. 177, and XII, p. 111. For River Hill Mine, see our Report XIII, p. 141.) The property is situated 1½ miles north of Placerville. Comprises the following claims: Belle, Logan, Jackson, Lyon, Bona Sate, Gentle Annie, Hall, Surplus, Lucky Star, Sobrante, Independent, Keystone, New Era, also mineral rights to 160 acres of adjoining land. The vein strikes N. 25° W., dipping 72° E. It has an average width of 5′ occurring in the slates of Mariposa formation. A shaft has been sunk on the vein to a depth of 1550′. The Gentle Annie shaft has a depth of 600′ on the vein. All machinery has been dismantled and sold. Both shafts are caved. Idle. G. M. Clark, of Stockton, owner.

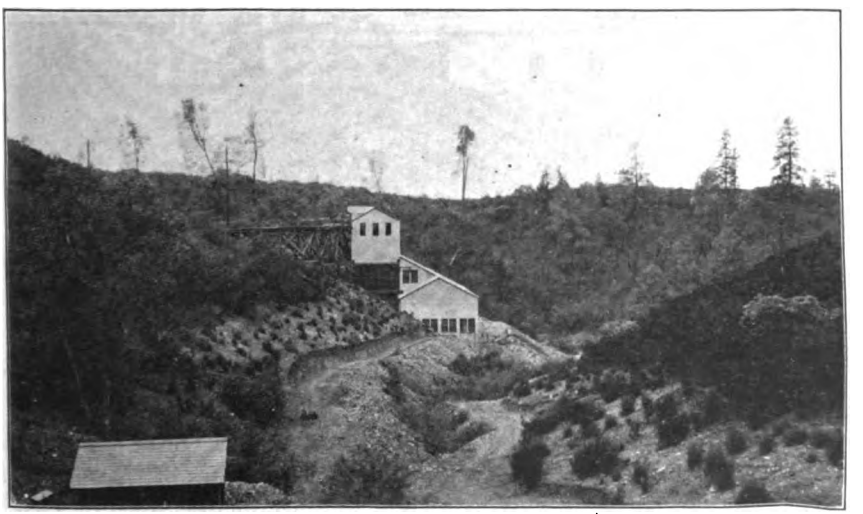
Rosecranz Mine. See our Reports VIII, p. 171; X, p. 176. It is 1 mile northwest of Garden Valley. Idle. H. S. Morey, Richard Rowland and R. Filippini, of Placerville, owners.

Ryan Mine. It is 1 mile south of Kelsey. Idle. M. B. Ryan of Placerville, and Barrett Bros., of Shingle Springs, owners.

Selby Mine. It is 4 miles south of Placerville. A vertical shaft has been sunk to a depth of 240′. Idle. Warren Larkin, of Placerville, owner.

Shan Tsz Gold (Shaw) Mines. See our Reports VIII, p. 193; X, p. 181; and XII, pp. 114 and 481. Situated 2 miles northwest of El Dorado, on ridge north of Dry Creek. The ore body is in the form of a quartz schist dike 100′ wide, occurring in contact with metamorphics and slates of the Calaveras formation. The general strike

of this dike is N. 10° E., and dips 85° E. The ore is free milling with 3% pyrite. Rich pockets of free gold are found on contact of dike with the surrounding formation. Developments consist of shaft 135′ deep and tunnel 400′ long crosscutting the dike. Drifts have been driven N. 200′ and S. 300′ on the footwall contact. The tunnel gives 150′ of backs and the ore is being mined from open cut above tunnel level. Ore is trammed from tunnel to mill and dumped over 2″ grizzly, the coarse material being crushed through a Feldsmiths No. 3 gyratory crusher. From mill bins the ore is fed to three 10-foot Lane mills, each driven by a 25 h.p. motor. Capacity of mill is 150 tons per 24 hours. Twenty-five men are employed. H. DeC. Richards, 621 Crocker Bldg., San Francisco, owner; Willis Lawrence, superintendent.



Shaw Mine, El Dorado, El Dorado County, showing mill.

Slager Mine. See our Report XII, p. 123. It is 4 miles north of Greenwood, on ridge south of middle fork of the American River. Idle. William Roush & Co., of Greenwood, owner.

Sherman Mine. Situated 1 mile north of Placerville on ridge south of Big Cañon Creek. Comprises 70 acres of mineral ground. The vein occurs in the slates of the Mariposa formation, and has an average width of 5′; strike N. 20° W., dip 74° E. A shaft has been sunk on an angle of 74° to a depth of 750′, and 1250′ north of the shaft on 750′ level a winze has been sunk on the vein to a depth of 350′. On the 100′ level, drift N. 100′ and S. 150′; on 200′ level, drift N. 700′ and S. 100′; on 300′ level, drift N. 700′ and S. 150′; on 400′ level, drift N. 1400′; on 500′ level, drift N. 900′ and S. 150′. Two pay shoots were developed which had a length of 60′. These shoots had a

trend 38° north. The ore is free milling with 3% pyrite. The equipment on property consists of: double drum hoist, and Giant air compressor driven by 125 h.p. motor. Mill: two 10″ x 20″ Blake crushers, 10 stamps weighing 1000 lbs. per stamp, 3 Wilfrey tables and two Frue vanners. Electric power was secured from the Western States Power Company. Idle. John Wright, of Indianapolis, Indiana, owner. G. M. Clark, of Placerville, agent.

Sherman Mine, Placerville, El Dorado County. A view of headframe.

St. Clair Mine. It is 1 mile northwest of Kelsey. Idle. John Peters and Thomas Gregory, of Kelsey, owners.

St. Lawrence Mine. See our Report XI, p. 202. Situated 2 miles northeast of Kelsey. Vein 6′ wide occurs in the slates of the Mariposa formation; strike N. 10° W., dip 60° E. An incline shaft has been sunk to depth of 900′ with a winze from 900′ level 200′ deep. Idle. Mierson Banking Company, Placerville, owner.

Starlight Mine. See our Report XII, p. 157. It is 2½ miles south of El Dorado. Vertical shaft 500′ deep. Idle. Sfarlight Mining Co., 206 Sansome St., San Francisco, owner.

Stillwagon (St. Lawrence) Mine. See our Reports X, p. 179; XII, p. 123. It is 7 miles east of Fairplay. Idle. S. A. Laine, of Omo ranch, owner.

Stuckslager Mine. See our Reports VI, Part II, p. 43; XII, p. 124; and XIII, p. 158. It is 1 mile south of Lotus. Idle. W. B. McKinney and C. H. Grube, of Lotus, owners.

Sunday Mine. It is 1½ miles northwest of Grizzly Flat. Tunnel 600′ long. Shaft 110′ deep. Idle. E. W. Witmer and John Melton Estate, Placerville, owners.

Sunrise Mine. It is 1 mile northeast of Kelsey. Idle. Mrs. Cora Grady, 311 N. 3d St., Victor, Colo., owner.

Superior (Tin Cup) Mine. See our Reports VIII, p. 187; X, p. 172. There is a shaft on the property, 400′ deep, sunk on an angle of 74°. Equipment: 60 h.p. boiler, single drum steam hoist. Idle. W. H. Martin, of San Francisco, owner.

Taylor (Idlewild) Mine. See our Reports VIII, p. 168; X. p. 176; XI, p. 205; XII, p. 113; and XIII, p. 145. Situated 1½ miles northwest of Garden Valley. Vein strikes northwest and southeast, dip 50° NE. and occurs on contact of a narrow belt of amphibolite schist and slate. Shaft 1200′ deep, sunk on an angle of 50°. Idle. W. E. Deane, of San Francisco, owner.

Treat Mine. See our Reports VIII, p. 178; XIII, p. 179. It is 2½ miles north of Grizzly Flat. Idle. Mrs. John D. Treat, of Oakland, owner.

Trench (Yellow Jacket) Mine. See our Report XII, p. 125. It is 1 mile south of Volcanoville. Idle. Mrs. Kate F. Lewis, Ithaca, N. Y., owner.

Tullis (Diamond) Mine. See our Report XIII, p. 159. Situated 2¼ miles south of Diamond Springs. Idle. Tullis Mining Co., San Leandro, Alameda County, owner.

Union (Springfield) Mine. See our Report VI, Part II, p. 43. It is situated 3 miles south from El Dorado, at 1180′ elevation, and comprises the following claims: Honey Ranch, Alabama, Union Clement Placer, Lot 4. Location giving 1300′ on lode; five veins occurring in the slates of the Mariposa formation have been proven on this property. Their general strike is N. 16° E., dip from 60° to 79° E., with an average width of 5′ to 10′. Four ore shoots were developed from 100′ to 250′ in length. The Springfield shaft has been sunk to a vertical depth of 1640′. This shaft is located 320′ east of vein, the hanging wall vein crossing the shaft at 1200′ level, while the west gouge vein intersected the shaft about 60′ above 1600′ level, and lies about 15′ east of shaft. Over 21,000′ of crosscuts and drifts have been run on this property from the Springfield and Clement shafts, the latter shaft being 900′ deep, sunk on an angle of 70°. The production from this mine is reported to have been in the neighborhood of $5,000,000. The ore is free milling with 1½% to 2% pyrite. The ore shoots developed have been stoped out from the 1300′ level to the surface. There is a 20-stamp mill on the property. Twenty men employed on development under supervision of H. H. Lang, consulting engineer. John A. Finch Estate, owners. Chas. Hussey, agent, 507 Empire State Bldg., Spokane, Washington.

Vandergreft Mine. It is 3 miles north of Nashville. Incline shaft 250′ deep. Tunnel 100′ long. There is a 10-stamp mill on the property. Idle. J. P. Vandergreft, of Placerville, owner.

Vann Mine. See our Report XIII, p. 161. It is ½ mile north of Georgetown. Idle. W. L. Dickerson, of San Francisco, owner.

Webster Mine. See our Report XII, p. 126. It is 2½ miles northeast of Georgetown. Idle. D. C. Webster, of Georgetown, owner.

Welch Gold Mines. See our Report XII, p. 126. Located ½ mile northeast of Greenwood. Idle. Henry Welch Mining Co., San Francisco, owner.

Wilhelm and **Last Chance Mines.** They are 8 miles southeast of Auburn, Placer County, on ridge east of north fork of the American River. Idle. G. E. Lukens, of Auburn, owner.

Woodland Mine. This property is located 3 miles east of El Dorado, on Mathenas Creek. Vein 12″ wide occurs in the slates of the Mariposa formation. Strike N. and S., dip 80° E. The ore is free milling with 2% pyrite. A vertical shaft has been sunk to a depth of 200′ and levels driven on the vein at 100′ and 150′ from collar of shaft. Mill: 5 stamps, weighing 1000 lbs. per stamp; one Wilfrey table. The mill is driven by 25 h.p. gasoline engine. Six men are employed. Woodland Mining Co., Sacramento, owner; C. Willhite, president; F. Smith, secretary; Edward Hollinsworth, superintendent.

Woodside Mine. Situated at Georgetown, comprising the Iowa, Brooklyn, Eureka, and Woodside mines. Vein 3′ wide in slate, strikes N.-S. and dips 60° E. A shaft has been sunk on vein to a depth of 210′. Idle. Woodside-Eureka Mining Co., Bacon Bldg., Oakland, owner.

Zentgraf Mine. See our Reports VIII, p. 200; XIII, pp. 161–162. Situated 8 miles east of Newcastle, Placer County, on the north fork of the American River. Idle. P. C. Drescher, of Sacramento, owner.

GOLD MINES—PLACER.

Since our last report very little activity has been shown in mining the auriferous gravel deposits of the ancient river channels that are located in the vicinity of Placerville, Georgetown, Volcanoville, Grizzly Flat, Henry Diggings, Omo House and Indian Diggings. These gravel deposits have been extensively mined in the past and have a large record for production of gold.

Alveoro Gravel Mine (Drift). Situated 3 miles east of Placerville. The channel has a north and south course. The gravel is partially cemented and capped by 300′ of andesitic tuff. The channel is 100′ to 300′ wide, with a depth of gravel from 6′ to 30′. A tunnel 4000′

long has been driven on main channel; there are two incline shafts from 400′ to 500′ deep. Idle. S. H. Maginess, of Placerville, owner.

Armstrong & Roberts Gravel Mine (Drift). See our Report XII, p. 101. Situated 3½ miles south of Grizzly Flat. Idle. W. T. Armstrong, of Grizzly Flat, owner.

Badger Hill Placer Mine (Drift). Situated 7 miles northeast of Placerville. Idle. George Riever, of Placerville, owner.

Benfelt Placer Mine (Drift). See our Reports VIII, p. 197; XII, p. 179. It is 2 miles east of Placerville. Idle. J. D. Benfelt, of Smith's Flat, owner.

Blacklock Mine (Drift and Hydraulic). See our Report XIII, p. 134. Situated 1½ miles northeast of Placerville. Idle. S. H. Maginess, of Placerville, owner.

Buckeye Hill Gold Mine (Drift). See our Report XII, p. 105. It is 9 miles northeast of Georgetown. Idle. Ida Barklage Brown et al., of Georgetown, owners.

California Mohawk Mining Co's. Mines (Drift). They are located at Fairplay, comprising the following placer claims: Bean Hill, Jolly Annie, Fairplay, Betty Wolly, River Hill, Blue Stocking, with three miles along the channel. Idle. California Mohawk Mining Co., 206 J St., Sacramento, owners. D. A. Disbrow, of Sacramento, agent.

Cañon Creek Fluming Company's Mine (Drift). See our Reports XII, p. 105; XIII, p. 142. It is 3 miles northwest of Georgetown. Comprises 300 acres of patented mineral land, and 4 miles of the bed of Cañon Creek below Georgia Slide. Idle. Gold Bug Mining Co., Cleveland, Ohio, owner.

Channel Bend Mine (Drift). See our Report XIII, p. 137. Situated 10 miles northeast of Georgetown, on the middle fork of the American River. Idle. Channel Bend Mining Co., San Francisco, owner.

Confederate Mine (Drift). See our Report XIII, p. 138. It is 2½ miles southwest of Fairplay, at 2725′ elevation, and comprises 40 acres. Idle. D. M. Dunn and A. F. Gillespie, Fairplay, owners.

Dividend Placer Mine (Ground Sluicing). See our Report XIII, p. 108. It is 2½ miles west of Shingle Springs. Idle. H. D. C. Hodgkins, of Shingle Springs, owner.

Franklin Placer Mine (Drift). See our Report XIII, pp. 140–141. It is 2½ miles east of Placerville, on the Coon Hollow Channel. Idle. Dr. W. W. Stone and J. Q. Wrenn, of Placerville, owners.

Gignac Mine (Drift). Situated on Texas Hill, near the town of Placerville. Idle. Dr. W. W. Stone, of Placerville, owner.

Giltedge Mine (Drift). See our Report XIII, p. 142. It is 3 miles south of Fairplay, on ridge south of Cedar Creek. Idle. Norton & Amsden, of Omo, owners.

Gold Channel Mine (Drift). See our Report XII, pp. 114, 115, 117, 118. Situated 8 miles northeast of Georgetown, comprising the following placer claims: Kentucky Flat, Norris Consolidated Placer Mine, Mississippi, Kenna and Morgan. Total holdings, 2134 acres. Idle. Gold Channel Mining Co., care W. H. Foss, 159 Lincoln St., Boston, Mass., owner.

Gray Eagle Cliff Mine (Drift). See our Report XII, p. 112. Situated near Volcanoville, comprising 100 acres of mineral land. Idle. D. C. Webster, of Georgetown, owner.

Grizzly Flat Placer Mine (Drift). See our Report XIII, p. 144. Located at Grizzly Flat. Idle. L. Gilson, of London, England, owner.

Hayward (Indian Diggings) Mine (Drift). See our Report XIII, p. 145. Situated at Indian Diggings, and comprises 358 acres. Idle. Hayward, Hobart & Lane Estates, Merchants Exchange Bldg., San Francisco, Cal., owner.

Horseshoe Flat Mine (Drift). Situated 2½ miles east of Newtown, comprising the following claims: Maginess, Eureka, Laura Hill, Horseshoe. Total holdings of 400 acres. Idle. S. H. Maginess, of Placerville, owner.

Kumfa Placer Mine (Drift). It is 2 miles east of Placerville at Smith's Flat. Idle. W. P. Carpenter, of Smith's Flat, owner.

Linden Placer Mine (Drift). See our Reports VIII, p. 196; XII, p. 115. It is 1 mile southeast of Placerville on the Coon Hollow channel. Comprises the following placer claims: Cedar Springs, Globe, Linden, Confidence, with total holdings of 150 acres. Idle. Linden Mining Company, Boston, Mass., owner.

Mooney Placer Mine (Drift). See our Report XII, p. 118. It is 8 miles east of Placerville. Idle. C. P. Winchell, of Placerville, owner.

Mount Gregory Mine (Hydraulic). See our Report XIII, p. 151. Situated 3 miles east of Volcanoville on ridge north of Missouri Cañon. Idle. A. Phelps and Porter, of Georgetown, owners.

Payne Gravel Mine (Drift). See our Report XII, p. 120. It is 3 miles south of Grizzly Flat on ridge south of Clear Creek. Idle. J. M. McClean, of Grizzly Flat, owner.

Potts and Maginess Mine (Drift). Situated ¾ mile east of Newtown. Comprises 100 acres of mineral ground on the Newtown channel. Idle. S. H. Maginess et al., of Placerville, owners.

Rising Hope Gravel Mine (Drift). Situated 3 miles southeast of Placerville on Texas Hill. Comprises 218 acres of mineral land. The ancient river channel has a north and south course. The channel is capped with 300′ of andesite tuff. The gravel is cemented, has a depth of 2′ to 7′, and the channel is about 700′ in width. A tunnel has been driven 1700′ in slate bedrock to tap the channel, and over 7000′ of development drifts have been driven on the property. The mine is on the junction of the Newtown and Smith's Flat channels. At present writing, driving the tunnel to tap the main channel and grading for a mill. Reported that a large tonnage of good grade gravel has been developed. Ten men are employed. S. M. Warren Company, Exchange Place, New York City, owner; G. W. Englehart, general manager; Charles Hansen, superintendent.

Riveria Placer Mine (Drift). It is ¼ mile east of Placerville on Coon Hollow channel. Idle. Dr. J. Q. Wrenn, of Placerville, owner.

Stewart Mine (Drift). See our Reports X, p. 180; XII, p. 123. It is 1½ miles southeast of Placerville. Idle. Ideal Mining Co., 2111 Fifth St., San Diego, owner.

Toll House Mine (Drift). See our Report X, p. 179. Situated 3 miles northeast of Placerville on ridge north of Rock Creek. Comprises the following placer claims: Hook and Ladder, Henry Clay, Cowan; total holdings, 134 acres. Idle. Selah Chamberlain, of San Francisco, owner.

Try Again Placer Mine (Drift). It is 3½ miles east of Placerville. Idle. Charles Varozza, of Placerville, owner.

Union Gravel Mine (Drift). Situated 2½ miles east of Placerville, on ridge north of White Rock Creek. The channel has a course of NE.-SW. and is capped with andesitic tuff 100′ thick. The character of gravel is blue cemented with quartz boulders. Depth of 6″ to 4′, with a width of 400′. Developments consist of two incline shafts 412′ and 285′ deep. Idle. Union Consolidated Gold Mining Co., Placerville, owner. J. E. Fox, of Placerville, agent.

Zimmerman Mine (Drift). Situated 1 mile south of Pacific on ridge south of south fork of the American River. Comprises 240 acres of mineral land. Four men are employed on development work. Prevolcanic Channel Gold Mining Co., Placerville, owner; J. H. Zimmerman, of Placerville, manager.

LIME AND LIMESTONE.

Alabaster Cave Lime Quarry. See our Bulletin 38, pp. 67–68. Situated 7 miles east of Newcastle, Placer County, on ridge southeast of the middle fork of the American River. The limestone lies in a stratum 50′ thick enclosed by mica schist. The character is crystalline, granular, white, clouded white and blue limestone. Quarry 50′ deep by 300′ long, by 50′ in width. Idle. W. T. Holmes Lime Company, Monadnock Bldg., San Francisco, owner.

Cave Valley Limestone Quarry. See our Bulletin 38, p. 68. Situated 9 miles east of Newcastle, Placer County. The limestone is crystalline, granular, white, clouded white, and blue in color. Idle. H. Cowell, of San Francisco, owner.

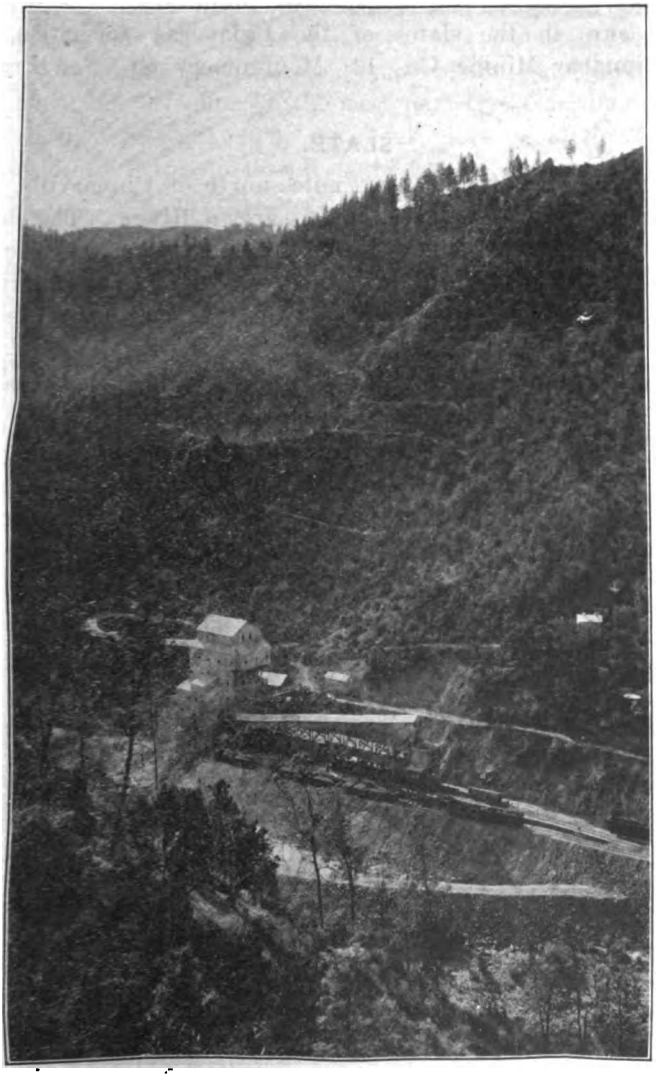
Mountain Quarries, owned by the Pacific Portland Cement Company, F. G. Drum, president; F. E. Erline, secretary; offices, 832 Pacific Bldg., San Francisco.

The Mountain Quarries are situated 6 miles northeast of Auburn, on the ridge south of the middle fork of the American River. The limestone occurs in the form of a lens in amphibolite schist. The general strike of this lens is north and south. The width of the deposit is from 300′ to 400′. Its depth has been proven to be 800 feet by means of diamond drill holes. The limestone is worked from an open quarry, the broken material falling through a 600′ shaft to ore bins in a tunnel, from which it is trammed a distance of 620 feet to storage bins located on the line of the Southern Pacific Railroad. The broken rock is shipped to the company's cement plant located at Cement, near Fairfield, Solano County. About 1200 tons a day are shipped from the quarries to this plant. 100 men are employed.

MARBLE.

Bind & Company, of Placerville, own a deposit of marble 2 miles south of placerville on Webber Creek. The color is white, mottled and blue gray. Undeveloped.

Hayward, Hobart and Lane Estates of San Francisco own a deposit of crystalline limestone at Indian Diggings, which is undeveloped on account of its distance from transportation.



View of quarry and loading bins, Mountain Quarries, El Dorado County. Pacific Portland Cement Co., owners. Photo by C. A. Waring.

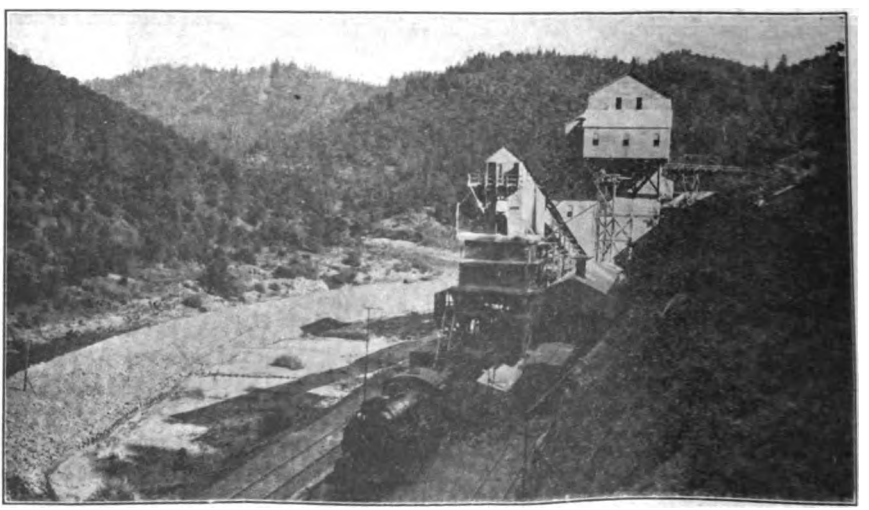
QUICKSILVER.

Bernard Cinnabar Mine. See Bulletin 27, p. 190; U. S. G. S. Mon. XIII, p. 384. It is located two miles west of Nashville, on Fanny Creek, south of Big Sugar Loaf Mountain. The deposit of cinnabar occurs in the slates of the Calaveras formation. Idle. Bernard Cinnabar Mining Co., 127 Montgomery St., San Francisco, owner.

SLATE.

California Slate Quarry. It is 2 miles north of Placerville, located on the north and south banks of the American River. The character of the deposit is a blue-black slate containing pyrite. The pyrite appears to be confined to certain layers of slate. The quarries are located on both banks of the river. Idle. N. L. Kohn, of Placerville, owner.

California-Bangor Slate Quarry. Situated 1 mile northwest of Kelsey, on Dutch Creek. The property consists of 432 acres. It is on the same belt of roofing slates as that of the Eureka quarry. The character is a blue-black slate of good quality, with a high tensile strength. The strike of the cleavage is S. 25° E. The quarry has not been worked for a number of years. California-Bangor Slate Co., 406 First National Bank Bldg., Oakland, owner.



View of storage bins of Mountain Quarries, El Dorado County. Owned by the Pacific Portland Cement Company. Photo by C. A. Waring.

Chili Bar Slate Quarry. See our Bulletin 38. Situated 2 miles northwest of Placerville, in Sec. 36, T. 11 N., R. 10 E. Idle. J. G. Mothersole, of Placerville, owner.

Eureka Slate Quarry. This property is situated 1 mile south of Kelsey and 7 miles north of Placerville. Comprises 640 acres of patented mineral land. The property was operated steadily from 1903 to 1909, and a very fine quality of roofing slate produced. The slate is blue-black in color, in the most part free from impurities, with a high tensile strength. The strike of cleavage is S. 25° E. The quarry opening on the north side of the cañon is 90′ high by 200′ long. The quarry on the south side of the cañon has a face over 200′ long and 70′ high on one end and 200′ high on the other end. This quarry has been sunk to a depth of 90′ below the cañon. The waste product from these quarries ran about 85%. The capacity of quarry when under operation was 100 squares of roofing slate per day.

Equipment: 150 h.p. compressor, 5 hoisting engines, slate trimming machines, saw tables, rubbing bed and planers. The product was transported from quarry by an aerial tram across the American River to Placerville. This tram is 3 miles long, there being a distance of 13,000′ between terminals, with 26,000′ of drawing rope; was operated by 35 h.p. Pelton motor. Water was secured from the Truckee General Electric Co. ditch, by pipe line 1½ miles long; with a head of 500′. Since the property was visited, operations have been resumed under the personal supervision of W. J. Dingee, 898 Monadnock Bldg., San Francisco, owner.*

*Since the above was written, it is stated that the Eureka Quarry has been sold (June, 1916) to the Sierra Slate Corporation, of New York. The new company expects to reopen the property on a large scale, and prepare for market from 1000 to 3000 squares per month. A "square" of slate is a sufficient number of pieces to cover 100 square feet of roof.

Eureka Slate Quarry, north of Placerville, El Dorado County.

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PLACER COUNTY.

By CLARENCE A. WARING, Field Assistant.

Field Work in October and November, 1915.

INTRODUCTION.

North of the "Mother Lode" region lies a district rich in mineral resources which needs only the stimulus of capital and stable, enterprising men to further develop its latent resources. Hydraulic mining, which occupied the early workers, is now "tied up" as it were, by federal antidebris legislation, which disheartened the operators and caused stagnation of the mining industry in general. Drift mining is

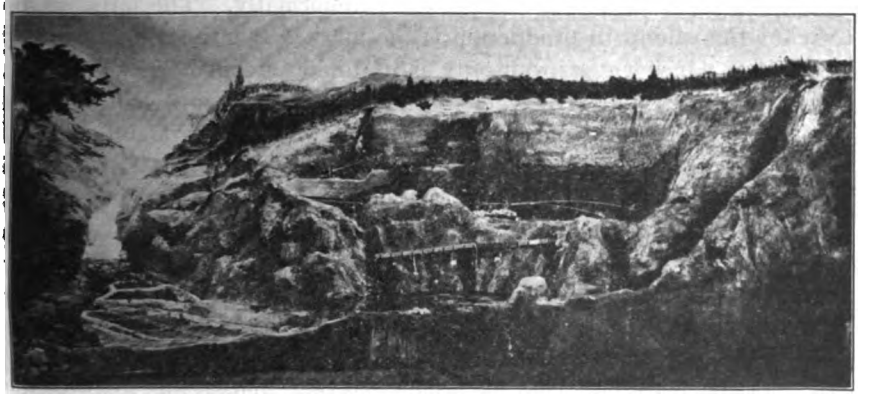

Photo No. 1. Model of a typical Hydraulic Mine of the Sierra Nevada Mountains. Installed by the State Mining Bureau in the Palace of Mines, Panama-Pacific International Exposition, San Francisco, 1915.

still being carried on and offers a few good opportunities. Quartz mining, with a few exceptions, is rather dormant and in need of capital to open up the prospects and old shafts, idle following a considerable period of depression.

Dredging is now one of the principal means of recovering gold in this region and holds considerable promise for the immediate future. The diversity of mining methods has made the work particularly interesting.

The writer has endeavored to obtain accurate information on prospects, as well as on operative mines, realizing that in the future our greatest resources lie in the many undeveloped and only partially prospected properties. It is to be regretted that time did not permit visits to many prospects which are no doubt worthy of note.

An attempt has been made to make this report a directory of all the mines in the counties covered, as well as reports on those which are active.

Acknowledgment is here made of the uniform courtesy and assistance of operators, employees and prospectors who made this report possible and made the work unusually pleasant.

Extending as it does, from the Sacramento Valley to the summit of the Sierras, Placer County offers a diversity of mining interests as well as a diversity of climate. In the middle fifties this county, with an estimated annual production of over $6,000,000* in gold, produced nearly one-tenth of all the yellow metal taken from the entire state. In 1914, with a production of $600,000 in gold, the county claims only about one-thirty-fifth of the total production. It is true that we had no dredgers in the early days, and these have maintained the high yearly state production. Considering, however, the fact that state production is only one-third what it was in the middle fifties, we see that the Placer County production has fallen off abnormally. The only reason seen for this slump in production is the marked inactivity of the drift and quartz mines which await only capital and enterprising, stable men to open them up and give a general feeling of confidence to the whole populace. The production table does not show a sudden decline in gold output; the decrease has been gradual but steady since 1894, and has fallen from $1,850,000 to $600,000, or to less than one-third in the last twenty years. Together with the decrease of gold production has been the shifting of population. Iowa Hill, which in 1859 claimed a voting population of 1249, now has only 69, and other mining towns have dwindled to small villages or disappeared entirely. Over 500 mining claims were recorded in 1887. Only 135 properties are now active, *i.e.*, being worked or having assessment work done. These are distributed as follows: 40 quartz, 44 drift, 15 placer, 3 dredge, 3 hydraulic, 1 asbestos, 2 chrome, 2 clay, 3 copper, 20 granite, and 2 magnesite. Of the 135 active properties, 64 were said to be producing in 1916 and are distributed as follows: 6 quartz, 18 drift, 12 placer, 2 hydraulic, 3 dredge, 2 chrome, 2 clay, 1 copper, 18 granite.

A revival of interest in mining is coming, in fact, many of the old properties are now being leased and work begun. This new activity will, no doubt, be more permanent than that of the old hydraulic days, and the mining industry will be on a firm foundation for years to come.

DESCRIPTION.

Name, derivation of.

Placer County derives its name from the Spanish word "placer," meaning a place where gold dust is found mixed with sand, earth or gravel.

*California Registers for 1856-7 and 1858-9.

Location and boundaries.

It was organized in 1851, and extends from Bear River and the north line of T. 17 N, southward to the American River and its middle fork. It is bounded by Yuba and Nevada counties on the north, by the state of Nevada on the east, by El Dorado and Sacramento counties on the south, and by Sutter County on the west.

Area.

The county embraces 1484 square miles, and has an average length of over ninety miles, and an average breadth of about 13 miles.

Population.

The census of 1910 placed the county thirty-first in rank with a population of 18,237. Auburn, the county seat, is a city of the sixth class, with a population of 2376 in 1915.

Valuation.

The assessed valuation of the county properties in 1915 was $14,947,936.

Topography.

The topography varies from a low valley land of 100 feet or more above sea level, about Roseville and Lincoln, to rolling foothills in the neighborhood of 1000 feet about Newcastle and Auburn, and rugged mountainous slopes about Alta and eastward which reach an elevation of over 7800 feet at Summit.

Vegetation.

The vegetation and forestry vary with the elevation. In the low western region the valley oaks predominate, while in the foothills the live oak and digger pine are plentiful. In the higher territory laurel oaks, bull pine, sugar pine and cedars predominate. Deciduous fruits and grapes do particularly well as high up as Colfax.

Drainage.

The county is well drained by the Bear River to the northwest, and by the American River with its numerous forks to the south, east and central parts. The extreme east drains by way of Lake Tahoe into the Truckee River, which flows into the state of Nevada.

Power.

The river system of Placer County is particularly well placed to furnish water capable of producing an enormous amount of hydro-electric power, besides being afterwards available for irrigation purposes. In the days of hydraulicking many large flumes and ditches were constructed to carry water for monitors, besides smaller ones for running water wheels to operate stamp mills and arrastras. At present the principal flumes have been taken over by the Pacific Gas and Electric Company which, with a system of artificial lakes, furnishes

a constant water supply to its many power houses which transmit electricity to the many cities of the Sacramento-San Joaquin Valley and San Francisco Bay regions. The northern and western portions of Placer County are thus well supplied by branches of the main power lines, one of which follows the railroad from Alta to Sacramento with power houses at Drumm, Alta, Auburn and Newcastle; another line from Colgate power house in Yuba County runs southward to Sacramento, crossing the county through Van Trent and Lincoln.

The eastern part of the county is less fortunate, but private capital has installed a small plant in Volcano Cañon which supplies electricity for lighting at Forest Hill and for the mines in that vicinity. A branch line of the Pacific Gas and Electric Company connects at Alta and passes eastward through Damascus and Forks House to the Black Cañon Mine near Westville.

Transportation.

The county is perhaps more fortunate than many others, since the main line of the Southern Pacific Railroad crosses its western end and follows along the full length of its northern side. A branch of the Southern Pacific from Roseville through Loomis, Lincoln and Sheridan to Marysville furnishes excellent transportation for the extreme western portion of the county. The Nevada County Narrow Gauge Railway from Colfax to Nevada City furnishes transportation in Placer County for a small region southeast of the Bear River and north of Colfax. Automobile and wagon roads traverse the county and follow the principal valleys and ridges, making most of the mines fairly accessible.

GEOLOGY.

Placer County furnishes an excellent field for geologic work, and although geologic maps[1] have been published of the whole region, there are many problems in geologic history which are open to discussion and intensive work. It is to be regretted that more detailed work has not been carried northwestward beyond the "mapped" limits of the Mother Lode (Folio No. 63) to determine more surely the possibilities of certain veins carrying mineral of commercial value with depth. It does not seem reasonable that a lode so persistent should hold out such excellent opportunities as far north as 120° 30′ and then disappear so suddenly or become barren, especially since the same granodiorite formation which underlies the Mariposa slates, diabase and amphibolite, is yielding such excellent returns in the region about Grass Valley. The fact is that veins do occur that have not been systematically mapped. Although the main "Mother Lode" is apparently shattered in the

[1]U. S. Geol. Survey, Folios Nos. 18, 39, 66 and reprints of 3, 5 and 11.

region north of 120° 30′, the main lode formations continue northward from Enterprise, Amador County, through Placerville and Georgetown, El Dorado County; Colfax, Placer County; Grass Valley and Nevada City, Nevada County, and northwestward towards Challenge, Yuba County. The special report[2] on the Grass Valley and Nevada City region is the only detailed area covered by the work done north of the area covered by the Mother Lode Folio, excepting that on the Ophir District[3] which can not, strictly speaking, be considered on the main lode. During the twenty odd years since the publication of these reports, the industry seems to have been left to take care of itself, and no detailed maps of the interlying vein systems have been made. To be of greatest economic value, geological reports should precede and point out opportunities rather than follow up development work which often depends on some accidental find which creates popular interest. Detailed reports on new territory should create an interest and lead to development work, should conditions warrant.

The reader is referred to the aforementioned Geologic Folios and Annual Reports for the geology of the county.

MINERAL PRODUCTION.

The mining industry in Placer County is confined at present to the production of gold, silver, copper, lead, clay and stone. The greatest value is obtained from the gold production. The silver and lead are derived from the refining of the gold and copper. The copper production for 1915 showed a decided increase over that for 1914 because of renewed activity by leasers.

Granite is quarried extensively in the region about Rocklin and furnishes building stone, monumental stone, and paving blocks. Clay is produced principally near Lincoln.

[2]Seventeenth Annual Report of U. S. Geol. Survey, 1895-6, Pt. II, pp. 13-263.
[3]Fourteenth Annual Report of U. S. Geol. Survey, 1892-93, Pt. II, 249-285.

PLACER COUNTY—Table of Mineral Production.

The following table shows the production of gold and silver since 1880, and the other minerals since 1894, as compiled from Mint reports and reports of the State Mining Bureau since 1894.

Year	Gold, value	Silver, value	Copper		Brick		Clay (pottery)		Lime and limestone		Stone industry, value	Miscellaneous and unapportioned		
			Pounds	value	M	Value	Tons	Value	Amount	Value		Mineral	Amount	Value
1880	$838,133	$640												
1881	850,000	6,500												
1882	800,000													
1883	810,000													
1884	887,820	5												
1885	906,301													
1886	1,071,663	1,397												
1887	855,510	556												
1888	850,000	1,000												
1889	1,245,491	1,975												
1890	1,008,602	1,045												
1891	998,495	5,921												
1892	1,159,080	2,120												
1893	1,351,250	616												
1894	1,851,215	664					22,000	$27,[illegible]60			$67,200			
1895	1,599,635	5,273					15,000	15,000			56,620	Asbestos	25 tons	$1,000
1896	1,674,844	6,690					10,000	10,000			44,216			
1897	1,524,941	6,784					7,500	7,500			39,412			
1898	1,498,022	5,670					12,000	12,000			29,833			
1899	1,100,081	1,206					15,000	15,000			61,525			
1900	986,155	12,058					15,000	15,000			115,669			
1901	900,745	4,888	11,200	$1,764			15,000	15,000			102,847			
1902	848,366	3,341	3,200	368			15,000	15,000			156,402			
1903	570,571	1,116	4,000	520			15,000	15,000	[1]1,500	$9,000	198,530	Platinum		280
									[2]4,000	4,000		Quartz		1,968
1904	778,355	9,320	600,000	76,500			16,100	16,100			123,448	Platinum		375
1905	597,798	8,041	367,250	57,291			20,000	10,000	[1]15,533	8,737	116,746	Platinum	2 ozs.	36
1906			200,000	38,600			20,000	15,000	[1]11,699	11,950	71,180	Platinum	.66 oz.	12
												Asbestos	50 tons	2,500
1907	482,772	3,338					20,000	20,000	[1]11,430	11,430	118,722	Asbestos	70 tons	3,500
									[2]38,869	79,768				
1908	358,006	2,194			13,000	$46,300	13,000	11,500	[1]1,727	1,710	178,469	Asbestos	50 tons	5,000

1909	281,372	1,492	----------	----------	2,083	52,300	45,300	35,250	[1]24,822	25,864	206,783	Unapportioned	1900-1909	862,362
												Asbestos	60 tons	6,000
1910	257.191	1,157	----------	----------	600	23,438	44,000	27,000	[1]10,000	12,100	242,773	Asbestos	200 tons	20,000
												Asbestos	125 tons	500
1911	251,298	2,585	118,624	14,828	700	18,000	43,120	29,200	----------	----------	218,951	Magnesite	300 tons	3,300
												Mineral paint	90 tons	584
1912	367,388	4,791	78,170	12,898	900	21,250	56,000	41,300	[2]222,595	200,000	231,415	Magnesite	50 tons	500
												Glass sand	1,000 tons	2,000
1913	220,785	2,972	429	67	1,900	40,000	63,600	47,200	----------	----------	205,749	Lead	805 lbs.	35
												Quartz	2,000 tons	4,000
1914	600,000	4,500	453	60	2,000	40,000	63,700	49,000	[2]202,575	202,575	208,598	Lead	385 lbs.	15
												Lead	711 lbs.	33
1915	414,319	24,543	*	*	2,000	40,000	49,126	37,536	[2]1,236	2,432	98,187	Unapportioned (copper, et al.)	----------	346,810
Totals	$30,775,784	$134,308	1,383,326	$202,896	23,183	$281,288	595,446	$486,086	569,566	$2,885,220	$2,885,220	----------	----------	$1,260,810

*Included in unapportioned.
[1]Barrels of lime.
[2]Tons of limestone.

MINING DISTRICTS.

Since few well defined mining districts exist in Placer County the following twenty-two districts have been selected from names in common usage throughout the region, together with those used on the books of the County Recorder of Placer County. Additions and changes have been made to a recent list[4] compiled from geographical names. The properties in *italics* are producing.

The **Blue Cañon** (Emigrant Gap) district includes all quartz, drift, and placer mines in the region about Blue Cañon. Slate and andesite are the prevailing formations. Active properties: Red Rock Quartz, Von Avery Quartz, Wild Yankee Drift and *Lost Camp* Hydraulic.

The **Butcher Ranch** district includes all quartz and placer mines in the region extending from Sheridan's and Oregon Bar, to and including Mammoth Bar on the middle fork of the American River. Diabase and slate are the prevailing rocks of the district. Active properties: Christmas Hill Quartz, Dewey Quartz, *El Dorado** and *Placer Dredge*, and *Pacific Dredge*.

The **Canada Hill** district includes all quartz, drift, and placer mines in the region about Canada Hill, Sailor Cañon, Secret Cañon, and Westville. It lies about 40 miles by wagon road about N. 78° E. of Colfax, which is the nearest railroad station on the Southern Pacific. Slate and andesite are the prevailing formations. Active properties: Black Cañon Quartz, Herman Quartz, Gold King Quartz, Golden Reward Quartz, La Trinidad Quartz, Prairie Flower Quartz, Canada Hill Drift, *Fulton* Drift, *Monumental* Drift, Reed Drift, and *Park* and *Brown* Hydraulic.

The **Cisco** district includes all quartz and placer mines in the region about Cisco. Slates, schists and granodiorite with andesite capping in places, are the formations represented. No operative properties.

The **Colfax** district (recorded as the Illinois district and includes the Capehorn district) includes all quartz mines and quarries in the vicinity of the town of Colfax, on the Southern Pacific Railroad, and placer mines on the Bear River and North Fork of the American River. Gabbro, diabase, serpentine, slate and amphibolite are the principal formations. Active properties: Big Oak Tree Quartz, Red Bird Quartz, *Collins* Placer, *Estey* Placer, *Gillett* Placer, *Thenis* and *Adams* Placer and Zelma Bell Placer.

The **Dairy Farm** (Van Trent) district includes the copper-gold mines in the region about eight miles east and northeast of Sheridan, which is on the Oregon branch of the Southern Pacific Railroad.

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[4]Bulletin No. 507, U. S. Geol. Survey, 1912, pp. 6 and 93–96.
*Italicized properties producing.

Amphibolite and diabase are the prevailing formations. Active properties: *Dairy Farm Copper,** Valley View Copper, and Bobtail Gold-Copper.

The **Damascus** (includes Pioneer district) district includes all quartz mines in the cañon of the North Fork of the American River, north of Damascus, and all placer mines in the region of Damascus and Red Point. The district lies about 18 miles N. 75° E. of Colfax. The automobile route is by way of Forest Hill, since the Iowa Hill wagon road is very steep. Slate capped in places by andesite are the prevailing rocks. Active properties: *Pioneer* Quartz, North Star Quartz, Eureka Drift, *Jarvis or Bob Lewis* Drift, Outhouse Consolidated or Sellier Drift, *Potato Flatiron* Placer, *West Chrome.*

The **Deadwood** district includes all the quartz, drift and placer mines on Deadwood ridge and in Indian Creek and the North Fork of the Middle Fork of the American River. The district lies east of Colfax and is reached by auto road, in dry season, by way of Westville, a total distance from Colfax of about 45 miles. A pack trail from Michigan Bluff cuts the distance from Colfax to 30 miles. Slate with andesite capping are the prevailing formations. Active properties: Rip Van Winkle, or Page and Buckman Quartz, and *Devil's Basin Consolidated* Drift.

The **Dutch Flat** (Gold Run, Towle) district, includes the drift and placer gold mines, the chrome mines and the asbestos mines in the region of the towns of Dutch Flat, Gold Run, Shady Run and Towle, all on the Southern Pacific Railroad. Gabbro, serpentine, slate and amphibolite, capped by andesite, are the predominating formations. Active properties: Rawhide Quartz, Federal Drift, *Dyer Drift,* Dutch Flat Drift, Haub Drift, Indiana Hill Drift, Moody Ridge Drift, *Stewart Drift,* Towle Magnesite, Morgan Asbestos.

The **Forest Hill** district includes all quartz, drift and placer gold mines on the Forest Hill divide, including those about the region of Bath, Baker Divide, Mayflower, Yankee Jim's, Spring Garden Camp, Todd's Valley and Paradise. The divide is reached by a 15-mile stage road from Colfax, or 30 miles from Auburn. Serpentine, slate and amphibolite, capped with andesite, are the prevailing formations. Active properties: *Dry Hill Quartz,* Eureka Consolidated Quartz, International Quartz, Mitchell Quartz, Dardanelles Drift, *Excelsior Drift,* Florida Drift, *Grey Eagle Drift,* Maus Drift, *Mayflower Drift,* Paragon Drift.

The **Gold Hill** district includes all quartz and placer mines and dredging ground in the region of Gold Hill and Virginia, 6 miles east of Lincoln. It includes the Belmont and Three Stars properties.

*Italicized mines producing.

Granodiorite is the country rock. Active property: *Gardella Gold Dredge.**

The **Hotaling** district includes the iron and limestone deposits in the region about Hotaling, 5 miles by road northwest of Clipper Gap, the nearest railroad station. Diorite, granodiorite and slate are the formations represented. No active properties.

The **Iowa Hill** district includes all the quartz, drift and placer mines north to the North Fork of the American River and along Shirttail Cañon and Indian Creek in the region about what is known as the Iowa Hill Divide, including Succor Flat, Wisconsin Hill, Independence Hill, Strawberry Flat and Monona Flat camps. The district lies about eight miles by road east of Colfax. Slate and amphibolite with andesite capping are the prevailing rocks. Active properties: Blue Wing Quartz, *Carey Drift, Dewey Drift, Mohawk Drift*, Penn Valley Drift, Santa Fe Drift, Union Drift, Waterhouse or Big Dipper Drift, Welcome Drift, *Booth Placer, Kinder River Placer, Pine Avenue Placer, San Francisco Placer,* Placer Counties Magnesite, *Turner* and *Butler* Chrome.

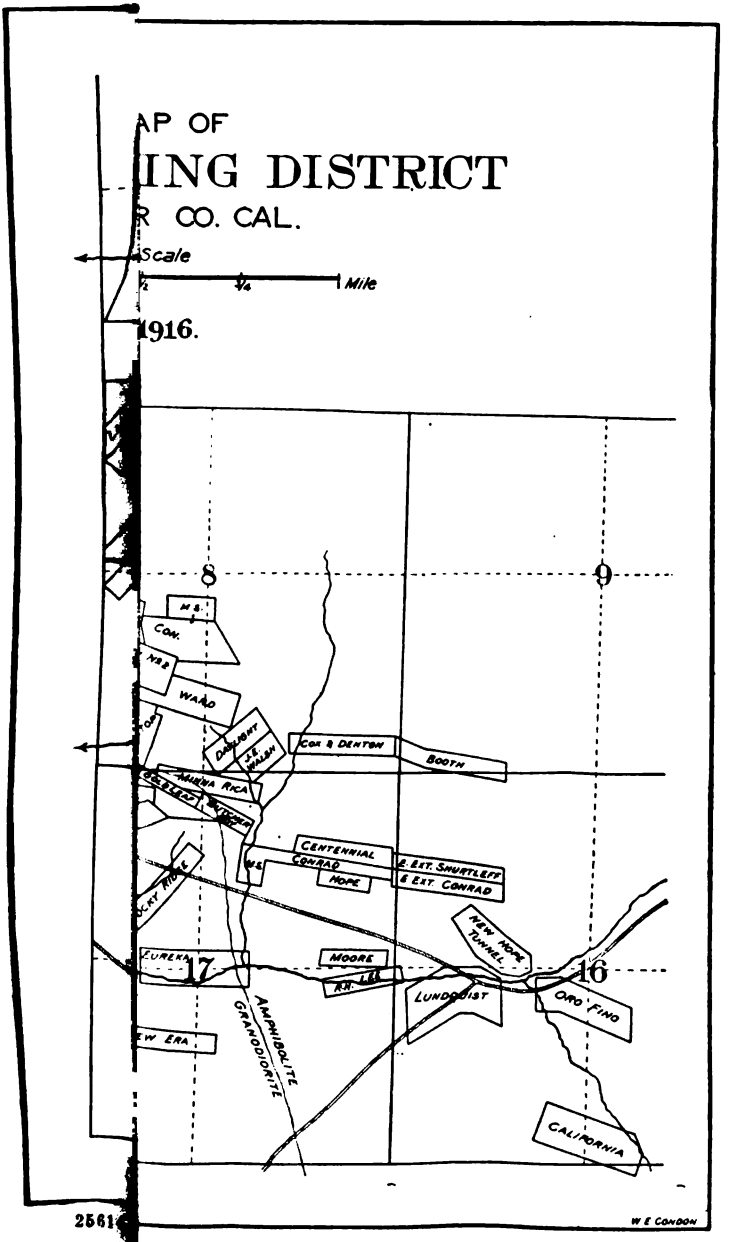
Bibl.: Rep. X, 1890, p. 419.

The **Last Chance** district includes all quartz, drift and placer mines in the region about Last Chance, Bald Mountain (Duncan Peak), and Duncan Cañon, including the Blue Eyes property, and the French Meadows region. The district is reached by trail 14 miles from Michigan Bluff, or by wagon road about 50 miles from Forest Hill and Bald Mountain. Slates with andesite capping are the principal formations. Active properties: Hermit Quartz, *Dixie Queen Drift, Glenn Consolidated Drift, Hometicket* Drift, Jack Robison Drift, *Pacific Slab* Drift, *Placer Gravel* or *El Dorado* Drift, Red Star Drift, *Park* and *Brown* Hydraulic, and Pine Nut Hydraulic.

The **Lincoln** district includes the region about the city of Lincoln, where clay and building stone are quarried. Eocene sedimentary rocks and andesite prevail. Active properties: *Gladding-McBean* Clay, *Lincoln* Clay.

The **Michigan Bluff** district includes all quartz and placer mines in the region of Michigan Bluff, Baker's Ranch and American Bar mine, near the Middle Fork of the American River. Serpentine, amphibolite and slate, with andesite capping are the common rocks. Active properties: Bunker and Nihill Quartz, Champion Quartz, Daniel Webster Quartz, Franklin Drift, Golden Sheaf Drift, Gorman Drift, Marian Drift, Swift Shore Drift, Turkey Hill Consolidated Drift, *Bogus Thunder Placer, De Maria Placer,* Lehigh Placer, and Pleasant Bar Placer.

Italicized mines producing.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NEW YORK TUNNEL
MOORE
R.H.
LUNDQUIST
ORO FINO
EUREKA
NEW ERA
AMPHIBOLITE
GRANODIORITE
CALIFORNIA
W E CONDON

The **New England Mills** (Weimar) district, includes all quartz mines in the region south of Powell Hill and about Weimar and Applegate. The mines lie chiefly east of the Southern Pacific Railroad. Placer deposits along the American River are also included. Slate and some intrusive serpentine are the principal formations. Active properties: Alameda Quartz, Annie Laurie Quartz, Big John Quartz, *Black Oak,** Quartz, Ruby Quartz.

The **Ophir** (includes Auburn) district lies south and west of Auburn and north of Newcastle. It includes all quartz and placer mines about Ophir and Duncan Hill. Granodiorite and amphibolite are the common country rocks. Active properties: Crandall Quartz, Eureka Quartz, Hathaway Quartz, Hope Quartz, *Little Banner Quartz, Oro Fino* or *Bullion Quartz,* Spanish Quartz.

Bibl.: Rep. X, 1890, pp. 427–430; Annual Rep. XV, U. S. G. S., Pt. II, 1892–3, pp. 243–284.

The **Ralston Divide** district includes all drift and placer mines along the divide between Long Cañon on the south and the Middle Fork of the American River on the north. The district is very inaccessible and is reached only by a steep trail 15 miles from Michigan Bluff or by a circuitous road via French Meadows, about 50 miles from Soda Springs Station near the Summit. Slate and andesite are the principal formations. Active property: *Ralston Divide Drift.*

The **Rock Creek** district includes all quartz mines north of Auburn, in the region south of the Hotaling district. Serpentine, diabase and amphibolite are the principal formations represented. No active properties.

The **Rocklin** (Loomis) district includes all granite quarries and placer deposits in the region about Rocklin. Granodiorite and andesite are the formations. Active quarries: *Alexson, Anderson,* Andrews, *California, Delano, Escola,* Griffiths, *Hebrick, Hendrickson, Huhtala, Leed, Oscar Kesti, Kesti, Liikola, Maki, Pacific, Pisila* and *Aho, Union* and *Wickman.*

The **Tahoe** district includes all the eastern part of the county adjacent to Lake Tahoe. It includes all gold and molybdenite prospects and mineral springs scattered throughout a large area of varied formations, chief among which are granodiorite and slate overlain by andesite and basalt. Active properties: *Chicago Quartz,* Joe Dandy Quartz, Lost Emigrant Quartz.

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*Italicized mines producing.

MINERALS AND MINES.

ASBESTOS.

The principal asbestos minerals are amphibole and serpentine. Tremolite and actinolite, two varieties of amphibole, are often found in such form that the fibres are fine, flexible, easily separated by the fingers and look like flax. These varieties are called "asbestos," "hornblende asbestos," or "amphibole asbestos," and are closely allied with the pyroxene and hornblende rocks. Chrysotile is a silky fibrous variety of serpentine which is superior in quality to amphibole asbestos. Chrysotile-asbestos so far as known occurs principally as "vein" or cross fibre, but also as "slip" fibre along fracture planes. Amphibole or hornblende asbestos is not known to occur other than as "slip" fibre. Chrysotile has been quarried in Canada to a depth of over 200 feet, and it is known to extend to a depth of over 400 feet. The deposits occur irregularly as a rule, and quarrying of large low-grade deposits is necessary to make such adventures paying or to properly develop the deposits. Exploration work by shafts is entirely misleading in determining the quantity in deposits of chrysotile. The deposits as a rule yield about 0.25 to 0.75 of one per cent chrysotile from the total rock quarried. The veinlets of chrysotile average $\frac{1}{4}''$ to $\frac{1}{2}''$ in width. The Canadian serpentine in which chrysotile occurs is of Cambrian age, while that in California is mostly Post-Jurassic or younger, geologically speaking.

As to acid-resisting qualities, amphibole asbestos is often preferable to chrysotile, since in order to resist acids the fiber should contain bases and silica in the proportion as 1:1. Chrysotile contains bases in the proportion as 3:2, and is attacked by very weak acids which dissolve the bases and leave almost pure silica without apparently destroying the fibrous condition. Boiling in dilute hydrochloric acid effects the same result. Chrysotile, however, withstands a temperature of 2000° to 3000° F. with no visible effect, although it becomes rather brittle upon losing a portion of its water of crystallization at high temperatures. Flame tests made by the writer on Canadian asbestos show that the tips of the fibers fuse and the fiber becomes very brittle in an ordinary Bunsen burner almost as easily as with specimens from California.

Bibl.: Mineral Resources of the U. S. 1914, Pt. 2, p. 98. Mines Branch Bull. No 69, Canada Department of Mines, 1910.

Large deposits of chrysotile occur in Shasta and Trinity counties and it is reasonable to expect economic deposits in and around the serpentine areas of Placer County. Although the California chrysotile is not so fine a product as the Canadian, it could be used for most building purposes.

The **Morgan Asbestos Co.** has opened up several small slip-fibre veins of amphibole (tremolite) asbestos, near a serpentine area south of Towle. The mineral has good acid resisting qualities but fuses rather easily. The fiber is long and of a lustrous gray-green color, silky and almost as fine as that of Canadian asbestos. It spins readily into very tough, flexible threads. Assessment work only was being carried on by the principal owner, Thomas E. Morgan, in the fall of 1915, but it is reported that an eastern asbestos firm has taken an option on the property and intends to open it up. The company office is at 1516 Franklin Street, Oakland.

The commercial application of tremolite is rather limited, but it could be used satisfactorily in the manufacture of fibrous wall powder and of mineral wool.

D. J. Sullivan, of Towle, and H. L. Kent and J. H. Johnson, of Auburn, are reported to have located deposits of asbestos and limestone near Towle, while **John McInnis,** of Forest Hill, is reported to have an asbestos prospect north of Butcher Ranch.

The **Placer County Properties Co.,** formerly the Sprague-Keasby Asbestos and Magnesia Co., have four claims along a ledge of white slip fiber tremolite asbestos, about ¼ mile east of Iowa Hill. The names of the claims from north to south are as follows: Blue Wing, Washington Consolidated, Dewey Consolidated and Clear Fiber.

Photo No. 2. View northeastward towards Iowa Hill, showing old hydraulic gravel banks. The X marks the outcrop of asbestos on the Blue Wing claim and approximately the location of the old Blue Wing or Ostrom quartz mine.

On the Blue Wing claims, in the SW. ¼ of NE. ¼ of Sec. 28, T. 15 N., R. 10 E., the asbestos ledge has been exposed in the bedrock of the old hydraulic workings and on the slope of the south side of the North Fork of the American River Cañon. It lies at the contact of serpentine to the west and Cape Horn slates to the east, is about 15 feet wide and exposed

for 100 feet. Specimens of the mineral from the northern exposure are a white, flax-like fiber about eight inches long, which does not fuse readily, is flexible and fairly strong. The same ledge is exposed in a small ravine on the Washington Consolidated claim. Where exposed to the surface waters, the asbestos is entirely changed to silica, but retains the fibrous structure to some extent, resembling silicified wood. The ledge is similarly exposed on the north side of the Dewey Consolidated claim, but is probably not over 6 feet wide. The same ledge is said to be exposed on the Clear Fiber claim to the south, and is said to be cut through by the old drift tunnel of the Morning Star mine in Indian Cañon.

The nearest shipping point is at Colfax, 8 miles by steep mountain roads. No development work to speak of has been done. A 20-foot tunnel run into the ledge on the Washington Consolidated claim is caved. A shaft on the Blue Wing claim would probably be the more successful means of development.

The four claims include about 164 acres. S. M. Sprague, manager, Auburn; Mrs. Gertrude Shelley, secretary, 326 Ochsner Building, Sacramento, Cal.

BRICK AND CLAY.

Sand and clay suitable for brick, terra cotta, tile, etc., underlie a considerable territory in the region about Lincoln. The greatest initial expense is that of opening up the pits so that the clay may be quarried conveniently and cheaply. The best clay beds lie at depths of from 10′ to 50′ below the surface and are of upper Eocene, or Ione age.

Gladding, McBean and Co., have a large plant at Lincoln, where they make a specialty of architectural tile and brick, vitrified sewer pipe, tile, etc. The plant is at an elevation of 170 feet and occupies about 25 acres, while the company holds about 400 acres of clay lands in Secs. 4, 9 and 10, of T. 12 N., R. 6 E., M. D. M. Water is obtained from the Lincoln gravity system from the South Yuba Ditch of the Pacific Gas and Electric Co. The company was organized in 1875, incorporated in 1886 and has operated continuously for forty years.

The clay beds in the different pits vary considerably in both quality and thickness. A section in the north pit shows soil 2′, volcanic breccia 10′, fireclay 10′, pipe clay 6′ and fine, white terra cotta clay 20′. The south pit is being worked by teams and hand labor and shows soil 1′, volcanic breccia 12′, light sandy clay 8′, fine sand 4′, sandy yellow clay 7′, sandy clay and gravel 6′ and clay below. Photo 6 shows how the material is worked in benches and loaded directly onto the cars which transport it to bins adjoining the manufacturing plant. The steam shovel is shown at work stripping off the volcanic breccia, which is broken

Photo No. 3. Hobart Building, San Francisco, faced with architectural terra cotta, manufactured by Gladding, McBean & Co. plant at Lincoln, Placer County.
Photo by Walter W. Bradley.

up by blasting and dumped as waste from a spur track to the north. At the pit illustrated, the sequence of rock strata is as follows: andesite capping 10′, fine sand 16′, gravelly clay 15′, pottery clay 20′ or more, underlain by a bed of lignite. The occurrence of small rolling knolls on the valley plain, indicating a doming of the sedimentary strata, brings the clay beds nearer the surface and permits of better drainage for the pits which can be worked only during the dry season.

The clay is handpicked at the pit and transported to the plant, where it is ground and tempered, then pressed by machinery and moulded by hand. The raw forms are then dried in heated rooms and later burned in kilns. Seventeen kilns are used for sewer pipe and brick and fifteen for architectural terra cotta. Electricity, steam and air are used for power, and oil for fuel. About 200 men are employed, including architects, foremen, pressers and common labor. Quarrying of the clay costs from 5 to 6 cents per ton, stripping off the andesite costs about 4 or 5

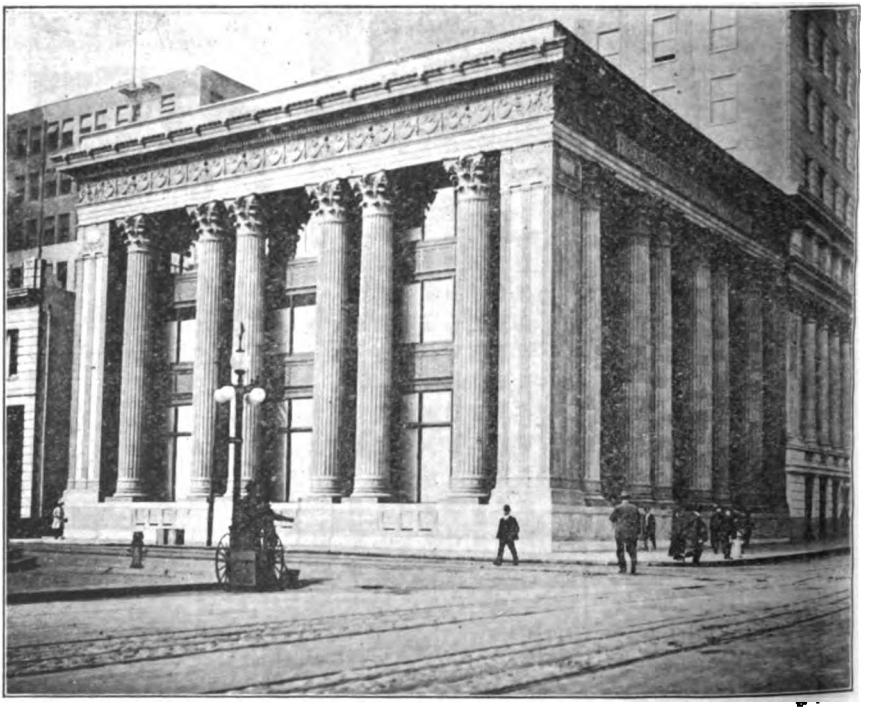

Photo No. 4. Headquarters of Firemen's Fund Insurance Co., San Francisco, faced with architectural terra cotta manufactured by Gladding, McBean & Co. plant at Lincoln, Placer County. Photo by Walter W. Bradley.

cents per ton more. The clay, ground and delivered to the presses, costs about 65 cents per ton. About 600 tons per day are taken from the pits during the dry season.

Owned by Gladding, McBean and Company, 311–317 Crocker Building, San Francisco; president, P. McBean; vice-president, A. J. Gladding; secretary, Athol McBean.

Bibl.: Rep. X, 1890, p. 415 and Plate I. Bull. 38, 1906, pp. 219, 220.

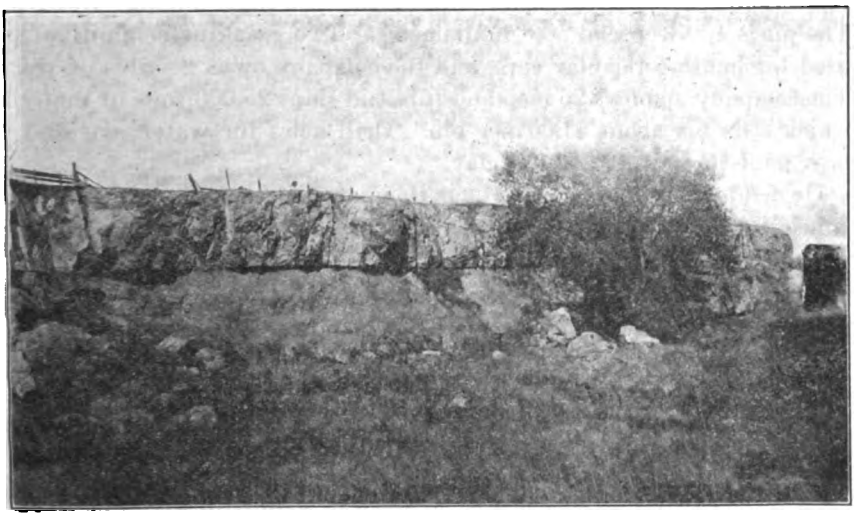

Photo No. 5. Old northern pit of Gladding, McBean & Co., two miles north of Lincoln; showing andesite capping.

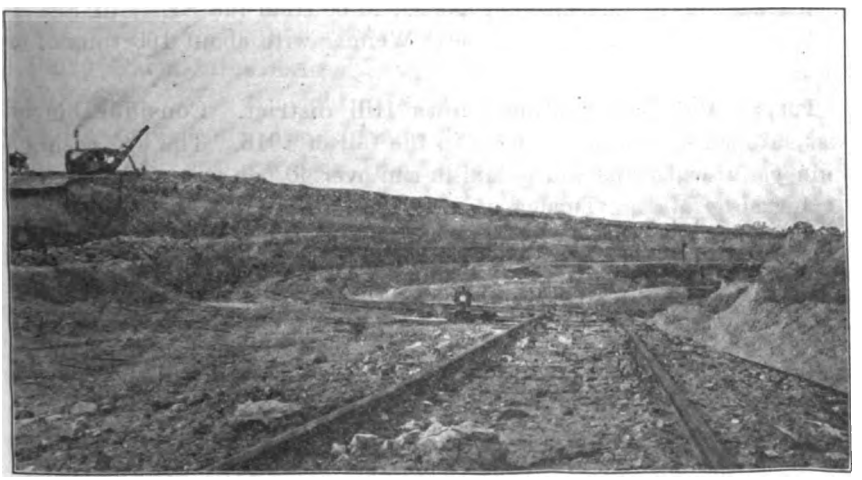

Photo No. 6. Main clay pit of Gladding, McBean & Co., one and one-half miles northwest of Lincoln, Placer County; showing method of working.

The **Lincoln Clay Products Company** property is located 2 miles northwest of Lincoln at an elevation of 130′. They hold 237 acres in the north half of Sec. 4, T. 12 N., R. 6 E., M. D. M. The deposits are similar to those nearer Lincoln, and the product is all shipped, no manufacturing being carried on. The clay is quarried by hand labor, loaded on dump cars, elevated by a 20 h.p. electric hoist to a platform, weighed and loaded directly into railroad cars for shipment. A $\frac{1}{8}$ mile spur

track connects with the main line of the Southern Pacific Railroad. The pit is 40′ deep and 500′ in diameter. Two gasoline locomotives are used for hauling the clay cars, and the company owns 2 miles of track. The company employs 25 men and it is said ships 25,000 tons of material which sells for about $1.00 per ton. Drill holes for water are said to have gone through 112 feet of clay.

Owned by Lincoln Clay Products Company; M. J. Dillman, president. Lincoln; Ed. S. Brown, secretary, Sacramento.

Other deposits of clay have been reported[5] in the region of Dutch Flat and Shady Run, and on Rich Flat south of Auburn. These still lie undeveloped on account of the limited demand for such materials.

CHROMITE OR CHROMIC IRON.

Several small detached deposits of chomite in or near areas of serpentine have been reported. One of these about 2½ miles from Dutch Flat is said to have about 400 tons of ore in sight. Two small deposits are reported on the Forest Hill divide, one of which is being prospected by John McInnis, of Forest Hill. Specimens have also been seen from a deposit reported by S. P. Collins to be one mile from Auburn. A specimen from Mr. R. L. Dunn is reported to be from the SE. ¼ of Sec. 21, of T. 14 N., R. 9 E., M. D. M., near Weimar with about 100 tons of ore in sight.

Turner and Butler Mine. Iowa Hill district. Considerable ore was shipped from this property in the fall of 1916. The ore occurs as kidneys in serpentine and is said to run over 40 per cent chrome.

Owned by Messrs. Turner and Butler of Iowa Hill.

West Chrome Mine. Damascus district. Ore was shipped in the fall of 1916, from the property of Wm. West in the Green Valley region, 9 miles southeast of Towle. The property was leased by the California Manganese Company, who packed the ore on mules 6 miles and then hauled it to Towle station on the Southern Pacific Railroad. Three men were employed at the mine. It is said that about 100 tons of ore were available at the property and the cost delivered at the railroad was $5.00 per ton.

COAL.

A bed of lignitic coal underlies the clay beds northeast of Lincoln in Sec. 9, T. 12 N., R. 6 E. The bed is of upper Eocene or Ione age and is from 5′ to 12′ thick. The quality of the coal is too poor to be marketable and all enterprises so far have been unprofitable.

Bibl.: Rep. VII, 1887, p. 151. U. S. G. S. Folios 3, 5 and 11, 1894. Reprinted 1914, Sacramento, p. 4.

[5]Bull. No. 38, Cal. State Min. Bur., 1906, pp. 218–220.

COPPER.

The Sierra Nevada Mountain range includes a copper belt[6] "which uns for about 500 miles through the eastern side of the state, with a ridth of from 50 to 75 miles. The deposits are mainly concentrated long a mineral belt which appears high in the range to the north, sweeps outheastward toward the central valley of the state, and then continues or about 300 miles southeasterly through the western foothills, to disppear in Kern County near the southern end of the range." From levada County southward this is known as the Foothill Copper Belt, nd all the deposits in western Placer County are included in this belt.

The **Algol** prospect, in Sec. 9, T. 13 N., R. 7 E., M. D. M., about miles northeast of Lincoln, has been abandoned. Mineralized lenses f ore varying from 20″ to 10′ in width were encountered. The develop- ent work consisted of two 120′ shafts, with 200 feet of drifts. The ore s malachite, with some native copper and gold. Seven shallow shafts unk at intervals, south of those on the Algol property, towards Coon reek, and outcrops of copper bearing rocks on the Lardner and Keiler anches, probably indicate the continuation of the same copper bearing ormation.

The **Big Pine** prospect in Sec. 16, T. 12 N., R. 8 E., M. D. M., has 170-foot shaft. Considerable chalcopyrite was encountered. Idle.

The **Dairy Farm Mine** located in the SW. ¼ of SE. ¼ of Sec. 27, . 14 N., R. 6 E., M. D. M., eight miles northeast of Sheridan has been orked since 1913, under lease by the Van Trent Mining Company, r. M. A. Newman, manager, Van Trent, Placer County, California. It s owned by the Dairy Farm Mining Company, E. B. Braden, president, 12 Merchants Exchange Building, San Francisco.

The property includes 160 acres of patented land south of the Bear iver from which water is obtained. Electric power is obtained from he Colgate branch of the Pacific Gas and Electric Co.

The mine was first worked for gold and silver, which occurred free ith iron oxides. At about 85 feet in depth sulphides were encountered hich averaged about 3% copper, with occasional values in gold. The ine has been worked principally for copper ever since, and the 100-ton apacity cyanide plant has fallen into disuse. The ore occurs as lens-haped bodies in amphibolite schist. The main ore body varies from 0′ to 60′ in width and strikes N. 2° W., with a dip of about 60° E.

The present workings consist of a 3-compartment incline shaft to a epth of 590 feet, with about 1000 feet of drifts, cuts and raises on each evel. Stoping is at present being carried on in the 200 and 300-foot evels, and about 500,000 tons of ore is blocked out. The shrinkage

[6]Bull. No. 50, 1908, p. 174.

system of mining is used, and about 150 tons of wall rock is taken ou to every 350 tons of ore.

The mine is equipped with a 600-ton hoist, a 70-foot, 4-post head fram and a 1200 cubic foot Laidlaw-Gordon air compressor, with 12 Waug and Water-Leyner drills. The ore is crushed with a 14" x 24" Buchana crusher and raised by a 125' link line elevator. The ore is sorted on 40-foot hand conveyor and the tailings carried away on a 200-foot wast conveyor.

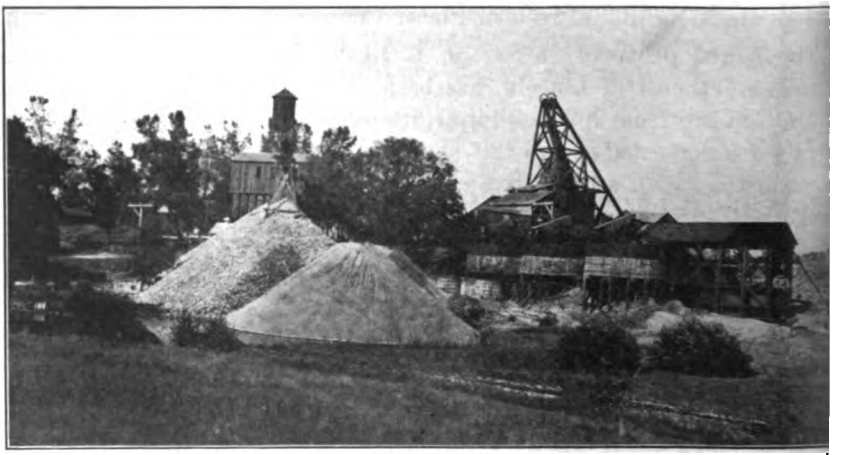

Photo No. 7. Dairy Farm Mine, eight miles northeast of Sheridan, Placer County. The on producing copper mine in Placer County in 1915.

The ore is transported by a narrowgauge railroad to a point northwe of Sheridan, whence it is shipped by the Southern Pacific Railroad t Richmond. The ore is finally shipped by steamers to Oregon, where is smelted. About 45 men are employed in the mine and 30 on to including those on the railroad. About 350 tons of ore are taken ou each day and the expense, delivered at the cars near Sheridan, is said t be less than $1.70 per ton. Timber for the mine is shipped from Sa Francisco and costs from $15.00 to $18.00 per thousand feet laid dow at the mine.

Other copper mines† and prospects which have not been operated i recent years are as follows:

The **Davenport** prospect, located in Sec. 15, T. 12 N., R. 8 E., a prospect 1 mile south of Auburn. The ore consisted of chalcopyrit malachite, with some iron oxides and pyrite in slate. The ore bod strikes S. 3° E. and is about 2 feet wide. Development consists of 70-foot incline shaft. Equipment consisted of a small hoist operated b a 10 h.p. steam engine. N. E. Davenport, Sacramento, owner.

†Bull.. No. 50, 1908, pp. 205–211.

The **Elder** prospect, in Sec. 4, T. 13 N., R. 6 E., is 4½ miles west of Clipper Gap, at an elevation of 1550 feet. The ore consisted of chalcopyrite, malachite and cuprite, with some pyrite and iron oxide. The wall rock is diorite and granodiorite. The ore body strikes N. 5° W., and dips 80° E. Development consists of a 25-foot vertical shaft. Idle.

Globe Consolidated. Ophir district. Sec. 8, T. 12 N., R. 8 E., M. D. M: Development work consists of a 250′ incline shaft. The ore was malachite and chalcopyrite associated with pyrite. Three shifts of 5 men each were worked for a few months in 1916 by leasers who are said to have shipped 2 cars of ore to Kennett, Shasta County.

Owned by C. R. Tracy, Auburn, California.

The **Greenhorn** prospect is located on the west side of Greenhorn Creek, near its confluence with the Bear River. The prospect shows disseminated chalcopyrite near a serpentine-slate contact. The prospect is near the road from Colfax to You Bet.

The **Nevada Mining Company,** L. G. Schuster, of Auburn, manager, have prospected in Sec. 32, T. 14 N., R. 8 E., M. D. M. The ore consists of chalcopyrite and malachite, with some pyrite and iron oxide present. The ore body, at the contact of diorite and slate, strikes N. 50° W. and dips 30° E. Development consists of a 55-foot, two-compartment shaft.

The **Thomen** prospect is located 8 miles north of Auburn, in Secs. 4 and 5, T. 13 N., R. 8 E., M. D. M. The ore consisted of chalcopyrite and malachite with some pyrite and iron oxides present. The ore body, in schist, strikes N. 5° W. and dips 80° E. Owned by A. Thomen, of Auburn. Idle.

The **Valley View or Whiskey Diggings** mine is located in Sec. 24, T. 13 N., R. 6 E., M. D. M., 6 miles NW. of Lincoln, at an elevation of 400 feet. The property is owned by the Western Consolidated Gold and Copper Co. F. K. Lippitt, president, Petaluma; Mrs. Edith Lockwood, secretary, Bacon Block, Oakland. It includes 90 acres of patented land. The lode, as indicated by gossan on the surface, is reported to be 200 feet wide and 1000 feet long. The ore consists of chalcopyrite, cuprite and some native copper, associated with pyrite and iron oxides, and some zinc sulphide. It is low grade and much the same kind of ore as produced at the Dairy Farm mine. The ore body strikes N. 60° W. and dips 72° NE. in schist. Development work consists of a 170-foot shaft and 400 feet of adits. Equipment consists of a hoist and two 5-foot Huntington mills. The mine was worked at first for gold, which occurred free in the gossan near the surface. Sulphides were encountered

at depth. Sixteen men were employed in September, 1916. Reported sold to J. E. Landis and W. C. Gaylord, in March, 1916, for the Guggenheim interests.

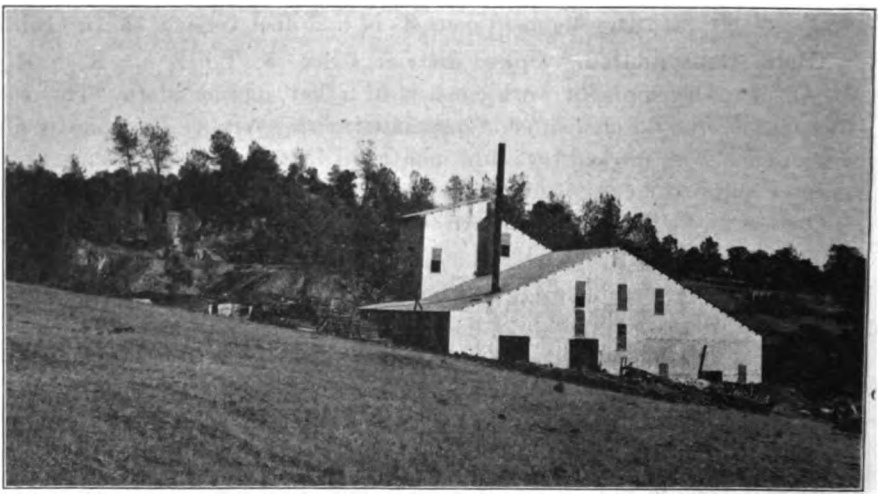

Photo No. 8. Valley View Mine, or Whiskey Diggings, six miles northeast of Lincoln, Placer County.

GOLD, SILVER AND PLATINUM.

DISTRIBUTION.

Gold and silver in Placer County occur in quartz veins and in gravels. The quartz veins occur generally in three belts, in which they are irregularly scattered. The belt which lies in the main line of the "mother lode" follows the Mariposa slates, the continuity of which is broken north of Garden Valley, El Dorado County, where the Middle Fork of the American River cuts across it. These slates, however, reappear in considerable area north of the river, especially east of Weimar, and continue unbroken northward to Colfax. The same enriched belt in diabase, granodiorite and amphibolite, may be traced northwestward through Grass Valley, Nevada County, and Challenge, Yuba County.

East and west of the main belt are two offshoots of the main vein system which, so far as present development shows, are more productive than the "mother lode" in Placer County. The eastern branch diverges southeast of Georgetown, El Dorado County, and is traced by a belt of serpentine, gabbrodiorite and amphibolite, which pass under the Forest Hill and other divides and reappear along the line of the following localities: Drummond Mine; Succor Flat; just west of Hayden Hill; south of Towle; west of Washington, Nevada County; and through Alleghany, Sierra County.

The western branch begins to diverge southwest of Placerville, El Dorado County, and passes northwestward through Ophir, Placer County, and Albin Hill and Brown's Valley, Yuba County.

Considering this vein system as a whole, one is impressed with the variations of country rock in which the enrichment occurs. These range all the way from the very basic peridotites and serpentines, through the less basic diabases and more acid granodiorites. The concentrated occurrence of the yellow metal seems to be due more to some little known process of magmatic segregation rather than to influences of the country rock through which it is disseminated. The only influence that the country rocks seem to have had has been the later secondary enrichment or impoverishment of the original ore bodies.

The original source of the platinum has not been definitely ascertained, although it is thought to occur disseminated in the more basic rocks. It is found, thus far, only as placer along with the gold and silver.

The gold in the gravel deposits was originally washed from the quartz veins during the process of erosion. It became concentrated in the river channels by long periods of stream erosion and re-erosion as the mountains were being uplifted and reshaped during periods of crustal movement of the earth. When the Sierra Nevada Mountains were finally uplifted, these river beds were raised high and dry and were covered over in many places by volcanic flows of lava, mud and tuff, which have served to cap large deposits of the gravels and prevent their erosion. Modern streams have cut through these lavas and ancient river channels and have gone on concentrating the gold just as it was concentrated before the uplift. These ancient gravel channels have been worked successfully both by hydraulicking and by drifting, the latter method being used where the capping is hard and thick. The former method can now be carried on only when suitable restraining dams are built for storing the tailings to prevent injury to navigable streams or their adjacent lands.

QUARTZ MINES.

Adams Mine. Ophir district. Sec. 20, T. 12 N., R. 8 E., M. D. M. 2½ miles southwest of Auburn. Elevation 1,050 feet. Fifteen-inch vein of quartz with galena and sulphurets in slate. Strike E.-W., dip 60°. 200-foot shaft. Idle. Owned by Calvin T. Adams, Newcastle.

Alameda Mine. New England Mills (Weimar) district. Sec. 25, T. 14 N., R. 9 E., M. D. M. Elevation 1400 feet. 120-foot dike in slate, carrying disseminated quartz, galena and iron. Strike N.-S. Dip 45° E. Open cut 600-feet and tunnel 275 feet. Assessment work

only. The Long Point mine adjoins it to the south. Owned by J. F. Wise and Martin Partridge, of Colfax.

American Bar Mine. Michigan Bluff district. Sec. 33, T. 14 N., R. 11 E., M. D. M. Elevation 1800 feet. Two miles SW. of Michigan Bluff. Quartz with galena and pyrite in slate. Strike N.-E., dip S.-E. Shaft forty feet and tunnel 1950 feet. Water ditch three miles from Stitchner's Gulch. Idle for past 15 years, except a little prospect work. Owned by J. A. Shields, Josephine Mine, El Dorado County.

Annie Laurie Mine. New England Mills (Weimar) district. Secs. 24 and 25, T. 14 N., R. 9 E., M. D. M Elevation 2000'. One hundred-foot dike, carrying free gold and sulphurets in quartz stringers. Strike NW.-SE., dip 40° E. Tunnel 50 feet. Assessment work only. Alameda Mine adjoins to the south. Owned by R. H. Young and E. Vore, of Weimar.

Bazacoo Mine. Butcher Ranch district. Secs. 22 and 26, T. 13 N., R. 9 E., M. D. M. Elevation 1700 feet. Eighteen-inch vein of ribbon quartz in slate. Strike NW.-SE., dip NE. Shaft 40 feet. Tunnel 400 feet. Patented. Idle. Owned by Sheridan Bros., Butcher Ranch.

Beauty Mine. Canada Hill district. Sec. 9, T. 15 N., R. 13 E., M. D. M. Elevation 6200 feet. A 2-foot quartz vein in slate, carries free gold with some galena and pyrite. The vein can be traced for 130 feet on the surface. It strikes N. 45° E. and dips 70° W. A 180-foot tunnel crosscuts the vein and 50 feet of drifting on the vein has been done. Equipped with hand outfit, windlass and shed. Ore averages $10.00 per ton. Claims called the Beauty and Big Beauty. Assessment work only. Owned by Henry Snyder, of Grass Valley, Cal.

Belle Union Mine. New England Mills (Weimar) district. Sec. 35, T. 14 N., R. 9 E., M. D. M. Two miles SE. of Weimar. Elevation 2000 feet. Eight feet of broken slate and quartz along a fracture in slate. Strike NE.–SW. Dip 80° SE. Tunnel 295 feet. Water power. Idle. Owned by D. Jones, Clipper Gap.

Belvoir Mine. Ophir district. Sec. 18, T. 12 N., R. 8 E., M. D. M. Elevation 1000 feet. Quartz vein carrying free gold and pyrite in granodiorite. Strike NE.–SW., dip 45° SE. Shaft 180 feet. Tunnel 800 feet. Steam power. Idle. Owned by J. Kaiser, Ophir.

Big Blue Mine. Dutch Flat (Gold Run) district. Sec. 3, T. 15 N., R. 10 E., M. D. M. Two miles NE. of Gold Run. Elevation 3050 feet. Five-foot quartz vein with galena and sulphurets. Strike N.–S., dip E. Shaft 170 feet. Idle. Owned by Moody and Garety, of Gold Run.

Big John Mine. New England Mills (Weimar) district. Sec. 25, T. 14 N., R. 9 E., M. D. M. Three miles east of Weimar. Elevation

,200 feet. Claims Tiger, Buena Vista, Ruby and Blue Bell. Twenty-oot dike with amphibolite footwall and slate hangwall. Strike N.–S., lip 45° E. Development consists of 50-foot open cut and 75-foot unnel, also 20-foot shaft and 90-foot incline. Take out enough gold ach year to pay for assessment work. Owned by Ed. Bigley, E. B.)dell, M. L. Odell and E. H., J. A. and M. A. Hinchey, of Weimar.

Big Oak Tree Mine. Colfax district. SE. ¼ of Sec. 33, T. 15 N., ?. 9 E., M. D. M. One mile west of Colfax. Elevation 2300 feet. Eighteen-inch vein of quartz, carrying free gold and pyrite, in diabase. Strike NE.-SW., dip 80° N. Incline shaft 180 feet. Drift of 40 feet on 120-foot level. This mine was closed about 1888 by an injunction obtained by the Rising Sun Mine, the owners of which claimed that the Big Oak Tree vein was a fork or spur of the Rising Sun patented vein, which lay between two of their north-south veins.

Three shifts of four men each were engaged in pumping out the Big Oak Tree mine during the months of September and October, 1915. An assay made for the writer of the mineralized quartz taken across the vein when the mine was pumped out ran $0.80 in gold per ton. Installation of new machinery with electric power was contemplated. Owned by J. C. Valentine of San Francisco. Leased by a Colfax syndicate, of which D. A. Russell, D. Falconer, D. A. Gillen and J. Toman, of Colfax, are the board of directors.

Black Cañon Mine. Canada Hill district. Secs. 2, 3 and 10, T. 15 N., R. 12 E., M. D. M. Three miles east of Westville. Elevation 5,500 feet. Quartz ledge in slate and metamorphic-sandstone, carries free gold and pyrite. Development work consists of a 300-foot shaft and two tunnels: No. 2, 400 feet long, and No. 3, 200 feet long. Equipment of the mine consists of an Ingersoll Rand Imperial Compressor, capacity 650 feet of air per minute, which runs air drills, a piston machine and a jack hammer at 90 pounds pressure. The 37 h. p. electric hoist is good to a depth of 500 feet. The 20-stamp mill, run by two 25 h.p. motors, has 1050 pound stamps or a capacity of 50 tons of ore per day. A 10″ x 12″ jaw crusher is run by a 10 h. p. motor. Power is secured by a 13-mile line from the Pacific Gas and Electric Company, at Alta. A 100 h. p. transformer is installed near the mine. Water is pumped by a 5 h. p. motor from Black Cañon Creek for the compressors, the overflow running to the batteries. There is plenty of pine timber on the property, and a sawmill is operated by the mine. The ore in the chutes averages $7.00 per ton, while the balance averages about $1.00 per ton. Probably an average of all the ore milled would be $3.00 per ton. Mining and milling costs about $2.20 per ton. The property has a shop, 26-room bunkhouse, large dining-room, and office. Owned by E. C. Cavanaugh and Judge Aiken Estate, of San Francisco, and the Dickson

Estate, of Titusville, Pennsylvania. J. Cullen, San Francisco, secretary; E. B. Quigley, superintendent and manager, Westville.

Black Oak Mine. New England Mills (Weimar) district. Sec. 35, T. 14 N., R. 9 E., M. D. M. Three miles south of Weimar. Elevation 1875 feet. Three-foot quartz vein carrying 3% sulphurets in slate. Strike N. 10° E., dip 65° E. Tunnel 150 feet, run to cut ledge. Drift N. 400 feet and S. 600 feet. Old shaft sunk in north drift. Equipped with tracks and push car. The Northern Light property adjoins the Black Oak to the northeast. Four men have been cleaning out the old workings preparatory to opening them up. Owned by Drexler Estate of San Francisco ⅜, Mr. Wyman, of Applegate, ⅛, and J. A. Graves, of Weimar, ½. Leased to John and Ed. Major and Frank Cannon, of Weimar, who have temporary quarters just south of the mine.

Black Spanish No. 2. Ophir district, Sec. 7, T. 12 N., R. 8 E., M. D. M. Quartz vein in granodiorite. Idle. Owned by J. E. Walsh, East Auburn.

Blue Bell Mine. Dutch Flat district. Sec. 3, T. 15 N., R. 11 E. Elevation 3000 feet. Two and one-half miles southeast of Shady Run. Four-foot free milling quartz vein in slate. Developed by tunnels. Patented. Idle. Owned by A. Percival Crittenden, of Towle.

Blue Wing or **Ostrom Mine** (formerly the Pritchard Gravel Mine). Iowa Hill district. Sec. 28, T. 15 N., R. 10 E., M. D. M. One and one-half miles NE. of Iowa Hill. Elevation 2800 feet. Twenty-foot quartz vein, with some free gold and sulphurets, between slate and serpentine. Strike N. 35° E. Dip 38°. Tunnel 150 feet. Shaft 30 feet. Claims, Blue Wing and Wolverine. The vein outcrops for about 500 feet, and is exposed both in the bedrock of the old hydraulic works and on the side hill which slopes steeply down to the American River. So-called assessment work is done yearly. An asbestos ledge claimed by the Placer County Properties Company is exposed about 100 feet west of the quartz vein. Water is available from the Gleason ditch, about ¼ mile east. Owned by W. A. Hilliard, of Grass Valley.

Bobtail Mine. Dairy Farm district. Sec. 18, T. 13 N., R. 7 E., M. D. M. Seven miles northeast of Lincoln. Elevation 500 feet. Three-foot quartz vein with diorite foot wall and slate hanging wall. Strike NW.–SE., dip NE. Shaft 60 feet. Drift 90 feet. Hand work, with windlass. Ore said to run about $10.00 per ton. Owned by Wm. Recknagel, of Auburn, who thinks the ledge is very much like that at the Dairy Farm.

Bonanza Mine. Damascus district. Sec. 11, T. 15 N., R. 11 E., M. D. M. One mile northeast of Damascus. Elevation 3200 feet. Four-foot quartz vein carrying free gold. Slate wall rock. Shaft 60

feet and one tunnel. Idle. Owned by Jerry J. Sullivan, San Francisco.

Bibl.: Placer County Register of Mines, 1902. State Min. Bur.

Bonnie Bee Mine. Blue Cañon district. Sec. 3, T. 16 N., R. 11 E., M. D. M. Three miles northwest of Blue Cañon. Elevation 3,450 feet. Three quartz veins, 4 feet, 6 feet and 12 feet wide; carrying free gold and sulphurets, in slate. Strike NW.–SE., dip 90°. Shaft 30 feet. Tunnel 140 feet. Some drifting. Water power was used. Electricity available. Mill. Idle. Owned by J. L. Waggoner Estate, Dutch Flat, and Bonnie Bee Gold Mining and Development Company.

Boulder Mine. Ophir district. Sec. 18, T. 12 N., R. 8 E., M. D. M. Patented. One-half mile east of Ophir. Elevation 950 feet. Two-foot quartz vein in granodiorite. Strike N. 40° W., dip SW. 45°. Shaft 250 feet. Tunnel 300 feet. Water power was used. Electricity now available. Mill. Idle for several years. Owned by Jack Smith. Leased by E. Lavelle, of Ophir.

Buena Vista Mine. New England Mills (Weimar) district. Sec. 24, T. 14 N., R. 9 E., M. D. M. Adjoins the Red Bird mine to the south. Free gold and pyrite in a 6-foot to 25-foot ledge of decomposed quartz in slate. Strike N.–S. Tunnel 125 feet. Mill tests are said to have run $6.00 in gold and $4.00 in sulphides. Owned by Ed. Bigley, of Colfax.

Bunker and Nihill Mine. Michigan Bluff district. Sec. 32, T. 14 N., R. 11 E., M. D. M. Three miles southwest of Michigan Bluff. Quartz vein, carrying free gold in slate. Owned by H. H. Bunker and J. A. Nihill, of Michigan Bluff.

Burner Prospect. Forest Hill district. Sec. 14, T. 13 N., R. 9 E., M. D. M. Strike N. 12° W., dip 45° E. Shaft 29 feet. Tunnel 40 feet. Ore said to assay $6.00 per ton. Owned by J. W. Burner, Forest Hill.

Butt's Mine. Ophir district. Sec. 21, T. 12 N., R. 8 E., M. D. M. A four-foot quartz vein, in granodiorite, carries free gold with some galena and sulphurets. Strike E.–W. Dip 45° S. Shaft 40 feet. Tunnel 800 feet. Five-stamp mill. Ore reported to have averaged $8.00 per ton. Idle for over 15 years.

Calf Pasture Mine. Rock Creek district. Sec. 34, T. 13 N., R. 8 E., M. D. M. Three and one-half miles north of Auburn. Elevation 1000 feet. Eight-foot vein of quartz in amphibolite. Strike NW.–SE. Dip 90°. Incline shaft 250 feet. Drifting 40 feet. Claims, Calf Pasture, Calf Pasture Extension. Patented. Adjoins the Rock Creek Mine. Idle. Owned by W. E. Dean, Kohl Building, San Francisco.

California Quartz Mine. Ophir district. Sec. 16, T. 12 N., R. 8 E., M. D. M. Two and one-half miles southwest of Auburn. Eighteen-inch

quartz vein, carrying free gold in amphibolite. Strike approximately E.–W., dip 50° S. One hundred feet of open cut along vein. Patented. Idle. Owned by a Mr. Hubbell, of Auburn, in 1902.

Bibl.: Register of Mines and Minerals, 1902. Cal. State Min. Bur.

Cash in Dump. Tahoe district. Sixteen miles southeast of Soda Springs Station by wagon road. Elevation 5480′. Thirty-foot incline shaft on 18″ vein of quartz striking N. 30° W. and dipping 32° SW. The vein is decomposed and porous near the surface and carries some iron sulphide. Three claims adjoin the Chicago Mine. Eight assays of the surface quartz are said to have averaged $51.00 per ton. Owned by H. M. Black and H. J. Ellert of Virginia City.

Centennial Mine. Ophir district. Sec. 17, T. 12 N., R. 8 E., M. D. M. Elevation 1180 feet. One 18-inch quartz vein in amphibolite, carrying pockets of free gold and sulphurets. Strike N. 80° W. Dip 70° S. Tunnel 1100 feet. Owned by Walsh Bros., Freeman Hotel, Auburn.

Central Mine. Damascus district. Sec. 3, T. 15 N., R. 11 E., M. D. M. Three miles north of Damascus on the North Fork of the American River, north of Humbug Cañon. Elevation 2200 feet. Five-foot quartz vein, carrying sulphurets, in slate. Tunnel 300 feet. Water power. Mill. Idle. Owned by Lee Dorer, of Towle, and H. T. Power, of San Francisco.

Champion Mine, Michigan Bluff district. Sec. 15, T. 14 N., R. 11 E., M. D. M. One and one-half miles northeast of Michigan Bluff. Three-foot vein of quartz, carrying free gold, in slate. Shaft 120 feet. Assessment work only. Owned by Daniel Webster Mining Company, made up of F. A. Leach, A. Dibble and Mr. Hampton, of Michigan Bluff.

Cherokee Mine. Last Chance district. Three seams of ribbon quartz, in slate, carrying sulphurets. Strike NW.–SE., dip 70° E. Shaft 55 feet. Drifts 200 feet. Water from Deep Cañon. Idle.

Bibl.: Rep. XII, 1893–4, p. 206.

Chicago or **Falls Creek.** Tahoe district. Sixteen miles southeast of Soda Springs Station by wagon road, in Sec. 32, T. 16 N., R. 14 E., M. D. M. Elevation 5200′. Upper tunnel 52′. Lower tunnel 15′ Eighteen-inch quartz vein strikes N. 30° W. and dips 35° E. in limestone. The vein carries considerable pyrite, chalcopyrite and free gold. Oxidized ore is said to assay $61.00 per ton while the sulphides assay $17.00 per ton in gold, ½ oz. silver and 8% copper. There is an excellent mill site 30′ from the tunnel, on Wubbena Creek which carries from 10″ to 12″ of water during the dry season. Owned by Tom Young of Cisco. Leased by H. J. Ellert of Virginia City and F. L. Bradley, M. A. and S. B. Wright of Berkeley, who shipped some ore in October, 1916.

Christmas Hill Mine. Butcher Ranch district. Sec. 26, T. 13 N., R. 9 E., M. D. M. One mile southeast of Butcher Ranch. Elevation 2800 feet. A 300-foot porphyry dike in slate carries quartz stringers. Strike N.–S. Open cut 350 feet. Owner works in mine every year. Owned by J. A. Ware, of Butcher Ranch.

Conrad Mine. Ophir district. Sec. 17, T. 12 N., R. 8 E., M. D. M., ¾ miles west of Auburn. Elevation 1150 feet. Thirty-inch quartz vein, carrying free gold, galena and sulphurets, in amphibolite. Strike approximately E.–W., dip 70° S. Shaft 130 feet. Tunnel 700 feet. Patented. Adjoins the Centennial, to which it is parallel. Owned by Wm. Walsh, Freeman Hotel, Auburn.

Crandall Mine. Ophir district. Sec. 8, T. 12 N., R. 8 E., M. D. M., 1½ miles west of Auburn. Elevation 950 feet. A two-foot vein of quartz in amphibolite, carries sulphurets. Strike NE.-SW., dip 70° SE. Shaft 70 feet. Tunnel 400 feet. White-Rogers 5-stamp mill. Worked by hand drills. Water power. Owned by Wm. Jull, of Auburn.

Crater Hill Mine. Ophir district. Sec. 12, T. 12 N., R. 7 E., M. D. M., 3½ miles west of Auburn. Elevation 1200 feet. Patented. A 2½-foot quartz vein, in amphibolite, carries galena and sulphurets. Strike N. 80° W., dip 48° S. Shaft 800 feet. Dump has been sorted and values taken out. Idle. The Kittler property is southeast of the Crater Hill, in the SW. corner of Sec. 7, T. 12 N., R. 8 E., M. D. M., 4 miles west of Auburn. A quartz ledge on the property, in granodiorite, carries galena and sulphurets. Strike E.–W., dip 45° S. Shaft 150 feet. Tunnel 400 feet. Idle. Owned by George A. Aldrich, of Auburn.

Bibl.: Rep. X, 1890, p. 433.

Dahlonega. Blue Cañon district. Sec. 12, T. 16 N., R. 11 E., M. D. M., 2 miles south of Emigrant Gap. Elevation 5350 feet. A 2½-foot quartz vein in slate carries sulphurets. Strike NE.–SW., dip SE. Tunnel 480 feet stoped to surface. In another tunnel run 100′ lower the ore did not pay. Steam power. Mill burned. Worked, off and on, for 40 years. Owned by the Dahlonega Gold Mining Company. Mr. Tripp of Redlands, president; A. E. Rudell of San Bernardino, secretary.

Bibl.: Register of Mines and Minerals, 1902. Cal. State Min. Bur.

Daniel Webster. Michigan Bluff district. Secs. 15 and 16, T. 14 N., R. 11 E., M. D. M., 1½ miles northwest of Michigan Bluff. Elevation 3600 feet. Claims, Daniel Webster and Champion. Placer patent. Two veins of free milling quartz, two feet and five feet thick, occur in slate. Strike NE.–SW., dip 80° E. Shaft 125 feet. Drifts 200 feet. Assessment work only. Owned by Daniel Webster Mining Company, made up of F. A. Leach, A. Dibble and Mr. Hampton, of Michigan Bluff.

Debb Mine. Dutch Flat (Shady Run) district. Sec. 4, T. 15 N. R. 11 E., M. D. M., 2 miles northwest of Shady Run. Elevation 38[illegible] feet. Patented. A four-foot quartz vein, in slate, carrying galena an[illegible] sulphurets, was discovered in the bed of the old hydraulic mine. Sha[illegible] 60 feet. Drift 60 feet. Idle. Owned by A. Percival Crittenden, [illegible] Towle.

De Maria or **Garbe Mine.** Michigan Bluff district. Located [illegible] miles southeast of Michigan Bluff. Includes 30 acres or more [illegible] unpatented land. Free crystallized gold occurs in quartz seams in [illegible] porphyry dike and is washed by the placer process. Owners, C. J. De Maria and Mr. Garbe, of Spring Garden.

Dewey Prospect. Butcher Ranch district. Sec. 22, T. 13 N., R. 9 E. M. D. M. Prospecting has been done on a quartz vein in slate west [illegible] the U. S. or Carlson ranch, by E. B. Gilbert, of Butcher Ranch.

Dewey and Stocker or **Burt Mine.** Forest Hill district. Sec. 3[illegible] T. 14 N., R. 11 E., M. D. M., two miles northeast of Forest Hill. Quart[illegible] vein in slate. Tunnel 1200 feet. Development work only. No or[illegible] milled. Idle. Owned by Mrs. S. Burt, of Forest Hill.

Don Prospect. Tahoe district. One-fourth mile east of the Lost Emigrant mine. Elevation 6700′. An 18″ vein along a fracture in schist. Strike N. 80° E. and dip 70° S. Fifty-foot tunnel. Assessment work only. Owned by John Lass and Walter J. Wren of Virginia City.

Dorer Mine. Dutch Flat (Towle) district. Sec. 3, T. 15 N., R. 11 E., M. D. M., 2½ miles SE. of Shady Run. Elevation 4016 feet. Free milling quartz vein in slate. Strike N.–S., dip E. Tunnel 450 feet. Idle. L. R. Dorer, of Towle, owner.

Bibl.: Rep. VII, p. 468; Rep. VIII, p. 207.

Drummond Mine. Iowa Hill district. Sec. 1, T. 14 N., R. 10 E., M. D. M., 3 miles southeast of Iowa Hill. Elevation 3,600 feet. Patented. Two veins of quartz in slate. Strike N. 60° W., dip 80° NE. Shaft 50 feet. Tunnel 810 feet. Idle. Owned by Hon. C. F. Reed and Mr. J. E. Walsh, Freeman Hotel, Auburn.

Dry Hill Mine. Forest Hill district. Secs. 31 and 32, T. 14 N., R. 11 E., M. D. M., 2 miles southeast of Forest Hill. Three claims. Quartz stringers, carrying crystallized free gold, in slate. Drifts 1500 feet. Worked off and on for fifteen years. Owned by L. C. Lorenzo and C. J. De Maria, of Spring Garden.

Eclipse Mine. Ophir district. Sec. 17, T. 12 N., R. 8 E., M. D. M., 2½ miles west of Auburn. Elevation 1000 feet. Patented. A quartz vein in granodiorite carries galena and sulphurets. Strike N. 70° E., dip 45° S. Shaft 297 feet. Old mill used water power. Idle. Owned by Eclipse Milling Company of Auburn.

Bibl.: Rep. X, 1890, p. 433.

Eureka Consolidated. Forest Hill district. Sec. 1, T. 13 N., R. 9 E., nd Sec. 31, T. 14 N., R. 10 E., M. D. M., one mile northwest of Spring rden and 6 miles southwest of Forest Hill. Elevation 2000 feet proximately. Six claims. Quartz stringers scattered through 200 et of amphibolite. Strike N. 11° W., dip 45° E. The ore is said to ay $5.00 per ton. Owned by O. F., Wm. and G. Seavey, W. A. epherd, H. Adams, and G. Coffin, of Forest Hill.

Eureka Mine. Ophir district. Sec. 13, T. 12 N., R. 7 E., M. D. M., ur miles west of Auburn. Elevation 900 feet. Claims, Eureka o. 1, Eureka Extension No. 1, Eureka No. 2, Eureka Extension No. 2. cludes about 69 acres. A two-foot quartz vein, in granodiorite, rries free gold, pyrite and galena. Strike N. 75° W., dip 68° S. eveloped by a 280-foot shaft on Eureka No. 1, with 1000 feet of rifting on the 130-foot and 280-foot levels. Equipment of the mine nsists of a 15 h. p. motor, which runs a compressor that furnishes r for six Waugh drills. Electricity is also used for the hoist, to a pth of about 1500 feet. Milling with two California Roller Quartz ills, run by electricity, costs about $2.00 per ton. Amalgamation bles are used, and the sulphides are sent to the Selby smelter. Two ifts of twenty men each are employed, and about thirty tons of ore er day are milled. The ore is said to average about $10.00 per ton. ine lumber from the divide costs about $13.00 per thousand. Lagging nd stulls cost about $2.50 and $6.50 per thousand, respectively, de- vered at the mine. Electricity is secured from the Pacific Gas and lectric Company. Owned and operated by the Borealis Consolidated ines Company; president, Dr. G. W. Hillegass, Oakland; manager, . P. Stephenson, Freeman Hotel, East Auburn.

Fall Ravine. Last Chance district. Sec. 14, T. 15 N., R. 13 E., . D. M., 10 miles northeast of Last Chance, on the south side of Bald ountain, near Flat Ravine. Elevation 6000 feet. A three-foot uartz vein, in slate, carries galena and sulphurets. Strike N.–W., dip 0° E. Shaft 350 feet. Tunnel 598 feet. Drifting 60 feet. Idle. wned by M. Savage, of Forest Hill.

Bibl.: Rep. XII, 1898–9, p. 208.

Gem Mine. Dutch Flat district. Sec. 2, T. 15 N., R. 11 E., M. D. M., ½ miles north of Red Point. Elevation 3200 feet. Patented. Quartz eins scattered through a 100-foot belt in slate. Strike NW.–SE., dip 0° NE. Shaft 70 feet. Tunnel 1200 feet. Idle for several years. wned by John Rablin, of Dutch Flat.

Gold Blossom. Ophir district. Sec. 12, T. 12 N., R. 7 E., M. D. M., our miles west of Auburn. Elevation 700 feet. Patents, the Ohio, old Blossom, Back Action and Harrison or Gold Blossom No. 2. hree-foot vein of quartz in granodiorite, carrying free gold, galena

and pyrite. Strike E.–W., dip 85° S. Three compartment shaft 8[illegible] feet deep in center of property Crosscuts every 100 feet to the ledg[illegible] Drifts 450 feet. Ten-stamp mill at shaft No. 1 and a 20-stamp mi[illegible] at shaft No. 2. Electric power available. The ore is reported t[illegible] average upward of $7.50 per ton in free gold and $0.75 in sulphuret[illegible] Considerable ore is blocked out. Idle. Owned by the Reed Estat[illegible] Auburn; J. H. Toler, manager; A. C. Lowell, executor.

Bibl.: Annual Rep. XIV, U. S. G. S., Pt. II, p. 270. Rep. [illegible] Cal. State Min. Bur. 1890, p. 431.

Gold King Mine. Canada Hill district. Sec. 8, T. 15 N., R. 13 [illegible] M. D. M., 10 miles east of Westville and 40 miles from Colfax, t[illegible] nearest railroad station. Elevation 5860 feet. Twenty acres. [illegible] banded quartz ledge in schist carries free gold, pyrite, arsenopyri[illegible] and galena. The vein is from 12″ to 20″ thick on the hangwall, strik[illegible] N. 10° E. and dips 60° W. A 200′ tunnel cuts the ledge at 12[illegible] and follows the vein for 80′. Ore milled ran about $3.50 per to[illegible] Assays said to run from $8.00 to $10.00 per ton. Owned by Jas. G[illegible] Dodds, Elizabeth T. Bell, and Nels Forthun, of Westville. Leased b[illegible] Henry J. Snyder and John Henessy, of Grass Valley, who have take[illegible] up the Gold Queen and Gold Prince claims, north and south respectivel[illegible] of the Gold King.

Golden Reward. Canada Hill district. Sec. 5, T. 15 N., R. 13 E[illegible] M. D. M., 10 miles east of Westville. Elevation 6000 feet, approxi[illegible] mately. Five claims, called the Golden Reward group. Twenty acre[illegible] A three-foot quartz vein, in slate, carries free gold and sulphides. Th[illegible] main N.–S. vein dips 45° and is cut by an E.–W. vein. Crosscu[illegible] tunnel 300 feet. Ten-stamp mill. Assessment work only. Owned b[illegible] Mrs. Wm. Bell and son, of Westville.

Golden Rule Mine. Rocklin district. Center of Sec. 17, T. 11 N[illegible] R. 8 E., M. D. M., two miles southwest of Rattlesnake Bar and eigh[illegible] miles east of Rocklin. Elevation 750 feet. A three-foot quartz vei[illegible] in granodiorite, carries free gold. Tunnel 1358 feet. Idle. Owne[illegible] by Wm. Kendall, of Sacramento.

Golden Scepter or **Ellen Dip.** New England Mills district. Sec. [illegible] T. 13 N., R. 9 E., M. D. M., two miles east of Applegate in Codfis[illegible] Cañon. Elevation 1625 feet. A thirty-foot mineralized belt betwee[illegible] serpentine and slate carries values which were concentrated on th[illegible] surface and hydraulicked in the early days. Strike N.–S., dip 90° Shaft 16 feet. Tunnel 270 feet. Later prospecting has not uncovere[illegible] a main vein. Assessment work only is now being carried on by th[illegible] owners, Ed. Vore, of Applegate and E. Ephraim.

Golden Sheaf Mine. Michigan Bluff district. Sec. 27, T. 14 N[illegible] R. 11 E., M. D. M., one-half mile south of Michigan Bluff. Claims N[illegible]

Chunk (quartz), and Beehive (placer). Idle. Owned by the Golden Sheaf Mining Company; E. P. Thompson, of Michigan Bluff, manager.

Golden West Mine. Blue Cañon district. Sec. 25, T. 16 N., R. 11 E., M. D. M., three miles southeast of Blue Cañon. Elevation 3000 feet. Patented. A 200-foot ledge in slate, carrying quartz stringers. Shaft 100 feet. Tunnel 1500 feet. Drifting 500 feet. Idle. Owned by Reuben H. Lloyd, San Francisco.

Bibl.: Register of Mines and Minerals, 1902. Cal. State Min. Bur.

Great Western. Canada Hill district. Eighteen miles SE. of Cisc in Sec. 31, T. 15 N., R. 13 E., M. D. M. Elevation 5000′. Four teen claims including 270 acres. A quartz ledge in diorite carries free gold and sulphides. A 430′ tunnel run to crosscut the ledge did not strike it, since apparently the vein dips rather flat. Assays near the surface of the vein are said to have run from $16.00 to $20.00 per ton. Owned by the Great Western Mining Company. Mr. Kelley, president; Martin Winters, secretary, Pier 36, North River, New York.

Green Mine. Ophir district. Sec. 8, T. 12 N., R. 8 E., M. D. M., two miles northwest of Auburn. Patented. Eighteen-foot vein of quartz in slate. Values in pockets. Shaft 300 feet. Mill. Idle. Owned by Wm. Kendall, of Dutch Flat.

Bibl.: Rep. XII, 1893–4, p. 209.

Hathaway or **Butts Mine.** Ophir district. Sec. 18, T. 12 N., R. 8 E., M. D. M., three and one-half miles southwest of Auburn. Patented. Adjoins the Eureka mine on the east. Elevation 675 feet. A three-foot quartz vein in granodiorite carries argentiferous galena, auriferous pyrite and zinc blende. About 2% of the ore is sulphurets. The concentrated sulphurets are reported to have run as high as $230 per ton. Strike of veins N. 75° W., dip 75° S. Shaft 756 feet. Tunnel 837 feet. Drifting 3,500 feet. Equipped with old 20-stamp (850 lbs. each) mill and 4 Woodberry concentrators. Electricity is now available for power. Bonded by Dr. G. W. Hillegass and associates of Oakland and E. P. Stephenson, of East Auburn. The same parties have bonded the Eureka, Kirkland and Kirkland Extension patents.

The Hathaway was taken over in 1916 by the Borealis Consolidated, the controlling interest of which is held by J. C. Winters of New York. The mine was being dewatered in October, 1916, and the shaft retimbered. The property will be worked in conjunction with the Eureka.

Bibl.: Rep. X, 1890, p. 429.

Herman Mine. Deadwood district. Sec. 29, T. 15 N., R. 12 E., M. D. M., 5 miles south of Westville. Elevation 4500 feet. Patented 1448 acres. Three veins of ribbon quartz varying from three feet to ten feet wide, in slate, carry free gold and silver, with pyrite and galena. Strike N. 10° E., dip 67° E. The veins can be followed for

1500 feet on the surface. Incline shaft 100 feet. Crosscut to ledge 1500 feet. Shaft 450 feet. Drifting on 100-foot level, N. 250 feet and S. 250 feet; on 200-foot level, N. 400 feet and S. 200 feet; on 300-foot level, N. 100 feet and S. 150 feet. No drifting on 450-foot level.

The mine was pumped out in July, 1915, and has produced on an average of 50 tons of ore per day since August 10, 1915. It is equipped with five air drills and two Water-Leyner drills. The ore is drawn from the mine in one-ton cars by mules. Two 200 h. p. steam boilers furnish power for an electric generator for lighting purposes, an air compressor and 1 Worthington and 1 Blake pump. Wood for fuel costs $3.00 per cord.

The mill has thirty 1200-pound stamps, which have a six-inch drop, 100 times per minute. The ore is crushed to 24 mesh and the pulp passes over amalgamation plates. The tailings are not impounded.

From thirty to fifty men were employed in October 1915. When visited in September, 1916, poles to obtain electric power from the Black Cañon line were on the ground but the mine had been shut down and was rapidly filling with water. Good ore is reported in the lower workings. Owned by the Herman Property Syndicate. Operated by the Pennsylvania Gold Mining Co., 2001 First National Bank Bldg., Pittsburgh, Pa.; C. H. Stolzenbach, Pittsburgh, Pa., president; Samuel H. Brockunier, superintendent, Westville, Placer County, Cal.

Hermit Prospect. Last Chance district. Section 30, T. 15 N., R. 13 E., M. D. M., five miles northeast of Last Chance, in Deep Cañon. Elevation 5500 feet. Quartz ledge in slate, carrying sulphides. Shaft 10 feet. Drift 20 feet. Owned by John Lass, of Summit.

Hope Mine. Ophir district. Sec. 17, T. 12 N., R. 8 E., M. D. M., 1½ miles southwest of Auburn. Elevation 1142 feet. Patented. Eighteen-foot quartz ledge, in slate, carrying sulphurets. Shaft 70 feet. Handwork, with windlass and pump. Owned by Andrew Johnson, of Ophir.

International Quartz Mine. Forest Hill district. Sec. 12, T. 13 N., R. 9 E., M. D. M., 7 miles southwest of Forest Hill. Free gold along the footwall of a 50-foot porphyry dike. Assays are said to run from $3.75 to $15.00 per ton. Owned by Patrick McInnis, of Butcher Ranch.

Joe Dandy. Tahoe district. One mile south of the Lost Emigrant mine. Elevation 6935′. Decomposed vein material, in decomposed limestone, strikes N. 70° E. and dips 70° SE. Opened up by a 34′ shaft and 25′ drift east along the vein material. The vein material pans. Claims, Joe Dandy and Billy Boy. Owned by John Lass, of Virginia City, and L. D. Heath, of Los Angeles.

Julia Mine. Damascus district. Sec. 3, T. 15 N., R. 11 E., M. D. M., 1½ miles NE. of Damascus. Four-foot quartz vein in slate. Strike

NE., dip 80° E. Tunnel 80 feet. Idle. Owned by J. D. Sullivan and A. P. Crittenden, of Towle.

Julian Mine, formerly the Bowlder Claim. Ophir district. Southeast corner of Sec. 7, T. 12 N., R. 8 E., M. D. M., three miles west of Auburn. Three-foot vein of ribbon quartz, carrying sulphurets, in granodiorite. Strike N. 10° E., dip 45° E. Tunnel 300 feet on vein. Shaft connects with tunnel at depth of 115 feet. Claim now covered by an orchard. Idle. Owned by Mrs. Dr. M. Schnabel, of Newcastle.

Bibl.: Rep. XII, 1893–4, p. 205.

LaFollette or Nob Hill Mine. Canada Hill district. Secs. 7 and 8, T. 15 N., R. 13 E., M. D. M., 8 miles east of Westville. Elevation 5,930 feet. Twelve-inch quartz ledge, in metamorphic sandstone, carries free gold, arsenopyrite, galena and sphalerite. Open cut 200 feet along vein. Ninety-foot tunnel. Twenty acres. Adjoins Gold King claim. Ore said to assay about $10.00 per ton. Owned by Henry Snyder, of Grass Valley.

La Trinidad or Sterritt Mine. Canada Hill district. Sec. 34, T. 16 N., R. 13 E., M. D. M., eight miles south of Cisco. Elevation 6000 feet. On the North Fork of the American River, in Sailor Cañon. Patented. Four-foot quartz vein in slate, carrying free gold, strikes NW.-SE. and dips 45° NE. Tunnel 200 feet, caved; 500′ drift with 700′ raise used as ore chute. Ten-stamp mill. Last leased to the Viking Company who installed considerable machinery. Most of the oxidized ore is said to have been stoped. The ore is said to have assayed $3.45 per ton. Owned by the New York Mining Company; Geo. F. Dennel, Cisco, superintendent; George Montgomery, of Mills College, manager.

Little Banner Mine. Ophir district. Sec. 22, T. 12 N., R. 8 E., M. D. M., 2 miles southeast of Auburn on the slope of the American River. Two claims. Three-foot to ten-foot quartz vein, in granodiorite, carries free gold and pyrite. Strike NE.–SW., dip SE. Tunnel 1,000 feet. Shaft 100 feet. Five hundred feet of drifts on the 100-foot level. The value of the ore ranges between $6.00 and $16.00 per ton. Equipment in 1915 consisted of a California Roller Quartz Mill. Owned by Charles Glover. Leased by Dr. G. W. Hillegass and associates, of Oakland; superintendent, E. Stephenson, East Auburn.

Live Oak Mine. New England Mills (Weimar) district. Sec. 23, T. 14 N., R. 9 E., M. D. M., two miles northeast of Weimar, in Live Oak Ravine. Free gold in a quartz vein in slate. Owned by Geisendorfer Estate. Bonded by Mr. Dan J. Williams, of Weimar, who is reported to have installed a Williams New Stamp and to have 4 men working. The ore is reported to assay $15.00 per ton in the 175′ shaft.

Lost Emigrant Mine. Tahoe district. Sec. 32, T. 16 N., R. 14 E., M. D. M., 12 miles by road southwest of Soda Springs station. Elevation 6700 feet. Twelve-inch to 4-foot quartz vein in diabase porphyrite, carries free gold and pyrite. Strike NW.–SE., dip 30° SW. Shaft 115 feet. Incline 500 feet. Drifting, 400 feet on 65-foot level, 50 feet on 300-foot level, 50 feet on 500-foot level. Old steam hoist and 4 1000-lb. stamps. Idle. Six hundred tons of tailings on the dump are said to assay $10.00 per ton. Owned by F. L. Heath et al., Donner post office, Placer County, Cal.

Photo 9. Lost Emigrant Mine, eight miles southwest of Soda Springs, Placer County. Snow Mountain in the distance.

Lundquist Mine. Ophir district. Sec. 16, T. 12 N., R. 8 E., M. D. M., two miles southwest of Auburn. Reported to have had a 12-foot quartz vein, in slate, carrying free gold and sulphurets. Strike NE.–SW., dip 40° E. Shaft 120 feet. Tunnel 200 feet. Idle. Owned by Mrs. Lundquist, of Auburn.

Malmberg. Ophir district. Sec. 16, T. 12 N., R. 8 E., M. D. M., 1 mile southwest of Auburn. Patented. Quartz vein in amphibolite. Shaft 110 feet. Idle. Owned by Mr. J. Malmberg, of Auburn.

Marguerite. Rock Creek district. Sec. 3, T. 12 N., R. 8 E., M. D. M., 1½ miles north of Auburn. Elevation 1360 feet. Patented. Reported to be a 5-foot quartz vein in serpentine. Strike NW.–SE., dip 80° SW. Shaft 310 feet. Idle. Owned by San Francisco parties.

Mars Quartz Mine. Damascus district, 5 miles west of Westville, near the Pioneer mine. Patented. Eighty acres. Three quartz veins, in slate, carrying gold and silver. One vein is reported to be 20 feet wide. Tunnel 500 feet. Three-stamp mill. Ore is said to average $3.50 per ton. Idle. Owned by Sam Wolford, Grass Valley, Cal.

Minna Ricca. Ophir district. Sec. 17, T. 12 N., R. 8 E., M. D. M., two miles west of Auburn. Elevation 1,000 feet. Reported to have been a 16-foot quartz vein, in slate, carrying free gold and sulphurets. Strike NE.–SW., dip 85° E. Shaft 150 feet. Tunnel 300 feet. Considerable good ore was taken from a chute. Idle. Owned by J. E. Walsh, East Auburn.

Bibl.: Rep. X, 1890, p. 433.

Mitchell Mine. Last Chance district. Located in El Dorado Cañon. Worked off and on since 1855. Owned by H. F. Adams, of Forest Hill, and Ben Taber (1/5), of Auburn.

Mollie Stark. Ophir district. Sec. 21, T. 12 N., R. 8 E., M. D. M., 1½ miles southwest of Auburn. Elevation 850 feet. Patented. Three veins of white quartz, in granodiorite, carry free gold and silver associated with galena and sulphurets. Strike NW.–SE., dip 74° SW. Shafts 40 feet and 18 feet. Incline 130 feet. Tunnel 200 feet. Drifting 270 feet. Idle. Owned by Mrs. Asa B. Eastwood, of Newcastle.

Moore Mine. Ophir district. Sec. 17, T. 12 N., R. 8 E., M. D. M., two miles southwest of Auburn. Elevation 1050 feet. Patented. Eight-foot quartz vein, in slate, carries free gold and sulphurets. Strike E.–W., dip 45° S. Shaft 300 feet. Idle. Owned by J. M. White, of Auburn.

North Star Mine. Damascus district. Reported to be in the neighborhood of the Pioneer mine. Seven-foot quartz ledge carrying free gold. Tunnels 80 feet and 90 feet. Owned by E. J. Power, E. J. Young and Henry F. Power, Berkeley.

Number Two Mine. Dutch Flat district. Sec. 10, T. 15 N., R. 10 E., M. D. M., one-half mile northeast of Gold Run. Elevation 2875 feet. Reported as a 12-foot quartz vein in slate. Strike N.-S., dip E. Open cut 80 feet. Shaft 40 feet. Idle. Owned by E. A. Moody and Mr. Garety, of Gold Run.

Old Pacific Mine. Ophir district. Sec. 25, T. 12 N., R. 7 E., M. D. M., one mile southwest of Newcastle. Reported as an 18-foot quartz vein, in granodiorite, carrying free gold, native silver and sulphurets. Strike E.–W., dip S. Shaft 200 feet. Idle. Owned by Mrs. Dr. M. Schnabel, of Newcastle.

Oro Fino Mine. Ophir district. Secs. 7 and 8, T. 12 N., R. 8 E., M. D. M., 4 miles west of Auburn. Elevation 1,002 feet. Claims: Bullion, Bullion No. 1, Bullion No. 2, Golden Eagle, Bellevue, Last Chance, Buckeye, California and Smith's Extension. Two-foot quartz vein in amphibolite. Strike E.–W., dip 65° S. Inclined two-compartment shaft 300 feet. Old Bellevue shaft 312 feet, with the following

drifts: 75-foot level, 370 feet drift; 117-foot level, 340 feet drift; 170-foot level, 200 feet drift; 224-foot level, 460 feet drift; 312-foot level, 730 feet drift. The 312-foot level connects with the Bullion No. 1 shaft, from which the ore is being worked and the water pumped. About one-half the ore between the Bellevue and Bullion No. 1 shafts has been stoped out. It is practically new ground between Bullion No. 1 and the old Bullion shaft, which is 100 feet deep with 100 feet of drift.

Photo No. 10.—Headframe and mill of the Oro Fino Mining Co., on Bullion No. 1, Ophir District.

Electric power is secured from the Pacific Gas and Electric Company. The equipment of the mine consists of a 350-foot air compressor, air drills, 1½-ton skips and telephone to the 300-foot level. A 75 h.p. electric motor runs the 10-stamp (1000-pound stamps) Joshua Hendy mill, two No. 5 Deister concentrators and 4-foot Joshua Hendy amalgamation barrel. About 28 men are employed.

About 30 tons of ore per day of 24 hours is milled. Mill tests are reported to have run from $17.00 to $18.00 per ton. About 70% of the gold is recovered on the amalgamation plates, while from 25% to 30% is recovered from the sulphurets. The ore taken as a whole averages about $7.00 per ton. Work in September, 1916, was being carried on in the 400′ level.

Owned by the Oro Fino Mining Company; H. Gridley, superintendent, East Auburn.

Pacific Slab Mine. Last Chance district. Sec. 33, T. 15 N., R. 12 E., M. D. M., 1 mile southwest of Last Chance. Quartz vein in slate, exposed in bedrock of drift mine. The ledge has not been worked.

Owned by the Pacific Slab Consolidated Mining Company, 1007 Monadnock Building, San Francisco; W. T. Davis, superintendent at drift mine.

Paragon. Forest Hill district. A quartz vein averaging 4 feet in width was encountered in the main tunnel of the Paragon drift mine about 300 feet from the portal at the contact of serpentine and amphibolite. The vein is exposed for over forty feet and strikes N. 65° E., dip 66° SW. The gravel is reported much richer near this vein. No developments. Owned by J. F. Thompson, of Bath.

Patrick Consolidated. Canada Hill district. Sec. 10, T. 15 N., R. 12 E., M. D. M., two miles southeast of Westville. Elevation 4800 feet. Three-foot quartz vein, carrying free gold, in slate. Strike NE.–SW., dip SE. Tunnel 550 feet. Idle. Owned by G. W. Snyder, of Damascus.

Pioneer Mine. Damascus district. Secs. 10 and 3, T. 15 N., R. 11 E., M. D. M., two miles northwest of Damascus. Elevation 3800 feet. Patented. Two quartz veins, one 14 feet wide carrying free gold and sulphurets. The wall rock is slate. Strike NE.-SW. Dip 80° E. Shaft 1200 feet. Tunnel 2300 feet. Drifts 2500 feet. Twenty-stamp mill. Employ thirty to forty men all year. Production between 50 and 60 tons per day. Owned by the Pioneer Gold Mines Company, 600 Thos. Clunie Building, San Francisco; C. M. Bandy, general manager; Fred Jost, superintendent at the mine.

Prairie Flower. Canada Hill district. Forty acres in Sec. 9, T. 15 N., R. 13 E., M. D. M., 8 miles east of Westville. Elevation 5,800 feet. Three-foot vein of ribbon quartz in slate carries free gold and pyrite. Strike N. 45° E., dip 70° W. Lower tunnel 1000 feet. Drift 500 feet, New 100-foot shaft. Stoped from lower tunnel to the surface for 400 feet along the vein. The last work consisted of a 50-foot winze and 60-foot shaft below the lower level. Water from Van Cliff Cañon furnishes power for five-1000 lb. stamps. Ore said to run between $6.00 and $10.00 per ton, and average $8.00 per ton between the two levels. Owned by Mrs. Wm. Bell and son, of Westville.

Quien Sabe Mine. Canada Hill district. Sec. 9, T. 15 N., R. 13 E., M. D. M., 8 miles east of Westville. Elevation 5,300 feet. Forty acres. A 2-foot quartz vein, in metamorphic sandstone, carries free gold and pyrite, strikes N. 5° W., dips 75° W., and follows the bedding plane of the metamorphic rocks. A tunnel crosscuts the ledge at 60 feet and follows the vein for 40 feet. A lower tunnel 150 feet long has not reached the vein. A 160-foot pipe line from Van Cliff Cañon, a branch of Antoine Cañon, furnishes power for a Hendy triple discharge 2-stamp mill, for six months of the year. Other equipment consists of 36-inch Pelton waterwheel and a jaw crusher. The ore is said to mill from

$3.00 to $8.00 per ton. Concentrated sulphides are said to have run about $380 per ton.

Owned by Peter Hinst and J. G. Dodds of Westville.

Rawhide Mine. Dutch Flat district. Sec. 4, T. 15 N., R. 11 E., M. D. M., three miles southeast of Towle. Two porphyry dikes 4 feet and 6 feet thick, in slate, carry free gold. Strike NW.–SE.; dip 45° NE. Open cut 20 feet. Shaft 70 feet. Tunnel 600 feet. Drifting 110 feet. Ten stamp mill. Water power. Fifteen men reported to be working in October, 1916. Idle in September, 1916. Owned by the Helester Gold Mining Co. Leased by Frank B. Keever. Frank Chase, Towle, foreman.

Razzle Dazzle. Ophir district. Sec. 20, T. 12 N., R. 8 E., M. D. M., 1½ miles east of Newcastle. Elevation 950 feet. Patented. Fourteen feet of decomposed quartz, carrying pyrite, in slate. Strike NW.–SE., dip 70° NE. Shaft 180 feet. Drift 60 feet. Idle. Owned by G. L. Threlkel, of Newcastle.

Reciprocity Mine. Gold Hill district. Sec. 11, T. 12 N., R. 7 E., M. D. M., three miles northwest of Ophir. Elevation 595 feet. A four-foot quartz vein, in granodiorite, carries gold and silver. Open cut 30 feet. Shaft 20 feet. Idle. Owned by I. Meyer, of Lincoln.

Red Bird Consolidated. New England Mills (Weimar) district. Sec. 24, T. 14 N., R. 9 E., M. D. M. Elevation 2000 feet. Auriferous quartz stringers in Mariposa slate. The mineralized ledge is about 25 feet wide and carries free gold and pyrite. Tunnel 200 feet. Double crosscut with 16-foot chamber. The Buena Vista mine adjoins the Red Bird No. 1 claim to the south, while the Red Bird No. 2 adjoins it to the north. The ore is said to average about $10.00 per ton. Owned by G. A. Tubbs, Colfax.

Red Rock Mine. Blue Cañon district. Sec. 24, T. 16 N., R. 11 E., M. D. M., three miles southeast of Blue Cañon. Elevation 4200 feet. Patented. Ten-foot quartz vein in slate. Strike NW.–SE., dip W. Mill moved. Water power. Idle for several years. Owned by N. B. Willey, Blue Cañon.

Rip Van Winkle Mine. Formerly called the Lady Bedford or Page and Buckman Mine. Deadwood district. Sec. 29, T. 15 N., R. 12 E., M. D. M., six miles south of Westville. Four-foot to ten-foot vein of ribbon quartz in slate, carrying galena and pyrite. Strike NW.–SE., dip 50° E. Shaft 60 feet. Tunnel 1200 feet. One mile southeast of the Herman mine. Ore is said to average $3.00 per ton. Old two-stamp mill dismantled in September, 1916. Assessment work only. Ore shoot said to have been lost by a fault. Owned by B. S. Buckman, of Michigan Bluff, and J. G. Dodds, of Westville.

Rising Sun Mine. Colfax district. Sec. 33, T. 15 N., R. 9 E., M. D. M., one mile northwest of Colfax. Elevation 2290 feet. Forty acres patented. One laminated quartz vein from 6 inches to 3 feet wide with several stringers, in diabase. The vein carries free gold, pyrite and chalcopyrite and strikes E.–W., with a dip 85° S.

Development consists of a shaft in the center sunk to the fourth level, with levels at 60′, 111′, 187′, 268′ and 350′; a second shaft (6 ft. x 12 ft.), with three compartments, to the east of the first has nine levels and is about 751 feet deep. The levels are 111′, 187′, 268′, 350′, 431′, 511′, 590′, 668′ and 751′ below the surface. A third shaft to the west of the main shaft has two levels at 111′ and 187′. The wall rock is hard and usually no timbering is required. A tunnel has been driven over 300 feet from a point .3 of a mile northwest of the property on the south slope of Bear River Cañon It was the intention to work the mine more cheaply from the tunnel, but it has never been completed. The shafts are now caved at the surface.

It is reported that 80% of the auriferous value is free gold, while the balance is obtained from the concentrated sulphides which run from $150 to $200 per ton. Little work has been done below the fifth level and considerable low grade ore still remains above the fifth level. All improvements, including mill, hoist, etc., have been destroyed by fire. Assays made for the writer ran as follows:

No. 1. Quartz vein material from dump at Rising Sun Mine, $1.10 per ton.

No. 2. Mineralized schist from same dump at Rising Sun Mine, $0.40 per ton.

The power line of the Pacific Gas and Electric Company, from Alta, passes within one mile of the property.

Owned by Marie A. Valentine Estate, New York, and Werry Bros., Colfax.

Roosevelt. Tahoe district. Seventeen miles southeast of Soda Springs Station in Sec. 4, T. 15 N., R. 14 E., M. D. M. One claim adjoining the old Lost Emigrant mine. An oxidized vein is 3½′ wide on the surface and 7′ wide at the bottom of a 28′ shaft. Quartz vein in diabase porphyrite. Owned by F. L. Heath et al., Donner, Cal.

Rublin Mine. Last Chance district. Sec. 34, T. 15 N., R. 12 E., M. D. M. On south side of the ridge towards Last Chance from the Pacific Slab mine. Shaft 150′. Tunnel 860′ was run to tap the vein at 500′ below the surface, but it is said that it was run too far south and never hit the vein. The tunnel was driven by machine drills supplied with air from a compressor run by water power. Idle. Owned by Messrs. Foley, McCarty and Casen of Chicago who bought it of D. M. Ray of Last Chance.

Ruby Mine. New England Mills (Weimar) district. Sec. 25, T. 14 N., R. 9 E., M. D. M., three miles east of Weimar near the American River. Elevation 2200 feet. Four-foot porphyry dike in slate, carrying free gold and sulphides. Strike N.–S., dip 45° E. Incline shaft 126 feet. Drift north 15 feet, south 14 feet. Ore said to assay $1.00 to $40.00 per ton. Assessment work only. Owned by E. H. Hinchey, Weimar, Cal.

Saint Lawrence Mine. Ophir district. Sec. 7, T. 12 N., R. 8 E., M. D. M., 3½ miles west of Auburn. Elevation 1000 feet. Patented. An 18-inch quartz vein in granodiorite carries free gold associated with pyrite and galena with some stibnite. Strike N. 70° W., dip 35° S. Shaft 300 feet. Tunnel 1000 feet. A 50 h. p. hoist and ten-stamp mill lie idle. Owned by the Reed Estate, of Auburn.

Bibl.: Rep. XIV, U. S. G. S., Pt. II, 1892, p. 271.

Salig Mine. Rock Creek district. Sec. 3, T. 12 N., R. 8 E., M. D. M., 1½ miles north of Auburn. Elevation 1300 feet. Patented. Quartz vein in slate, carrying free gold and silver in sulphurets and galena. Strike NW.–SE., dip 75° E. Shaft 200 feet. Idle. Owned by A. L. Smith, of Auburn.

Salsic Mine. Rock Creek district. Sec. 3, T. 12 N., R. 8 E., M. D. M., ¾ of a mile northwest of Auburn. One-foot quartz vein carrying free gold, pyrite and galena, in slate. Strike N. 45° W., dip 75° E. Idle. Owned by Smith and Fulweiler, of Auburn.

Bibl.: Rep. XII, p. 212, 1893–4.

Secret Town Mine. Gold Run district. Sec. 10, T. 15 N., R. 10 E., M. D. M., 1½ miles southeast of Gold Run. Elevation 2875 feet. Two-foot quartz vein in slate. Strike NW.–SE., dip 60° E. Shaft 75 feet. Tunnel 20 feet. Idle. Owned by E. A. Moody and J. E. Everhart.

Shady Run or **Midas Mine.** Dutch Flat district. Secs. 27 and 28, T. 16 N., R. 11 E., M. D. M., 1½ miles northeast of Shady Run. Elevation 2700 feet. Patented, 640 acres. Stringers of quartz, carrying arsenopyrite and 3% sulphurets in a 38-foot porphyry dike. Strike NW.–SE., dip 90°. Shaft 140 feet, tunnel 570 feet. Six drifts. Water-power mill. Idle. Owned by R. Watson, Midas.

Southern Cross Mine. Damascus district. Sec. 4, T. 15 N., R. 11 E., M. D. M., four miles northwest of Damascus. Patented. Three quartz veins, 2½′, 4′ and 5′ wide in slate carry free gold, sulphurets and galena. Strike NW.–SE., dip 60° E. Tunnel No. 1, 700 feet; No. 2, 500 feet. Mill burned. Idle. Owned by E. L. Ford, of Towle, and A. W. Nicholls, of Berkeley. J. E. Hines, superintendent, Rock Springs, Wyoming.

Spanish Mine. Ophir district. Sec. 7, T. 12 N., R. 8 E., M. D. M., 2½ miles northwest of Auburn. Elevation 1050 feet. Patented. Sixteen-foot vein of quartz, carrying free gold, in granodiorite. Strike NW.–SE., dip 45° NE. Shaft 200 feet. Bonded to Brown, DeCon and Company, of San Diego. Reported to be installing a hoist and compressor, and to have leased the mill on the Peachy Consolidated property. Owned by the Reed Estate, Auburn.

Texas Mine. Blue Cañon district. Sec. 20, T. 16 N., R. 12 E., M. D. M., four miles south of Emigrant Gap. Elevation 5600 feet. A three and one-half foot quartz vein, in slate, carries sulphurets. Strike N.–S., dip 60° E. Shaft 110 feet. Tunnel 400 feet, was never completed to bottom of shaft. Idle for 4 years. Owned by the Halsey Estate, of Towle. J. L. Gould, Alameda, president. Reported bonded to the Oakland Consolidated Gold Mining Company, Oakland, Cal.

Three Stars or **Columbia Mine.** Ophir district. Sec. 2, T. 12 N., R. 7 E., M. D. M., 7 miles west of Auburn. Elevation 850 feet. Patented. Claims: North Star, Middle Star and Morning Star. Two quartz veins, carrying free gold, silver and sulphurets, in granodiorite. Shafts 524 feet and 724 feet. Incline 541 feet. Drifts 3,176 feet. Water-power mill.

The Morning Star has a 90-foot shaft and 95-foot incline on a 12-inch vein of free milling quartz in granodiorite. Strike NE.–SW., dip 45°. Idle.

Owned by the Columbia Gold and Silver Mining Co., E. H. Vance, 1911 Webster St., Oakland.

Tiger Mine. New England Mills (Weimar) district. Sec. 25, T. 14 N., R. 9 E., M. D. M., three miles east of Weimar. Elevation 2200 feet. A three-foot quartz vein in slate carries free gold. Strike N.–S., dip 45° E. Open cut 50 feet. Shaft 30 feet. Incline 90 feet. Tunnel 50 feet. Adjoins the Red Bird No. 1 Mine. Idle. Owned by Ed. Bigley, J. W. Hinchey and Mr. Odel, of Weimar.

Tyler Mine. Near Clipper Gap. Thirteen-foot ledge of quartz, carrying sulphurets. Tunnel 190 feet. Owned by Levi Tyler, of Clipper Gap.

Van Avery Mine. Blue Cañon district. Sec. 14, T. 16 N., R. 11 E., M. D. M., 1½ miles southeast of Blue Cañon. Elevation 4625 feet. Patented. Three quartz veins, one 6 feet wide, carrying free gold and sulphurets, in slate. Strike NW.–SE., dip 77° W. Tunnel 600 feet. Water power. Idle for 20 years. Buildings burned. Said to have never paid. Owned by L. Balliét, of San Francisco.

Washington Mine. Forest Hill district. Sec. 30, T. 14 N., R. 11 E., M. D. M., 1½ miles east of Forest Hill. Elevation 3400 feet. Patented.

Two veins of ribbon quartz, 3 feet and 20 feet wide in diabase and serpentine. Strike N. 74° W., dip 80°. Tunnel 1400 feet. Water power. Mill removed. Idle for some time. Owned by A. M. Nihill, of Nevada and Jack Nihill, of Michigan Bluff.

Wubbena Mine. Tahoe district. Sec. 32, T. 16 N., R. 14 E., M. D. M., 10 miles southeast of Soda Springs station on the Southern Pacific railroad. Elevation 6500 feet. Twenty-foot quartz vein, carrying free gold, in diabase. Strike north of west, dip south. Shaft 50 feet. Incline shaft 100 feet. Tunnel 50 feet. Idle. Prospect only. Owned by Herbrant, Eustice and Co., of Woodland.

GOLD—DRIFT MINES.

Allbright Mine. Rocklin district. Sec. 36, T. 12 N., R. 7 E., M. D. M., 2 miles east of Penryn. Surface hydraulicked. Bedrock tunnel reported to have been run 500 feet in slate and upraise made to the loose gravel, but little pay found. Idle.

Bibl.: Rep. XII, p. 204.

Alta Mine. Dutch Flat district. At Alta. Alta Gold Mining and Development Co., held ¾ mile along the cement "White" and "Blue" channels. A 2000-foot tunnel was started to top the gravels. Idle since Mr. J. E. Doolittle, of Dutch Flat, the superintendent, died.

American Hill. Canada Hill district. In Sec. 24 T. 15 N., R. 12 E., M. D. M. In Lost Cañon, 4 miles by trail southeast of Secret House. Gravels similar to those at Canada Hill occur. A large channel 250′ wide and ¼ mile long and a small channel from 6′ to 40′ wide are said to occur. Work is said to have been mostly done along the south rim of the large channel.

Owned by Ben Denton of Westville.

Avalon Mine. Forest Hill district. Avalon Mining Company of San Francisco, ran a tunnel. Abandoned.

Azalea, or **Blue Cañon Mine.** Blue Cañon district. Sec. 22, T. 16 N., R. 11 E., M. D. M., 2 miles southwest of Blue Cañon. Elevation 4000 feet. Patented 360 acres. One and one-half miles on channel. Tunnel 3300 feet; did not strike a pay channel. Free wash gravel carried low values. Water-power. Prospect work only. Owned by the Azalea Gold Mining Company, J. B. Knapp, president, Blue Cañon.

Baker Divide Mine. Forest Hill district. Portions of Secs. 12, 13 and 18, T. 14 N., R. 10 E., M. D. M. On the Baker Divide, three miles northeast of Forest Hill. Elevation 2838 feet. Tunnel 3300 feet in cement gravel. Upraise 125 feet. Drifting 375+ feet. Idle. Owned by Mrs. Soule and Mr. Bacon, Bacon Block, Oakland.

Bibl.: Rep. VIII, p. 466.

Baker Ranch Prospect. Michigan Bluff district. Sec. 17, T. 14 N., R. 11 E., M. D. M., near the road from Forest Hill to Michigan Bluff. Elevation 3700 feet. Two short tunnels in a gravel channel. Gravel panned for values. Some work during rainy season. Owned by Mr. F. B. Ellsworth, of Baker Ranch.

Bald Mountain Mine. Last Chance district. Portions of Secs. 21, 22 and 28, T. 15 N., R. 13 E., M. D. M., in Flat Ravine, 10 miles southeast of Westville. Elevation 5800 feet. 160 acres. 10,000 feet is claimed along a north-south channel extending from Bald Mountain to Millers Defeat, 800′ tunnel and 1000′ drift along rim of channel. New 200′ tunnel 300′ lower in elevation than the 800′ tunnel. 100′ shaft with 150′ drift and 600′ along channel caved. Two 60′ shafts caved. Channel said to be 200′ wide where crosscut. Gravels said to have paid $6.00 to $7.00 per man in upper part of channel where drifted. Claim overlapped on the northwest by the Fall Ravine quartz mine. Idle. Owned by A. Harpending, 2607 Fruitvale Ave., Oakland, Cal. Fred W. Venzke, original locator, Westville, Cal.

Banner Mine. Dutch Flat district. Sec. 34, T. 16 N., R. 10 E., M. D. M. At Dutch Flat. Elevation 3100 feet. Patented. Cement gravel. Shaft 50 feet. Owned by E. C. Uren, Nevada City.

Bartley Consolidated Mine. Dutch Flat district. Sec. 26, T. 16 N., R. 10 E., M. D. M. Elevation 3600 feet. Patented 110 acres. Large deposit of low grade, free wash, blue gravel. Depth 200 feet. Channel 4000 feet. Tunnel 1400 feet. Idle. Owned by Wm. Rablin, of Dutch Flat.

Belle Verne Prospect. Last Chance district. Secs. 26 and 35, T. 15 N., R. 12 E., M. D. M. Across Grouse Cañon from the Hometicket mine. Elevation 4800 feet. Eighty acre claim. Channel said to run east-west on the south side of Grouse Cañon and may be 2000 feet long. Gravel is 2 feet deep and 30 feet wide and is capped with andesite. Tunnel 50 feet driven towards channel. Owned by George H. Smith, of Last Chance.

Ben Franklin Mine. Forest Hill district. One hundred and sixty acres on Swindle Hill near Yankee Jim's. Elevation 2350 feet. Near forks of Brushy Creek and Devil's Cañon. Bedrock tunnel 1200 feet. Upraise 50 feet. Idle. Owned by Joe Gilbert and R. C. Burry, of Forest Hill.

Bibl.: Rep. XII, 1893–4, p. 205.

Big Bar Prospect. Last Chance district. Sec. 20, T. 14 N., R. 13 E., M. D. M. Large bar in Duncan Cañon below the Blue Eyes property. Ground was tested for value and it was found to have been drifted by Chinese in the early days. Abandoned by Messrs. Threlkeld and Blohm, of San Francisco, and W. T. Davis, of Last Chance.

Big Gun. Forest Hill district. Idle. J. F. Thompson, Bath.

Bigelow. Forest Hill district. Idle. J. F. Thompson, Bath.

Black Hawk Mine. Forest Hill district. Secs. 13 and 14, T. 14 N., R. 10 E., M. D. M., 3 miles north of Forest Hill. Idle. Owned by W. A. Freeman Estate, Thomas Nichols, manager, Auburn.

Blue Eyes Prospect. Last Chance district. Sec. 32, T. 15 N., R. 13 E., and Secs. 5, 7, 8 and 17, of T. 14 N., R. 13 E., M. D. M., 2500 acres. Assessment work done on a bedrock tunnel. Channel not yet reached. Tunnel reported to be too high. Old hydraulic work was done in the Pine Nut pit. Owned by S. S. Caples, of Michigan Bluff.

Bogus Thunder. Michigan Bluff district. No information.

Bowen Mine. Michigan Bluff district. Sec. 10, T. 14 N., R. 11 E., M. D. M., 2 miles northeast of Michigan Bluff. Elevation 3400 feet. Bowen claim patented. Hold 2000 feet on a gravel channel. Assessment work only on other claims. Owned by Mrs. F. A. Bowen and sons of Michigan Bluff.

Brooklyn and Olympia Prospect. Last Chance district. Secs. 26, 35 and 36, T. 15 N., R. 12 E., M. D. M., one mile northeast of Last Chance. Elevation 4580 feet. Two hundred and thirty-five acres. Reported as one mile along a cement gravel channel. Tunnel 800 feet follows channel. Owned by Messrs. Threlkeld and Blohm, of San Francisco; W. T. Davis, superintendent, at Last Chance.

Burns Mine. Michigan Bluff district. Sec. 22, T. 14 N., R. 11 E., M. D. M., one-half mile north of Michigan Bluff. Elevation 3500 feet. Two hundred acres. Early work on cement gravel channel. Tunnel 800 feet. Shaft 130 feet. Channel lost. Assessment work only. Owned by the Michigan Bluff Mining Company; secretary, Wm. Burns. Placer County Bank, East Auburn.

Canada Hill Mine. Canada Hill district. Secs. 4, 5 and 9, T. 15 N., R. 13 E., M. D. M., 8 miles east of Westville. Elevation 6300 feet. Patented. Three hundred and ten acres. Reported to have one mile along a channel of free wash gravel. Old tunnel 1500 feet caved. New tunnel has entered gravel. Twelve men employed in November, 1915. Owned by Mr. E. H. Armstrong, of Grass Valley.

Carey Mine. Iowa Hill district. Sec. 27, T. 15 N., R. 10 E., M. D. M. At Monona Flat. Elevation 3200 feet. One hundred and twenty acre claim. Cement gravel channel with slate bedrock and andesite capping. Course of channel N. 20° W. Tunnel 250 feet. Some drifting. Channel is reported to be from 6 inches to 4 feet deep and 100 feet wide. One thousand eight hundred pound hand-cars are used to carry the gravel to a bin, where it is washed by water from Indian Cañon. Work is carried on all year. Two men work and mine about

18 cars per day. The gravel averages $1.00 per car. Owned and operated by Mr. Bonham, of Iowa Hill.

Cedar Creek Mine. Dutch Flat district. Sec. 3, T. 15 N., R. 10 E., M. D. M., 1½ miles south of Dutch Flat. Elevation 3500 feet. Four hundred and sixty acres. Reported to embrace 1½ miles along a channel of free wash gravel. A bedrock tunnel 7 feet x 9 feet is 2200 feet long. The gravel channel is reported to have been about 40 feet wide. Of the four upraises, only one is open. Idle. Property in charge of Mr. F. K. W. Develey, of Blue Cañon. Owned by J. L. Gould, of Alameda.

Bibl.: Rep. VII, p. 206.

Copper Bottom Mine. Iowa Hill district. Patented. Idle. Owned by John Peters, of Sheridan.

Dam Mine. Damascus district. Secs. 23 and 26, T. 15 N., R. 11 E., M. D. M., 2½ miles southeast of Damascus. Elevation 3715 feet. Patented 174 acres. Reported to have had four miles along a channel with free wash gravel 500 feet deep. Main 7500-foot tunnel is caved. Power plant removed. Idle. Owned by the Damascus Mining Company, Margaret Ogden, president, Monadnock Building, San Francisco.

Damascus or **Sunny South Mine.** Damascus district. Secs. 14, 15 and 23, of T. 15 N., R. 11 E., M. D. M., one mile southeast of Damascus. Elevation 3748 feet. One thousand five hundred and forty-eight acres of claims. White and blue cement gravel channels 900 feet deep. Tunnel 9000 feet. Worked out. Idle. The Red Point Mine is said to be on a continuation of the same channel. Owned by the Hidden Treasure Mining Company, of Michigan Bluff; H. T. Power, 625 Call Building, San Francisco.

Dardanelles Mine. Forest Hill district. Secs. 34 and 35, T. 14 N., R. 10 E., M. D. M., 1½ miles southwest of Forest Hill. Elevation 2600 feet. Patents, Dardanelles and Oro. Area 312 acres. Reported to be a 2500-foot channel of cement gravel on slate. Tunnel 3000 feet. Handwork. Two men working. Car capacity one ton. Work about four tons per day, tunneling, and eight tons per day breasting. Gravels average about $1.50 per ton. Prospect work only by the leasers. Owned by T. L. Chamberlain, of Auburn. Leased by Chester F. Bowman and Samuel G. Bowman, of Forest Hill.

Devil's Basin Consolidated. Includes the Lofruth Mine. Deadwood district. Sec. 1, T. 14 N., R. 11 E., and Sec. 25, T. 14 N., R. 10 E., M. D. M., ½ mile north of Deadwood. Elevation 3700 feet. Claims: Harkness, Washington, Elk Horn, Devil's Basin Consolidated, Devil's Basin and Rattlesnake. Tunnel 5000 feet. Worked by the owners,

R. Lofruth, of Deadwood, and J. E. Ferguson, of Michigan Bluff, who employ two men. Some good gravel is said to have been struck in October, 1915, which ran $3.50 per car.

Devil's Gate. H. G. Munger, 525 Adler St., Portland, Ore.

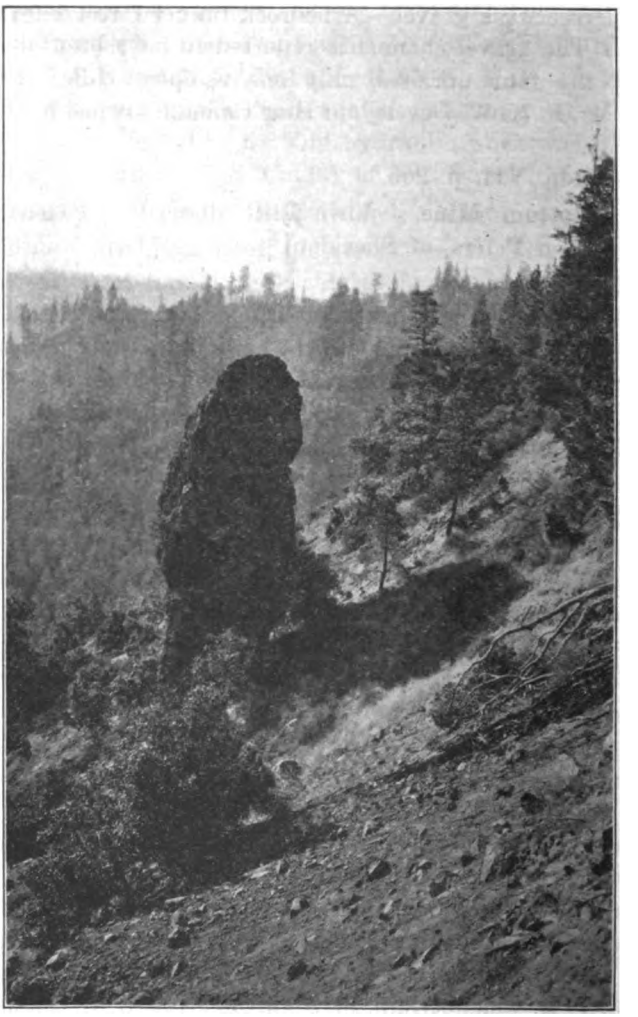

Photo No. 11. Devil's Horn, in Devil's Basin, on the eastern slope of Deadwood Ridge, at head of the trail to Last Chance. The "horn" shows how the andesite has intruded the slates and gravels in places.

Dewey Consolidated Mine. Iowa Hill district. Secs. 33 and 34, T. 15 N., R. 10 E., M. D. M., ½ mile southeast of Iowa Hill. One hundred and thirty-seven acres. Running tunnel to strike what is supposed to be a part of the "Blue Lead" channel. Property recently surveyed.

Owned by A. and B. Rossi, of Sacramento (½), and P. T. Langenour, J. W. Monroe, J. L. Stephens, Harvey Willoughby, Daniel Woods and J. P. Keene, of Woodland; and Manuel Chapman and Ralph Sparks, of Winters (½). J. P. Keene is superintendent.

Dixie Queen Mine. Last Chance district. Secs. 9, 16 and 17, T. 14 N., R. 13 E., M. D. M., 9 miles southeast of Last Chance on the west side of Duncan Cañon and south of the Blue Eyes property. Elevation 4000 feet. Two hundred and forty acre claim. Cement gravel channel on slate with capping of andesite. Course of channel SW. Tunnel 700 feet. Breasted for 240′; 600′ of crosscuts. Gravel washed in sluice boxes by water from Duncan Creek. Cars hold 1800 lbs. Equipment consists of: hand outfit for 8 men, shop and cabin. Two men work steadily and employ two others. Gravels average $1.00 per car. Said to have been $5000.00 taken out since 1906. Owned by Joseph Scherer and John Franks, of Last Chance.

Dutch Flat Blue Lead. Dutch Flat district. Sec. 3, T. 15 N., R. 10 E., M. D. M. Small patented claim adjoining the Federal Drift Mine. Cement gravel, blue lead. Gravel from 50 feet to 110 feet deep. Tunnel 1000 feet. Shaft 400 feet. Owned by C. S. Jordan, of Dutch Flat, and J. L. Gould, of 16 Ensloe Ave., Alameda.

Dyer or **Wisconsin Mine.** Dutch Flat district. Sec. 35, T. 16 N., R. 10 E., M. D. M., ½ mile west of Dutch Flat. Elevation 2800 feet. Twenty acres. Cement blue gravel channel in slate. Channel 300 feet. Tunnel 800 feet. Seven men drifting and breasting. Gas engine runs air compressor equipped with one Sullivan air drill. Distillate costs $0.12 per gallon at the property. Gravel is washed in hopper with 100 feet of sluice boxes. Owned by J. L. Gould, 16 Ensloe Ave., Alameda. Leased by Messrs. Fred Husler and Chas. Wachter, locally known as the "Swiss Boys."

Eagle Bar Mine. Forest Hill district. Wm. Duffy, Forest Hill.

Elite. Dutch Flat district. Secs. 31 and 32, T. 16 N., R. 11 E., M. D. M., one mile southeast of Shady Run. Elevation 3950 feet. Four hundred and twenty-five acres. Gravel reported to be 500 feet deep. Shaft 153 feet. Tunnel 1100 feet. Idle. Owned by R. Monroe et al., of Dutch Flat.

Eureka. Damascus district. Includes 3,000 acres in Secs. 17, 18, 19 and 20, in T. 15 N., R. 12 E., and in Secs. 24 and 25 of T. 15 N., R. 11 E., M. D. M., 1½ miles southeast of Forks House. Elevation 4400 feet. Free wash gravel. Tunnel 4000 feet. Prospecting only at present. Owned by the Eureka Consolidated Drift Mining Co.; J. A. Ferguson, superintendent, Forest Hill, and Chas. Leach, U. S. Mint.

Excelsior. Forest Hill district. Sec. 26, T. 14 N., R. 10 E., M. D. M. Worked through the New Hope, 3500 foot bed-rock, tunnel with

portal in Sec. 35, T. 14 N., R. 10 E., M. D. M. One-half mile southeast of Forest Hill. The channel is on the Blue Lead and was located in the early 70's but was not worked until 1913. The company now owns all claims between the Dardanelles and the Gore, including also the Banner and the Garland Mill Slope, including about 2000 acres. The channel northeast of here has all been worked out through the Mayflower and Paragon tunnels. The channel varies from 20 feet to 100 feet wide and has a course about N. 20° E. The bed rock is slate and the cement blue gravel requires blasting. Work consists of drifting along the channel and stoping out the chambers. Mine equipment consists of a 350-cubic-foot air compressor and eight Ingersoll and Sullivan air drills. Electric power, 700 h. p., is brought from Horseshoe Bar.

The gravel is screened through a revolving grizzly lined with T-rails and the fine material run through a 6-stamp triple discharge mill. Six months gravel was blocked out when visited in September, 1915. Water is obtained from the tunnel, through which drain the old Harley shaft and Independence slope. Owned by Excelsior Gold Mines Co., Inc., M. Jenks, president, San Francisco; R. B. Elder, manager, Berkeley.

Federal Drift Mine. Dutch Flat. Sec. 34, T. 16 N., R. 10 E., M. D. M. Elevation 3000 feet. Patented land in town of Dutch Flat. One hundred and twenty-five acres. Slate bed rock. Channel thought to be a branch of the Dutch Flat Blue Lead and strikes approximately N. 80° E. A two-compartment vertical shaft over 80 feet deep struck gravel in November, 1915, but water was encountered. A mule whim was used for hoisting and five men were employed. Owned by the Federal Drift Mining Company, Dr. W. B. Coffey, president; W. T. Watson, superintendent, Dutch Flat.

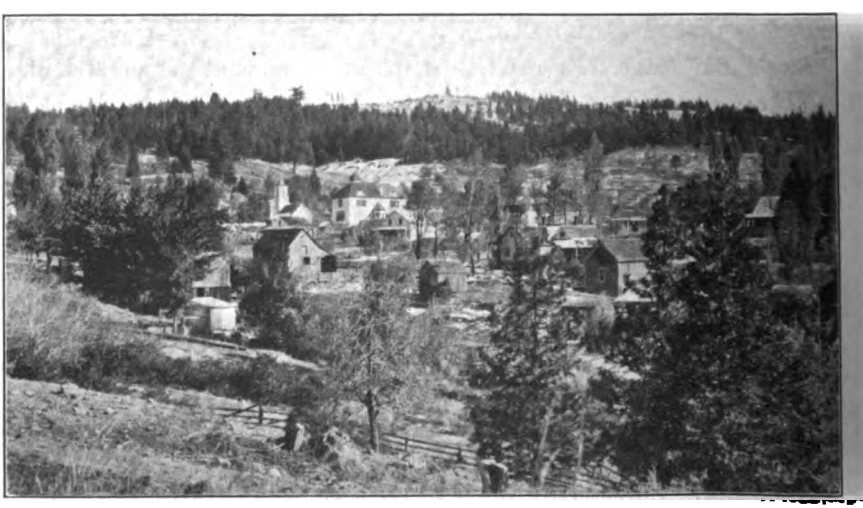

Photo No. 12. View eastward towards the town of Dutch Flat. The X in center marks the location of the Federal Drift shaft.

Fitzpatrick. Iowa Hill district. Sec. 32, T. 15 N., R. 10 E., M. D. M., one mile west of Iowa Hill. Tunnel 2000 feet. Two men prospecting on an old property. Owned by M. E. Poor, Monona Flat, Iowa Hill.

Florida. Forest Hill district. Sec. 25, T. 14 N., R. 10 E., M. D. M., one mile northeast of Forest Hill. Elevation 3550 feet. Patented. Cement channel. Tunnel 650 feet. Some development work being done. Owned by Mr. Rice.

Flying Fish. Dutch Flat district. Sec. 34, T. 16 N., R. 10 E., M. D. M., ½ mile southwest of Dutch Flat. Elevation 3100 feet. Ten acres. Cement gravel. Idle. Owned by Ed. C. Uren, Nevada City.

Franklin. Michigan Bluff district. Sec. 10, T. 14 N., R. 11 E., M. D. M., 2 miles northeast of Michigan Bluff. Elevation 3400 feet. Tunnel 800 feet. Expect to strike Bowen channel in another 100 feet. Two men employed. Owned by A. Dixon, of Michigan Bluff.

Gleason Mine. Iowa Hill district. Said to be three miles southeast of Iowa Hill. Patented. Cement gravel channel with slate bedrock. Idle. Owned by Gleason Consolidated Mining Co., 3793 Twentieth St., San Francisco; Miss M. T. Gleason, Iowa Hill.

Glenn Mine. Last Chance district. Secs. 22, 27, 28 and 34, T. 15 N., R. 13 E., M. D. M., 6 miles east of Last Chance. Elevation 5000 feet. Cement channel on the northwest side of Duncan Cañon. Drifting up the channel has been carried on recently by Mr. F. A. Moss, who with Mr. M. C. Threlkeld, leases the property from the owners, G. R. Cowen, of San Francisco, Geo. McCauley and K. A. Robinson, of Auburn.

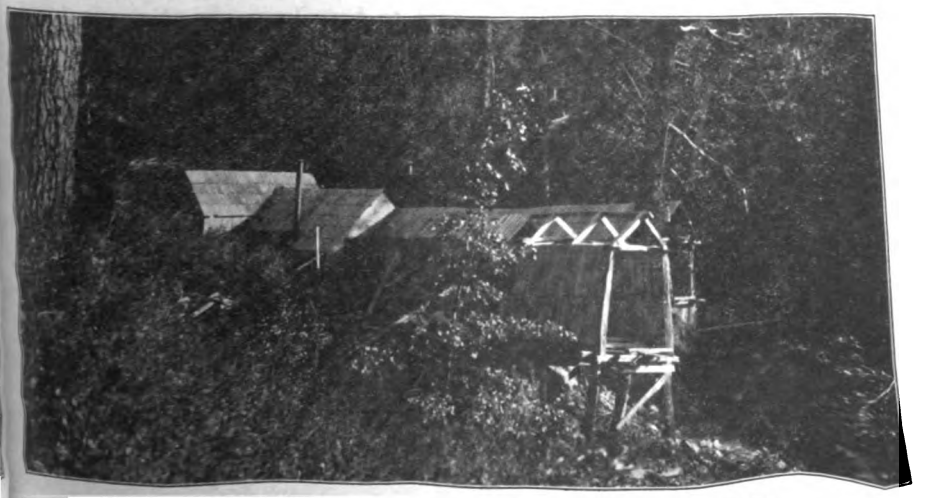

Photo 13. Glenn Mine, eight miles east of Last Chance, Placer County.

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The course of the lower channel is N. 60° W. and it has been covered with andesite. A later channel deposited gravels on top of the andesite and was capped by a more recent lava flow. The bedrock consists of schist and is steep and cut full of potholes. The pay gravel is from 10′ to 100′ wide. Equipment consists of shop, tools, snowsheds, bunk house and superintendent's house. Former work seemed to have been northeast of the channel, and considerable work was done by the present operators before the channel was opened up.

Gold Ring or **J. D. Peters Mine.** Dutch Flat district. Sec. 1, T. 15. N., R. 10 E., M. D. M., 2½ miles southwest of Towle. Elevation 1500 feet. Sixty-three acres. Cement gravel channel 30 feet wide. Idle. Owned by Mr. West, of Green Valley, or Towle.

Golden Channel. Blue Cañon district. Sec. 1, T. 16 N., R. 11 E., M. D. M. Elevation 4800 feet. One and one-half miles southwest of Emigrant Gap. Patented. Four hundred and eighty acres. Reported as free wash gravel 130 feet wide. Could not find a pay channel. Shaft 105 feet. Idle for 14 years. Owned by J. W. Hyatt, Emigrant Gap.

Golden Nugget. Blue Cañon district. Sec. 12, T. 16 N., R. 11 E., M. D. M., two miles northeast of Blue Cañon. Elevation 4000 feet. Patented 640 acres. Reported to include one mile of channel, carrying free wash gravel 450 feet deep and 75 feet wide. Tunnel 325 feet. Idle. Owned by C. M. Everhart, of Gold Run.

Golden River or **Red Point Mine.** Damascus district. Secs. 12, 13, 14, 23 and 24, T. 15 N., R. 11 E., and Secs. 3, 4, 5, 6, 7, 8 and 18, of T. 15 N., R. 12 E., M. D. M., one mile north of Forks House. Elevation 3827 feet. Patented. One thousand feet of free wash gravel. Tunnels over 18,000 feet. The gravel is said to have been about worked out. Idle. Owned by the Société des Mines de Golden River, of Paris, France. Leased to Messrs. Bird and J. A. Ferguson, of Forest Hill.

Golden Sheaf. Michigan Bluff district. E. S. Thompson, Michigan Bluff.

Golden Star. Iowa Hill district at Succor Flat. Tunnel, 675 feet. Prospecting for blue gravel. Owned by N. E. Booth and R. L. Wills, of Auburn. Leased to Robert McClanahan, of Iowa Hill.

Golden Streak. Iowa Hill district. Said to be a channel 80′ wide, 5000′ long and varying from 0′ to 8′ deep capped by 400′ of lava. A 1200′ bedrock tunnel is contemplated to reach the gravels.

Owned by the Golden Streak Mining Co., Henry Lobner, F. H. and Walter Schulze, F. D. Kuenzley, and P. W. Crider, of Colfax.

Golden West. Canada Hill district. Secs. 4 and 5, T. 15 N., R. 13 E., M. D. M., eight miles east of Westville. Elevation 6500 feet. Claims: Big Hill (150 acres) and Bunker Hill (140 acres). Patented 400 acres. Claim 1 mile along a channel, of red and blue gravel, 130′ wide. Development work consists of an incline shaft and a 2200′ bedrock tunnel which, it is said, lacks only 200′ of work to reach the channel. Some gravel from an upper tunnel is said to have run $5.00 per car. The operators are reported about to resume work after four years idleness. E. H. Armstrong, of Grass Valley, manager.

Gorman Mine. Michigan Bluff district. Sec. 27, T. 14 N., R. 11 E., M. D. M., one mile south of Michigan Bluff Drifting in cement gravel channel. Owned by A. Gorman, of Michigan Bluff.

Grey Eagle. Forest Hill district. Secs. 5 and 6, T. 13 N., R. 10 E., M. D. M., five miles southwest of Forest Hill, on Owl Creek. Elevation 2400 feet. Hold all claims eastward to the Franklin and are negotiating for others, which will extend the holdings to the San Francisco claim. Present holdings include about 6000 feet of cement gravel channel with a volcanic capping. The gravel averages 5 feet thick and 50 feet wide. Little timbering is necessary. Present working consists of a 3000-foot bedrock tunnel in slate, which crosscuts the E.-W. channel. Drifting has been carried eastward along the channel for 4000 feet. The gold is fine like bran, the largest pieces being valued at about $1.00. Tunneling costs about $11.00 per foot. When visited in October, 1915, the mine equipment consisted of an air compressor and six air drills. The gravel is drawn in one-ton cars by a horse to an old 10-stamp mill, repaired for temporary use. The camp included an office and bungalow, warehouse, shop, change room and 12 bunk houses. Water is pumped from the mine by one 2-inch centrifugal pump, one 4-inch single acting pump and one 7-inch duplex pump, which lift 10 inches of water 50 feet. Electricity is obtained from the Excelsior line, owned by the Pacific Gas and Electric Co., and costs 1½ cents per K. W. H. Twelve men were employed. Freight from Auburn costs ½ cent per pound.

New equipment contemplated consists of a revolving screen and conveyor belt; a three-stamp triple discharge Hendy mill with 24-mesh screen. The fine gravel will be run through sluices, while all gravel 1 inch or over will be crushed.

Owned by the California Chief Development Co.; Walter Fitch, president, Eureka, Utah; Chas. L. Austin, manager, Forest Hill.

Hard Climb. Last Chance district. Secs. 3 and 9, T. 14 N., R. 13 E., M. D. M., 6 miles southeast of Last Chance, on Duncan Ridge on the southeast side of Duncan Cañon. Elevation 4000 feet. Four hundred acres in claims. A lava capped channel is worked by those

interested when water is available. In 1908 a tunnel was run 75 feet into gravel and some gold taken out. About 60 feet lower and 1000 feet north of the first tunnel, another tunnel was run 40 feet on the channel, but the gravel encountered did not carry much value. A new 200′ tunnel, in conglomerate and 50′ of gravel, is said to look promising. Owned by F. M. Tillotson, Hiram W. McCullough and Chas. H. Hilton, of Last Chance, and Mrs. Mary Haviland, of Michigan Bluff.

Hassler. Ophir district. In Long Ravine, 2 miles southeast of Auburn on the road to Folsom, Sec. 28, T. 12 N., R. 8 E., M. D. M. Prospecting is being carried along a NW.–SE. channel, said to be 2″–12′ deep, 75′ wide and 1000′ long. The channel is capped with lava, gravel, mud, etc. Development consists of a 340′ incline shaft on an angle of 30°. The values are said to run out to the rims of the channel on the bedrock. Equipment consists of a 25 h. p. steam hoist used to raise the gravels, and a 1600 lb. car. The gravels are said to run from $4.00 to $14.00 per ton, and 150 cars are on the dump ready for washing.

Owned by Harold Powers, San Francisco, and E. C. Gaylord et al., of Auburn. Leased by J. W. Wright, Frank Wooldridge and G. P. Johnson of East Auburn.

Haub. Dutch Flat district. Sec. 28, T. 16 N., R. 11 E., M. D. M., ½ mile northeast of Shady Run. Elevation 3720 feet. Thirty-three acres. Reported as free wash white gravel. Channel 40 feet wide. Tunnel 960 feet. Shaft 30 feet. Some work being carried on. Owned by Robert Watson, of Blue Cañon.

Bibl.: Register of Placer County Mines, 1902, Cal. State Min. Bur.

Hermit or **Great Channel.** Michigan Bluff district. Sec. 3, T. 14 N., R. 11 E., M. D. M., four miles north of Michigan Bluff. Elevation 3400 feet. Free wash gravel. Shaft 75 feet. Tunnel 2200 feet. Idle. Owned by Mrs. Bowen and sons, of Michigan Bluff.

Hidden Treasure. Damascus district. Secs. 26, 27, 34 and 35, of T. 15 N., R. 11 E., M. D. M., 5 miles north of Michigan Bluff. Elevation 3644 feet. Patented 1545 acres. Reported as free wash gravel. Channel 300 feet wide. Tunnel 8300 feet. Electric power was used for traction, hoisting, pumping and blower. Idle since fall of 1914. Owned by the Hidden Treasure Mining Co., of Michigan Bluff; Harold T. Power, secretary, 625 Call Building, San Francisco.

Bibl.: Rep. VIII, p. 469; Rep. IX, pp. 29–120; Rep. X, p. 451; Rep. XII, p. 209.

Hogsback Mine. Canada Hill district. Secs. 2 and 3, T. 15 N., R. 12 E., M. D. M., three miles east of Westville. Elevation 4524 feet. Patented 1545 acres. Reported as free wash gravel. Tunnel 2500 feet. Thought to be the same channel that was worked at Red Point. Idle. Owned by Compagnie des Mines et Minerais, 26 Rue de Chateaudon, Paris, France; J. A. Ferguson, superintendent, Forest Hill.

Bibl.: Rep.VIII, p. 472.

Homestake. Forest Hill district. Sec. 31, T. 14 N., R. 11 E., M. D. M., two miles south of Bath, in Volcano Cañon. Elevation 1260 feet. Idle. Owned by M. Savage, of Forest Hill.

Home Ticket. Last Chance district. Secs. 26 and 35, T. 15 N., R. 12 E., M. D. M., one mile east of Last Chance. Elevation 4700 feet. Twenty-one claims. Cement gravel channel in slate averages 7 feet thick. A channel with a northerly direction is cut by one with an east–west course. Tunnel 4300 feet. The gravel is mined by hand work and then washed in hoppers by water from a reservoir in Grouse Cañon, owned by the Pacific Slab Mine. During the dry season scarcity of water compels them to chute the water for sluicing. Between 15 and 20 men are employed. Owned by J. F. Thompson, of Bath, and others. Frank B. Keefer, president, San Francisco. Leased by D. M. Ray, of Last Chance.

Indiana Hill. Dutch Flat district. Secs. 9 and 10, T. 15 N., R. 10 E., M. D. M., 1½ miles southeast of Gold Run. Assessment work only. Owned by J. L. Sparhawk, Iowa Hill.

Jack Robison. Last Chance district. Sec. 16, T. 14 N., R. 13 E., M. D. M. Elevation 4070′. An 80′ tunnel in loose gravel has penetrated a blue gravel. Equipment consists of bunk house and shop. The gravels are sluiced by water dammed up from the mine. The channel is thought to run diagonally across the ridge in a NE.–SW. direction. Owned by S. S. Caples, Michigan Bluff.

Jarvis or **Bob Lewis Mine.** Damascus district. Secs. 14 and 15, T. 15 N., R. 11 E., M. D. M., ½ mile northeast of Damascus. Elevation 3850. One hundred and sixty acres. Cement gravel channel said to be 400 feet wide. Fourteen hundred foot tunnel. Owned by H. M. Jarvis, of Mobile, Alabama. Leased to Geo. Brown, Orin Jones, Jack Creighton and Bob Craig, of Last Chance, who have been drifting along the channel and producing since June, 1915.

Jupiter Consolidated. Iowa Hill district. Sec. 11, T. 14 N., R. 10 E., M. D. M., 3½ miles southeast of Iowa Hill. Patented 250 acres. Reported to have a channel one and one-half miles long in free wash gravel on the north side of Shirttail Cañon. Shaft 250 feet. Idle. Owned by the McGeachin Company.

Live Oak. New England Mills (Weimar) district. Sec. 22, T. 14 N., R. 10 E., M. D. M., 2 miles northeast of Weimar in Live Oak ravine. Elevation 2000 feet. Owned by the Geisendorfer Estate. Bonded to Dan J. Williams, of Weimar.

Lost Camp. Blue Cañon district. SE. Corner of Sec. 23, T. 16 N., R. 11 E., M. D. M., 1½ miles southeast of Blue Cañon on the north fork of the North Fork of the American River. Elevation 4500 feet. Six hundred acres. Tunnel 300 feet. Now operated as a hydraulic mine. Owned by George F. Miller, of Blue Cañon.

Macedon Mine. Canada Hill district. Sec. 1, T. 15 N., R. 12 E., M. D. M., four miles east of Westville. Elevation 5000 feet. Patented 110 acres. Reported to have 3000 feet along a free wash gravel channel which is about 70 feet wide. Tunnel 200 feet. Owned by Dr. C. W. Richards and Mrs. A. Snyder, of Sacramento, and Mr. Rey, of the Britton & Rey Co., San Francisco.

Maguire, or **Foss Mine.** Dutch Flat district near Lowell Hill. Worked by drifting in the early days. Wm. Maguire and wife the present owners reported to be going to hydraulic the gravels.

Marian Mine. Michigan Bluff district. Sec. 35, T. 14 N., R. 11 E., M. D. M., two miles south of Michigan Bluff. Elevation 3800 feet. One hundred and eighty-five acres in claims. Cement gravel channel in slate with andesite capping. Tunnel 600 feet. Development work only. The owner expects to strike the channel in about 50 feet. Owned by E. A. Hills, of Michigan Bluff.

Maus Tunnel. Forest Hill district. Sec. 36, T. 14 N., R. 10 E., M. D. M., one mile east of Forest Hill. Elevation 3000 feet. This claim lies between the Excelsior and the Paragon properties, but does not extend northwestward as far as the probable course of the Blue Lead channel. Tunnel 1000 feet. It is reported that 500 feet more of tunnel with raises will be run.

Bibl.: Grass Valley Union, October, 1916.

Mayflower Mine. Forest Hill district. Parts of Secs. 22, 23, 24, 25 and 26, T. 14 N., R. 10 E., M. D. M., two miles northwest of Forest Hill. Elevation 2700 feet. Claims: Eastern, Portuguese and Brushy Slide. Patents: You Bet, Center Hill, Orono, Hancock and Watson, Banner, Coates, Slater, Live Oak, Rockby Point, High Run, Justice, Nil Desperandum, Gore and Freeze Out. Twenty-six hundred acres. Three cement gravel channels in slate. The Orono channel averages 40 feet wide, and a 3500-foot bedrock tunnel has been driven in mining it. The Blue Lead channel averages 300 feet wide, and a 14,800 foot bedrock tunnel has been driven in course of mining it. The Upper Lead channel averages 250 feet wide and a 3500-foot tunnel in bedrock and gravel has been driven. In a shaft which was sunk to bedrock,

about 325 feet of blue gravel was passed through. Drifting is being carried on in all three of these channels. Two air compressors serve seven machine drills and a forge. The gravel is trammed in 1½-ton cars.

Water and steam power are used, depending on the abundance of water and time of year, to run a 20-stamp mill which crushes the gravel. The pulp passes over amalgamation plates and then over riffles. Sixteen men are employed and the miners move about 3½ cars of gravel per man per day. It is claimed that the net production of this mine during the last forty years has been about $3,600,000.

Owned by the Mayflower Gravel Mining Company; Geo. L. Duffy, president, 2352 Mission Street, San Francisco.

Missouri Mine. Forest Hill district. Secs. 33 and 34, T. 14 N., R. 10 E., M. D. M., one mile southeast of Yankee Jim's. Elevation 2650 feet. Tunnel run but apparently struck little gravel. If carried southward into the San Francisco claim, this tunnel might encounter gravel. Idle.

Mohawk. Iowa Hill district. Sec. 26, T. 15 N., R. 10 E., M. D. M., three miles north of east of Iowa Hill on Succor Flat. Elevation 3200 feet. Claims: Gravel channel, with a north–south course, in amphibolite. Incline shaft. Two men said to have been working for two years. Hand labor. Owned by N. E. Booth, of Colfax.

Monumental. Canada Hill district. Sec. 4, T. 15 N., R. 13 E., M. D. M., 8 miles east of Westville. Elevation 5300 feet. Five claims.

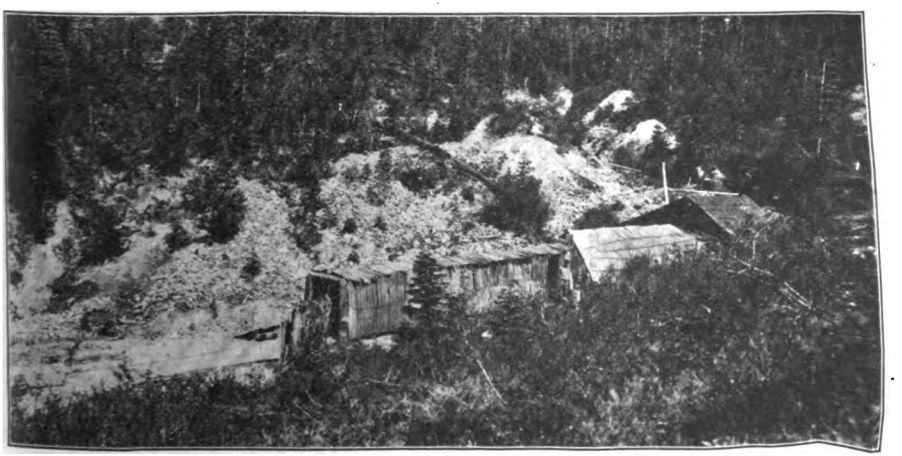

Photo 14. Tunnel entrance to Monumental Mine, Canada Hill District, Placer County.

Two hundred acres. Adjoins the Golden West property. A gravel channel running N. 60° W. is about 80 feet wide, with andesite capping. Tunnel 400 feet with some drifting. A 5 h. p. gasoline

engine is used to run a barrel mill 8′ long x 30″ in diameter for loosening up the values. Eighty feet of sluice boxes. Three men work all year. Eighteen hundred feet of Reed channel worked out. Some gravel is poor while other carries values up to $8.00 per car. Owned by Peter F. Hinst, E. W. Smith and A. A. Bissell, of Westville.

Moody Ridge. Dutch Flat district. Secs. 3 and 10, T. 15 N., R. 10 E., M. D. M., two miles east of Gold Run. Elevation 3650 feet. Patented 120 acres. Some tunneling. Remains undeveloped. Owned by Mr. Moody, of the Pacific Hardware Company, of San Francisco.

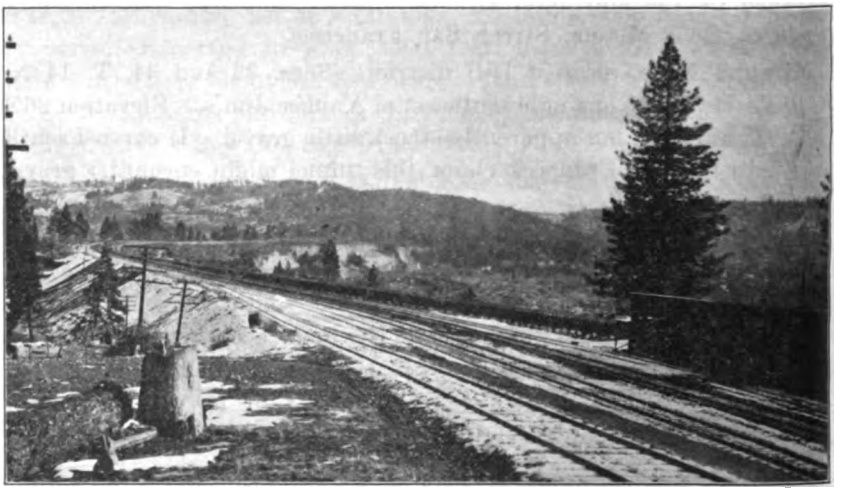

Photo No. 15. View northeastward up the railroad right of way near Gold Run, showing hydraulic gravel banks and pit to the right.

Morning Star. Iowa Hill district. Secs. 33 and 34, T. 15 N., R. 10 E., M. D. M., one mile northwest of Iowa Hill. Elevation 2700 feet. Patented 160 acres. Reported to have 5500 feet along a gravel channel. Tunnel 4800 feet. Shaft 488 feet. Idle. Owned by the McGeachin Co., H. T. Power, Call Building, San Francisco.

Bibl.: Rep. VIII, p. 472; Rep. IX, p. 29; Rep. X, p. 420; Rep. XII, p. 211.

Mountain Chief. Michigan Bluff district. Sec. 34, T. 14 N., R. 11 E., M. D. M., 1½ miles south of Michigan Bluff, northwest of the North Fork of the American River. Idle. Owned by Fred Outhouse, of Forest Hill.

New Baccarat. Lincoln district. Sec. 23, T. 12 N., R. 6 E., M. D. M., three miles southeast of Lincoln. Shallow drifting in residual gravels. One hundred and sixty acres. Tunnels 325 feet. Idle. Owned by Lincoln parties.

Photo No. 16. Panorama of old hydraulic workings at Gold Run, showing the proximity of the old working face to the railroad right of way to the left. The cement gravels in the bedrock still remain to be worked.

New Basil Consolidated. Canada Hill district. Secs. 2, 3, 10 and 11, T. 15 N., R. 12 E., M. D. M., 2½ miles east of Westville. Elevation 4900 feet. Three hundred and eighty acres. Cement gravel channel. Tunnel 3000 feet ran out of channel. Shaft 160′. The Black Cañon Quartz Mine occupies a portion of this property, and it is intended to obtain electric power from the Black Cañon Power Line for driving a new shaft. Idle. Owned by R. F. McLeod, 350 California St., San Francisco.

North America Prospect. Dutch Flat district. Secs. 28 and 29, T. 16 N., R. 11 E., M. D. M., one mile northeast of Shady Run or Midas. Tunnel 150 feet. Idle. Owned by L. K. Develey and brother, of Blue Cañon.

Occidental. Iowa Hill district. Sec. 3, T. 14 N., R. 10 E., and Sec. 34, T. 15 N., R. 10 E., M. D. M. Elevation 3300 feet. Patented 171 acres. Cement gravel channel. Tunnel 3100 feet. Probably worked out. Idle. Owned by W. E. Wretman, Garden City Bank Bldg., San Jose.

Oro. Michigan Bluff district. Sec. 10, T. 14 N., R. 11 E, M. D. M., 2½ miles northeast of Michigan Bluff. Elevation 3500 feet. Idle for several years. Owned by A. Dixon, of Michigan Bluff, as are also the Willey and Yule and Willey claims which lie north of the Turkey Hill consolidated.

Outhouse Consolidated or **Sellier Mine.** Damascus district. Sec. 34, T. 15 N., R. 11 E., M. D. M., 6 miles north of Michigan Bluff. Nine hundred and twenty acres. Claims: Never Fail (160 acres), Maintop (160 acres), Electric (160 acres), Golden Promise (160 acres), Up-to-Date (160 acres), and Brimstone (120 acres). A 310-foot shaft on the Mountain Sheaf claim is said to have struck the rim of a channel. Assessment work is being carried on in this shaft and in a shaft on the Georgia claim. Using a 12 h. p. gasoline engine to pump water. Three men employed. Owned by the Outhouse Consolidated Mining Co., Mr. Fred Outhouse, president, Forest Hill.

Pacific Blue Lead or **George Fulton.** Canada Hill district. Secs. 4 and 5, T. 15 N., R. 13 E., M. D. M. Elevation 6320′. Four hundred and thirty acres. Claim 1 mile along a blue channel 11′ deep and 150′ wide in which the gravel benches above the bedrock ran from $0.50 to $37.00 per car; also 1 mile along a white channel 6′–14′ deep and 125′ wide from which 1000 cars are said to have averaged $2.50 per car. The channels run East–West and the main bedrock tunnel 450′ long struck white gravel and crossed the channel into the rim of the blue

channel. The gravels are washed in sluice boxes and the tailings dumped into Flat Ravine.

Owned by Leo P. Harris, Westville or 2279 West Twentieth St., Los Angeles.

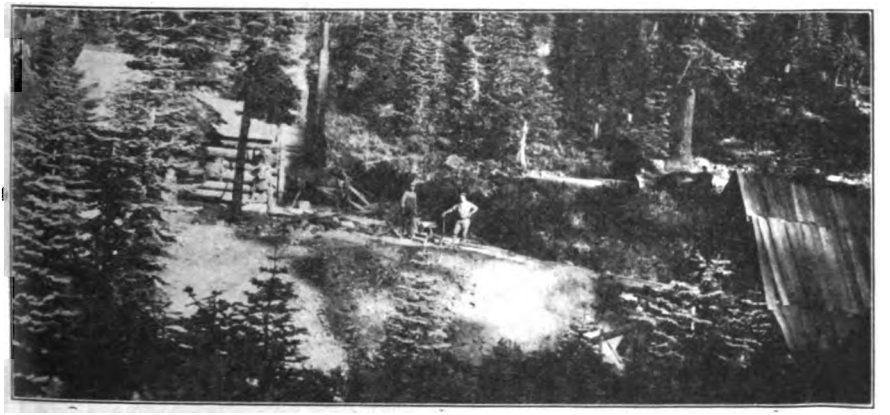

Photo 17. Camp, at the Pacific Blue Lead Drift Mine, Canada Hill District, Placer County.

Pacific Slab Mine. Last Chance district. Secs. 27, 28, 33 and 34, T. 15 N., R. 12 E., M. D. M., 1½ miles southwest of Last Chance. Twelve miles by steep trail from Michigan Bluff. Five hundred and twelve acres. Claims: Pacific Slab, Bob Lewis, New York and Ohio. Discovered about 1852 and worked off and on ever since. The channel is in slate capped by andesite and the gravel is fairly well cemented. The pay gravel consists of the lower 5 feet of gravel above bedrock, but the

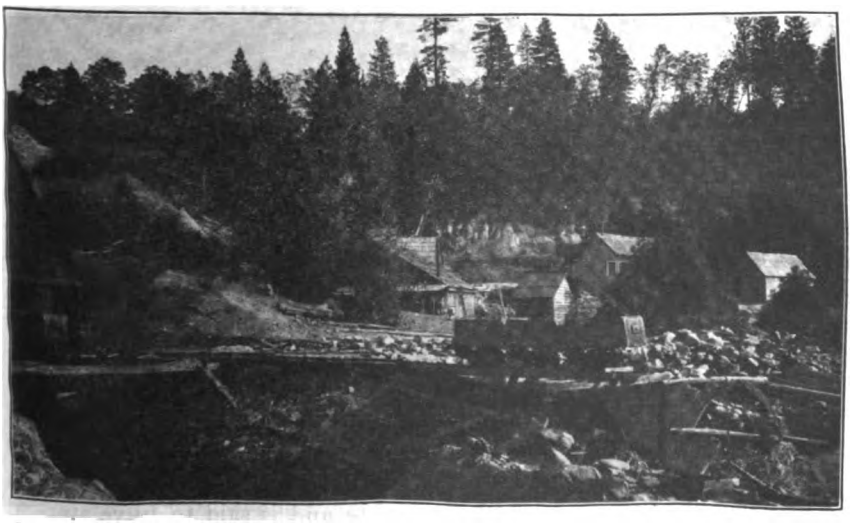

Photo No. 18. View eastward of the Pacific Slab Mine, Last Chance District, showing office, cook house, gravel bin and hydraulic monitor.

gravel is in places 20′ to 50′ deep. The channel has been followed for over 4000 feet. A 215–foot raise provides ventilation and entrance for supplies. Six-foot split pine costs $9.50 per thousand, while 1½″ x 6″ x 5′ lagging costs $20.00 per thousand, and 3–foot lagging costs $15.00 per thousand. The mine is equipped with a 6″ x 6″ Gardner air compressor, run by a 30″ Pelton–Doble water–wheel under a head of 130′, which serves air drills.

About 3500 feet from the portal of the tunnel a 40-foot channel 2′ deep from the northeast has cut the main channel in two. In September, 1916, work was being carried on in the small channel by 4 men who took out about 8 cars of gravel per day. Owned by the Pacific Slab Consolidated Mining Co., M. C. Threlkeld, president, 1007 Monadnock Building, San Francisco; Chas. H. Blohm, secretary; W. T. Davis, superintendent at the mine.

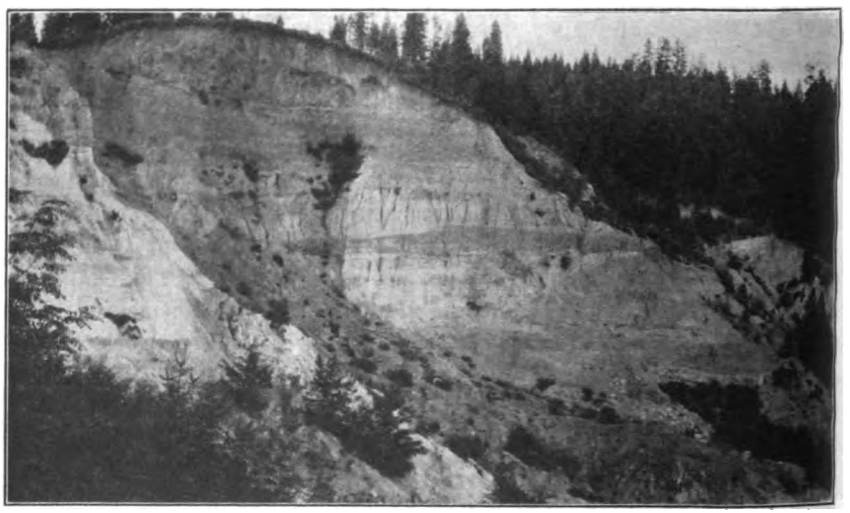

Photo No. 19. Hydraulic bank above the old Paragon tunnel at Bath, Forest Hill District, showing lens-shaped gravel strata.

Paragon or **Breece** and **Wheeler Mine.** Forest Hill district. Secs. 19, 24 and 30, T. 14 N., R. 11 E., M. D. M., 2 miles northeast of Forest Hill. Elevation 2900 feet. Five hundred acres patented. Cement gravel channel in amphibolite and serpentine capped by andesite. A tunnel 1¾ miles long follows the channel and connects with the Mayflower tunnel. There are estimated to be about 15 miles of drifts. Three channels were worked. The main or "Blue Lead" channel averaged 300 feet wide and the gravel is said to have averaged $4.50 per car of 16⅔ cubic feet. The Paragon channel, 150 feet higher than the "Blue Lead," averaged 45 feet wide and is said to have averaged $10.00 per car. The Orono or volcanic channel averaged about 250

feet wide and the gravel is said to have averaged $5.00 per car. The Paragon lead, to a distance of 3000 feet from the portal of the main tunnel, is said to have produced $900,000. The Orono channel is said to have been worked for 1800 feet and produced $75,000. The gravel was crushed in a Blake crusher and a 10-stamp mill. The pulp was passed over amalgamation plates and through sluice boxes and the tailings run into Volcano Cañon. Two men in the mine are doing development work to determine the direction of the Paragon channel at a point about one mile in the Blue Lead tunnel. Owned by J. F. Thompson, Box 178, Long Beach, Cal.

Penn Valley. Iowa Hill district. Sec. 27, T. 15 N., R. 10 E., M. D. M., at Monona Flat, 1½ miles northeast of Iowa Hill. Elevation 3200 feet. Patented 120 acres. Gravel channel in amphibolite with gravel capping. Tunnel 3000 feet. Present work consists of prospecting. Owned by B. T. Jamieson and Robert Smith, of Iowa Hill.

Placer Gravel Gold or the **El Dorado Mine.** Last Chance district. Sec. 26, T. 15 N., R. 12 E., M. D. M., ½ mile northeast of Last Chance. Elevation 4700 feet. Claims: El Dorado of 160 acres and others. Said to include 4000 feet along a cement gravel channel in slate. The channel course is approximately N. 35° W., and capped with andesite. The pay gravel is said to be 40 feet wide and 6 feet deep. Bedrock tunnel 4000 feet. Channel is worked through a 30-foot raise. Loaded cars run by gravity and each hold one ton of gravel. Each miner handles two cars of gravel per day. The mine lies north of the Home Ticket and is thought to be on the same "Big" channel which occurs in the Pacific Slab mine. It has been leased for the past two years by H. E. Gorman, Berry Griffin and Roy Anderson, of Last Chance. Owned by the Pacific Slab Gold Mining Company; Mr. D. M. Ray, of Last Chance, part owner. Marshal Sherbert, secretary.

Placer Queen. Canada Hill district. Eighteen miles east of Westville. Elevation 6230′. A 3000′ tunnel is said to have been run but to have been above the channel. A lower tunnel is contemplated to strike the channel which is thought to run E.–W. towards Canada Hill. Owned by the Placer Queen Gold Mining Company. Leased by W. Duffy, of Michigan Bluff.

Ralston Divide Gravel Mine. Ralston Divide district. Secs. 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, of T. 13 N., R. 12 E., Secs. 4, 5, 6, 7, of T. 13 N., R. 13 E., Secs. 22, 23, 27, 28, 31, 32, 33, 34, of T. 14 N., R. 13 E., and Secs. 34 and 35, of T. 14 N., R. 12 E., M. D. M. Elevation 3500 to 5000 feet. Ten thousand acres. Reported to have 10 miles along the Ralston Divide capped with andesite, which is underlain by gravel channels. Considerable prospecting has been carried on for several years. Scarcity of water permits work to be carried on only part of the year. In September, 1916, 8 men were doing hydraulic and drift work on the

Pat Goggins property on the Ralston Divide. Owned by the California and Hawaiian Development Co., Alaska Commercial Building, San Francisco; W. Duffy, manager, Michigan Bluff.

Red Star. Last Chance district. Three miles east of Last Chance. Claims: Red Bird No. 1 and Red Bird No. 2. The Buena Vista claim adjoins Red Bird No. 1 to the south. The channel appears to be rather scattered and no good values have been found. Old 250′ tunnel with two branches in search of pay gravel. New 325′ tunnel with two 50′ branches. Water is obtainable by a long ditch from Duncan Cañon. At present water is taken from the tunnel. Gravel from the old tunnel is said to have run about $0.10 per car. Equipment consists of shop, car, and tools. Assessment work only, by D. M. Ray and M. Savage of Forest Hill. Was bonded by Graham and Cates, Pacific Building, San Francisco, who did considerable development work.

Reed Mine. Canada Hill district. Sec. 8, T. 15 N., R. 13 E., M. D. M., 8 miles east of Westville. Elevation 6000 feet. Reed claim, 80 acres; White claim, 70 acres. Cement gravel channel, with NE.–SW. course, in schist. Tunnel 1800 feet. The pay gravel is reported to be 100 feet wide and 5 feet thick. Drifting under the old hydraulic works is said to have about worked out the channel. Owned by Mr. J. D. Meredith, of Grass Valley. Bonded to Mr. Henry Snyder, of Canada Hill.

Rough and Ready. Forest Hill district. Secs. 35 and 36, T. 14 N., R. 10 E., M. D. M., one mile east of Forest Hill. Idle. Channel probably worked out.

Sailor Cañon. Canada Hill district. Sec. 34, T. 16 N., R. 13 E., M. D. M. Patented. Cement gravel channel. Reported as having an 1800-foot tunnel. Some gravel is said to have run $2.00 per car. Idle. Owned by the Sailor Cañon Gravel Mining Company; W. H. Duffy, superintendent, San Francisco.

Bibl.: Rep. X, p. 426.

Santa Fe. Iowa Hill district. Ten acres in claims. Tunnels: No. 1, 1000 feet; No. 2, 400 feet, are said to lie above and below the Canada Hill channel. Thought to be the same channel as that found at the Monumental mine. Owned by Morgan Green & Co., of Auburn.

Shaw Brothers Mine. Dutch Flat. One-half mile south of Alta. Idle. Shaw Brothers, deceased.

Shell or **Shackleton.** Blue Cañon district. Said to have ¾ mile along a lava capped channel. An old tunnel, now caved, was in 4′ of wash gravel. A slide is said to have covered up the ravine, and work thus far has consisted of building a reservoir and washing off the loose slide material. Where bedrock has been exposed good values have been found. The owners intend to begin drifting soon. Owned

Small Hope. Forest Hill district. Sec. 27, T. 14 N., R. 10 E., M. D. M., 3½ miles north of Forest Hill. Forty acres. Cement gravel channel. Reported to have 2000 feet of tunnel. Idle. Owned by Mr. Federer and James Nicholson, of Sacramento.

Bibl.: Rep. XII, p. 212.

Southern Cross. Dutch Flat District. Sec. 34, T. 16 N., R. 10 E., M. D. M., ¼ mile northeast of Dutch Flat. One hundred and forty acres. Gravel channel reported to be 40 feet wide. Tunnel 300 feet. Idle. Owned by George Nicholls, of Dutch Flat.

Bibl.: Register of Mines, 1902, Cal. State Min. Bur.

Spring Garden Consolidated. Forest Hill district. Secs. 5, 6, 7 and 8, T. 13 N., R. 10 E., M. D. M. Patented 530 acres. Reported to include 5000 feet along a gravel channel. Owned by N. W. Nash, of Sterling, Cal. Reported sold at sheriff's sale on Aug. 10, 1915, for $1,650.00.

Bibl.: Auburn Herald, Aug. 14, 1915.

St. George. Forest Hill district. Sec. 33, T. 14 N., R. 10 E., M. D. M., 1½ miles southeast of Yankee Jim's. Elevation 2700 feet. Idle. A. M. Colwell, manager, at Yankee Jim's.

Starr Mine. Last Chance district. Sec. 26., T. 15 N., R. 12 E., M. D. M. Elevation 4800 feet. Idle. L. C. Haines, manager, Westville.

Photo No. 20. Stewart Gravel Mine, near Gold Run. The tailings pile, from the drift workings, may be seen just back of the superintendent's house.

Stewart Mine. Dutch Flat district. Sec. 9, T. 15 N., R. 10 E., M. D. M., one mile south of Gold Run. Said to include 3000 acres lying south of the Southern Pacific railroad and 15,000 feet of channel, of

which only 2000 feet have been worked. The channel is said to be 400 feet wide and the blue cement gravel 80 feet wide. Water is obtained by the company's own ditch from Cañon Creek. Fifteen Chinamen employed. Owned by the Stewart Gravel Mining Co., Mrs. G. A. Stewart, president; J. D. Stewart, secretary, East Auburn.

Swift Shore. Michigan Bluff district. Secs. 34 and 35, T. 15 N., R. 11 E., and Secs. 2 and 3, T. 14 N., R. 11 E., M. D. M., three miles north of Michigan Bluff near the head of Volcano Cañon. Tunnel 810 feet along a gravel channel. Worked continuously for forty years. Two men working make wages. Owned by J. S. Vickford, of Michigan Bluff.

Tagpole Consolidated. Canada Hill district. Sec. 6, T. 15 N., R. 13 E., M. D. M., 6 miles east of Westville. Elevation 5500 feet. Owned by J. L. Sparhawk, of Iowa Hill.

Truro. Iowa Hill district. Secs. 21 and 22, T. 15 N., R. 10 E., M. D. M., 3 miles east of north of Iowa Hill. Elevation 1000 feet. Patented. Tunnel 350 feet. Idle. Owned by J. L. Pearson, of Iowa Hill.

Turkey Hill Consolidated. Michigan Bluff district. Includes the Boston and South Dakota and the Weske. Portion of Secs. 9, 10, 15 and 16, T. 14 N., R. 11 E., M. D. M., 2 miles north of Michigan Bluff. Patents: Weske No. 1, No. 2 and No. 3. Main tunnel over one mile. Gravel channel varies between 100′ and 300′ wide. Two men prospecting. Owned by the Turkey Hill Consolidated Gravel Co., Wm. Muir & Sons, principal stockholders, Michigan Bluff.

Union Mine. Iowa Hill district. Sec. 28, T. 15 N., R. 10 E., M. D. M., one mile north of Iowa Hill. Elevation 2900 feet. Cement gravel. Tunnel 1200 feet. Assessment work only. Owned by Wm. Hales and son, of Iowa Hill.

Volcano. Michigan Bluff district. Sec. 15, T. 14 N., R. 11 E., M. D. M., 1½ miles north of Michigan Bluff in Volcano Cañon. Idle. Owned by Mr. Wm. Muir, of Michigan Bluff.

Waterhouse, Big Dipper or **Harmon.** Iowa Hill district. Sec. 3, T. 14 N., R. 10 E., M. D. M., 2 miles southeast of Iowa Hill, in New York Cañon between Prospect and Wisconsin Hills. Patents: Big Dipper, Morning Star, Jupiter, Occidental and Weber. Water ditch from Shirttail Cañon. Tunnel 700 feet. Two men prospecting and running a tunnel. Owned by the McGeachin Mining Co., J. E. Rose, manager, Iowa Hill.

Watts Prospect. Iowa Hill district. Sec. 26, T. 15 N., R. 10 E., M. D. M., at Monona Flat, two miles northeast of Iowa Hill. Patented. An east–west gravel channel in amphibolite capped with andesite. Tunnel 3000 feet. Idle. Owned by John Watts, of Colfax.

Welcome Consolidated. Iowa Hill district. Five miles south of Colfax. Two hundred and forty acre claim. Tunnel 420 feet. Two men doing assessment work. Owned by Mr. Schwab, of Iowa Hill.

Wild Yankee. Blue Cañon district. Three and one-half miles east of Shady Run. Gravel deposit forty feet deep. Tunnel 100 feet, caved. Assessment work only. Owned by F. K. W. Develey, of Blue Cañon.

X-Ray. Canada Hill district. Ten miles east of Westville. Two miles north of Sailor Flat on the south slope of the North Fork of the American River. Three hundred and twenty acres. Two channels reported and two tunnels 300′ and 600′ said to have been run but not to have struck the channels. The main lower channel is said to be the same as that at the Placer Queen mine. Owned by F. Stevens, of San Francisco.

GOLD—HYDRAULIC MINES.

Since the Federal antidebris laws of 1893 went into effect, hydraulic mining in Placer County has practically ceased. The tailings from the Dutch Flat region were washed into the Bear River, where, with those

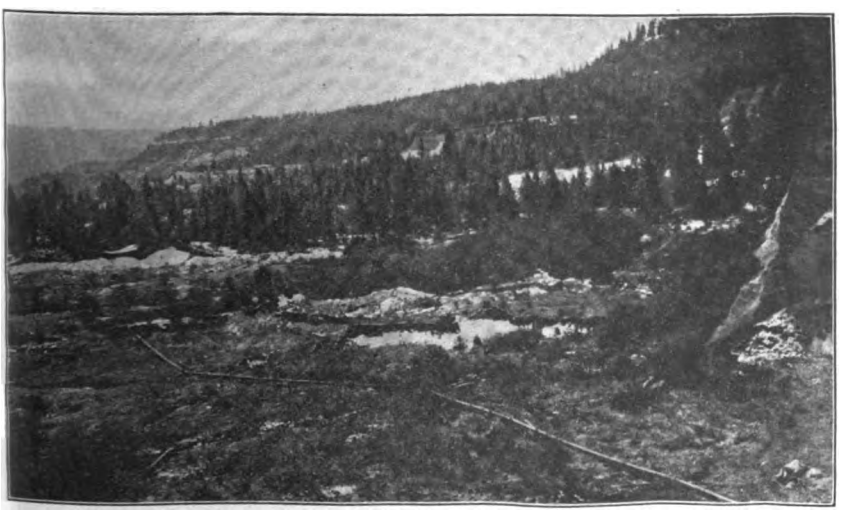

Photo No. 21. Old hydraulic workings, just northwest of Gold Run. The bedrock is rapidly being covered by a growth of pine trees, the largest of which probably date back to 1893.

from You Bet, Red Dog and other districts in Nevada County, they filled the river bed in places 10 feet to 20 feet deep. Dams have been projected by the California Debris Commission at points both north and west of Colfax, on the Bear River, to restrain tailings from these districts, but the sites have been held at such exorbitant prices by the owners that it has not been economically possible to carry out the plans. When such methods can be applied the dams can be paid for by a tax on those operating. These dams could act as storage reservoirs for

water supply, from which hydroelectric power could be generated, as well as for the gravel tailings, and would be beneficial to the country in many ways.

The gravel tailings from Gold Run, Iowa Hill, Yankee Jim's, Forest Hill, Bath, Michigan Bluff and the Ralston Divide, all found their way into the American River. Restraining dams could be built in the forks of this river, should it be permitted and receive proper financial backing.

Lost Camp. Blue Cañon district. Sec. 23, T. 16 N., R. 11 E., M. D. M., 2 miles southeast of Blue Cañon on the Southern Pacific Railroad.

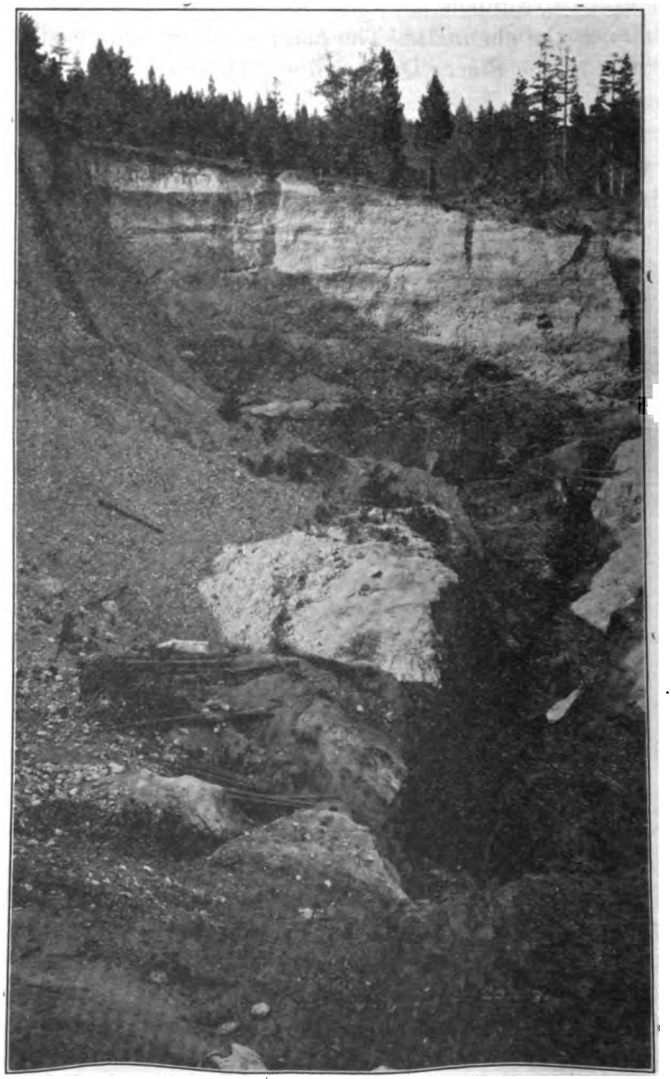

Photo No. 22. Lost Camp Placer Mine, Blue Canyon, Placer County.

An old road leads from Blue Cañon to the property. Elevation 4500′. Six hundred acres. Water is obtained from the Pacific Gas and Electric Co. for 10 cents per miner's inch. Hydraulic monitors are used under a 100 foot head. The course of the channel is East–West and it is about ¾ mile long and is ¼ mile wide at the lower end. The gravels in the main channel are about 65′ deep. About 1200′ of sluice boxes are used, 550′ of which are in a tunnel. The grade of the boxes is 7″ to every 16′. Most of the gold is caught in the upper eight boxes and some nuggets run as high as $80.00 in value. Coarse gold is obtained from the lower gravels and fine gold from the upper. The tailings are caught by a dam, in Blue Cañon Creek, constructed of gravel held by wire fencing. Owned by Geo. F. and J. J. Miller, of Blue Cañon.

Park and Brown. Last Chance district. Sec. 21, T. 15 N., R. 13 E., M. D. M., 12 miles northeast of Last Chance near the wagon road from Westville to Last Chance over Bald Mountain. Elevation 6480′. One

Photo No. 23. Park and Brown Hydraulic Mine, four miles southeast of Canada Hill, Placer County. Duncan Peak lies in the distance to the right.

hundred and sixty acre placer claim. The deposit consists of metamorphic sandstone and shale, of red and yellow ochre colors, with a stockwork of quartz stringers up to 18″ in thickness. The surface has been decomposed and the values concentrated in the upper 3′ to 6′. The deposit covers an area on a side hill about 400′ wide and 1500′ long. Hydraulicking has been carried on for six years and about ¾ of the surface has been worked. Water is obtainable for about six weeks in the spring by a ditch from the head of Deep Creek. A head of from 50′ to 150′ is used for the monitor. It is said that about $1500 per season is cleaned up. It is possible that the bedrock could be worked on a large scale and run through a stamp mill to recover the values from the quartz stringers. Water could be piped from the head of Deep Cañon. Owned by C. McKinley, of Auburn, and A. Harveson, of Last Chance.

Pine Nut or **Lincoln Consolidated.** Last Chance district. Sec. 20, T. 14 N., R. 13 E., M. D. M. Nine miles northwest of Last Chance on a branch wagon road from the Bald Mountain road. Elevation 4000′. Claims: Lincoln and White Prairie. Two hundred and eighty acres. The channel, where exposed, is from 12′ to 15′ deep and was opened up by an 85′ tunnel. Water is obtained by a 1½ mile ditch from Spruce

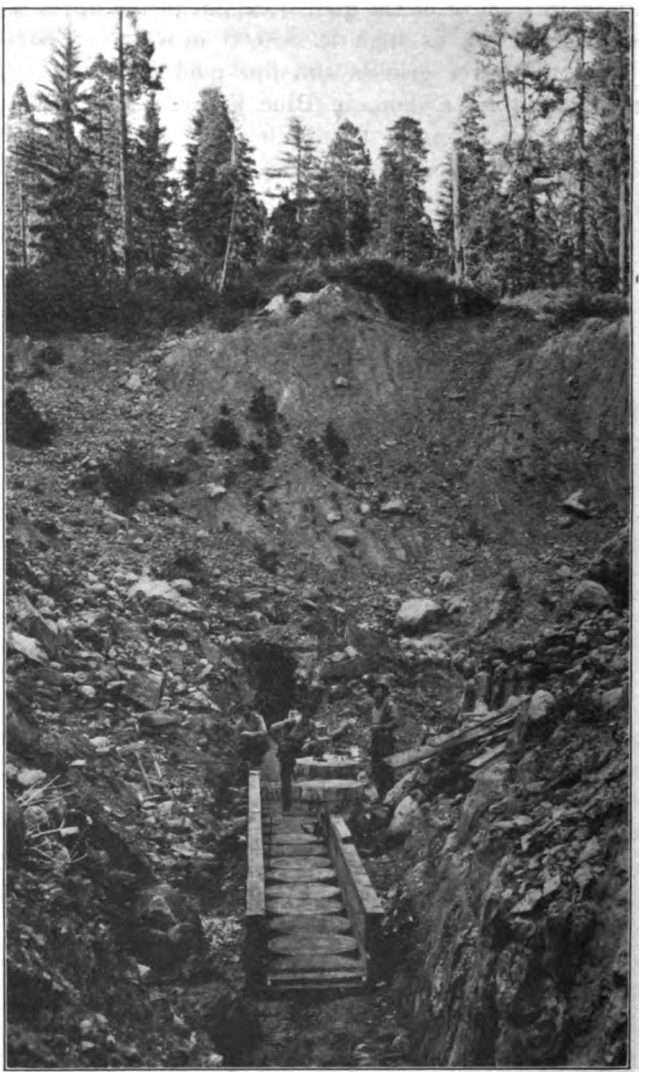

Photo No. 24. Installing sluice boxes for hydraulicking at the Pine Nut Mine, Canada Hill District, Placer County.

Cañon. Equipment consists of 1200′ of 11 inch pipe, 1 monitor and 60′ of sluice boxes. The owners are preparing to put in a dam in a branch of Duncan Cañon. Owned by Fred C. Davidson and George Scherer, of Last Chance.

Following is a list of some of the hydraulic mines in Placer County, all idle, which could probably be operated profitably should restraining dams be constructed at a low enough cost:

Name	District	Section	Twp.	Range	Owner and address
Big Gun	Michigan Bluff	22	14 N.	11 E.	J. F. Thompson, Bath, Cal.
Gold Run	Dutch Flat	4 and 9	15 N.	10 E.	Gold Run Ditch and Mining Co., J. L. Gould, Mgr., Alameda, Cal.
Little Bear River	Dutch Flat	34 and 35	16 N.	10 E.	Wm. Nicholls, Jr., Berkeley.
Polar Star	Dutch Flat	34 and 35	16 N.	10 E.	Wm. Nicholls, Jr., Berkeley.
Pond	Forest Hill	3 and 4	13 N.	10 E.	G. L. Duffy, Michigan Bluff.
Southern Cross	Dutch Flat	34 and 35	16 N.	10 E.	Wm. Nicholls, Jr., Berkeley.

GOLD—PLACER MINES.

(Surficial or Sluicing.)

Considerable placer mining is carried on along the rivers in Placer County by parties of from one to three men. Some of these miners work on claims owned by old settlers and pay a royalty, while others work independently and prospect wherever the gravels pan favorably. Workmen with rockers and longtoms recover on an average of $2.00 per day in gold per man. Occasionally a rich streak of gravel or pocket is found.

Acacia Claim. Damascus district. Sec. 14, T. 15 N., R. 11 E., M. D. M. Idle since 1906. Reported to be leased to Oakland parties. Owned by George McAuley, of Auburn.

Bibl.: Colfax Record, Oct. 8, 1915.

Bear River Claim. Dutch Flat district. Sec. 4, T. 15 N., R. 10 E., M. D. M., 1½ miles southwest of Dutch Flat. Elevation 2500 feet. Reported to have 5000 feet along the bed of the Bear River. Idle. Owned by E. C. Uren, of Nevada City.

Bear River Extension. Colfax district. Sec. 14, T. 15 N., R. 9 E., M. D. M., 3½ miles north of Colfax. Elevation 2000 feet. Patented ½ mile along the Bear River. Worked in 1902 with an hydraulic elevator. Idle. Owned by E. R. Waring, formerly of Colfax.

Bear River Tunnel Co. Colfax district. Sec. 6, T. 15 N., R. 9 E., and Secs. 5, 6 and 7, of T. 15 N., R. 10 E., M. D. M. Elevation 2200

feet. Patented. Five miles along the bed of Bear River. In 1902 the tailings were concentrated. Idle. Owned by E. C. Uren, of Nevada City.

Bogus Thunder. Michigan Bluff district. Sec. 19, T. 14 N., R. 12 E., M. D. M., six miles east of Michigan Bluff by trail. Two hundred and fifty acres in claims. Loose gravel bars along the North Fork of the Middle Fork of the American River. Owned by S. S. Caples, of Michigan Bluff. Leased by B. E. Caples and W. S. Tripp, of Michigan Bluff.

Booth River Claim. Iowa Hill district. Sec. 29, T. 15 N., R. 10 E., M. D. M., 1½ miles northwest of Iowa Hill. Elevation 1300 feet. Three claims in bed of North Fork of American River. Gravels are sluiced. The two Booth brothers work together on the claim. The gravels are said to be mostly old hydraulic tailings, and that about $120.00 in gold per month is recovered, except occasionally when rich finds are made. It was reported that in about two and one-half months of the fall of 1915 over $2900 was taken out. Owned by John Booth, of Iowa Hill.

Cambridge. Iowa Hill district. Secs. 9, 16, 17, 19 and 20, T. 14 N., R. 10 E., M. D. M., 4 miles south of Iowa Hill. Patented. Four miles of tailings in the bed of Shirttail Cañon. The gravels were sluiced in 1902. Idle. Owned by Mrs. Stemple, of Colfax.

Cañon Creek Tailings. Dutch Flat district. Sec. 10, T. 15 N., R. 10 E., M. D. M., 1½ miles northeast of Gold Run. Elevation 1310 feet. Ten acres. One and one-half miles along Cañon Creek. Idle. Owned by the Stewart Gravel Mines, Inc., of East Auburn.

Collins. Colfax district. Sec. 31, T. 15 N., R. 10 E., M. D. M. Reported to have 7000 feet of gravel tailings along North Fork of the American River below the Booth claims, extending up the river from ½ mile above the Forest Hill bridge. Three claims called the Boston, Annis and Keystone. Leased to Petit Bros. and Mr. Brown, of Colfax. Gold is recovered by sluicing old tailings along the river. About $3.00 per day in gold per man is reported to be recovered. Owned by W. B. Fowler, of Colfax.

Gillett. Colfax district. Sec. 31, T. 15 N., R. 10 E., M. D. M. Twelve acres along the bed of the North Fork of the American River. Sluicing during dry season. Owned by F. N. Gillett, of Colfax.

Haney Consolidated. Last Chance district. Sec. 4, T. 14 N., R. 13 E., and Sec. 33, T. 15 N., R. 13 E., M. D. M. East of the Blue Eyes drift mine, on the northwest side of Duncan Cañon. Reported to hold one mile along Bloody Ravine, the bottom of which was cleaned up in

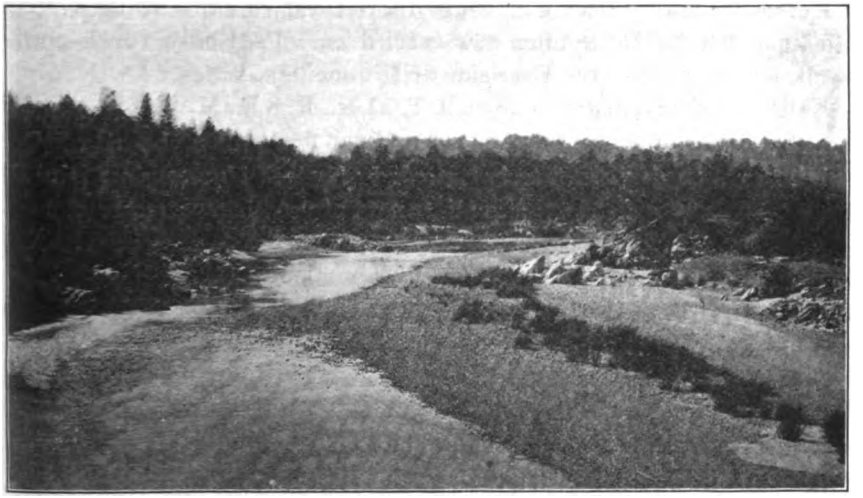

Photo No. 25. Gravels in the American River just below (west of) Rattlesnake bridge. Old hydraulic tailings may be seen on the terrace to the right. Considerable of the gravel in the river has come from the hydraulic mines above. Property of M. A. Kelley, of Auburn.

1854. It is thought by the owner that some gold can still be obtained from the flats and sides of the ravine. Owned by Thos. F. Haney, of Last Chance.

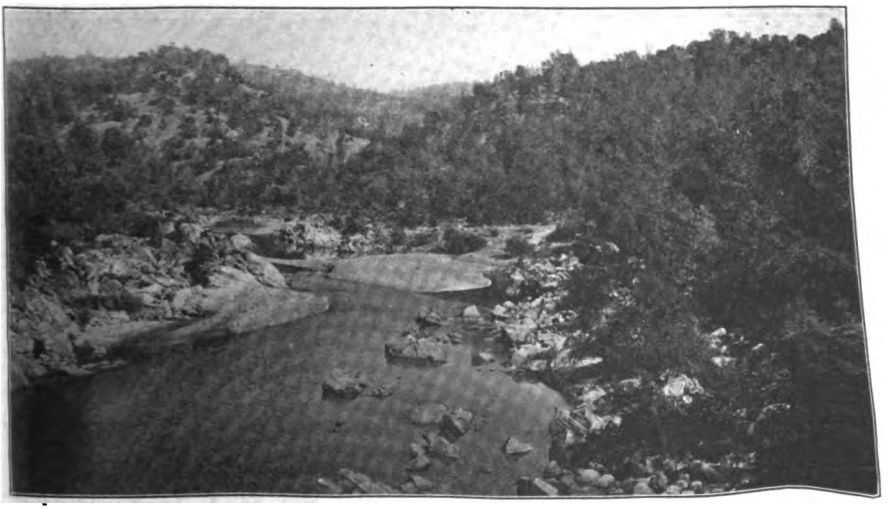

Photo No. 26. Gravel bars along the American River, just above (east of) Rattlesnake bridge. Old hydraulic tailings are said to cover virgin auriferous gravels in these bars which could be worked to advantage by hydraulic elevators. The hard, rugged, granitic bedrock would probably make dredging unfeasible.

Horseshoe Bar. Michigan Bluff district. Two miles southwest of Michigan Bluff. No mining now carried on. Used only for a power plant, which supplies the Excelsior drift mine.

Kelly. Auburn district. Sec. 9, T. 11 N., R. 8 E., M. D. M. Gravel bars for one mile along the American River north of Rattlesnake Bar. Owned by M. A. Kelly, of Auburn. These gravels have recently been prospected and pan well in gold.

Kinder River. Iowa Hill district. Sec. 28, T. 15 N., R. 10 E., M. D. M. One mile north of Iowa Hill. Claim along the north fork of the American River, adjoining the Booth claim. Two men sluicing on a small scale. Owned by Mr. Schworb, of Iowa Hill.

Lehigh. Michigan Bluff district. Sec. 30, T. 14 N., R. 11 E., M. D. M. Sluicing was carried on but the gravels are practically worked out. Owned by J. F. Thompson, of Bath.

Martin. Iowa Hill district. Sec. 31, T. 15 N., R. 10 E., M. D. M., 2 miles west of Iowa Hill, along the bed of the North Fork of the American River. Twenty acres. Some sluicing was carried on in the gravel tailings. Idle. Owned by F. P. Gallaher, of Colfax.

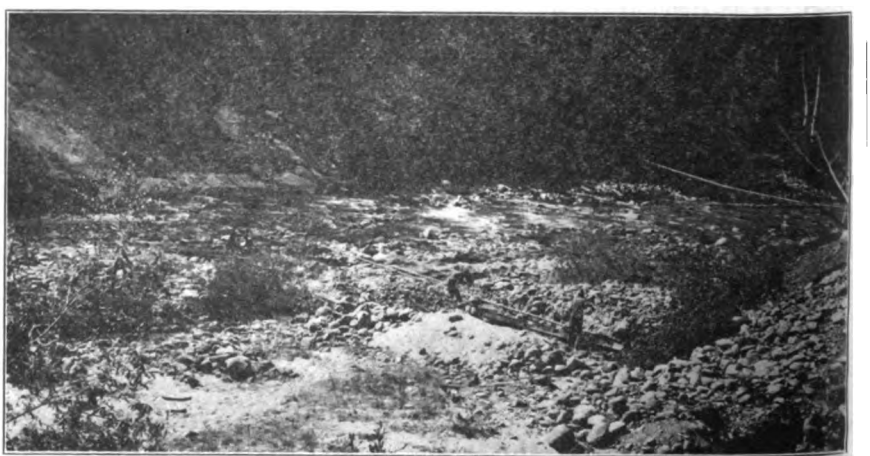

Photo No. 27. Sluicing bench gravels on the south side of the North Fork of the American River, one-half mile below the Iowa Hill bridge, east of Colfax. A small gas engine is used to pump water from the river into the sluice boxes.

Pine Avenue. Four miles west of Iowa Hill on the North Fork of the American River. Near the Booth claim. Assessment work only.

Pleasant Bar. Michigan Bluff district. Sec. 33, T. 14 N., R. 11 E., M. D. M., 2½ miles southwest of Michigan Bluff. Was worked with a hydraulic elevator and sluices. Assessment work only. Owned by E. Kavanaugh, No. 40 J st., Sacramento.

Potato Flatiron. Damascus district, near Red Point. Four men said to be working. Owned by Oakland and Alameda parties. Leased by Jack Creighton, manager, of Damascus.

Rocky Bar or **Estey.** Colfax district. Sec. 1, T. 14 N., R. 9 E., M. D. M., 3 miles east of Colfax and ¼ mile below the Iowa Hill bridge on the North Fork of the American River. The property is reached by a trail along the south side of the American River from the Iowa Hill road. Elevation 1050′. Claims "Swastika," "First Chance," "Rocky Bar," "Rocky Bar Extension." The claims include bench gravels along the river which are shoveled into sluice boxes and washed with water pumped from the river by a small gasoline engine. A diving suit is worn by the owner who recovers gold from the deep pools in the bed of the river. Owned by O. L. Estey of Colfax.

Various attempts have been made to recover gold from the American River bed and from the Feather River bed in Butte County. Coarse gold has been recovered from the bedrock in rough places where a dredge could not be operated and where the river channel could not be diverted without unwarranted expense. The use of divers' suits is an ambitious attempt to recover gold, but the difficulty and slowness of working under water must necessarily make the work expensive and in many cases prohibitive to financial success. The method will probably never become of great economic importance.

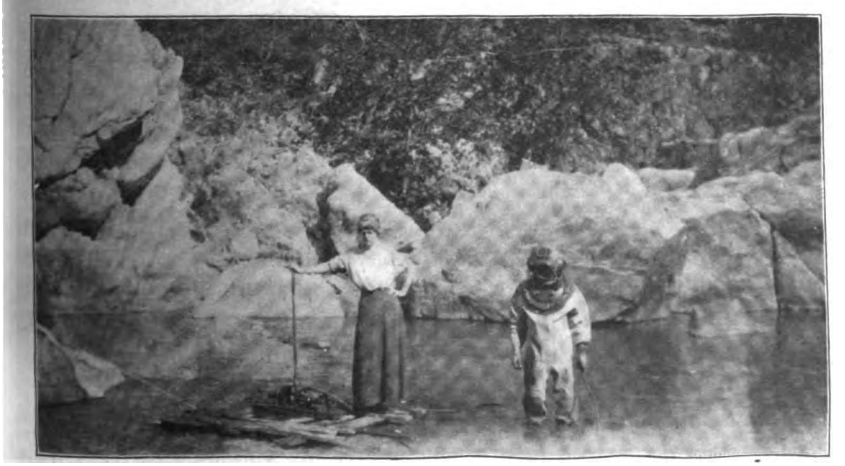

Photo No. 28. Diving outfit used for the recovery of gold from the deep pools in the bed of the North Fork of the American River, east of Colfax.

San Francisco. Iowa Hill district. Sec. 4, T. 14 N., R. 10 E., M. D. M., claim one mile southeast of Iowa Hill, adjoins the Harman, or Big Dipper, claim. Worked by the owner, S. Delmu, of Iowa Hill.

Swamp Angel Mine. Dutch Flat district. Secs. 7 and 18 of T. 16 N., R. 11 E. Four miles north of Towles at Lowell Hill. Worked when water is available. Owned by A. W. Hawkins of San Luis Obispo.

Theniss and Adams. Colfax district. Sec. 1, T. 14 N., R. 9 E., M. D. M. Gravel bars on the west side of the North Fork of the American River, just above the bridge on the stage road from Colfax to Iowa Hill. Elevation 1200 feet. The gravel is loose and about 6 feet deep. The gravel is not worked to bedrock and is washed in a hand rocker. The fine gold is caught on an old carpet, while the finest probably escapes. Two men save about $16.00 in gold per week. Worked by Martin Theniss and F. C. Adams, of Colfax.

Zelma Bell. Colfax district. Sec. 19, T. 14 N., R. 10 E., M. D. M. Along the bed of the North Fork of the American River, north of the mouth of Shirttail Cañon. Forty acres. Owned by the Zelma Bell Mining Co. Assessment work only.

GOLD—DREDGES.

Dredging is being carried on along the Middle Fork of the American River and along Auburn Ravine. In 1915 three dredgers produced $93,812 in gold. Large deposits of gravel in the Bear River await a feasible means for working them. The nature of the bedrock is such that they might be dredged.

El Dorado and Placer Gold Mining and Power Co. Butcher Ranch district. Sec. 35, T. 13 N., R. 9 E., M. D. M., 1½ miles south of Butcher Ranch, near Poverty Bar. About 3½ miles up the Middle Fork of the American River from the Pacific or Yukon dredge. The gravel bars are partially covered by hydraulic tailings and average about 25 feet in depth. The dredger hull is 45′ x 85′, and carries a line of 79 buckets of 3½ cu. ft. capacity each. It is capable of dredging 35 feet below the water line. Five electric motors have an aggregate of 220 h. p. and receive their current from an extension from the line of the Pacific dredger. Three shifts of four men each operate the dredger. Owned by the El Dorado Gold Mining and Power Company, W. B. Pennycook. J. J. Madigan, W. D. Sullivan and Chas. Malin, all of Vallejo, are financially interested.

Gardella Gold Dredge Co. Gold Hill district. Sec. 8, T. 12 N., R. 7 E., M. D. M., ½ mile northwest of Virginia and north of the road from Lincoln to Newcastle. Elevation 350 feet.

The gravels being worked were partially drifted in the early days by the Chinese and are comparatively fine and angular, there being no coarse boulders, such as are found in the main stream channels. The deposits average about sixteen feet in depth, the upper portion being clay. The pay gravel varies from 1′ to 8′ in thickness and lies on a

granitic bedrock. The channel is about 900 feet wide, and about 6 years work for one dredge has been outlined. A 160-foot front is worked and about 75,000 cubic yards of gravel are handled each month. The gravel is said to average about 12½¢ per cubic yard, the cost of working being about 7¢ per cubic yard. The land is low and is sometimes partially covered by overflow from Auburn Ravine during the rainy season. Three shifts of men, of three men each, including dredgemasters, are employed on the dredger, while three men are employed most of the time cutting trees and brush. The sale of oak wood from the trees probably pays for the cost of clearing. The dredge was built by the Risdon Iron Works and has 62 5-cubic-foot, close-connected

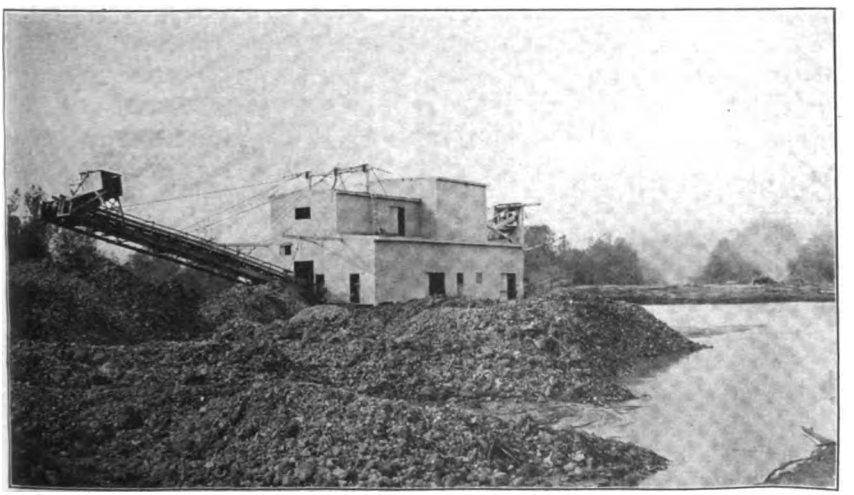

Photo No. 29. Gardella Dredge, near Virginia, four miles northeast of Lincoln, working gravel and alluvial deposits north of Auburn ravine.

buckets. The boat is 40′ x 90′. Electricity is obtained by tapping the main Pacific Gas and Electric Company's line from Drumm, at Ophir. The motors on the dredge develop about 500 h. p.

The company owns portions of the Peterson, Conley and Chevalier ranches, including 105 acres, besides having options on other property. Owned by the New Castle Gold Mining Company, Lawrence Gardella, of Oroville, manager.

The Gaylord gold dredge which was working on the American River, below Rattlesnake Bar near Loomis, was reported closed down in November, 1915. The ground was worked out. The dredge was a small one with 3-cubic-foot buckets, and six men were employed.

Oroville Dredging Company. Dairy Farm district. Sec. 31, T. 14 N., R. 7 E., M. D. M., 5 miles northeast of Sheridan and one-half mile

south of the Bear River. Elevation 954 feet. Two Risdon dredgers were operated several years ago, but have been removed. Owned by W. P. Hammon, of Oroville.

Pacific Gold Dredging Company, subsidiary of the Yukon Gold Dredging Company. Butcher Ranch district. Sec. 5, T. 12 N., R. 9 E., M. D. M. On the Middle Fork of the American River near Mammoth Bar. The dredger is of the Bucyrus type and is equipped with a line of 77 7½-cubic-foot buckets, and a shaker screen made of one-inch cast manganese steel. About 4500 cubic yards of gravel are handled daily. The gravel averages 28 feet deep and consists of loose gravel with

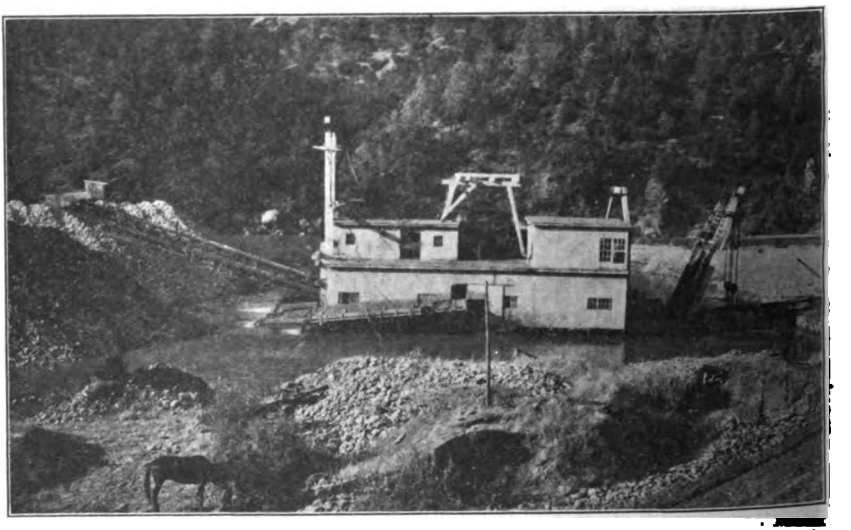

Photo No. 30. Bucyrus Dredger of the Pacific Gold Dredging Co., working near Mammoth Bar on the Middle Fork of the American River.

boulders. The bedrock is slate, which is decomposed in places one foot deep. The gravel probably averages considerably over 10¢ per yard, while the bedrock probably averages over $1.00 per yard. Owned by the Pacific Gold Dredging Company, S. R. Guggenheim, president, 417 Hobart Bldg., San Francisco; Chas. K. Lipman, secretary; H. C. Perring, superintendent, Auburn and Oroville. C. A. Anderson, dredgemaster.

GRANITE.

The quarries in the granodiorite east of Rocklin are the only ones producing granite in the county. The quarries northeast of Rocklin in the region of Loomis and Penryn are all idle. The granodiorite at Rocklin is light-colored and fine-grained and composed principally of quartz and feldspar, with fine crystals of hornblende and scales of biotite. The rock quarried at Penryn is coarse-grained and composed

principally of quartz and feldspar, with quite large crystals of hornblende and flakes of biotite.

Alexson, Gabriel and Company. Formerly the Placer Granite Company. Rocklin district. Worked by G. Alexson and son and son-in-law. Owned by Gabriel Alexson, of Rockland.

Anderson Quarry. Rocklin district. Worked by O. Anderson and three sons and son-in-law. Owned by Oscar Anderson, of Rocklin.

Andrews-Quinn Quarry. Rocklin district. Owned and worked by Oscar Andrews, of Rocklin.

California Granite Company. Rocklin district. Sec. 19, T. 11 N., R. 7 E., M. D. M. Eight acres owned, which includes the old Mantyla

Photo No. 31. California Granite Quarry at Rocklin, Placer County, looking north.

quarry. The company also leases the old Waters quarry. Equipped with a steam hoist, electric compressor and three derricks. Air hammer drills and wedges are used for splitting the blocks. Two saws are in use; one a revolving wheel 7 feet in diameter, with teeth set at an angle of 26°, which will cut 48 inches to a depth of 30 inches in 46 minutes; and a California Granite Cutter consisting of steel plates ¼ inch thick, set as teeth along a horizontally moving frame. Steel shot are fed to the cutting edges of both of these saws. From 50 to 100 men are usually employed. Owned by the California Granite Company, Adolph Pernu, president; A. Bocci, 518 Sharon Bldg., San Francisco, secretary; John Hall, superintendent, Rocklin. The same company is also operating a granite quarry near Porterville, Tulare County.

Delano Granite Company. Rocklin district. Sec. 20, T. 11 N., R. 7 E., M. D. M., 80 acres leased for quarry purposes. Steam hoist, 2 derricks, air compressor and hammer drills. Produce about 15,000 cubic feet of stone yearly. Costs about 50¢ per cubic foot to quarry and load on the cars. Sold for 75¢ per cubic foot laid on the cars at Rocklin. The stone is sold chiefly for building and monumental purposes. Owned by the Delano Granite Company, Inc., L. E. Delano, president; I. T. Delano, secretary, Rocklin.

Photo No. 32. Delano Quarry, east of Rocklin, Placer County, looking southward.

Escola, Kaivola and Tuperinan. Rocklin district. Sec. 30, T. 11 N., R. 7 E., M. D. M. Quarry southeast of Rocklin, with derrick. Sell curbstone and rip-rap. The three owners do their own work.

Griffith's Quarry. Penryn. Sec. 35, T. 12 N., R. 7 E., M. D. M. Coarse grained granodiorite. Quarry idle. One man works occasionally getting out tombstones from granite already quarried. Owned by David Griffith, of Penryn.

Hebrick Quarry. Rocklin district. Sec. 30, T. 11 N., R. 7 E., M. D. M. Small quarry being worked by L. Hebrick and two brothers and father. Leased by Louis Hebrick from his father.

Hendrickson Quarry. Rocklin district. Sec. 30, T. 11 N., R. 7 E., M. D. M. Small granodiorite quarry being worked for curbstone by the two Hendrickson brothers, a cousin and a son-in-law. Owned by Hendrickson Bros. and Company.

Huhtala and Kanasto Quarry. Rocklin district. Mr. Huhtala and two sons and Mr. Kanasto work a quarry on rented ground. Equipment consists of a steam hoist.

Oscar Kesti Quarry. Rocklin district. Sec. 19, T. 11 N., R. 7 E., M. D. M. Owned by Oscar Kesti who, with his son and one hired man, gets out curbstone and rip-rap.

Kesti Quarry. Rocklin district. Sec. 30, T. 11 N., R. 7 E., M. D. M. Messrs. Sam and Otto Kesti work a rented quarry. Sam Kesti also owns a quarry in the same section which he with two helpers works for curbstone and paving blocks.

Leed Quarry. Rocklin district. Werner Leed produces some curbing and rubble.

Liikola Quarry. Rocklin district. Ed Liikola rents a quarry and sometimes employs one man.

Maki Quarry. Rocklin district. Jacob Maki rents a quarry and takes out curbstone, paving bricks and rip-rap.

Pacific Granite Company. Rocklin district. Sec. 29, T. 11 N., R. 7 E., M. D. M. Elevation 204 feet. One mile southeast of Rocklin.

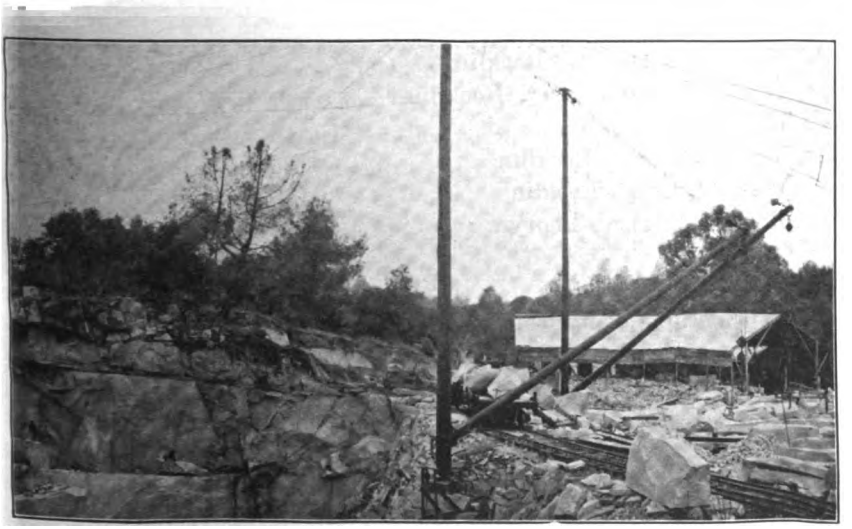

Photo No. 33. Pacific Granite Quarry, one mile southeast of Rocklin, Placer County.

Spur track to quarry. Own the old Copp quarry and rent the Werner Leed quarry. Equipped with steam hoist and electrically operated compressor. Hammer drills are used, with 100 lbs. air pressure, and about one foot per minute can be drilled. A specialty is made of mausoleums and building stone. About 35¢ per ton is received for rip-rap. From 6 to 8 men, all of whom are interested in the company, do their own work. Carl Ranta, president, Rocklin; Wm. Maki, secretary, Rocklin.

Pisila and Aho Quarry. Rocklin district. Sec. 30, T. 11 N., R. 7 E., M. D. M. Equipped with steam hoist. Rented and worked by Messrs. Pisila and Aho, of Rocklin.

Union Granite Company. Rocklin district. Sec. 30, T. 11 N., R. 7 E., M. D. M., ½ mile spur track from Rocklin. Four acres leased at 25¢ per ton royalty. Equipped with one steam hoist. Hand drills are used. Street curb and monumental stone are sold at 49¢ and 70¢ per cubic foot, respectively, at the quarry. Mat Ruhkala, manager, Rocklin.

Wickman Quarry. Rocklin district. Sec. 30, T. 11 N., R. 7 E., M. D. M. Owned by Oscar Wickman, who works the quarry aided by his two sons and two hired men.

Idle Quarries are as follows:

Adams and Waldo, Rocklin.
Brady and Began, Rocklin.
Carlaw Bros., Loomis.
Dunns Quarry, Rocklin.
Hoyt's Quarry, Rocklin.
Hytiman's Quarry, Rocklin.
Janiala Jacob Quarry, Rocklin.
Kakkinan, Rocklin.
Marks Quarry, Rocklin.
Perno Quarry, Rocklin.
Roberts Quarry, Penryn.

IRON.

A considerable deposit of magnetic iron ore occurs along the contact of the Calaveras slates with granodiorite near Hotaling, 5 miles northwest of Clipper Gap. Lack of a cheap fuel has prevented further development, but with electric power near-by the property should be valuable. Over 15,000 tons of pig iron were produced in 1883 by the California Iron and Steel Company, later the Phoenix Iron and Lime Company. Several thousand tons of hematite ore are reported to be on the dump and the remains of the old smelting furnace and buildings are still to be seen.

Bibl.: Rept. IV, pp. 237–239, 1884; Bull. 38, pp. 298–9, 1906.

LIMESTONE.

Lenses of limestone occur commonly associated with the metamorphic rocks throughout the county, but are seldom of large enough extent, or, if so, near enough to transportation, to be economically valuable. A lens of considerable size is cut by the Middle Fork of the American River, 5 miles northeast of Auburn and is being worked on the El

Dorado side of the river by the Pacific Portland Cement Co. The portion of the deposit in Placer County will no doubt be worked in time. Small deposits northward in the same belt occur two or three miles south of Clipper Gap. A lens one mile north of Hayden Hill, three miles southeast of Towle, cut by the North Fork of the American River, is about two miles from the railroad, but no development work has been done.

The **Holmes Lime Company** owns a lime quarry near Newcastle but it has been idle the past few years. H. W. Postlewaite, president, 380 Monadnock Building, San Francisco.

The **Spreckels Sugar Company** is reported to have purchased the Mason property near Applegate in Secs. 8 and 9, of T. 13 N., R. 9 E., M. D. M. The company is reported to have secured the property for a limestone deposit which is suitable for sugar refining. The rock will be shipped to company's refineries on San Francisco bay.

MAGNESITE.

Magnesite deposits have been located in the serpentine area 5 miles northeast of Iowa Hill, in Cañon Creek, ¼ mile south of Towle, and on the south slope of Bear River, 2½ miles north of Towle. The magnesite occurs as stockwerk in the serpentine, with an occasional widening of the veins.

The **Placer County Properties Company,** formerly the Sprague-Keasby Asbestos and Magnesia Co., holds 400 acres in claims in Sec. 13,

Photo No. 34. Outcrop of magnesite on the Snowball Claim, 5 miles northeast of Iowa Hill.

of T. 15 N., R. 10 E., and Secs. 7 and 18, of T. 15 N., R. 11 E., M. D. M., about five miles northeast of Iowa Hill. The topography to the north, on the slope towards Giant Gap is very steep, but that of the Snowball

(160 A.) claim is more gentle. There is an abundance of timber and water on the latter claim.

Three outcrops of magnesite, about the size of that on the Snowball claim (see Photo No. 34), occur on the south slope of the North Fork of the American River. A tunnel, originally driven into the serpentine bedrock in search of gold bearing gravels, cuts through a stockwerk of magnesite veins, varying from threads up to eight inches wide. Not enough magnesite is exposed in this tunnel to pay for mining it, but it proves the continuity of the veins with depth. The tunnel is driven at a considerable distance east of the main magnesite outcrops, so it does not reveal their size, with depth.

The property has not yet been sufficiently developed to either prove or disprove its value. It could be developed on a small scale and the product calcined on the property at comparatively small cost. This would be the more feasible plan, since the product would have to be hauled 30 miles by way of Forest Hill to Colfax. Whether the proceeds from the product would pay for the development work is questionable, but such a plan might partially defray expenses while at the same time it would determine the value of the property. Owned by the Placer County Properties Co., S. M. Sprague, president, East Auburn; Mrs. Gertrude Shelley, secretary, 326 Ochsner Bldg., Sacramento.

Bibl.: U. S. Geol. Surv. Bull. 540, pp. 501–503, 1913. Min. Res. of the U. S., 1914, Pt. II, p. 579.

Towle Magnesite deposits. Outcrops of magnesite in the region of Towle occur in brecciated serpentine. An outcrop is reported in the bed of Cañon Creek, in Sec. 6, T. 15 N., R. 11 E., M. D. M., about ¼ mile south of Towle station; another in Sec. 24, T. 16 N., R. 10 E., about 2½ miles north of Towle on the south side of Bear River; and a third in Sec. 36, T. 16 N., R. 10 E. No development work has been done on any of the deposits to determine their commercial value.

Owned by J. H. Johnson, of East Auburn, and J. D. Sullivan, of Towle.

Bibl.: Min. Res. of the U. S., 1914, Pt. II, p. 579.

MINERAL PAINT.

Ochre has been reported on the Chamberlain-Keena-Shepard property, near Gold Run. The deposit is probably of little importance.

MINERAL WATER.

The following mineral spring descriptions by Gerald A. Waring are largely taken from U. S. Geological Survey, Water Supply Paper No. 338; with additional information included by the writer.

"**Brockway Hot Springs.** The only noteworthy thermal springs in the basin of Lake Tahoe are at the north end of the lake, near Stateline Point, at a fishing and boating resort, known as Brockway, where in 1909 a hotel and four cottages provided accommodations for 100 people. The springs rise in the lake, within a few feet of the shore, bubbling up from numerous vents principally at two localities. One of these localities is at the boat pier, where one spring has been cemented so as to form a drinking basin near the lake edge." A temperature of

Photo No. 35. Brockway Hot Springs and bathing pool on the northern shore of Lake Tahoe, Placer County.

120° F. was recorded in this spring, and the discharge was about 3 gallons a minute when visited in September, 1916. A spring behind the bar had a temperature of 140° F. A warm swimming pool has been constructed by placing a concrete wall around the springs in the lake and an 18 room bath house built. The temperature of the bathing pool is 66° F. Water from another group of springs, which is situated in the lake near its edge, about 150 yards northwestward, is pumped to a tank nearby and used for bathing and for laundry purposes. The temperature of this spring in September, 1916, was 130° F. The water is faintly sulphureted, but seems to be only slightly mineralized otherwise, for it is very soft and excellent for laundry use.

"The springs rise from granodiorite which is overlain on the slopes above by andesitic lava. A probable fault has been mapped by Lindgren[7] as passing southeastward through the lake, about one-third of a mile west of the springs.[8] The fault appears to furnish the most plausible explanation for the existence of the springs."

Owned by M. Lawrence and H. O. Comstock, Brockway Hot Springs, Cal.

"**Cisco Iron Spring.** A cold spring that yields perhaps 8 gallons a minute is situated in a small depression in a group of alders on a gentle slope on the southern side of the cañon of South Fork of Yuba River, half a mile north of Cisco railroad station and 100 yards south of the wagon road. The soil is deeply iron stained for a number of yards along the overflow channel. The spring is well known locally, as it furnishes excellent cold drinking water. The surrounding rocks are the slates, and schists derived from them, that have been mentioned in speaking of the sulphur springs near South Fork of Yuba River a mile or two upstream from the iron spring."

When visited in September, 1916, the temperature of this spring was 44° F. and flowed 2 gal. per min. Iron was being deposited along the overflow.

"**Deer Park Springs.** In the cañon of Bear Creek, 8 miles in a direct line southeast of Summit Soda Springs, four small springs form drinking pools of cool, mildly carbonated water that deposits considerable iron. They were formerly known as Scott Springs but are now known as Deer Park Springs. The place has been conducted as a resort since the eighties. In 1909 a hotel, a dining hall, and seven cottages provided accommodations for 150 guests. The buildings are situated in a little flat on the northwestern side of Bear Creek, and the springs are on a hillside 150 to 200 yards eastward, across the stream. Small rustic houses have been erected over the springs, two of which are beneath one roof. Two of them are known as Soda Springs, one as the Sulphur Spring and one as the Iron Spring. Their waters have the distinctive tastes indicated by these designations and differ somewhat though not markedly in composition, as is shown by the following analyses of three of them; all are secondary-alkaline, primary-saline waters."

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[7] Lindgren, Waldemar, Geol. Atlas, Truckee folio (No. 39), U. S. Geol. Survey, 1897.
[8] This fault is not shown on Map No. 1 of the atlas accompanying the report of the California State Earthquake Commission, probably through oversight.

Analyses of water from Deer Park Springs, Placer County, Cal.

(Analyst, G. E. Colby (1909). Authority, owner. Constituents are in parts per million.)

	Soda No. 1	Soda No. 2	Sulphur
Properties of reaction—			
Primary salinity	33	19	31
Secondary salinity	0	0	0
Per-salinity	0	0	0
Primary alkalinity	13	13	13
Secondary alkalinity	54	68	56
Subalkalinity	17	7	17

Constituents	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values
Calcium (Ca)	160	7.99	205	10.29	114	5.69
Magnesium (Mg)						
Sulphate (SO_4)	174	3.62	84	1.75	111	2.31
Chloride (Cl)	45	1.27	39	1.09	32	.89
Carbonate (CO_3)	297	9.90	367	12.23	210	6.99
Silica (SiO_2)	76	2.52	31	1.03	53	1.76
Total solids	990		900		670	
Carbon dioxide (CO_2)	Present	Present	Present	Present	Present	Present
Hydrogen sulphide (H_2S)					Present	Present

"The springs rise in an area of granitic rock that is probably an eastward extension of the material that forms the mountains to the west. At the springs this rock is decomposed to gravel and to kaolin-like clay. It is nearly surrounded by andesitic lava, which covers the slopes less than 100 yards east of the springs."

"**Florence Spring.** A quarter of a mile northeast of Summit Soda Springs, on the northern side of the stream, there is a carbonated spring that is locally called Florence Spring. It has a considerably larger flow than the springs of the Summit group, and it is not so strongly carbonated, but it probably contains more iron, for the water tastes of iron and deposits much iron along its overflow channel. The spring has not been improved, but it has been used to some extent for drinking."

"**Heath Soda Springs.** Five miles in a direct line westward from the Summit Springs in the canyon of North Fork of American River, on its northern side, are the carbonated springs known as Heath Soda Springs. They yield considerably more water than the Summit Springs but are not so strongly carbonated. They have not been improved, and as the place is not easily accessible it is rarely visited. The springs issue in an area of granitic rock, within a quarter of a mile of the western border of an area of altered slates; andesitic lava covers the slopes 2 miles northward and westward." Owned by the North Fork Association.

"**Iron Springs near Lake Tahoe.** A mile northwest of McKinney, on the western side of Lake Tahoe, two small iron springs rise in the woods on a gentle slope about 350 yards above the main wagon road and form pools about a foot in diameter and a foot in depth, four yards apart, which are used for drinking. The water tastes distinctly ferruginous and has deeply iron stained the soil for about 75 yards below the springs. The staining is probably caused by the fact that the water contains a small amount of carbon-dioxide, which holds the iron in solution until this gas has escaped, when the iron is precipitated and deposited along the overflow course."

"The springs issue from lake deposits of sand and gravel near the base of steep slopes of andesitic lava."

When visited in September, 1916, the lower spring flowed ⅛ gal. per min. and had a temperature of 49° F.

Analysis of Water from Lake Tahoe, Cal.

(Analyst F. W. Clarke. U. S. Geol. Survey Bull. 330, p. 122.)

Constituents	1	
	By weight	Reacting values
Sodium (Na)	7.4	.32
Potassium (K)	3.8	.08
Calcium (Ca)	9.4	.47
Magnesium (Mg)	3.0	.24
Sulphate (SO_4)	5.5	.11
Chloride (Cl)	2.3	.07
Bromide (Br)		
Carbonate (CO_3)	28	.93
Silica (SiO_2)	14	.46
Total	72.9	

McGlashan Mineral Spring is located on the Truckee River, 9 miles south of Truckee. The water is strongly carbonated, carries iron, and arises in decomposed granite and boulders. A small bottling plant is operated by J. G. Kirchner, leaser.

"**Powderhorn Creek Carbonated Spring.** A small, cool, carbonated spring lies near the mouth of Powderhorn Creek, 5½ miles in a direct line southwest of Deer Park Springs, but it is unimproved and is known mainly to hunters and fishermen. Small carbonated springs of similar character probably issue at other places in this region, but they are of little note and are known chiefly to the local sportsmen."

"**Salt Springs on North Fork of American River.** On the western bank of North Fork of American River, about 2 miles east of Colfax, there are a few saline and alkaline seepages that are known to local hunters as salt licks, or deer licks. Springs that yield perhaps 10 gallons a minute issue 25 or 30 feet above the river from a bank at the

cañonside. There is said to be a considerable saline deposit along their courses in summer, but when the locality was visited the small deposit that was seen consisted mainly of soda and alum. The surrounding rock is slate of Carboniferous age, which has been described by Lindgren.[9] The saline material is apparently derived from these old sediments."

"**Sereno Creek Carbonated Spring.** About 3½ miles south of Soda Springs station, a short distance east of the road, is a small spring that forms a drinking pool. It is on the eastern side of the cañon of Sereno Creek, near the base of steep slopes of andesite that overlies rhyolitic lava."

"**Sulphur Spring on Middle Fork of American River.** A small spring of strongly sulphureted water is situated in the cañon of Middle Fork of American River, about 20 miles west of Tahoe. The water issues at the base of a bluff of morainal material, on the southeast side of the stream. It has been visited by fishermen and others who penetrate this portion of the Sierra, but it is not well known."

"**Summit Soda Springs.** A number of groups of small carbonated springs lie in the Sierra west of Lake Tahoe. One of the northernmost of these groups has long been known as Summit Soda Springs, although the springs are about 13 miles by road south of Summit station, on the Southern Pacific Co's railroad. The springs are situated in a little flat beside North Fork of American River, and in the late eighties or early nineties a hotel was built, and the place was conducted as a resort for several years. The hotel burned in 1898, however, and since then the property has not been open to the public."

When visited in September, 1916, the owner, Mr. Joseph W. Stanford of Warm Springs, Alameda Co., had built a private stone mansion and caretakers' quarters on the property. Only two springs were being used.

"Four cool, carbonated springs rise in the flat on the south side of the North Fork, and a fifth rises at the edge of the stream. Three of them have been enclosed by spring houses and are used as drinking springs. All have small flows, but they are strongly carbonated and deposit noticeable amounts of iron. The following analyses of one of the principal springs show the water to be moderately alkaline and saline.

[9] Lindgren, Waldemar, U. S. Geol. Survey Geol. Atlas, Colfax folio (No. 66), pp. 1–2, 1900.

Analyses of Water from Main Spring, Summit Soda Springs, Placer County, Cal.

(Constituents are in parts per million.)

	1	2
Properties of reaction:		
Primary salinity	34	36
Secondary salinity	0	0
Tertiary salinity	0	0
Primary alkalinity	13	14
Secondary alkalinity	53	50
Tertiary alkalinity	328	339

Constituents	By weight	Reacting values	By weight	Reacting values
Sodium (Na)	238	10.34	248	10.76
Potassium (K)	8	.20	Trace	Trace
Calcium (Ca)	210	10.48	183	9.14
Magnesium (Mg)	20	1.64	21	1.73
Iron (Fe)	22	.79	23	.82
Aluminum (Al)	10	1.11	16	1.77
Chloride (Cl)	272	7.69	272	7.69
Carbonate (CO_3)	201	15.76	----------	13.94
Metaborate (BO_2)	Trace	Trace	----------	----------
Silica (SiO_2)	33	1.09	35	1.16
Totals	1,014	----------	941	----------
Carbon dioxide (CO_2)	1,593	72.41	1,586	72.09

1. Analyst and authority, Winslow Anderson (1888).
2. Analyst, J. F. Rudolph (1878). Authority, U. S. Geol. Survey Bull. 32.

"On the hillside 200 to 500 yards southward, there are four other carbonated springs which have been developed only to the extent of excavating small basins about them."

"The main springs issue in an area of granitic rock, the minor ones, on the hillside to the southeast, issue from schists that are a result of contact metamorphism between the granitic rock and slates. A mile southward the slopes are covered with andesitic lava, and Tinker Knob, 3 miles to the east, is a volcanic mountain.[10] "

"Near the road, 2 miles westward, downstream from the Summit Springs, there are considerable deposits of lime carbonate, and small quantities of carbonated water still seep at a few points in them. North of the railroad, on the wagon road to Truckee, there are also carbonate deposits that are the work of mineral springs."

"**Sulphur Springs near South Fork of Yuba River.** In the cañon of South Fork of Yuba River, less than a mile north of Cisco railroad station, are two small springs, one of which forms a drinking spring near the wagon road on the southern side of the river. The other is some distance farther upstream, on the northern side of the river, and

[10] A detailed description of the geology of this region is given by Waldemar Lindgren, U. S. Geol. Survey, Geol. Atlas, Truckee folio (No. 39), p. 5, 1897.

has been little used. Their waters are only faintly sulphureted. The rocks of the locality consist of slates, in part altered by contact metamorphism, that are of Jurassic and Triassic age."

MOLYBDENITE.

A pegmatitic vein carrying large, pure flakes of molybdenite has been found in granodiorite somewhere near the Rubicon River by Mr. Sherry Willits, of Auburn. The size and extent of the deposit could not be learned.

QUARTZ.

Quartz crystals have been sold commercially from a vein near Shady Run by Mr. J. Churchill, of 42 E. Main street, Stockton. The deposit has not been worked for over two years.

TALC.

Talc or soapstone occurs rather commonly along fracture planes in many of the mines. A deposit has been reported in the Bobtail mine in the Rock Creek district. Owned by Wm. Recknagel, of Auburn.

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SACRAMENTO COUNTY.

By CLARENCE A. WARING, Field Assistant.

INTRODUCTION.

Two weeks were devoted in October, 1916, to the mineral industry of Sacramento County. Appreciation is here expressed for the courteous treatment and coöperation of the several operators.

DESCRIPTION.

Location, boundaries and area.

Sacramento County is bounded on the north by Sutter and Placer counties; on the south by the San Joaquin and Mokelumne rivers and Dry Creek; on the east by El Dorado and Amador counties, and on the west by the Sacramento River and Steamboat and Sutter Sloughs.

The county was organized in the year 1849 and covers an area of 983 square miles.

Population and county seat.

The population of the county in 1913 was 90,000—75,000 of which were centered in Sacramento, the county seat and State Capitol, situated at the confluence of the American and Sacramento rivers.

Topography and drainage.

Sacramento County lies mainly in the central valley of California, extending from the Sierran foothills on the east down to the Sacramento River on the west. The highest elevations in the county southeast of Folsom are less than 900 feet, while the lowest in the southwestern portion of the county are slightly below sea level.

The eastern portion of the county is well drained from the north by the American River, which empties into Sacramento River, and by the Cosumnes River and Dry or Jackson Creek, which drain into San Joaquin River by way of Mokelumne River. The western portion of the county is largely low land protected from flooding by levees.

Power.

Two power lines of the Pacific Gas and Electric Company enter the city of Sacramento from the northeast. The Great Western Power line crosses the western side of the county from north to south, making a detour east of the city of Sacramento. The American River Electric Company, owned by the Pacific Gas and Electric Company, serves the eastern part of the county with power lines, following the American River from Folsom to Sacramento and following the State Highway from Sacramento to Stockton.

Transportation.

The Southern Pacific main line enters the city of Sacramento from the southeast from Stockton and passes northeastward through the county to Roseville, Placer County. The company has branch lines from Sacramento to Placerville, El Dorado County by way of Folsom, and from Sacramento south along the east side of Sacramento River to Walnut Grove. The Western Pacific main line crosses the west side of the county from south to north through the city of Sacramento.

The Central California Electric Traction railway runs from Sacramento southeastward through the county to Stockton. The Oakland, Antioch and Eastern Electric railway crosses the river at Sacramento and runs southwestward to San Francisco. The Northern Electric railway runs north from Sacramento to Marysville.

Good highways radiate from the city of Sacramento to Stockton, Folsom and Roseville. Branch roads make all parts of the county easily accessible. River boats ply between Sacramento and San Francisco and furnish a cheap means of transportation.

ECONOMIC GEOLOGY.*

The higher northeastern portion of Sacramento County, in the region east and southeast of Folsom, is made up of diabase, amphibolite schist and slate.

To the extreme northeast in the region of Represa these old metamorphics are intruded by granodiorite, which is being quarried for stone. Ancient river gravels overlie these older rocks in the region of Mormon Island, where they were placered in the early days.

Along the lower foothills sedimentary strata of upper Cretaceous (Chico) and upper Eocene (Ione) age are exposed. These strata are composed of shales, sandstones, clays, sands and gravels interbedded with volcanic tuffs and breccias. They are overlain along the edge of the valley by alluvium. Where the American River enters the valley, broad terraces have been left on either side. These terraces are made up principally of gravels and sands which are being dredged for their gold content. Certain clays in the valley alluvium have been found to be suitable for the manufacture of brick, tile and terra cotta. Sands in the Sacramento River are being utilized for sand lime brick and for concrete work. Certain of the deeper alluvial sands have been found to yield natural gas, which is thought to be derived from underlying older sedimentary deposits.

*For a geologic map of eastern Sacramento County see U. S. Geol. Survey, folio reprint 3, 5 and 11, 1914.

MINERAL PRODUCTION.

The mineral production of Sacramento County during the year 1915 consisted of gold, silver, platinum, brick, natural gas and granite, valued at $2,632,658. The county stands tenth among the counties of the state as a mineral producer and fourth as a gold producer.

SACRAMENTO COUNTY—Table of Mineral Production, 1880-1915 (Inc.).

Year	1 Brick	4 Natural Gas	3 Gold	5 Platinum	6 Silver	2 Copper	7 Miscellaneous stone
1880			$342,514				
1881			425,000		$1,000		
1882			400,000				
1883			480,000				
1884			270,000				
1885			353,522				
1886			280,000				
1887			158,525		176		
1888			150,000				
1889			210,075				
1890			193,584				
1891			142,830		4		
1892			121,900				
1893			90,000				
1894	$56,250		70,326				75,000 cu. ft. State's use.
1895	65,025		145,872				85,000 cu. ft. State's use.
1896	44,200		138,050				$12,018
1897	16,700		93,050				90,413
	*1,500						
1898	44,000	$12,000	57,301				18,135
1899	93,600	10,000	115,906				14,249
1900	53,400	11,750	176,007		986		17,296
1901	62,180		229,034		544	$316	10,808
1902	78,198	31,200	425,894		330		19,516
1903	120,000	30,518	335,646		234		20,398
1904	30,000	39,200	419,287		75		26,161
1905	135,000	43,564	668,382	$700	206		34,000
1906	108,000	52,874	986,624	200	3,640		19,220
1907	128,624	52,874	790,973		2,034		18,561
1908	63,491	55,000	1,166,055		1,621		195,628
1909		60,000	1,669,814		2,856		235,210
1910		49,203	1,396,874		4,606		210,287
1911	76,571	83,890	1,812,826		3,047		133,344
1912	161,535	96,000	1,712,587		3,544		197,733
1913	144,191	36,000	2,503,633		3,406		238,476
1914	160,923	40,000	2,164,491	7,000	3,500		253,235
1915	82,973	54,000	2,131,813	6,217	3,151		284,127
Totals	$1,726,961	$758,073	$22,823,485	$14,117	$34,960	$316	$2,049,515

*Pottery.

MINERALS AND MINES.

BRICK.

The **Independent Pressed Brick Company,** formerly the Sacramento Sand Brick Company, is manufacturing sand-lime brick on the east bank of the Sacramento River, just above the Southern Pacific Railroad shops in the city of Sacramento. Fine sharp sand is teamed from the bed of the Sacramento River. Lime is crushed and raised by a small

bucket elevator to a pulverizer. The lime is then measured and dumped into a large revolving mixer with the proper proportion of sand. The two materials are thoroughly mixed and subjected, while being mixed, to jets of steam for about 20 minutes. The product is run through a Quaker brick machine and the green bricks piled on cars which are run into brick cylinders. The cylinders hold 9,000 bricks each and in them the bricks are subjected to steam for 9 or 10 hours, at which time the process is complete. The finished bricks are piled in sheds for shipment.

Any color of finished bricks may be produced by adding the desired color to the mixing cylinder. The finished bricks are claimed to become harder the longer they stand since the lime tends to recrystallize. The plant has a capacity of 12,000 bricks daily.

Crude oil, supplied from two 20,000 gallon tanks, is used as fuel for generating steam in a 60 h. p. boiler. Water is raised, by a 3 h. p. electric motor, from a 50′ well into a 20,000 gallon tank for use at the plant.

Owned and operated by the Independent Pressed Brick Company, John Trede, president; F. A. Wilcox, vice president; Mrs. J. Trede, secretary, all of Sacramento.

The **Muddox Pottery Co.** manufacture sewer pipe from clay obtained from Amador County. The plant is at Thirtieth and L streets, Sacramento. H. C. Muddox, owner.

The **Panama Pottery Co.** manufacture ornamental pottery from clay obtained from Lincoln, Placer County. The plant is at Twenty-fourth Street road, Sacramento.

The **Riverside Brick Yard,** owned by the Sacramento Transportation Company, is located near Riverside, about three miles south of Sacramento city limits. Loamy soil, clay and sharp sand are steam-shoveled from the lowlands near the Sacramento River and hauled to the brick works upon the bank of the river in dump cars drawn by steam locomotives. The material is tempered with water, thoroughly mixed in pug mills and run through Monarch brick machines. The green bricks are dried in tiers in the drying yard and are then ready for burning in a continuous kiln 250′ long, 60′ wide and 12′ high. The burned bricks are loaded on river barges ready for shipment. Common building bricks only are manufactured. About 85 men are employed during the brick-making season; enough bricks being made ahead to run the kilns during the winter. Between 5 and 6 million brick, per year, are produced and sold in San Francisco and Sacramento. Equipment consists of: 1 Marion steam shovel with a 1½ cu. ft. bucket on a 40′ x 100′ wood hull, 2 locomotives and 32 dump cars, 4 Monarch brick machines (2 now in use), 2 continuous kilns (1 in use). Coal is used for fuel throughout

the plant and about 2½ tons are consumed in a kiln in 24 hours to produce 35,000 brick. Twenty-five men are employed all year. A 250 h.p. Corliss steam engine runs a shaft for all the brick machines, which are operated for from 3 to 4 months of each year and require about 30 men for each machine. The steam shovel digs to a depth of about 12 feet and is operated only about 2 months of each year. The company's plant at Freeport has been inoperative for several years.

The company office is at Front and N streets, Sacramento. P. G. Harney, president; H. Rolff, superintendent at the plant.

Bibl.: Rept. X, pp. 506–8, 1890.

The **Sacramento Clay Products** plant is located on lot 16 of Rancho del Paso, about 4 miles northeast of Sacramento on the Southern Pacific Railroad near the main highway to Roseville. Clay is taken from near the plant, mixed with clay from Lincoln, Placer County, and tempered with water. The stiff mud is run through presses. The plant is equipped with 1 Berg brick press, 2 American clay machines, 1 hollow tile machine and 4 kilns. Crude oil is burned in the kilns. Fourteen men are employed. The company manufactures fire brick, face brick, hollow tile and Denison interlocking tile.

Owned by the Sacramento Clay Products Company, J. P. Dargitz, manager, 311 Ochsner Building, Sacramento.

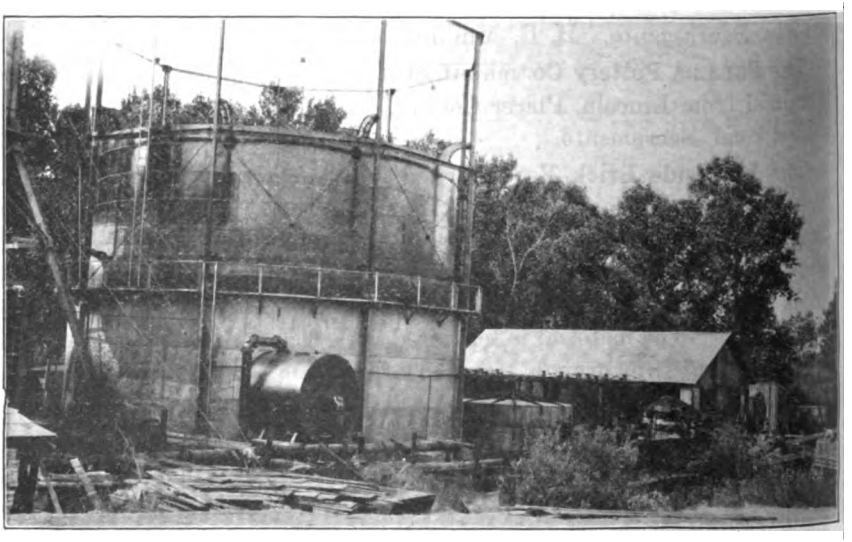

Photo No. 36. Wells Nos. 1, 6, 7, and 2 of the Sacramento Natural Gas Company, at the foot of Y street, Sacramento. Well No. 1 is to the left of the gas holder while No. 7 is housed in.

NATURAL GAS.

The **Sacramento Natural Gas Company** owns eight producing gas wells in the city of Sacramento on the east side of Sacramento River. The wells range from 1380′ to 2935′ in depth. Natural gas is brought up by artesian water and caught in traps which empty into large storage containers, the water flowing into the river. Water from well No. 3 is used in the Sacramento Swimming Baths. Gas is reported to have been first struck at a depth of 293 feet, but the larger flows come from a greater depth. The eight wells produce in the neighborhood of 250,000 cu. ft. of gas per day, which is consumed in the city of Sacramento. The company has an auxiliary plant for the manufacture of gas from crude oil.

Sacramento Natural Gas Company, 427 J st., Sacramento, J. N. Jensen, Manager; H. C. Keyes, Secretary.

Bibl.: Rept. X, p. 505; 1890, Bull. 3, pp. 5–15, 1894.

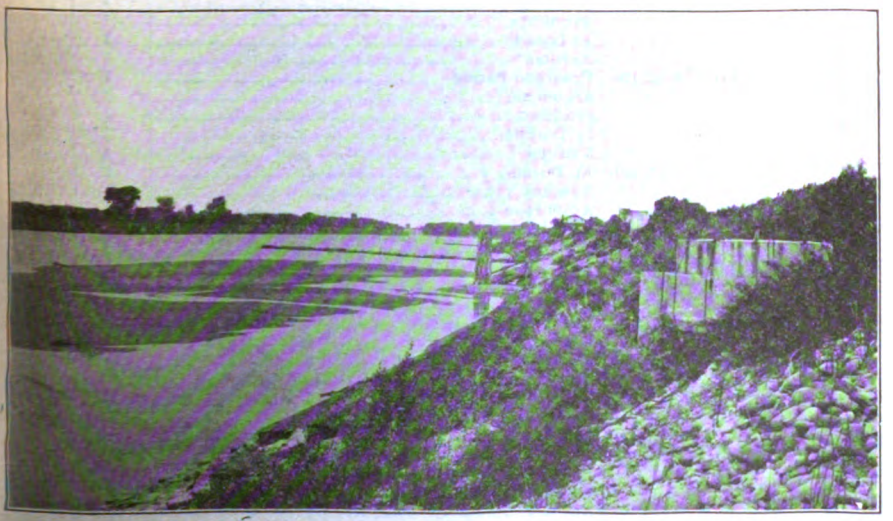

Photo No. 37. Wells Nos. 8 and 9 of the Sacramento Natural Gas Company, on the east bank of the Sacramento River. Well No. 9 is just south of the club house in the picture.

GOLD.

Gold was taken from the bed of the American River and from its benches solely by placering and sluicing until 1899, when the first gold dredge was put in operation in the county. After the first rich surface [illegible]-ups were made, the gravels remaining were too deep to be worked economically on a small scale. The successful operation of dredgers, for recovering the gold from deep gravels, has kept up the county gold production since their institution. The reclamation dredges being used by the Natomas Company the last year are highly satisfactory and their use in other dredging fields should be encouraged.

Since dredging operations began the gold production and number of dredgers operating each year is as follows:

Year	Gross value	Increase+ or decrease-	Companies operating	Number of dredgers	Total dredgers
1899	----------	----------	Colorado-Pacific	1	1
1900	$17,200	+$17,200	Colorado-Pacific	1	
			Ashburton	1	2
1901	47,619	+30,419	Colorado-Pacific	1	
			Ashburton	1	
			Syndicate	1	3
1902	155,194	+107,575	Colorado-Pacific	2	
			Ashburton	1	
			Syndicate	1	4
1903	102,097	−53,097	Colorado-Pacific	1	
			Ashburton	1	
			Syndicate	1	3
1904	348,990	+246,893	Colorado-Pacific	1	
			Ashburton	1	
			Syndicate	1	
			Folsom Development Co.	2	5
1905	569,124	+220,134	Colorado-Pacific	1	
			Ashburton	1	
			Syndicate	1	
			El Dorado	1	
			Natoma	5	9
1906	921,300	+352,176	Colorado-Pacific	1	
			Ashburton	1	
			Syndicate	1	
			El Dorado	1	
			Natoma	5	9
1907	649,511	−271,789	El Dorado	1	
			Natoma	5	6
1908	1,109,196	+459,685	Ashburton	1	
			El Dorado	1	
			Natoma	8	10
1909	1,534,136	+424,940	Ashburton	1	
			El Dorado	1	
			Natoma	8	10
1910	1,369,594	−164,542	Ashburton	1	
			Natoma	7	8
1911	1,805,071	+435,477	Ashburton	1	
			Natoma	9	10
1912	1,672,797	−132,272	Natoma	9	
			Union	1	
			Ashburton	1	11
1913	2,498,603	+825,806	Natoma	10	
			Union	1	
			Ashburton	1	12
1914	2,161,653	−336,950	Natoma	10	
			Wilkesbarre (or Union)	1	11
1915	2,129,781	−31,872	Natoma	9	
			Wilkesbarre	1	
			Indiana	1	11
1916	----------	----------	Natoma	11	11
	$17,091,866	----------	Total dredge production.		

The best gold values are found along the ancient courses which the American River took to reach the valley. These old channels and their terraces are, in most cases, covered with from 20 to 70 feet of gravel, sand and alluvium, in places interbedded or overlain by beds of volcanic material. The north side of the American River, west of Folsom, is made up almost entirely of volcanic material which carries little or no value and covers the gravels so deep as to make dredging unprofitable. The bed of the river and the two terraces on the south side have yielded good values. The gravels in the lower terrace average between 6 and 8 cents per cubic yard, while those on the upper terrace average between 8 and 9 cents per cubic yard. The channel gravels are underlain by volcanic tuff and slate, from 12″ to 18″ of which is dredged to recover any values which may have worked into it. The main bedrock is not in all cases reached by the dredgers, but where the slate is reached excellent values are found.

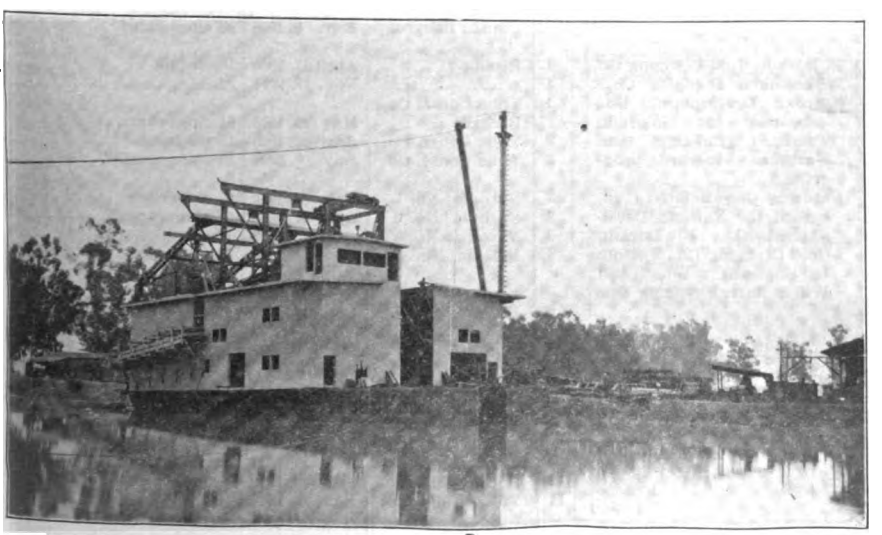

Photo No. 38. Dredger No. 4 of the Natomas Consolidated of California, under construction in November, 1915. The first reclaiming gold dredge built in California.

The following table shows the history of dredging in Sacramento County since its beginning:

TABULAR HISTORY OF SACRA

Company	Dredger No.	Type of construction	Year commissioned	Number and type of buckets	Bucket capacity, cubic feet	Rated capacity, horsepower
Colorado-Pac. Gold Dredging Co.	1	Risdon (steam)	April, 1899	Open link	5½	------
	2	Risdon (elec.)	1902	----------	5	------
Ashburton or New England Exploration Co.	1	Bucyrus	Mar. 1, 1900	Double lift Open link	7½	------
	2	Bucyrus	May, 1908	Single lift Close conn.	7	------
Syndicate	1	Risdon	1901	Open link	5	------
Folsom Development Co.	1	Western Eng. Const., Bucyrus	Feb. 20, 1904	Close conn.	5½	------
	2	Western Eng. Const., Bucyrus	Mar. 16, 1904	Close conn.	5½	------
	3	Company Const., Bucyrus	Jan. 1, 1905	87 close conn.	5½	490
	4	Company Const., Bucyrus	Nov. 15, 1905	68 close conn.	13	415
	5	Western Eng. Const., Bucyrus	Dec. 10, 1905	73 close conn.	9	540
	6	Western Eng. Const., Bucyrus	Mar. 8, 1908	86 close conn.	9	790
El Dorado Gold Dredging Co.	1	Risdon	April 25, 1905	Open link	7	------
Wilkes-Barre Dredging Co.	1	----------	Nov. 10, 1914	----------	----------	----------
Natoma Development Co., (absorbed the Colorado Pacific, Syndicate and Natomas Vineyard properties.)	1	Yuba Const. Co., Bucyrus	May 10, 1908	61 close conn.	13½	645
	2	Yuba Const. Co.	April 22, 1908	Close conn.	8	------
	3	Yuba Const. Co.	July 2, 1908	61 close conn.	8	------
Natomas Consolidated (absorbed the Natoma Development Co., El Dorado Gold Dredging Co., Folsom Development Co. and Wilkes-Barre Dredging Co.)	1	Natoma, No. 1	Dec., 1916	67 close conn.	15	711.5
	2	Natoma, No. 2	April 22, 1908	68 close conn.	8½	462
	3	Natoma, No. 3	July 2, 1908	72 close conn.	8½	438
	4	Folsom, No. 4	Nov. 15, 1905	67 close conn.	15	600
	5	Folsom, No. 5	Dec. 10, 1905	82 close conn.	9	588
	6	Folsom, No. 6	Mar. 8, 1908	86 close conn.	9	505
	7	Folsom, No. 8	May, 1913	98 close conn.	9	613
	8	Yuba Cons. Co.	Jan. 23, 1911	83 close conn.	15	1,122
	9	Yuba Cons. Co.	Aug. 10, 1911	83 close conn.	15	1,146
	10	Yuba Cons. Co.	Sept. 30, 1912	83 close conn.	15	1,105
	11	Yuba Cons. Co.	Nov. 10, 1914	----------	9	505

MENTO COUNTY DREDGERS.

Type of screens	Dredger capacity, cubic yards per month	Depth dredged, feet	Acres dredged	Days operated	Cubic yards dredged	Cost per cubic yard in cents	Remarks
Shaker	35,000	----------	25	1,460	960,000	----------	Dismantled 1903.
Shaker	60,000	----------	54	1,460	2,100,000	----------	Dismantled 1906.
Shaker	115,000	26	155	2,555	6,000,000	7.8	Dismantled 1906.
Shaker	90,000	12-48	8	210	450,000	8	Dismantled 1913.
Shaker	----------	----------	108	2,012	3,000,000	----------	Closed down 1906.
Shaker	66,000	Av. 45	54	1,655	2,995,000	----------	Dismantled Aug. 20, 1908.
Shaker	----------	Av. 17	150	1,380	5,350,000	----------	Dismantled Jan. 14, 1909.
Revolving	180,000	30	*81.5	1,460	*3,600,000	----------	Dismantled May, 1912, and machinery used in building Natoma No. 7.
Revolving	250,000	Av. 20	*209	1,140	*6,500,000	3.0	Renamed Natoma No. 4. Dismantled.
Revolving	----------	50-75	*89	1,110	*3,500,000	----------	Renamed Natoma No. 5. Still operating.
Revolving	130,000	Av. 60	*18.9	285	*1,565,598	5.8	Renamed Natoma No. 6. Still operating. Monitor equipment.
----------	----------	----------	40	1,335	1,260,000	----------	Dismantled 1909.
----------	----------	----------	§26	474	1,601,000	8.46	Discontinued operations Feb. 29, 1916.
Shaking	250,000	Av. 19	†60.02	225	*3,048,254	2.4	
Revolving	162,000	Av. 24	‡16.38	135	*626,300	2.4-3.1	
Revolving	102,000	Av. 42.5	8.50	180	583,900	3.9	
Revolving	270,000	32	§611.00	§2,584	§21,812,000	3.22	Rebuilt Feb.-Nov., 1916, as reclaiming dredge.
Revolving	170,000	35	§368.00	§2,727	§14,789,000	4.00	
Revolving	140,000	40	§272.00	§2,729	§13,567,000	4.48	
Revolving	250,000	22	§499.00	§2,287	§18,177,000	3.01	Rebuilt Nov. 1, 1914,-Jan. 13, 1916, as reclaiming dredge.
Revolving	140,000	50	§139.00	§2,577	§11,412,000	5.96	Sank June 8, 1913. Resumed operations Nov. 2, 1913.
Revolving	130,000	50	§131.00	§2,721	§11,010,000	6.58	Extensive repairs May 22-July 31, 1913.
Revolving	180,000	60	§174.00	§2,259	§9,518,000	6.00	Sank May 4, 1912. Resumed operations May 14, 1913.
Revolving	200,000	60	§94.00	§1,519	§9,401,000	5.54	Burned Oct. 20, 1911. Resumed operations Jan. 20, 1913.
Revolving	200,000	60	§122.00	§1,778	§11,673,000	5.84	
Revolving	200,000	60	§140.00	§1,363	§9,120,000	5.27	
Revolving	----------	----------	§5.00	§76	§353,000	4.87	Acquired from Wilkes-Barre Dredging Co. on Mar. 28, 1916.

*To January 1, 1909. †During eight months. ‡First eight months. §To June 30, 1916.

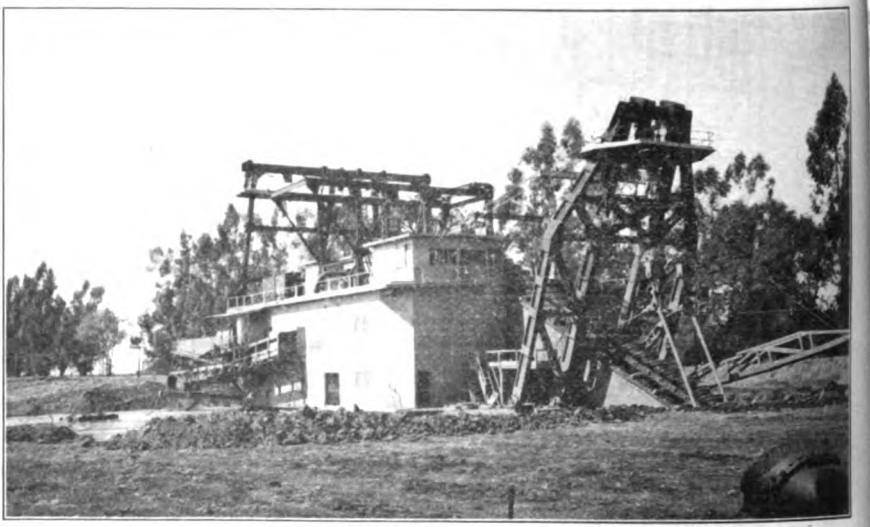

Photo No. 39. Reclaiming Dredge No. 4 of the Natomas Consolidated of California, showing bucket line, operating at Nimbus, Sacramento County. September, 1916.

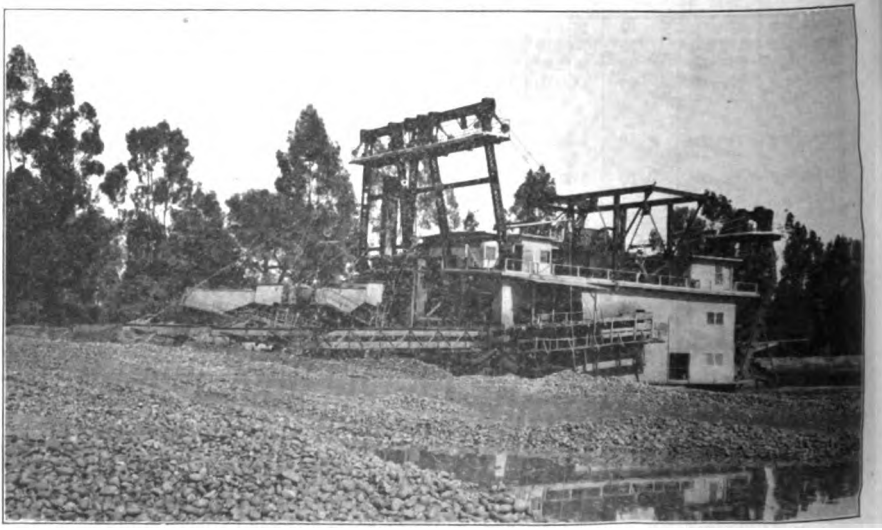

Photo No. 40. Reclaiming Dredge No. 4 of the Natomas Consolidated of California, showing the arrangement of the tailings stackers. Operating at Nimbus, Sacramento County. September, 1916.

The dredgers of the **Natomas Consolidated** are all run by electricity supplied by the Great Western Power Company and the Western States Gas and Electric Company. The tendency the last few years has been to build the boats with steel hulls and enlarge the bucket capacity. The latest type of boat in this field is the reclaiming gold dredge of which Natomas No. 4 is a working example. This dredge is equipped with 15 cubic foot buckets and revolving screen the same as the other large type dredgers, but additional tailings stackers have been added. Two stackers handle the coarse discharge from the revolving screen, while two other stackers handle the fines from the riffles. The lengths of the four stackers are so arranged that the coarse material is deposited nearest the boat and the fine material at a distance, so it will run back towards the boat and fill the interstices between the cobbles. The revolving motion, back and forth, of the boat distributes the tailings evenly across the fill. The land needs but little leveling to fit it for agricultural purposes again and the Natomas Company maintains its own reclaiming department, which is replanting the dredged grounds to orchards and vineyards. Emery Oliver, manager, Forum Building, Sacramento.

Bibl.: Bull. 57, pp. 174–205.

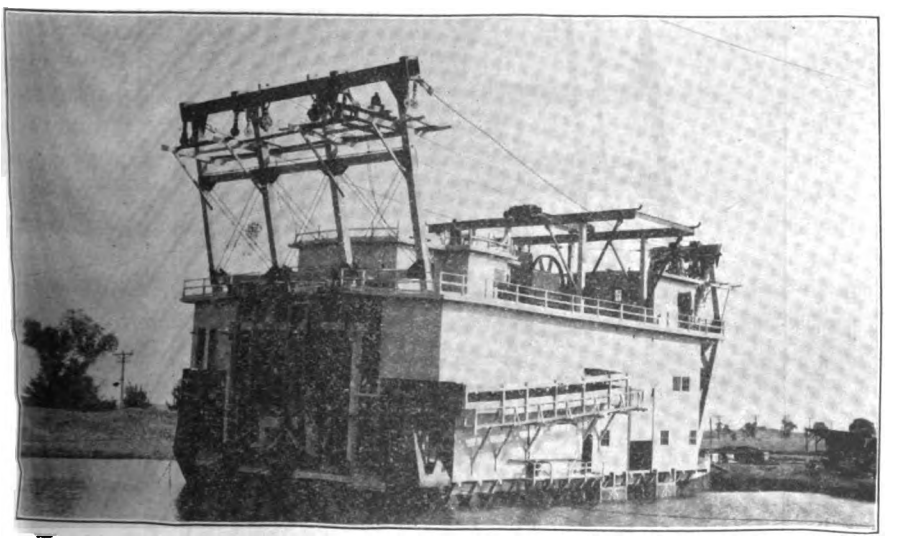

Photo No. 41. Dredge No. 1 of the Natomas Consolidated of California, being rebuilt as a reclaiming dredge, near Fair Oaks, Sacramento County. September, 1916.

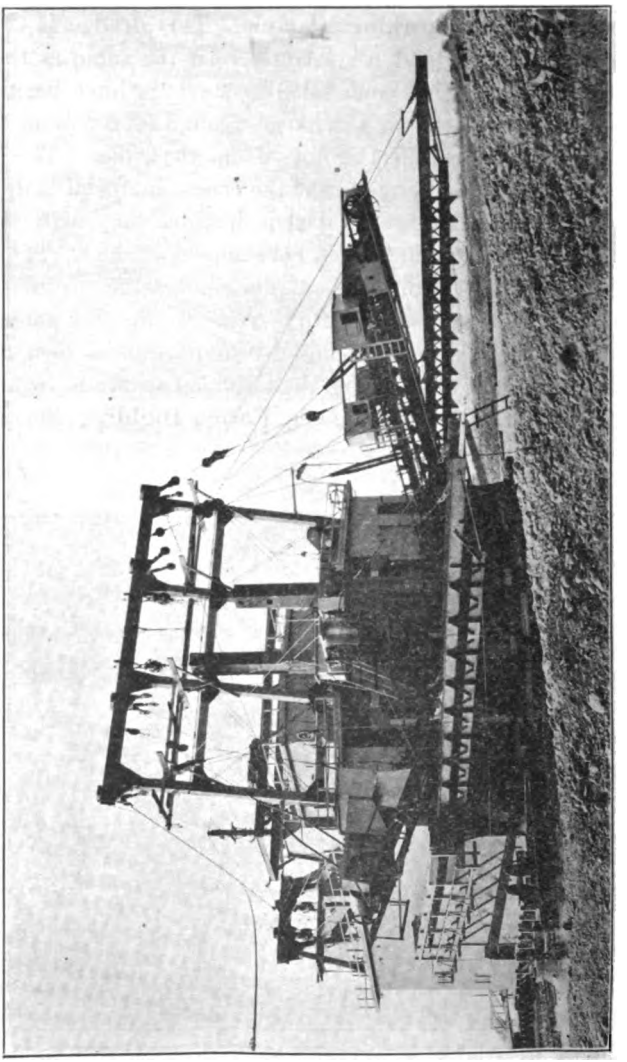

Photo No. 42. Dredge No. 1 of the Natomas Consolidated of California, being rebuilt as a reclaiming dredge, near Fair Oaks, Sacramento County. November, 1916.

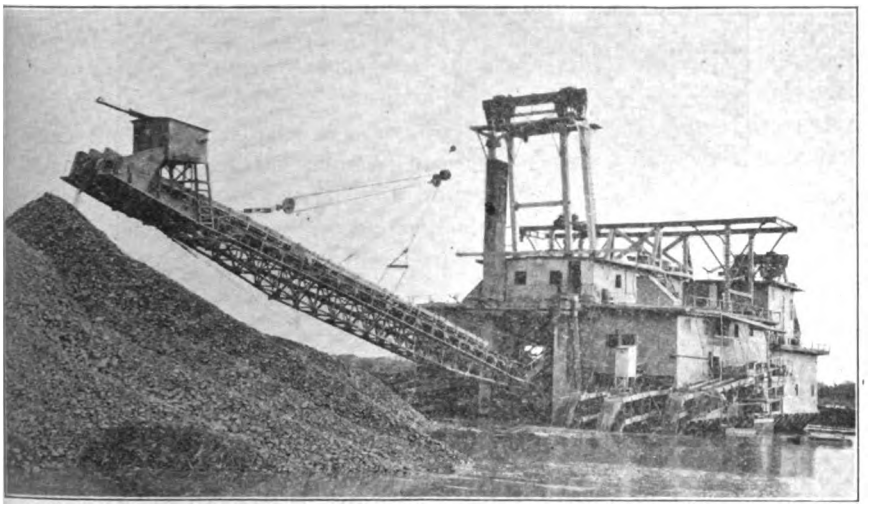

Photo No. 43. Dredger No. 9 of the Natomas Consolidated of California, operating south of Natoma, Sacramento County.

GOLD—DRIFT MINING.

The **Gray Mining Company** are drifting from the bottom of a 40′ shaft near the head of Alder Creek, at the old "Rhodes Diggings," 3 miles southeast of Folsom. Elevation 350′. Early work in this region consisted of surface placering, and then the Embach Mining Company did some drifting from a shaft fitted with electric hoist. Present work is being carried on about one-half mile further up the creek, where coarse gold is being taken from blue gravel on a slate bedrock. The channel is thought to run north-south and to be about 50′ wide and 4000′ long. It is covered with volcanic gravel and tuff and present work consists of opening up the channel. Equipment consists of a 16′ hoist and horse whim; 7½ H.P. distillate engine and valveless rotary pump. Three men are employed in the mine and three work on the surface.

The company, consisting of D. P. Gray and son E. R. Gray of Folsom, and C. J. Heeseman of Oakland, are leasing the ground from John A. Britton of San Francisco.

MISCELLANEOUS STONE.

Crushed rock.

The **Natomas Consolidated** of California, owns a large rock crushing plant at Fair Oaks which converts dredge tailings to a commercial product. Pebbles and boulders are loaded by a steam shovel, with 2½ cu. yd. bucket, into dump cars having a capacity of 4 cu. yds. each. Two narrow gauge locomotives and 30 dump cars are used. Clean gravel is dumped into bins and carried by a 380′ conveyor belt to a

Photo No. 44. Bucket line of Dredger No. 9 of the Natomas Consolidated of California, operating at Natoma, Sacramento County.

revolving screen. Dirty or wet gravel is passed through a revolving screen, 6′ in diameter and 30′ long with $\frac{1}{4}$″ holes, where it is washed; everything over $\frac{1}{4}$″ passing to the conveyor belt with the dry clean gravel. The fine slickens is washed down a flume and distributed over the leveled land. The gravel is then carried to a screen 5′ in diameter by 30′ long with $2\frac{1}{2}$″ perforations. Everything over $2\frac{1}{2}$″ in diameter is crushed, the dust washed out, and run through sizers for the following: $\frac{1}{8}$″ x $\frac{1}{2}$″, $\frac{3}{4}$″ x 1″, $1\frac{1}{2}$″ x $2\frac{1}{2}$″, dust x $\frac{3}{8}$″. The balance of the

material is stored as washed gravel. The following crushers are used: One 42″ x 26″ jaw crusher, 7-36″ x 10″ jaw crushers and 1-48″ Symons disc crusher. A conveyor belt passes under all of the discharge belts and any mixture of sized rock can be obtained. The railroads are arranged under the conveyor belts so that the cars run from the yard by gravity. The production of the plant is about 1500 tons of crushed rock and 500 tons of washed gravel in 10 hours.

Natomas Rock Crushing Department, Forum Building, Sacramento, or Alaska Commercial Building, San Francisco.

Bibl.: Bull. 57, p. 203.

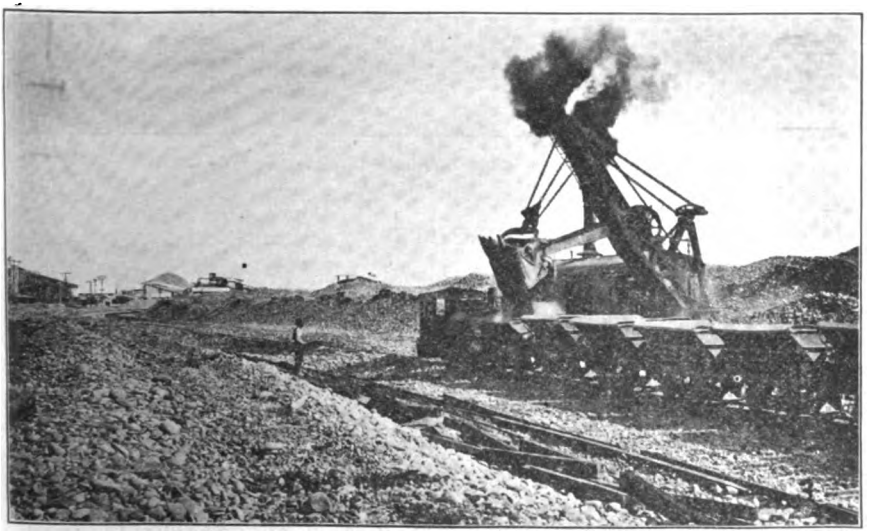

Photo No. 45. Loading cobbles with steam shovel for Natoma Rock Crushing Plant near Fair Oaks.

Photo No. 46. Natoma Rock Crushing Plant near Fair Oaks.

GRANITE.

The Folsom Granite Quarry is situated on the east bank of the American River at Folsom State Prison. The grounds include 483.92 acres, practically all of which is made up of granodiorite and diabase. The quarry sites are about 50 feet above the bed of the river and just east of the canal.

Early work was carried on in diabase, the contact of which, with the granodiorite crosses the American River just north of the site of the old rock crusher. The farther this rock was quarried into the hill the deeper it was decomposed until 100′ back from the river bank a 100′ face shows 50′ of decomposed rock. Work was also carried on in granodiorite in an old quarry just below the dam, but better rock has been opened up at the quarry now being worked just east of the prison power plant. The granodiorite is dark and medium-grained and the prison buildings built of it in 1888 show no sign of weathering. All work is done by prison labor. Equipment consists of hand and hammer drills, two derricks, and a tramway to the prison grounds. The convicts are taught to quarry, cut stone and do the masonry and some have even attempted sculptural work.

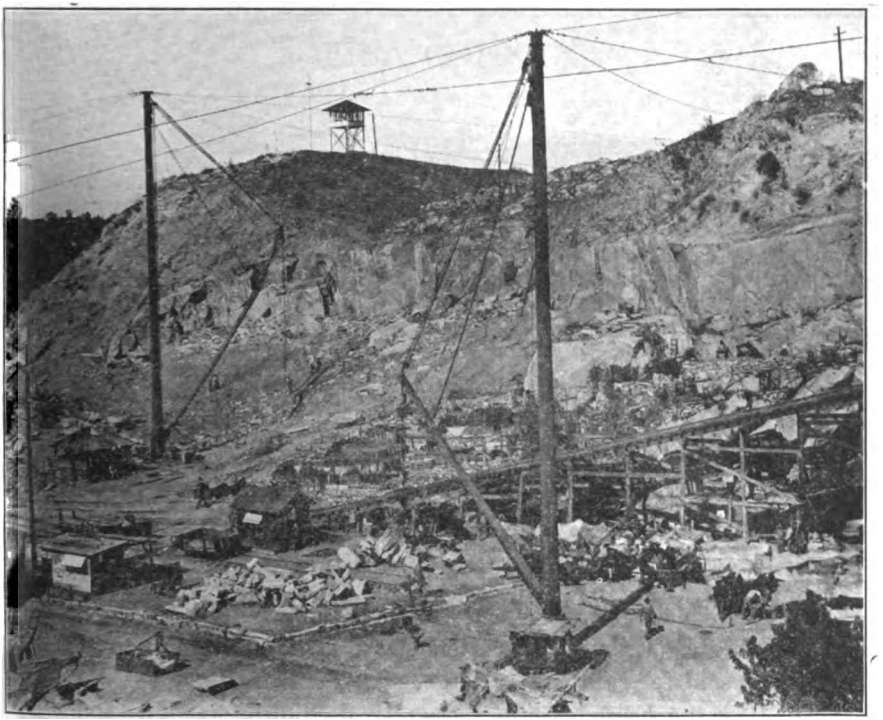

Photo No. 47. Granite Quarry at Folsom State Prison, Represa, Sacramento County. Worked by the convicts at the prison. Courtesy of J. J. Smith, Warden.

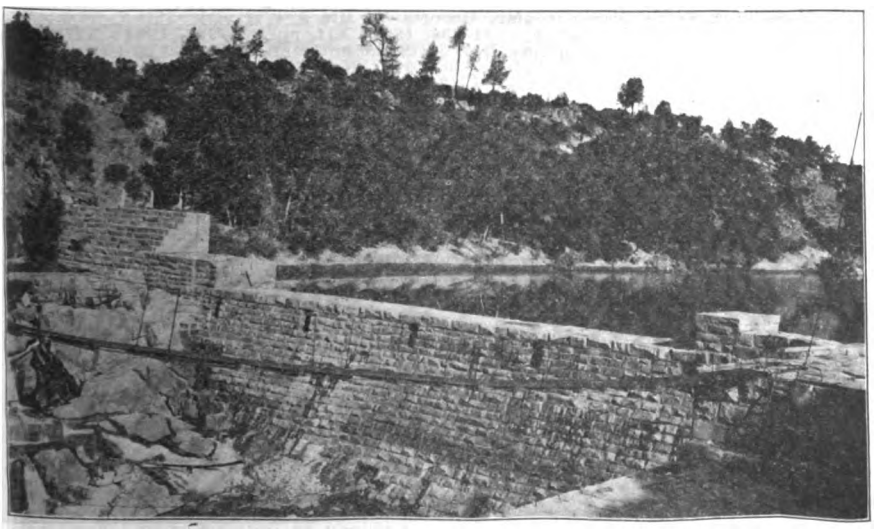

Photo No. 48. Dam across the American River at Folsom State Prison, built of granite blocks from the prison quarry by convict labor.

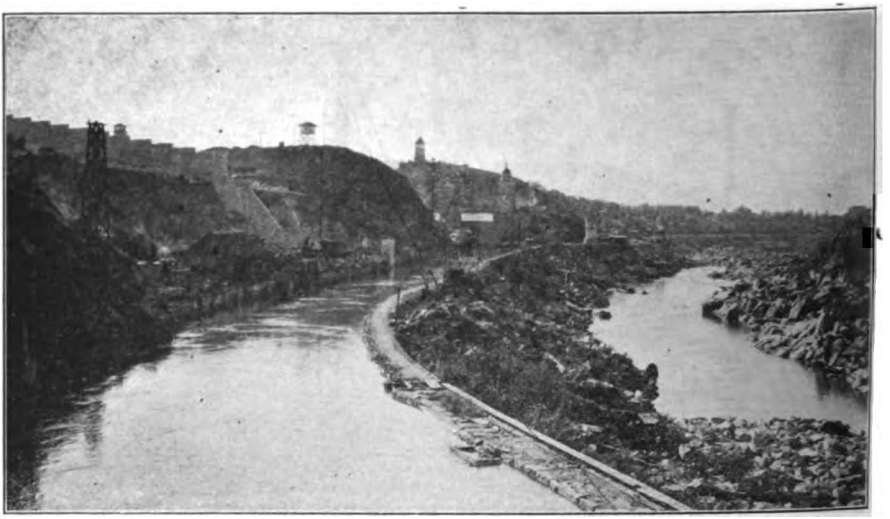

Photo No. 49. View down the American River from the Folsom Prison dam, showing granite outcrops along the river bed and along cuts made for the outlet canal. The prison buildings and walls were built of granite blocks by convict labor.

The granite blocks have been cut for use in the prison buildings, walks, dam, canal, etc. Rip-rap is used along the canal and about 8000 tons per year is sold for railroad ballast.

Owned by the Folsom State Prison, J. J. Smith, warden, Represa, California.

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YUBA COUNTY.

By CLARENCE A. WARING, Field Assistant.

INTRODUCTION.

Four weeks were spent by the writer, in August, 1915, doing field work in Yuba County. All available information was first obtained at Marysville and vicinity, after which the route took in Browns Valley, Strawberry Valley, Eagleville, Woodleaf, Challenge, Rackerby, Oregon House, Dobbins, Comptonville, Smartsville, Waldo and Wheatland.

The writer endeavored to obtain reliable information concerning all operating mines, old mines and prospects.

Appreciation is here expressed for the courteous treatment and coöperation of the several mine owners and operators.

DESCRIPTION.

Location and boundaries.

Yuba County lies in the north central part of the state and borders the east side of the Feather River. It is bounded on the northwest by Butte and Plumas counties, on the southeast by Placer and Nevada counties and on the east by Sierra County.

Area.

It was organized in 1850 and covers an area of 625 square miles, or 400,000 acres.

Population and county seat.

The population in 1910 was 10,042, of which 5,430, or over one-half, were at Marysville, the county seat, situated at the confluence of the Feather and Yuba rivers.

Topography and Drainage.

Extending as it does, from the Feather River into the middle western slope of the Sierra Nevada Mountains, Yuba County includes diversified topography and climate. The main drainage systems of the Yuba and Bear rivers and Honcut Creek carry all waters to the southwest into Feather River.

Vegetation.

Trees in the valley region consist of oaks and willows, while in the foothills oaks and digger pine predominate. In the more elevated eastern portion of the county, red pine, sugar pine, fir, cedar, and laurel-oak are abundant, and lumbering is one of the principal industries. Grains do well in much of the region. Rice and hops are yielding good returns in the region about Marysville and Wheatland, respectively.

Power.

The western and southeastern parts of the county are well provided with power lines. The Pacific Gas and Electric Company, with power plant at Colgate, has a line southwestward through Smartsville, with branches to Wheatland, Yuba County, and Van Trent, Placer County; also a branch northwestward through Bangor, Butte County. Another line eastward to Nevada City, with branch northward to Alleghany, Sierra County, serves the southeast corner of Yuba County. Branches from the main lines could easily be extended to most any part of the county.

Water power is available in many of the streams during the winter and spring. Internal combustion engines are often cheap and practicable.

Transportation.

The San Francisco and Portland line of the Southern Pacific railroad crosses the southwestern part of the county through Wheatland and Marysville, while the Northern California line of the same company runs northward from Marysville.

The Western Pacific railroad crosses the west side of the county and is paralleled south of Marysville by the Northern Electric railroad, which crosses the Feather River north of Marysville.

Fair mountain roads tap all the northeastern and mountainous portions of the county.

GENERAL GEOLOGY.

The general geology of Yuba County is similar to that in the adjoining, Nevada and Placer, counties.

The main central portion of the county consists generally of gabbro-diorite and granodiorite grading off on either side into the more basic diabases, which in turn grade into metamorphic, amphibolitic rocks. Schists and slates in places overlie the igneous rocks and are intruded by serpentine in the northern part of the county. Alluvial sands and gravels cover the entire western portion of the county, while auriferous gravels, in places, lie along the old channel courses.

The general trend of the rock formations is northwest-southeast.

ECONOMIC GEOLOGY.

The areal geology of Yuba County has been covered by U. S. Geological Survey Folios Nos. 17, 18 and 43, but no detailed work has been done on the geologic occurrence and association of ore bodies.

The northeastern portion of the county is crossed from southeast to

northwest by the serpentine, slate and amphibolite belt which accompanies the Mother Lode southward. The region includes many quartz veins which in places carry gold values with pyrite. The veins are, as a rule, pockety.

The central portion of the county is made up of granodiorite, gabbrodiorite, diabase and amphibolite schist, which have a northwest-southeast trend and include quartz veins carrying gold with pyrite, galena and chalcopyrite. In the western portion of the area the veins carry a larger proportion of copper sulphides, and a belt along the foothills which carries good gold values from concentration on the surface carries fair copper values with depth.

Ancient river channels throughout the northeastern and central portions of the county carry considerable gold.

Asbestos, chrome and manganese are usually associated with serpentine areas, while talc is often found along fracture planes in the schists.

The western portion of the county is made up of gravel and alluvial wash from the mountains to the east. The gravels in places carry gold values, which make them good dredging land.

Sand in the bed of Yuba River is used for construction work, and clay beds along the alluvial slopes are available for brick and pottery.

MINERAL PRODUCTION.

The mineral production of Yuba County during the years 1914 and 1915 consisted of gold, platinum, silver and sand. The demand for minerals during the last year has encouraged the opening up of other prospects which are now adding to the state's production of chrome and manganese.

Other mineral deposits of possible economic value, but as yet undeveloped, are: asbestos, clay, copper, ochre, and soapstone.

YUBA COUNTY—Table of Mineral Production, 1880-1915 (incl.).

Year	Brick	Clay	Gold	Macadam	Mineral water	Sand	Silver	Miscellaneous
1880			$943,860				$428	
1881			800,000				1,300	
1882			750,000					
1883			455,000					
1884			250,000					
1885			207,448					
1886			149,203					
1887			162,426					
1888			150,000					
1889			112,053				15	
1890			141,781					
1891			37,576					
1892			44,218					
1893			30,839					
1894			107,480					
1895			111,482					
1896			171,687					
1897			141,638					
1898			166,865					
1899			189,927					
1900			280,366				4,625	
1901			188,908				846	
1902			155,630				2	
1903			125,830				41	
1904	$3,000	$750	139,528					
1905		80	324,135		$800		369	
1906					800			
1907			1,766,770		720		6,187	
1908	10,000		2,031,486	$5,750			9,997	
1909	6,600		2,469,865	5,650			4,156	[1]$568,564
1910			3,204,278				5,372	
1911			2,997,072			$9,318	5,299	
1912			2,773,408			15,526	6,198	
1913			2,491,505			8,068	7,571	
1914			2,800,000			14,895	6,000	[2]2,377
1915			2,703,710			149,292	5,254	[2]4,174
Totals	$19,600	$830	$29,568,969	$11,400	$2,320	$197,094	$63,670	$575,115

[1]Unapportioned, 1900-1909.
[2]Platinum.

MINING DISTRICTS AND ACTIVE MINES.

The following mining districts listed by the United States Geological Survey,[1] with the addition of the Strawberry Valley district, are here outlined, together with the names of the active mines in them. Names of producing mines are *italicized.*

The **Browns Valley** district includes all quartz and placer mines along Browns Valley Ridge, 10 miles northeast of Marysville. Diabase and amphibolite schist are the prevailing rock formations. Active properties: None in 1916.

The **Brownsville** district includes all quartz, placer and drift mines in the region about Brownsville, which lies 34 miles northeast of Marysville and 36 miles east of Oroville. It includes Rackerby, Challenge and Woodleaf. The prevailing country rock is granodiorite and diabase. Active properties: B. A. C. Quartz Mine, Beehive or Mt. Hope Quartz,

[1]J. M. Hill, Mining Districts of the Western United States. U. S. Geol. Survey Bull. 507, pp. 112-13, 1912.

Beaver Quartz, Easy Money Quartz, Horseshoe Quartz, Santa Rosa Quartz.

The **Camptonville** district includes all quartz and placer mines in Yuba County east and south of the North Yuba River, in the region about Camptonville, 47 miles northeast of Marysville and 23 miles north of Nevada City. The prevailing country rock is granodiorite, diabase and amphibolite, slate, quartzite and limestone. Active properties: None.

The **Dobbins** or **Indiana Ranch** district includes all quartz and placer mines in the region about Dobbins, 30 miles northeast of Marysville. It includes Oregon House, Frenchtown and the region west of the Yuba and North Yuba Rivers. The prevailing country rock is gabbrodiorite and diabase. Active properties: *California Mother Lode,** Eich Quartz, Good Title Quartz, Red Cross Quartz.

The **Marysville** (Yuba Basin) district includes all placer and dredging property along the lower Yuba River. Alluvial sands and gravels are the mineral carriers. Active properties: *Marysville Dredging Co., Pacific Gold Dredging Co., Yuba Consolidated Goldfields Co., Marysville Sand Co., Pratt Building Material Co., Yuba River Sand Co.*

The **Smartsville** district includes all quartz and placer mines, in Yuba County, in the region of Smartsville, 27 miles east of Marysville and 14 miles west of Grass Valley. It also includes Waldo, or Cabbage Patch, and Sicard Flat. Diabase is the prevailing country rock. Active properties: *Boston Hill* or *Barton, Wheaton* or *Julius Cæsar, Alcalde* Placer, *Archimedes* Placer, *Industry Bar* Placer, Lone Tree Quartz.

The **Strawberry Valley**, or **Eagleville** district, includes all quartz and placer mines in Yuba County, in the region about Eagleville, Strawberry Valley and Clipper Mills, Butte County, and southward to the North Yuba River. Gabbrodiorite, slate, amphibolite and serpentine are the prevailing rock formations. Active properties: None.

The **Wheatland** district includes all placer mines in Yuba County along the lower part of Bear River. Alluvial sands and gravels are the mineral carriers. Active properties: None.

MINERALS AND MINES.

ASBESTOS.

Small amounts of amphibole slip-fiber asbestos occur in the serpentine areas of the northern portion of Yuba County. No deposits of commercial importance have been developed, but the following prospects and outcrops were noted:

1. Small seams in serpentine exposed in old hydraulic workings at Galena Hill, in Sec. 35, T. 19 N., R. 8 E., at an elevation of 2900 feet, on the property of W. S. Godfrey, of Camptonville.

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*Names of producing mines are *italicized*.

2. Small seams exposed in serpentine 1½ miles east of south of Challenge on Pike County Hill, at an elevation of 3000 feet. No work.

3. Small seams along contact between serpentine and slate in the shaft of the Mt. Hope quartz mine at an elevation of 3100 feet, in Sec. 8, T. 19 N., R. 7 E., near Challenge.

4. Small seams in serpentine in road-cut and old tunnel in Sec. 18, T. 19 N., R. 7 E., M. D. M., on road from Challenge to the Mt. Hope Mine.

5. Very small seams in serpentine exposed by hydraulic work in the old Kingbird drift mine in Sec. 36, T. 20 N., R. 7 E., M. D. M. Elevation 3800 feet near Clipper Mills, on patented land.

6. Small seams in serpentine in road-cut one mile west of Strawberry Valley.

7. The Butte County Pine and Hardwood Co. have sunk a 20-foot prospect shaft, one-half mile below the Mount Hope Mine, near the road to Orovile, at an elevation of 3000 feet. White slip fiber amphibole asbestos of fair quality occurs more or less irregularly along a serpentine-slate contact.

BAUXITE.

Bauxite has been reported[1] from the J. F. Dempsey Ranch, 2 miles southeast of Smartsville. Analysis of samples taken from the deposit have proved it to be only a white siliceous clay.

The deposit was encountered while running a 300-foot tunnel to cross-cut a supposed copper bearing ledge which carries pyrite only.

CLAY.

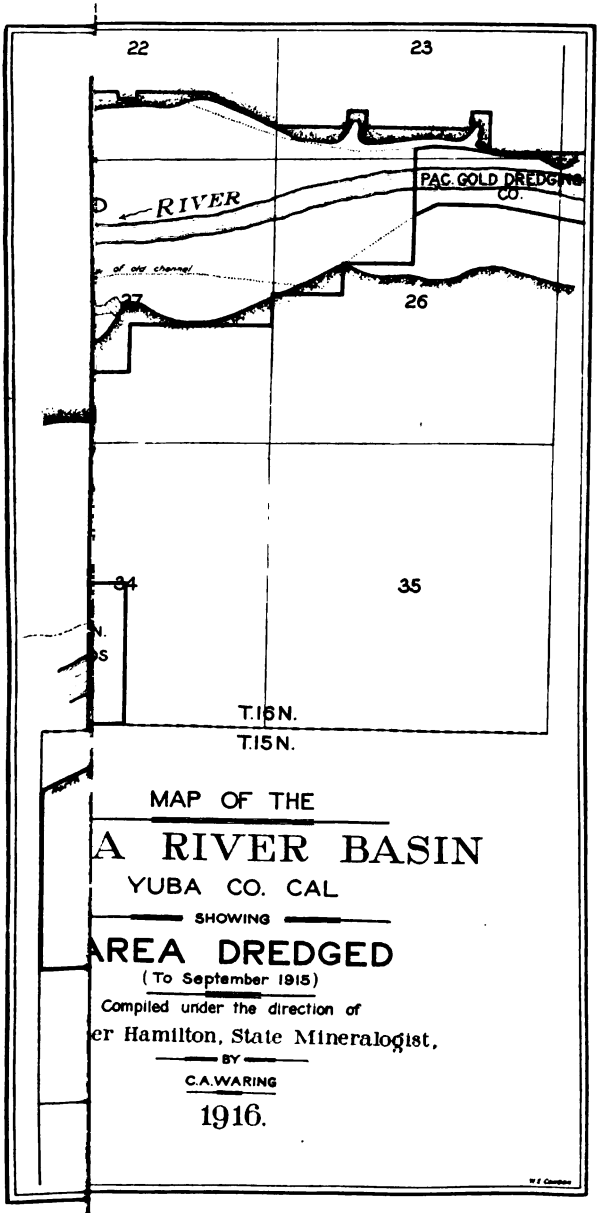
Shipments of clay were occasionally made, before 1905, by **D. P.** and **R. H. Durst,** of Wheatland, to Gladding, McBean and Company, of Lincoln, Placer County.

The black clay loam used was 6 feet deep and overlain by 18 inches of soil. Deposits similar to that on the Durst Ranch are abundant in the valley portion of Yuba County.

A siliceous, white clay, formerly reported to be bauxite, was taken from a tunnel on the **J. F. Dempsey Ranch,** 2 miles southeast of Smartsville. Kaolin to be used in the manufacture of fire brick has recently been reported to be shipped from the Dempsey Ranch, to Oakland.

COPPER.

The **Ayer Mine** on the Brady ranch, 4 miles west of Smartsville, is in Sec. 35, T. 16 N., R. 5 E., M. D. M., on patented land at an elevation of 300 feet. The ore consists of pyrite and chalcopyrite in a quartz vein. Some calcite is present. The vein is about 3 feet wide as exposed by the gossan and strikes N. 40° W. The dip is nearly vertical. A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RIVER
PAC. GOLD DREDGING CO.
of old channel
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MAP OF THE
A RIVER BASIN
YUBA CO. CAL
SHOWING
AREA DREDGED
(To September 1915)
Compiled under the direction of
er Hamilton, State Mineralogist,
BY
C.A.WARING
1916.

thirty-foot shaft has been sunk on the vein, which has walls of slate. Idle. Owned by Frederick Ayer, of Marysville.

A deposit of copper reported on the **John Dempsey ranch,** in Sec. 3, T. 15 N., R. 6 E., M. D. M., one mile south of Smartsville at an elevation of 750 feet, shows only pyrite. Prospecting for copper in 1911 by a 126-foot shaft and two 135-foot tunnels disclosed only sulphur and pyrite. The strong sulphuretted water of a spring near the mouths of the tunnels acts on scrap iron and leaves a deposit of ferrous iron, which oxidized to ferric iron and then to red iron oxide in a short time.

GOLD—DREDGERS.

Gold dredging along the Yuba River commenced in the latter part of 1903. Since operations began the gold production and number of dredgers operating each year is as follows:

Year	Amount	Increase+ or decrease–	Companies operating	Number of dredgers	Total dredgers
1903	$25,736	----------	W. P. Hammon and R. D. Evans	1	1
1904	74,263	+$48,527	W. P. Hammon and R. D. Evans	2	2
1905	188,967	+114,704	Yuba Cons. Gold Fields	8	8
1906	1,205,165	+1,016,198	Yuba Cons. Gold Fields	8	
			Marysville Dredging Co.	2	10
1907	1,688,032	+482,867	Yuba Cons. Gold Fields	10	
			Marysville Dredging Co.	2	12
1908	1,969,089	+281,047	Yuba Cons. Gold Fields	12	
			Marysville Dredging Co.	2	14
1909	2,441,919	+472,840	Yuba Cons. Gold Fields	12	
			Marysville Dredging Co.	2	14
1910	3,172,476	+730,557	Yuba Cons. Gold Fields	12	
			Marysville Dredging Co.	3	15
1911	2,964,737	—207,739	Yuba Cons. Gold Fields	11	
			Marysville Dredging Co.	2	13
1912	2,716,197	—248,540	Yuba Cons. Gold Fields	12	
			Marysville Dredging Co.	2	14
1913	2,420,455	—295,742	Yuba Cons. Gold Fields	10	
			Marysville Dredging Co.	2	12
1914	2,755,734	+335,279	Yuba Cons. Gold Fields	10	
			Marysville Dredging Co.	2	12
1915	2,676,090	—79,644	Yuba Cons. Gold Fields	10	
			Marysville Dredging Co.	2	12
1916	----------	----------	Yuba Cons. Gold Fields	11	
			Marysville Dredging Co.	3	
			Pacific Gold Dredging Co.	1	15
Total	$24,298,840	----------			

The map shows the area which has been dredged thus far.

The gold occurs in pay streaks in old river gravels which overlie a bedrock of volcanic tuff and are overlain by from 10′ to 40′ of hydraulic tailings. The bedrock lies from 30′ to 110′ from the surface and, as a rule, carries no values.

The Yuba River furnishes abundant water for floating the dredgers, which handle all the gravel and a few inches of the bedrock. The total gravel handled averages from 10¢ to 30¢ per cubic yard.

In 1916 there were two companies operating, with a third company building a dredger.

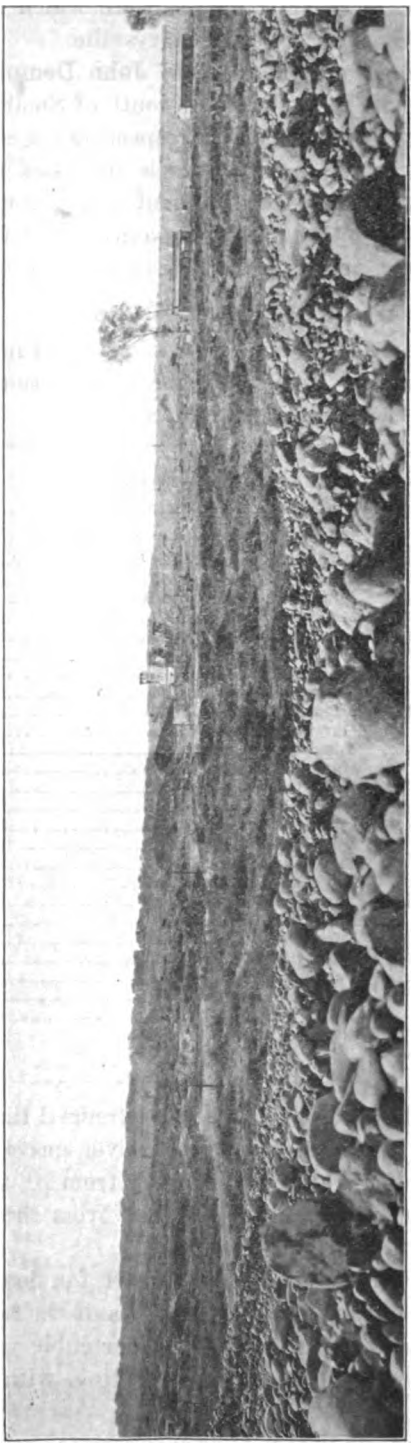

Photo No. 50. View northward showing Marigold dredgers Nos. 3 and 4 and new bunk houses and a portion of the area to be dredged.

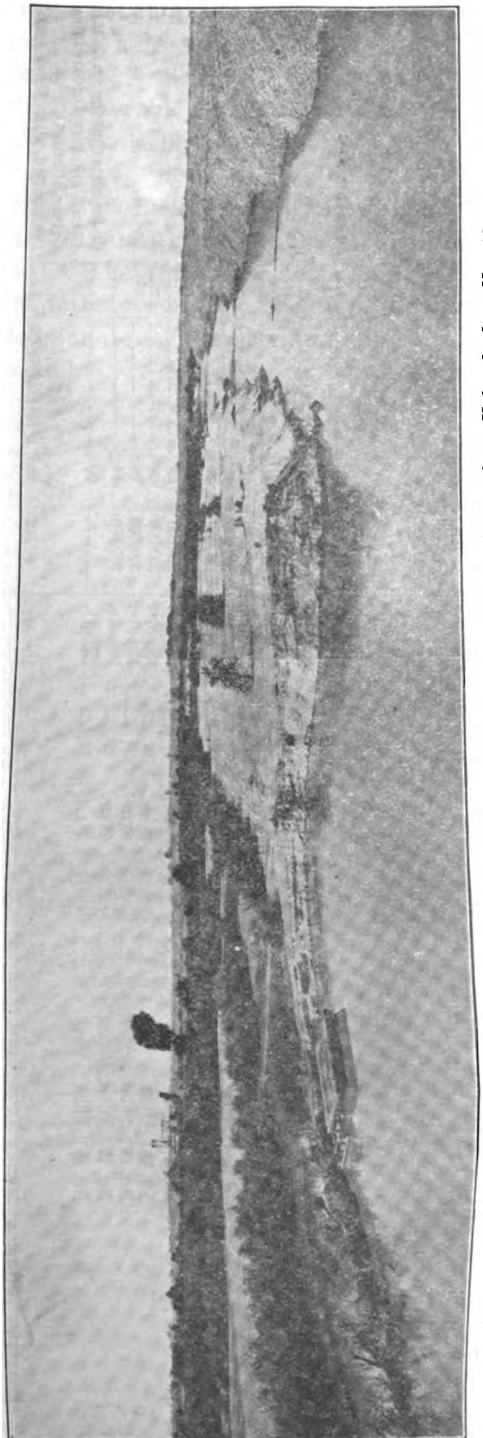

Photo No. 51. View southwestward, showing Yuba Consolidated dredger No. 13, from Yuba dredger No. 12.

Tabular History of Dredging in Yuba County Since its Beginning.

Company	Dredger No.	Type of construction	Year commissioned	Number and type of buckets	Bucket capacity, cubic feet	Rated capacity, horsepower	Type of screens	Dredger capacity, cubic yards in 30 days	Depth dredged below water line, feet	Acres dredged	Cubic yards dredged, bank measurements	Cost per cubic yard in cents	Remarks
W. P. Hammon and R. D. Evans.	Yuba No. 1	Bucyrus and Western Eng. Const. Co.	1903-4	-------	6	------	Shaking	----------	60	------	----------	------	Dismantled.
	No. 2	Bucyrus and Western Eng. Const. Co.	1904	-------	6	------	Shaking	----------	60	------	----------	------	Dismantled.
Yuba Consolidated Gold Fields. (Acquired holdings of W. P. Hammon and R. D. Evans.)	No. 3	Bucyrus and Boston Machine Shop Co.	1905	90 c.c.	7½	------	Revolv.	125,000	68	------	----------	------	
	No. 4	Bucyrus and Boston Machine Shop Co.	1905	89 c.c.	7½	------	Revolv.	125,000	64	------	----------	------	Rebuilt with steel hull, 1914.
	No. 5	Bucyrus and Yuba Gold Fields.	1905-6	89 c.c.	7½	------	Revolv.	125,000	64	------	----------	------	Dismantled.
	No. 6	Bucyrus and Yuba Gold Fields.	1905-6	89 c.c.	7½	------	Revolv.	125,000	64	------	----------	------	
	No. 7	Marion Machinery	1906	89 c.c.	7½	------	Revolv.	125,000	64	------	----------	------	
	No. 8	Marion Machinery	1906	89 c.c.	7½	------	Revolv.	125,000	64	------	----------	------	
	No. 9	Yuba Const. Co.	1907	95 c.c.	7½	------	Revolv.	125,000	65	------	----------	------	
	No. 10	Yuba Const. Co.	1907	95 c.c.	7½	------	Revolv.	125,000	65	------	----------	------	Burned.
	No. 11	Yuba Const. Co.	1908	96 c.c.	7½	405	Revolv.	125,000	65	------	----------	------	
	No. 12	Yuba Const. Co.	1908	91 c.c.	7½	------	Revolv.	125,000	65	------	----------	------	
	No. 13	Yuba Const. Co.	1910	89 c.c.	16	------	Revolv.	300,000	68	------	----------	------	
	No. 14	Yuba Const. Co.	1913	96 c.c.	17	------	Revolv.	300,000	78	------	----------	5.0	All steel hull.
	No. 15	Yuba Const. Co.	1916	98 c.c.	17	------	Revolv.	300,000	84	------	----------	------	
	No. 16	Yuba Const. Co.	1917	98 c.c.	17	------	Revolv.	----------	80	------	----------	------	Under construction Oct., 1916 (two stackers for dredging river channel).
Marysville Dredging Co.	Marigold No. 1	Yuba Const. Co. and Marion St. Sh. Co.	1906	93 c.c.	7½	320	Revolv.	90,000	60	59	5,260,000	------	Dismantled 1911. Used 6 yrs.
	No. 2	Yuba Const. Co. and Marion St. Sh. Co.	1906	93 c.c.	7½	320	Revolv.	70,000	60	31	2,830,000	------	Dismantled 1909. Used 4 yrs.
	No. 3	Marysville Dredging Co. and Union Iron Wks.	1909	84	9	455	Revolv.	204,000	65	121	----------	5.0	
	No. 4	Marysville Dredging Co. and Union Iron Wks.	1911	84	9	455	Revolv.	204,000	65	109	----------	5.0	
	No. 5	Marysville Dredging Co. and Union Iron Wks.	1916	87	16	872	Revolv.	400,000	68	6	----------	------	
Pacific Gold Dredging Co.	Pacific No. 2	Marion	1917	100	9	700	Revolv.	----------	70	------	----------	------	Building west of Park's Bar.

The **Marysville Dredging Company** is operating three dredgers northwest of Marigold, a dredging town 8 miles northeast of Marysville.

Dredgers Nos. 3 and 4 each have 84 9-cubic-foot buckets, and each handles about 2,500,000 cubic yards of gravel per year, covering an area of from 20 to 25 acres. They excavate to a depth of from 50′ to 80′, and operate on an average of about 88% of the time. The total cost of operation, material, labor, electricity, repairs, general expense (including depreciation and fixed charges), taxes and insurance, is less than 5¢ per cubic yard. The gravels are thought to average about 15¢ per cubic yard. The tailings conveyor belts last about 8 months. Electric power is used to operate each dredge and two shifts of 3 men each are employed. The tables are cleaned up every ten days.

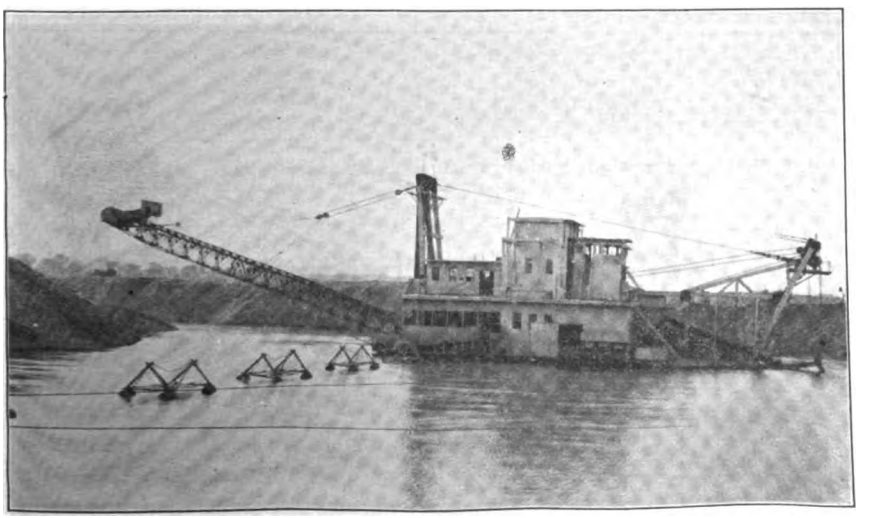

Photo No. 52. View northwestward of Marigold dredge No. 3, one mile northwest of Marigold, Yuba County. September, 1915.

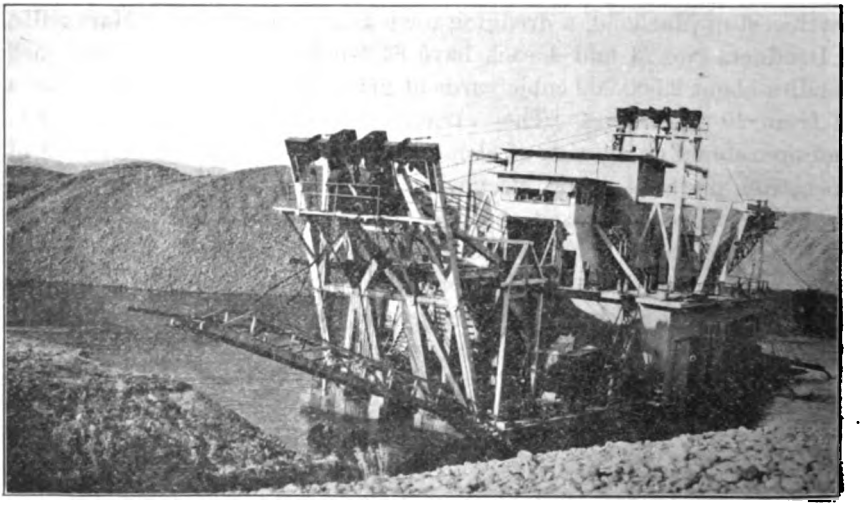

Photo No. 53. View northwestward of Marigold dredge No. 4, one mile northwest of Marigold, Yuba County. September, 1915.

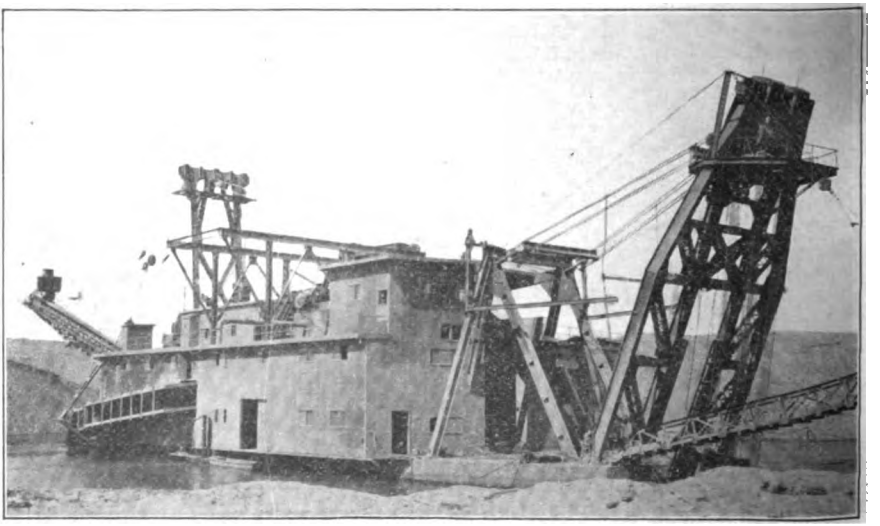

Photo No. 54. Marigold Dredge No. 5 operating at Marigold, Yuba County. September, 1916.

The company builds its own dredges, the machinery being furnished by the Union Iron Works, of San Francisco. The dredges complete cost about $200,000 each.

The head office of the company is at 14 Ashburton Place, Boston, Mass., and its president is F. Lothrop Ames. The local office is at Marigold, with Thos. D. Harris, manager, and A. D. Snodgrass, cashier.

The **Pacific Gold Dredging Company,** formerly the Yukon Gold Dredging Company, controlled by the Guggenheim Mining Syndicate, has secured about one and one-half miles along the Yuba River, extending from the property of the Yuba Consolidated Goldfields Company to the river narrows. It lies below the Parks Bar bridge in Sec. 25, T. 16 N., R 5 E., M. D. M., and is reached from the Browns Valley road.

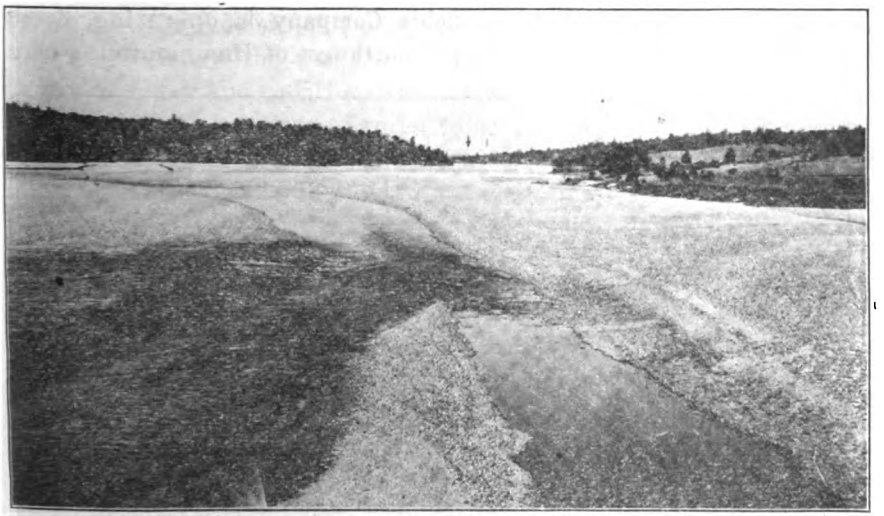

Photo No. 55. Gravel deposits, consisting of hydraulic tailings overlying pay gravels, in the Yuba River below Park's Bar Bridge. The arrow marks the location of the new Pacific dredger. September, 1916.

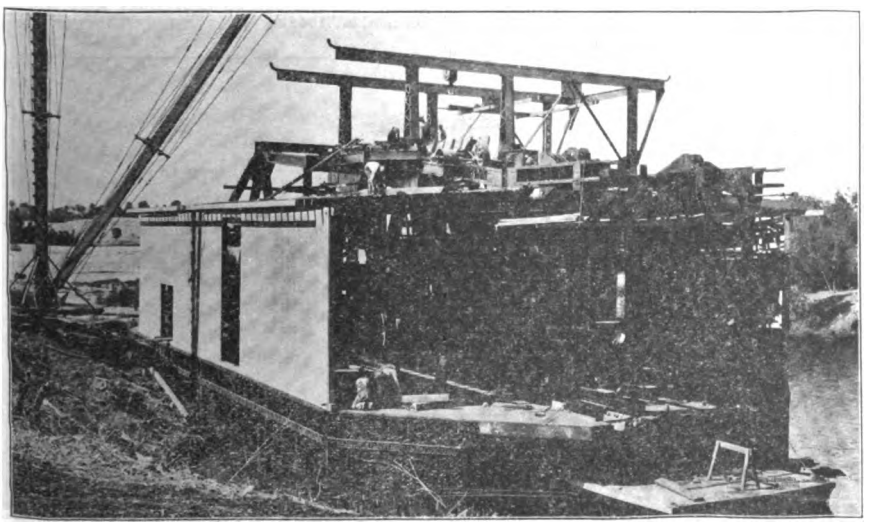

Photo No. 56. Pacific Gold Dredge under construction below Park's Bar Bridge on the Yuba River, Yuba County. September, 1916.

The company in September, 1916, had 50 men at work constructing a Marion type dredge with 100 9-cubic-foot close-connected buckets and revolving screen. The hull is 12′ deep, 60′ wide, and 135′ long. The boat will have a rated h. p. of 700 and will dig 70′ below the water line. The dredger will probably be running by 1917. R. Guggenheim, president, 417 Hobart Building, San Francisco; Chas. K. Lipman, secretary; H. C. Perring, superintendent, Marysville.

The **Yuba Consolidated Goldfields Company** is operating eleven dredges on their property north and northwest of Hammonton, a town

Photo No. 57. Yuba Consolidated dredger No. 13, one and one-half miles west of Hammonton. September, 1915.

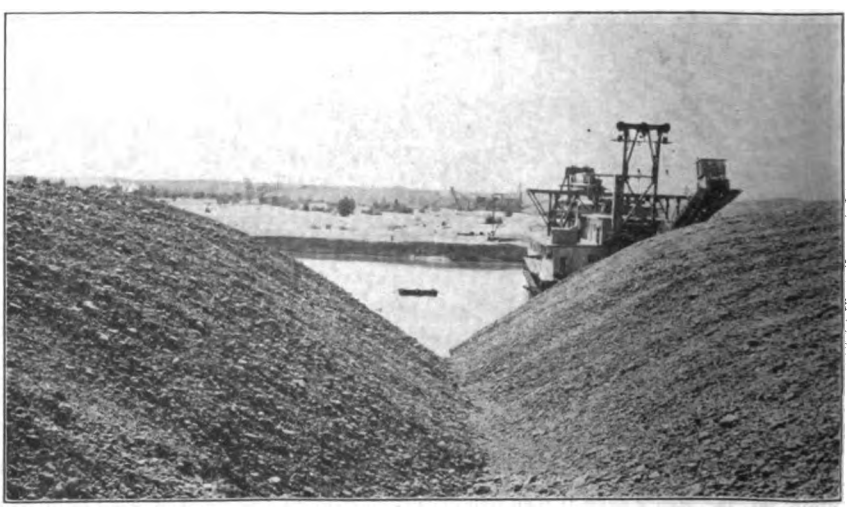

Photo No. 58. View westward from the tailings pile of Yuba dredge No. 14 in the foreground and Nos. 11 and 9 in the distance. September, 1915.

of dredging people named after W. P. Hammon. The property adjoins that of the Marysville Dredging Company to the north and northeast. The company owns the old settling basin south of Hammonton and also considerable land south of Browns Valley in the region of Dry Creek, all of which is dredgeable.

The eleven dredges are all run by electricity and were mostly designed and built by the Yuba Construction Company of Marysville. The latest dredges are now built with steel hulls, excavate to a depth of from 70′ to 80′ below the water line, handle about 10,000 cubic yards of gravel per day and cost from $300,000 to $500,000 each.

The yardage handled is figured from bank measurements since there is about 20% expansion while working. Recovery of values ranges between 70% and 100%. The total cost of operation runs slightly below 5¢ per cubic yard. The gold values average between 16¢ and 17¢ per cubic yard.

The dredger crews on the small boats consist of 1 dredgemaster, 1 winchman, 2 oilers and 1 helper. The large boats require an extra oiler. A repair crew of 25 men and a shop crew of 20 men are employed for the 11 dredges, besides teamsters, truckmen, etc. Wages are as follows: dredgemaster $150.00 per month, winchman $4.00 per day, oilers $3.00 per day, helpers $2.50 per day, shop men $2.50 to $5.00 per day.

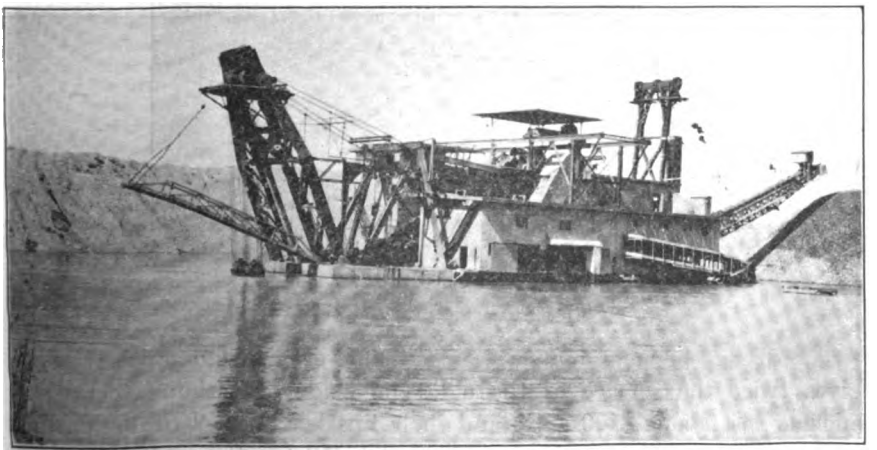

Photo No. 59. Dredger No. 14 of the Yuba Consolidated Goldfields working 2 miles northeast of Hammonton. September, 1915.

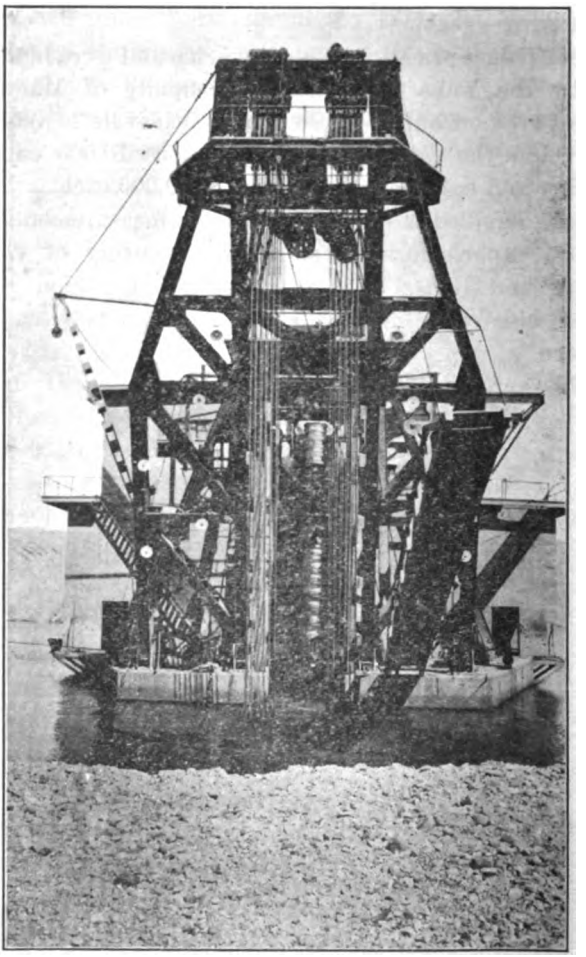

Photo No. 60. View of the bucket line of dredger No. 14 of the Yuba Consolidated Goldfields, 2 miles northeast of Hammonton.

The dredge buckets and screens are made of manganese steel, which gives twice the service of the old type made of carbon steel. The buckets cost about $400 each, and their lips last from 9 to 12 months. The tailings conveyor belts last from 8 to 12 months and cost about $11.00 per foot.

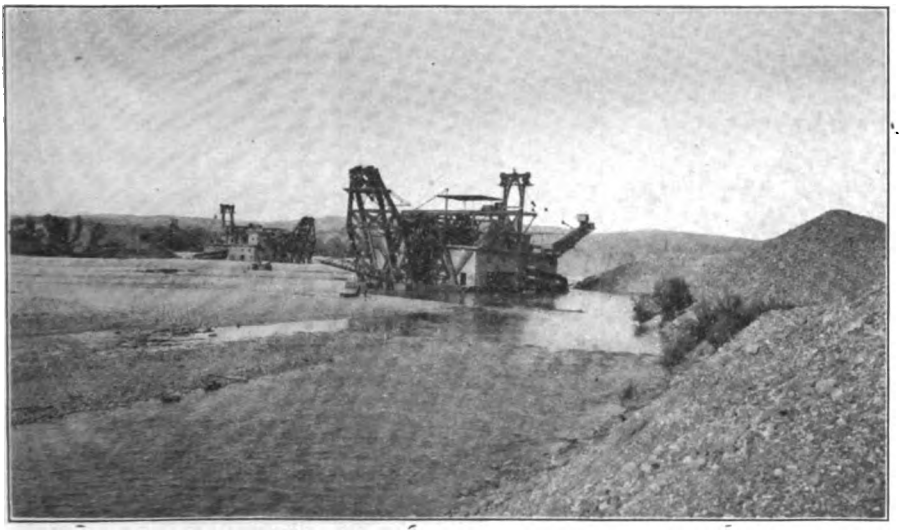

Photo No. 61. Dredgers Nos. 14 and 15 of the Yuba Consolidated Goldfields Company operating near Hammonton, Yuba County. September, 1916.

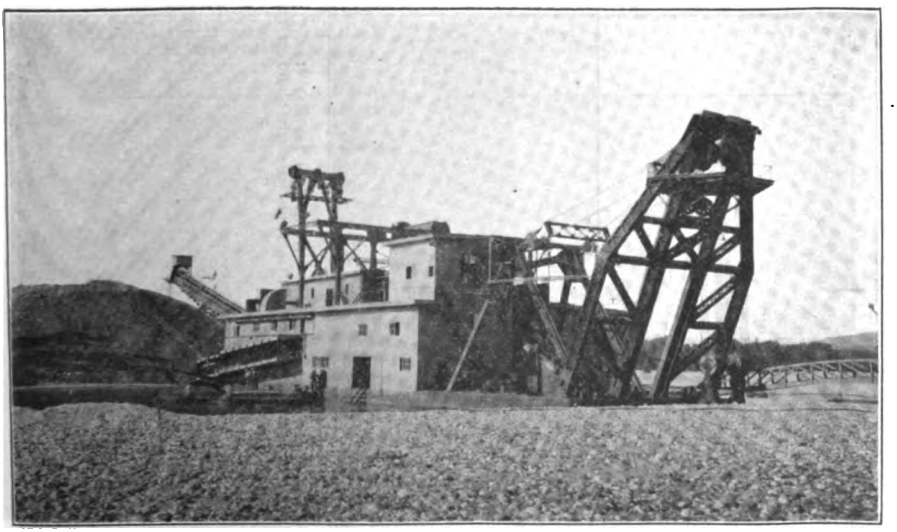

Photo No. 62. Dredger No. 15 of the Yuba Consolidated Goldfields Company, operating near Hammonton, Yuba County. The largest gold dredger in the world. September, 1916.

The Yuba Consolidated Goldfields Company is incorporated under the laws of the state of Maine. The officers are George L. Huntress, president; R. E. Paine, 50 Congress St., Boston, Mass., secretary-treasurer; W. P. Hammon, managing director; Newton Cleveland, Marysville, Cal., general manager.

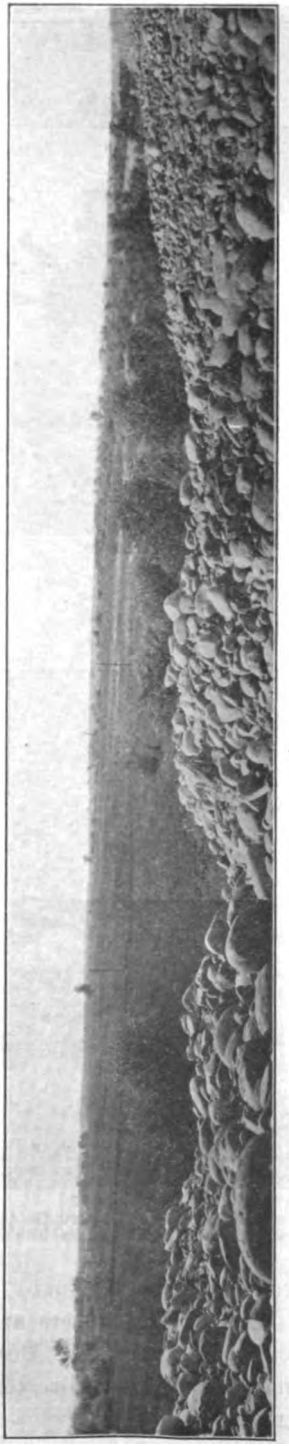

Photo No. 63. View westward towards Yuba dredgers (from right to left) Nos. 7, 8, 12 and 13 showing encroachment on agricultural land leaving boulder piles. In Sacramento and Butte counties such boulders are being crushed and sold for economic purposes.

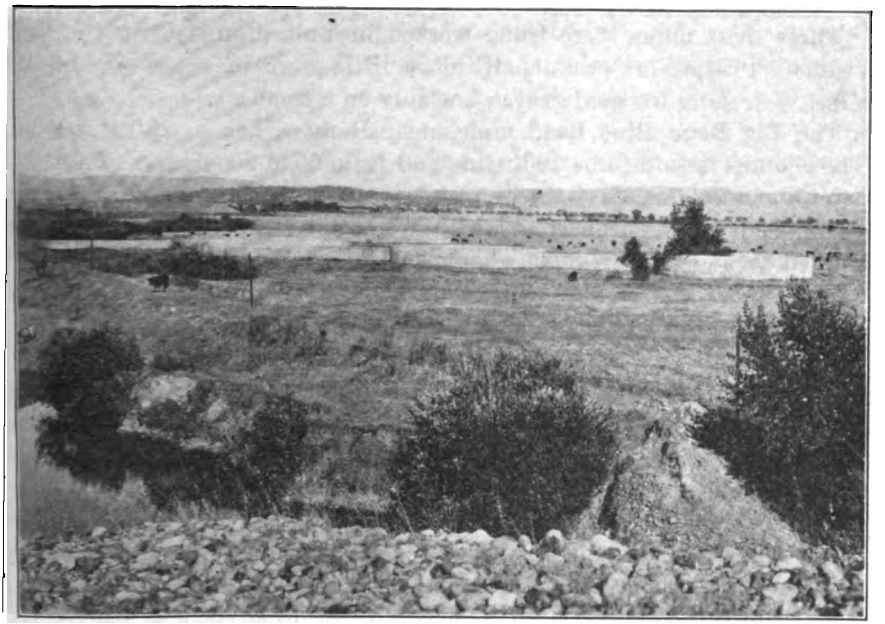

Photo No. 64. View eastward up the Yuba River, just north of Marigold, showing abandoned settling basin and concrete outlet intended by the Government to prevent floods. The dredge tailings form very effective barriers for flood control. The proposed settling basin will probably be dredged by the Yuba Consolidated Goldfields Company.

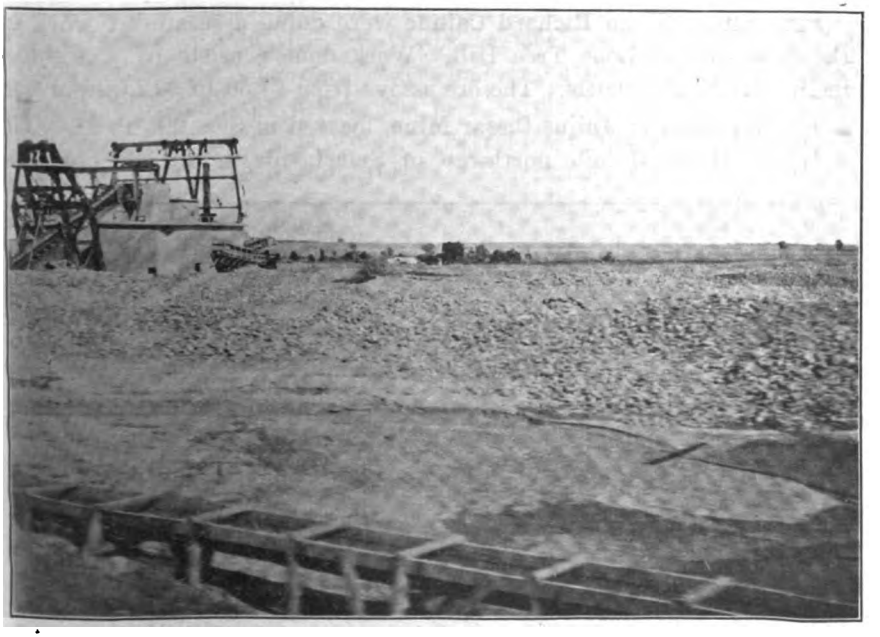

Photo No. 65. Reclaiming gold dredge, of the Natomas Consolidated of California, at Natoma. The tailings stackers of this dredge deposit the cobbles underneath and spread the silt on top—just the reverse of the old type dredgers. Photo by Walter W. Bradley.

GOLD—DRIFT MINES.

Three drift mines were being worked in Yuba County, at the time visited. Prospectors occasionally do a little work in some of the old mines, searching for gold gravel, but only on a small scale.

The **Big Bend Blue Lead** mine, near Bangor, has a 2500′ tunnel. The channel is said to be 100′ wide and from 5′ to 20′ deep. The 1080 acres includes the old Catskill property near the old Grove, Bishop, Reifus and Turner properties, which are on the same channel and were worked through shafts. The channel is supposed to be a continuation of the one at Smartsville. Owned by F. F. Ford and C. G. Fowler, of San Francisco.

The **Boston Hill** or **Barton Mine,** formerly known as the **Never-sweat,** is located in Sec. 36, T. 20 N., R. 7 E., M. D. M., near Clipper Mills in the Strawberry Valley district. The deposit consists of coarse gravel, overlain by andesite. Two tunnels have been run, a lower one 900 feet long and an upper one 300 feet. Improvements consist of a shop and a bunkhouse. The channel is thought to be the same as that at the Kingbird mine. Owned by C. F. Adams and Walter Walker, of Clipper Mills, who are working the mine.

The **Old Pittsburg Drift Mine,** in Sec. 17, T. 19 N., R. 8 E., M. D. M., near Camptonville on the North Yuba River, is worked occasionally during the winter by prospectors. It has been abandoned by the owners.

Paul Ehmann and **Richard Cainne** were doing assessment work on the west side of Lone Tree Hill. Work done consists of a 150-foot incline shaft with drifts. The ore assays from $1.50 to $12.00 per ton.

The **Wheaton** or **Julius Cæsar Mine,** located in Sec. 29, T. 16 N., R. 6 E., M. D. M., 1 mile northwest of Smartsville, is on the old Blue

Gravel property, leased from the Excelsior Water and Mining Company by Mr. A. G. Wheaton and son, of Smartsville. The mine is on the south side of a ravine near Sucker Flat, at an elevation of 600 feet.

Development consists of a 120-foot 45° incline shaft and drifts. Development work was being carried on when visited, and it was stated to pay for itself. Twelve cubic yards of gravel per day are hoisted in a 17 cubic foot skip. Pay gravel averages $1.50 per cubic yard. All work thus far has been carried on along the south rim. Three gravels are encountered: a soft, blue bedrock gravel averages about $3.00 per yard; a hard cement pay dirt averaging about $2.00 per yard; and a loose red gravel averaging about $1.00 per yard.

Equipment consists of a hoist and two 12-foot arrastras run by waterpower. Water is obtained from the Excelsior Water and Mining Company, through an 8-inch pipe, at 10¢ per miner's inch.

GOLD—HYDRAULIC MINES.

No hydraulic mining is now carried on in Yuba County. Antidebris legislation is too exacting to permit small owners to operate, since the dams required would probably cost more than could be realized from working the gravels. Some of the more important old mines which might be placed on a producing basis are as follows:

The **Bean Boys Mine,** located in the SW. ¼ of Sec. 1, T. 19 N., R. 7 E., M. D. M., near Clipper Mills, Strawberry Valley district. Elevation 3450 feet. The gravels are from 10′ to 12′ deep in a branch of the North Fork of Yuba River. Water was obtained from Hampshire and Grizzly creeks. A log dam 50 feet long and 4 feet high, which was constructed to hold the debris, has been washed out. A 75-foot head is obtained for the water which is carried through a 7-inch pipe to a 1½-inch nozzle on a canvas hose. The owner, Mr. Rufus Bean, of Clipper Mills, intends to reconstruct the dam and finish working out the gravels.

The **Deer Creek, Enterprise, Pittsburg** and **Smartsville Consolidated** hydraulic mines near Smartsville are all now patented property and owned by the Excelsior Water and Mining Company, of Sacramento. They have not been worked, save by prospectors and pocket hunters, in recent years.

Bibl.: Register of Mines in Yuba County, 1905, State Min. Bur.

The Golden Needle Mine, located in Sec. 34, T. 19 N., R. 6 E., M. D. M., Brownsville district, is patented and owned by Messrs. Pierce, Chadbourne, Woods and Dobbyns, of Brownsville. It is at an elevation of 2150 feet, and water is obtainable from the Forbestown ditch. The deposit consists of wash gravel carrying coarse gold. A log dam was built for holding the debris. Two nozzles can be used under an 80-foot head.

The **Horse Valley Mine,** in Secs. 34 and 35, T. 19 N., R. 8 E., M. D. M., near Camptonville, is controlled by a Mr. Leacher, from Pennsylvania. Elevation 2900 feet. Water is obtainable from Willow Creek. A tunnel has been run to obtain a grade for the sluice boxes. A cement debris dam is contemplated on Brandy Creek.

The **Kingbird Mine,** located on Sec. 36, T. 20 N., R. 7 E., in the Strawberry Valley district near Clipper Mills, is patented and owned by Messrs. E. H. Adams and R. Bean. Elevation 3800 feet. Water is obtained from Hampshire Creek. The old channel was 1,500 feet long and the loose gravel from 30 to 180 feet deep, has a bedrock of serpentine. A 14″ pipe was used to supply the monitors. Considerable tunneling was done. Idle.

The **Nevada Mine,** located in Secs. 8 and 9, T. 18 N., R. 8 E., M. D. M., in the Camptonville district, is patented and owned by R. H. and R. W. Postlethwaite, of San Francisco. Elevation 2000 feet. The gravel is 15 feet deep, with a two-foot capping of andesite. A 3-mile ditch carried water from a tributary of the North Yuba River and supplied 4 giants under a 400-foot head. Idle.

The **New Blue Point Gravel Mine,** leased by the Tar Mining Company, is owned by P. Campbell Estate, of Smartsville, and located near

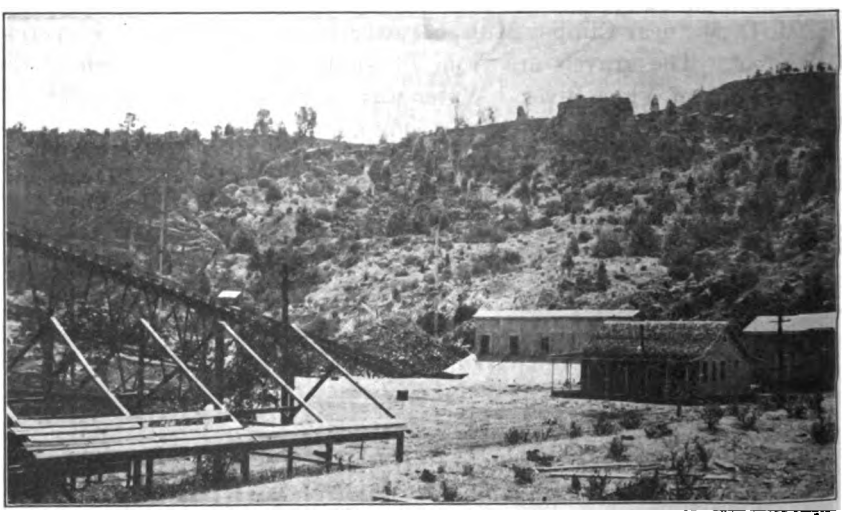

Photo No. 67. View of office, dredger and conveyor belt, also gravel slide which closed operations, at the property of the Tar Mining Company, Smartsville, Yuba County.

Sucker Flat one-half mile north of Smartsville. Elevation 600 feet. The company intended to hydraulic the gravel banks, use a dredger to catch the values, and stack the tailings with aerial trams. A large slide stopped operations, and it is thought that the values did not show up as expected.

Equipment consists of the following: one 8-inch and one 6-inch monitor to wash down gravels; 1500 feet of 36-inch pipe line; two large sectional hoists for boulders, made by the American Hoist and Derrick Company, St. Paul, Minn., capacity 30 tons each and run by electricity; Yuba Construction Company dredger with 7½-cubic-foot buckets; 2 1,500-foot aerial wire rope trams, built by A. Leachen & Sons Co., St. Louis, Mo.; office with concrete vault, draughting room, etc.

It is said that $600,000 worth of stock was sold, a large portion of which was invested in equipment. Idle.

The **Railroad Hill** property in Sec. 36, T. 19 N., R. 8 E., M. D. M., is two miles NW. of Camptonville at an elevation of 2800 feet. The gravel is 30 feet deep, with no capping. Water is obtainable from French Creek by a 2-mile ditch. This old property is sluiced occasionally by prospectors.

The **Union Mine** in Secs. 22 and 23, T. 19 N., R. 6 E., M. D. M., of the Brownsville district, is owned by the Union Gravel Mining Company of Brownsville. Elevation 2300 feet. Forty-acre patent. Water obtained by a ½-mile ditch from a tributary of the Yuba River, furnished one monitor under a 60-foot head. Idle.

The **Weeds Point Mine** is located in the NE. ¼ of the NW. ¼ of Sec. 35, T. 19 N., R. 8 E., M. D. M., two miles northwest of Camptonville. It was reported that preparations were being made in October, 1915, to build a concrete restraining dam for tailings so that the mine might be hydraulicked.

The **York Mining Company** operated on New York House Flat, 1½ miles west of Challenge, in Sec. 25, T. 19 N., R. 6 E., M. D. M. About 7 acres were hydraulicked and the property is said to be worked out. Idle. Owned by Mulberry Foss, Forbestown, Butte County, Cal.

GOLD—PLACER MINES (Surficial or Sluicing).

Considerable placer mining is carried on along the streams and ravines of Yuba County, particularly during the spring months. Following are the names of properties and parties operating in the fall of 1915.

The **Alcalde Placer** is in the bed of Yuba River about 8 miles northeast of Browns Valley. It is owned by W. R. Hendricks, of Browns Valley, and worked by B. A. Schubert, who took out about $150.00 in the summer of 1914.

The **Archimedes Placer** in the N. ½ of N. ½ of T. 16 N., R. 6 E., M. D. M., near Smartsville, is owned by E. A. Forbes, of Browns Valley. The property consists of a river claim in hydraulic tailings, worked with sluice boxes.

The **Boston Consolidated** which is owned by L. F. Pratt, George Hardy, Chas. Mason et al., includes the Boston Boys claim and others along the Yuba River northeast of Browns Valley.

The **Bright Star** is a river claim in the bed of Yuba River near Parks Bar Bridge in Sec. 20, T. 16 N., R. 6 E., M. D. M. Elevation 200 feet. Owned by W. J. Forbes, of Browns Valley, and J. E. Ebert, of Marysville. Sluice boxes are used. Reported sold to the Pacific Gold Dredging Co., in 1916.

The **George** placer is in Sec. 17, T. 18 N., R. 7 E., M. D. M., 3 miles north of Dobbins. The placer is on a 160-acre patent, at an elevation of 2250 feet. The ground is sluiced in a deep ravine, a branch of Labadie Creek, during the rainy season. The loose gravel varies from 2 feet to 20 feet in depth. The bedrock is rough and the gold is coarse. The large bowlders are piled along the center of the ravine. Owned by M. E. George, of Dobbins, who works the deposit in the winter time.

The **Industry Bar** placer lies 10 miles northeast of Browns Valley and 2½ miles above the Alcalde Placer. It is just above the mouth of Keystone Ravine on the south side of Yuba River. The river bed is worked every summer.

The **Landers Bar** placer adjoins the Alcalde placer to the south and lies 7 miles northeast of Browns Valley, just above the narrows of Yuba River. It adjoins the property of the Pacific Dredging Company to the south and includes the full width of the river. The gravels are from 30′ to 40′ deep, including an overburden of hydraulic tailings. Owned by B. A. Schubert, of Browns Valley.

Placering in gravels west of **Smartsville** is being carried on by Mr. Spencer and others of Smartsville.

Idle placers follow:

Fillmore Hill, SE. ¼ of SW. ¼ of Sec. 29, T. 16 N., R. 6 E., M. D. M., near Smartsville. Owned by the S. O. Gunning Estate, of Marysville.

Forbes, in Secs. 8, 10, 11, 14, 15, 16 and 17, T. 16 N., R. 6 E., M. D. M., near Smartsville, owned by E. A. Forbes, of Browns Valley.

Golden Gate, in SW. ¼ of NE. ¼ of Sec. 34, T. 16 N., R. 6 E., one mile south of Smartsville, owned by the Excelsior Water and Mining Co.

Lone Cedar, in Sec. 4, T. 17 N., R. 6 E., M. D. M., near Oregon House.

Lone Jack, in Sec. 16, T. 16 N., R. 5 E., M. D. M., near Browns Valley.

Joe Losey, in SE. ¼ of NE. ¼ of Sec. 19, T. 16 N., R. 6 E., near Browns Valley. Forty-acre patent. Raised benches above the Yuba River. Gravel 4 feet to 100 feet. One-quarter mile back from river on the hillside. Owned by Joe Losey.

Montclair in the W. ½ of the SW. ¼ of Sec. 21, T. 16 N., R. 6 E., M. D. M., 1½ miles NW. of Smartsville in the bed of Yuba River. Idle.

Mosquito, 6 miles SE. of Brownsville in the Dobbins district. Prospected only by the owners, C. E. Morey and John Nelson, of Dobbins.

GOLD—QUARTZ MINES.

The quartz veins of Yuba County have yielded many rich pockets of free gold and have furnished the gold which is now being placered and dredged in the river channels. The county offers considerable opportunity for prospectors and pocket hunters, and certain groups of veins could no doubt be worked profitably and milled. Since the presence of considerable copper with the ores makes cyaniding unprofitable, some flotation system would seem more feasible.

Abbot Mine. Brownsville district. In SW. ¼ of Sec. 8, T. 18 N., R. 6 E., M. D. M., at Rackerby. Elevation 1430 feet. Patented 159 acres. Three-foot quartz vein, carrying 5% sulphurets, at granite-porphyry contact. Strike W. 40° E. Dip 70° NW. a 65-foot 2-compartment shaft follows the vein from the surface. Equipped with old head frame. About 100 tons are reported to have been taken out and milled at the Santa Rosa mine. The ore milled about $5.00 per ton. Mine has not been worked since 1906. Owned by N. B. Abbott, of Rackerby.

Albion King Mine. Smartsville district. One-half mile NW. of Waldo in Sec. 33, T. 15 N., R. 6 E., M. D. M. Elevation 500 feet. Patented. Two-foot quartz vein along contact of porphyry with slate. Strike N. 45° W. Dip 45° W. Open cut 40 feet. Idle for three years. Owned by Wm. B. Ross, of Waldo.

Arbucco Mine. Brownsville district, 1½ miles NE. of Challenge in Sec. 16, T. 19 N., R. 7 E., M. D. M., on road from Woodleaf to the Mt. Hope Mine. Patented. Elevation 3000 feet. Three-foot vein of ribbon quartz at contact of serpentine with granite. Strike N. 30° E. Dip 45° N. Workings caved. Idle for years.

B. A. C. Mine. Brownsville district. One mile north of Brownsville in Sec. 26, T. 19 N., R. 6 E., M. D. M. Elevation 2600 feet. Patented 224 acres, with a good stand of pine, fir, spruce and cedar. Water is obtainable from the South Feather Ditch Company, but the mine makes enough water for present operations. Four-foot quartz vein, wih free gold and pyrite, in diabase. Strike N.–S. Dip 41° E. Two hundred and fifty-foot incline shaft. Six hundred feet of N.–S., drifting on 110-foot level. Hand drilling. Steam power. Wood costs $2.25 per cord. Equipment consists of hoist, jaw crusher, 5-stamp mill with 12-mesh screens, ball-mill, amalgamation tank, two 3-foot diameter x 10-foot depth agitating tanks and zinc precipitating cones.

The cyanide plant was being installed when visited in August, 1915. When operating it was expected to employ about 20 men in the mine and 10 men on the surface in 3 shifts. Miners receive $3.00 per day.

The ore is said to average $12.00 per ton. Operations reported to have closed down in October, 1915, to develop more ore.

Owned by J. H. Batcher, W. S. Graham, B. F. Hartley and Mrs. B. A. Campbell, who are called W. S. Graham and Co., with home office at Brownsville. J. C. Campbell, mine superintendent.

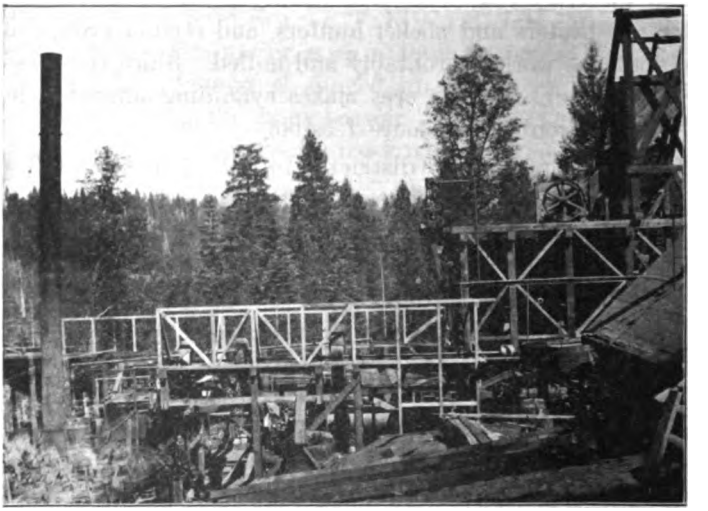

Photo No. 68. View northward of the mill and cyanide plant of the B. A. C. mine at Brownsville, Yuba County.

Beehive or **Mount Hope Mine**. Brownsville or Mount Hope district. Sec. 8, T. 19 N., R. 7 E., M. D. M., two miles south of Woodleaf on main road from Woodleaf to Oroville. Elevation 3050 feet. Four claims, one of which is patented. Eighty acres. Four-foot to 6-foot vein of ribbon quartz, carrying pyrite, along contacts of quartz diorite and schist. Strike N. 80° E.; dip 45° E.; 200-foot incline shaft; 150 feet of drifting on the 100-foot level. New 400-foot tunnel being run for drainage is now 300 feet long. Hand labor, steam hoist and air compressor; 4-foot wood for fuel costs about $3.50 per tier. Mill includes eight 750-lb. stamps, 2 amalgamation tables and one Frue concentrator.

When visited in September, 1915, the incline shaft was caved at a depth of 20 feet, and some work had recently been done to open it up. The machinery was in fair condition, but the buildings were beginning to go to pieces. Owned by Mrs. M. A. G. Blake, of Oakland. Leased on May 15, 1914, to J. D. Johnston, of Newport, Rhode Island, and David T. Graham, of Glendale, Los Angeles County, Cal.

Bibl.: Rep. XIII, p. 501; XII, p. 317.

Beaver, Union, Cassa or **Golden Mary Mine.** Brownsville district. W. ½ of Sec. 34, T. 19 N., R. 6 E., M. D. M., 1½ miles southwest of Brownsville. Elevation 2450 feet. Claims: Golden Ribbon, G. R. South Extension, G. R. North Extension, Big Oak, Big Oak North Extension, Grey Bonnet, Grey Bonnet North Extension, Grey Bonnet North Fraction. A 6-foot quartz ledge carrying pyrite and chalcopyrite at contact of granite and porphyry. Strike N. 15° W.; dip 38° W.; 170-foot incline shaft. Drifts: N. 165′ on 100-foot level; SW. 114′ and S. 100′ on 100-foot level; 83′ N. on 133-foot level. About 80 feet of cross-cutting has been done on the surface. Hand drilling. Ore hoisted in bucket drawn by 40 h. p. Standard Distillate engine. One Joshua Hendy crusher, one 5-foot Huntington mill, with 16-inch rolls and one 4-foot x 10-foot amalgamation table. Two miners and a hoistman employed. The tailings are turned into a small creek near by. There is considerable pine, fir, spruce and cedar on the property. Water is obtained from the Forbestown Ditch at $0.10 per miner's inch. Owned by C. C. Beaver, of Browns Valley. Leased by the Cassa Gold Mining Co., of which Mr. McAnnini is president, and George Gale, 423 Coe Building, San Francisco, secretary-treasurer. Mr. W. A. Saunders, of Oakland, is superintendent.

Bibl.: Rep. XIII, p. 500, 1896.

Bessie Mine. Browns Valley district. One-half mile north of Browns Valley in Sec. 16, T. 16 N., R. 5 E., M. D. M. Elevation 270 feet. Patented. A 3-foot quartz vein carried some free gold in places. Strike N.–S.; dip 35° W.; 40-foot incline shaft; 100 feet of drifting. Owners hoped to run into Flag vein towards which the Bessie vein was thought to dip. Assessment work only. Owned by Byron Burris, of Browns Valley.

Bismark Prospect. Smartsville district. One-half mile south of Waldo in Sec. 33, T. 15 N., R. 6 E., M. D. M. Elevation 400 feet. Patented. Tunnel 550 feet. Greatest vertical depth 200 feet. Work was discontinued before the ledge was struck. Idle for 15 years. The ore shows a few colors by panning.

Black Maria. Smartsville district. SE. corner of Sec. 20, T. 16 N., R. 6 E., M. D. M., 2 miles northwest of Smartsville. Patented. Elevation 350 feet. Eighteen inch quartz vein in slate. Strike N. 20° W.; dip 40° SW.; 40-foot shaft; 175 feet of drifts. Idle. Owned by S. O. Gunning Estate, Marysville, Cal.

Boa Prospect. Smartsville district, 2 miles northwest of Smartsville, in Sec. 29, T. 16 N., R. 6 E., M. D. M. Elevation 650 feet. Four-foot quartz vein in slate carries sulphurets. Strike N. 45° W.; dip 50° SW.; 100-foot shaft. Idle for seven years. Abandoned by M. C. Meeker, of Camp Meeker, Sonoma County, Cal.

Bibl.: Rep. XIII, p. 499.

Bullard's Bar Prospect. Dobbins district. Six miles northwest of Dobbins in NW. ¼ of Sec. 13, T. 18 N., R. 7 E., M. D. M. Elevation 1900 feet. Patented. Eighty-five-foot quartz vein at contact of granite and slate. Strike N.–S.; dip 45° E.; shaft 15 feet; tunnel 155 feet. Owned by George A. Mix, of Bullard's Bar, and bonded to C. L. Crane. Idle.

Burns Prospect. Smartsville district. Three-quarters of a mile northeast of Smartsville. Elevation 500 feet. Three-foot quartz vein in slate. Strike NW.–SE.; dip NE.; 50-foot shaft; 200-foot tunnel. Assessment work only. Owned by J. Burns, of Smartsville.

Bibl.: Rep. XIII, p. 499.

California Mother Lode or **Eagle Gold Mine.** Indiana ranch district, 32 miles northeast of Marysville; 2 miles northwest of Dobbins.

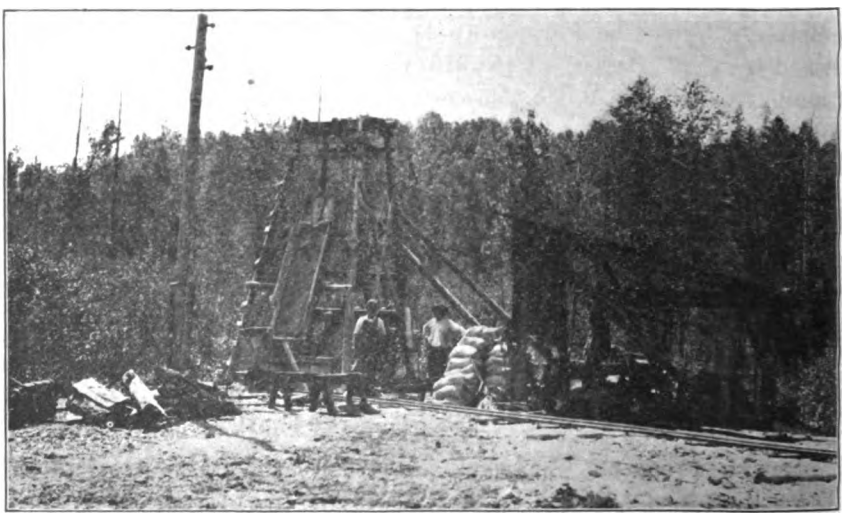

Photo No. 69. New work on the Mother Lode vein at Indiana Ranch, near Dobbins, Yuba County, California.

Elevation 1860 feet. Twelve claims, including the Eagle Gold, Delaware and Frisco Fraction. Two hundred and forty acres. The Mother Lode vein averages about 3 feet in width and can be traced on the surface for about a mile, along a slate-diabase contact. It has several parallel stringers, and strikes N.–S., with a dip of about 65° to the east. The ore carries free gold, pyrite, arsenopyrite, chalcopyrite and tellurides.

The old workings, where most of the work has been done, were idle when visited in August, 1915. The equipment consisted of electric hoist, 10-stamp mill and tube mill. The old shaft is 300′ deep and has five levels at 65′, 100′, 140′, 200′ and 300′. The tailings are impounded.

A new 60-foot vertical shaft with 160-foot drift to the south was being worked near Indiana Creek when visited. Six men were employed, 2 on the surface and 4, in two 8-hour shifts, underground. A 20-foot hoist, with 20 h. p. motor, air compressor and one air drill were being used. Miners received $3.50 and did about 4 feet of development work per day. The new workings make about 75 inches of water. Power is furnished by the Colgate line, and costs about $.06 per k. w. h. The ore is hauled to Marysville by a 3-ton Packard truck. Considerable pine, fir, cedar and spruce grow on the property. Owned by the California Mother Lode Mining Co., of San Francisco; president and manager, W. C. Wilkins; treasurer, C. S. Brooks; mine superintendent, F. L. McPherson, Dobbins, Yuba County, Cal.

Chandler Mine. Brown's Valley district. Two miles south of Browns Valley in Sec. 22, T. 16 N., R. 5 E., M. D. M. Elevation 200 feet. Patented 160 acres; 30 feet of vertical shaft. A rich pocket was worked out with horse whim about 30 years ago. Idle. Owned by August Eymard, of Browns Valley.

Cleopatra Prospect. Smartsville district. In Secs. 28 and 29, T. 16 N., R. 6 E., M. D. M., one mile northwest of Smartsville. Elevation 550 feet. Patented in 1914. A 4-foot quartz vein, in diorite, carries free gold. Vein strikes N. 45° W. and dips 45° SW.; 45-foot shaft. Idle. Owned by Chas. F. Ayer, Boston, Mass.

Conwell Prospect. Indiana ranch district. Sec. 23, T. 18 N., R. 7 E., M. D. M., 4 miles northeast of Dobbins. Adjoins the Summit Hill mine to the north; 90-foot incline shaft. Idle for 30 years.

Dakota Prospect. Brownsville district. One and one-half miles northwest of Brownsville. Idle for 20 years. Property now homesteaded by C. C. Beaver.

Dannebrog Group. Browns Valley district. In Sec. 16, T. 16 N., R. 5 E., M. D. M., at Brown's Valley. Elevation 250 feet. Patented. Thirty-inch quartz vein carrying free gold, pyrite and chalcopyrite in diabase, strikes N. 35° W.; 900-foot incline shaft on vein; 1000 feet of drifting. Idle for 20 years. Owned, together with the adjoining, idle, Hawkeye and Pennsylvania mines, by the Rideout Bank, of Marysville.

The Hawkeye is opened up by 25′, 40′ and 50′ shafts with 200′ of drifting, and showed an 18″ to 2′ vein of free milling quartz; about 400 tons were milled in the Pennsylvania mill.

The Pennsylvania Mine has a 180-foot shaft near the old mill. Three ledges are said to have been followed in a 100-foot fissure. Equipment consists of a ten-stamp mill and one Baer Mill. Idle for three years. The ore is said to have run from $7.00 to $500 per ton. The property was turned over to the Rideout Bank by F. W. Johnson, of Marysville.

It is thought, by the owners, that the property could be worked at a profit under good management.

Bibl.: Rep. XIII, pp. 499–500, 1896.

Deadwood or Miller Prospect. Brownsville district. Secs. 15 and 16, T. 19 N., R. 6 E., M. D. M. Three miles NW. of Brownsville. Elevation 2660 feet. A 5-foot quartz vein. Strike NE.–SW.; dip SE. Several shallow shafts. Idle. Owned by C. W. Roberts and Mr. Frye, of Forbestown, Butte County.

Easy Money Prospect. Brownsville district. In Sec. 19, T. 19 N., R. 7 E., M. D. M. One mile northwest of Challenge. Elevation 2600 feet. Quartz vein strikes N. 25° W. and dips 70°W. Three hundred and fifty-foot tunnel being driven to drain 40-foot shaft. All hand labor by leasers. The 350-foot tunnel cut a 5-foot quartz ledge at 310 feet. On land of Southern Pacific railroad company. Two claims, the Easy Money and Easy Money Extension; owned by Mr. Harvey, of Brownsville. Work being done for one-half interest by F. Foster and T. Reis, of Challenge.

Eich Prospect. Indiana ranch district, near Oregon House. Eight-inch quartz vein. Strike N.–S. Dip 50° W. Outcrops on surface for 300 feet; 10-foot shaft. Hand labor with windlass. Patented 680 acres. Owned by Mrs. Kate Eich and two sons, A. J. and H. D. Eich, of Oregon House.

Fairview Prospect. Browns Valley district. Sec. 9, T. 16 N., R. 5 E., M. D. M., one mile northwest of Browns Valley. Elevation 350 feet. Three-foot quartz vein, in porphyry, carrying free gold. Strike N.–S. Dip 45° W.; 35-foot shaft; 30-foot drift. Idle for several years. Owned by Whittier and Stevens, of Browns Valley.

Garbet Prospect. Brownsville district. East of Santa Rosa Mine and northeast of Rackerby. A 2-foot quartz ledge. Ore said to have milled $6.00 per ton. Owned by Mr. Garbet, of Rackerby.

George Prospect. Indiana ranch district. Sec. 17, T. 18 N., R. 7 E., M. D. M., three miles north of Indiana Ranch. Elevation 2250 feet. Patented 160 acres. Pine, spruce, and cedar on property. A 30-inch quartz vein, in granite, carrying free gold and pyrite. Strike NE.–SW.; dip 45° E. Shaft 14-foot. Hand labor. Owned by M. E. George, of Dobbins.

Golden Key. Brownsville district. In SW. cor. Sec. 33, T. 19 N., R. 6 E., M. D. M., 1½ miles NE. of Rackerby. Elevation 2300 feet. Patented. A 2-foot quartz vein at diorite-porphyry contact. Strike E.–W.; dip vertical; 60-foot open cut; 30-foot and 50-foot shafts. Idle for over 14 years. Owned by W. J. Mellon, of Challenge. Leased to G. S. Peynton, of the Santa Rosa Mine.

Good Hope. Smartsville district. Sec. 34, T. 15 N., R. 6 E., M. D. M., ¾ mile southeast of Waldo. Elevation 400 feet. An 18-inch quartz vein along slate-porphyry contact. Strike N. 45° W.; dip 45° SW.; 150-foot shaft. Old four-stamp mill. Idle. Owned by Mrs. Eva C. Sanford, of Waldo.

Good Title or **Templar No. 1.** Indiana ranch district. NW. corner of Sec. 20, T. 18 N., R. 7 E., M. D. M., 3 miles northwest of Dobbins. Elevation 2150 feet. Patented. A 30-inch quartz vein carrying 1% sulphurets. Old workings caved. Seven hundred-foot lower tunnel open and being worked by Mr. Williams and two sons. Hand labor. Water power in winter and 8 h. p. gas engine in summer. Mill with two 275-pound stamps, built by Union Iron Works, has a capacity of 3 tons in 24 hours. Cyanide tank with one ton capacity every six days. Owned by T. J. Williams and two sons and sister-in-law, of Dobbins.

Hansonville Mine. Brownsville district. Secs. 5 and 8, T. 18 N., R. 6 E., M. D. M., ¼ mile east of Rackerby. Patented. A 3-foot quartz vein, carrying 3% sulphurets, along contact of serpentine and porphyry; 220-foot shaft; 40-foot incline, 475-foot drift. Idle. Owned by Mrs. Pierce, of Brownsville; L. A. Wyman, of Boston, Mass., agent.

Hibbert and Burris. Browns Valley district. In Sec. 16, T. 16 N., R. 5 E., M. D. M., ¼ mile northwest of Browns Valley. Patented. A 4-foot quartz vein in diorite. Strike E.–W.; dip 40° N.; 170-foot shaft; 360-foot tunnel. Idle. Owned by B. Burris and Mrs. E. Hibbert, of Browns Valley.

Higgins or **Elk Prospect.** Dobbins district. In Sec. 19, T. 18 N., R. 7 E., M. D. M. Elevation 2300 feet. The 5-stamp mill stood near the California Mother Lode tailings pile and has not worked for 20 years. A pockety quartz vein varying from 1′ to 9′ in width has a strike NE.–SW., and dipped nearly vertical. Owned by the Elk Gold Mining Co., but reported to have been relocated by S. Bishop and F. L. McPherson, of Dobbins.

Hillside Prospect. Dobbins district. Sec. 23, T. 18 N., R. 7 E., M. D. M. Four miles northeast of Dobbins. Elevation 2750 feet. Patented. An 18″ to 2′ quartz vein, carrying pyrite and chalcopyrite. Strike N. 45° W.; dip vertical; 60-foot incline shaft. Idle for 6 years. Owned by R. L. Hill, Jr., 1169 Broadway, Oakland, Cal.

Horseshoe. Brownsville district. SW. cor. Sec. 21, T. 19 N., R. 7 E., M. D. M., 1½ miles northeast of Challenge. Elevation 3200 feet. Patented. Eighteen-inch vein of ribbon quartz, carrying free gold, in schist. Strike N.–S.; dip 75° W.; 90-foot shaft and 450-foot drainage tunnel. Pine, fir, and cedar on property furnish fuel at $3.50 per tier. Equipment consists of a Joshua Hendy boiler, Ingersol-Rand air compressor, one 2¾ inch cylinder Ingersol-Rand butterfly drill. Seventy-

five pounds air pressure is used. Three men employed. Owned by Fred C. Clemens and Mrs. Addie Clemens, of Challenge, and Joseph Supple, of Oregon.

Jefferson Mine. Browns Valley district. SE. cor. Sec. 16, T. 16 N., R. 5 E., M. D. M., ¼ mile south of Browns Valley. Elevation 250 feet. Patented. A 12-foot quartz vein in diabase. Strike N. 10° W.; dip 45° E.; 800-foot incline; 1500 feet of drifting. Said to have paid $3,000,000 in dividends down to the 600-foot level. Idle. Owned by F. W. Johnson, of Marysville.

Bibl.: Reps. XIII, p. 501; XII, p. 321.

Last Chance or **Dexter.** Browns Valley district. In Sec. 16, T. 16 N., R. 5 E., M. D. M., ¾ mile NW. of Browns Valley. Elevation 320 feet. A 6″ to 2′ quartz vein, carrying free gold and sulphides, along diorite-porphyry contact. Strike N.–S.; dip 45° W.; 90-foot shaft. Mill with five 800 lb. stamps run by 20 h. p. gas engine. Owned by Chas. Yates et al., of Marysville.

Leal Prospect. Brownsville district. In Sec. 26, T. 19 N., R. 6 E., M. D. M., ½ mile west of north of Brownsville, near the Leal sawmill. Elevation 2500 feet. Patented 120 acres. Quartz vein 200 ft. long in diabase carries sulphides; 20-foot shaft on a pocket from which it is said $2,000.00 has been taken out. Owned by M. Leal, of Brownsville.

Lillian Francis or **Scott Mine.** Indiana ranch district. Sec. 30, T. 18 N., R. 7 E., M. D. M. Elevation 1700 feet. Patented 156 acres. Two quartz veins, called the Scott and South Scott, lie along the contact between serpentine and porphyry and vary from 18 inches to 30 inches wide. Strike N.–S.; dip vertical. Hoist run by 8 h. p. gas engine. Pump run by 20 h. p. steam engine. Two-stamp mill run by 20 h. p. gas engine. Tailings impounded.

Assays of the ore are as follows:

1	Gold,	$10 50	Silver,	$0 05
2	Gold,	8 06	Silver,	10
3	Gold,	2 88	Silver,	13
Average	Gold,	$7 15	Silver,	$0 09

The veins are said to have been very rich near the surface from erosional concentration and the ravines have all been placered.

Costs are as follows:

Wood delivered	$3 50 per cord
Distillate	14 per gallon
Freight from Honcut	40 per hundred
Freight from Marysville	50 per hundred
Mining timber delivered	05 per foot
Lagging delivered	5 00 per M.

Miners demand $3.00 per day of 8 hours.

The Pacific Gas and Electric Co's plant at Colgate furnishes the region with power. Water is obtained from a creek on the property and there is a sparse stand of pine and oak trees. Owned by Mr. Chester Merriam, of Dobbins.

Little Kingbird. Strawberry Valley district. Sec. 36, T. 20 N., R. 7 E., M. D. M. One mile northeast of Clipper Mills. Elevation 3850 feet. Patented 680 acres. A 12-inch quartz vein, carrying sulphides, in amphibolite. Strike NW.–SE.; dip 50° NE.; 125-foot incline shaft; 400-foot tunnel; 50-foot drift at end of tunnel. Development is said to have cost $2.50 per foot. Yellow and sugar pine, fir, spruce and cedar cover the property. Water is obtainable from a tributary of Grizzly Creek.

About one mile east of the Little Kingbird is the so-called *Big Ledge,* or *Kingbird,* prospect. A 16-foot shaft has been sunk in a 20-foot solid quartz ledge which strikes N. 70° E. The quartz carries a very small amount of sulphide but looks rather barren. Owned by the Little Kingbird Mining Co., of Clipper Mills. Those interested are Parish and Rufus Bean, of Clipper Mills, W. J. Mellon, of Challenge, J. E. Ebert, of Marysville, and a Los Angeles party.

Lone Tree. Smartsville district. In Sec. 20, T. 15 N., R. 6 E., M. D. M., 4 miles northwest of Waldo. Elevation 650 feet. Patented 80 acres. An 18-inch quartz vein, carrying free gold, in slate. Strike N. 40° W.; dip vertical; 100-foot incline shaft. Hand drilling. Horse whim. Intended to install a 5-stamp mill with 20 h. p. gas engine; 4 men employed. Development work mostly on a new incline shaft, 200 feet below the old shaft of Jack Stevens. Assays of the ore ran between $10.00 and $29.00 per ton. Owned by F. Ayer, of Smartsville. Leased by H. L. and C. F. Johnson, H. L. Hite and C. E. Kibbie, of Waldo.

Lucan Prospect. Brownsville district. East of Rackerby. A 200-foot shaft and four 10-foot prospect pits. Idle. Owned by W. H. Carlin, of Rackerby.

Manwaring Prospect. Smartsville district. Sec. 33, T. 15 N., R. 6 E., M. D. M. Considerable drifting. Idle.

Manzanita or **Abbie Mine.** Brownsville district. Sec. 28, T. 19 N., R. 6 E., M. D. M., three miles west of Brownsville. Elevation 2400 feet. An 8-foot quartz porphyry vein along contact of diorite and slate. Strike E.–W.; dip 45° N.; 300-foot shaft; 60-foot tunnel; 195 feet of drifts. It is reported that a new hoist is being installed. Owned by Boston parties. Mr. Young, of Brownsville, superintendent.

The **Marc Anthony Gold** and **Silver Mine** belongs to the same group as the Black Maria. Located in Secs. 20 and 28, T. 16 N., R. 6 E., M. D. M., ¾ mile north of Timbuctoo. A 6-foot quartz vein in slate; 195-foot incline; 30-foot tunnel; 225 feet of drifts. Idle for 3 years.

Napa and Oro. Brownsville district. Sec. 16, T. 19 N., R. 6 E., M. D. M., 4 miles northwest of Brownsville. Property corners on road from Forbestown to Oroville. Elevation 3000+ feet. An 8-foot quartz vein in porphyry. Strike N.–S.; dip 45° W.; 45-foot shaft. Water from Forbestown ditch. Pine trees on property. Owned by B. D. Dobbyns, of Brownsville, and P. S. King and W. Collins, of Napa.

Nineteen Hundred and One. Browns Valley district. Sec. 16, T. 16 N., R. 5 E., M. D. M. One mile north of Brown's Valley. Elevation 260 feet. Patented. Two 3-foot quartz veins in diabase. Strike N.–S.; dip 45° E.; 40-foot shaft. Idle. Owned by E. F. Forbes, of Marysville, and B. Burris, of Browns Valley.

Northern Light. Brown's Valley district. Sec. 16, T. 16 N., R. 5 E., M. D. M., ½ mile north of Browns Valley. Elevation 250 feet. Patented. A 3-foot quartz vein in slate. Strike N.–S.; dip 40° E.; 35-foot shaft. Idle. Owned by Mrs. Ella Porter, of Browns Valley.

North Star or **Eagleville Mine.** Strawberry Valley district. In Secs. 20 and 21, T. 20 N., R. 8 E., M. D. M., two miles northeast of Strawberry Valley. Elevation 3700 feet. Patented. There are 10 narrow quartz stringers, from 2″ to 18″ wide, in slate and granite. Strike N. 47° E.; dip from 65° to 87° SE.; 150-foot vertical shaft; 250-foot south drift and 400-foot north drift. Hand labor. Equipment consists of steam boiler, one 2-stamp Gates improved mill, 16-foot amalgamation table and 12-foot concentrating table. Ore is said to have milled $6.00 per ton. Sulphides stored. Idle. Owned by G. W. Lund, of Willows, Nora I. Haines, of Oakland, and Richard Schumann.

Nugget and Coronado Mining and Milling Co. Smartsville district. Sec. 20, T. 16 N., R. 6 E., M. D. M., 2 miles northwest of Smartsville. Elevation 300 feet. A 4-foot vein of free milling quartz along contact of slate and granite. Strike N. 45° W.; dip 45° W.; 80-foot incline shaft. Unpatented. Abandoned.

Ora Lewa. Brownsville district. In Sec. 7, T. 18 N., R. 6 E., M. D. M., one mile west of Rackerby. Elevation 2100 feet; patented; 178 acres. There are 10 small pockety quartz stringers striking both E.–W. and N.–S. in porphyry along granite contact. Dip 45° S. and E. 73-foot shaft and 60-foot drift caved. Owned by J. E. Ebert, of Marysville, and W. J. Mellon, of Challenge.

Peerless Mining Co. Smartsville district. In Sec. 28, T. 16 N., R. 6 E., M. D. M., one mile northwest of Smartsville. Elevation 340 feet. Unpatented. A 6-foot quartz vein, carrying sulphurets, along diorite-slate contact. Strike N. 45° W.; dip 40° S.; 140-foot incline; 250-foot tunnel. Assessment work only. James Byrne, manager, Smartsville, California.

Rattlesnake. Browns Valley district. Sec. 9, T. 16 N., R. 5 E., M. D. M., one mile north of Browns Valley. Elevation 260 feet. Patented. An 18-inch vein of free milling quartz in diorite. Strike E.–W.; dip 40° N.; 300-foot incline shaft; 500 feet of drifts. No equipment. Idle. Owned by Mr. George Smithurst, of Browns Valley.

Bibl.: Rep. XIII, p. 502.

R. C. Mine. Brownsville district. In Sec. 26, T. 19 N., R. 6 E., M. D. M., ¼ mile east of Brownsville, near main stage road to Woodleaf. Elevation 2200 feet. Patented. A 4-foot quartz vein along diorite-slate contact. Strike N.–S.; dip 45° E.; 137-foot shaft; 800-foot tunnel. Waterpower available. Part of B. A. C. property. Bonded by W. S. Graham and Co., of Brownsville.

Red Cross Gold Mine. Dobbins district. Sec. 29, T. 18 N., R. 7 E., M. D. M., one mile north of Dobbins. Elevation 1950 feet; 8 claims and a fraction of which 2 claims are patented; 40 acres. Pine, fir and cedar on property. Two blanket veins of decomposed quartz, from 8″ to 18″ thick, lie 20′ and 40′ below the surface. Strike N. 70° W. and dip 70°. Old shallow tunnels caved; 40-foot new shaft and sinking. Hand windlass; 2½ h. p. gas engine runs pump. Water level at 30 feet below surface. Handpicking; no blasting required. Ore said to run from $20.00 to $50.00 per ton. Prospecting is said to have been carried on for 5 months. Two men employed at $3.00 per day. Owned by Red Cross Gold Mining Company, R. E. Brannan, president, Gladstone Hotel, Chicago; J. C. Merriam, vice-president, Dobbins; Patrick Brannan, secretary, Marysville; John J. Wyatt, managing director, Dobbins.

Red Ravine Mine. Dobbins district. Sec. 30, T. 18 N., R. 7 E., M. D. M., two miles northwest of Dobbins. Elevation 1750 feet. Pine, fir, cedar and oak trees on property. Water available in Indiana Creek. An 18-inch quartz vein, carrying free gold and sulphides with sylvanite, along a diorite-porphyry contact. Strike N.–S.; dip 80° E.; 90-foot shaft; 100-foot north drift; 75-foot south drift. "O. and S." steam engine, which runs a No. 1 Garden City fan and a pump. A 2-stamp mill and old Frue concentrator. It is said that $65,000 was taken from the main shaft at a depth of 35 feet. Owned by the Red Ravine Mining Company, of Marysville, which levied an assessment of $.002 per

share in July, 1916, for development purposes. Harry Bell, president, Dobbins; H. A. Geach, secretary, Marysville.

Rogers Mine. Brownsville district. Sec. 6, T. 18 N., R. 6 E., M. D. M., one mile northwest of Rackerby. Elevation 1500 feet. Pine and oak trees on property. Water from Honcut Creek or the Forbestown ditch. Patented 227 acres. An 18-inch quartz ledge carrying free gold with chalcopyrite along slate-porphyry contact. Strike N. 45° E.; dip 30° S.; 150-foot tunnel which follows the ledge for 50 feet. A 3-stamp mill run by water from Honcut Creek. Idle. Owned by Mr. John Rogers, of Rackerby.

Santa Rosa Mine. Brownsville district. Sec. 5, T. 18 N., R. 6 E., M. D. M., ½ mile north of Rackerby. Elevation 1770 feet. Patented. Three-foot quartz vein in slate. Strike E.–W.; dip vertical; 475-foot tunnel. Equipment consists of five 700-lb. stamps, one 5′ x 12′ amalgamation table and 2 Frue concentrators. Leased by G. S. Peynton, Rackerby, Cal.

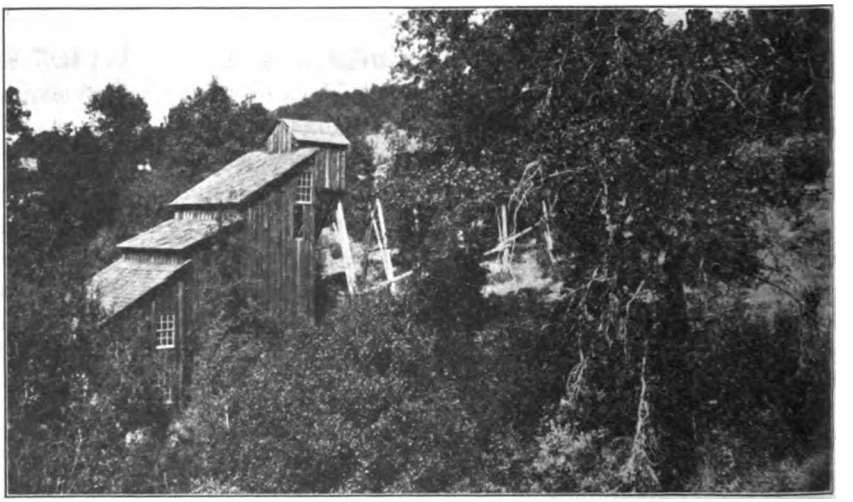

Photo No. 70. Mill at the Santa Rosa Mine, near Rackerby, Yuba County, California.

Seaborg and Davis. Brownsville district. Sec. 32, T. 19 N., R. 6 E., M. D. M., 1½ miles north of Rackerby. Elevation 2300 feet. Patented 160 acres. Five quartz veins varying from 2′ to 30′ wide, along contact of porphyry and diorite. Strike N.–S.; dip 50° W.; 100-foot incline shaft put down by contract for $12.00 per foot. Lumber costs $18.00 per M. from the lumber mills near Rackerby. Water available from the Forbestown ditch at $0.10 per miner's inch. Idle. Owned by J. E. Ebert, of Marysville, and W. J. Mellon, of Challenge.

Slag or Old Flag Mine. Browns Valley district. Sec. 9, T. 16 N., R. 5 E., M. D. M., ¾ mile north of Browns Valley. Elevation 280 feet. Patented. Two veins of ribbon quartz, varying from 10′ to 4′ wide, along contact of serpentine and porphyry. Strike N. 45° W.; dip 35° SW.; 300-foot incline; 800-foot drift. Idle for 25 years. Owned by Mrs. E. Hibbert, of Browns Valley.

Bibl.: Rep. XIII, p. 502, 1895–6.

Smithurst Mine. Browns Valley district. Secs. 8 and 9, T. 16 N., R. 5 E., M. D. M., 2 miles north of Browns Valley. Elevation 300 feet. Patented. Six-inch to 3-foot quartz vein in diorite. Strike N.–S.; dip 45° W.; 70-foot incline shaft, with 100-foot drift north and 100-foot drift south. Workings full of water and said to be caved. Winze sunk at end of south drift. Steam power. Equipment consists of pumps, boilers, blacksmith shop, 1898 model Risdon mill with five 850-lb. stamps, bunkhouse. Ore said to average $20.00 per ton. Idle since 1911. Owned by George W. Smithurst, of Browns Valley.

Spanish Mine. Brownsville district. Sec. 33, T. 19 N., R. 6 E., M. D. M., 1½ miles northeast of Rackerby near the Golden Key mine. Elevation 2100 feet. Claim on government land. Pine and cedar on property. Water available from Forbestown ditch. A 7-foot quartz ledge along contact of porphyry and diorite. Strike N.–S.; dip 30° W.; 60-foot open cut; 50-foot double compartment shaft open and timbered; 50 tons of the old dump milled $4.00 per ton. Owned by W. J. Mellon, of Challenge. Option held by G. S. Peynton.

Spotted Cow Prospect. Dobbins district. Sec. 15, T. 18 N., R. 7 E., M. D. M., 4 miles northeast of Dobbins and 1½ miles northwest by trail from Summit House. Contains 20-acre location on railroad land. A 10-foot quartz ledge in granite. Strike E.–W.; dip 45° S.; 30-foot drift. Idle. Owned by F. B. Binninger, of Dobbins.

Summit Hill Mining Co. Dobbins district. In Secs. 22, 23 and 26, of T. 18 N., R. 7 E., M. D. M., 4 miles northeast of Dobbins, on main road to Bullard's Bar. Elevation 2530 feet. Pine, fir, spruce and cedar on property. A 3′ to 6′ quartz vein along contact between slate and granite. Strike N. 20° E.; dip 47° NW.; 260-ft. incline shaft. On 260-foot level, 100-foot south drift; 100-foot level, 300-foot south drift. Workings flooded with water. Large dump. Idle. Owned by O. H. Greenewald, 310 Sansome Street, San Francisco.

Sweet Vengeance. Browns Valley district. In Secs. 4, 5 and 9, T. 16 N., R. 5 E., M. D. M., 1½ miles north of Browns Valley. Elevation 360 feet. Patented. A 20-foot quartz vein in diorite. Strike N.–S.; dip 60° W.; 350-foot incline, 2-compartment shaft with 100-foot north drift and also a south drift. Shaft flooded. No equipment. Idle. Owned by A. F. Jones, Tonopah, Nevada.

Templar No. 3. Dobbins district. Sec. 29, T. 18 N., R. 7 E., M. D. M., ½ mile east of Indiana Ranch. A 2-foot quartz vein in granite. Strike NE.–SW.; dip 12° E. Worked out to 50 feet in depth. Idle. Owned by J. Merriam, Dobbins.

Too Handy. Browns Valley district. Sec. 22, T. 16 N., R. 5 E., M. D. M., one mile southeast of Browns Valley. Patented. A 12-inch quartz vein; 30-foot shaft. No equipment. Idle. Owned by Mr. Sweezy, of Sacramento, and Mr. McAustin, of Live Oak.

Twentieth Century Wonder Mine. Brownsville district. In Sec. 5, T. 18 N., R. 6 E., M. D. M., ½ mile north of Rackerby. Patented 78 acres. A 6″ to 3′ quartz vein, carrying free gold, in diorite. Strike E.–W.; 100-foot incline shaft on vein connects with 200-foot tunnel. Equipment consists of a hoist run by a gas engine, 5-stamp mill and Deister concentrator. Idle for one year. Owned by Mrs. Josephine Rose de Marshall, of Rackerby. Option held by a Mr. Peynton.

Whitney. Smartsville district. Sec. 3, T. 14 N., R. 6 E., M. D. M., one mile southeast of Waldo. Elevation 200 feet. Patented. Six-foot quartz vein in diorite. Strike N. 45° W.; dip 60° E.; 50-foot shaft; 14-foot drift. Idle. Owned by J. E. Ebert, of Marysville.

William Arthur Mine. Brownsville district. Sec. 5, T. 18 N., R. 6 E., M. D. M., ½ mile north of Rackerby. Elevation 1750 feet. Patented 120 acres. Water available from Forbestown ditch. An 18″ to 2′ quartz stringer, carrying free gold, in diorite. Strike N.–S.; dip 35° W.; 30-foot incline shaft. The ore pans. Owned by M. P. Beaver, of Rackerby.

MINERAL PAINT.

On the **Dempsey ranch,** in Sec. 3, T. 15 N., R. 6 E., M. D. M., near Smartsville, is a 12-foot hill capping of light red volcanic tuff which could probably be used for mineral paint. The ore would have to be hauled 14 miles to Wheatland. The property is patented and owned by Mr. John Dempsey, of Smartsville.

PLATINUM.

Considerable platinum is recovered each year by dredgers along the Yuba River. The production by counties has not been segregated until the last few years. Although platinum occurs with the gold in the drift and hydraulic mines, it is not often recognized nor saved.

SAND.

Sand is being shipped quite extensively from the bed of the Yuba River just east of Marysville. A large amount was used by the county in the construction of a new concrete bridge east of Marysville, and

contractors have been shipping large quantities to be used in the state highway.

The **Marysville Sand Company,** J. W. Walker, superintendent, is operating from the levee just east of Marysville in Sec. 24, T. 24 N., R. 3 E., M. D. M. The company has a spur track from the Northern Electric but also ships by way of the Southern Pacific and Western Pacific railroads.

The company has a lease on a portion of the bed of Yuba River 900 feet wide and 2,000 feet long. A 2½ cubic foot drag line bucket is operated by a 4 h. p. donkey engine. A 60-foot derrick carries the 1¼-inch steel carrier cable. The bucket averages a trip every 1½

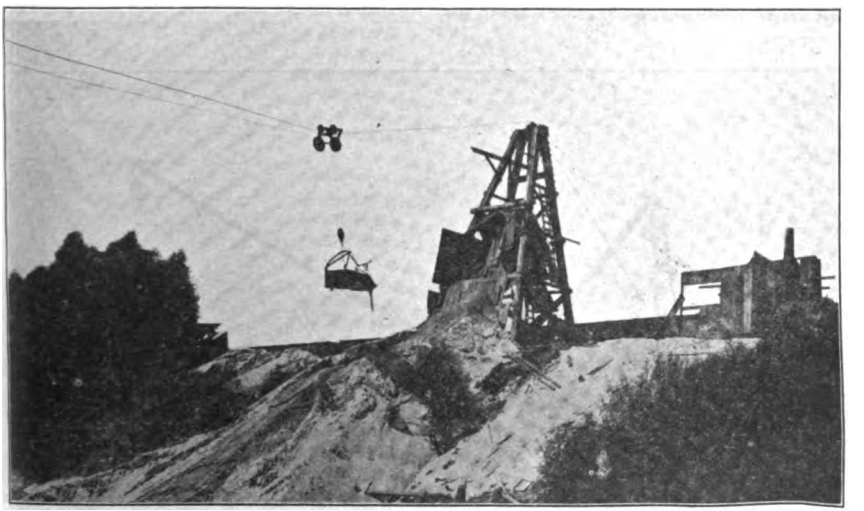

Photo No. 71. View northward of the drag-line bucket of the Marysville Sand Company, at Marysville, Yuba County, Cal.

minutes. About 300 cars of 55 tons each are shipped per month. One engineer and three helpers are employed. The sand is taken from the river wet, loaded directly into cars and shipped to points along the Pacific coast. The company has been operating since May 1, 1915.

The **Pratt Building Material Company,** W. A. Smith, 615 C street, Marysville, superintendent, is operating in the bed of the Yuba River in Sec. 24, T. 15 N., R. 3 E., M. D. M., 300 yards below the Yuba River Sand Company. Equipment consists of a one-cubic yard drag-line bucket operated by a donkey engine which loads one bucket in 1½ minutes directly into the cars. An engineer and two helpers are employed.

The wet sand is taken from the river and is sold to the State Highway Commission and to local contractors for $0.20 per ton. About 150 fifty-ton cars are shipped monthly. The claim has been worked for two years.

The **Yuba River Sand Company,** E. H. Oliver, president, L. L. Green, secretary, Marysville; is operating 100 feet southwest of the Southern Pacific railroad bridge near Marysville. Equipment consists of a $\frac{3}{8}$ cubic yard clamshell bucket, operated by a donkey engine, which makes a trip every $\frac{1}{2}$ minute. Sand is taken out, wet, from a pit in the bed of the Yuba River and loaded directly into the cars on a spur track from the Southern Pacific railroad run out on the river bed. About 12 cars of 40 cubic yards each were being shipped each month for use on the state highways.

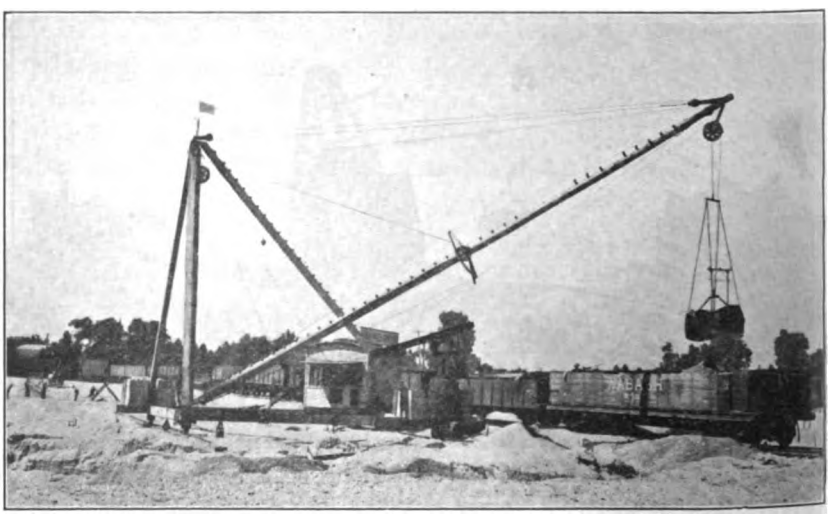

Photo No. 72. View northward of the clamshell bucket and hoist of the Yuba River Sand Company, in the bed of the Yuba River, at Marysville, California.

TALC OR SOAPSTONE.

A deposit of soapstone outcrops at Galena Hill, near Camptonville, just below Weeds Point, the hydraulic mine near the mouth of the sluice tunnel. The deposit is about 8 feet thick and parallels a quartz vein, but has never been opened up.

Others deposits of talc have been reported, but they have, as a rule, been found to be small and to lack convenient transportation facilities.

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CALIFORNIA STATE MINING BUREAU

FERRY BUILDING, SAN FRANCISCO

FLETCHER HAMILTON State Mineralogist

San Francisco December, 1916

Mines and Mineral Resources

OF

San Bernardino County
Tulare County

CHAPTERS OF STATE MINERALOGIST'S REPORT
BIENNIAL PERIOD 1915-1916

CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO
1917

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Mines and Mineral Resources

OF

San Bernardino County
Tulare County

By H. C. CLOUDMAN, EMILE HUGUENIN, F. J. H. MERRILL, Ph.D., and W. BURLING TUCKER, Field Assistants

CALIFORNIA
STATE PRINTING OFFICE
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PREFACE.

The two counties herewith included present radically different features, both as to topography, climate, etc., and as to the industries. San Bernardino County, lying in the southeastern portion of the state, is mostly desert, and the development of its various mineral resources is its chief industry. The only portion of the county devoted extensively to agriculture is the southwestern corner. This has become famous for its orange groves. Tulare County embraces a large portion of the lower San Joaquin Valley extending on the east to the high Sierras, in which are located rich mineral areas. In the valley lands, agriculture is, of course, its dominant industry. Stock raising is an important pursuit in the mountains. The production of magnesite from the foothills in the vicinity of Porterville is now its most important mineral activity.

This report represents the result of several months' work in the field in which we endeavored to visit all active mineral properties and such undeveloped mineral deposits that held promise of future commercial exploitation.

Acknowledgment is here made of assistance rendered by the various owners and operatives, both during the field work and in subsequent preparation of this report.

SAN BERNARDINO COUNTY.

By H. C. CLOUDMAN, EMILE HUGUENIN and F. J. H. MERRILL, Ph.D., Field Assistants.

INTRODUCTION.

The following report on the Mines and Mineral Resources of San Bernardino County has been prepared as a result of field observations by the authors, covering the entire county. The preliminary field work was done by H. C. Cloudman during the winter of 1913–1914, and later work by F. J. H. Merrill* and Emile Huguenin up to July, 1916, particularly in those districts which have more recently become active, namely: Goldstone, Clark Mountain, New York Mountain, Signal and Vidal districts. It has been supplemented by field observations in the Atolia district in June, 1916, by Walter W. Bradley, mining statistician of the State Mining Bureau.

Grateful acknowledgment is here accorded to the numerous mine owners and operators for their uniform courtesy in assisting the writers in their investigations.

September, 1916.

FLETCHER HAMILTON,
State Mineralogist.

HISTORY.

This county, formed by act of legislature in April, 1853, is still the largest in the state, although in 1893, jointly with San Diego County, it contributed part of its territory to form Riverside County. Its present area of 20,157 square miles, exceeds that of the states of Massachusetts, Connecticut, Rhode Island and Delaware taken together.

It owes its name to the fertile valley south of the San Bernardino Range, which was visited by the Franciscan priests in 1810, on May 20th, the Feast Day of San Bernardino of Sienna, whose name was given to the old mission built, about that time, almost three miles west of what is now Redlands. This mission was destroyed by the Indians in 1812, rebuilt in 1820, and again destroyed in 1834, only slight vestiges now remaining.

In 1851 this valley was visited by Mormons from Salt Lake City who founded the city of San Bernardino.

TOPOGRAPHIC MAPS.

Many topographic sheets covering portions of San Bernardino County have been completed and published by the United States Geological Survey, most of them pertaining to the southwestern corner of the county, as follows:

*Mr. Merrill died November 29, 1916. He was State Geologist of New York, 1890–1904.

Scale 1 mile equals 1 inch, or 1 ÷ 62,500.

Cucamonga, San Antonio, San Bernardino, Hesperia, Redlands. Deep Creek, Randsburg.

A number of the above are included in the Southern California Sheet, No. 1, Scale 1 ÷ 250,000.

Scale 1 inch equals 2 miles, or 1 ÷ 125,000.

San Gorgonio, Parker, Needles, Camp Mojave, Ivanpah.

General maps of the county have been compiled by J. S. Bright, Jr., once county surveyor, and by J. A. Sourwine, who now holds that office.

A county map on the scale of 1 inch equals 5¾ miles, has been published by the C. F. Weber Co., of 365 Market street, San Francisco.

Map of the Mojave Desert and adjacent region, compiled in 1908 by A. Russell Crowell, on the scale 1 inch equals 8 miles, covers the county from the Colorado River west to the meridian of 119° 30′ W., and from the Riverside County boundary north to the parallel of 38° 30′, and shows also the position of many mining districts and mines. Blue line prints of this are on sale in Los Angeles.

GEOLOGY.

This report contains little new detailed matter on the geology of San Bernardino County, as attention was paid more particularly to economic developments and exploitation. Much valuable geological detail will, however, be found in the Guide Book of the Western U. S., Part C, the Santa Fe Route, written by Mr. N. H. Darton and others, and issued by the U. S. Geological Survey, as Bulletin 613.

The earliest professional report on this region was by Professor William P. Blake, in Vol. V, of the Reports on the Pacific Railroad Expedition in 1852 under Lieutenant R. S. Williamson.

Additional matter will be found in Bulletin No. 308, of the U. S. Geological Survey, entitled a Geologic Reconnaissance of Southwestern Nevada and Eastern California, by Sidney H. Ball.

Of late southern California has been surveyed geologically by Robert T. Hill, under the auspices of the U. S. Geological Survey. His forthcoming reports on this subject will be exhaustive and of great interest.

TOPOGRAPHY.

The topography of this county is striking and varied, being essentially a combination of mountain ranges and desert plains. As the general details are characteristic of the Great Basin, a description of this will cover many features of this part of California.

Features of the Great Basin.

The Great Basin, to which the desert region of San Bernardino County belongs, is an elevated region in Nevada and contiguous por-

tions of Oregon, California, and Utah, comprising about 208,500 square miles.

The southwest corner of Wyoming, the southwest corner of Idaho, a large area in southeast Oregon, the west half of Utah, almost the whole of Nevada, much of southern California, and a strip along the east border of this last named state are embraced within the limits of

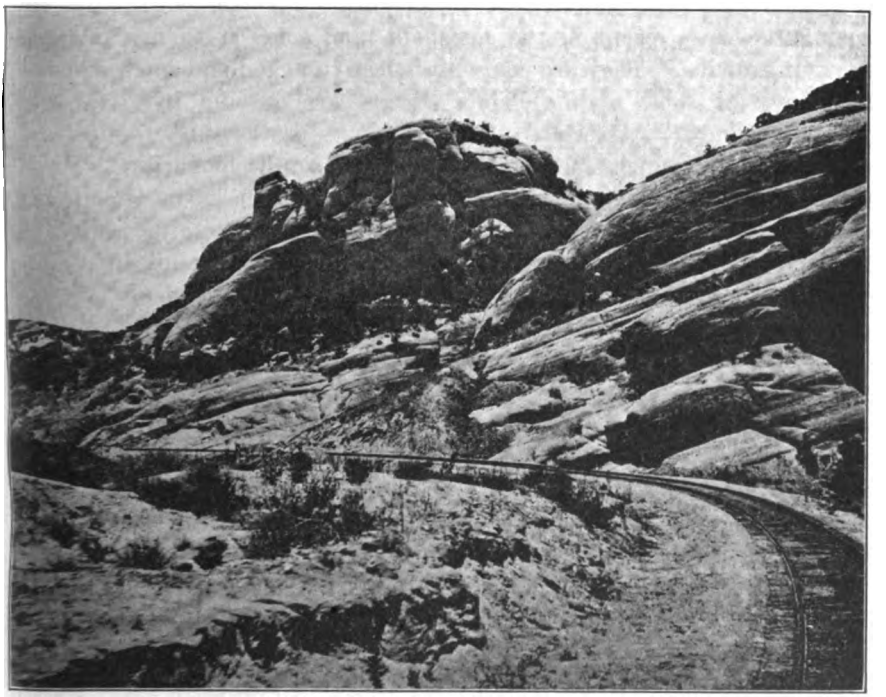


Photo No. 1. Characteristic exposure of tuffs near Victorville, San Bernardino County. Photo by Walter W. Bradley.

the Great Basin. Its form is approximately that of a triangle, with one angle extending into southern California, west of the Colorado River; the northern side being formed by the south divide of the drainage basin of the Columbia River, the eastern by the west divide of the Colorado River basin, and the western by the central part of the Sierra Nevada crest, and by other high mountains. The northern boundary and much of the east limit is not conspicuously uplifted, being plateau, rather than mountain. None of its streams flow to the ocean, and in this it differs from all other provinces of the United States. The region is arid, the precipitation being less than 20 inches a year.

The Great Basin is not, as its name implies, a topographic cup. Its surface is of varied character, with many independent closed basins draining into lakes or "playas," none of which, however, has outlet to

the sea. The mountain chains, from their peculiar geologic character, are known as of the "Basin Range type" though not exactly conterminous in distribution with the Basin, and are echeloned in short ranges trending north and south. Many of them are fault mountains, the crust having been broken and the blocks tilted so that there is a steep face on one side and a gentle slope on the other.

This is the basin range type of mountain. These mountains are among the most recent in the continent, and some of them, at least, are still growing. They are characteristically rugged and bare, though the crests of some of the higher ranges are covered by a scanty growth of timber. Associated with the ranges are low hill groups and mesas, many of which also, have a north and south elongation. From the mountains with distinct crests to the small hillocks in the desert valleys there is every gradation, and between the mountains and hills are broad, gently sloping valleys, of which branches extend into and. in places, across the mountains. The latter are cut by deep cañons, and a few of these form the channels of streams which descend to the valleys on alluvial fans and commonly disappear before the playas in the center of the valley is reached.

These valleys are enclosed basins which slope rather steeply next to the mountains, but decrease rapidly in grade, the central portion being a flat in which the eye can see no difference in relief. This level bottom is, in most cases, a playa,[1] which, during the greater part of the year, is a level waste of hard clay, but after heavy rains is covered by a thin sheet of water. By rain-wash and wind action detritus from the mountains is carried to these valley floors, raising their level, and often burying low mountain spurs, so as to cause neighboring valleys to coalesce. Hence, every hill within the area furnishes, each year, material with which it is slowly being buried by the constantly growing flat valleys. The borders of given valleys are, as a rule, approximately equal in elevation, though the desert gravels extend to greater elevations on the higher inclosing mountains. In such cases, while the slopes are of approximately equal descent, the playa is nearer the lower hills. Near the mountains the alluvial slopes are scored by numerous drainage lines, and hills protrude through their surface. Bays and arms of detrital wash extend from the inclosed basins into the mountains and, in places, two opposed arms meet and form a strait of alluvial material.

The plateau "lowlands" in the center of the Basin are approximately 5000 feet in altitude. Southward the altitude falls, Death Valley and Salton Sink being in part below the level of the sea. The whole basin is marked by three features of elevation—the Utah basin, the Nevada basin, and, between them, the Nevada plateau.

[1]Spanish, (*playa*) shore or beach.

Mojave River.

This, the most important river on the desert of that name, is formed by the union of two branches, Deep Creek and West Fork, which have their origin in and near Holcomb Valley in the San Bernardino Mountain Range. The course is northerly for 70 miles, in an air line, then it takes an easterly direction for 60 miles and sinks into Soda Lake. Within the entire distance the river sinks and rises eight different times. Its first disappearance is at the junction of the forks 12 miles

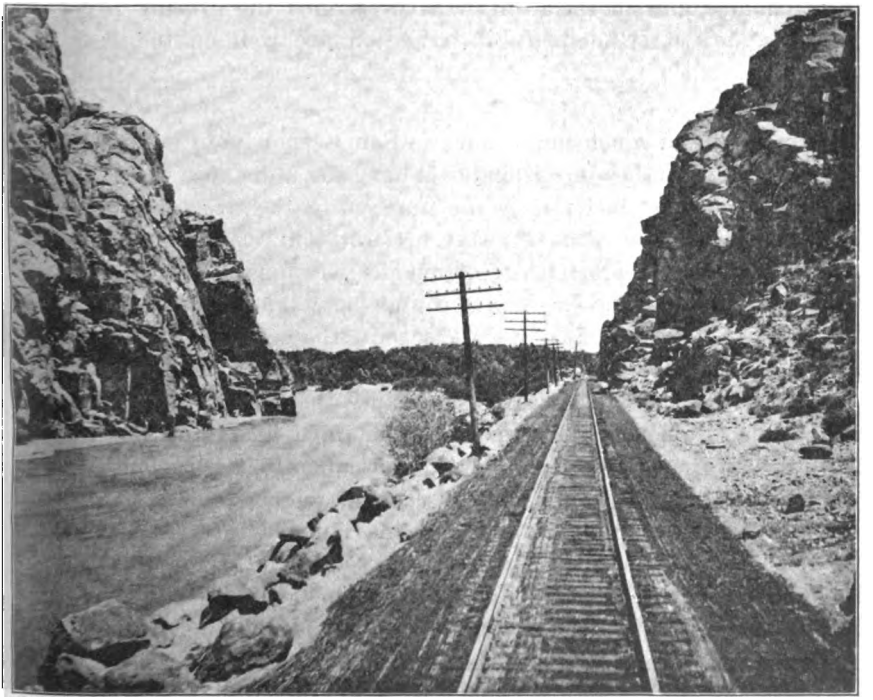


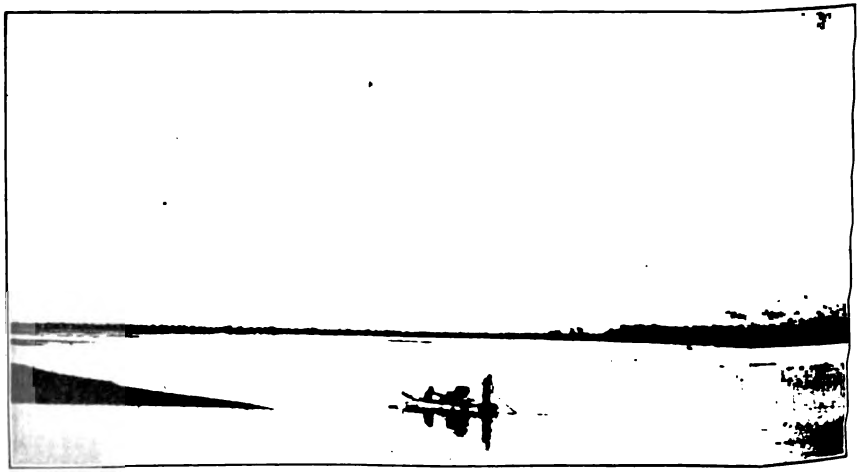
Photo No. 2. The "Gibraltar of the Mojave" River at Victorville. The river here passes through a narrow break in a rough, rocky ridge which rises abruptly out of the plain. Photo by Walter W. Bradley.

above Victorville, whence its flow is subterranean. It appears again at Victorville (see Photo No. 2) and sinks again for five miles, reappears at Oro Grande and flows on the surface for five miles, sinking again at Cottonwood; is visible for one mile and then sinks for 15 miles, rises again at Barstow and is seen at this point for one mile, again sinking for six miles, and coming to the surface at Fish Pond. It then runs in view for one mile and goes out of sight for 12 miles; rises again near Otis and flows on the surface for one-half mile; then sinks until Camp Cady is reached. Here it is visible for one mile and sinks again for 18 miles, rising at Cave Cañon. From this point the flow is visible for 10 miles, and the river sinks for the last time near Soda

Lake (except in the season of floods) and, rising finally 20 miles below the lake, it unites with the Amargosa River and empties into Death Valley near Saratoga Springs. This river, the one stream that forces its way through the sands, apparently sinking and rising in flood time, floods itself over its "bottoms" and irrigates flats that yield rich crops of various kinds of feed that are well cared for and used to fatten stock in winter. These crops have given a very good idea of the productiveness of the desert soil when properly irrigated. Changes in the stream channel and in the rainfall have lessened the grazing area in late years, but other methods of irrigation are well on the way to success.

Colorado River.

Another river of much importance to San Bernardino County is the Colorado, which washes its eastern boundary for a distance of 90 miles. This river is formed in Utah by the junction of the Green and Grand rivers, which rise in regions of heavy precipitation, mainly in the form of snow. The Colorado emerges from deep cañons a short distance above Needles, and between this point and the Mexican border occupies a series of valleys which aggregate several thousand acres of arable land. In this region, the waters are heavily laden with sediment, which is a serious obstacle to their diversion, since the grade of the river is so slight that sufficient fall can not be obtained by taking the water out of the river in a short canal, and consequently a very long canal is required in order to command any considerable areas of land in the valley. Flat-bottomed boats and gasoline launches are used on the river near Needles and above it (see Photo No. 3) but, below this point, navigation is so difficult and precarious as to be practically of little importance. At low water the channel is so broad, shallow, and change-



able that boats are constantly running aground, and at high water the currents impair navigation. A few cable ferries are in operation near Needles, and carry across automobiles and other vehicles for a nominal charge.

TRANSPORTATION.

The development of San Bernardino County has been greatly augmented in recent years by increased transportation facilities, and at

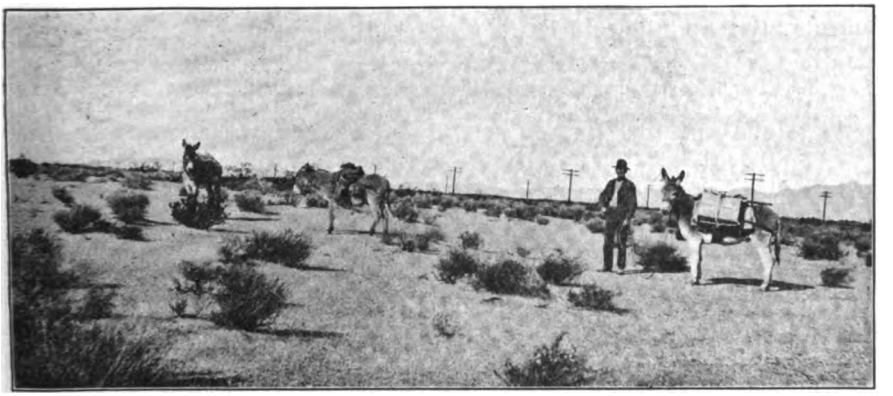


Photo No. 4. Primitive transportation on the desert by burros.

present travel is accomplished with much greater ease and safety than heretofore. In former years the burro was the chief mode of conveyance, but of late this patient beast has been largely though not entirely

Photo No. 5. Modern transportation and desert mountains.

replaced by railroads and highways. We now have the Santa Fe, the Salt Lake, the Southern Pacific and the Tonopah and Tidewater rail-

National Highway now sufficiently complete to permit the use of the automobile. Nearly every section of the county can be traversed with the automobile, and numerous branches lead from the main lines of both railroads and highways.

Photo No. 6. A. T. & S. F. (Santa Fe) railway bridge over the Colorado River below Needles.

WATER.

Another factor in recent development is the increased facility for obtaining water. In early days the desert was considered dry and barren, but of late it has been proven that water can be obtained by digging or boring at almost any playa or "lake." Occasionally, in times past, springs of water were found rising to the surface, but in most cases their flow was not permanent and lasted only through the rainy season. Recent developments have shown that bodies of water lie beneath the sands and that it is not difficult to obtain water by deep drilling. The heavy expense of hauling water from remote points is now being eliminated by such wells.

MINING DISTRICTS.

The organized mining districts of San Bernardino County are discussed in the reports of the State Mineralogist. VIII, IX, X, XI. XII and XIII, and are shown on Plate V of Bulletin 507 of the U. S. Geological Survey, p. 114. The list is here given with their map numbers on that plate.

lue	Lime			ellaneous and unapportioned	
	Barrels	Value	Ton	Mineral	Value
21,600	40,000	$32,000	5		
32,556	87,864	87,674	30		
27,000	37,427	34,977	17		
56,000	12,000	12,000			
50,000	50,000	35,000	6		
80,000	16,000	16,100	16		
21,000	26,261	33,261	7		
59,842	38,783	43,028	54		
73,600	76,582	65,832	48		
57,000	39,923	28,692	52		
	25,000	21,500	28	Sandstone	$2,000
	17,024	14,740	27		
	20,910	17,146	19	Tungsten	5,500
	8,600	8,600	74		
			104		
			22	Unapportioned 1900-1909	4,035,856
			224	Mineral water	25,000
				Barytes	840
				Soapstone	1,000
			243		
96,200			8	Mineral paint	1,200
	121,544	113,856	22	Barytes	550
				Mineral water	25,000
				Other minerals	1,391,304
				Mineral water	5,100
	84,637	93,100	23	Mineral paint	561
				Glass sand	400
				Other minerals	1,240,575
				Mineral water	7,350
80,000	[2]		62	Tungsten concentrates	840,947
				Zinc	4,941
				Other minerals[1]	62,316
64,798	702,555	$657,506	1,18		$7,628,440

5,086,815	Limestone
3,892,703	Brick
1,445,701	Clay
74,792	Marble
9,829,979	Stone
440,012	Gems
104,940	Miscellaneous
5,164,798	
657,506	Grand total

Plate V, Map No.	Name of district	Metal mined
121	Alvord	Gold.
122	Arondo (Slate Range)	Gold.
123	Arrowhead	Gold.
124	Atolia	Tungsten.
125	Blackhawk (Silver Reef)	Gold.
126	Brightwood (Providence Mountains)	Silver.
127	Bullion (Standard)	Copper.
128	Calico (Daggett)	Silver.
129	Cave Cañon	Iron.
130	Cima	Silver.
131	Cottonwood	Gold.
132	Crackerjack	Gold.
133	Dry Lake	Copper.
134	Garlic Spring	Iron.
135	Grapevine	Gold.
136	Hart	Gold.
137	Helen	Gold.
138	Holcomb	Gold.
139	Ibex	Gold.
140	Iron Mountain	Iron.
141	Ivanpah (Copper World)	Copper.
142	Kane Springs	Copper.
143	Kelso	Iron.
144	Kewanee	Gold.
145	Kingston Range	Iron.
146	Knob Peak	Gold.
147	Lava Beds (Newberry)	Gold.
148	Monument Peak (Whipple Mountains)	Copper.
149	Morongo (Lone Valley)	Gold.
150	Needles	Gold.
151	New York (Manvel, Barnwell)	Gold and tungsten.
152	Ord	Gold and copper.
153	Oro Grande[2]	Gold and silver.
154	Owl Holes	Manganese.
155	San Antonio	Gold.
156	Shadow Mountains	Copper.
157	Signal (Vontrigger)	Copper and tungsten.
158	Silver Mountain[2]	Gold and silver.
159	Spangler	Gold.
160	Stedman	Copper.
161	Stringer	Gold.
162	(Omitted)	
163	Trojan (Providence)	Gold.
164	Twenty-nine Palms	Gold.
165	Vanderbilt	Gold.
166	(Omitted)	
167	Virginia Dale (Monte Negro)	Gold.
168	(Omitted)	

[2]Silver Mountain was formerly the same district as Oro Grande.

MINERAL RESOURCES.

In describing the mineral deposits of a given county the alternatives are presented of discussing them separately or in connection with the mining districts in which they occur. Since, however, most districts include many useful minerals, a more satisfactory review of the subject can be given by taking the various products separately and stating their distribution with the conditions of their occurrence.

This plan will, accordingly, be followed in this report, the metals being taken up first, in alphabetical order; followed by the non-metals likewise.

METALS.

Among the mineral products of this county some of the metals are foremost in their totals of value, as will be noted by the table of total yield.

Tungsten has been produced since 1905, but there being only a single operator in the county up to 1915, the output for San Bernardino for that period can not be segregated. The production of tungsten for 1915 exceeds the sum of all other metals in the list, except gold.

COPPER.

Throughout the mountain ranges which traverse the Mojave Desert in this county useful minerals and metallic ores abound. Among the latter, copper is widely distributed, though mainly in quantities too small for commercial exploitation. As with many other resources of this great mineral field, there has been but a small beginning made in the prospecting and development of the copper deposits of these rugged hills, though there is a considerable number of more or less promising copper claims showing superficial development.

The largest amount of copper produced in the county has been from the Copper World Mine, fully described in our Bulletin 50, "Copper Resources of California." However, the work in recent years has been confined mostly to those mines in the southeastern portion of the county in the vicinity of Vidal. The reader is referred to the above mentioned bulletin for description of the old copper mines and prospects, most of which have been idle since the publication of that report.

Amazon Mines in the Silver Mountain mining district, six miles east of Oro Grande, consists of six claims. Oxides of copper occur in a contact vein between limestone and diorite. Development consists of two shafts, 265′ and 175′ deep respectively, and several tunnels. About 300 tons of sorted ore were shipped several years ago. Idle: worked for assessment only. Owners, F. H. Cline et al., Oro Grande, Cal.

Bibl.: Report XI, p. 363; XII, p. 69; XIII, p. 60.

American Eagle Group, consisting of 19 claims in the Whipple Mountain mining district, is in Sec. 32, T. 3 N., R. 4 E. S. B. M., 13 mi. north of Vidal, the shipping point. Mine is opened by a shaft. There is said to be large body of low grade sulphides exposed, varying up to 10% copper and from $2 to $21 in gold. The values are erratic. One car shipped to smelter a few years ago assayed 6.35% copper, however, the company was penalized due to a high silica content (65% to 75%) and received no returns. Idle until recently. Ten men are now employed in development work under supervision of J. B. Baker. Owner, American Eagle Gold & Copper Co.; president, A. L. Crew, 419 Homer Laughlin Bldg., Los Angeles.

Big Butte Mine, in the Ibex District, is six miles west of Needles. Elevation 1100′. Development consists of a 125′ shaft and numerous short tunnels and open cuts. Ore contains gold, silver, and copper. One carload was shipped to Needles during 1913. Idle. Owner, K. K. Horan, Needles, Cal.

Black Diamond Mine in the Silver Mountain district is eight miles east of Oro Grande. Gold, silver, and copper occur in a vein along contact of a porphyritic dyke and granite. Opened by a 150′ shaft and several small cuts. Idle. Owner, Joseph Scheerer of Victorville.

Black Mountain Mining Company has a group of 96 claims, in Sec. 36, T. 10 N. R. 21 E., 9½ miles west of Needles. Idle. Nick Jahriess of Needles, president.

Bumper Group, Needles district, consists of six claims, 12 miles south of Needles. Elevation 1200′. The ore is said to contain malachite, azurite, franklinite and zincite. It is exposed by shaft 22′ deep and a tunnel 65′ connecting with the bottom of the shaft. Worked for assessment only. Owners, E. H. and H. A. Norton, Needles, Cal.

California Gold and Copper Company's Mine, Signal district, is nine miles north of Goffs and 1½ miles east of Vontrigger and consists of nine patented claims. Elevation 3700′. The country rock is diorite, porphyry and granite. The ore carries malachite, azurite, chalcopyrite, bornite, pyrite and gold. It is said to average 4% copper. Development consists of three shafts, 317′, 150′, 100′ deep respectively, and over 5000′ of underground workings. A 15 h.p. Fairbanks-Morse hoisting engine is installed at the main working shaft. The reduction plant consists of rock breakers, arrastra and a 160-ton cyanide plant. The copper is separated electrolytically on copper plates. The plant is operated by electricity generated by a 100 h.p. Fairbanks-Morse gas engine. The reduction plant was erected in 1913—started operating in 1914. Idle for past year. A. H. Cram of Riverside is president. This property has recently been taken over under lease and bond by L. H. Mitchell and Sons of Los Angeles, who are to reopen the mine and put the mill into activity shortly.

Camp Vera Group is in the Morrow mining district, 25 miles north of Barstow. Idle. Owner, W. J. Rodgers, Barstow.

Bibl.: Bull. 50, p. 334.

Copper King Mine is in the Ivanpah district, 12 miles west of north of Cima, a station on the Salt Lake Route. The mine has been idle for several years.

Bibl.: Bull. 50, p. 330.

Copper Mountain Mining Company, Silver Mountain district. The mine is worked for assessment only.

Copper World Mine, Ivanpah district, is in the Clark Mountains, 20 miles northwest of South Ivanpah, the terminus of a branch line of the A. T. & S. F. R. R., leaving the main line at Goffs. The elevation at the mine is 5300′. This property is said to have produced over $750,000. A smelter was erected at Valley Wells, five miles southwest of the mine, and the ore hauled by team to it. The smelter was abandoned, due to the high cost of smelting and the losses in the slag. The ore was later shipped to Needles. The mine has been recently reopened after having been idle for several years. The dump is now being shipped via Cima to the Needles smelter. Six men are employed at the property.

Bibl.: Rep. XIII, p. 61, Bull. 50, pp. 326–328.

D. & W. (Dayton & Wilbur) Mine, Whipple Mountain district, is 13 miles north of Vidal, adjoining the American Eagle Group. Elevation 1800 feet. The ore containing malachite, azurite and gold, occurs in a quartz porphyry in diorite. Mine is opened by a 750′ shaft and over 5000′ of underground workings. Equipment consists of an 18 h.p. Western engine for hoist; 35 h.p. engine for mill; 45 h.p. Commercial gas engine for compressor. Air drills are used. A 10-ft. Lane Mill rated at 50 tons capacity was installed in 1913, but was worked only a short time. There has been very little ore produced and only a few test runs made at the mill. Idle for the past two years, but resumed work on a small scale in April, 1916. Owner, D. & W. Mining Co., 708 San Fernando Bldg., Los Angeles; secretary, Joseph Simon.

Bibl.: Bull. 50, p. 337.

Desert Butte Group is 40 miles southeast of Amboy and 3½ miles south of Kilbeck Siding, on the Parker branch of the A. T. & S. F. R. R. The ore is said to contain copper, gold, silver, lead and zinc. The greatest vertical depth below the outcrop is 45′: the vein is exposed by a drift tunnel 325′. At the time visited (April, 1914) had 40 tons of ore ready to ship to Selby. Owners, Geo. B. Parks and A. J. Crowley, Barstow, Cal.

The Desert Queen Copper Mines Company is working a property in the northern portion of the county, east of the Tonopah & Tidewater Railroad, and reported to be hauling a fairly high-grade ore by auto trucks to Baker, Cal., for shipment to the International smelter in Utah.

Giant Ledge Gold and Copper Mines, New York Mining district, 10 miles northwest of Ledge, a station on the Ivanpah branch of the Santa Fe R. R. Elevation 5,700 ft. Idle for past four years. Owner, Giant Ledge Gold & Copper Company, 500 Frost Bldg., Los Angeles, L. M. Gregory, president.

Bibl.: Bull. 50, p. 333.

tion is granite, underlying schist. The veins occur in a fine-grained quartz porphyry and carry the carbonates and oxides of copper with some values in gold. Development consists of a 42′ shaft and several hundred feet of open cuts. Said to have shipped to Needles about 1400 tons of ore varying from $6.00 to $8.00 per ton. Now worked only for annual assessment. Owner, Robert Andrews of Bagdad.

Hermit Mine, formerly called the Blue Jacket, is in the Silver Mountain district four miles east of Oro Grande. Elevation 3500′. Worked in the early '80s at which time a mill was erected at the property. Relocated 1910 by present owner. Now worked for assessment only. Owner, H. L. Atwood of Oro Grande.

Bibl.: Report VIII, p. 500.

Hidden Hill Mine (see under Gold).

Home Mine in the old Hikorum (Old Dad Mountain) district 12 miles north of Bagdad. Elevation 2960′. Oxides of copper are said to occur in a quartz vein in granite, which also carries low values in gold. A 75-ft. shaft was sunk on the vein. There has been no production and the mill is idle. Owners, L. V. Root and Jos. Luxon, Needles, Cal.

Hoosier and Missouri Groups are in Sec. 28, T. 10 N., R. 3 W., S. B. M., 12 mi. northwest of Barstow. The ore carrying values in gold, silver, copper and lead occurs in a quartz ledge, said to vary up to 15′ in width on a contact of rhyolite and granite. Development consists of a 90′ shaft and 300′ of drifts. Now worked for assessment only. Owners, J. W. Foglesong and E. Troutmen of Barstow.

Ivanpah Mine, Ivanpah district. Idle.

Bibl.: Bull. 50, p. 330.

Ivanpah Mammoth Mine. Idle.

Bibl.: Bull. 50, p. 330.

Juanita Group, in the Morrow district, adjoins the Juanita mine. Idle for many years.

Bibl.; Bull. 50, p. 335.

Juanita Mine, in the Morrow district, 26 miles east of Johannesburg. Idle. Owner, Union Development Co. of Boston, Mass.

Bibl.: Bull. 50, p. 335.

Josie K. Mine, in the Ibex district, is six miles west of Needles and three miles south of Hartoun, the nearest shipping point. Elevation 1000′. Oxides of copper and gold occur in a quartz vein at contact of rhyolite and granite. Ore said to assay up to $11.00 gold, and 14% copper. Vein is exposed along the strike for 4000′ by a series of shallow shafts. No recent work has been done and the mine is idle. C. E. Kane of Needles, owner.

Leastock Gold and Copper Company, Barnwell district. Idle.

Needles Mining and Smelting Company,[8] (formerly the Arizona-Mexican Mining and Smelting Company) is a subsidiary to the U. S. Smelting, Refining & Mining Co.; D. R. Muir of Needles is manager. The old company, which practically consisted of the same parties as the Cocopah Company, bought out the Fletcher Smelting Co. and erected a new plant on the side of the old one, a short distance northwest of Needles, on the bank of the Colorado River. The plant consists of one lead furnace, one copper furnace, one roasting furnace, crusher and sampling floor, assay and general office. The lead furnace is 120″ x 42″, with six water jackets, one in front, one in rear, and two on each side, boshed; automatic lead well; eight tuyeres on each side; sheet iron hood and pipe descending into dust chamber. This type of furnace is known as a 100-ton furnace, although it can attain this capacity only with exceptionally favorable ores.

The copper furnace consists of an oval, iron water-jacket from the crucible to the feed floor (14 feet above) 96″ x 36″, with ten tuyeres and iron hood, the same as the lead furnace. Notwithstanding its similar size, its capacity is greater than that of the lead furnace, owing to the faster smelting of copper ore. The roasting furnace is of the McDougall pattern, a huge iron cylinder, nearly 30 feet high, with six separate compartments all connected. The fire place is under the lowest one, but coal has been replaced by oil, and two pipes furnish the necessary fuel. The ore is charged from above, a vertical shaft rotating in the center, furnished with arms to which blades are attached, keeps stirring the pulp and moving it continually from one compartment to the other until it drops out from the last one, being finished. This roaster gives great satisfaction and forms a very essential part of the plant, because the ores treated are mostly sulphides, and most of the iron required for fluxing is obtained by roasting pyrites. Incidentally a little copper matte is obtained from the lead furnace, but the bulk of the copper ore is smelted by itself in the special furnace, in a manner different, however, from the process used at the Valley Wells smelter. No attempt is made to obtain metallic copper directly from smelting the oxides, because it has been found that this method entails too great a loss in the slag and that it is more advantageous to save the copper values in the form of matte. Sufficient sulphides are therefore added to the oxidized copper ores to produce a high-grade matte, which is shipped East for further treatment.

New York Mine (*see* Sagamore mine).

Orange Blossom Mining and Milling Company, Hikorum (Old Dad Mountain) district, nine miles north of Bagdad. Idle.

Bibl.: Bull. 50, pp. 338–339.

[8]Bull. 50, pp. 330–331.

Orange Blossom Extension Mine, in the Hikorum district, adjoins the Orange Blossom Group on the north. The ore is deposited in a contact vein between granite and birdseye porphyry. The vein varying from 4′ to 20′ carries quartz, iron and lime with values in gold, copper (mostly oxides) and a little silver. The mine is opened by a 715′ shaft and over 4000′ of levels, drifts, raises, etc. A 25 h.p. Fairbanks-Morse hoisting engine was installed at shaft. A mill was erected in 1913, consisting of eight Nissen stamps, one Wilfley table and one Frue vanner. The power is supplied by a 60 h.p. Fairbanks-Morse gas engine. Electricity for pumping and lighting purposes about the plant is generated by a 25 h.p. Fairbanks-Morse special electric direct connected engine. Water is brought to the mine from a spring in Old Dad Mountains by a 4″ and 5″ pipe line; however, it is reported that sufficient water for working purposes can be pumped from the bottom of the shaft. Mill ran only a short time and property is now idle. Owner, Hope Mining Co., president L. N. Root, Needles, Cal.

Bibl.: Bull. 50, p. 340.

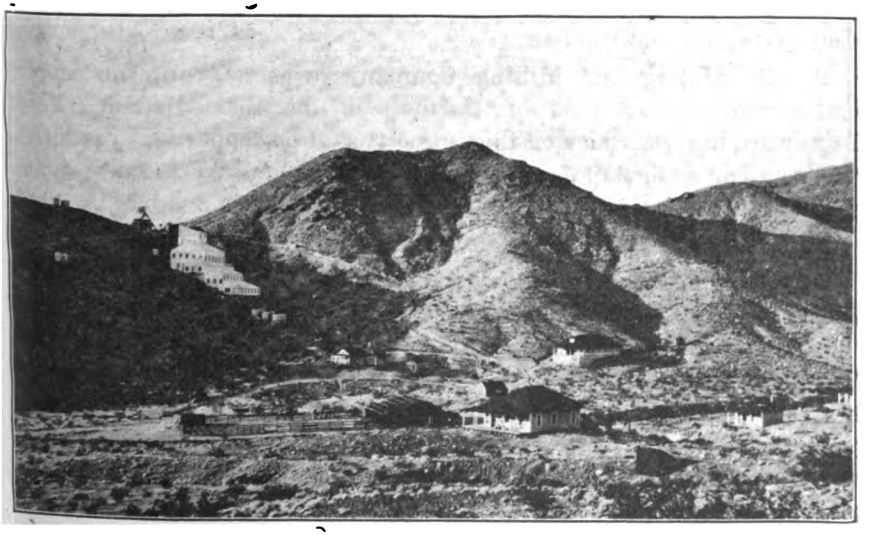


Photo No. 7. Orange Blossom Extension Mine.

Osborn Group, in Ord Mountain, is 14 miles southeast of Daggett, and consists of nine patented and eight unpatented claims. Elevation 5000′. The ore occurs in a contact vein, which it is said can be traced for several miles. The hanging wall is granite and the footwall decomposed porphyry. Copper is deposited both as the carbonates and sulphides. A great amount of development work was done. Ore was concentrated at a small custom mill one mile north of the mine, then shipped to the smelter. It is said to have produced $20,000, but is now idle. Owners, Bert Osborn et al., Daggett, Cal.

Bibl.: Rep. X, p. 528; XII, p. 234; XIII, p. 226; Bull. 50, p. 28.

Pacific Mines Corporation (formerly the Bagdad, Chase, and Roosevelt Consolidated) office 1219 Hollingsworth Bldg., Los Angeles; Frank A. Keith, president; Geo. D. Mendenholt, general manager. This company's property, consisting of 27 patented claims, is seven miles due south of Ludlow. A railroad connects the mine with Ludlow. The ore is deposited in an igneous mineralized breccia zone formed by a fault. This brecciated zone strikes E.-W. and dips 25° to 35° N. Its average width is from 12′ to 15′. It has been proven on the surface along its strike for 2,000′. The ore is mainly chalcocite and pyrite carrying values in gold and is in a quartz porphyry gangue. Development consists of a main working shaft 450′ on a 40° incline, also shafts of 200′, 140′, and 120′, respectively, all sunk on the ore body, with several thousand feet of levels, drifts, etc. The shafts are all equipped with gas engine hoists. A two-stage Sullivan compressor supplies the necessary air for the pneumatic drills. The ore, about 100 tons daily, is shipped to the United Verde Copper Company's smelter at Jerome, Arizona. Sixty men are employed. This property has been the most productive one in San Bernardino County since its operation by the present company.

Rosalia Mining and Milling Company owns a group of copper claims three miles west of Hartoun in the Ibex district. Very little work has been done on this property and no copper was produced. There is said to be 60 tons of ore on dump which assays $17.00 per ton gold and 4% copper. Idle. C. E. Kane of Needles, president.

Rose Mine (see under Gold).

Sagamore Mine (formerly known as the **New York Mine**), is on the southern slope of the New York Mountains, about 10 miles west of Purdy, a station on the Ivanpah branch of the Santa Fe Railway. The elevation at the mine is 5800 feet. This old property, consisting of 8 claims, was first worked over thirty years ago, but lay idle for many years. The recent discovery of the unsuspected presence of tungsten in the ore has led to considerable activity, and a small concentration mill has been erected. The ore, which occurs in well defined quartz veins, is base, carrying sulphides of iron, copper, lead, zinc, and antimony, with oxides of copper, rhodochrosite, wolframite, and low values in gold. It is proposed to recover the wolframite from the concentrate by a magnetic separation. Fifteen men are employed. Owner, Sagamore Mining Company of Philadelphia; William C. Doak, superintendent at mine, Goffs, Cal.

Bibl.: Bull. 50, pp. 331–333.

Standard Mine, in the Ivanpah district, 15 miles north of Cima and 3 miles north of the Copper King Mine. Some copper ore was shipped from here, but no mining has been done in recent years.

Bibl.: Bull. 50, p. 330.

Three States Mine, in the Silver Lake district, 6 miles west of Silver Lake, consists of 3 claims named Arizona, Nevada, Utah. The country rock is limestone intruded by porphyritic and dioritic dykes. The ore is chalcopyrite. Shipped a few tons to the smelter several years ago, but due to the high cost of transportation and smelting charges, little profit was realized. Owners, T. R. Whelan, Percy McCabe, and C. Yake, Silver Lake, Cal.

Tuscarora Mining and Milling Company is developing a mine in the Whipple Mountain district, 7 miles northeast of Calzona. The vein between a schist footwall and diorite hanging varies from 5′ to 10′ in width and is proven on the surface for 2500′. The ore is free milling and said to average 2½% copper and $10 to $25 gold and is shipped to the smelter. Mine is opened by a shaft which is equipped with a 12 h.p. Western gas engine hoist. Five men are employed. John Jarvis, Vidal, superintendent.

Vidal Mining Company's mine in the Whipple Mountain district north of Vidal, has been idle until very recently. Now under lease to P. H. Newman. No records are available as to its former production.

Winifred Group, Old Dad Mountain district, is 9 miles north of Bagdad, near the Orange Blossom mine. Development consists of a 300′ tunnel and a couple of winzes. A few tons of ore, said to have assayed 12% copper and carrying values in gold up to $200, were produced several years ago. No recent work has been done and the property is idle. Owner, F. P. Seburn and Bro., Needles, Cal.

The following **Copper Mines** or operators in San Bernardino County made shipments of ore, in varying amounts, during the year 1915:

Name	Values in
John W. Brunk, Vidal, Whipple Dist.	Copper
Maricopa Queen Oil Co. mine near Milligan	Silver, copper
Office 434 First National Bank Bldg., Long Beach. W. T. Brayton, secretary. Mine leased to Desert King Mining Company.	Lead, gold
Pacific Mines Corporation, Ludlow	Copper, gold
Office, 1219 Hollingsworth Bldg., Los Angeles. Frank A. Keith, president; Geo. D. Mendenholt, Gen. Mgr.	Silver
Pioneer Mine, J. F. Marrs, Cima	Copper, silver, gold
Geo. Sumner, Vidal	Silver, copper
Mark Genemiel, Vidal	Copper, silver
J. Jarvis, Vidal	Copper, silver
R. P. Gilliland, Vidal	Copper, silver

In addition to the above, the following were developing and expect to ship ore during 1916:

Henry Roberts and Burkes Bros., Calzona	Copper
Vidal Mining Co., Calzona; R. H. Newman, lessee	Copper

GOLD.

This precious metal has long been mined in San Bernardino County, and, in 1915, its production amounted in value to $416,967, and a total of $6,086,815 from 1880–1915, inclusive, there being no segregated data earlier than 1880.

In discussing its distribution it is deemed necessary to use a geographic classification of the known deposits and productive mines. Therefore, the following grouping is adopted as convenient:

There are, in this county, two chief groups of auriferous veins:

A. Those of the San Bernardino Range.
B. Those of the desert ranges.

In connection with the members of both groups are areas of placer gravel which have been worked with some success.

A. Veins of the San Bernardino Range. These occur mainly on and near the north slope of these mountains and close to the south margin of the Mojave Desert. The chief districts are: Bear Valley, Black Hawk, Holcomb Valley, and Morongo districts, gold.

B. The chief districts of the desert veins are: Arrowhead, Dale, Goldstone, Ivanpah, Ord, Oro Grande, Steadman, Twenty-nine Palms and Vanderbilt. The only placer ground recently worked on the desert is that north of Barstow by the Cool-Gardie Mining Company.

SAN BERNARDINO MOUNTAIN GOLD BELT.

This auriferous zone, the largest in the county, has a southeasterly trend, and is mainly confined to the four ranges of public lands east of the San Bernardino Meridian, extending three townships north of the San Bernardino Base Line.

As noted by Mr. W. H. Storms,[4] the main range of the San Bernardino Mountains, of which the axis trends southeast, is granite, and, also, the country adjacent, extending northward to the south side of Bear Valley. On the north side of Bear Valley, limestone occurs, and farther north quartzite and mica schist, uptilted and fractured by intrusive granite. The metamorphic rocks, which are limestone, quartzite, and mica schist, the latter occurring in relatively small amount, are members of a series which extends from near Twenty-nine Palms northwesterly along the north flank of the San Bernardino Mountains to West Camp, 12 miles northwest of Victorville, a distance of 85 miles. Remnants of limestone occurring southeast of Twenty-nine Palms in the Ophir Mountains, indicate that this limestone formation is over 130 miles in length. Throughout this distance at several points, quartzite appears, being well developed at Oro Grande, about Bear Valley, Holcomb Valley, and southeastward as far as the Ophir Mountains, which lie south of the Monte Negro District and north of Eagle

[4] Rept. XII, p. 229.

Mountain. Gold, silver, and lead occur along the entire length of this belt. The strata are everywhere very much disturbed and shattered. Granite dykes cut the sedimentary rocks, which are faulted, crushed and folded. Dykes of diorite, felsite, and porphyritic rock also play an important part in this connection. The mines have been developed where the greatest disturbances seem to have occurred. A notable instance of this is seen in the Gold Mountain mine.

West of the San Bernardino Range, gold is found at intervals for a long distance through the San Gabriel Range into Los Angeles County. The westernmost occurrence is at the Dawn mine, on the south slope of Mount Lowe. Farther east, gold has been found in the gravels of San Gabriel Cañon, and on the west slope of Mount San Antonio, as well as on its north and east slopes, where some placer channels have been worked.

Discovery of Gold in San Bernardino Range.

Prospecting had begun in the San Bernardino Range as early as 1859, and in May, 1860, substantial discoveries of this metal were made in Holcomb Valley and Bear Valley, and productive mining began in the same year. About the same time, gold was found in the placers of Lytle Creek. Here in 1867 a New York company installed a plant for hydraulic mining and operated for some time with an extraction, it is said, of $2000 per week.

Placers of Lytle Creek.[5]

This creek has its source on the east slope of Mount San Antonio, where are the headwaters of its North, Middle and South Forks, and the auriferous gravels are found from the slopes of Mount San Antonio to near the mouth of Lytle Creek Cañon. The gold is mainly in river terraces, which rise 150 feet or more above the valley bottom.

From the mouth of the cañon northwesterly, 5 miles to Pratts, there is more or less pay dirt, and considerable work was once done here. The available places, however, are nearly exhausted, and work has been discontinued for a long time. At Texas Point, some $80,000 is reported to have been taken out by the hydraulic process, which was here first used in this county. Above this point the bottom of the ravine spreads out in flats, covered by large granite boulders.

Quartz veins, bearing gold, occur at many places among the cañons and on these, more or less mining has been done in past years, but none of them are now actively worked.

The placers were first worked in 1860 and since that time some gold has been recovered at intervals.

In June, 1894,[6] fifty men were at work along the stream, and this number was augmented almost daily by new arrivals, until upwards of

[5]Rept. XII, p. 233; XIII, p. 324.

100 men, mostly working independently, were engaged in gold washing. Four miles above the old Texas Hill mines, hydraulicking was carried on in a small way, and it was generally believed that all the miners engaged in sluicing, rocking and hydraulicking, were doing well.

At present, 1915, little is being done except with dry washing machines; since the heavy drafts made on the water supply by agricultural areas near Rialto interfere greatly with the use of water for mining.

San Antonio Placers.[1]

On the northern slope of San Antonio Peak, at an elevation of 8140 ft., an old river channel of auriferous gravel was discovered in the summer of 1882. In many respects this gravel resembled that of the Pliocene beds so extensively worked in the middle and northern counties of California. The gold was 900 fine. This channel was developed by three companies, each owning 1500 feet of ground.

In 1889 the Bald Mountain gold mines were in successful operation; the width of the channel, ascertained by crosscuts being 200′ to 250′. Its course was northwest. The workings of 1889 were on the westerly rim of the channel.

Water was obtained from melting snows and caught in reservoirs of small dimension. It was used under 300-ft. pressure head through a 6-inch pipe, with 2½″ x 3″ nozzle.

The season was necessarily short, commencing in May and ending in November. The gravel first passed over a grizzly, then through three 16-foot boxes, 16″ wide and 24″ deep, set at 16″ grade to the box.

Quicksilver was not used in the boxes or ground sluices, but in the under-currents; cross riffles, 2″x4″, 1½ inches apart, were used in the boxes, set at a sharp angle.

The mine was worked only by day, but the yield was reported at $8.00 daily to the hand. Six men were employed.

At the head of the San Gabriel Cañon in Los Angeles County, northwesterly from this point and at about the same elevation, the same character of gravel was seen.

The gravel banks of the San Gabriel River were claimed to be rich, and several companies were formed to work them, but for some reason all the projects fell through. At one time an English mining company was organized but suspended after incorporating and selling a few shares of stock.

Bear Valley District.[2]

This district lies along the valley of Bear Creek, southeast of Holcomb Valley district, and 25 miles northeast of San Bernardino city, occupying part of T. 3 N., R. 1 E. and R. 1 W. It is situated on the

[1]Rept. IX, p. 237.
[2]Report X, p. 522; XII, p. 229; XIII, p. 320.

northerly slope of Mount San Bernardino at an elevation of 5000 feet above sea level. It is well timbered and watered, the forest consisting of conifers of large size, suitable for lumber, much of which has been sawed in the valley. A project was long ago mooted to construct a large V-flume for floating timber, which would have been of advantage.

At the outlet of the valley, a substantial and costly dam was built having a capacity to store 8,000,000 gallons of water. The dam abuts against the rocky sides of the narrow gorge that forms the outlet, arching inward, with the arc of a circle 345 feet in diameter. It is 20 feet wide at the bottom and slopes up to 3 feet of width at the top, which is 60 feet above the bedrock foundation. This dam is considered able to withstand 20 times the pressure to which it will be ordinarily subjected when the reservoir is full. The structure is composed of large granite blocks, quarried on the banks of the reservoir, laid in Portland cement, and the interstices are filled with beton. One thousand six hundred barrels of cement were used. The lake formed by the dam, known as Great Bear Lake, extends over 5 miles back into Bear Valley, with an average width of 1 mile and a depth of 12 feet.

This mining district is wholly a placer field, and has been worked at intervals since 1860, but nothing is being done there now.

Along the spurs extending into Bear Valley from the high hills on the south may be seen remnants of an ancient river channel. The wash consists of well rounded pebbles and cobbles of granite, quartzite, slaty rocks, and some eruptives, all of which are foreign to the immediate neighborhood, except the granite. This wash material is bedded in coarse granite sand. The cemented wash was "prospected," as was also the concentrate from natural erosion in some of the adjacent gullies which cut the deposit, but in no case was gold discovered. The cemented wash is usually covered with a heavy accumulation of angular and sub-angular cobbles, mostly of quartzite and fine granitic sand and rock fragments.

The Rose Mine[9] (quartz) is in T. 2 N., R. 3 E., 65 miles northeast of San Bernardino, and about 15 miles east of Great Bear Lake. Geologically the mine is an unusual one, consisting of a succession of ore shoots or chambers along a line of fracture which extends east and west, dipping about 45° N. The fissure cuts at a small angle through crystalline limestone, quartzite, and mica schist, being usually accompanied by a granite dike which is never absent where an ore body is found. The ore bodies occur in regular form and size, and are chiefly a mixture of quartz and calcite, with a varying but usually large amount of scaly hematite (sometimes containing as much as 45% of iron). The gold occurs in a greater or less amount, depending on the

[9]Report XII, p. 334.

proportion of iron. Heavy hematite ore has been shipped in considerable quantity, containing $200 to $500 per ton in gold. Owing to the fact that the gold is covered with a film of iron oxide, a simple stamping of the ore has been found insufficient to render the particles easily susceptible to amalgamation, and a subsequent grinding of the tailings has been resorted to with good results. The mine is equipped with a 5-stamp mill and grinding pan. In 1894 a large quantity of tailings were reground. The main incline, at some distance from the surface, passes from the fissure into the hanging wall. This shaft is sunk at a point where the series of ore chambers reach the surface. As depth is attained, the ore passes to the west, and at the bottom of the shaft, 450 feet in depth, the ore lies nearly 300 feet west. The lower western portion of the mine was being diligently prospected in July, 1894, for new ore bodies, with very favorable indications of the close proximity of a "shoot." That portion of the property lying east of the main shaft, while not neglected, has received comparatively little attention, and the existence of an ore body in that direction remains to be determined. No considerable amount of crosscutting has been done, though the appearance of the ground, in many places, suggests the advisability of such a course. The high grade of the ore and its unusual geological features attracted much attention, and were an incentive to a large amount of prospecting in the vicinity. This mine is now being worked under lease to O. J. Salisbury, Fret Bldg., Salt Lake City, Utah. The Morongo Mining Company of Riverside, Cal., owners.

Christie Mine (quartz). See Report XII, p. 231. This is near the head of Lone Valley, adjoining the Rose mine on the west. The ore shoot discovered in the Rose mine, near the surface, was found to pitch west into the Christie, as depth was attained. The development consists of a vertical shaft.

Gem Mine (quartz).[10] In Lone Valley, 45 miles east of Victor, adjoining the Christie mine on the north. It has a 4′x7′ two compartment shaft, 90 feet deep. There is no machinery at the mine. A. G. Watts was formerly the owner.

Gold Mountain Mine[11]. This is in Secs. 6 and 7, T. 2 N., R. 2 E., 7 miles northeast of Bear Valley Lake, and 36 miles east of Victorville, at an elevation of 7000 feet, on a quartzite mountain 8000 feet in altitude, overlooking the Mojave Desert. The surface formations are quartzite, schist, granite, and silicified limestone, while the ore is on the contact between quartzite and schist. The quartzite is greatly shattered, and in some places crushed and pulverized. In those portions which sustained the greatest amount of crushing, irregular bodies

[10]Report XIII, p. 321.
[11]Report XII, p. 232; XIII, p. 322.

of massive quartz have been formed, and these quartz bodies contain the greatest amount of gold. A close inspection of the quartzite at some distance from any of the ore bodies of this mine shows the frequent occurrence of finely disseminated pyrite. From this it appears that the crushing of the quartzite afforded an opportunity for the deposition of the pyrites in considerable quantity through large areas of the rock, and also for the infiltration of gold-bearing solutions derived from the normal rock, into those portions prepared by crushing for their reception, thereby mineralizing the crushed zones. That all, or nearly all, the stained quartz contains gold in small quantity there is little doubt.

Water is obtained by pumping, from an artesian well and from what is known as "Baldwin Lake." The 40-stamp mill, once on the property, was burned, after which time nothing was done until 1893, when a new experimental mill and cyanide plant were built. These were abandoned after a short trial.

This property was formerly owned by the De Lamar Gold Mountain Mining Company and at that time was controlled by E. J. Baldwin and associates of San Francisco. Until recently it has been owned and operated by T. H. Oxnam, late of Los Angeles and Victorville, but now deceased. The company's name is **Gold Mountain Mines Company** with offices at Doble, San Bernardino County. The officers were: T. H. Oxnam, president; A. B. Menefee, secretary.

The Black Hawk District.[12]

The Black Hawk District is located 40 miles by road southeast of Victorville in the north side of the San Bernardino Range. The topography of this region is marked by some notable features. Traversing it centrally and opening out on the Mojave Desert is a deep gorge known as Lookout or Black Hawk Cañon, with a heavy gradient and precipitous sides; that on the west being in places almost vertical. Towering above the walls are rough crags of granite gneiss and porphyry. Striking across the broken and rocky region is a heavy belt of stratified limestone 5 or 6 miles in width, overlying a lode, or more properly speaking, a bed of auriferous quartz mixed with spar, which can be traced on its exposure for a distance of 2 miles on the west side of the cañon. This ore bed is soft and loose, and is underlaid for the greater distance with porphyry, changing at some points to syenite and micaceous slate. Its average thickness is 30 ft., though it varies from 10′ to 50′. It dips to the southwest at an angle of 35° to 45°.

The pay ore occurs in chimneys or shoots, separated from each other by intrusions of porphyritic rock. These shoots vary in length from 150′ to 900′.

The district was organized about 1870 but it was not until 20 years later that any effective work was done there. An English syndicate

[12]Report IX, p. 226; X, p. 524; XI, p. 364; XII, p. 230; XIII, p. 320.

undertook extensive operations at the Black Hawk group, and they planned to build a 60-ton mill; however, the quantity of ore proved to be smaller than had been anticipated, and a small mill was erected, which was run only a short time.

There has been very little mining done in this district in the past 10 years and that, mostly by prospectors.

The Black Hawk Group, consisting of 23 claims, was first worked in 1890 by the English syndicate mentioned above. They drove 6 tunnels, varying from 40′ to 100′ in length, and numerous open cuts. A 10-stamp mill was erected and a pipe line laid at a cost of $80,000, to bring water to the mill from a group of springs owned by the company 7 miles to the southwest. The mill was operated by steam power and wood was used for fuel. This was a heavy item of expense, wood costing, delivered at the mill, $4.00 per cord. The company operated only a short time and the mill was removed. The property is now idle.

Bibl.: Report IX, p. 226; X, p. 524; XI, p. 364; XII, p. 230; XIII, p. 320.

Holcomb Valley District.[18]

This district lies principally in T. 3 N., R. 1 and 2 E., S. B. M. It is bounded on the north by the Mojave Desert, east by the Black Hawk District, south by the Bear Valley District, and west by the San Bernardino range. The annals of San Bernardino County state that prospecting for gold began in this county as early as 1859, the miners meeting with good success. The first pay dirt in this valley was found by Jack Martin and W. F. Holcomb. The news caused a great rush, and in a short time a number of prospectors were at work panning dirt. In May, 1860, W. F. Holcomb and Ben Ware located the first claims in Holcomb Valley, 5 miles north of Bear Valley, and for two or three years these valleys formed an organized district. Men rushed in from all parts, settlements were formed, and stores, hotels, restaurants, etc., flourished. The diggings were shallow and easily worked; consequently, they were worked out in a few years. About 1870 a 40-stamp mill was erected at Gold Mountain, near Bear Valley, but soon after was destroyed by fire. This was followed by a 5-stamp mill near the site of the former mill, but it was never used and was finally removed. In 1876 a 10-stamp mill was built in Bear Valley, but this, too, proved to be a disastrous investment, in spite of the fact that "Lucky Baldwin" was one of the owners of the property. About 1887 an English company was formed by Alex. Del Mar, extensive plans were made and a large amount of money expended, but the difficulty of obtaining water and fuel proved to be too great a handicap. Today increased facilities for working have greatly improved the condition of this district. Most of the past failures were due to poor management, and some large enter-

[18]Report X, p. 523; XII, p. 233; XIII, p. 323.

prises now being inaugurated, if backed by ample capital under competent superintendence, ought to prove successful. At the present time little is being done in this valley.

The Holcomb Valley Company, Ltd.,[14] of London, owned in Holcomb Valley a large tract of placer ground, which, after several unsuccessful attempts, they were sluicing in 1894, on quite an extensive scale, employing a steam shovel, a separating machine, and elevators, the latter being used to dispose of the coarser tailings. The gold-bearing material, as then described,[15] was not "gravel" in the ordinary sense of the term, but angular, granitic detritus, containing very few washed or rounded stones. The material was mostly fine. Occasionally cobbles occurred, but these were exceptional. The gravel was overlain by 4′ to 8′ of light, loamy material, while the substratum contained more clay, and was also richer in gold. In 1894 active operations were going on. A ponderous steam shovel mounted on a flat car was moved forward and backward as required, on a track laid on a crib of timbers. The machine was advanced, from time to time, toward the bank of alluvium. At each load it took up about a cubic yard of gravel, and sometimes more, and dumped it into a hopper which, through a feeder, discharged into a revolving screen. This caused a separation of the coarse from the fine material. The coarse pebbles and cobbles passed through the screen cylinder and were taken up by the buckets of a conveyor, which delivered them to a belt conveyor, arranged so as to deposit the tailings on the bank of the cut 30 feet distant. The finer material passing the meshes of the screen dropped into a sluice box beneath, and was carried by a stream of water over riffles and blankets. The fine tailings were conducted through a half-round steel flume, at the foot of which they were shoveled out of the tail race by hand.

The capacity of the plant was from 1000 to 2000 yards per day, depending on the water supply, which, during 1894, was very low. The management felt considerable satisfaction at the operation of this plant, as it was the only means so far employed which promised success to the undertaking. Since which time the property has been idle.

Holcomb Valley Mining Company (placer). This company owned a tract of placer ground near the head of Upper Holcomb Valley. During June, 1894, a shaft was sunk and a large quantity of water was encountered, but it was hoped that by continued pumping bedrock could be reached.

It is said that a large amount of coarse gold has been taken from the upper part of the valley. Holcomb Valley Mining Company of Los Angeles, owner, J. Burnap of Los Angeles, superintendent.

[14]Report X, pp. 520–523.
[15]Report XII, p. 233.

Morongo District.[16]

This is a gold and silver district in the San Bernardino Mountain Range at an elevation varying from 5000 to 6000 feet. It is in T. 2 N., R. 5 and 6 E., S. B. M., and lies 46 miles north of Seven Palms Station, on the Southern Pacific Railroad. It is bounded on the northwest by the Black Hawk District; on the northeast by the desert; on the south by the watershed of the Whitewater River and on the west by the Oro Grande District. Water and timber are plentiful and a large amount of profitable work was formerly accomplished. Of late years interest in this region has declined, and but little work is now carried on.

The most extensively developed lode in this district is the Morongo King, which, together with the Overly Scott and the Glasgow, constituted the **Morongo King Group** of mines. These 3 claims are on one lode, having a general northeast and southwest strike, and dipping about 65°. The vein outcrops for several hundred feet. On the Morongo King a shaft was sunk to a depth of 180′. At 100′ two drifts were run on the ledge for a distance of 30′. All these workings showed pockets of free-milling gold ore, of which between 80 and 90 tons were formerly on the dump. This ore carries a large percentage of sulphides. Eighty feet northeast of this shaft another was sunk 30′ on the vein, which here shows a width of 4½′. Near the north end of the Overly Scott claim a 14-foot shaft shows a 7-foot vein of similar ore.

The **Nichols Mine** was opened by four shafts sunk on the vein, which was 12′ wide, and contained high-grade ore. The shafts were 100′, 70′, 38′ and 20′ deep, respectively, and there seemed to be a good prospect of developing a valuable property.

Not far from the above mine was the **Rattlesnake** claim, on which a good deal of work was done, developing a fine body of ore that carried from 40 to 60 ounces of silver per ton, and a small amount of gold.

Five miles west of the Morongo King mines wood and water were to be had in fair supply. Antelope Springs, 1½ miles to the east, also afforded enough water for the use of the mill. On the **Capital, Scandalosa,** and **Monitor** claims, shafts were sunk varying from 10′ to 50′ in depth, each of which showed fair prospects in gold. There were several other lodes in this district which seemed to carry either gold or silver, and sometimes both, in paying quantities.

DESERT VEINS.

Arrowhead District.

This district at the southwest end of the Providence Mountains adjoins the Trojan District on the south in T. 9 N., R. 13 and 14 E., S. B. M., and is 28 miles west from Fenner, on the Santa Fe Railway. From 1883 to 1887 considerable work was done in the district, several arrastras having been worked by Mexicans on the gold-bearing ores,

[16]Report VIII, p. 504; IX, p. 226; X, p. 526; XII, p. 234; XIII, p. 324.

which yielded from $30.00 to $50.00 per ton. The veins have a north and south trend, and can be traced for a considerable distance, the walls being granite and porphyry. For several years, until recently, the district has remained dormant, but a new era seems now at hand and it gives promise of heavy production. Several properties were recently being developed, the most important being the Hidden Hill, because of its previous large returns and the ore now blocked out ready for treatment.

Hidden Hill[17]. This mine, which is on the east slope of Providence Mountains, 20 miles north from Fenner, was located in 1882 by Messrs. Thompson, Miller, West and Cook, and comprises three claims and a fraction, i.e., Hidden Hill, Bill McKinley, Golden Queen and Golden Queen Fraction, covering 70 acres. A company was formed and at present the officers are as follows: Frank Crawford, president; T. J. Murphy, treasurer; A. D. Nescus, general manager, with offices at Needles.

The most promising workings thus far are on the Golden Queen claim, the deposit being of quartz, carrying gold and copper.

At present all ore exceeding $50.00 per ton in value is shipped to the smelter, but it is said that the company contemplates the erection of a concentrating and amalgamating plant to treat the lower grade ores.

The **Mable Group** is three miles north of the Hidden Hill Mine in the Providence Mountains. Development consists of two shafts, 140′ and 65′, respectively. In No. 1 shaft the vein is said to be 4 ft. wide, with pay streak 14″ wide carrying values that run from $120 to $500 per ton. Considerable high-grade ore has already been shipped to the Needles smelter. Thomas A. Gannon is the owner.

Dale Mining District.

Dale is near the south boundary of San Bernardino County, in T. 1 S., R. 12 E., S. B. M., about 45 miles south of Amboy, on the Santa Fe Railway, and 50 miles north of Mecca, a station on the Southern Pacific Railroad, 90 miles east of Banning.

The first locations in this district were made in the early '80s, and work has been carried on in a small way ever since until during the last 5 or 6 years more active and systematic work has been done.

There are many properties located all over this district, extending over a territory of some 8 or 10 square miles, but the main properties which are now being developed are confined to an area of about 4 square miles.

[17]Report XIII, p. 323.

The following are the principal properties:

Supply Group
O. K. Group
Brooklyn
Virginia Dale
Ivanhoe
Carlisle
Leota
Bon Ton
and others less known.

The **Supply Group** is at an elevation of 2,350 ft. and covers 530 acres. This property is the most important one of the district, and for many years was a regular producer, having yielded over $250,000. The mine is opened by a 1100′ shaft and over 5000′ of underground workings. The shaft is equipped with a 50 h.p. Fairbanks-Morse hoist. The mine was operated for several years under lease and bond by the United Greenwater Copper Co., 30 Church St., New York, at which time about 80 men were employed. The ore was treated by dry crushing and direct cyanidation. Capacity of mill, 100 tons per 24 hours. Gas engine supplied the necessary power. Ceased operations in the winter of 1915 and the property is now idle. Owner, H. A. Landwehr, Union Oil Bldg., Los Angeles.

O. K. Group. This property, also owned by H. A. Landwehr, is now developed to a depth of some 800′ with laterals and drifts of over 100′. Elevation 2350′. This mine has produced around $200,000 in gold, and has a 10-stamp mill and cyanide plant of 50 tons capacity, modern in every way. The shaft is equipped with a 25 h.p. Fairbanks-Morse gasoline hoist. This property was also under lease to the United Greenwater Copper Company, but no development work is now being carried on. Water was pumped from a well at Dry Lake, which is close by.

Brooklyn. The Brooklyn Mining Company of Highland, Cal., owns the Brooklyn Group and the Los Angeles Group. The Brooklyn Group is developed to a depth of 650′ or 700′ and is a producer at the present time. This property is equipped with a Nissen stamp mill and cyanide plant and 8 or 10 men are continuously employed.

Virginia Dale Group.[18] This important group of claims owned by the Sigafus Estate of Riverside, is developed to a depth of some 350′. Drifts and laterals are developed to a distance of some 500′ or 600′, and the mine is equipped with a Lane mill, built about 6 or 7 years ago. This mill was not operated to any great extent, only about 1000 to 1500 tons of ore having been treated. The veins are from a few inches to 2 feet in width. Active work was commenced on the group in the

[18]Report XIII, p. 314.

summer of 1896, at which time a 5-stamp mill was moved there from Twenty-nine Palms.

Ivanhoe. Developed to a depth of 250′ or 300′, and is also equipped with a mill and cyanide plant, but has not been operated beyond doing the assessment work during the last 4 or 5 years owing to the differences of opinion among the stockholders.

Carlisle. Opened up quite extensively and has changed hands within the last few months, and development work is carried on steadily and continuously. It is said considerable ore has been developed, and that the erection of reduction works is now contemplated.

Exchequer Mine. This property is owned by John McGrath and Al McRae, of San Bernardino, and comprises 100 acres. It is four miles south of Dale, at an elevation of 2000 ft., and the development work consists of three shafts, 110′, 100′ and 40′, respectively, with a 50-foot drift in the 100-foot shaft. It is equipped with a roller mill made in San Bernardino, and 20 h.p. gasoline hoist. The property is now idle because of lack of water.

The **Other Properties** referred to have been developed in a small way to a depth of 100 feet or more; some drilling also has been done, but most of the work carried on has been the necessary yearly assessment work. The district as a whole has a promising future; it is well mineralized and the veins are easily traceable for some distance. While here and there rich bunches of ore have been encountered at various times and places, there is nothing to prove that it will make a high-grade camp. All indications point toward a medium grade ore averaging around $10.00, with veins from 2½′ to 5′ wide, and amenable to treatment. Where amalgamation has been carried on, from 60% to 75% of the values have been saved on the plates. Amalgamation and cyanidation have saved from 90% to 97%.

The main drawbacks to operating in the district are that it is isolated and inaccessible from the railroad, and the cost of development work has increased considerably, owing to the expense of freighting, $20.00 per ton freight from the railroad points being the usual charge.

Water supply has been also somewhat of a drawback, yet this is not now a serious hindrance, as ample water can be had in the district within a reasonable distance. The fact, however, that the mines are dry and the ground easily worked, and that timbering, while necessary, is not burdensome, is greatly in their favor. Heavy ground has been encountered in a few places, but not to an extent to warrant comment.

Since the cessation of work by the United Greenwater Copper Company in 1915, very little actual mining has been done in that district, other than yearly assessment work.

Goldstone District.

The Goldstone district lies 33 miles north of Barstow on the Mojave Desert at an altitude of 3500 ft. above sea level. This district comprises an area of approximately 8 miles by 4 miles, which lies in a general northwest and southeast direction. It is reached by automobile stage from Barstow over a fairly good desert road.

In the following description of the geology of the district, we have drawn freely from the report of A. E. Rau,[19] who made a comprehensive study of this region.

The district is of sedimentary origin, the center of which lies in a basin, surrounded with low hills. It is in these low hills that the recent discoveries have been made. Originally the area was flat, the result of deposition from lakes and seas. In these depositions limestones, shales, etc., alternated. At the end of the Tertiary or beginning of the Quaternary age an upheaval, probably due to the intrusion of a great dyke, tilted these sediments to the dip they now have. (*See* Plate I.)

The stratifications have no tendency to bend to the horizontal and this main dyke along the axis is fairly vertical and shows continuity throughout.

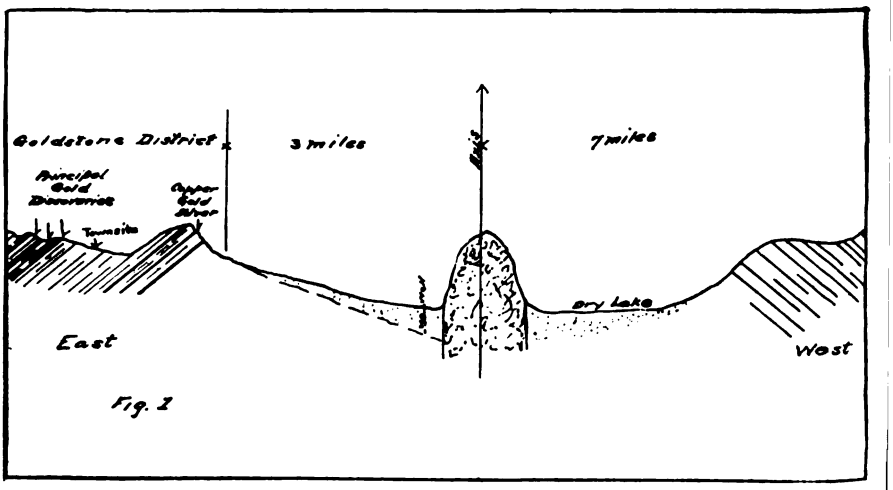


Plate I. Geological cross-section through Goldstone and country to eastward. By courtesy of A. E. Rau.

The sediments have been intruded by a system of minor dykes which run through the country in a general northwest direction and lie parallel to the limestones, shales, etc. These minor dykes are dioritic and are probably due to the same or a slightly later eruptive period. They are partly metamorphosed and influenced the metamorphism of the sediments, mainly along the contacts, causing the impregnation of the sediments with quartz often at distances from the dykes. (*See*

[19]The Goldstone District, by A. E. Rau, Mining and Oil Bulletin, Chamber of Mines and Oil, Los Angeles, June, 1916.

Plate II.) The greater part of the mineralization is found in the quartz bodies contiguous to the dykes. Much of the vein filling resulting from this metamorphism is found in the limestones and is therefore irregular.

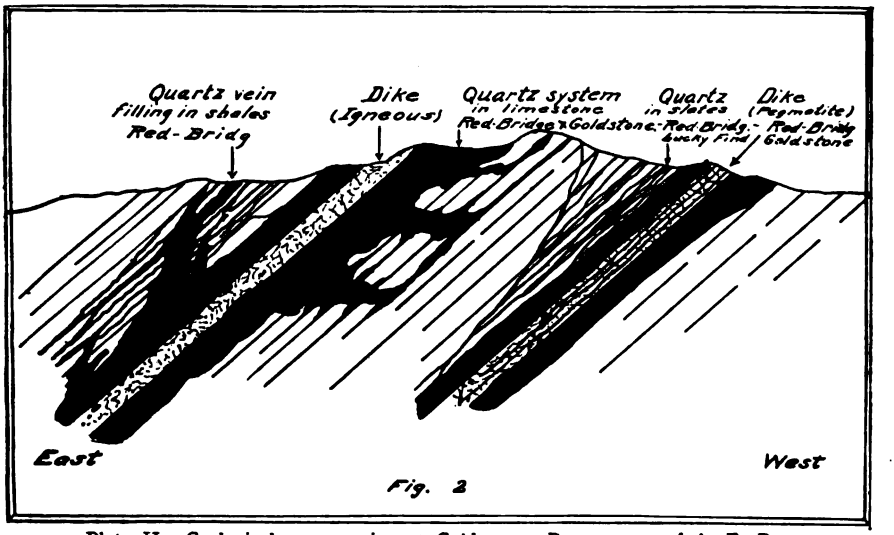


Plate II. Geological cross-section at Goldstone. By courtesy of A. E. Rau.

Many fine specimens of gold-bearing quartz have been found near the surface. These rich depositions are due to surface enrichment resulting from erosion, and redeposited near the surface. All of the valleys of this region are enriched with placer material. Besides the free gold, pyrite, galena, chalcopyrite, malachite, and argentite have been uncovered.

The original discovery was made in December, 1915, but no active work was undertaken until the following March. The district has now been practically covered with claims and considerable activity was manifested during the summer. The two companies described below control the greater part of the field and numerous lessees are working their claims.

Water is hauled to the camp from the Seeber well in the valley, 3 miles to the south, and sold at 1½c per gallon.

A boarding and lodging house have already been built, and the miner is charged $1.00 daily for board. Miners' wages are $4.00 per day, or $3.00 per day and board.

A small quartz mill is now being erected at Seeber well by Mr. Bellander of Los Angeles, which will be operated as a custom mill. Expect to commence milling October 1, 1916.

Goldstone Mining Company has five groups of claims in this district and is sinking a 2-compartment shaft on the site of the original dis-

covery. Most of the work done so far has been open-cut work with the idea of locating the various veins. About 40 tons of ore averaging $200 per ton were shipped during the early summer. There are a number

Photo No. 8. Camp of Goldstone, looking southwestward. Photo by Ralph Roseberry.

of lessees working on the different claims and considerable good ore has been uncovered. The company is drilling for water and hopes to develop it at a depth of a few hundred feet. Ore is now hauled by

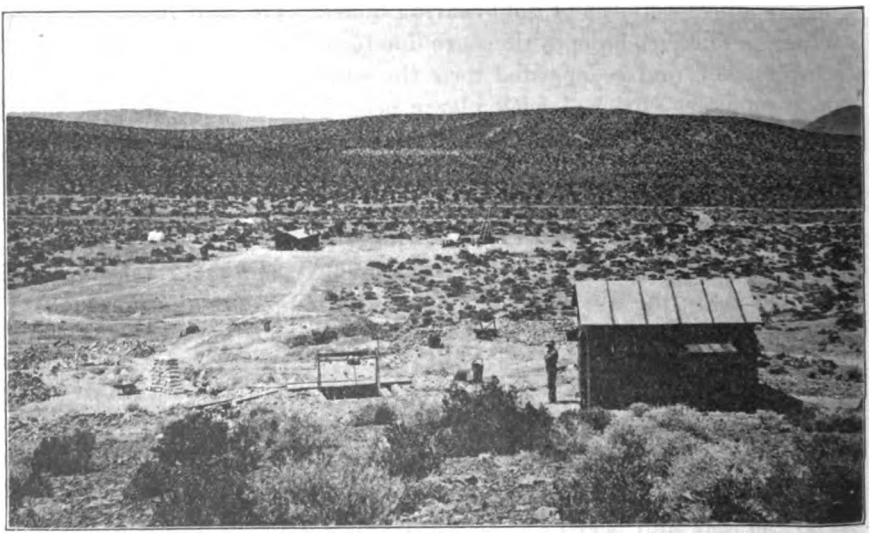


Photo No. 9. Main shaft of Goldstone Mining Co. High grade ore sacked ready for shipment—in the left foreground.

motor truck to Barstow at a cost of $6.00 per ton. It is expected to install machinery this fall and operate on a larger scale. Chapin C. Rumrill, president; G. M. Leonard, secretary; Albert C. Turner, con-

sulting engineer; main office, Springfield, Mass.; home office, Barstow, Cal.

Red Bridg Gold Mines Company owns 9 full claims and 3 fractions adjoining the property of the Goldstone Mining Company. This company has about 30 lessees on its property. Each lease consists of 200 ft.

Photo No. 10. Open cut work at original strike at Goldstone Mine. Shaft in background.

on the lode by the full width of the claim. The work so far done has been mostly open-cut and considerable high-grade ore had been sacked and ready for shipment at the time visited. They expect to start operations on company account during the late fall. W. B. Redfield, president and general manager; Thos. L. Henderson, secretary, Barstow, Cal.

Ivanpah District.[20]

This district is 100 miles northeast from Daggett, and near the Nevada state line. It is in T. 17 N., R. 13 E., and about 80 miles north of Fenner, on the Santa Fe Railway. The silver-bearing lodes, though not large, are considered rich, several of them being well developed. Two small mills were at one time running. This was originally a silver camp, but later some gold prospects have opened. (*See* under Silver.)

Mescal District.[21]

This is 9 miles northwest of Ivanpah and 90 miles north-northwest from Fenner, a station on the Santa Fe Railway. The veins, though not numerous, are of fair size, and carry a good grade of gold-bearing

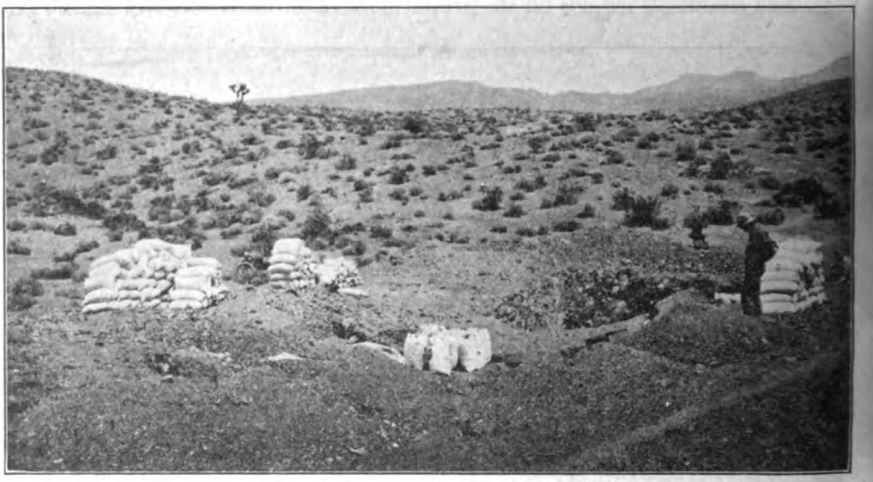


Photo No. 11. High grade ore sacked for shipment at the Red-Bridg Mine.

quartz. The **Cambria Mine**, upon which most of the development work has been done, was opened by two tunnels run on the ledge 300′ in length. A 10-stamp mill was operated on ore which yielded $20.00 per ton in free gold, the bullion ranged from 938 to 990 fine.

Ord District.[22]

This is bounded by a very irregular line, having T. 10 N., R. 2 E., near its center, the principal group of mines being 14 miles south of Daggett.

"It is an arid, timberless, and almost waterless area, its surface being divided between rugged mountains, sandy plains, and low-lying alkali flats. Although an old district, organized about 1870, Ord has not produced much bullion, only one small mill having been erected there, nor has the population ever been large. It contains many veins, on some of which a large amount of work has been done, the entire expenditure aggregating, it is said, $40,000. The altitude of these mines averages about 4500 feet above the sea. They are in granite. Fourteen locations of 1500 feet each were made, nearly all the property of the Painsville Company, which obtained U. S. patents for most of them, and worked on them for several years. About one-half of these claims, at the northerly end of the series, carry some copper and silver as well as gold, the balance being strictly auriferous. For a short distance beneath the surface the ores were much decomposed and were free

[21] Rept. X, p. 532.
[22] Rept. X, p. 528.

milling, the sulphides of iron and copper coming in at greater depths. The ore occurred in shoots, which, so far as explored, ranged from 200′ to 400′ in length.

Photo No. 12. Open cut mining at Red-Bridg property, showing face of metamorphosed sediments. Photo by Ralph Roseberry.

"The veins have a north and south strike, and dip easterly at an angle of 70°, the ore chimney pitching south. The principal mines were the Painsville and Rio Vista, on which several shafts were sunk and connected by drifts. Considerable work was done on the Last Chance, Central, Modesto, Josephine, and Coupon claims. On the latter was a vein 60′ wide, as shown by cross-cutting. A number of shafts were sunk and a long tunnel driven, it being possible to obtain, by tunneling, backs of more than 800 feet. The great body of the ore developed in this district was of little value, as it carried an average of only $8.00 per ton in gold, not enough, it was said, to pay the expense of working on the ground or of shipment. With improved facilities for either, it might become proportionately valuable, as it was said to exist in great quantities. A few small springs supply all the water to be had in the district.

"In the southwest part of this district, at a point 12 miles north from Babbitt Springs, a rich deposit of chloride or hornsilver, with some gold, was struck in the fall of 1889. Several small lots of this ore sent to Selby Smelting Works yielded large returns. As but little work was done on this vein, which was narrow and occurred in limestone, its actual or even prospective value was not determined. Much prospecting was induced by this strike, but did not result in any valuable discoveries. This claim was known as the Cox."

The following other properties were known in 1914:

Gold Peak Mine. This property, owned by J. C. Turner, of Victorville, is located 37 miles northeast of that town, at an elevation of 4000 feet. The deposit is a fissure vein in granite, on which a shaft 210 feet has been sunk, and several feet of drifting done. This mine has, it is said, produced $40,000 to date, most of the ore having been treated in a custom mill 8 miles distant. This mill has lately been acquired by the owner of the Gold Peak mine.

The Gold Brick Mine, comprising 60 acres, is owned by George B. Parks and T. C. Nicklin of Barstow; the claims being known as Gold Brick, Gold Coin, and Golden Eagle. Most of the work has been done on the Golden Eagle, on which is a 100-foot shaft and 70 feet of drifting. The property is 20 miles south of Daggett, and 17 miles south of Barstow. The vein is of quartz in altered granite. It is 50 ft. wide with a 3-ft. pay streak, but is of too low grade to pay to work with the present equipment.

Osborn Group (see under Copper).

Oro Grande District.

This district, which was equally well known as the Silver Mountain Mining District, lies about the town of Oro Grande (Halleck post office) on the A. T. & S. F. Railway, and was formerly described, with respect to its limits, as follows:[28]

Commencing at Stoddard's Crossing on the Mojave River; thence southwesterly to the Panamint Crossing on the Mojave River; thence due west to the county line between Los Angeles and San Bernardino counties; thence to the southeast corner of Kern County; thence to the place of beginning, covering in all about 20 townships, in the southwestern angle of San Bernardino County. It embraces all the mines for some miles around, though in fact each group of mines or hills has been given a separate name. However, as these so-called districts are mostly without organization all the claims and mines will be considered under one head.

Victorville and Oro Grande, stations on the A., T. & S. F. Railway, 6 miles apart, are distributing points from the railroad to all of the mines and to agricultural areas that are rapidly developing. It was in this district that the earliest discoveries were made in the western part of the Mojave Desert and for 10 years prior to 1890 much work was carried on. At one time this district was the largest and richest in the county, the chief products being gold, silver, marble and limestone. Besides these, paving blocks, cement and other building materials are produced today.

[28] Report X, p. 527.

The geology of the district about Oro Grande[24] is complex, the formations being uptilted, greatly faulted, and broken, besides being intruded by dykes of felsitic rock, diorite, and quartz porphyry. The region may be described in the following general terms:

From the town of Oro Grande, which stands on the east bank of the Mojave River, the country rises eastward in a gentle slope for half a mile; thence gently rolling hills are reached, which in turn gives place to more rugged masses and finally to a rough mountainous area, the hillsides being almost precipitous. The low-lying country about the base of the hills is made up mostly of schistose micaceous rocks, quartzose mica schist predominating. The first hills of any size are eruptive, mostly of light greenish felsite and a coarse grained porphyritic rock. Beyond are prominent hills of dense, hard quartzite resting upon crystalline limestone, the highest hills being made up of practically the same materials (quartzite and limestone), in part schistose, with some mica schist, and many intrusive dykes of all the previously mentioned eruptives, prominent among them being a dark green diorite.

In 1880 when a big boom was at its height the Oro Grande Mining & Milling Company erected a 10-stamp mill to work the local ores. Many locations were made and recorded and considerable work was done.

In 1890 the Embody and Carbonate mines (silver) were opened and created considerable excitement, and in the later '90's a 10-stamp mill was erected at Victorville to treat the ores from the various mines. Following this, several mills were erected, and a smelter was built and the district flourished for a long time.

Carbonate Mine.[25] The principal mine of this district and the one which gave the camp its fame is the Carbonate mine, 1½ miles east of Oro Grande, at 3000 feet elevation. It was discovered by a man named Collins, who was working in a lime quarry nearby. Collins found croppings of ore—limonite and manganese—containing silver. He developed the property somewhat, but it finally passed into the hands of a Los Angeles company which opened the mine quite extensively.

The limestone and schist which enclosed the vein have a general trend northeast and southwest, the dip of the main workings being not over 20°. Here an incline shaft was sunk 225 feet on the vein. At the bottom, the shaft has a vertical depth of about 100 feet. Two veins of ore, consisting principally of siliceous and earthy oxide and black oxide of manganese with carbonate of lime, sometimes crystallized, were followed from the surface to the bottom of the incline. These

[24] Report XI, p. 360.
[25] See Report IX, pp. 230-233; X, p. 527; XI, pp. 361-362; XII, p. 268; XIII, pp. 33, 320, 607.

veins were very irregular in width, varying from a mere seam to upwards of 2 feet in places and averaging 1 foot.

The values lay chiefly in the lead carbonate and silver which accompanied the gangue minerals. The two veins were at the contact between massive blue limestone and mica schist. The latter is from 1′ to 4′ in width, the ore lying both above and below it, the whole being inclosed between hanging and footwalls of crystalline limestone. At various points in the workings was a light-colored, much decomposed rock, resembling felsite, which appeared to have been injected between the strata in a thin sheet. It was notable that where the buff-colored, granular rock occurred in contact with the vein an enrichment of the ore was noticeable, and its absence was marked by a low value of the ore, or no ore at all. In the incline at a depth of 40 feet, a short drift was run in on ore of good grade. At 180 feet from the collar of the shaft a discovery was made that caused this mine, and in fact the entire camp, to become a scene of great excitement.

At this place a small wedge of crystalline, granular quartz and calcite appeared, and with it, flakes of free gold. Just below the point of this discovery the wedge widened to several inches, and the rock was a mass of glittering sheets and shot-like pieces of gold. Assays of the material, it is said, gave fabulous returns. The ore was broken down on canvas, and every ounce of it sacked on the spot. It was followed down some distance but gradually thinned out below the 200-foot level, where the drifts were run, one 50′ northeast, the other 40′ southwest. From these drifts considerable rich quartz was obtained.

This mine subsequently produced considerable high-grade ore, but the work of late has been by "chloriders" and the mine is now in poor shape for working on a large scale.

The Embody Mine was described, in substance, as follows by Mr. W. H. Storms:[26]

Within half a mile of Oro Grande and on a lower spur or ridge that makes down from the hills is the Embody mine, which, during the excitement at this locality in 1890, attracted considerable attention. The gold-bearing material is a friable quartzose, micaceous rock, and the deposit has the appearance of an impregnation without definite form.

The shoot of gold-bearing ore makes across the strike of the schist, and thus the deposit differs from those of the Homestake in the Black Hills of South Dakota, where micaceous schists have been silicified and hornblende schists metamorphosed to chloritic schists, the whole carrying gold across a broad zone 1600 feet in width and 6000 feet in length. Here gold occurs in shoots or veinlike zones, without definite limits of any character. Further, too little development has been done to permit

[26]Report XI, p. 361.

of positive prediction as to the future of this mine. The formation strikes northeast, and dips 70° SE.

The country is somewhat broken up, but no considerable masses of shattered rock were observed. The croppings are quite heavily stained with red and brown iron oxides, and this evidence of mineralization can be traced for some distance. Two shafts, one nearly 100′ deep, the other about 30′, were sunk on the deposit, exposing rock of uniform character, all carrying some gold. The width of the gold-bearing zone was undetermined, but was estimated to be from 6′ to 20′.

As far as learned a "mill run" had never been made on the rock from this mine. Mining operations had been stopped and, in 1889, the property was involved in some sort of dispute. The value of the rock was stated at $8.00 to $10.00 per ton.

The **Evan Davis Group** consists of 80 acres and is 50 miles east of Victorville at an elevation of 5000 feet, the several claims being known as the Valley View, Hidden Treasure, Ben Hur and Acme, on which some development work has been done. This mine is owned by Glenn A. Davis, who has milled considerable ore (amount not recorded) with an arrastra. The country rock is porphyritic granite, but the deposit is gold in diorite.

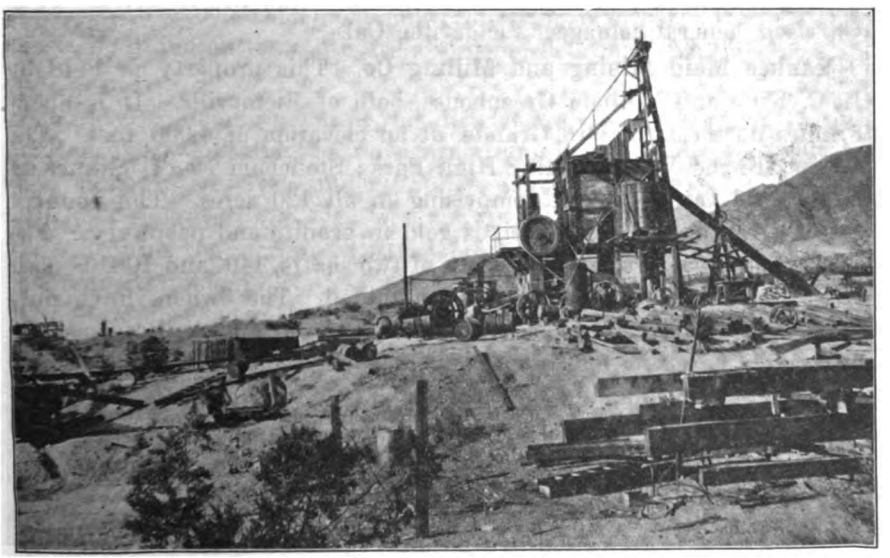


Photo No. 13. Mill and headframe at shaft of the Ozark Mine.

Ozark Mine is 9 miles by auto road northeast of Victorville and consists of 5 claims. The original location was made 25 years ago, but very little work was done up to the time of its acquisition by the present owner in 1913. Gold occurs in quartz porphyry along a contact

of rhyolite and diorite. The ore body strikes east and west and dips almost vertically to the south. It averages 115′ in width and is said to assay $6.00 per ton, with 65% of the value free milling—the remainder being in sulphides. This ore body is being developed by a 2-compartment vertical shaft, now down about 100 ft. Some drifting has been done on the 50-ft. level to determine the width of the ore body. The present work, however, is being done on a 6″ quartz stringer which outcrops about 1000 ft. south of the main contact deposit. A 110′ shaft has been sunk on this stringer and drifting is now being done along the vein at the 90′ level. The ore is said to average $50 to $60 per ton. It is reduced in a 10-stamp mill. The mine equipment consists of a 25-h. p. Fairbanks-Morse compressor, machine drills, blacksmith shop, etc. The mill is equipped with a rock crusher, ten 850-lb. stamps and two Standard concentration tables operated by a 50 h. p. Fairbanks-Morse gas engine. Expect to develop sufficient water in the shaft for working purposes. The work thus far has been entirely development and only a few test runs have been made at the mill. Company is incorporated for 1,000,000 shares of par value of $1.00, and hope to raise sufficient funds to sink the main working shaft to the 150-foot level. Six men are employed. Owner, Ozark Mining & Milling Co., 522 H. W. Hellman Bldg., Los Angeles. J. S. Garrison, general manager, Victorville, Cal.

Yankee Maid Mining and Milling Co. This property is held by L. C. King and William Greenhouse, both of Victorville. It is about 8 miles northeast of Oro Grande, at an elevation of 4,000 feet. The claims are the Yankee Maid; High Park; Stoneham No. 1, Stoneham No. 2, and Little Gladys, comprising in all 120 acres. The country rock is granite and the deposit is gold in granite and porphyry. The underground work thus far consists of two shafts, 140′ and 100′ respectively, ore from which is now being milled. The owners have purchased a mill on the Mojave River in the town of Victorville, formerly owned by Charles E. Jones of Anaheim, which is equipped with 5-stamps and a 50-ton cyanide plant. They are now repairing the mill and developing the mine preparatory to a steady run.

Oro Grande Mine.[27] This is in the mountain of the same name, and in Silver Mountain District at an elevation of 3750 feet. The gangue is laminated quartz, with a clay gouge on both walls which are porphyry and granite.

A well-timbered shaft, 6′x9′ and 250′ deep has developed the mine to that extent. There is also another shaft, No. 2, 100′ from the first, which was sunk 50′ and showed 2′ of quartz. The quartz in this mine carries pyrites and is reported to yield $12.00 per ton in free gold.

[27]Report IX, p. 227.

The remoteness of the Oro Grande property from water, however, and the cost of transportation, compelled the company to stop work, notwithstanding that it owned a good 10-stamp mill in connection with the mine.

Oro Fino Mine.[28] This property is in Silver Mountain District, 10 miles from Oro Grande, at an elevation of 3790 feet. The vein strikes east and west, and the country rock is feldspathic granite. The lode is from 6″ to 20″ wide, and carries high-grade gold rock. The mine is at present idle.

Four Brothers Mine (formerly Whatnot Mine). This is on Whatnot Hill, in the Oro Grange Range and in Silver Mountain District, 3½ miles east of the Mojave River. The vein strikes north and south with a width of from 10″ to 12″; the gangue is quartz. It is developed by a tunnel 300′ long on the vein, with shafts to the surface, and some winzes and crosscuts. The vein was found to be spotted with occasional rich ore, the assays in 1889 being $60.00 in gold, and $20.00 in silver per ton. Diorite forms both foot and hanging walls. The mine has recently been reopened and is now being worked by Scheerer Bros. (Jos. Scheerer et al., Victorville), the present owners. Water is obtained by pumping from the incline shaft of the Scheerer Gold mine (formerly Black Diamond), one mile east of the Whatnot. Three other claims adjoining on the south are also being developed for tungsten.

Steadman District.

The only producing mines of this district are the old **Bagdad, Chase** and **Roosevelt Consolidated,** now owned and operated by the **Pacific Mines Corporation.** See under Copper, page 16.

Twenty-nine Palms District.[29]

This adjoins the Morongo District on the east, includes the greater portion of T. 1, 2 and 3 N., R. 8, 9, and 10 E., being near the vague and not well-defined boundary between the Mojave and the Colorado Deserts. There are many metalliferous lodes in this district, most of them gold-bearing. They are rather narrow, ranging from one to three feet in width. While many of these lodes have been prospected, but little deep work has been done. Some of the ore worked years ago by arrastras yielded as high as $100 per ton, and nearly all of that worked by the two small mills in the district has been of high grade.

This district being well out in the desert, neither wood nor water is in large supply. There are, however, several large springs in the vicinity. From one of these issues a stream sufficiently strong to flow for three miles before it disappears in the sand. Most of this flow could be dammed and stored, there being near the spring a suitable site for a reservoir.

[28] Report IX, p. 228.

Although mineral-bearing lodes are known to exist east of this locality, no mining districts have as yet been organized in that region.

Vanderbilt District.[20]

This district is situated among the hills which form the northeastern end of the New York Mountains. It is reached by the Ivanpah branch of the Santa Fe Railway. The geology of the district is simple. The rocks of the region are chiefly gneissoid and schistose, granitic and hornblendic rocks, intruded by pegmatitic dikes. The strike of the country rocks, over an area of 20 square miles of this region, is almost uniformly north and south, the dip varying, but usually nearly perpendicular. The eastern borders appear to become more gneissoid, and contain more hornblende than the section immediately about the village, and westerly is found a belt of limestone, beyond which occurs granite of normal type. Large dikes of rhyolite and vitrophyre occur in these western granites, and ferruginous quartz veins which contain some gold, but are usually low grade and not of a character to attract much attention.

The veins are grouped in systems and have direct relations, and are due to common causes, viz: the fissuring of the rocks; the injection of dikes along many of the planes of weakness thus formed, a subsequent movement of the rocks, and later, the deposition of ores in those fissures.

Very little work is being done in the district and the following are the only companies operating:

J. Z. Barnett Mining Company, Adolph Johnson, president; H. H. Hodge, secretary; own 8 claims in the New York Mountains, 12 miles northeast of Lanfair at an elevation of 5500 feet. Development consists of 3 shafts and a couple of thousand feet of underground workings. The main working shaft is 300 feet deep and is equipped with a 15 h.p. Fairbanks-Morse gas engine hoist. The ore is shipped to the Selby smelter. Three men are employed.

The Vanderbilt Development Company, No. 301 Storey Building, Los Angeles, is working a property in this district, and made shipments of high-grade ore during 1915.

Other Districts.

There are numerous prospects and some few mines scattered over the desert in other localities than those specifically described above. The following is a list of those properties which actually produced gold during 1915:

Bagdad-Chase Gold Mining Co., Barstow;
Big Four Mining Company, Needles;
Emperor mine, Kunze and Conway, Needles, owner;
Horn Mine, J. E. Kelton of Blythe Junction, owner;
Pioneer Mine, in Providence Mountains, J. F. Marrs, owner;
Piute Mine, F. A. Crampton, Cima, owner;
Riggs Mining Company, Frank Riggs of Silver Lake, owner;
Sunnyside Group, Vidal district, Clyde Stewart of Parker, Arizona, owner.

Desert Placers.

Numerous areas of placer gravel are known to exist on the Mojave Desert, but only one area has been thus far profitably mined. This district lies 15 miles due north of Barstow at an elevation of 3500 feet above sea level. The placers are deposited in a broad desert valley and were evidently washed down during heavy floods from the granitic ranges to the north.

Cool Gardie Placer Mine is in Sec. 29, T. 32 S., R. 46 E., M.D.M, and has been worked spasmodically since 1900. This property is reached by a good desert road (Goldstone road) from Barstow. It consists of 9 claims totaling 1500 acres. A battery of dry washers and concentrators (especially designed and patented by the mine owners) are used to extract the gold, as there is not sufficient water present for operating a wet-concentration mill. Two 50 h.p. gas engines supply power for the mill. This property is said to have produced over $100,000 to date. Owner, Cool Gardie Mining Co., 15 Broad St., New York; Henry Mountain, president.

IRON.

The existence of large iron ore deposits in the desert regions of San Bernardino County has long been known; however, none of the deposits have as yet been worked commercially. Quoting from a report[21] by C. Colcock Jones—"This condition is not due to a lack of all the essential materials and factors for success in iron and steel smelting, but is rather due largely to the general fact that it is only within a comparatively few years that the centers of population on the Pacific Coast have attained a size that would entitle them to the position of distributing or freight centers, or that the back-country has been enough built up to make it sufficiently interesting to the railroads to foster trade from the local centers to the interior points rather than seek to supply such local centers to the interior by a transcontinental haul."

Mr. Jones estimates that there are 20,000,000 tons of available, high-grade ore and double that amount of probable ore in Riverside and San Bernardino counties.

The principal deposits of San Bernardino County are: Cave Cañon Group, north of Baxter; Iron Age, 6 miles east of Dale; Iron Mountain Group, 10 miles west of Silver Lake; and the Vulcan Group, in the Providence Mountains, 4 miles east of Kelso. Less important deposits occur in the Kingston Mountains, north of Amboy, south of Blythe Junction, and in the Lava Beds district south of Daggett.

The iron ore deposits of San Bernardino County will eventually become of importance both on account of the exhaustion of high-grade

[21] "The Iron Ores of California and Possibilities of Smelting." Bulletin of the

ores in the eastern section of the country, and because of the necessity for supplying the growing demands of the Pacific Coast more cheaply than is done at present. An important factor in the development of these deposits would be the utilization of California oil in smelting iron ores. The use of hydro-electric power, for which there are large available resources in the southern Sierra Nevada Mountains, would also be of great importance in the development of these districts.

The Cave Cañon Group (of the Iron Chief Mining Co.) is in Secs. 12 and 13, T. 11 N., R. 7 E., S.B.M. Of this deposit Mr. C. K. Leith[22] writes as follows:

"The Cave Cañon iron area which contains the Cave Cañon mines, is about ¼ mile north of Scott station[23] on the Salt Lake Railroad. It lies on the south side of the hills, between a complex of acid and intermediate rocks on the north and coarsely crystalline marble on the south, dipping southward at about 30°. The iron ore is mainly along the contact, but apparently projects into the igneous complex below and into the marble above. Little patches of marble were seen in what was taken to be iron ore. The exposure is much broken and covered by desert varnish, with the result that the surface distribution is not at once obvious. While the iron-ore debris covers the slope, in several places the igneous rocks project through it. The ore occurs in two belts, one along the trend of the other, but separated by an erosion valley. The western belt is about 2000 feet long and the eastern 1700 feet long. The width of outcrop reaches a maximum of 450 feet. Its average width for the western belt may be 300 feet and for the eastern belt 100 feet. The true thickness of the ore body, assuming that it follows approximately the contact of the limestone, is probably less than half the width of outcrop because of the southward dip of the formation and the fact that the erosion slope follows the dip. Four tunnels are reported on the property. Two were seen in ore, the longer one 30 feet in length. The ore is mainly red hematite and limonite, soft and broken, showing limestone bedding. In one of the western tunnels green iron silicates were observed in the ore. Commercial analysis from two sources show a percentage of iron above 60% and phosphorous within the Bessemer limit." This group is patented and no work is at present being done to develop the property. Owner, E. H. Harriman Estate.

Bibl.: Bull. 38, p. 299.

Iron Age Mine, consisting of three patented claims, is in Sec. 29, T. 1 S., R. 13 E., S. B. M., 6 miles east of Dale, and about 45 miles by road south of Amboy, a station on the Santa Fe Railway. Quoting from the report by E. C. Harder and J. L. Rich:[23a]

[22] U. S. G. S., Bulletin 285, p. 198.
[23] Now called Baxter. See map on p. 99.

"The mountain range in which the iron ores are located consists of intrusive diorite, granitic, and syenitic rocks of varying texture—granitic, porphyritic, and aphanitic. In the southern part of the Pinto Mountains metamorphosed sediments are associated with these rocks, but elsewhere no sediments occur.

* * * * * * *

"The Iron Age iron ores are largely hematite altered from magnetite, in the form of veins cutting intrusive granite and granite porphyry. Metamorphic minerals, chiefly garnet and epidote, are locally associated with the ore and country rocks. The principal iron-ore veins occur over an area about half a mile square, the larger ones on account of their resistant nature, forming the summit of a large hill. Several small veins occur in the area between the Iron Age deposit and Dale. The ores are very pure and of high grade, but the veins are not of sufficient extent to make the deposit very attractive commercially." Owner, A. R. Rhea of Los Angeles.

Bibl.: Bull. 38, p. 299; U. S. G. S., Bull. 430, pp. 228–239.

Iron Mountain. This locality is described as follows by J. H. Crossman:[84]

"Magnetic iron and hematite are found in the Lava Bed Mining District, Secs. 27 and 28, T. 6 N., R. 4 E., S. B. M. Two massive veins occur in this district on the southerly slope of the range of mountains, which is a southeasterly prolongation of the Ord Range. The latter is about 30 miles long from its extreme southeasterly point to its northwesterly extremity.

"The ridge known as Iron Mountain, where these immense deposits lie, is about 18 miles southeast, from Newberry Station, on the Santa Fe Railway.

"The Lava Bed Range of mountains is entered on its northerly border through a narrow gorge. The rocks in both walls of this cañon are jagged, angular, and black, and stained by oxide of iron. At the entrance this defile is 50 feet wide by 200 feet in height, the walls being vertical in places; in others, slightly inclined. Passing in for 400 feet, an amphitheater is reached. This space is surrounded by rock of the same character as that in the walls of the pass or gorge. Thence, southerly for 5 miles, volcanic rocks, tuff and sandstones of volcanic material are found. Reaching the summit at an elevation of 3880 feet all traces of volcanic action have disappeared.

"The rocks are granitic in character on the southerly slope of the mountain, and at its base. At an elevation of 3025 feet is found the iron deposit under consideration, 8 miles from the summit. The mines are named: Dick Turpin, Nos. 1 and 2; Tip Top, Nos. 1 and 2; and Bessemer, No. 1.

"These veins are well defined, with dissimilar walls and with a selvage or, as more commonly called, a clay gouge. They strike N. 20° E. and dip into the hill northwest at an angle of about 30°.

"The Tip Top and Dick Turpin are separated by 150 feet of syenite, and lie nearly parallel, continuing in their southerly course at a small angle of inclination. The Turpin ores are remarkably pure and highly magnetic. The Tip Top is the northerly vein, and lies at an elevation of 3205 feet. The vein is composed of hematite and magnetic iron, with a gray soft material known as nut ore. It strikes N. 70° W. Its northern wall is an irregular belt of dolomitic limestone; the southern, syenite. At this point the vein is 30 feet wide, increasing to 150 feet as the hill is descended 400 feet. The ore occurs as a well-defined vein in places, not in beds, as usual. The dolomitic formation that bounds the Tip Top on the north is irregular in form and strike and is, in turn, bounded by the granitic rocks, a prolongation of the Ord Mountain Range.

"The strike of the Bessemer No. 1 is due north and south, and this deposit also shows a strong body of magnetic ore reported free from phosphorus and sulphur. This mine has been but little developed, including some small pits and a 10-foot shaft. The ore body is traceable from its northeasterly exposure at an elevation of 3350 feet, in a southwesterly direction through the low foothills at an elevation of 3025 feet, for a distance, on the line of strike, of 3200 feet, with an average width of 80 feet, increasing in places to 400 feet." The present owners are Mrs. Phoebe Owens, San Francisco, and E. S. Lake, Los Angeles.

"Four miles southeasterly from this point, and on the same mountain range, occurs an extensive body of highly magnetic iron ore, the maximum width of which is 100 feet, the minimum 20 feet. The strike of the vein is the same as above."

Iron Mountain Group is in Secs. 11, 12, 13 and 14, T. 15 N., R. 6 E., S. B. M., about 10 miles west of Silver Lake. It has been estimated that this deposit contains 12,000,000 tons of good iron ore. There has been no development and the property is idle. Owner, Colorado Fuel and Iron Company, Denver, Colorado.

Bibl.: Bull. 38, p. 299; Bull. of A. I. M. E., Sept., 1915, p. 1889.

Vulcan Group is in the Providence Mountains 4 miles east of Kelso, a station on the Salt Lake Route in the southeast corner of T. 10 N., R. 13 E. It covers 260 acres. The ore, accompanied by vein filling, is a semi-hard red hematite and is a replacement of limestone near its contact with an igneous rock, monzonite. The largest lens has been estimated to measure 775′ x 350′, with a vertical exposure of 260′, making it a quarry proposition. The average analysis of the Providence Mountain iron ore is given by C. Colcock Jones[35] as follows: Iron.

alumina, 0.568%; magnesia, 0.201%; lime, 0.444%; sulphur, 0.059%; volatile, 1.85%.

The work done has been confined to exposing the formation and besides several shallow workings, there is a 100-foot tunnel with numerous crosscuts. A full description of this deposit, to which the reader is referred, is given by the owner, C. Colcock Jones of Los Angeles, in the Engineering and Mining Journal of April 17, 1909, entitled: "An Iron Deposit in the California Desert Region."

LEAD—ZINC.

(See also under Silver.)

Ibex Mine (lead, silver, zinc) is in the Black Mountains, 16 miles southwest of Zabriskie and 6 miles north of Saratoga Springs. Elevation 1300 feet. Although this property is recorded in Inyo County, it is actually located in San Bernardino County.

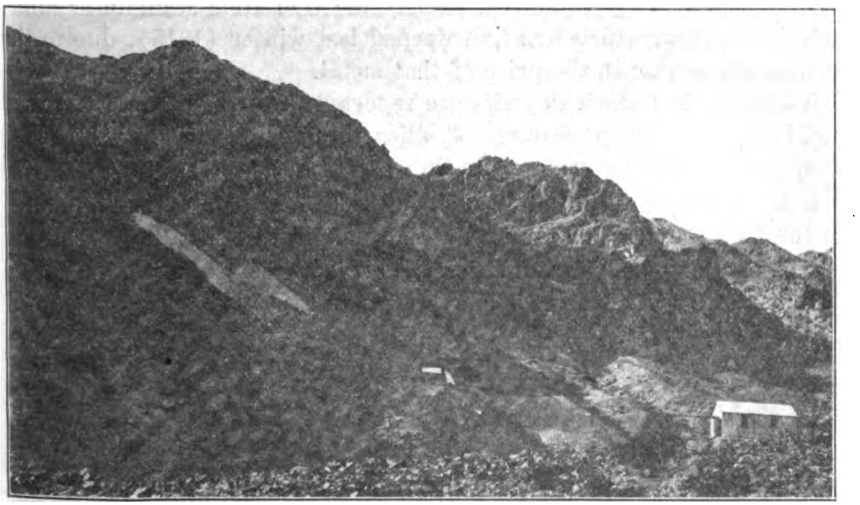


Photo No. 14. Mine dumps and compressor plant at the Ibex Mine, 15 miles southwest of Zabriskie, in the Black Mountains, San Bernardino County. Photo by C. A. Waring, March, 1916.

The deposit is a vein averaging 3′ to 5′ in width in dolomite. Strike N.–S., dip E. The vein can be traced on the surface along its strike for 1800 feet. The ore is argentiferous galena with carbonates of lead and zinc. Occasional bodies of anglesite and linarite are associated with the galena. Shipping ore is said to have averaged 44% lead, 33% zinc, 16 oz. silver, $16.00 gold. Development consists of 4 tunnels (see Photo No. 14), the longest being in 100′ on the vein. Mining is at present

[84]"The Pacific Coast Iron Situation," Bull. of A. I. M. E., Sept., 1915, p. 1889.

confined to gouging out rich ore bodies near the surface. There are 19 men employed at $4.00 per shift. Ore is sacked at the tunnels and packed on burros down to base of hill to a 4-ton Kelly quad motor truck which hauls it to Zabriskie. Shipping (March, 1916) from 7 to 8 tons daily. Located September, 1914. Worked since January, 1916, by Ibex Spring Mining Co., S. F. Brock, manager. Property recently reported purchased by the Goodsprings Mining Co. of Nevada.

Hooper and Goselon of Victorville are working a zinc prospect 8 miles west of Victorville and claim to have encountered some high grade ore.

D. R. Oliver of Oro Grande made a shipment of zinc ore to an eastern smelter in 1915.

MANGANESE.

Very few deposits of manganese of any commercial importance are known in San Bernardino County. Only one up to the time of this writing has actually produced, namely the Owl Hole Manganese mine, described below, which was first opened last winter (1915), due to the enormous increase in the price of that metal.

Numerous low grade deposits are reported through the desert region, but in general the percentage of silica contained is too high to make them at present of commercial value.

I. D. Garringer et al., of Daggett, Cal., own a deposit of manganese in the Lava Mountains 5 miles by road northwest of Ludlow. The ore is said to average 40% manganese. As it is a recent location very little development work has been done. Owners expect to mine the deposit in the near future.

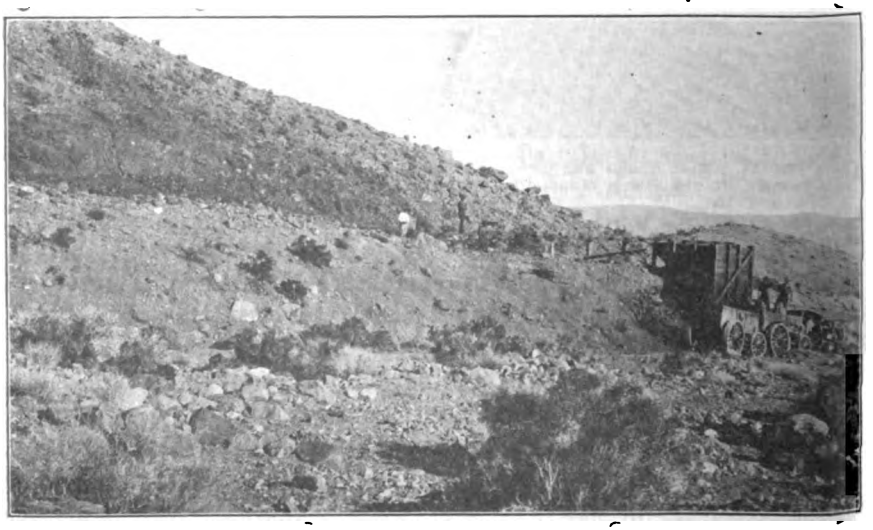


Photo No. 15. Owl Hole Manganese Mine, one mile northwest of Owl Hole Spring, Owl Mountains. Photo by C. A. Waring, March, 1916.

Owl Hole Manganese Mine: northwest of Owl Hole Spring, Owl Mountains and southwest of Death Valley Narrows. There are lenses of manganese ore on granite overlain by granitic conglomerate. The lens pictured (see Photo 15) is 75′ thick and 100′ long. First class ore as shipped carries 75% MnO_2 and less than 1% $Fe2O_3$. Second class ore carries about 55% MnO_2. At the time the mine was visited the ore sold for from $30.00 to $50.00 per ton. The ore was hauled 35 miles to Riggs station in two 6-ton wagons drawn by a Model 18 Yuba Ball Tread Tractor. The trip one way took 16 hours and on an average of three trips per week were made. The contract price for hauling was 35 cents per ton-mile. Owned by Alex. Yeoman of Silver Lake.

SILVER.

In the year 1881 important discoveries of silver ores were made in the desert regions of San Bernardino County. From that time to date $13,892,703 has been produced. The most important silver districts were the Calico, Ivanpah, Providence, and Silver Reef districts. Mining in these districts was most active during the eighties and early nineties. Most of the old mines ceased operations when the price of silver dropped below $1.00 and since that time they have only been worked spasmodically by "chloriders." Many of these properties are still accessible and with new capital and skilled management might again become profitable.

Calico District.

By far the largest production of silver in San Bernardino County was derived from the Calico district now practically dormant. This district is seven miles north of Daggett on the Santa Fe Railroad and embraces the southern slope of the Calico Mountains.

The following description of the geology and ore deposits is quoted from a report of Waldemar Lindgren.[36]

"Between the Mojave Valley and the next depression northward there is a mountain complex of about 2000 feet elevation above the plain, or 4000 feet above the sea level. The mining district of Calico lies on the southern slope of this complex. The Land Office maps place Calico in Sec. 22, T. 10 N., R. 1 E., S.B.M.

"Geology.—Going from Cajon Pass northeast towards Calico, along the Mojave River, the nearly horizontal, presumably Tertiary, sandstones of the desert are for a long distance the most prominent geologic feature; in places granite, metamorphic slates and limestone masses are exposed. Finally, at Barstow station, almost in line with the great eastern fault of the Sierra, liparite and other Tertiary eruptives are met with and from here on towards the Providence Mountains near the Colorado River they are very conspicuous. These eruptions are doubtless younger than the Tertiary sandstones of the desert. The form of

[36] "The Silver Mines of Calico." Trans. Am. Inst. Min. Engrs. Vol. XV, p. 718.

the mountains, the oft-occurring craters, and finally the great masses of tuffs, give evidence in favor of their comparatively recent origin.

"The wide, nearly level Mojave Valley south of Calico is covered with Quaternary detritus, or shallow, dry lake-beds, smooth and hard as a floor. The complex north of the valley is predominantly composed of highly-disturbed masses of liparite and tuffs, together with clay and sand strata, derived from the former.

"Assuming Clarence King's determination of the age of liparites of the Great Basin to apply to this region—a very probable supposition—they should be regarded as early as Pliocene; the tuffs and sandstones would be referred to the Pliocene, and be parallel to the Shoshone Lake deposits of King.

"The sandstone and clay strata—the former loose and friable, the latter soft and greenish—form a zone along the foothills about ¼ to ½ mile wide. The strike of the strata is nearly east and west at Calico, but changes gradually to northwest and southeast towards the northwest, following the trend of the foothills; to the east of Calico they bend more northeast and southwest. Near the desert the strata are inclined at very steep angles, and often crumpled and folded in an extraordinary degree; but, going northward, they soon become regular, dipping uniformly south at an angle from 40° to 25°. At some places in Wall Street Cañon they contain pebbles of liparite besides those of quartzite and granitic rocks.

"Most of the ore deposits occur in liparite or in its tuffs, as veins along fractures and dislocations of a more or less regular character; as simple, once open and subsequently filled fissure veins; as impregnations along complex fissure-systems, or filling and cementing more or less extensively, fractured zones. The gangue is predominantly barite with jasper; the present ores are haloid salts of silver, hydrosilicate, and carbonate of copper, resulting from primary rich silver sulphides and copper pyrites. Another class, closely connected with the former, occur as irregular surface-deposits in tuff or (rarely) in liparite, in the former case often approximately following planes of bedding."

The most important mine of this district and the only one at which any work was being done when visited is the Silver King mine.

Bibl.: Reports VIII, pp. 491–498; X, p. 530; XI, pp. 337–345; XII, p. 376; XIII, pp. 606–609.

The Daggett Reduction Company, General Office, Springfield, Mass., W. P. Hubbard, president, Phil. M. Chandler, secretary, is constructing a 200-ton cyanide plant below the old Silver King mine, 5 miles north of Daggett. This plant is to treat the tailing dumps of the old silver mines which, it has been estimated, contain about 150,000 tons that is said will average $3.00 per ton.

The treatment will be briefly stated as follows: the material will be sluiced down to the plant and passed through a classifier; that which is already fine enough so as to held in suspension (150–200 mesh) will go

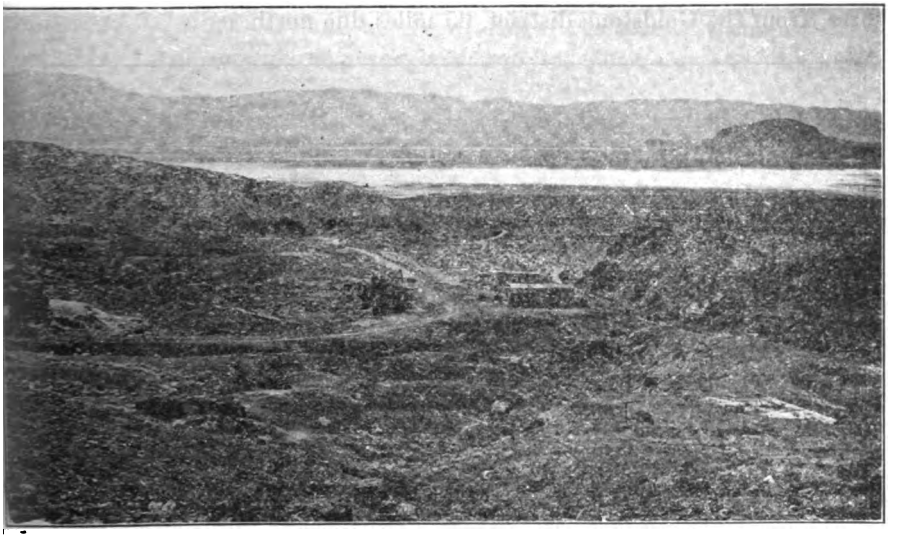


Photo No. 16. Old camp of Calico, looking south from Calico Mountains, Dry Lake in middle distance.

directly to the cyanide tanks, and the over size to a tube-mill where it will be reground to the required fineness. Mechanical agitation is to be used in a series of 10 wooden tanks. The solution used will be 1%

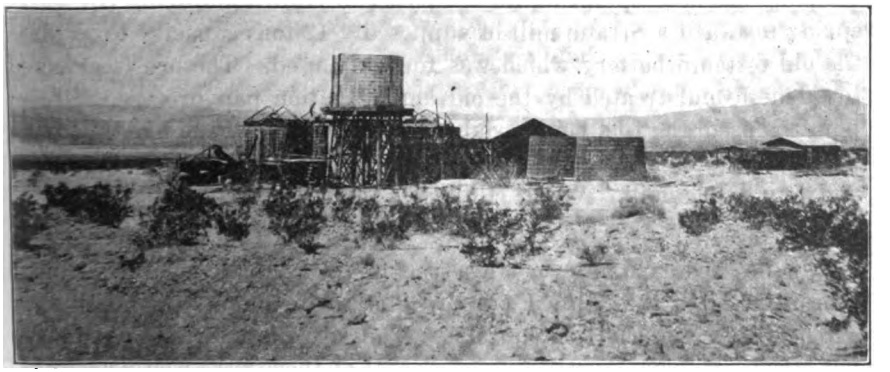


Photo No. 17. Cyanide plant of the Daggett Reduction Co. in process of construction, five miles north of Calico.

KCN. The process is a continuous one of agitation and decantation evolved by the superintendent, Mr. Millett—the solution being fed from the bottom and the clear pregnant solution decantated from the top. No filter is required. Zinc boxes are to be used for precipitating the

built by the Chicago Pneumatic Tool Co., have been installed to supply the necessary power. Water is obtained from a well sunk by the old Silver King Company. Expect to start operations in September, 1916. The company later plans to construct a 5-stamp mill for treating custom ores, from the Goldstone district, 35 miles due north.

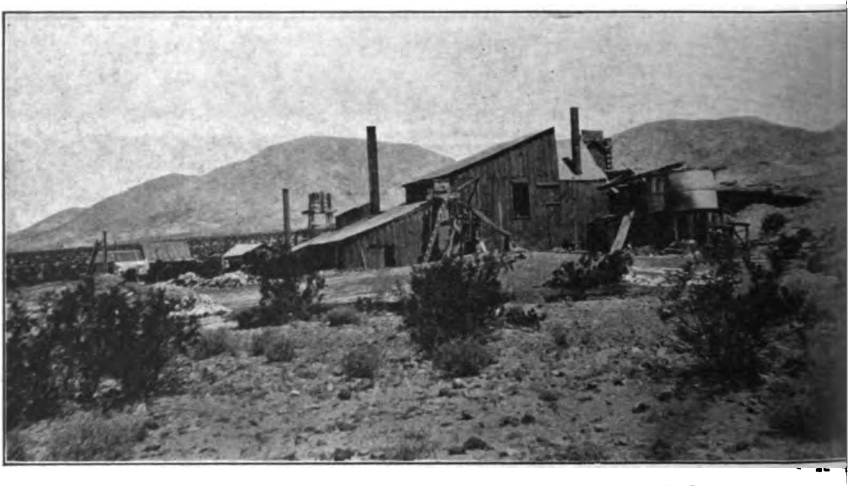


Photo No. 18. Mill of the Olivier-Funk-Osborn Co. south of Calico.

Olivier-Funk-Osborn Co. have a lease on the Silver King mine and are "chloriding" in the old workings. No new development work has been undertaken. The ore is hauled by team 2 miles to their mill situated in the flat below the mines, 5 miles north of Daggett. This company has been operating for the past two years and during the early spring installed a Straub mill of supposedly 12 tons capacity to replace the old 5-stamp battery which was formerly used. The ore is crushed to 40-mesh and treated by the old amalgamation pan process. Steam power is used, the fuel being crude oil. The ore is said to average from 15 to 20 ounces silver per ton. Five men are employed at the mine, and four at the mill. W. H. Olivier of Daggett is superintendent.

Ivanpah District.

This lies about 20 miles northwest of South Ivanpah, the terminus of a branch line of the Santa Fe from Goffs, and embraces the northward extension of the Clark Mountains. The silver-bearing lodes, though not large, are conisdered rich, and several of them were well developed. This district produced a few large mines, all of which are now idle. Among the most important producers were the following: Allie and Beatrice; Bob Lee and Hattie; Coliseum; Lizzie Bullock; and the Stonewall mines.

Providence District.

This district, formerly known as the Trojan district, is situated in the Providence Mountains, about 25 miles west of Fenner, a station on the Santa Fe Railway. These mountains extend for 80 miles from southwest to northeast and at Mount Edgar reach an altitude of 6400 feet. In these mountains a very rich body of silver ore was uncovered and worked for years. The principal mine here was the Bonanza King, located in the early '70s. Development work was continued and in 1880 a 10-stamp dry crushing mill was erected by the Bonanza Consolidated Company, which, it is said, made a record run in 1881, showing a clean-up of $251,500 in 115 days and in 1884 showed returns of nearly $1,000,000 in 18 months' work. Unfortunately the drop in the price of silver made the mine too low grade a proposition for the method used in operation, and it was closed down for several years. The ore, being chloride of silver, was crushed dry and amalgamated by the "Boss Process," which consisted in bringing the ore in direct contact with quicksilver in pans arranged in a continuous series. There are records of many other mines here, such as the Kohinoor; Cook and Thompson; Belle McGilroy; and others, but all of them are now idle.

The Bonanza King Mine. This property is owned by Messrs. Holbrook & McGuire, Crocker Building, San Francisco. It lay idle for some time after an active period about 1906, but was examined and a thorough report rendered. This aroused much interest and new development work was started in 1914. The mine again became a producer in 1915 with a good outlook for continued activity. This mine is at 4260 feet elevation.

The country rock is Carboniferous limestone, the ore deposit being of argentiferous galena in a silicified limestone breccia near a contact with intrusive monzonite. The breccia occupies a shear zone 400′ to 600′ wide, the strike of this being N.–S., and the dip 25° E., but the dip of the seams of ore varies greatly. The greatest depth below the surface is 465′ and approximately 20,000′ of underground work have been driven and stoped. The early day mill was destroyed by fire and, in 1906, a new 10-stamp mill, equipped with Western Gas engines of 50, 35, and 15 h.p., respectively, was installed by the Trojan Mining Co. The acreage is 220, of which 60 are patented. Mr. J. C. Gurney is superintendent at the mine.

Bibl.: Reports X, p. 532; XIII, p. 606.

Providence Group. This group of claims, located 15 miles south of the Bonanza King mine, is claimed by Sidney Dennis, J. A. Hopkins, and J. P. Borland, of Fenner, and consists of 220 acres. The deposit is gold in porphyry and decomposed granite. A small amount of development work has been accomplished.

Pilot Group. This group, comprising 120 acres, joins the Providence group on the north, and is owned by C. J. Eaton of Fenner. Several small shipments have been made, and the returns were sufficient to encourage negotiations for the installation of heavier machinery. This work is now progressing.

Silver Reef District.[37]

Four miles northeast of the Black Hawk mines, and 2½ miles from Old Woman's Springs, in the Mojave Desert, is an exposure of limestone and quartzite, resting on a massive crystalline rock, consisting of quartz, feldspar, biotite and hornblende. This exposure or reef extends from the mouth of Texas Cañon out upon the plain, its surface sloping downward at an angle of approximately 5° for a distance of 4 miles, terminating in a bluff 40′ to 100′ in height. Along the eastern edge the strata drop off abruptly as though sharply eroded. At the northern end the reef is faced by a low range of hills composed of the above mentioned hornblendic rock. From this point it swings west and with irregular outline extends for 5 or 6 miles toward Rabbit Springs. Its entire area, fully 25 miles square, is cut by gulches varying from 20′ to 150′ or more in depth, that have been eroded through the sedimentary strata down into the underlying crystalline rock. These cañons have resulted from natural drainage, having started in slight depressions in the rolling plateau of limestone. At one point on the extreme northern edge, hills of considerable size have been formed by the folding and tilting of the strata. The limestone has been subjected to violent compression, as throughout the area it is faulted and broken into a myriad of small fragments.

In viewing many mining claims on the reef and traveling over the greater part of its area, no piece of limestone was seen that would weigh 300 pounds, most of the pieces measuring under 6″ or 8″. Along certain zones considerable masses had been granulated and even pulverized. This fractured rock had subsequently been loosely cemented by the infiltration of carbonate of lime into the crevices.

It was at one time asserted that a shaft sunk in the reef passed through the limestone into the "wash" of the desert beneath. On investigation it was found that the limestone had indeed been cut through, but the underlying rock proved to be crystalline hornblende rock in place, but somewhat decomposed. Over considerable area the limestone is underlain by a quartzite stratum of variable thickness, less than a foot in some places, and in others 10′ to 12′. Over some limited areas quartzite is wanting altogether. The limestone is mostly crystalline, varying in color. A small portion is pure white, the greater part is gray or bluish, and some of it is black.

[37]Report XI, p. 365; XII, p. 377; XIII, p. 328.

The Ore Deposits. For fully 8 miles along the irregular front of the reef deposits of silver ore have been found. These ore deposits are usually marked by cherty siliceous rock, which, being harder than the limestone, stands out from its weathered surface in bunches and small, vein-like masses. Often, in breaking the cherty rock, stains of copper carbonate are found, and from such rock silver and sometimes gold is obtained. Numerous shafts, cuts and tunnels have been made on the claims, 20 or more in number, and in every one, ore of good grade has been found, although the quantity is usually small. A shipment from a claim called No. 1 returned 129 ounces of silver per ton in the Oro Grande mill. By assay 20 ounces could be found in ore from any of the claims, and rock of a higher grade running into thousands of dollars per ton was not unknown on the reef.

The ore occurred usually in bunches, sheets, or stringers, which "rolled" more or less, but in a general way followed the downward stratification of the limestone. The stringers were from 4″ to 2′ in thickness, pinching and swelling longitudinally in their downward extension. The average value of the ore thus far found, was probably about $50 per ton. The mines were all opened by the discoverers who were men of limited means, and no systematic exploration for larger ore bodies has been made. They may exist, though there are no surface indications that such is the case. At one claim, No. 9, a sample was taken from 20 feet across the mineralized zone and found to assay 11 ounces of silver with $2.00 in gold. This rock was taken from a shallow cut 4′ wide, 5′ deep and 20′ long.

The ore deposits all occur in zones of limestone that has been crushed into small fragments. In a few places, in contact with or close to the ores, is a thin intrusive sheet of igneous rock much decomposed and leached. This, to a great extent, has, doubtless, been the source from which the minerals of the great ore deposits were derived. In many places the quartzite which underlies the limestone was found to contain galena, lead carbonate, wulfenite, zincblende, pyrite, copper, gold and silver. Some of this rock contained sufficient lead to be classed as a smelting ore.

The ores in the limestone were chiefly chloride of silver and embolite (chloro-bromide of silver), usually accompanied by copper-carbonate, sometimes a copper-silver sulphide, wulfenite, lead and iron in various forms, with occasionally manganese oxide in a gangue of calcite and quartz. Hornsilver in crystals was found in the fractures and in small cavities of a pure blue limestone, taken from a shaft on a claim at the east edge of the district. People in Pasadena, Riverside, Daggett, and Victorville were the principal owners of the claims. Timber could be obtained in the main range 5 or 6 miles back of the mines, and an abundance of water could be had from a cañon in the neighbor-

ing mountains or from Old Woman's Springs, 2½ miles east of the principal claims on the reef.

According to the latest reports all properties in this district are now idle.

TUNGSTEN.[38]

Up to the early part of the year 1915, the Atolia District in western San Bernardino County, with the adjoining Stringer District in Kern County, was practically the only tungsten producing area of any consequence in California. Production on a commercial scale began in 1905 in the Stringer District, followed by Atolia in 1906, according to the statistical reports of the State Mining Bureau. To the end of 1914 the output for the State amounted to a total of $1,513,936. For 1914, Atolia led the entire United States, its tungsten yield for that year surpassing that of the Boulder Creek District in Colorado. The output of San Bernardino County for 1915 was $840,947 and for California $1,005,467.

During the latter part of 1915 and the early months of 1916, because of the high prices prevailing, prospecting was much stimulated and the known tungsten-bearing areas have been considerably extended both in San Bernardino and Kern counties. Shipments have also begun from mines opened up in the Clark Mountain and New York Mountains districts in eastern San Bernardino County. In these latter areas, wolframite and hübnerite are the principal ores with some scheelite, while at Atolia it is scheelite only.

Atolia District.

Atolia is five miles south of Johannesburg, on the Kramer-Johannesburg branch of the Santa Fe. For comparison and because it merges into the Atolia District on its margin, it may not be out of place to first briefly outline the characteristics of the adjoining Stringer District, though described in a recently issued report of the State Mining Bureau on Kern County.[39] The one is in eastern Kern and the other in western San Bernardino, the division being mainly an artificial one, and marked only in part by a low ridge in the northern part of the area under consideration (*see* Map, Plate III). The Stringer District, so called because of its being characterized by narrow stringers and seams in schist, is on the eastern slope of the Rand Mountains. These stringers have been worked to a greater or less extent for some years for their gold content. There are other associated stringers carrying scheelite. Though somewhat closely associated, the gold and tungsten, for the most part, do not seem to be found in the same veins. Passing down the slope southeastward toward Atolia, the topography is that of shallow ravines and low, rolling ridges. From the placer wash in this area considerable

[38] Supplemented and revised to June, 1916, by observations at Atolia of Walter W. Bradley, mining statistician of the State Mining Bureau; and to July, 1916, in the Clark Mountains, New York Mountains and Signal districts by Emile Huguenin, field assistant.

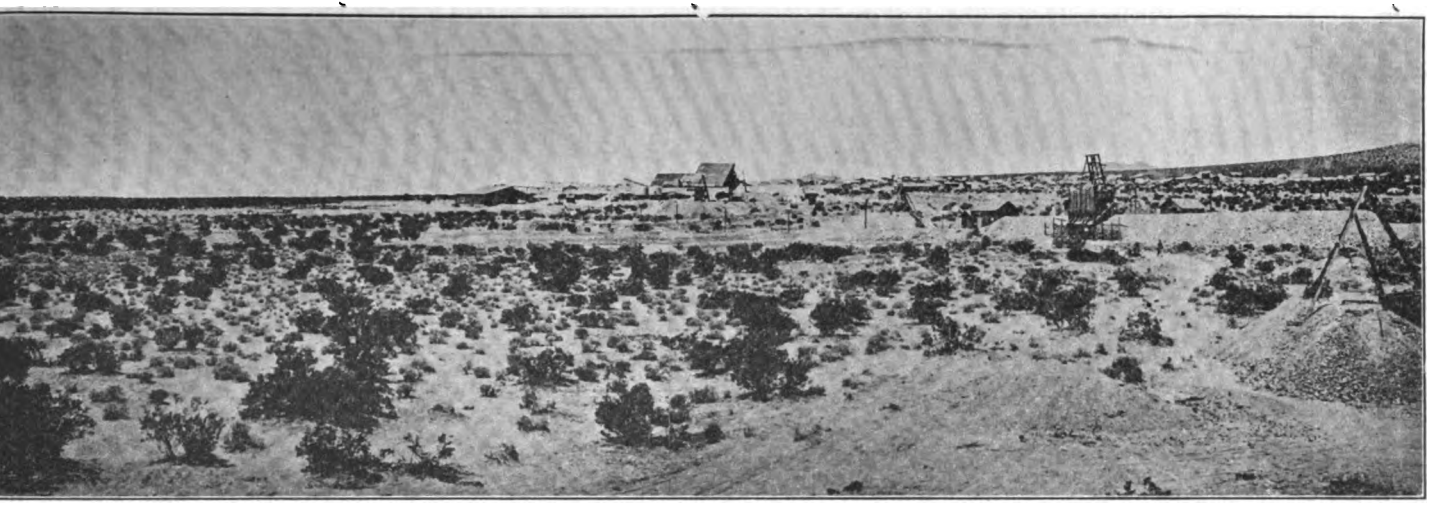


Photo No. 19. Panoramic view of Atolia, San Bernardino County, looking westerly from Skylark shaft of Osdick Group. Atolia Mining Co. mill in center; "Spanish Lease" (Atolia Co.) headframe and ore-bin, right center. The light colored streak of ground stretching from Atolia mill to left limit of picture is the "Spud Patch." On the skyline back of the Spanish Lease headframe may be seen a part of the Rand Mountains in Kern County. Photo by Walter W. Bradley, June 2, 1916.

tungsten and gold both are being extracted. Various forms of sluices, hand and power jigs (some of them rather crude), and dry concentrators are in use. (*See* Photos No. 20 to No. 23, incl.)

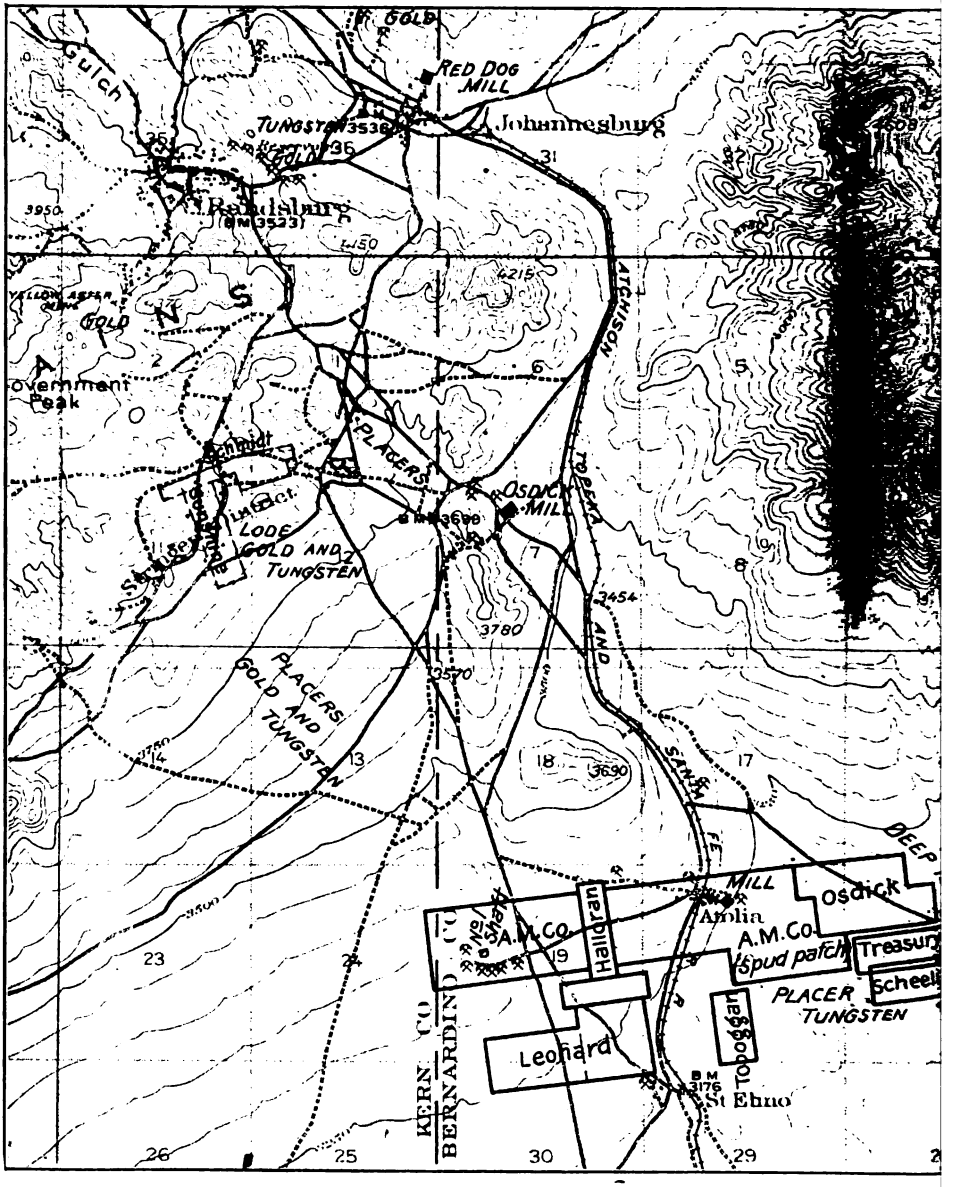


Plate III. Map showing approximate, relative positions of the principal tungsten groups at Atolia, C
Topography from U. S. G.S., Randsburg Quadrangle.

Continuing southeastward we come into the granite area of the Atolia District. (*See* photo No. 19.) A portion at least of the placer wash

of its western edge may have been derived from the Rand Mountains along the upper part of the slope. At and near the surface the granite is largely decomposed and disintegrated into a yellowish-brown, angular

Photo No. 20. Home-made, hand-driven, dry concentrator, working scheelite placer ground at Atolia. Photo by C. A. Waring, March, 1916.

sand. In this sand at certain places are found pieces of scheelite derived from the veins, and varying in size from small bits up to masses weighing up to 100 pounds and more. Such an area is the now famous "Spud Patch" of the Atolia Mining Company, so called because these scheelite masses were dug up much as one would dig potatoes out of the ground. This placer scheelite, except in the deepest ground at the eastern end of the district, is quite angular, showing that it has not traveled far from its parent body. The placer scheelite is also high grade, when well cleaned, assaying above 70% WO_3.

The scheelite veins of Atolia occur in a zone in the granite, some 2000′ to 2500′ wide and nearly two miles in length, coursing about 10° S. of W. The dip is north and varies from 13° to 80°. A fresh specimen of this granite taken from the "Spanish Lease" dump of the Atolia Company and examined in thin section under the microscope showed it to be a biotite-hornblende granite, with the hornblende in part altered to pyroxene (probably augite). The feldspars are orthoclase and albite. Magnetite, titanite and apatite are present as accessory minerals. The entire structure of the rock shows it has been under a

tremendous strain. Macroscopically it is a medium-grained, gray granite. To the north of the granite is a schist area.

Though this tungsten-bearing zone has been proven for a length of approximately 10,000 feet along its strike, the individual veins are not continuous for any considerable distance. They are parallel and

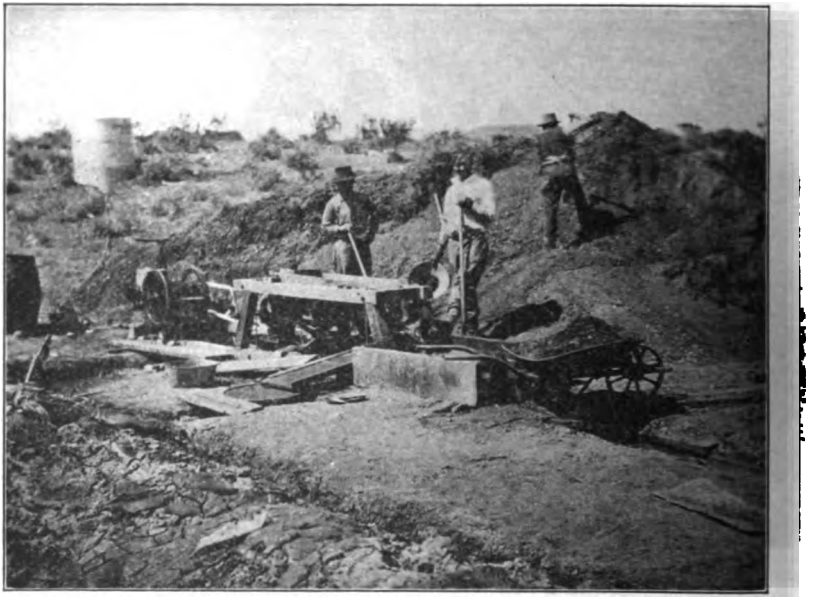


Photo No. 21. The Winans combination jig and sluice in operation near Atolia on placer ground carrying scheelite.

overlap each other much like the longitudinal cracks in a well-dried stick of timber. At both the east and west ends of the zone the veins appear to feather out. The sketch map, Plate III, shows the approximate relative positions of the main properties. The outlines there given are approximate only.

In the placer ground both in the Stringer and Atolia areas during the height of the boom several different styles and forms of concentrators and "washers" (both wet and dry) were in use—some of them crude home-made contrivances. Of the more successful wet machines may be mentioned a combination sluice and jig (*see* Photo No. 21) consisting of a short sluice-box with riffles, and a screen bottom. Water is forced up through the screen from a compartment underneath; and the sluice-box has an endwise shaking motion similar to a table concentrator. Of the dry concentrators the Stebbins (*see* Photos Nos. 22–23) seemed to be doing satisfactory work.

Water is, of course, scarce. A partial supply is obtained from the pipe-line of the Randsburg Water Company. This is supplemented by water brought in by the railroad in tank cars from Hinkley station on

the main line, between Barstow and Kramer. A 10,500-gallon tank car of water costs $18.40 at Atolia or Johannesburg. Needless to say tailings are run to settling ponds and tanks and the water re-used.

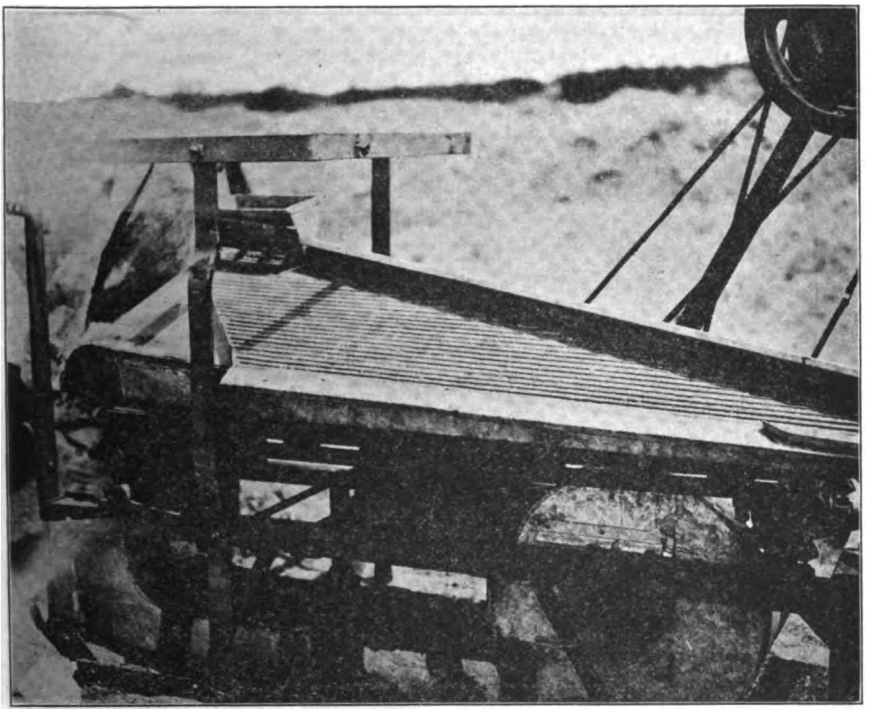


Photo No. 22. Stebbins dry concentrator. The top is a diamond-slotted screen, with riffles, and an air chamber underneath. Photo by Walter W. Bradley.

Atolia Mining Co.: E. C. Voorhies, president and manager; E. A. Stent, secretary; office, 1404 Humboldt Bank Bldg., San Francisco; Chas. S. Taylor, superintendent at the mine. The elevation is 3300 ft. (U. S. G. S.) at Atolia station. The company has 62 patented claims and 35 locations unpatented. The deepest shaft (No. 1) and the greatest extent of underground development work are at the west end of the group. No. 1 shaft is 900′ deep, with a winze from the bottom level reaching a little below 1000′. Good ore was obtained on the 200′, 300′, 400′, 600′, 700′, 800′ levels, and some on the 900′, the 800′ level being the best. On the 900′ level, the amount was small, but the ore has come in again in the winze. The largest shoot, so far, has been opened up for a continuous length of 1400′, along the vein. There are a number of other shafts varying in depth to 335′. As already stated in a preceding paragraph, the individual veins are not continuous throughout the two-mile length of the zone, but are parallel and overlap. In the Atolia company's ground, these veins vary from mere seams up to

3′ in width, and dip from 13° to 80° N. (except one which dips S.). In the larger veins the scheelite is massive, like the specimen on exhibition in the museum of the State Mining Bureau, and assays up to 80%

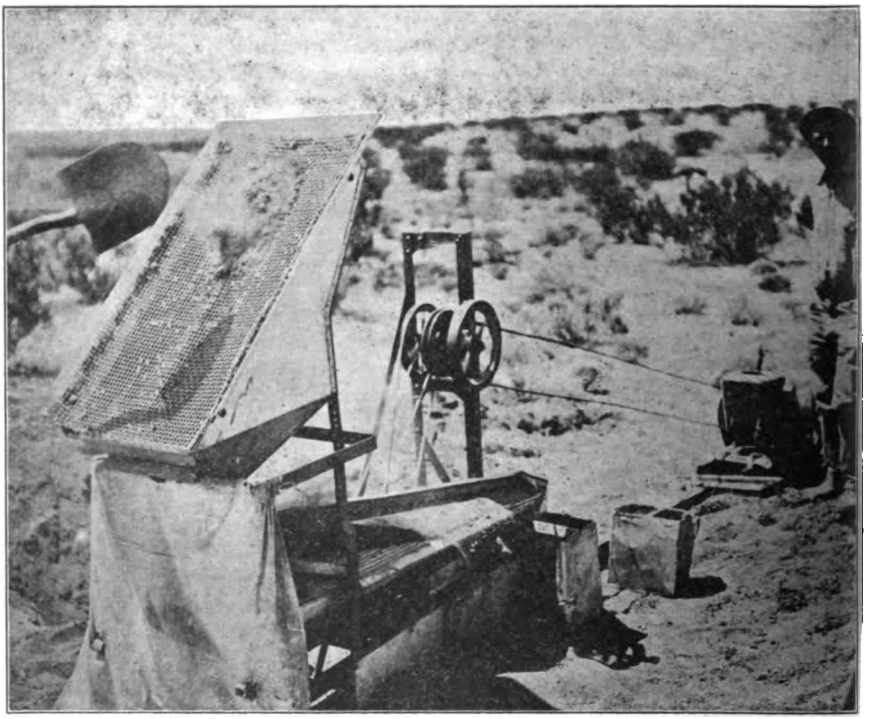


Photo No. 23. Stebbins dry concentrator in operation, concentrating scheelite from placer wash on Leonard Group near Atolia. Photo by Walter W. Bradley.

WO_3. The other vein minerals occurring here and in part very intimately associated with the scheelite, are quartz and calcite. The scheelite is pinkinsh to yellowish white in color and in general appearance somewhat resembles orthoclase feldspar (but of a higher specific gravity, of course).

The concentrating mill which the company had built in the latter part of 1915, was destroyed by fire in January, 1916, and a new mill of 70 tons daily capacity has since been erected. When visited (June 2, 1916) this mill was operating at about half capacity. A Huntington mill is used for grinding, and the pulp is handled on the following concentrators: Wilfley, both single and double-deck Deisters, and Johnston vanners. The concentrates, before being sacked for shipment, are dried on the flat top of a special, low-built furnace fired by oil. About 60,000 gallons of water are consumed daily. The tailings are run to settling ponds, and the water pumped back to the mill tanks.

During 1915, considerable of the eastern portion of the company's ground, including the "Spud Patch," was worked by leasers. With the expiration of the leases at the beginning of the new year, and the completion of the mill, the entire property was operated on company account. As a consequence of the high prices prevailing for tungsten during the early months of 1916, "high grading" became notorious; and the company, as a matter of self-protection, was obliged to curtail operations in certain areas, particularly in the Spud Patch.

Photo No. 24. West end of the "Spud Patch," Atolia Mining Co., at Atolia. Depth of placer wash, 10 inches to 2 feet. Photo by Walter W. Bradley.

Gustave Group, located south of Atolia townsite on the west side of the railroad and adjoining the Atolia Company's ground. Some coarse float has been obtained by trenching in the course of which some small veins have been uncovered.

Halloran Claims (see Leonard).

Leonard Group. A Mr. Leonard has options on two or three groups of claims east and southeast of No. 1 Atolia shaft. This includes 5 claims owned by Mrs. Halloran of Long Beach (one of which, a patented claim, is the only break in the continuity of the main group of the Atolia Company's claims) and 3 claims of a Mr. Gallagher of Los Angeles, C. D. Crane et al., Randsburg, are leasing. They are operating mainly in the placer ground on the south side of the group, with dry concentrators. (*See* Photos, Nos. 22 and 23.) In the lode ground a maximum depth of 90 feet has been reached and some 2% ore taken out.

McBride Group (see Treasury).

Osdick Group. P. J. Osdick, Atolia, owner. This group which consists of eleven claims, part of them patented, adjoins the Atolia Company on the east; and has been the most important single producer in

the district outside of the Atolia. The Skylark claim of this group is the one adjoining the Atolia ground, and is under lease to R. F. Bibb et al. This claim under the Lypps & Brock lease (expired in April,

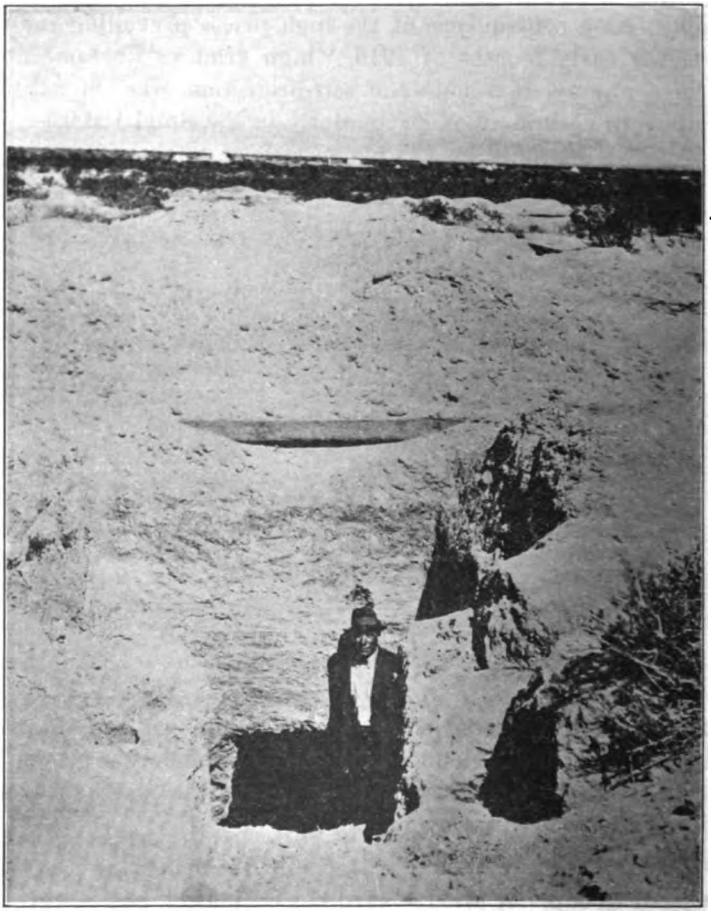


Photo No. 25. At east end of the "Spud Patch," Atolia Mining Co. Depth of placer wash, about 18 feet. The best values are found close to bedrock. Photo by Walter W. Bradley.

1916) is the one from which the famous pocket of 14 tons of high-grade vein scheelite sold for $45,000 in March, 1916. It was stoped from above the 50-foot level. The present lessees on this block are sinking the Skylark shaft below 150′ and drifting on the 50′ and 100′ levels. Some good stoping ground is reported blocked out between these two levels.

Other portions of the group are also being worked by leasers. There are several other shafts, 40′, 50′, 60′ and shallower in depth. Most of the Osdick group is in the lode zone, but there is some placer ground in the southeast corner, having a depth of 18′–20′ to bedrock.

The Quirk claims are one mile north of Atolia on a 4-inch vein which is parallel to the main Atolia system. There is a 40-foot shaft from which a small tonnage of high-grade scheelite has been taken.

Rose Fraction, R. Scott and F. Weise, owners, Atolia. Small production.

The Scheelite Group, located by —— Hart of Los Angeles, partly overlaps the Treasury group on the south.

Toboggan Group, Elmer Beebe et al., Atolia, owners. It is about ½ mile south of the Atolia mill. One small lot of high-grade ore was obtained from a pocket near the surface; but when visited, no lode mining was being done. Leasers were taking out some high-grade placer gravel and coarse float.

The Treasury Group, owned by D. V. McBride, M. H. Elliott and C. W. Peterson adjoins the Atolia and Osdick groups on the south and east. The claims have been divided into 40 blocks of about 200 feet square each; and in May, 1916, were being worked by some 26 sets of leasers. This is placer ground similar to the "Spud Patch" of the Atolia company, but deeper, averaging 20′–25′, though some of the shafts are as shallow as 12′–15′ to bedrock, while one lease has pay dirt at 54′.

White Flower Claim, A. Nixon, Randsburg, owner. Developing.

Clark Mountain District.

This district embraces that portion of the old Ivanpah District in the immediate vicinity of Clark Mountain. It is reached by road from Nipton, Cal., or Roach, Nevada, both of which are stationed on the Salt Lake Route. Tungsten ores were discovered on Clark Mountain about eight years ago, but it was not until the enormous increase in the price of that metal during the past winter that active work was undertaken. Many locations were made, but only one producing mine has as yet been developed.

Mojave Tungsten Company, 165 Broadway, New York; Foster S. Naething, general manager. This company, incorporated in November, 1915, owns a group of ten patented claims, and has locations on two others. Wolframite and scheelite occur associated together in a system of narrow quartz fissure veins in granite. The ore is fairly high grade, bunches often encountered containing 30% tungstic oxide. Considerable development work has been done and it is reported that a large tonnage of ore has been blocked out. A small concentration plant has recently been completed and the property is producing about one ton of high grade concentrates daily. Twenty men are employed.

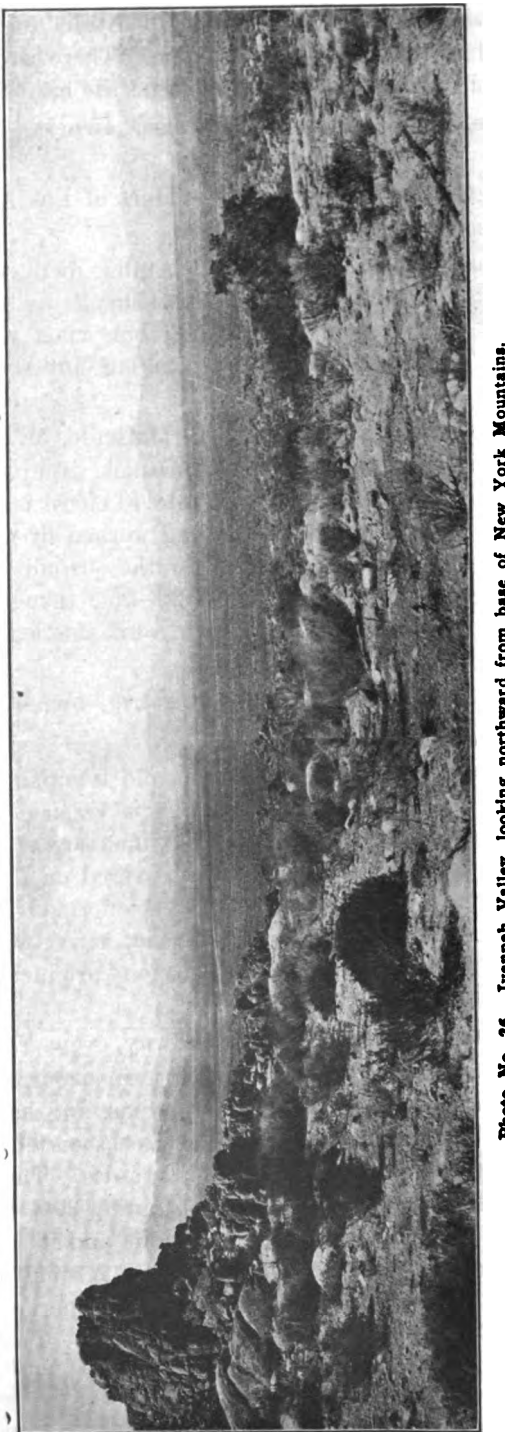


Photo No. 26. Ivanpah Valley, looking northward from base of New York Mountains.

New York Mountains.

The New York Mountains lie in the northeastern portion of the county trending in a general northeast and southwest direction. They are an extension of the Providence Mountains. The geology of the region is simple. Quoting from our Report XIII, p. 325: "The nuclear mass of the range is grano-diorite, which has uplifted the older sedimentary rocks on its flanks, the upper portion or dome of the great anticline having been eroded, leaving only the very rugged line of serrated peaks and ridges flanked on both sides and about the ends of the range by quartzites, limestone, mica schist, and conglomerates."

The grano-diorite has been intruded by a system of pegmatitic dikes which lie parallel to the structural trend of the range. It is in these dikes that the tungsten ores occur. On the north slope of the mountain the ore, wolframite, is deposited in well-defined quartz veins in the pegmatite. The veins vary in width from 2″ to 1′. On the south slope wolframite and hübnerite are found disseminated throughout the dike rock and not in any regular vein systems. The discovery of the tungsten ores in these mountains is of very recent date, and practically no development work has been done. The discoveries on the north slope have been confined to Cliff Cañon, about 5 miles southwest of South Ivanpah, at elevations which range from 4800′ to 5500′, while those of the south slope lie in that portion of the range due south of the former but closer to the summit, the elevation being from 6500′ to 6700′.

Carbonate Group. J. R. Comerford, Matt McCarthy and Geo. Carruthers of South Ivanpah have a group of six claims in Cliff Cañon on the north slope of the New York Mountains 2 miles southeast of Brant, a station on the Salt Lake Route. These claims are named: Carbonate, Ruby, Lucky Strike, North, Ella May, and Oversight. A fairly good wagon road which, with little expense, could be made an auto road, connects the railroad with the camp. Wolframite is deposited in narrow quartz veins varying from 2″ to 1′ in width. Six distinct veins have thus far been located. They strike in a general northeast and southwest direction, almost with the trend of the dike in which they occur. The quartz is very friable and free of impurities, carrying only occasional pyrites with the wolframite, which makes in bunches in the quartz. An old tunnel driven several years ago on the Carbonate claim by the Garvanza Mining Company cut an 8″ vein which shows excellent values in the face. The owners are now drifting on this vein and have taken out several hundred pounds of high grade ore. Only surface work has been done as yet on the other veins, all of which show good values. Water for working purposes is obtained from a 35-ft. well sunk in the cañon below the old Garvanza mill. The owners will sell this property on very reasonable terms.

R. H. Shafer, E. W. Schloerb, and W. L. Field of Ivanpah have filed locations on a group of five claims in Cliff Cañon adjoining the group described above. No development work has as yet been done.

Sagamore Mine (see under Copper).

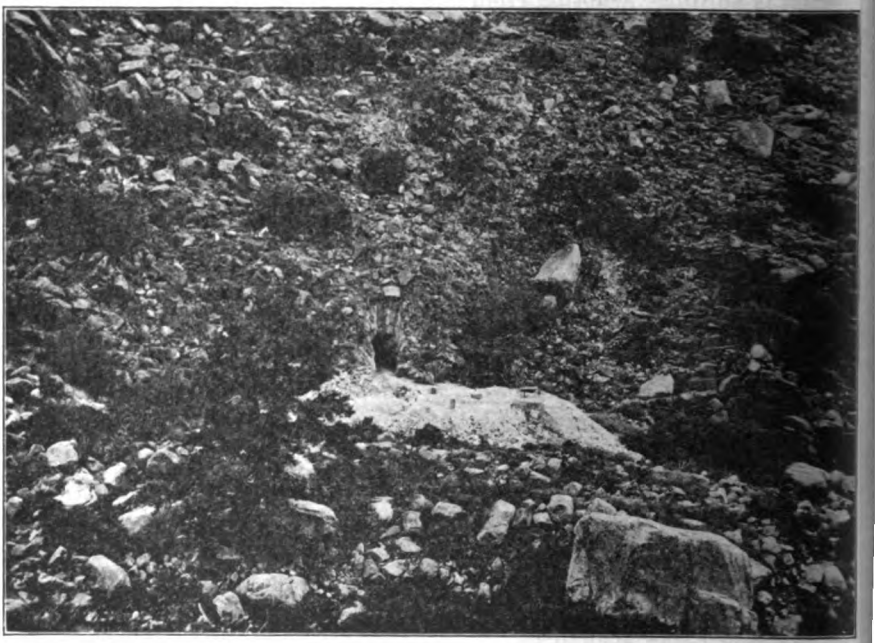


Photo No. 27. Carbonate tunnel on property of J. R. Commerford et al., cutting 8 inch tungsten bearing vein. Owners now drifting on this vein. Cliff Cañon, New York Mountains.

Tungsten King Group, consisting of seven claims, lies on the south slope of the New York Mountains at an elevation of 6700 feet and is 15 miles north of west of Ledge Station. Small crystals of hübnerite and wolframite occur irregularly disseminated throughout a pegmatitic dike which varies in width from 25′ to 60′. (See photos Nos. 29 and 30.) The dike strikes N. 75° E. and pitches almost vertically to the south. It outcrops for at least 1200′ along a saddle of the mountains, 1000 ft. in elevation above the camp. There has been no development work on this property as it was located quite recently (May, 1916). A few tons of high grade ore, mostly float, found in the vicinity of the dike, have been sacked and are ready for shipment. It is estimated that this dike contains between 1% and 5% of tungstic oxide. The ore is very clean and free from base metals, the gangue being quartz and feldspar. It concentrates very easily, as shown by the test run made at the Reynolds Mill at Goffs (see below). It suffers the disadvantages of being rather inaccessible and lack of water—the nearest water being hauled from a well in the wash below the Gold Chief mine, five miles

by road from the camp. The owners claim to have refused an offer of $100,000 for the property. Owners, J. F. Brooke, F. M. Brooke, F. W. Chausse, and J. G. Bliss, Goffs, Cal.

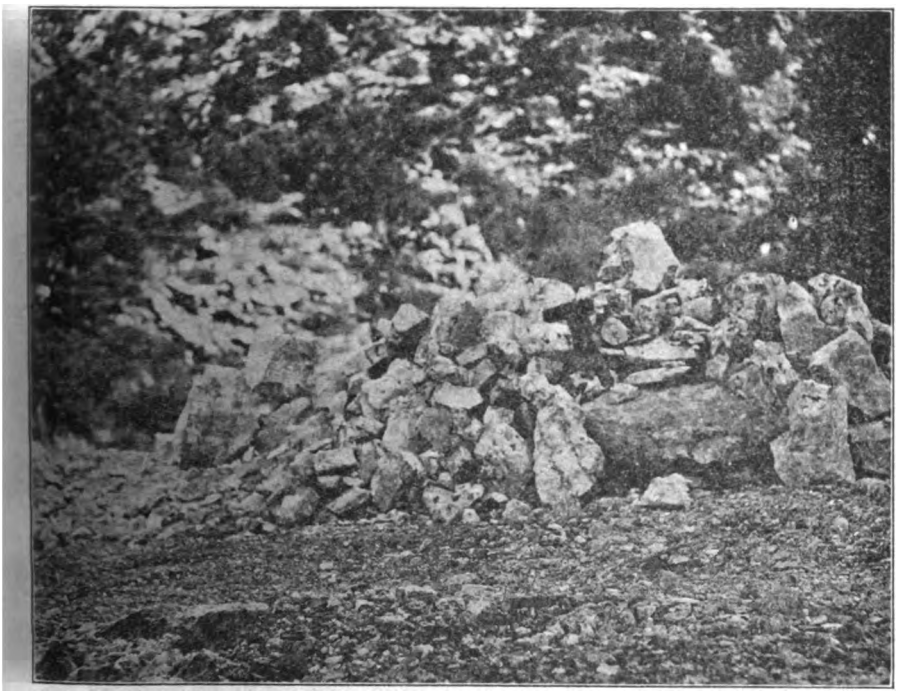


Photo No. 28. Tungsten ore at mouth of Carbonate tunnel. The wolframite shows as black spots in the rock.

Many other claims have been located in this district, but there was practically no work being done on them at the time visited.

The Signal District.

This district lies in R. 18 and 19 E., T. 11 N., S. B. M., from 6 to 10 miles, by fairly good desert road, north of Goffs. The general altitude is about 3500 ft. above sea level. It extends in a N.W.–S.E. direction for about 4 miles over low rolling hills and presents the usual much weathered, broken, desert condition.

The geology of the district is simple, consisting essentially of granite underlying altered limestone and intruded by diorite and pegmatitic dikes. The limestone has been eroded to a great extent and the granite is exposed over large areas. The ore is deposited in quartz veins that occur both as contacts along the limestone and the granite, and as fissures in the granite. It is mostly wolframite, although occasionally hübnerite is found. The wolframite is usually deposited in fairly large crystals and makes in bunches in the quartz. The hübnerite has been found in small elongated crystals disseminated throughout the quartz.

The occurrence of tungsten ores in this district has been known for some time, but it has been only within the last six months that much interest has been aroused. The high price of this metal, during the

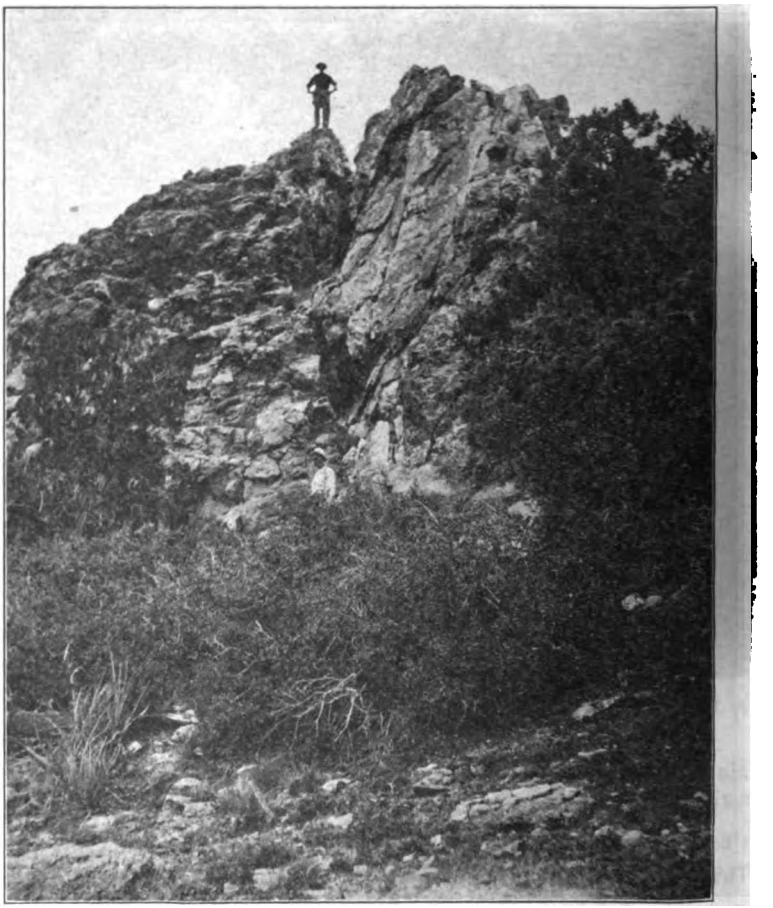


Photo No. 29. Exposure of pegmatitic dike, carrying wolframite and hübnerite at western extremity of outcrop of the Tungsten King Group, New York Mountains. The dike is here at least 60 ft. wide.

early spring, led to considerable prospecting and many promising prospects are now being developed. A few small shipments have been made, most of which were from rich float found in the vicinity of the outcrops. Some of the ore was hauled to Goffs, where a small custom mill was erected. (See Reynolds Mill below). The completion of the 50-ton concentration mill of the Louisiana California Mining Company (see under Vanadium) which is to treat custom tungsten ores, should be a big factor in the further development of that district.

The **Argosy Mine,** consisting of three claims, is six miles north of Goffs and is the most southerly deposit of that district. The ore is

deposited in finely disseminated crystals of hübnerite and wolframite in a system of veinlets in a pegmatitic dike. These veinlets, varying from 4″ to 6″ in width, strike with the general trend of the dike, east and

Photo No. 30. Eastern extremity of the outcrop on the Tungsten King Group, New York Mountains.

west, and dip about 45° N. The ore is said to average 2%. Development consists of a 140′ drift along the dike and a 38′ raise which connects the face of the drift with the surface. Water for working purposes is hauled by motor truck from Goffs. Idle at the time visited, but a bond had been given on the property and it is expected that operations will be resumed on the completion of the Louisiana California Mining Company's mill, 2 miles north of the mine. Owners, E. E. Fuller and C. B. Jacobs, Goffs, Cal.

J. C. and **W. O. Kinsman,** of Goffs, have a group of claims in this district 8 miles north of Goffs, and are prospecting for tungsten ores. Rich float has been found on a number of their claims.

Lombard and Main, formerly the California Vanadium Company, have a large number of claims adjoining the property of the Louisiana California Mining Company and have uncovered a few promising veins. Some development work was done several years ago on gold-bearing veins on this property, and the later work is practically all superficial. Several tons of fairly high grade float have been found and treated at

the mill lately erected by the owners. The mill consists of Braun rolls and a Stebbins dry concentrator. About one ton of concentrates, that is said will average 75% tungstic oxide and are being held for higher market price, have been produced. The dry concentrator is reported to be thoroughly satisfactory for the treatment of this ore. It is operated by a gas engine. Mill was idle when visited, as the owners were doing some prospecting work on their claims. Owners, A. L. Lombard and J. F. Main Estate, Goffs; office address, 540 I. W. Hellman Bldg., Los Angeles.

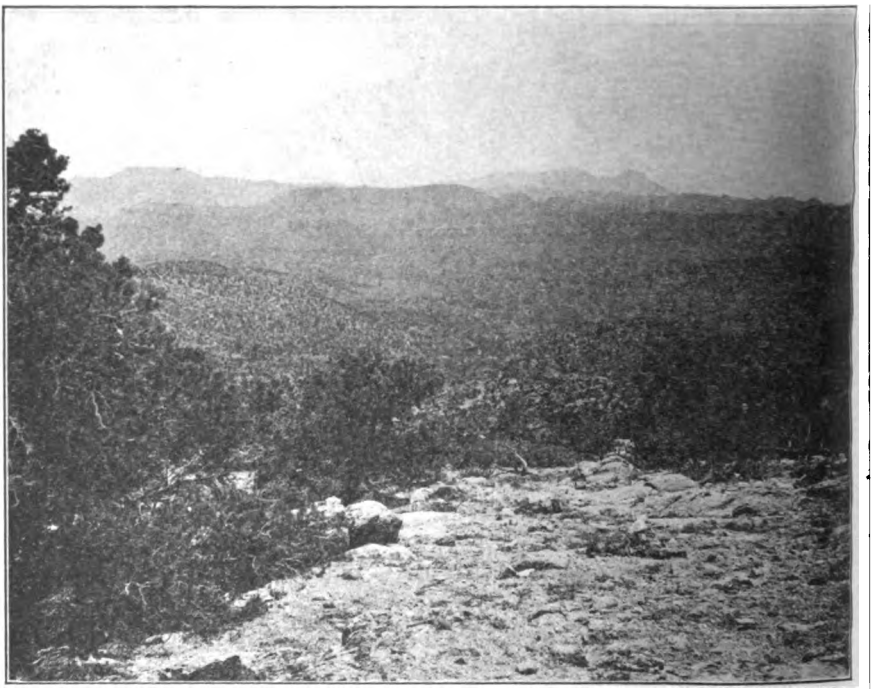


Photo No. 31. Looking southward from the Tungsten King Group in the New York Mountains, approximately 1200 ft. in elevation above the floor of the cañon seen in the middle distance.

Joseph Lord and A. A. Irish, Grosse Bldg., Los Angeles, have a group of 32 claims ten miles south of Goffs, and extending to the southern limit of the district. A 75-ft. well was sunk on the property and this gives sufficient water for camp uses. As the locations were made in March, 1916, there has not as yet been any great amount of development work done. Most of the claims are being worked by leasers and a number of shafts are now being driven on the different veins. The general strike of the veins is N. 40° W. and the dip 60° to 80° NE. The greatest depth attained when visited was that on the

Mills, Beauchamp, and Binney lease; 80 ft. on the vein. The vein showed excellent values throughout its depth, and stoping is being done on the 50 ft. level. The ores from this property are concentrated by hand jigs erected at the well (see Photo No. 33). A small jaw crusher

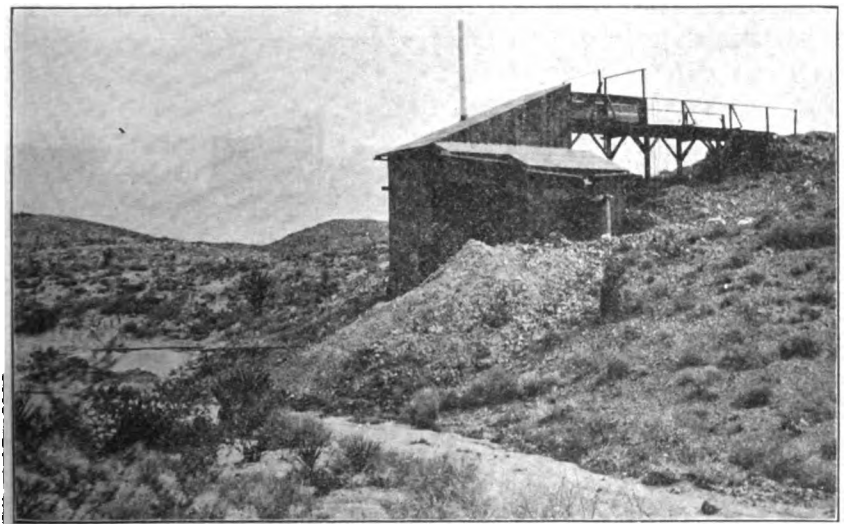


Photo No. 32. Dry concentration mill of Lombard and Main, Signal District, 8 miles north of Goffs.

[illegible]ted by a gas engine reduces the ore to the required size before j[illegible]ng. Some small shipments were made during the early part of t[illegible]ummer, and several tons are now ready for shipment. The following leasers are working one or more claims each at this property:

Baker and Binney
Boose, Michael & Buchanan Co.
Cox, F. B.
L. F. Grosbeck, C. C. Grosbeck and Sam Tinker
George Irving and Roy Schumaker
K. G. Lyons, F. Pisch and F. Cordier
Mills, Beauchamp & Binney

all of Los Angeles, Cal.

Reynolds Custom Mill was erected last spring by H. I. Reynolds of Boulder, Colo., at Goffs, to treat the tungsten ores of the Signal and New York Mountain districts. The mill consists of a jaw crusher, Hendricks rolls, two Morse Bros. jigs, and a Deister concentration table. A 25 h.p. gas engine was installed to operate the mill—capacity said to be 25 tons per 24 hours. Water was bought from the Santa Fe R. R. Co., who have wells at Goffs. This mill was operated only a few days on some ore from the New York and Signal districts and proved a failure. The ore was not crushed fine enough and did not make a clean

concentrate. Mill is now idle and it is reported that it is to be remodeled.

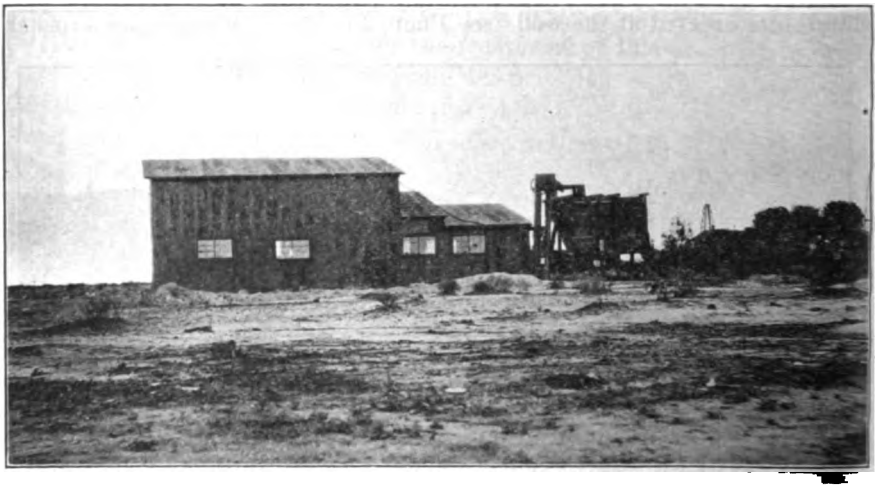


Photo No. 33. Custom Mill at Goffs, built by H. I. Reynolds for concentrating tungsten ores of the Signal and New York Mountains districts.

As in the New York Mountains **numerous claims** have been taken in this region, but the work thus far has been entirely superficial. The decline in the price of tungsten during the summer has somewhat dis-

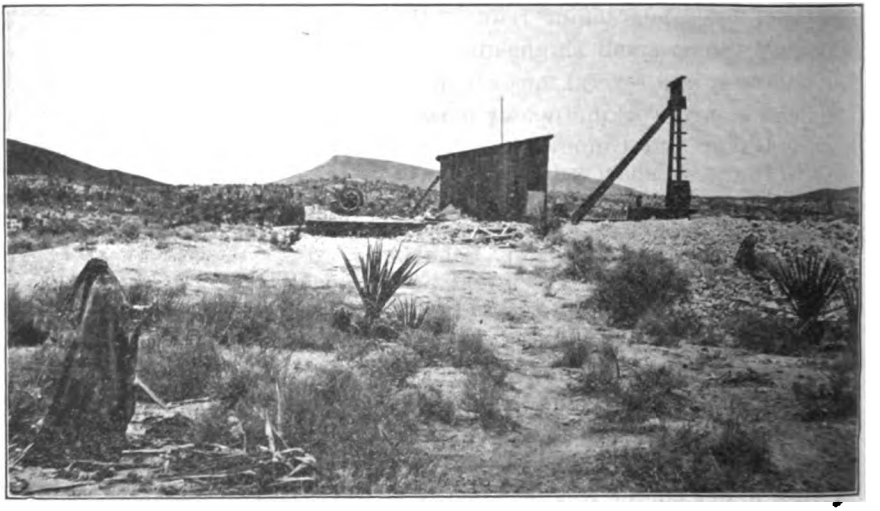


Photo No. 34. Rock crusher and hand jigs at well on the Lord and Irish property, Signal district.

couraged many of the locators, so that the district is not as active as it was when the higher prices prevailed.

Tungsten ores have also been found in the **Providence Mountains,**

properties were worked during the spring, but are now idle, and it is said that some excellent ore was found. The ore is wolframite and its occurrence is said to be similar to that of the New York Mountains. The following parties made small shipments from this district: **Edward Bluett** of Kelso; **Desert Mining Company**, A. B. Carpenter, manager,

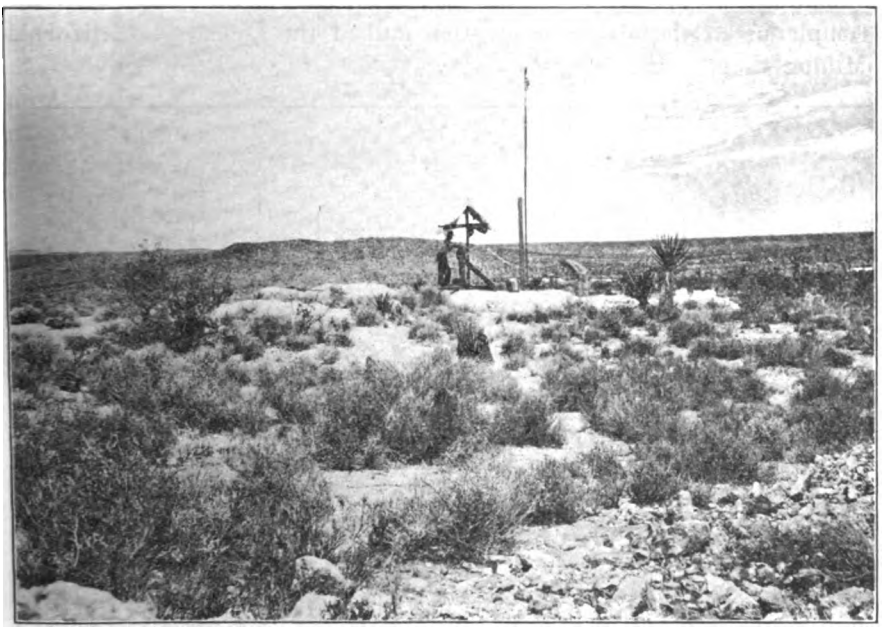


Photo No. 35. Eureka shaft of the Boose, Michael & Buchanan Co. lease, Signal district.

Union League Bldg., Los Angeles; **Pierce & Creighton**, American Bank Bldg., Los Angeles.

The occurrence of **Tungsten** is also reported near the old Rose mine in Rattlesnake Gulch, and near the new gold camp of Goldstone. See also Four Brothers Mine, under Gold, p. 41.

VANADIUM.

The only known occurrence of vanadium ores in California is that found in the Signal District, 8 miles north of Goffs at the properties of Lombard and Main, and the Louisiana California Mining Company. The ore occurs in the gold quartz veins and has been identified by Schaller as cuprodescloizite.[40] "Samples of vanadium ore sent to Schaller by A. L. Lombard and J. F. Main from Camp Signal proved to be coated with cuprodescloizite (21% V_2O_5 in the mineral). The associated lead minerals are cerusite and vanadinite from which the cuprodescloizite seems to be derived. A qualitative test showed the presence in quantity of lead, copper, zinc, vanadium, and a little water.

[40] Journal Wash. Academy of Science, 1911, Part I, p. 149.

A direct quantitative determination of the vanadium gave 21% of V_2O_5. The material when examined under the microscope was seen to be well crystallized in minute, colorless, or pale yellow plates. Some of these are square or oblong, others irregularly shaped. * * * "

While there has not been as yet any commercial production of vanadium, we may expect such production during this year with the completion of the new concentration mill of the Louisiana California Mining Company.

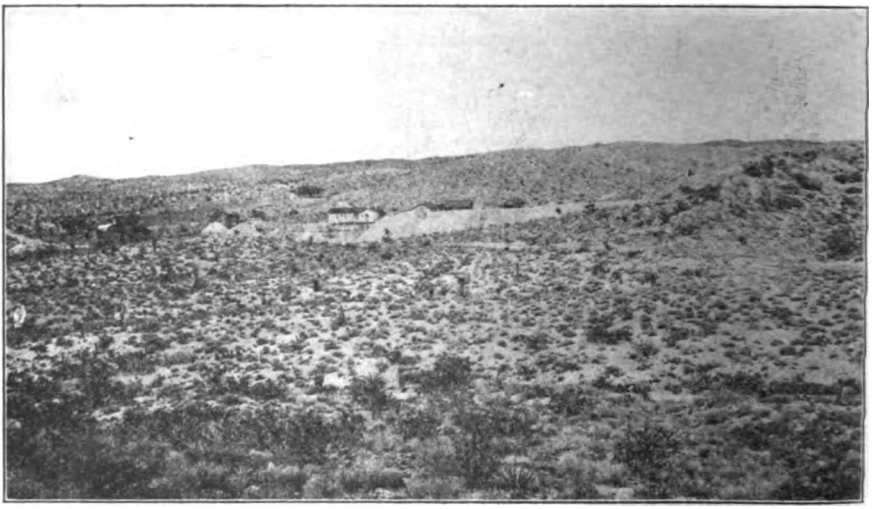


Photo No. 36. Camp of the Louisiana-California Mining Co., Signal District, 8 miles north of Goffs.

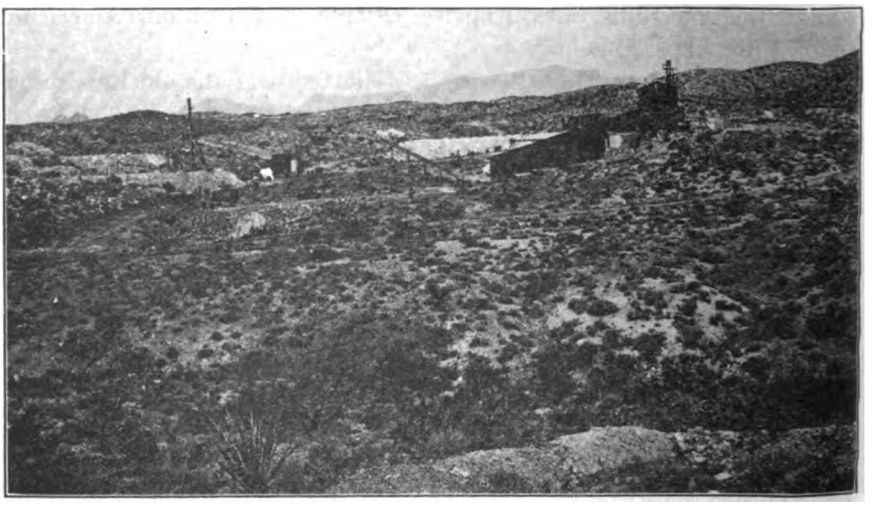


Photo No. 37. New 50-ton mill of the Louisiana-California Mining Co. The head-frame of the 900-ft. shaft is seen at right extending above the top of the mill. The 200 ft. shaft is indicated by the headframe and dump at the left.

Leiser, manager, Goffs. This property, consisting of 8 claims, and developed essentially for gold, reports the occurrence of vanadium in the lower workings of the mine. The vanadium occurs as a coating along seams in the quartz vein in the form of cuprodescloizite. The vein

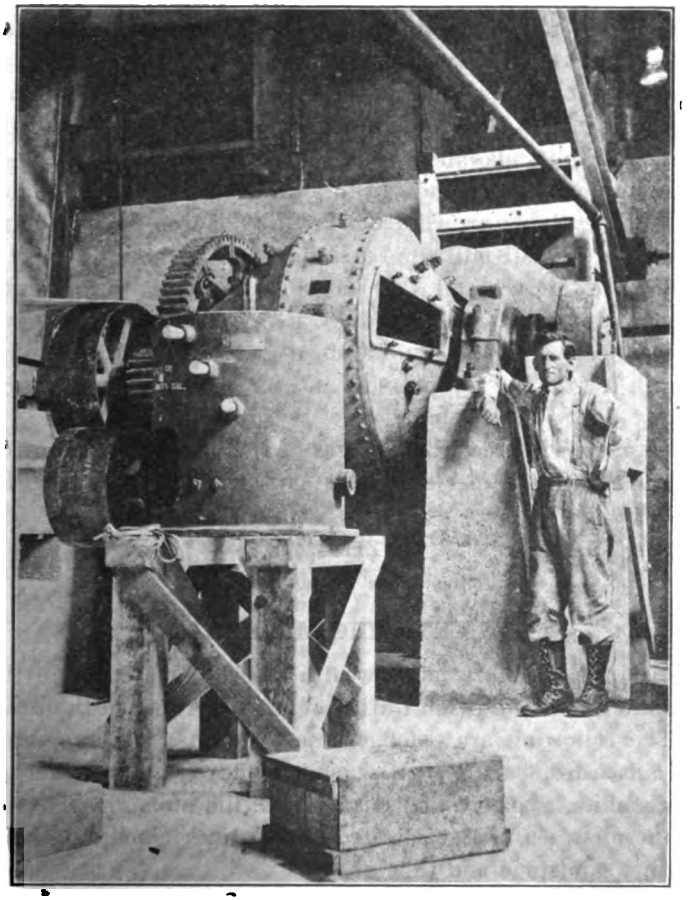


Photo No. 38. Hardinge ball-mill in plant of the Louisiana-California Mining Co. Clean-up pan in the foreground.

varying from 4′ to 12′ in width is deposited along the contact of granite and porphyry. It strikes N. 60° E. and dips 45° N. The development consists of two vertical shafts of 900′ and 200′, respectively, with numerous levels, crosscuts and drifts. The 900′ shaft was driven for water and supplies approximately 2000 gallons per 24 hours. These shafts are not connected and will later be abandoned as working shafts as they are of only one compartment and inadequate. It is planned to sink a two-compartment working shaft north of the 900-ft. shaft and crosscut to the vein. Both of the shafts are equipped with gas engine hoists. Some stoping is now being done on the 150′ and 200′ levels of

the 200′ shaft. Air drills are used. The ore will be concentrated at the new 50-ton mill erected just east of the 900′ shaft.

The flow sheet is, briefly, as follows: Ore is fed to a No. 3 Gates gyratory crusher, sized to crush 1″ or smaller, and elevated by a 35 ft. 9″ bucket conveyor to a 250-ton storage bin above the mill, then by gravity to a Challenge automatic ore feeder and into a 4½′ Hardinge ball mill, rated at 50 tons capacity. It is discharged through a 20-mesh screen onto a specially designed shaking amalgamator, then going to two 5′ x 10′ amalgamation copper plates; subsequently to a Richards hydraulic classifier. The coarse sands are diverted to a Wilfley table, while the slimes go to a Deister slimer. The middlings from the Wilfley table are returned by a 3″ Byron Jackson slime and sand pump to the ball mill for regrinding. The table tails are run to a 5′ Avoca dewaterer, and the water returned to the circuit. The dewatered tails are to be stacked by a 50-ft. belt conveyor, without further treatment. A 120 h.p. Western gas engine will supply power for the mill, for the air compressor, and for a 25 k.w. generator which is to supply light for the plant.

This company will treat custom ores of the district in lots of not less than 50 tons at $5.00 per ton, and expect to start milling in September, 1916.

ZINC.

(See under Lead—Zinc.)

NONMETALLIC MINERALS.

San Bernardino County has a wealth of crude materials in the nonmetallic minerals, in addition to the metals described in the preceding pages. The following are among those which are either operative or potential: asbestos, barite, borax, cement, clays, fuller's earth, gems, granite, graphite, gypsum, infusorial earth, limestone, marble, mineral paint, mineral water, nitrates, petroleum, salines (including salt, soda and potash), sandstone and talc.

ASBESTOS.[11]

Fire-Proof Mine, J. B. Friend, Victorville, locator. This mine is situated about 4 miles west of Cottonwood, a station on the Santa Fe Railway, probably in the southeastern part of T. 9 N., R. 4 W., S. B. M. The asbestos is stated to occur in a seam in a shale country rock, from 5′ to 6′ wide. A small portion of the asbestos is claimed to be of rather good quality. None has been shipped. This is probably the same mine mentioned under the name of Scorpion in the Ninth Report of the California State Mining Bureau, p. 236.

In the Mining Bureau museum is a specimen of asbestos from near Barstow.

BARITES.

L. A. Davis, Stagg post office, reports he has a deposit of barite near Ludlow; also dolomite and a strontium mineral (probably celestite). He also states he has a deposit of fluorspar, ½ mile from Ludlow.

Ellis Mallery and associates, 214 H. W. Hellman Bldg., Los Angeles, are opening up a deposit of crystalline barite, stated to analyze up to 96% $BaSO_4$, near Barstow.

O. D. Mansfield of Barstow reports the occurrence of barytes on his claims six miles north of Barstow. The barite is deposited in a vein averaging 3′ in width in limestone. It is said that the vein can be traced for 2000 ft. The deposit is undeveloped. Several other minor deposits are reported in that vicinity none of which have been developed.

Bibl.: Bulletin 38, p. 264.

T. G. Nicklin of Barstow, reports that he has a deposit of witherite (barium carbonate) associated with strontium carbonate.

BORATES.

(See also under Salines.)

The production of borax in San Bernardino County was for many years its leading industry, but with the exhaustion of the colemanite mines of the Pacific Coast Borax Company near Calico in 1904 it ceased and there has been no recent work on the many other deposits, most of which are low grade, marsh or playa deposits which could not compete with the colemanite deposits of Inyo, Los Angeles and Ventura counties.

The **Calico** deposits were by far the most important ones in the county and have produced over $9,000,000. As these deposits were described in detail in former publications of this bureau no further mention will be made of them here. The ruins of the Pacific Coast Borax Company's concentrator, four miles north of Daggett, and of the Blumenberg plant, bear mute testimony to the former activity of that now dormant district.

Bibl.: Reports IX, p. 225; XI, p. 345; XII, p. 35; XIII, p. 46; Bull. 24, pp. 56–60.

The **Searles Lake** borax beds were the first worked in the county. They were discovered in 1868, but not worked until 1874. From then on to 1881 the principal production of borax was from this marsh deposit worked by the San Bernardino Borax Mining Company. The physical peculiarities and probable origin are described by Dr. H. De Groot in the State Mining Bureau Report X, as follows:

"Locally considered Searles' marsh lies near the center of an extensive mountain-girdled plain, to which the phrases 'Alkali Flat,' 'Dry Lake,' 'Salt Bed,' and 'Borax Marsh' have variously been applied, the

contents and physical features of this basin-shaped depression well justifying the several names that have been applied to it. It is, in fact, a dry lake, the bed of which has been filled up in part with the several substances named. Its contents do, in reality, consist of mud, alkali, salt and borax, largely supplemented with volcanic sand. This depression, which has an elevation of 1700 ft. above sea level and an irregular oval shape, is about 10 miles long and 5 miles wide, its longitudinal axis striking due north and south. It is surrounded on every side but the south by high mountains, the Slate Range bounding it on the east and north, and the Argus Range on the west, the view to the south being shut out by low mountains, conical peaks and broken hills which break away to the southeast. Conspicuous in that direction stands a series of splintered buttes, so slender and pointed that the name 'Needles' has been applied to them.

"No doubt but this basin was once the bed of a deep and wide-extended lake, the remains of a former inland sea. The shore line of this lake is distinctly visible along the lower slopes of the surrounding mountains at an elevation of 600 ft. above the surface of the marsh. Further up, one above the other, faint marks of former water lines can be seen showing the different levels at which the surface of the ancient lake has stood. In the course of time this lake was extinguished, having been filled up with the wash from the adjacent mountains, originally much taller than they are now."

The **American Trona Corporation** is constructing a large plant at Searles Lake for extracting these salts. (*See* under Salines.)

Bibl.: Report X, pp. 534–539; Bull. 24, pp. 63–65; U. S. G. S., Bull. 580-L.

Colemanite has been discovered in a well on a ranch 9 miles by road northwest of Kramer, in Sec. 22, T. 11 N., R. 8 W., S. B. M. A bed of colemanite 40 ft. in width was encountered at a depth of 370 ft. The deposit is bonded to the Pacific Coast Borax Company, but no further work has been done on it.

Bibl.: U. S. G. S. Min. Resources 1914, Part II, p. 287.

Numerous other borax deposits occur in different parts of the county, none of which have been developed. The following descriptions of them are taken from the report of Dr. Gilbert E. Bailey.[42]

Cave Springs. Borax deposits, consisting of borate of lime associated with carbonate of soda, salt, and sulphate of soda, have been recently located southeast of Cave Springs, near the Daggett road, but no development work has been done. It is reported that borate "mud beds" similar to those near Daggett have also been discovered in this district, which lies along the south flank of the Avawatz Mountains.

[42]Bulletin 24, "The Saline Deposits of Cal.," pp. 60–64.

China Lake. This playa lake lies partly in this county and partly in Kern County. It is located in R. 40 and 41 E., T. 25 S., M. D. M. It was once a part of Searles Lake, being really a pool or depression in the southwest portion of that lake in recent geological times. Deposits are similar to those of Searles Lake. Undeveloped. E. E. Teagle, C. H. Churchill et al., Johannesburg, Cal., owners.

Coyote Holes or **Willow Springs Lake.** The playa lake, about 20 miles northeast of Daggett, is locally known as Coyote Holes, or Willow Springs, from two springs on its north and south edges. It is in T. 11 N., R. 2 E., S. B. M. At Coyote Holes is a "marsh" of about 300 acres that is surrounded by a crust of borax. The marsh itself is mainly a carbonate of soda bed. The borax is mainly ulexite or "cotton ball" borax, and is undeveloped.

Lone Star. Beds of colemanite have been discovered in the south flank of the Lone Star Range, almost directly north of Leach's Spring, in T. 18 N., R. 2 E., S. B. M. These beds are from 3′ to 5′ thick and outcrop for intervals for a distance of about two miles.

Lone Willow. Outcrops of colemanite similar to those of Lone Star have been discovered a few miles west of the Lone Willow Springs in the south flank of Brown's Mountain. No development work has yet been done upon them.

Lower Cañon Beds. In the alternating strata of sedimentary beds in the Lower Cañon niter beds, situated in the cañon of the Amargosa River, evidence of the presence of borates has been found. Colemanite and ulexite have both been found as "float," and an examination of the numerous strata will in all probability show the existence of beds of commercial value.

Mojave Sink. The sink of the Mojave River is situated in T. 11 to 13 N., R. 8 and 9 E., S. B. M. Borax has been found in the playa layers of this lake that is locally known as Soda Lake. It is associated with the carbonates and sulphate of soda, but no attempt has been made to explore the deposits to see if the borax exists in commercial quantities. Around Borax and Barrell Springs the borax is too spotted and in too small quantities to be of value. Borings might give waters carrying values.

Owl Springs. The Owl Springs, or Owl Holes, are located in T. 18 N., R. 3 E., S. B. M. Priceite and colemanite both occur in large quantities at the niter beds of this district, associated with carbonate and sulphate of soda.

Palma Lake. Borax mixed with natural soda has been discovered six miles from Twenty-nine Palms. The deposits cover large portions of Sec. 26, 29, 31, and 32, in T. 9 E., R. 2 N., S. B. M. The deposits are similar in many respects to the well known Searles Lake. Some

development work was done by Messrs. Johnson and Williams, of Riverside.

Pilot Beds. Borate deposits have been found at the south end of the Slate Range, southeast of Searles Lake. These deposits are mainly borate of lime in strata underlying the niter beds. No work has as yet been done to show their extent and value. The property is in the hands of W. R. Fales of Los Angeles.

Salt Springs. These are located in T. 18 N., R. 7 E., S. B. M., on the south fork of the Amargosa River. They form here a playa lake deposit of several hundred acres, similar to those already described at Coyote Holes, Owl Springs and elsewhere.

Saratoga Beds. These beds are located in T. 18 N., R. 5 E., S. B. M. They occupy the flats around Saratoga Springs at the foot of Funeral Range, in the bottom of the south end of Death Valley. Claims covering 5600 acres have been made on this portion of the bed of the ancient lake. The borax occurs around the springs and in the flat as a crust mixed with soda compounds. These crusts are from 1′ to 3′ deep, the richest borates being found in "pools" and "basins" varying from a few feet to several acres in extent, making the beds, as a whole, quite spotted as all of the borax deposits are. Rich portions are also found along the shallow river channels that wind everywhere through the flats. Samples taken have varied from 7% to 40% borax; from 10% to 60% sulphate of soda; from a trace to 5% carbonate of soda; from 8% to 25% chloride of soda, and from 10% to 50% insoluble matter. There is present also more or less magnesia and some iodine. Traces of boric acid were found in the Saratoga Springs, which are warm springs that issue with considerable force and in large volume from beneath the lavas. The overflow of these springs forms lakes that cover the greater portion of a section. It is probable that boring will reveal the presence of beds of borates and waters rich in borax.

Besides in the beds around the springs, borax in considerable quantities has been found in the niter fields three miles south, along the flank of the Avawatz range, and is described under the head of "Niter."

CEMENT.[42]

Cement, as used in building, is a compound of lime, alumina and silica that hardens in contact with water. It differs from quicklime in that it does not slack, expand, crumble, nor give off heat when wet, but chemically combines with part of the water into a firm, artificial stone. There are two principal classes of cements—the natural rock or Rosendale cement, and the artificial product, or Portland cement, to which may be added a third—the Pozzuolana, or slag cement.

[42]Bulletin 38, pp. 171–172.

Natural Rock Cement.

A limestone which in nature contains sufficient clay or other aluminous material, mixed with carbonate of lime, so that it requires only burning and grinding to form a cement, is called a waterlime or natural cement rock, and the product is natural or Rosendale cement, sometimes called Roman cement. Natural cement rock was discovered in the United States near Chittenango, N. Y., in 1818. Later it was found in large quantities elsewhere in New York and in Pennsylvania, Indiana, Kentucky and other states. Ulster County, New York, and Louisville, Kentucky, were for a long time the centers of this important industry. Natural cement is generally inferior to Portland, and, in most places, its market has been taken by artificial product.

A natural cement rock is known in California near El Toro, Orange County, and claimed to be of good quality. Such a material was worked at one time at Benicia, in Solano County.

Portland Cement.

Portland cement is a compound consisting chiefly of silicates and aluminates of lime, produced by the calcination to incipient vitrification of a mechanical mixture of calcareous and argillaceous materials, the clinker thus produced being subsequently ground to a fine powder. Its chemical composition varies considerably, the principal constituents being lime, silica, alumina, and oxide of iron, which are apparently in the following proportions: lime, 60% to 64%; silica, 20% to 24%; alumina, 6% to 10%; iron oxide, 3% to 5%. These constituents, as a rule, amount to about 96%, the remainder consists of small quantities of sulphuric anhydride, magnesia, alkalies, etc.

The use of Portland cement is principally based on its characteristic quality of hardening rapidly under water or in a moist atmosphere.

Portland cement was first manufactured in England and so named in 1824 by Joseph Aspdin of Leeds, who patented a calcined mixture of limestone and clay. The name was based on a resemblance of the set cement to the famous Portland limestone used in building. The growth of the industry was at first slow. Not until 1851 was it brought prominently before the world, and soon after its manufacture began in Germany, France and elsewhere on the continent. The increase in output was rapid from this time, especially in Germany and England, which countries formerly exported large quantities to the United States.

Colton Cement Plant,[44] in Secs. 19 and 30, T. 1 S., R. 4 W., S. B. M. This is operated by the California Portland Cement Company, 401 American Bank Bldg., Los Angeles, Dan Murphy, president; T. J. Fleming, secretary and general manager; E. J. Strock, superintendent at the plant.

Preliminary work was begun about 1892 and in 1894 the works

[44]Report XII, p. 380, 1894.

were producing about 50 barrels per day and employing 25 men.[45] In 1896 the capacity of the plant was 200 barrels per day, and 75 men were employed.[46] Since that time the capacity of the plant has been increased nearly three-fold.

The works are about 1¼ miles west of Colton, at the north end of Slover Mountain, south of the Southern Pacific Railroad. This mountain is a knoll of crystalline limestone, about a mile long, more than half a mile wide, and 500 feet high. Near its summit, on the northeast, is the quarry from which the rock was formerly obtained. Here the limestone is very coarsely crystalline, some of the calcite rhombs being more than one inch in diameter. Analyses of this stone show it to be very nearly pure carbonate of lime. One analysis gave:

Lime	55.210%
Carbon dioxide	43.384%
Silica	0.550%
Alumina and iron oxide	0.850%

The composition of the stone in the quarry is said to be remarkably uniform, as its appearance would indicate. A tunnel was driven through the mountain from the level of the quarry floor to a point directly above the old cement works, and the broken stone from the quarry was run through the tunnel on small tram cars and dumped into a rock crusher. After crushing it was sent by gravity down a long chute to the old cement mill now used only for making lime. The rock is finely pulverized in a Griffin mill, and then thoroughly mixed with clay in a mixer. The mixed product is fed into eight rotary kilns, where it is burned to clinker with an oil fire. A patent appliance which is used for spraying the oil into the furnaces is said to be a great aid in burning. The clinker from the kilns is spread out and sprinkled with water for the double purpose of cooling and seasoning it. It is then ground in Griffin mills and tube mills and sacked for shipment.

The clay is now obtained from Chester, Riverside County, a station on the Santa Fe Railway, east of Corona, and is shipped in by rail. The gypsum is shipped from Amboy, Cal. Besides cement, this company produces crushed stone, lime, and marble dust for making carbon dioxide gas for soda fountains.

Golden State Portland Cement Company: this company, formerly known as the Wyman Limestone Company, is incorporated under the laws of Arizona with officers as follows: F. O. Wyman, president; C. W. Russell, secretary; W. K. Watkins, superintendent; C. W. Green, foreman; J. J. Quint, head chemist; with offices at the works and also at 522 Marsh-Strong Bldg., Los Angeles. The plant is at Oro Grande (P. O. Halleck) and consists of an up-to-date and complete cement

[45] Report XIII, p. 612, 1896.
[46] Bulletin 38, p. 183.

plant where the limestone is ground, burned and the clinker ground into cement, the company employing about 60 men. The quarries are four miles east of the plant, the rock being transported from the quarries to the plant by a local railway owned by the cement company. The total area of land owned is 320 acres, and about 600 barrels of cement are made per day, the output to date amounting to 300,000 barrels. Electric power is generated by steam at 7 cents per h.p.-hour.

The Riverside Portland Cement Company: office, Mills Bldg., San Francisco, owns extensive undeveloped deposits of limestone, shales, and silica, said to be suitable for the manufacture of Portland cement in the vicinity of Oro Grande and Victorville, which will ultimately be worked when their Riverside deposits are exhausted.

Southwestern Portland Cement Company, C. Leonard, president; O. J. Benford, secretary; general office, H. W. Hellman Bldg., Los Angeles; L. D. Gilbert, engineer and general manager, Victorville, Cal.

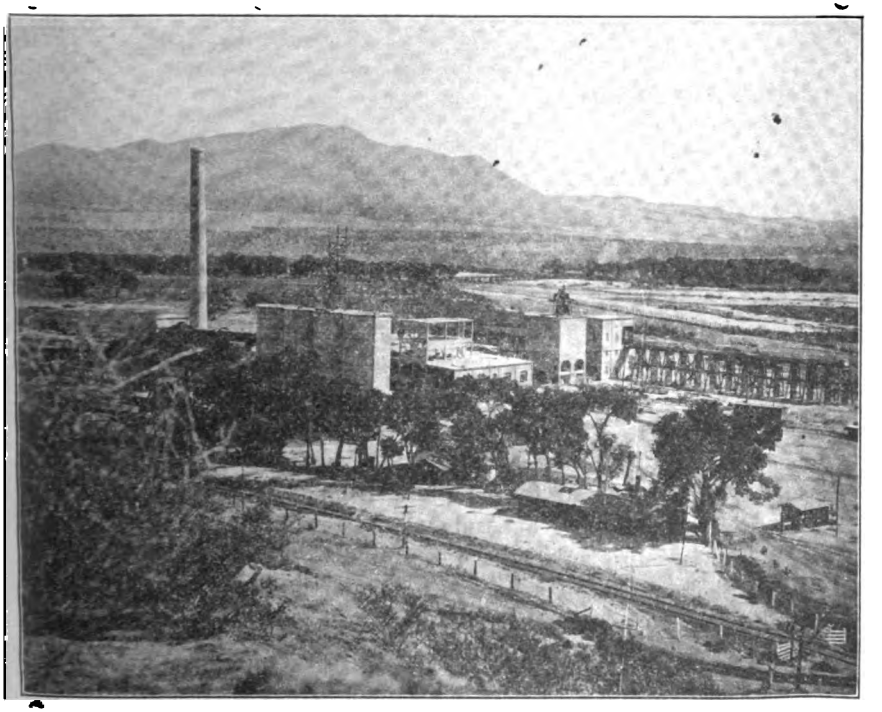


Photo No. 39. Plant of the Southwestern Portland Cement Co., 1 mile north of Victorville. The quarries are situated in the low mountains at right background. Santa Fe Railway seen in foreground.

This company owns a deposit of limestone, shales and silica covering about 250 acres six miles northeast of Victorville. A large modern cement plant is being constructed one mile north of Victorville and it is expected to begin manufacturing cement by September 1, 1916. The

plant is built entirely of reinforced concrete, and its capacity is to be, for the present, 300,000 barrels yearly. It is planned to double the capacity in the near future. One kiln 9′ x 200′ has been installed, and

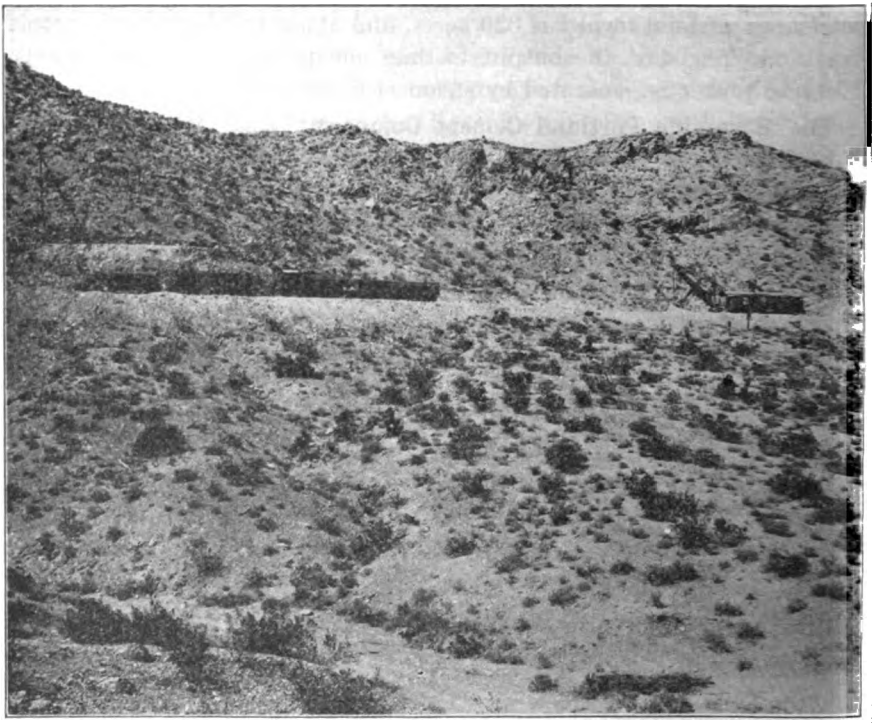


Photo No. 40. Southwestern Portland Cement Co.'s Quarry, 5.6 miles northeast of plant. Steam shovel is seen at right.

all the concrete work laid for a second one. The plant will be operated by electric power supplied by the Southern Sierras Power Company. Gypsum will be shipped to the plant from the Consolidated Pacific Cement Plaster Company at Amboy. A steam railroad, incorporated under the name Mojave Northern Railroad Co., has been built to haul the material from the quarries, 5.6 miles northeast, to the plant. The material is to be quarried by steam shovels. About 65 men will be employed upon the completion of the plant.

CLAY.

Brick Clay.[47]

Taylor Bros. Brick Company. A. E. Taylor, manager, 1240 W. Olive Ave., Redlands. This company owns two clay deposits; one is in Redlands on West Olive avenue, about one mile west of the center of town and covers about five acres, of which about one acre has been worked out. The clay is from 3′ to 5′ deep and is underlaid by sand.

[47] Bulletin 38, p. 252.

The material is a sandy loam. The bricks are made in a Potts soft-mud brick machine, air-dried, and burned in open kilns, using oil as fuel. The yard is equipped with an 80 h.p. boiler and a 35 h.p. engine. The capacity of the yard is 42,000 bricks per day, employing 23 men.

The other deposit is in San Bernardino, on G street, south of the Highlands branch of the Santa Fe Railway, and covers about 30 acres. The material is a sandy loam. The method of manufacturing the brick, the equipment and the capacity of the yard are similar to those of the Redlands brickyard.

Pottery Clays.

There are several known deposits of high grade clay in the county, most of which have never been developed, and all of which are now idle.

R. H. Atwood of Oro Grande owns a deposit of kaolin in T. 6 N., R. 4 W., S. B. M., 4 miles east of Oro Grande. A 100′ drift has been run in the deposit. Idle.

Bibl.: Bulletin 38, p. 226.

C. F. Blackburn of Victorville has an undeveloped deposit of kaolin 6 miles east of Oro Grande, said to be about 40 ft. thick. Idle.

Bibl.: Bulletin 38, p. 226.

J. B. Friend, Victorville, formerly located a clay deposit in T. 6 N., R. 3 W., S. B. M., about 10 miles east of Victorville. This clay is said to be suitable for the manufacture of fire brick, pressed brick and tiles. Some was shipped to Tropico, Los Angeles County, in former years, but there has been no recent production.

Bibl.: Bulletin 38, p. 227.

G. J. Lingenfelder and **R. H. Grear,** Daggett, have located two claims, Kaolin No. 1 and No. 2, on a bed of clay, 12 miles northeast of Barstow. The clay bed is several feet thick, and is exposed for 3000 feet along the strike. It is gray in color and very hard. It underlies a bed of rhyolite tuff, 8″ to 2½′ thick, which has been partially kaolinized. Undeveloped.

M. Mulcahy and **Mrs. M. Falconer,** Daggett, own a deposit of clay in the Calico district 6 miles by road north of Daggett and 5 miles west of Yermo, a station on the Salt Lake Route. The clay bed is from 2′ to 3′ thick, exposed along a ravine below the old Silver King mine in folded sediments (*see* Photo No. 41). The clay is gray in color, hard, and appears to be very uniform in character. No development work has been done at this property.

Velvet White Filler Company, 825 Los Angeles Investment Bldg., Los Angeles; A. L. Beardsley, president; A. B. Clark, secretary. This company owns a deposit of "whiting" in the Silver Mountain district, 3½ miles east of Oro Grande. The deposit consists of seams of white silica, talc and kaolin in an igneous formation. A plant was built at

Bryman Siding for treating this whiting. The process is briefly as follows: It is washed in tanks, and an inverted screw separates the clay from sand, the clay floats into settling tanks, then into presses.

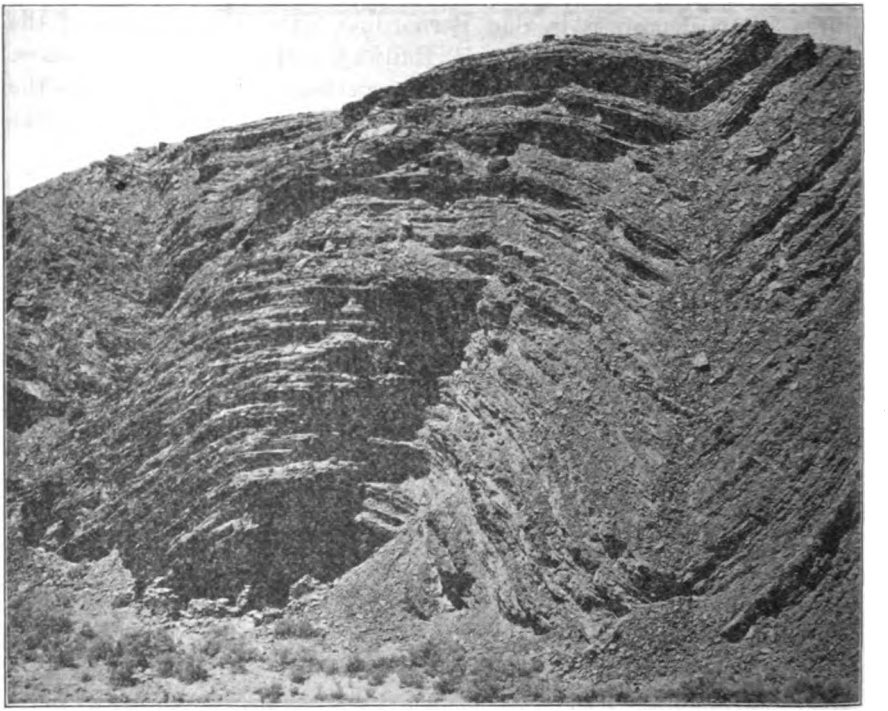


Photo No. 41. Clay beds exposed in Tertiary sediment at Calico, on claim of M. Mulcahy et al.

It is subsequently dried by steam heated dryers, reground and sacked. It is used for paint filler, sizing paper, and some porcelain work. This property has been idle for sometime, but it is reported that it is to be reopened shortly.

DOLOMITE.

Joseph Scheerer of Victorville has a deposit of dolomite on his claims east of Oro Grande. (*See* under Limestone.)

FELDSPAR.

J. H. Sloan, Barstow, made shipments of several carloads of feldspar during 1916 from a quarry which he has opened up near Hinkley. He also reports a body of strontium ore nearby. From the following

analysis of the feldspar made by Smith, Emery & Co., it is probably *anorthoclase*:

Analysis of Sloan Feldspar.

Silica (SiO_2)		74.84%
Alumina (Al_2O_3)		14.71%
Iron oxide (Fe_2O_3)		1.13%
Lime (CaO)		0.96%
Magnesia (MgO)		1.00%
Potash (K_2O)		3.00%
Soda (Na_2O)	by difference	4.36%
Total		100.00%

FLUORSPAR.

L. A. Davis, Stagg, post office (Ludlow)—see under Barytes.

FULLER'S EARTH.

J. Reed,[48] 428 Court St., San Bernardino, owns a deposit containing fuller's earth, claimed to be of considerable extent, about 12 miles north of Barstow. The fuller's earth occurs in sandstone and conglomerate. It is gray, red and brown in color.

W. E. Van Slyke,[48] 716 Fifth St., San Bernardino, has located a deposit of fuller's earth, claimed to be of considerable extent, in the northern part of T. 9 N., R. 22 E., S. B. M., on the north side of the Sacramento Wash, opposite Java, a station on the Santa Fe Railway. About 1902 some work was done on this deposit, showing a face over 80 ft. long.

Wm. B. Werner, 2378 West Twenty-first St., Los Angeles., has recently located two deposits of fuller's earth in the vicinity of Daggett, one gray in color, the other white. They are both said to be very pure and the deposits extensive.

GEMS.

Agate or Chalcedony.

F. M. Myrick of Randsburg has a fine deposit of blue agate or chalcedony, 37 miles east of Johannesburg and about 2 miles northeast of Lead Pipe Spring. Quoting from the report of Douglas B. Sterrett[49]: "The blue chalcedony occurs as fillings in joints, fractures and vesicular cavities in rhyolite, forming veins and irregular masses. Much of it is very delicately banded, showing straight, curved or angularly bent layers. In some specimens the agate passes into crystal quartz, lining or filling geode cavities.

"Agate containing bright red inclusions found 45 miles northeast of Johannesburg and 15 miles northeast of Lead Pipe Spring was discovered by Mr. Myrick, after whom it was locally called 'Myrickite'."

Some of this myrickite was polished and cut for jewelry, but there has been no work on these deposits recently.

[48] Bulletin 38, p. 275.
[49] U. S. G. S., Min. Resources 1913, Part II, p. 650.

A deposit of **Bloodstone** and **Jasper** was found in the vicinity of the myrickite and many cut gems from this deposit were sold in southern California. There has been no recent production.

Opals have been found in several localities on the Mojave Desert, but not in sufficient sizes and quality to warrant mining operations.

Bibl.: Bulletin 37, pp. 76, 77, U. S. G. S. Min. Resources 1911, Part II, p. 1059; 1913, Part II, pp. 675, 676.

Lapis Lazuli.

A small deposit of this mineral occurs in the NE. ¼, Sec. 6, T. 1 N., R. 7 W., S. B. M., and was described at length by Mr. Gordon Surr[50] of San Bernardino, from whose report this description is taken. The locality is on the north slope of the south fork of Cascade Cañon, 1½ miles south of east of the "Hogback," a well-known landmark in San Antonio Cañon, to which Cascade Cañon is tributary.

The "blue rock" lazurite) was thought by prospectors to carry silver and the deposit was opened with this idea. A pit 15′ deep apparently went through the "blue rock" and it was abandoned. No lapis lazuli was found in place, but about 150 lbs. of loose rock with some of the blue intermixed were found in the talus on the slope and in the drift in the stream bed. The country rock consists chiefly of quartzites and limestones. The lapis lazuli was apparently found in a layer of dark quartzite. It is not of good quality being mixed with a number of other minerals and is of no commercial importance. Specimens are on exhibition in the museum of the State Mining Bureau, and in the Chamber of Mines and Oil at Los Angeles.

An occurrence of **Lazulite** is reported in Breyfogle Cañon. The lazulite occurs in a vein cutting schist. The vein is said to vary from 1″ to 5′ in thickness and can be traced several miles. Some pretty specimens have been cut into gems that are unusual and very attractive. This has erroneously been called "lapis lazuli," but it is of different chemical composition.

Bibl. U. S. G. S. Min. Resources 1911, Part II, p. 1060.

Turquoise.

The following description is quoted from the report of Dr. George F. Kunz,[51] who made a thorough investigation of the gems and ornamental stones of California:

"In the extreme northeastern part of this county have been discovered old and abandoned mines of turquoise covering an area of many square miles. Associated with these mines were found the relics of an early race; and it is supposed that this is the original source of much of the turquoise found in the hands of the Indians of the southwestern United States and Mexico. The turquoise occurs in small veins and also in

[50] Mining & Engineering World, Dec. 27, 1913.
[51] Bulletin 37, pp. 107 *et seq.*

kidney-shaped masses about the size of a bean. Much of it is of good quality.

"The first published announcement of turquoise discoveries in this region was made through the writer in 1897 in his report to the United States Geological Survey.[52] The locality was given as near Manvel. Mr. T. C. Bassett had observed in this neighborhood a small hillock where the float rock was seamed and stained with blue. On digging down a few feet, he found a vein of turquoise, a white talcose material inclosing nodules and small masses of the mineral, which, at a depth of 20 feet, showed fine gem color. Two aboriginal stone hammers were met with, as is usual at all the turquoise localities in the southwest, and from this circumstance the location was named Stone Hammer mine.

"The State Mining Bureau reported about the same time that turquoise had been found in the desert region between Death Valley and Goff's Mining District, nearer the former, and that good samples were in the museum of the Bureau.

"In the spring of 1898 many reports of extensive discoveries were announced and much attention was given by the press to the accounts of the region, both for the turquoise itself and for the remarkable archeological remains associated with the ancient workings. The district was seen to cover quite a large area in northeastern San Bernardino County, near the Arizona and Nevada lines.

"On the reports of prospectors reaching San Francisco as to a great group of ancient turquoise mines with cave dwellings, stone implements and rocks covered with inscriptions an exploring party was organized by the San Francisco 'Call' and Mr. Gustav Eisen of the California Academy of Science became attached to it as archæological expert.[53] The party set out early in March, 1898, going first to Blake Station on the Santa Fe Railroad, thence north to Manvel, and onward some 60 miles across the Ivanpah Sink, and up into the mountains to an altitude of over 6000 feet through an exceedingly rugged country to reach the region reported. The turquoise district, as described by Mr. Eisen and others of the party, occupies an area of 30 or 40 miles in extent, but the best mines are in a smaller section, about 15 miles long by 3 or 4 in width. The region is conspicuously volcanic in aspect, being largely covered with outflows of trap or basaltic rock reaching outward from a central group of extinct craters. These flows extend for many miles in all directions, and appear as long, low ridges, separated by valleys and cañons of the wildest character. Among these basaltic rocks and in the valleys are found smaller areas of low, rounded hills of decomposed sandstones and porphyries, traversed at times by ledges of harder crystalline rocks, quartzites and schists. In the cañons and in the sides

[52] Min. Res. U. S., 1897, p. 504.
[53] U. S. G. S., 20th Rept. Min. Res. 1898, pp. 582-584, and San Francisco "Call," March 18, 1898.

of the hills are the old turquoise mines, appearing as saucer-like pits, from 15′ to 30′ across and of half that depth, but generally much filled up with debris. They are scattered about everywhere. Around them the ground consists of disintegrated quartz rock, like sand or gravel, full of fragments and little nodules of turquoise. Whenever the quartzite ledges outcrop distinctly they show the blue veins of turquoise, sometimes in narrow seams, sometimes in nodules or in pockets. The mode of occurrence appears closely to resemble that at Turquoise Mountain, Arizona. A few prospectors have dug into the old, half-filled depressions and found stones of good color and quality, and ordinary ones may be picked up almost anywhere out of the decomposed quartz. Stone tools are abundant in the old workings, and the indications are plain that this locality was exploited on a great scale and probably for a long period, and must have been an important source of the turquoise used among the ancient Mexicans. From an archæological point of view this locality possesses remarkable interest. The cañon walls are full of caverns, now filled up to a depth of several feet with apparently wind-blown sand and dust, but whose blackened roofs and rudely sculptured walls indicate that they were occupied for a long time by the people who worked the mines. In the blown sand were found stone instruments and pottery fragments of rude type, incised but not painted. The openings to these caves are partially closed by roughly built walls composed of trap blocks piled upon one another with no attempt at fitting and no cement, but evidently made as a mere rude protection against weather and wild beasts. The tools, found partly in the caves and largely in the mine pits, are carefully wrought and polished from hard basalt or trap, chiefly hammers and adzes or axes, generally grooved for a handle and often of large size. Some are beautifully perfect and others much worn and battered by use.

"The most impressive feature, however, is the abundance of rock carvings in the whole region. These are very varied, conspicuous and peculiar, while elsewhere they are very rare. Some are recognizable as 'Aztec water signs,' pointing the way to springs; but most of them are unlike any others known, and furnish a most interesting problem to American archæologists. They are numbered by many thousands, carved in the hard basalt of the cliffs, or, more frequently, on large blocks of the same rock that have fallen and lie on the sides of the valleys. Some are combinations of lines, dots, and curves into various devices; others represent animals and men; a third and very peculiar type is that of the 'shield figures,' in which complex patterns of lines, circles, cross hatchings, etc., are inscribed within a shield-like outline perhaps 3 or 4 feet high. One curious legend still exists among the neighboring Indians that is in no way improbable or inconsistent with the facts. The story was told Mr. Eisen by 'Indian Johnny,' son of

the Piute chief, Tecopah, who died recently at a great age and who, in turn, had received it from his father. Thousands of years ago, says the tale, this region was the home of Desert Mojaves. Among them suddenly appeared from the west or south a strange tribe searching for precious stones among the rocks, who made friends with the Mojaves, learned about these mines, and worked them and got great quantities of stones. These people were unlike any other Indians, with lighter complexions and hair, very peaceable and industrious and possessed of many curious arts. They made these rock carvings and taught the Mojaves the same things. This alarmed and excited the Piutes, who distrusted such strange novelties, and thought them some form of insanity or 'bad medicine' and resolved on a war of extermination. After a long and desperate conflict, most of the strangers and Mojaves were slain, since which time, perhaps a thousand years ago, the mines have been abandoned. Mr. Eisen connects this account with the existence of a fair and reddish-haired tribe, the Mayos (not Mayas), in parts of Sinaloa and Sonora, some of whom may have reached these mines and carried on a turquoise trade with Mexico. This region has since been opened at several points, and at least a dozen mines, worked by various parties, mostly with Eastern capital." The principal work was done by the Himalaya and the Toltec mining companies, both of which are now idle. The turquoise obtained, when pure and of good color, was cut into fine gems, also the white and blue combination known as turquoise matrix, when small portions and veins of turquoise are distributed through the rock, the whole being cut and polished as an ornamental stone. The paler varieties of turquoise were cut into beads, etc., long strings of which were sold. Most of the material produced was sent to New York. The yield in 1900 was estimated at a value of $20,000.

Himalaya Mining Company. This company has operated turquoise mines in San Bernardino County. They were owned by Mr. L. Tannenbaum of New York and are situated in the Solo Mining District about 30 miles northwest of Cima and the same distance east of Silver Lake on the Tonopah and Tidewater Railroad. There are five claims in this group, all on the same ledge, which consists of a bird's-eye porphyry with some granite, with a N.-S. strike, and dip 75° W. The pockets of turquoise, which is practically the only gem found, lie in this porphyry surrounded by a friable mass of so-called silicate of lime. The shafts 80 feet in depth have been sunk on the property, but 40 feet was the lowest level at which gem turquoise was found. From this level the mine has been practically stoped to the surface. There is no timber at the mine, but some small pine can be secured 10 miles north. Water was found by sinking a well 85 feet; it could be used for drinking, but was of very inferior quality. Work was done by screening and washing, entirely by hand, there being no machinery of any kind on the prop-

erty. Other improvements were bunk houses, etc. The mine was closed down on the first day of March, 1903, and no work of any account has been done since that date. For the two months during which the mine was worked in that year, six men were employed, at an average wage of $2.50 per day. The expense of mining was very high—about $20.00 per foot. Giant powder was used exclusively, and it required about 10½ pounds to the foot.

The shipments that year (January and February, 1903) as given by the Wells-Fargo agent amounted to 431 pounds of matrix and ordinary turquoise and 49 pounds of picked material.

Toltec Gem Mining Company. The California property of this company consists of three groups of mines situated in San Bernardino County on the desert about 30 miles northwest of Cima on the Salt Lake Route, and about 50 miles west from South Ivanpah which is the terminus of a branch of the Santa Fe Railroad from Goffs. The altitude is between 5000′ and 6000′, and there being no water at either of the camps, it is necessary to haul it over the mountains from 1 to 5 miles. These camps are about 6 miles apart and are known as East Camp, Middle Camp and West Camp in the old Solo Mining district. Death Valley is within 20 miles of West Camp. These mines are all patented. The qualities of the turquoise taken from these various camps vary widely, from quite soft to very hard. The same company also has turquoise mines in Nevada, 60 miles due east of these. Here stone hammers were met with at a depth of 18 feet. Scarcely any turquoise was found much below 100 feet from the surface, and a 200-foot shaft failed to reveal any at all. This fact, which is also reported from the mines of the Himilaya Company, is a curious one, indicating that the turquoise must be in some way a product of rather superficial alteration. The mines of both these companies have been quite large producers. The Toltec Company obtained one gem-stone of rather a pale blue, that cut into a perfect oval measuring 32 by 45 millimeters, and weighing 203 carats.

GRAPHITE.

A deposit of graphite is said to occur near the head of the Santa Ana River in the San Bernardino Mountains, about 15 miles from East Highlands, a station on the Santa Fe Railroad. It is undeveloped. Owner, W. E. Van Slyke, 716 Fifth St., San Bernardino.

Bibl. Bulletin 38, p. 280.

GYPSUM.

San Bernardino County contains gypsum deposits in many places on the desert, the most notable, and at present the only one worked, being that of the Consolidated Pacific Cement Plaster Company in the Amboy sink. A similar deposit is said to exist at Danby dry lake, 32 miles southeast of Danby station on the Santa Fe railway.

Gypsum occurs also in thin-bedded deposits associated with the beds of rock salt in the Avawatz Mountains and to a lesser extent in the

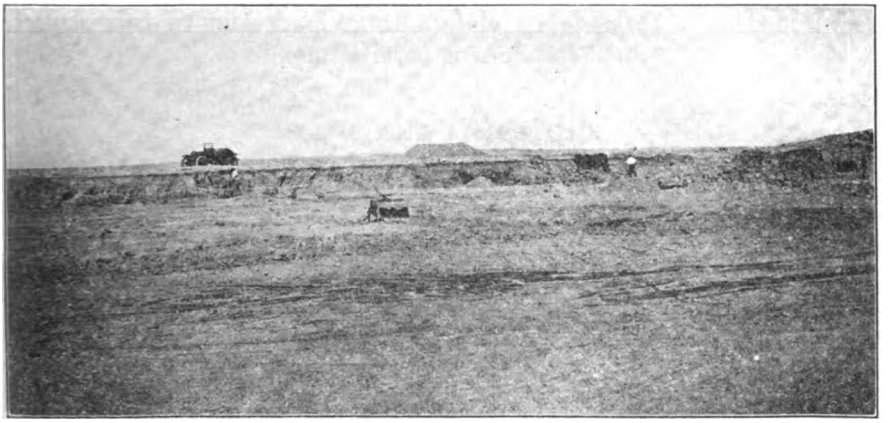


Photo No. 42. Mining gypsum with plow and scraper at dry lake deposit of the Pacific Consolidated Cement Plaster Co., near Amboy, Cal.

borax beds of the Calico district. A deposit was located some years ago near Camp Cady on the Salt Lake Route but very little work was done on it.

Bibl. Bulletin 38, p. 287; U. S. G. S. Bulletin 413, pp. 25–28.

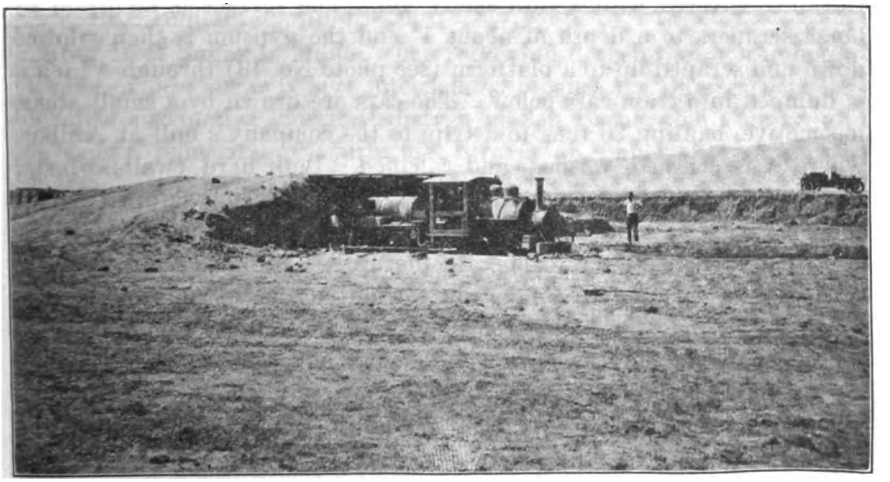


Photo No. 43. Steam engine used to haul gypsum to the plant of the Pacific Consolidated Cement Plaster Co. at Amboy, Cal.

Consolidated Pacific Cement Plaster Company, office, 612 San Fernando Bldg., Los Angeles; J. D. Bowersock, president; D. A. Mulvane, secretary. This company, formerly known as the Pacific Cement Plaster Co., has been working the Amboy dry lake deposit 2 miles southeast of Amboy for the past ten years. This lake bed is very extensive,

covering several thousand acres, and is of a type common to the Mojave Desert. The gypsum occurs loosely cemented with sand in coarse crystals up to ¼″ across, deposited in a bed varying from 4′ to 6′ in

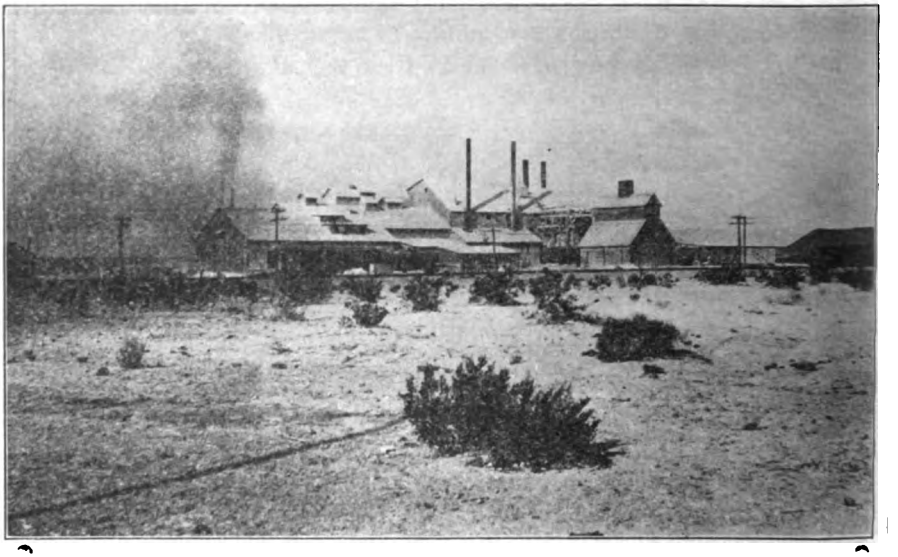


Photo No. 44. Plant of the Pacific Consolidated Cement Plaster Company at Amboy, Cal.

thickness covered with a thin sandy soil. The surface is stripped by horse scrapers to a depth of about 1′ and the gypsum is then plowed down and scraped up to a platform (see photo No. 43) through which it is dumped into tram cars below. The cars are drawn by a small steam locomotive, hauling 20 tons to a trip, to the company's mill at Amboy, where it is crushed, washed, and calcined. Both hard (wall) plaster and cement plaster are manufactured, the latter being shipped to the cement plants of southern California at Riverside, Colton, Oro Grande and Victorville. Power to operate the mill is supplied by a 400 h.p. Corliss, cross-compound, condensing, steam engine. Crude oil is used for fuel. Water is brought from the Santa Fe Railway Company. At the present time the company is working only one shift, producing approximately 100 tons daily. Thirty men are employed. Mexican labor is used at the quarry. F. E. Towne Jr., is manager at the property.

M. Mulcahy et al. of Daggett have two gypsum claims in the Calico District, 2½ miles west of Yermo on the Salt Lake Route. The gypsum occurs in an impure bed varying from 2′ to 4′ in width, associated with the borax beds in the Tertiary sediments of the Calico Range. Very little work has been done on this deposit and it is at present of no commercial importance.

INFUSORIAL EARTH.

A small deposit of infusorial earth is claimed to occur in the northern part of T. 2 N., R. 9 E., S. B. M., about 12 miles from Twenty-nine Palms, and 40 miles from Palms Station. It is stated to be about 2 feet thick. This is on unappropriated government land.

Bibl.: Bulletin 38, p. 292.

LIME AND LIMESTONE.

Limestone deposits of great commercial value occur in several localities in San Bernardino County, the most important ones being those at Baxter, Colton and Oro Grande, described below.

The limestone produced in this county is used principally to make lime. This material is produced by burning or calcining limestone, thereby driving off the carbon dioxide and leaving calcium oxide or lime.

The lime burned at Colton and Oro Grande is principally used in the manufacture of cement. The Baxter limestone is shipped to the sugar factories of the south, where it is used to burn lime for the manufacture of beet sugar. As the beet sugar industry is rapidly increasing, there is a constant demand for a high grade limestone for this purpose. Lime is also used for mortar and plaster in building operations, as a furnace flux, as a fertilizer, in glass manufacture, and many other minor industries.

Bibl.: Bulletin 38, pp. 61–64.

How Beet Sugar Is Made. The following description of the manufacture of beet sugar is here interpolated because the Baxter District is the most productive limestone district in San Bernardino County, and the sugar refineries of California furnish an important market for limestone.

First the beets are hauled to the factory by the farmers, or, as in the case of the American Beet Sugar Company, are cultivated by the company, and deposited in large roofed bins with V-shaped bottoms, which are connected with the factory by various mechanical devices, through which a moderate flow of water carries the beets into the first washing machine. By patented mechanical devices the beets are stirred about and washed until thoroughly cleaned, then by conveyor are carried to the roof of the plant, where they pass through an automatic weigher and slicer, and are sliced in such a manner as to open up the cells of the beet as far as possible. The sugar beet is cellular in structure, and in its minute cells is enclosed the saccharine fluid, so that in slicing it is desirable to open as many of them as possible, and in such a way as to make a clean cut without rupturing the cells. The beets next drift into a diffusion battery, where the sugar is extracted by soaking the sliced beets in water. The mass of sliced beets is termed

"cosettes." They are next placed in a tank with warm water, which passes out at the bottom and into the next tank, and from one to another until fourteen tanks or cells have been used. The water is now drawn off and tank number two becomes number one, and number one is emptied of its "cosettes" and refilled, becoming number fourteen, and so the cycle is continued, extracting in this way all of the sugar from the "cosettes" in a solution which now has the color of ordinary vinegar. The liquid is then taken to a measuring tank, near by, from which it goes to a mixer, where it is mixed with lime produced in kilns at the works and then transferred to a large tank for carbonation; in this the lime and some other foreign matter that it contains is rendered insoluble by means of carbon dioxide gas collected from the kilns and forced through the bottom of the carbonating tank. Then the liquid goes through the filter press rooms, where by means of an elaborate series of frames it is filtered and becomes clear. When this process is finished for the second time, the syrup is treated with sulphur fumes and then passes into the "quadruple effect" (four large boilers in which most of the water contained is evaporated), the remainder being termed "thick juice." This syrup is boiled in a vacuum pan and its content becomes raw sugar, which is then further cleaned of its molasses by other machines known as centrifugals. The sugar is now damp like wet snow, and by means of a granulator it is dried; and by means of sieves it is separated into the finer or coarser grades ready for market.

Baxter Deposits.

Baxter and Ballardie Quarries comprise four claims totaling 118.62 acres in the S. ½ of Sec. 12, T. 11 N., R. 6 E., S. B. M., and are owned by D. F. and D. A. Baxter and A. W. Ballardie of 915 Union Oil Bldg., Los Angeles. These claims, known as the White Marble No. 1, No. 2. No. 3, and Evening Star, join the Mojave River at a point near Baxter Station, on the Salt Lake Route, 197 miles east of Los Angeles. They cover outcroppings for a distance of about 4500 ft., ranging from 400′ to 800′ in width and from the level of the desert (1380′) to a height of 600′. The hills are almost free of soil, the only overburden being a talus of broken limestone on the north side, which slopes at an angle of about 20°; the south fissures are very precipitous in places and have bunches of talus at the base which afford good sites for quarrying operations. The limestone is broadly stratified and varies slightly in color and texture. That nearest the railroad siding, or the south exposure of Marble Placer No. 1 (*see* Plate IV) is of a salmon pink or flesh color. This type constitutes 75% of the deposit. Near the center of the hill, forming as it were the backbone of the formation, is a strip of blue limestone of about 10′ to 20′ in thickness, constituting roughly

10%. There are some beds of pure white, dense, close-grained metamorphosed limestone or marble well adapted for ornamental or building purposes (*see* Photo No. 46). Analysis of a sample of the limestone from the quarry of the Sugar Lime Rock Company showed as follows:

H_2O	0.21%
SiO_2	2.24%
$Fe_2O_3Al_2O_3$	0.53%
$CaCO_3$	97.93%
$MgCO_3$	.54%
$CaSO_4$	.15%
Total	101.60%

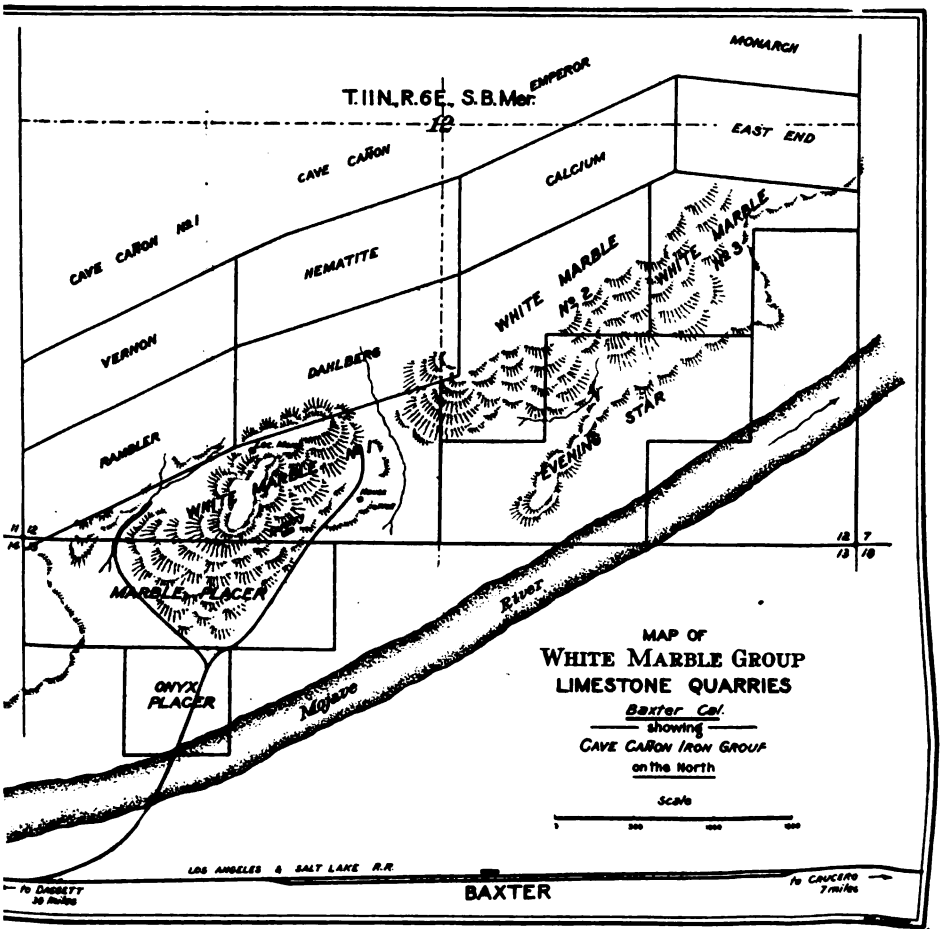


PLATE IV.

A portion of this deposit is under lease to the **Sugar Lime Rock Company,** whose officers are: A. R. Peck, president, Trust and Savings Bldg., Los Angeles, and Henry C. Lee, secretary, 522 Pacific Electric Bldg., Los Angeles. Ben C. Brock is superintendent at the

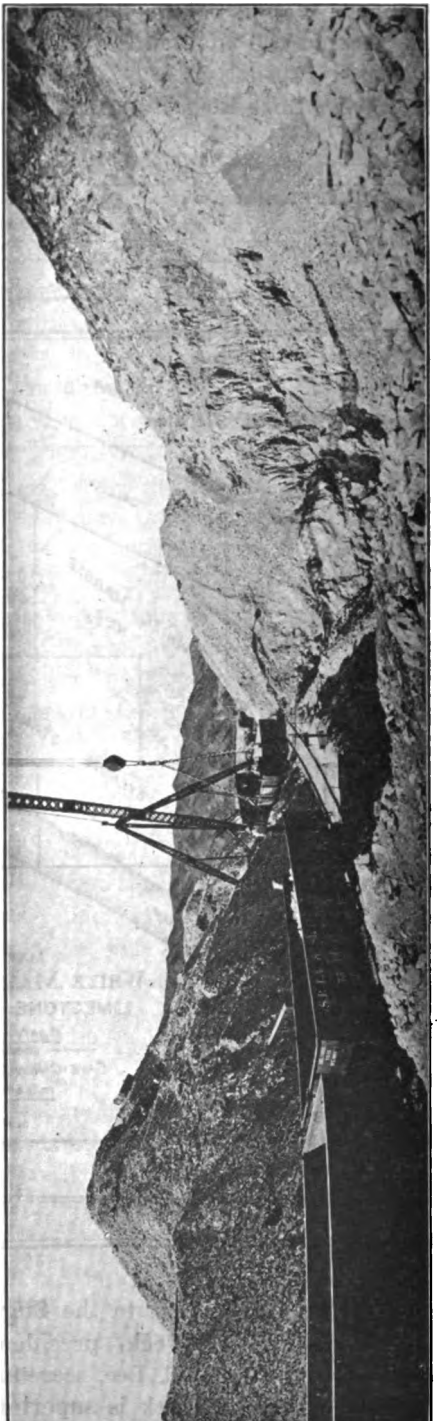


Photo No. 45. White Marble Claim No. 1, showing large dumps of undersize limestone at left which is sold for flux and plaster. Baxter and Ballardie Limestone Quarries at Baxter, Cal. Photo by courtesy of D. F. Baxter.

Photo No. 46. White Marble Claim No. 2, showing large undeveloped deposit of white marble suitable for building or decorative purposes. Baxter and Ballardie Limestone Quarries at Baxter, Cal. Photo by courtesy of D. F. Baxter.

quarry, and about 50 laborers and 10 mechanics are employed. This company has a spur track from Baxter to the White Marble No. 1 claim, where most of the quarrying is now being done and the limestone is shipped to the sugar beet factories at Oxnard, Santa Ana, Huntington Beach, Los Alamitos, Anaheim and Chino. The equipment consists of one 110-ft. steel boom derrick, 35 h.p. Fairbanks-Morse gas engine, a pumping plant of 30 gallons per minute and storage capacity of 15,000 gallons; nine 1½ cu. yards dump cars, machine drills and compressor, several thousand feet of track, and all the necessary bunk and boarding houses for the crew.

West and south of the White Marble Group, in Sec. 13, is a quarry owned by the **Southern Pacific Railroad Company,** also operated by the Sugar Lime Rock Company. This is a continuation of the White Marble deposit, and is known as the Marble Placer Claim (see Plate IV). The Sugar Lime Rock Company is shipping about 65,000 tons of limestone annually to the several sugar factories and has been operating since 1914.

Colton Deposits.

California Portland Cement Company, 401 American Bank Bldg., Los Angeles. This company owns Slover Mountain, ½ mile southwest of Colton, in Secs. 19 and 30, T. 1 S., R. 4 W., S. B. M., which is an isolated knoll of crystalline limestone about 500 ft. high. Quoting from Bulletin No. 38, p. 77: "The limestone is generally very pure, especially the coarser crystalline variety, which runs 98½% to 99% calcium carbonate. The lime burned from this limestone slakes very quickly and flashy, but must be slaked with a great amount of water to prevent it from being burned. The fine-grained limestone is not so pure, but makes a better plaster."

The lime is burned during only a part of the year, employing 8 to 10 men. T. J. Fleming is general manager.

(See also under Cement and Marble.)

A small deposit of white, coarsely crystalline limestone occurs 3½ miles southwest of Slover Mountain in Sec. 33, T. 1 S., R. 5 W., S. B. M. It was formerly quarried and burned in a small kiln on the Santa Ana River, but is now idle. Owners, Mrs. O. Burns, San Bernardino, and Rev. P. J. Stockman of Santa Barbara.

Bibl.: Bulletin 38, p. 77.

Oro Grande Deposits.[54]

The limestones here are interstratified with reddish brown quartzite and brown shale. In the quarries the limestone varies from 60′ to 200′ in thickness, but the total thickness or total extent of the limestones in this region is not known. In the area surrounding the quarries are

[54]Bulletin 38, p. 77.

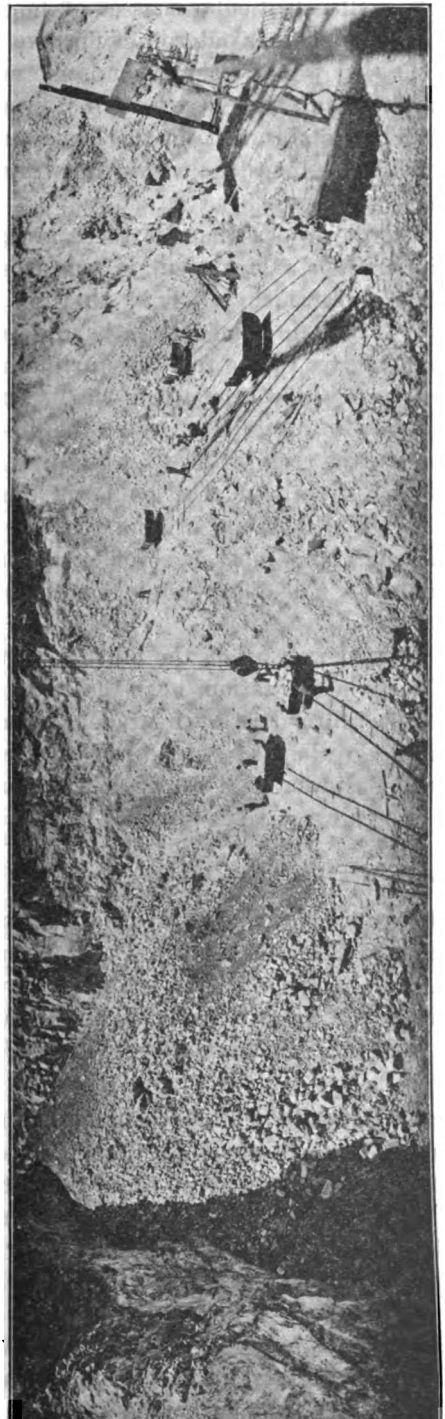


Photo No. 47. The Pit Quarry on White Marble No. 1, showing method of quarrying the Baxter and Ballardie limestone deposits at Baxter, Cal. Photo by courtesy of D. F. Baxter.

isolated outcrops of smaller lenticular masses of limestone. About 3 miles east of Victorville is another outcrop of massive crystalline white and clouded limestone that would make a handsome marble.

The limestone is hard and coarsely crystalline, mostly dark blue in color, with numerous iron stains, but, in the large quarry nearest the railway, there is much white limestone with dendrites along the surface in the joint and cleavage planes.

At several places in the upper quarries there are great clusters of calcite and aragonite crystals, which occur in prisms, sometimes 4 or 5 inches long, and stained brownish yellow by the iron oxide. There is also considerable pyrite and in some places bornite, along the joints, the weathering of which gives rise to free sulphur in a number of places and in others to stains of yellow-brown iron rust. The impurities are not in sufficient quantity to materially injure the quicklime, but they are sufficient to disfigure the rock for use as a building stone.

The rock is so much fractured that no large dimension stone is available, but this condition is an aid in lime quarrying as the stone is used in small dimensions and must be broken up artificially if not already broken by nature. The quarrying is done by hand-drilling and blasting.

The quarries are located well up on the hillside, east of the railway, and northeast of Oro Grande Station, near the middle of T. 6 N., R. 4 W. The road to the railroad is down grade, part of it very steep. Some of the lime kilns are located on the railway, several north and one south of Oro Grande Station, and two of the kilns are on the hillside half a mile east of the railway. The stone is hauled by wagons from the quarries to the kilns.

Hoey Quarry: This was formerly operated for the American Beet Sugar Company at Oxnard, but has been idle for some years.

Oro Grande Lime and Stone Company, P. C. Thompson, manager, 408 Stimson Bldg., Los Angeles. This company owns a quarry in Sec. 9, T. 6 N., R. 4 W., 3½ miles east of Oro Grande, which was formerly operated for the American Beet Sugar Company, but is now idle.

Scheerer Limestone Deposits. These deposits are near Victorville and have been owned for some years by Joseph Scheerer of Victorville. He has recently sold portions of these deposits to the Southwestern Cement Company and to T. Henshaw for the Riverside Portland Cement Company. The first named company is now building a 5000-barrel per day plant out of Victorville and has a spur track connecting it with the quarry. Scheerer still retains other extensive limestone deposits in Secs. 23 and 24, T. 6 N., R. 4 W., S. B. M., 3½ miles northeast of Victorville and near both the Santa Fe and Salt Lake railroads. There is a good wagon road to the property; and the

best quarry sites are easily accessible by about a 2% grade from a spur track which can be run from a point on the right bank of the Mojave River about 3 miles below Victorville, a distance of 4 miles. The deposit forms a series of sharp and round-topped hills, rising abruptly on the west, and sloping off more gradually to the east, with the limestone resting on and against granite. (See also under Granite.)

Analyses of the limestone by Smith, Emery & Co., San Francisco, show 93.3% to 99.2% $CaCO_3$, a trace to 1.3% MgO, and variable amounts of silica from a trace to 5.8%. Besides this high-grade limestone, there are also deposits of dolomite, suitable for marble.

Scheerer also has limestone deposits in Secs. 27, 28, 32, 33, T. 10 N., R. 2 W., S. B. M., 2 miles west of Barstow and adjoining the old Waterman silver mine. They are ½ mile from the railroad, and the limestone is high-grade, being suitable for lime, cement or sugar making.

Superior Limestone Quarry, owned by the American Beet Sugar Company, adjoins the Oro Grande Lime and Stone Company's quarry in Secs. 9–16, T. 6 N., R. 4 W. Limestone from this quarry was shipped to the sugar beet factories at Oxnard and Chino for several years previous to 1914, since which time the quarry has been idle.

Other Deposits. A large deposit of limestone said to be very pure is being quarried near Cajon, on the Santa Fe railroad, by the **Big Pines Lime and Transportation Company**, with offices at 1129 Merchants National Bank Bldg., Los Angeles. This company has recently contracted for a large production. Ten men are employed. W. J. Hunter is engineer in charge of the property.

Maurice Mulcahy and **J. C. McMillan**, Daggett, Cal., own a deposit of limestone in the vicinity of Daggett, 4 miles south of Gale Siding on the Santa Fe Railway. The limestone is white, rather coarsely crystalline, and is almost pure calcium carbonate. It is said to outcrop for 400′ along the strike in beds varying from 35′ to 80′ in width. Undeveloped.

MARBLE.

Nearly all the limestone found in San Bernardino County may be classified as marble, but in recent years very little has been quarried for building or monument purposes. It is mostly used for burning lime. (See under Limestone.) Most of the marble produced in the county for building or ornamental purposes was from the quarries on Slover Mountain near Colton, operated by the California Portland Cement Company. In his report on Slover Mountain, W. A. Goodyear[55] wrote as follows:

"It consists chiefly of limestone, which, however, varies greatly in character. Some of it is very fine-grained and pure white, and could

it be obtained in sound, unspotted blocks of uniform texture and sufficient size, it would make a fine statuary marble. But much of it is very coarsely crystalline often showing cleavage planes half an inch or more in diameter; yet even of this coarse rock much is very compact, takes a fine polish, and makes a handsome marble. Some of it contains graphite scattered through in streaks and spots, and some of it contains micaceous hematite. Some of it also contains a good deal of silica, and therefore would not make good lime.

"Aragonite (wrongly called 'onyx') also occurs here in veins and bunches, delicately and beautifully striped and banded with various shades of yellow and brown, as some agates are. If, as seems possible, it can be obtained in slabs of sufficient size, it will make extremely handsome mantel-pieces, table tops, etc.

"In the north end of the hill the rock strikes about N. 70° E., magnetic, and dips 45° SE. But in a large part of the hill the metamorphism has gone far enough to greatly obscure and, in places, entirely obliterate the stratification. A mill was long ago built here for sawing, cutting, and polishing the marble, which was used to a considerable extent for building and ornamental purposes in San Bernardino and elsewhere. A good deal of lime has also been burned at various points around the foot of the hill. But a mile or two away on the opposite or south side of the Santa Ana River all the hills are of granite."

Baxter and Ballardie Quarry. (*see* under Limestone). There is a deposit of crystallized white and yellowish white limestone at this property which takes a fine polish and would make a very attractive building stone. None has been quarried as yet for this purpose.

California Portland Cement Company, 401 American Bank Building, Los Angeles, owns the following quarries on Slover Mountain near Colton:[56]

1. Colton Cement Works Quarry. (*See* under Cement.)

2. Crusher Plant Quarry, on the northwest corner of the mountain about 200 yards from the cement works. The limestone is similar to that in the quarry of the Colton Cement Works, but the inclusions of hornblende are larger. The rock is crushed in a spindle crusher to a size of about 2 inches in diameter and is used for concrete.

3. Marble Dust Quarry and Plant, on the west side of the mountain. The limestone is purer without inclusions of the hornblendic material. The rock is broken down by hand in the quarry, then crushed in a Potts crusher to ½″ in size; next it passes through a 30″ Sturtevant mill and then through 4 screens. The grit is used for coating tarred roofing paper; the finer material passes through a 36″ Sturtevant mill, where it is ground to impalpable dust. This material is used in a mixture with asphalt for street paving.

[56] Bulletin 38, pp. 102–104.

4. **The Colton Marble Works**, formerly operated by the Colton Marble Company, were shut down in 1910. They were on the south side of Slover Mountain, and used marble from two quarries. The lower quarry, about 30 feet above the works, was the larger. The dark-bluish gray limestone dips about 10° northwesterly. In the upper quarry, 160 ft. above the works, the limestone has a very light color. The beds are from 5′ to 7′ thick. The rock is broken down by hand-drilling, the holes having the depth of the beds, with about 5′ face, blasting being done with black powder. The marble was principally used for ornamental building purposes, but some monument work is turned out. It has been used in the Academy of Sciences, Crossley, and Monadnock buildings of San Francisco, in the latter, being trimmed with verde antique marble from Sec. 28, T. 7 N., R. 2 W., S. B. M., and also in the Lankershim Hotel, Los Angeles. It was mostly cut in 1″ stock. The plant was equipped with 6 gang saws; one 14-foot ribbing bed; 2 polishing machines; 1 countersinking machine; 1 tile machine, and 1 machine for cutting plumbers' slabs, etc. Power was furnished by a 100 h.p. boiler using oil as fuel; one 50 h.p. steam engine, and one 50 h.p. electric motor.

Scheerer Marble Deposits (*see* also under Limestone). Some white marble was produced from this quarry during the past year (1915). It is fairly accessible, being only 3½ miles by a good wagon road from Scheerer Siding on the Santa Fe Railroad. Joseph Scheerer of Victorville is the owner.

St. Francis Marble Mine is in Sec. 28, T. 10 N., R. 1 W., S. B. M., about 2½ miles northeast of Barstow. White, variegated and gray colored marble is said to occur in slabs 1′ to 4′ thick, in a deposit of considerable extent. Very little development work has been done as it is worked for assessment only. Owners, Chas. McIlroy and F. C. Mitchell, Barstow, Cal.

Three Colored Marble Quarry is in the unsurveyed portion of T. 7 N., R. 2 W., S. B. M., 22 miles south of Barstow and 10 miles southeast of Hicks Station on the Santa Fe Railroad. The marble is found on the east flank of a bare, rugged ridge, locally known as Stoddard Peak Ridge, and is reached by a good desert road from Barstow. The only water in the district is at Stoddard Well, 6 or 8 miles from the deposit on the road to Barstow. The deposit consists of a number of beds of brecciated mottled green, black, and white marble varying in thickness from a few inches to over 10 ft. Where best developed the marble occurs through a thickness of 200 ft. or more. The strike of the beds is north and south, the dip westward at a low angle into the ridge.

Quoting from the report of R. W. Pack[57]: "The marble is essentially a brecciated, white, crystalline limestone recemented by a greenish

calcareous cement. The brecciated fragments are angular and vary in size, some of them being as much as 6 or 8 inches in length. In general effect the marble is mottled green, black, and white, but this appearance varies greatly, owing to the irregular size and staining of the brecciated fragments, to their irregular spacing, and to the differences

Photo No. 48. Three Colored Marble Quarry—showing large broken blocks at face of quarry. The block marked X measures roughly 6'x7'x9'.

in the tone of the cementing materials. The marble shows very little decomposition from weathering, but it is extensively jointed and the surface outcrops show very few unbroken blocks more than 3 ft. in diameter. Many of the joints unquestionably disappear with depth. This is well shown in a small cut driven about 20 ft. into the hill near the center of the deposit (*see* photo No. 48), where several large blocks apparently free from flaws, were obtained."

The deposit is practically undeveloped, only a few hundred feet of stone having been removed, some of which was used in the Stevens building at Santa Barbara. The quarry at present is 25′ wide, 20′ into the hill, with a 30′ face. This deposit is of great commercial value as the marble is a highly ornamental stone. No work is now being done on it. The owner will lease or sell this property. E. T. Hillis, owner, Barstow, Cal.

Verde Antique Marble Quarry, formerly known as the Gem Quarry or the Kimble Mine, is in Sec. 28, T. 7 N., R. 2 W., about 2 miles southwest of the Three Colored Marble Quarry. It was worked years ago, and some of the marble, a mottled serpentinous limestone of yellowish green color, was used for interior decoration in several buildings in Los Angeles and San Francisco. The quarry has been idle for a number of years.

Bibl.: Bulletin 38, pp. 147–148.

Numerous **other deposits** of marble occur in the county, none of which have been developed to any extent, and all of which are idle. For detailed descriptions of these deposits see our Bulletin No. 38, pp. 102–106.

MINERAL PAINT.

Mulcahy Deposit. A deposit of mineral paint occurs in the Calico district, 5 miles by auto road west of Yermo on the Salt Lake Route. This deposit is a vein of hematite ochre, which was cut by a tunnel driven to cut a silver ledge below the old Silver King group. The vein outcrops on the surface about 35′ above the tunnel and varies in width from 6″ at the outcrop to at least 2′ in the bottom of the tunnel. Another vein of the same material is exposed a couple of hundred feet distant in an open cut. The material is of a uniform deep red color, greasy to the touch, free of grit, and crumbles readily in the hand, leaving a metallic red stain. It appears to be an excellent mineral paint, but as yet the deposit is undeveloped. The owners are now trying to find a market for the material. Owners, J. C., M. and John Mulcahy, Daggett, Cal.

MINERAL WATER.

In the following descriptions of the mineral springs of San Bernardino County free use has been made of data from U. S. G. S. Water Supply Paper 338, by Gerald A. Waring, who made a thorough investigation of the springs of California.

Arrowhead Hot Springs are located some 7 miles east of north from San Bernardino and at about 500 ft. in elevation above the floor of the valley. The name is derived from the location on the mountain side just above them, of an area of scanty vegetation in the shape of an arrowhead several acres in extent. (*See* Photo No. 49.) This striking

landmark is associated in Indian legends with the hot springs. It is stated that within the memory of the white inhabitants of the district, the mountainside has been burned over two or three times by brush fires; and yet the new growth of vegetation still retains the characteristic outline of the arrowhead.

The fine three-story hotel with bathing facilities at the springs was erected in 1907 on the site of the earlier building which was burned.

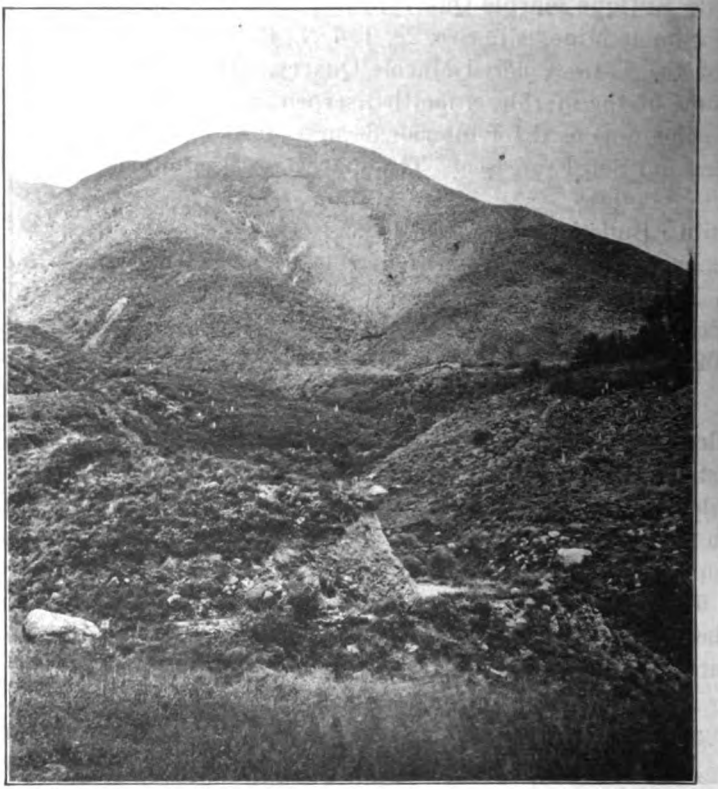


Photo No. 49. The Arrowhead at Arrowhead Hot Springs, San Bernardino County, Cal. Photo by Walter W. Bradley.

It is reached by an electric carline from San Bernardino. The springs form two groups situated about 400 yards apart. The upper group comprises perhaps half a dozen springs whose observed temperatures range from 110° to 145° F. The water is confined in two concrete storage basins that are in part the foundations of the original bathhouse, and it is thence piped to the baths and the heating pipes throughout the hotel, which is about 200 yards southwest of the basins. The Palm Spring, on the mesa north of the hotel, is in this group. The second group lies in a ravine to the west and also comprises about half a dozen springs. Water from one of these is pumped to the storage

basins at the upper group to augment the supply for the hotel. The hottest water is in the spring known as El Penyugal, in the lower group. This spring is surrounded by a concrete basin and the water is used for drinking. A temperature of 187° was recorded in the basin and in sampling for one of the analyses the basin was drained and a temperature of 202° registered. The spring discharges perhaps 15 gallons a

Photo No. 50. The Steam Caves at Arrowhead Hot Springs. Photo by Walter W. Bradley.

minute. Granite Spring is on the mesa on the west side of Penyugal Cañon. The total yield of the Arrowhead Hot Springs is hard to estimate, but it is probably not far from 50 gallons a minute. Water from a cool spring, Fuente Frio, situated about a quarter of a mile north of the hotel, was placed on the local market as a table water during 1909. Agua Fria is the water of Cold Cañon at the head of the pipe line leading to the main reservoir on the high mesa north of the hotel. Analyses of several of the springs are given below. The hot springs are stated to carry small amounts of arsenic, as well as possessing some radio-activity.

Confirmation of radio-activity has been made recently by Prof. Gilbert E. Bailey[58] of the University of Southern California, who conducted a series of experiments at Arrowhead during the past summer. The instrument used was similar to that employed by Schlundt & Moore[59] in testing the waters of Yellowstone Park, Wyoming. "The Arrowhead hot springs issue from fissures that are a part of the great Cajon

[58]Letter to State Mining Bureau, Oct. 12, 1916.
[59]U. S. G. S. Bulletin 395.

Analyses of water from Arrowhead Hot Springs and Waterman Hot Springs, San Bernardino County, California.[a]
(Constituents are in parts per million.)

	1		2		3		4		5		6		7		8		9	
Temperature	Hot		89°C.(193° F.)		94°C.(202° F.)		Hot		70°C.(158° F.)		82°C.(180° F.)		Cool		Cool		70° to 98° C. (158°to200°F.)	
Properties of reactions:																		
Primary salinity	86		93		89		86		82		82		50		42		82	
Secondary salinity	0		3		2		1		0		0		0		0		0	
Tertiary salinity	0		0		0		0		0		0		0		0		0	
Primary alkalinity	0		0		0		0		6		8		18		18		8	
Secondary alkalinity	14		4		9		13		12		10		32		40		10	
Tertiary alkalinity	47		21		30		42		26		27		18		71		22	
Constituents	**By weight**	**Reacting values**	**By weight**	**Reacting values**	**By weight**	**Reacting values**	**By weight**	**Reacting values**	**By weight**	**Reacting values**	**By weight**	**Reacting values**	**By weight**	**Reacting values**	**By weight**	**Reacting values**	**By weight**	**Reacting values**
Sodium (Na)	313	13.6	291	12.6	289	12.6	315	13.7	254	11.0	222	9.65	35	1.52	15	0.65	249	10.8
Pottassium (K)	Trace	Trace	31	.79	31	.79	10	.26	18	.46	11	.28	0.3	.01	1.2	.03	12	.31
Lithium (Li)	------	------	Trace	Trace	Trace	Trace	------	------	Trace	Trace	Trace	Trace	------	------	------	------	Trace	Trace
Barium (Ba) and strontium (Sr)	------	------	Trace	Trace	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Calcium (Ca)	44	2.20	16	.80	29	1.45	43	2.15	29	1.45	21	1.05	11	.55	5.0	.25	24	1.20
Magnesium (Mg)	Trace	Trace	2.1	.17	2.0	.16	Trace	Trace	1.4	.12	0.7	.06	2.1	.17	2.6	.21	0.6	.05
Iron (Fe)	Trace	Trace	------	------	------	------	Trace	Trace	------	------	------	------	------	------	Trace	Trace	------	------
Sulphate (SO_4)	542	11.3	548	11.4	532	11.1	565	11.8	424	8.83	360	7.50	15	.31	4.2	.09	402	8.37
Chloride (Cl)	81	2.28	65	2.40	90	2.54	78	2.20	65	1.83	55	1.55	29	.82	14	.39	63	1.78
Carbonate (CO_3)	66	2.20	18	.60	58	1.93	64	2.13	77	2.57	71	2.37	30	1.00	14	.47	67	2.23
Metaborate (BO_2)	------	------	------	------	6.4	.15	------	------	------	------	------	------	------	------	------	------	------	------
Silica (SiO_2)	224	7.48	85	2.82	99	3.28	205	6.80	91	3.02	73	2.42	16	.53	30	1.00	81	2.69
	1,270	------	1,076.1	------	1,136.4	------	1,280	------	959.4	------	813.7	------	133.4	------	86.0	------	806.6	------
Hydrogen sulphide (H_2S)	------	------	4.3	.25	8.5	.50	------	------	2.2	.13	2.3	.13	------	------	------	------	2.4	.14

1. El Penyugal. Analyst, Oscar Loew, 1876; Wheeler report, p. 198.
2. El Penyugal. Analyst, E. W. Hilgard; Crook, pp. 116-117.
3. El Penyugal. Analyst, G. E. Bailey, 1910; advertising matter.
4. Spring near hotel. Analyst, Oscar Loew, 1876; Wheeler report, p. 198.
5. Granite. Analyst, G. E. Bailey, 1910; advertising matter.
6. Palm. Analyst, G. E. Bailey, 1910; advertising matter.
7. Fuente Frio. Analyst, G. E. Bailey, 1910; advertising matter. **(An earlier analysis of this water by Dr. Frederick Salathe is very similar.)**
8. Agua Fria. Analyst, G. E. Bailey, 1910; advertising matter.
9. Waterman. Analyst, G. E. Bailey, 1910; advertising matter.

[a]Waring, *loc. cit.*, p. 34.

fault running from the San Gorgonio Pass, across the Cajon region to Tejon Pass, where it joins the San Andreas fault. The geologic and chemical evidence is that the waters of these hot springs are not from local rainfall and seepage, but are magmatic. The waters of Penyugal Spring, Mud Springs and the Steam Caves were tested, all showing radio-activity."

About half a mile from the hotel, on the east side of Waterman Cañon, are the "Steam Caves." They have been artificially formed and consist of tunnels cut into the bluff, from the sides, roofs and floors of which the mineral-bearing vapors issue. Small cottages equipped as dressing rooms are connected with the caves by a covered way. (*See* Photo No. 50.

Bitter Spring is about 12 miles east of Garlic Spring and near the southeast side of a small intermittent lake. It formed a watering place on the emigrant road between Salt Lake City and San Bernardino as early as 1852 and has been a camping place since that time, but the water contains large amounts of sodium and sulphates.

Deadmans Holes. These are small pools known as Deadmans Holes, in the playa surface at the northwest side of Mesquite Dry Lake near the road between Victorville and Dale Mining Camp. These pools or springs are sometimes used as watering places, but their water contains large amounts of alkaline material, probably sodium, magnesium and sulphates.

Garlic Spring is on the road between Daggett and Death Valley, about 35 miles northeast of the former place. It yields a small supply and has been used as a camping place, but its water contains a large amount of sodium, magnesium and sulphates.

Harlem Hot Spring. Hot water formerly issued at Harlem Hot Spring on the alluvial slope 2 miles below the base of the San Bernardino Mountains. A well casing has been sunk in the former spring and the water is pumped for bathing, and in summer for irrigation also. During periods following seasons of abundant rainfall the well overflows, but the water level usually stands a few feet below the surface. The property is beside an electric car line and is only a few minutes ride eastward from San Bernardino. It has been made a recreation and picnic ground and the water supplies a swimming plunge and tub and mud baths. A partial analysis of the water, which has a local market as a table water, is tabulated beyond, with that of water from Urbita Hot Springs. Primary salinity is dominant in both waters.

Paradise Springs. In the desert of western San Bernardino County is an isolated group of thermal springs that may properly be described here. They are 25 miles by road north of Daggett and on the eastern slope of a granitic mountain. Two warm springs and a few seepages issue in a belt 250 yards long, on the side of a wide drainage

slope that opens southeastward to the desert. The highest temperature observed was 102° and the total flow is perhaps 25 gallons a minute.

In the early emigrant days these springs were a favorite camping place for travelers, and the area of green in this stretch of desert earned them the name of Paradise Springs. The locality is still used as a camping place by prospectors, and in 1908 a 1½-inch pipe line extended from the springs southward and westward 2 miles to the Paradise Mountain gold mine. The water issues on slopes 500 feet above the desert floor, but evaporation in the region is so great that a considerable alkaline deposit has formed at the springs. The water rapidly corroded the pipe leading to the mine.

A prospect drift exposes iron-stained graphic granite about 40 yards above the warmest spring, and there is a ledge of crumpled, quartzitic rock near by. It seems probable that these dikes or ledges may act as dams that here bring water to the surface from moderate depths, at a locality where intrusive rocks have produced an abnormal temperature gradient.

Salt Spring at the southeast end of South Death Valley and about 5 miles southwest of Dumont railroad station, is probably better known than the saline springs farther north in the valley. It was mentioned many years ago by Fremont, who camped there in April, 1844, and described the springs as being "a very poor camping ground; a swampy, salty spot, with a little long, unwholesome grass; and the water which rose in the springs being useful only to wet the mouth but entirely too salt to drink."[61] The springs are in the cañon of South Branch of Amargosa River. This cañon forms a pass between the Kingston Range and the Avawatz Mountains, but desert travel has been mainly north of it, through the cañon of the main branch of the river. It has been said that the water contains arsenic, as several people have perished from drinking it, but the fatalities have probably been due rather to the effect of such a strong solution of Epsom and Glauber salts on persons who were nearly delirious with thirst.

Sulphur Springs, near Bullion Mountains. Several springs of strongly sulphuretted water issue near the southern end of Bullion Mountains, in flat land on the road that leads southeastward from Victorville to Dale mining camp. The yield of water is considerable, but it tastes too strongly of hydrogen sulphide to be palatable. It is seldom used for watering, as there is better water about 2 miles farther north.

Urbita Hot Springs: about 1 mile south of San Bernardino a recreation park known as Urbita Hot Springs has been built about a group of artesian wells that yield thermal water. This water supplies a swimming plunge, tub baths, and a small lake. The warmest well yields

[61] Fremont, J. C., Report of the exploring expedition to the Rocky Mountains, p. 264, 1845.

about 200 gallons a minute of mildly sulphuretted water that is said to have a temperature of 106°. The following partial analysis shows that, like the water at Arrowhead and at Harlem springs, it is not highly mineralized, but small amounts of sulphur and iron constituents in the water cause it to stain the enameled bathtubs:

Analyses of water from Urbita Hot Springs and Harlem Hot Spring, San Bernardino County, California.

(Analyst, E. W. Hilgard. Authority, advertising matter. Constituents are in parts per million by weight.)

	Urbita	Harlem
Properties of reaction:		
Primary salinity	Dominant	Dominant
Secondary salinity	0	(?)
Tertiary salinity	0	0
Primary alkalinity	Small	(?)
Secondary alkalinity	Small	Small
Tertiary alkalinity	Present	Present
Residue:		
Combined water	80	60
Soluble in water	310	260
Insoluble in water	25	90
	415	410
Portions soluble in water:		
Sulphate (SO_4)	133	144
Chloride (Cl)	21	10
Carbonate (CO_3)	42	16
Chiefly sodium (Na) and potassium (K)	114	90
Portions insoluble in water:		
Silica (SiO_2)	10	50
Calcium (Ca), magnesium (Mg), carbonate (CO_3) and sulphate (SO_4), chiefly calcium	15	40

As has been previously stated, the area along the western base of San Bernardino Mountains is a faulted zone. The issuance of hot water within this area therefore seems to be due to a fault or structural break in the granitic rocks, which allows deep-seated thermal water to reach the surface. The abnormal temperature of Harlem Hot Springs is possibly due to leakage into the alluvium of heated water that rises in the faulted zone. This may also be the source of the warm water at the Urbita wells, though there is a bedrock area 1 mile south of these thermal wells that may cause underground alluvial water to rise from a depth sufficient to account for its high temperature. Warm water is also obtained from other flowing wells in this locality. The sulphurous elements of the water from the Urbita wells are probably derived from material in the alluvium rather than from constituents in deep-seated hot water that may enter the alluvium.

Valley Spring. A few strongly saline springs issue in the southern extension of Death Valley proper, in the portion that is known as South Death Valley. Valley Spring, which rises in a marshy area on the western side of South Death Valley, is probably the largest of these.

The water forms a clear stream that flows for a short distance, but it is strongly saline. The source of the water is believed to be Amargosa River, which normally sinks a few miles to the southeast. A portion of its flow is apparently brought to the surface at the spring by a ledge of rock that is there exposed above the valley floor.

Warm Spring, at Baldwin Lake. Baldwin Lake is a small intermittent water body at the upper end of Bear Valley, in San Bernardino Mountains. In a marsh at the western end of the lake warm water rises in a pool about 20 feet in diameter and has been used to some extent for bathing, but as the flow is slight and the temperature of the water is only 88°, it has not become important.

Warm Springs, in Lytle Cañon. About 13 miles in a direct line north of west from the Waterman Springs in Lytle Cañon a hot spring forms a pool in the creek bed. The water was at one time used for bathing and the place was known as Tyler's Bath. It is not improved, however; the flow is small and the water is only 90° in temperature.

NITER.

Nearly all the niter beds, so far as discovered, are situated in the northern part of San Bernardino County, and extend across the boundary line into the southern part of Inyo County. They are found along the shore lines, or old beaches, that mark the boundary of Death Valley as it was during the Eocene times. (Bulletin 24, pp. 155–156.)

The general appearance and geology of the beds have been described in our Inyo County report (1916) so will not be repeated here. No niter has been produced from these beds, but considerable sampling has been done, mainly by the two companies mentioned below, who are now actively engaged in trying to promote their full exploration and development. With the construction of the proposed spur railroad to the Avawatz salt deposits (see under Salt) the beds of the California Nitrate Development Company will be easily accessible, a factor that should greatly aid in their early development.

California Nitrate Development Company, 40 California St., San Francisco, A. W. Scott, Jr., president; Sam Hubbard, secretary. This company owns the Owl, Round Mountain, Saratoga, and Valley beds, in San Bernardino County, and the Confidence beds in Inyo County, totaling 8800 acres. The Saratoga beds consisting of 1920 acres are the only claims patented. These beds form the main portion of a partially eroded beach that lies at the junction of the Avawatz Range and Death Valley. The road from Johannesburg to Saratoga Springs passes through the eastern portion of the beds. Water is available at Saratoga Springs in sufficient quantities for all working purposes.

The Owl beds lie 20 miles southwest of Saratoga Springs on the Johannesburg road on the east flank of the Owl Mountains. Water is also available here in smaller amounts.

The Round Mountain beds are the western extension of the Saratoga beds. The Valley beds lie 12 miles northwest of Saratoga Springs on the north rim of Death Valley.

Bibl.: Bulletin 24, pp. 176–178.

Pacific Nitrate Company, 527 Consolidated Realty Bldg., Los Angeles; Walter R. Fales, president; C. B. Ellis, secretary. This company owns the Upper Cañon and Lower Cañon niter beds, a total of 2200 acres along the Amargosa River. Those claims are patented. The beds are very accessible, as the Tonopah and Tidewater Railroad traverses the claims. Water for working purposes can be obtained from the Amargosa River.

The Upper Cañon beds extend along both sides of the Amargosa River, and over the line into Inyo County. (See Inyo County report.)

The Lower Cañon beds are located on the east side of the Amargosa River, 4 miles south of the Upper Cañon beds. Considerable prospecting has been done on these claims, over 14 miles of trenches having been dug. It is said that present development shows from 5% to 10% niter in the "caliche," which varies from 6″ to 18″ in thickness.

Bibl.: Bulletin 24, pp. 174–175.

Several **other occurrences** of the niter beds in San Bernardino County are reported, none of which have been developed.

PETROLEUM.

Exploration for petroleum has been carried on in that portion of the Mojave Desert between Mojave and Barstow by several different companies spasmodically since 1900. Indications of oil were reported by two companies, but no quantity was found. The greatest depth attained was 3000 ft. In 1912 R. W. Pack[62] of the United States Geological Survey made a reconnaissance of the eastern part of the region, and is entirely adverse to the idea that oil occurs in this region. He writes: "Traces of oil and gas are present in different parts of the world in fine-grained sedimentary beds, and it is possible that similar traces of oil may exist in the fine-grained detrital beds of this region, but it is highly improbable that oil and gas occur here in greater amounts. The principal reasons for believing that this land will not prove productive are: (1) The lack of strata from which it would seem reasonable to believe that oil might have been formed, especially the lack of thick masses of organic material (diatomaceous and foraminiferal shale) such as those which occur in or near all the oil fields in the southern half of California and in which oil is believed to have origi-

[62] U. S. G. S. Bulletin 541, pp. 141–154.

nated; (2) the lack of structural features favorable for the collection of petroleum even if it existed disseminated through the strata."

The following is a brief description of the work done in this district.

The Kramer Consolidated Oil Company's well is in the NW. ¼ of Sec. 11, T. 10 N., R. 5 W., 3 miles north of Hawes, a station on the Santa Fe Railroad. The well was drilled to a depth of 3000 ft. and it is said some light gravity oil was obtained.

The Chicago-Barstow Oil Company's well is on the SW. ¼ of Sec. 35, T. 11 N., R. 1 W., S. B. M., 8 miles north of Barstow. This well attained a depth of 2720 ft. and is said to have shown traces of oil at several levels. The rig caught fire and was completely destroyed.

The Barstow Paraffine Oil Company's well is in the SE. ¼ of Sec. 17, T. 32 S., R. 44 E., about a mile west of Black Cañon, and was known as the Giroux well. It attained a depth between 300′ and 400′ and was abandoned.

The Mojave Oil Company's well is in the SE. ¼ of Sec. 14, T. 11 N., R. 12 W., 2½ miles southeast of Mojave. A depth of about 1200′ was attained and some indications of oil reported.

Bibl.: U. S. G. S. Bulletin 541, pp. 151–152.

SALINES.

(Other than Borax.)

Salt.

There are inexhaustible deposits of salt widely distributed over the desert portion of San Bernardino County, many of which have not been developed. Several companies are now producing limited amounts and there is an excellent outlook for an increased production in the near future. The following is a brief description of the companies now engaged in developing salt deposits:

Avawatz Salt and Gypsum Company, 1112 Garland Bldg., Los Angeles, Cal.; H. H. Kerckhoff, president; Thos. L. Henderson, secretary. This company has 52 claims, containing about 5200 acres, along the northeast margin of the Avawatz Mountains, 10 miles west of the Tonopah and Tidewater Railway. A large bed of rock salt, which is said to be over 95% pure, sodium-chloride and 10′ to 12′ thick, outcrops for a distance of several thousand feet. This rock salt occurs in an old lake bed, overlaying a basement complex of stratified rocks, and being partially concealed by later gravels. In the lake bed occur also beds of gypsum and celesite. In general the strike of the beds follows the north edge of the Avawatz Mountains, curving to the northwestward. As a rule the salt is massive and shows no crystalline structure and is reddish or brown in color, due to small amounts of iron oxide or colored clay. Considerable development work has been done at this property, over 5000′ feet of shafts, drifts and cuts having been driven.

The company is now preparing to construct a spur track from the Tonopah and Tidewater Railroad to their deposit and expect to start producing shortly.

Bibl.: Bulletin 24, pp. 126–128; U. S. G. S. Bulletin 540, pp. 526–530.

Consumers Salt Company, 304 Grant Bldg., Los Angeles; L. E. Stump, president; J. G. Hunter, secretary. This company is working a deposit of rock salt in an old lake bed 4 miles south of Saltus Siding

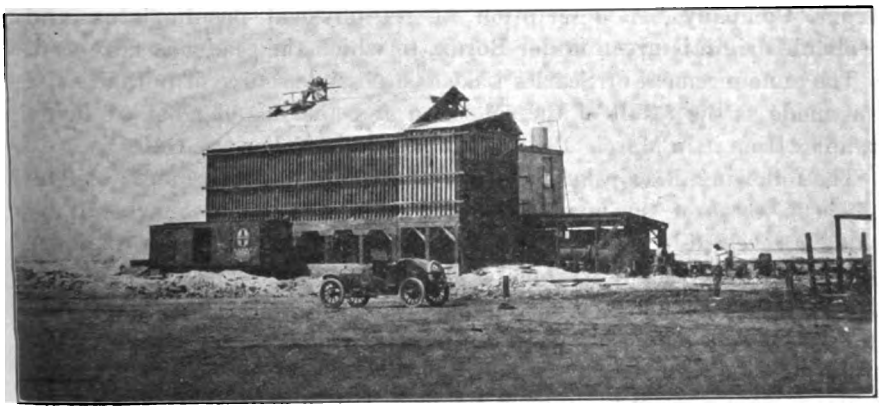


Photo No. 51. Mill of the Consumers Salt Company at Saltus, 3 miles east of Amboy.

on the Santa Fe Railroad. The 4′ overburden of sand and gravel is removed, and the salt blasted out with dynamite. A narrow-gauge railroad connects the mine with the mill, located at Saltus, 3 miles east of Amboy. The salt is hauled to the mill in 6-ton cars by a steam engine, where it is crushed, washed in a saturated brine, and then dried in a rotary calciner. Mill is operated by a 25 h.p. gas engine. The water is pumped from a well at the mill. The salt is mainly marketed for use in freezing ice-cream. Producing about 300 tons monthly, but expect to increase this production shortly. Four men are employed.

R. B. Evans, Pasadena, Cal., is working a deposit of rock salt at Danby Dry Lake, south of Ward Siding. The salt is quarried and hauled by wagon to Ward, from where it is shipped to consumers in southern California. Only a small production has recently been made from this deposit, as a modern plant is necessary for refining the salt. Six men are employed.

The Milligan Salt Company is producing a high grade table salt at Milligan, a siding on the Parker branch of the Santa Fe Railway, 23 miles west of Blythe Junction, the nearest post office. The salt is produced by evaporating a saturated brine in vats and recrystallizing the

salt. Very little salt has been as yet produced, as the work has been largely experimental. Fred D. Smith of Milligan is manager.

Descriptions of the numerous **undeveloped salt deposits** of San Bernardino County appear in our Bulletin 24, "The Saline Deposits of California," pp. 126–133, so will not be repeated here.

Soda and Potash.

Searles Lake, for many years an important source of borax, is now being exploited as a source for potash and soda by the **American Trona Company.** A description of its physical peculiarities and probable origin is given under **Borax,** to which the reader is referred.

The announcement of Searles Lake as a possible source of potash salts was made as the result of the collection and analysis of a set of brine samples from it in March, 1912, by E. E. Free and Hoyt S. Gale[82].

The following description is extracted from Mr. Gale's report: "The physical status of the main saline deposit in the bed of Searles Lake today is revealed by a large number of borings that have been put down by private interests in various explorations of the salt beds and by the analyses that have been made from them. So far as has been determined the main salt body appears to be a bed at least 11 or 12 miles in extent and having a depth of from 60′ to 70′. This body of salt is chiefly crystalline, in part compact, but in general is believed to be of cellular or open crystalline structure, being really a body of salts standing in the residual brine from which it is crystallized. Experiments in the wells that have been put down appear to show that this brine is in nearly all parts of the salt bed free to flow and that it stands high in the deposit, approximately at the actual surface of the salts."

The following is a complete average analysis of the brine made from samples collected March 6, 1912, by the United States Geological Survey:

SiO_2	0.08%
As	.09%
Na	33.19%
K	6.25%
CO_3	7.11%
SO_4	12.20%
Cl	36.20%
B_4O_7	2.40%
Total	98.52%

Total salts (ignited residue percentage of original sample), 33.30; specific gravity, 1.2974.

American Trona Corporation, 366 Pacific Electric Bldg., Los Angeles, Alfred von der Ropp, president; J. H. Brown, secretary. This company was incorporated in 1913 to operate a plant primarily for the extraction of borax and potash and eventually other salts from

[82]U. S. G. S. Min. Resources 1912, Pt. 11, p. 886. See also Bull. 540, p. 405; and Prof. Pap. 98A.

the Searles Lake brine. An elaborate and costly experimental plant was erected to test different types of apparatus, and the 31-mile railroad built from Searles, on the Nevada and California Railroad, to

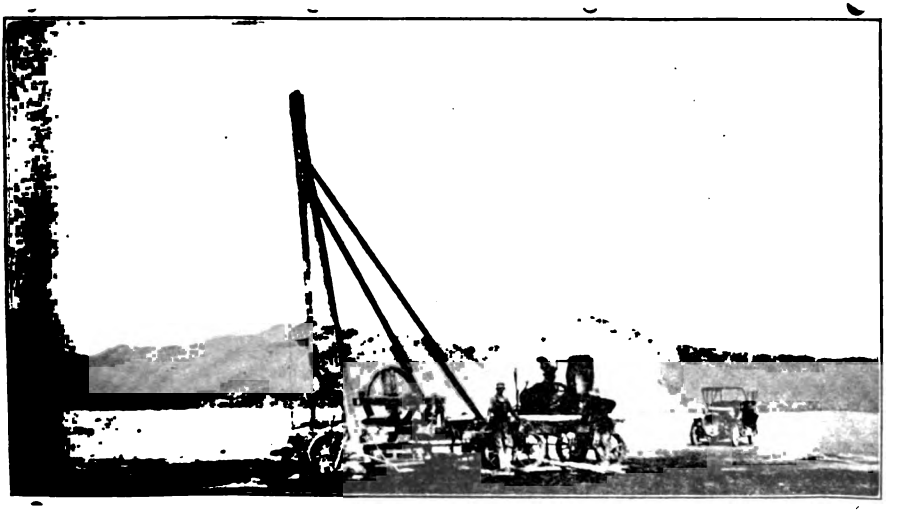


Photo No. 52. Drilling at Searles Lake.

the town of Trona, where the new million-dollar plant is being erected (see photo No. 54). It is expected that 500,000 gallons of brine will be handled daily at the new plant, which will be completed during this

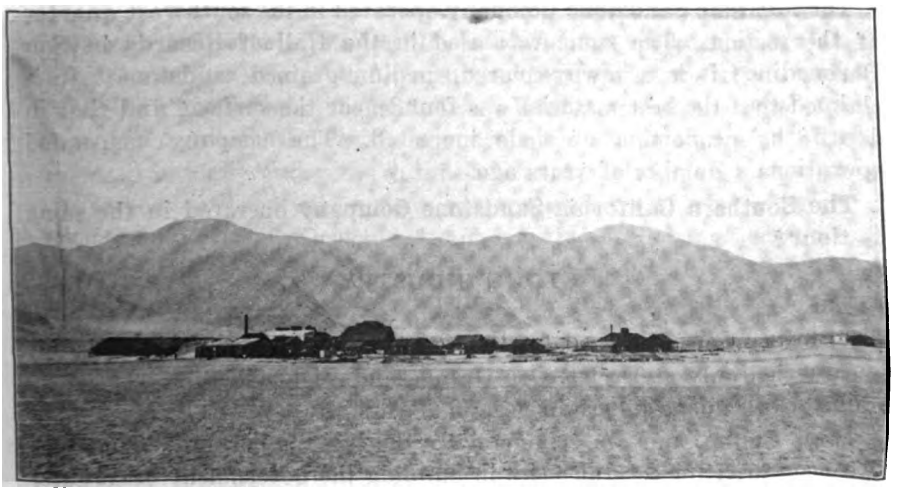


Photo No. 53. Camp of the American Trona Company previous to the construction of the new plant, at Trona, Searles Lake, Cal.

year (1916). A first concentration of the salts will be made here and the product shipped for further treatment in the refinery of the company at San Pedro, Los Angeles County.

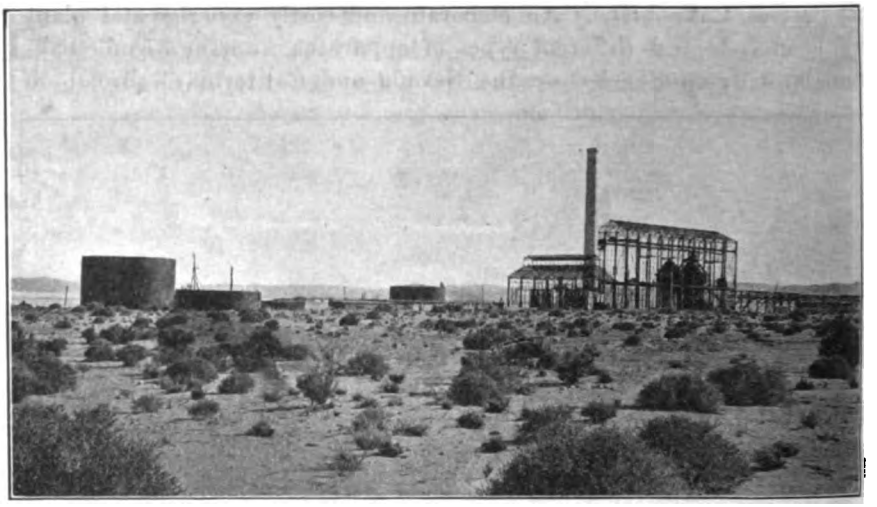


Photo No. 54. New million-dollar plant of the American Trona Corporation at Trona on northwest edge of Searles Lake, for the extraction of borax and potash from the brine of Searles Lake. Photo by C. A. Waring, March, 1916.

SANDSTONE.[64]

There is a deposit of sandstone suitable for building purposes in the east end of the San Bernardino Valley, on Mill Creek, in Sec. 7, T. 1 S., R. 1 W., S. B. M. In former years two companies were formed to quarry this material, but both of them are now out of existence.

The Mentone Sandstone Company operated in the southwest quarter of the section. The stone was used in the Hall of Records in San Bernardino; it is a tawny-colored, medium-grained sandstone. It is claimed that the best material was found near the surface, and that in depth the proportion of shale increased. The company suspended operations a number of years ago.

The Southern California Sandstone Company operated in the same section.[65]

STONE INDUSTRY.

Granite.

Granite occurs over considerable areas in San Bernardino County, but is quarried only at Declez, Oro Grande and Victorville.

The Declez deposits are in Sec. 35, T. 1 S., R. 6 W., S. B. M., 9 miles west of Colton, and are commercially the most important. The stone has been used for several years in building the government breakwater at San Pedro, for building stone used in Los Angeles buildings, and for curbstones used in several of the southern cities. This material is described on our Bulletin 38, p. 48, as follows. "The stone is rather dark-colored biotite granite, which has a gneissoid structure in places.

[64]Bulletin 38, p. 132.
[65]See also Report IX, p. 335.

There are a number of feldspar veins from 2″ to 4″ wide, which consist principally of orthoclase feldspar, but in a few places contain large biotite crystals. The rock is partially disintegrated for a few feet from the top, but below this comparatively thin weathered portion it is bright and fresh, and below the few feet of weathered stone the rock could be quarried in blocks large enough for dimensional stone, and good building and monument stone could be obtained."

The Russell-Greene-Foel Company, 816 Higgins Bldg., Los Angeles, are quarrying this stone for use as ballast, rubble and riprap.

The Oro Grande Quarries[66] have furnished considerable granite in past years, but they are not in operation at present. About two miles south of Oro Grande the Mojave River cuts a narrow cañon through the granite, which forms rocky hillsides on each side of the river. On the west side of the river the granite is deeply disintegrated, and except on the river bluff no solid granite appears at the surface. On the east side of the river the granite is in rounded ledges, and rounded boulders of disintegration cover an area of more than a square mile. In several different places over this area small granite quarries have been operated, the product being mostly Belgian (paving) blocks. The quarries are in Secs. 28 and 29, T. 6 N., R. 4 W. Most of the work has been done on the surface boulders, but in a few places some work has been done on the solid ledge underneath the boulders. The quarrying has been done almost entirely by hand, and most of the product has been paving blocks, although some building and monument stone has been shipped.

Joseph Scheerer of Victorville has a deposit of granite in Secs. 26 and 27, T. 6 N., R. 4 W., which has been given the trade name of "Scheerer's Firestone." Though somewhat pulverulent under blows it has shown unusual fire-resistant qualities for a granitic rock. Scheerer has used it for several years in lime-kiln construction, and more recently it has been utilized with success as a rotary cement kiln lining by the Riverside Portland Cement Company. The following extract of a letter from a member of their staff, dated October 2, 1915, is of interest:

"I am pleased to inform you that the firestone blocks taken from your property near Victorville and placed in a rotary kiln of the Riverside Portland Cement Company, have proved to be of exceptional quality. This stone was superior to any brick used. Unfortunately we were compelled to close this kiln down after a three months' run, so did not find out the real life of these blocks, but on inspection of lining, found the fire brick on each side of this stone reduced to about 4 inches, while the firestone ran from 6 to 7 inches in thickness. The firestone was also placed at point in kiln where it was exposed to a higher temperature than the bricks. I am not in a position to give you data on

[66] Bull. 38, pp. 48–50.

second consignment of these blocks. Personally, I believe you have an exceptionally good material owing to its heat resisting qualities."

Microscopic examination of a thin section of the rock shows it to be a highly acid granite, consisting mainly of quartz and orthoclase with a minimum of mica, and a small amount of albite. The feldspars show a slight kaolinization, and it may be that a slight fusion of this kaolin results in cementing the rock particles and so assists in resisting the slight abrasion as well as the high temperature of the cement kiln. The spur track of the Southwestern Cement Company will pass through both this and the dolomite deposit owned by Scheerer. The "firestone" has been located by separate claims, covering an area of 70 acres.

Mr. Scheerer has also a quarry in Sec. 29, from which considerable granite has been quarried by the Santa Fe Railroad for use as rubble and riprap along its roadbed between Victorville and Oro Grande. The stone is hauled from Scheerer's Siding.

Near **Victorville** several quarries were formerly operated producing principally paving blocks. Only one quarry is at present being worked.

The **Victor Quarry** is in Sec. 3, T. 5 N., R. 4 W., S. B. M., 2 miles north of Victorville. It is also known as the Stockholm Stone Quarry. Granite boulders of a yellowish cast are cut by hand into paving blocks, varying from 8″ to 12″ long, 4″ to 6″ wide, and 6″ thick. Some curbstones have been cut from these boulders. This quarry has been worked spasmodically since its location in 1904. Mr. James Hargraves, Victorville, Cal., is the owner.

Bibl.: Bull. 38, p. 51.

Crushed Rock, Sand and Gravel.

The California Portland Cement Company produces crushed rock for macadam and for concrete from their quarries near Colton.

The Colton Sand Company, C. M. Lestrange, manager, Colton, is developing a large deposit of sand near Colton which is said to be very clean and well adapted for use in making cement. Three men are employed at the property.

STRONTIUM.

Beds of celestite (strontium sulphate) are stated to occur associated with the colemanite layers at the old borax mines of the Pacific Coast Borax Company at Calico. No attempt has as yet been made to utilize this strontium mineral, commercially. See also Avawatz Salt and Gypsum Company, under Salt.

L. A. Davis, Stagg, post office (Ludlow)—*see* under Barytes.

T. G. Nicklin, Barstow, reports he has a deposit of high grade strontianite (strontium carbonate), covered by four claims. It is 10 miles north of Barstow by a good wagon road. A deposit of wither-

ite (barium carbonate) is stated to be associated with the strontianite. Developing.

J. H. Sloan, Barstow (*see* under Feldspar).

TALC.

This mineral occurs in the vicinity of Riggs, a station on the Tonopah and Tidewater Railroad, and has been mined on a small scale for several years by the **Silver Lake Talc Company** of Los Angeles. The talc is remarkable for its whiteness, its mode of occurrence, and its origin. Quoting from the report of J. S. Diller[67]: "The talc deposit near Riggs, 10 miles north of Silver Lake, has been traced northwest and southeast nearly a mile and opened at several points. As elsewhere in the region it lies between limestone and diorite, although there is much red granitic and aplitic intrusive as well as mica schist and other metamorphic rocks near by. This talc body has a thickness of 5 feet and is well banded, as if stratified parallel to the overlying limestone. The best talc is near the bottom. In thin sections under the microscope it appears to be made up of fibrous and nonfibrous material, apparently talc and tremolite."

Other deposits of talc occur on Sheep Creek, 20 miles northwest of Silver Lake, and in the hills 7 miles east of Riggs. These occurrences are essentially the same as that at Riggs, but very little development work has been done on them.

Ibex Talc Mine, south of Zabriskie, and owned by the Fifty Associates Securities Company, Union Oil Bldg., Los Angeles. The talc occurring here is a high grade, white material similar to that described above.

[67] U. S. G. S. Mineral Resources 1913, Pt. II, pp. 159–160.

TULARE COUNTY.

By W. BURLING TUCKER, Field Assistant.

Field work in June, 1916.

DESCRIPTION.

Tulare County, one of the largest counties of the San Joaquin Valley, is bounded on the northwest and north by Fresno, on the east by Inyo, on the south by Kern, on the west by Kings County. It has an area of 4856 square miles. The eastern half of the county lies in the Sierra Nevada. The western half extends across the Tulare Valley, and is all of it, nearly level, except a small portion in the extreme west which extends into the Coast Range. The eastern boundary of the county commencing at the crest of the Sierras embraces Mount Whitney, which is the highest peak in the United States, with an altitude of 14,501′. Besides Mount Whitney on the northeast boundary line between Tulare and Inyo counties are: Mount Tyndall, 14,300′, Mount Williamson, 14,364′, Mount Bernard, 14,030′, Mount Russell, 14,190′, Mount Langley, 14,042′ and Mount Le Conte, 13,960′.

Situated in the north central part of the county are the Sequoia and General Grant national parks which contain the greatest groves of the oldest, the biggest and the most remarkable trees (*Sequoia Washingtoniana* or *gigantea*) living in the world. They number 1,156,000, of which 12,000 exceed 10 feet in diameter. The General Sherman tree, most celebrated of all, is 279.9′ high with a diameter of 36.5′.

The General Grant National Park is usually mentioned with the Sequoia because, though separated by six miles of mountains and forest, the two are practically the same national park. It contains 2536 acres and was created only for the protection of the General Grant tree, a monster sequoia, 264 feet high and 35 feet in diameter. The sequoias are found scattered all over the park, which has an area of 161,597 acres. The country is one of the most beautiful in America, abounding in splendid streams, noble valleys, striking ridges and towering mountains.

Watershed and rivers.

As the eastern boundary of the county commences at the crest of the Sierras and extends north and south about 75 miles, embracing a series of the highest peaks of the Sierra Nevada; its watershed is the greatest in area of any of the Valley counties. From this great watershed flow of the Kaweah, St. Johns, Tule, and White rivers, while in the northeastern section the Kern River has its headwaters and flows south through the county into Kern.

Railroad facilities.

The county is traversed by both the Southern Pacific and Santa Fe systems with their main lines and branches. The Visalia Electric

Railroad is in operation between Visalia and Redbanks, via Farmersville, Exeter and Lemon Cove.

Agriculture.

The soil, climate, and water conditions of the valley are suitable for alfalfa and grain. Dairying is, therefore, a very profitable industry. The soil in the foothills east of Porterville, Lindsay, Exeter and Visalia is a red adobe strongly impregnated with iron, making it valuable land for citrus fruit culture. This business in Tulare County has outstripped all other industries, and it is stated to have the largest citrus acreage of any county in the state.

The fruit in this belt ripening a month to six weeks earlier than that in southern California, the soil and climate can not be exceeded for the production of deciduous fruits of all kinds.

Stock raising is a very profitable and growing industry, owing to the extensive ranges of fine grazing land in the foothills and mountains.

Hydroelectric power plants.

Mount Whitney Power and Electric Company. The plants of the Mount Whitney Power and Electric Company derive their water supply from two distinct watersheds of the western slope of the Sierra Nevada Mountains. These comprise the East, Middle, and Marble forks of the Kaweah River, and two forks of the Tule River. The former watershed is the more northerly, has an area of 250 square miles and its elevation ranges from 2600 to 12,400 feet at its eastern boundary. The latter watershed has an area of 88 square miles and its elevations rise over 10,000 feet. A characteristic of both watersheds is the rapid fall of the river-beds. This will amount to 300–400 feet to the mile, and follows the general precipitous nature of the rugged country. Above 4000 feet a heavy covering of snow is found throughout six months of the year, and at the extreme altitudes much snow remains the year round. The water flow during the melting time is necessarily large. The precipitous cañons afford little possibility for the construction of reservoirs. A number of small natural lakes have been increased by the construction of dams, and these serve to augment the low water flow.

KAWEAH PLANT NO. 1. This power house is on the south bank of the Kaweah River, about two miles below the junction of the Middle and East forks, and is about 4 miles east of the town of Three Rivers. The power house building is constructed of galvanized corrugated iron. Within the building are three main generating units and two exciter units. The generators are Westinghouse, 3-phase, 450 k. w., 440 volt, revolving armature machines operating at 450 r. p. m. There are four Westinghouse oil-insulated and self-cooled raising transformers, each having a capacity of 500 k.w.

The plant has its diversion in the East Fork of the Kaweah about five miles above its junction with the Middle Fork where about 20 cu. ft.

per second flow is available during the season of low water, storage being secured from several natural lakes in the high Sierras. These include Lady Franklin Lake, impounding 23 million cu. ft. of water, Silver Lake, Eagle Lake, and Monarch Lake, whose estimated storage is 21 million cu. ft. The diversion is at the outlet of the natural basin where a small, granite masonry dam maintains the water level for the intake of the conduit. A 50-foot tunnel through a jutting rock spur delivers from this basin to a timber flume. This flume has a capacity of 17 cu. ft. per second and is 30,000 feet long, following the very precipitous mountain side of the south slope of the cañon. The flume is 3 feet wide by 2 feet deep with a grade of 20 feet to the mile. The plant is served by a pressure pipe 3300 feet long. The pipe has a diameter at the top of 24 inches, and the thickness is No. 12, B. W. G., with lap-riveted construction. As the pipe descends, the diameter decreases to 23, 22, 21 and finally 20 inches, of which diameter the last 1,160 feet is in lap-welded pipe. The thickness at the power house is ¼ inch. The pipe line terminates with a section parallel to the power house building in which are placed 3 cast steel branch fittings. From these connection is made to each water wheel nozzle. The static head on this line is 1310 feet.

KAWEAH PLANT NO. 2 is across the river from No. 1 plant and about a mile below it. This is the only plant on this system that may be termed a low-head installation, the static head of the pipe line being 351 feet. The diversion is in the Middle Fork about one mile above its junction with the East Fork. This diversion was made at a natural dam site, between two granite ledges and consists of a low granite masonry dam whose maximum height is 8 feet. At the west end is the intake for the canal, in which are four hand-operated sluice gates, each 2 ft. 5½ in. wide by 6 ft. 6 in. high. The canal follows the hillside for a distance of four miles, of this, 3.15 miles is in a concrete-lined ditch. The remainder is divided into several sections of timber flume. This conduit had a capacity of 80 cu. ft. per second. The ditch is 4½ ft. wide at the bottom and 11½ ft. at the water surface with a depth of 3½ feet. The grade is 5.28 ft. to the mile. At the lower end is a set of 5 sliding gates to allow the water to pass into the head of the pressure pipe line. The elevation of the intake of this canal is 1400 feet. The pipe line has a total length of 1000 feet, and a single diameter of 40 inches. There are three branches in this final section of the pipe, which supply water to the three generating units originally installed in the plant.

This plant consists of a General Electric 500 k. w. 2300-volt 3-phase revolving field generator, operated at a speed of 450 r.p.m. It is direct connected to a Victor-Girard type turbine, controlled by hydraulic-operated gate valve. A General Electric 1500 k. w., 2300-volt, 3-phase

generator operating at a speed of 720 r. p. m., is direct-connected to a Pelton-Francis turbine, having a capacity of 2250 h. p. There are two General Electric 4-pole, 125 volt, 30 k. w., exciters, which operate at 1050 r. p. m. These are direct-connected and driven by Platt Iron Works Girard type turbines. There are seven Stanley G. I. 350 k. w. oil insulated raising transformers.

KAWEAH PLANT NO. 3. The power house is located directly above the intake of No. 2 plant, so that its discharge is caught behind the dam of No. 2 and immediately diverted into that canal. No. 3 plant derives its water from two diversions, one in the Middle Fork, about ¾ of a mile from the junction of the Marble Fork, while the other is in the Marble Fork, about the same distance from the junction already mentioned. The canal is carried along the north bank of the Marble Fork above the junction of the two branches, then an inverted siphon, which is a steel pipe 48 inches in diameter, carries the flow from the Marble Fork diversion across the Middle Fork to the point where it joins the main canal. Where the pipe crosses the bed of the Middle Fork, it is buried in solid concrete. The length of this inverted siphon is 1085 feet, and the maximum static head is 125 feet. The waters of the two branches are thus mingled, and are then carried in a continuation of the Middle Fork conduit, which follows the east slope of the Middle Fork to a terminus in a forebay reservoir for the No. 3 power house. The total length of this concrete conduit, including both branches, is 25,000 feet. Of this 5000 feet comprises the section from the diversion in the Marble Fork, including the inverted siphon. The Middle Fork branch is 3300 feet long. The remainder is the conduit from the junction to the forebay reservoir. The Marble Fork and main sections are built upon a grade of one foot in 1000 feet. Of this 6000 feet is in a concrete-lined ditch having a bottom width of 6 feet, and a depth of 4 feet. The remainder of this branch is in slab bench construction of which 12,700 feet is in single slab construction, and 3000 feet in double slab construction. That part of the main canal which receives its water from the diversion in the Middle Fork to the point of juncture with the siphon from the Marble Fork, is built on a grade of 2 feet in 1000 feet. This section consists of 3300 feet of concrete flume, having a width of 6 feet inside and a depth of 2 feet. The forebay reservoir at the terminus of the line, has a capacity of 11½ acre feet. Intake from pressure pipe line is direct from forebay reservoir to power house. Total length of pressure pipe is 2589 feet. Diameter at top is 40 inches and is reduced to 36 inches; at which size it enters the power house. The total static head is 776 feet. The power house is a reinforced concrete building 50′ x 50′ inside measurements. This plant consists of two 1750 k.w., 2300 volt, 3 phase, Westinghouse generators, direct-connected to Pelton-Doble impulse wheels operating under a head of 776 feet.

TULE RIVER POWER PLANT is situated 1½ miles above Springville. The water supply is secured from the Nelson and Doyle forks of Tule River. The main conduit follows the north slope of the Tule River Cañon to a point where the river makes a bend to the north. The line itself is composed of 23,600 feet of wooden flume, 11,206 feet of concrete-lined ditch and 228 feet of concrete flume. The total length of the conduit is 6.9 miles. At the terminus of the canal is a small regulating reservoir with a capacity of 17,500 cu. ft. The pressure pipe line to the power house enters the forebay reservoir and is carried from the reservoir directly down the hillside to the power house. The total length of pipe is 2814 ft. The power house contains two 1000 k. w. 2300 volt, General Electric generators, driven by Doble wheels, operating under an 1130 ft. head. An auxiliary steam station, having a capacity of 6750 k. w. is located at Visalia.

Bibl.: Journal of Electricity, Power and Gas, Vol. XXXI, "System of Mt. Whitney Power and Electric Company," by R. W. Van Norden.

San Joaquin Light and Power Company. The plant is situated at the junction of the Nelson and Doyle forks of the Tule River. The water supply is obtained from the Doyle Fork by means of a concrete-lined tunnel and flume, 6 miles in length. With a high head of 1425 feet this plant has a capacity of 2000 k. w.

Mining conditions.

Tulare County continues to be the most important source of magnesite in this country. On account of the difficulty in securing imports of magnesite from European countries, the demand for California magnesite has been very active during 1915 and 1916, the result being that there has been a great revival in mining this mineral, and a large tonnage is being shipped from Porterville, Lindsay, and Exeter.

There has also been a renewal of mining activity in the Mineral King and White River districts.

MINERAL RESOURCES.

Tulare County's mineral resources consist of asbestos, brick, clay, chromite, copper, feldspar, gold, graphite, gems, infusorial earth, lead, limestone, magnesite, marble, natural gas, quartz, glass sand, silver, soapstone, miscellaneous stone, and zinc.

ANTIMONY.

Lady Alice Mine. Situated ¼ mile south of Mineral King, on slope of ridge west of East Fork of Kaweah River. Vein of quartz slightly mineralized with antimony sulphide strikes N. 10° W. and dips 50° W. Width of vein is 2 feet. The formation is slate. Several shallow prospect holes have been sunk along the outcrop of the vein. Idle. Arthur Crowley of Mineral King, owner.

Year	Gold, value	Silver, value	laneous nd	Value
1880	$1,125	$526		
1881	8,181	36		
1882	5,000	2,000		
1883	4,000	1,000		
1884	70,000			
1885	7,500			
1886	6,900	50		
1887	15,640	167		
1888	25,000			
1889	39,340	250		
1890	43,019			
1891	15,095			
1892	24,355	11		
1893	12,818			
1894				
1895	16,320			$960
1896	20,092			1,500
1897	12,830	214		
1898	12,400			
1899	13,610			88
1900	10,445	433		
1901	14,616	100		
1902	11,648			
1903	9,215		09	50,108
1904	1,100			
1905	2,300	13		
1906	20			2,200
1907				
1908				360
1909				185
1910			ıral gas	1,000
1911				
1912				200
1913				200
				796
				5,050
				2,400
1914				13,065
				30
				1,888
1915				6,500
				1,830
Totals	$402,569	$4,800		$88,360

*Includes chrome and silica.

Gold
Silve
Brick
Gem
Gran
Magn
Ston
Misc

C

ASBESTOS.

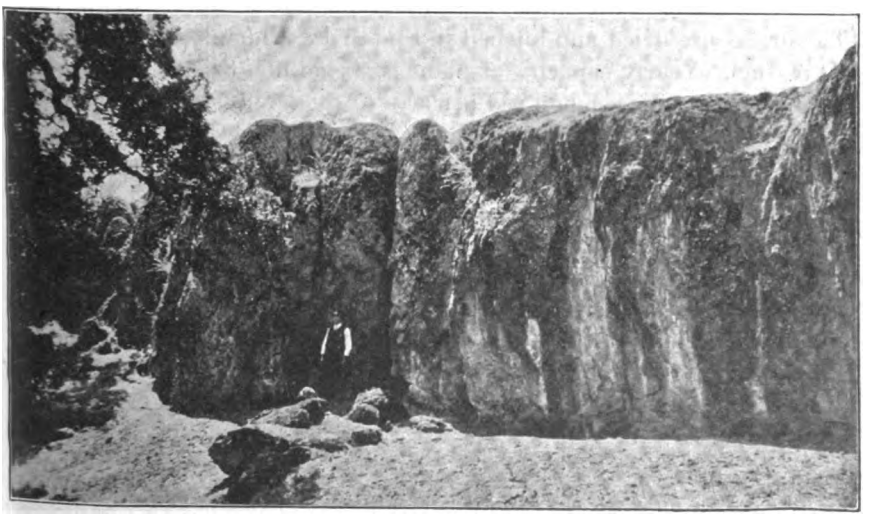
In the serpentine area east of Porterville are some small deposits of asbestos, none of which are of commercial value. One deposit is on the McCann Ranch, 1 mile south of White River. On the James Ranch north of Porterville there is a deposit of fair grade asbestos. Asbestos, but not of the best quality, is obtained in Frazier Valley in T. 20 S., R. 29 E., on Tule River, 25 miles east by south of Tulare City.

CLAYS.

South of Porterville there is a large deposit of fire clay, which from tests made is reported to produce a fine quality of fire brick.

In the neighborhood of Exeter and Visalia are extensive deposits of brick clays.

Sear's Clay Deposit is situated 8 miles southeast of Ducor, in Secs. 26, 27, 35, T. 24 S., R. 28 E. The clay bearing strata extend about ½ mile south of White River and about 2 miles in length along the south



Sear's Clay Deposit, 8 miles southeast of Ducor. Showing 8-foot overburden of clay and gravel.

bank of the river. An overburden of gravel and clay 6′ to 8′ thick overlies a bed of white and blue plastic clay. A number of small cuts have been made along the south bank of the river. These pits show a white clay 6′ to 8′ thick overlaying a blue plastic clay. The strata of the clay beds have a general northwest-southeasterly strike. The development of this deposit has been only superficial, so the depth of the clay beds has not been determined. The clay is suitable for tile, sewer pipe, fire brick, vitrified brick and terra cotta. W. A. Sears, of Porterville, owner.

Pioneer Brick Company. John Etzenhouser, president; Arthur Etzenhouser, secretary. The plant is located on Mill Creek, near the eastern limits of the city of Visalia. The bricks are made in a soft mud machine, seasoned in racks and burned in field kilns, using oil as fuel. Most of the output consists of common red brick, but a few pressed brick are made each year. Capacity of plant is 40,000 brick per day.

S. P. Brick Company. W. D. Trewhitt, president; L. E. Hayes, secretary and general manager; office, 435 Powell Bldg., Fresno. The plant is located ¾ of a mile south of Exeter, in Sec. 14, T. 19 S., R. 26 E. The deposit covers an area of 20 acres. About a couple of acres have been worked by pits, showing a good quality of brick clay for a depth of 15 feet. The material from pits goes to a Scott-Madden pulverizer, the product after being pulverized is elevated and screened over a piano wire screen.

The screened material goes direct to pug-mill, then to stiff mud machine, which has a capacity of 55,000 bricks per 9-hour day. From the latter machine the material is fed to a board delivery cutting table. The bricks are dried and burned in Steward & Clamp open kilns, using oil as fuel. Yearly capacity of plant is six million bricks. Most of the output consists of common red brick.

Shale.

Valencia Heights Shale Deposit. Six miles east of Porterville, in Sec. 34, T. 21 S., R. 28 E., a strata of clay shale about 1500′ to 2000′ in width cuts through the serpentine belt east of Porterville. The strike of these shale beds is NW.–SE. with dip of 75° NE. The outcrop can be traced easily on the surface and shows up plainly, where it is cut by an irrigation ditch and also by the county road. The quality appears good for the manufacture of brick, sewer pipe, tile and conduits. The following analysis was made by Smith Emery Company, of San Francisco:

Silica	68.52%
Alumina	16.04%
Iron oxide	4.00%
Lime	0.58%
Magnesia	2.35%
H_2O	1.78%

Ignition loss of 3.02%.

C. H. Weed, of Porterville, owner.

CHROME.

In the foothills north and southeast of Porterville a number of deposits of chromic iron of good commercial grade have been developed and worked out during the past year. The ore occurs in lens-shaped deposits in the serpentine, and as a rule are small and of shallow depth.

The most extensive deposit was on the Vaughan Ranch, north of Deer Creek from which about 800 to 1000 tons of good grade chrome ore was extracted and shipped.

Bowlin Chrome Mine. Lee Bowlin, Exeter, owner. In Sec. 20, T. 19 S., R. 27 E., 4 miles north of Lindsay. A series of small lenses of chromite occurred in the serpentine. The general strike of these lenses was northwest and southeast. About 100 tons of ore has been shipped from these deposits. The deposits have been worked out.

James Chrome Mine. Mrs. J. H. James, Porterville, owner. In Sec. 11, T. 21 S., R. 27 E., 4 miles north of Porterville. A lens of chromite occurred in the serpentine, 161 tons of ore of good quality was shipped from this property.

Sattlefield Chrome Mine. Lee Bowlin, of Exeter, owner. In Sec. 20, T. 19 S., R. 27 E., 6 miles northeast of Lindsay. Property under lease to E. L. Sattlefield and Bros. of Lindsay. In foothills northeast of Lindsay, a series of narrow lenses of chromite have been discovered in the serpentine, which strikes northerly and southerly. The width of ore developed varies from 2′ to 5′. Two open cuts have been made, and about 75 tons of ore extracted. The quality of the ore is very good.

Vaughn Chrome Mine. D. A. Vaughn, of Porterville, owner. It is 4 miles southeast of Porterville. On the south slope of ridge north of Deer Creek, two large sized lenses of chromite were developed and extracted. One was at an elevation of 650 feet on south slope of hill. The general strike of this lens was N. 20° W. In extracting the ore an open cut 100′ in length, 25′ wide and 15′ deep was made. About 300′ north of this lens at an elevation of 880′, an open cut and tunnel was driven on a large deposit of chromite which had the same general strike as the lower lens. The open cut is 150′ long by 12′ wide by 10′ deep. On the same general strike of these lenses, at an elevation of 1050 feet and about 1000 feet north of No. 2 workings, occur two small lenses of ore. On the top of this ridge the indications look encouraging for the occurrence of small lenses of chromite. Reported that 800 to 1000 tons of ore was shipped from this property during 1916, which averaged 45%. The shipments were made by California Magnesite Company of Porterville, which has a lease on the property.

Waddell Chrome Mine. Frederic Gill, Exeter, owner. Under lease to H. G. Waddell and F. R. Brann of Lindsay. Situated in Secs. 17, 20, T. 19 S., R. 27 E., 4 miles northeast of Lindsay. A series of narrow lenses of chromite occur in a belt of serpentine in foothills northeast of Lindsay on the Gill ranch. The general strike of these lenses is N. 40° E. One mile north of the main deposit on an adjoining hill at an elevation of 800 feet, a series of narrow lenses occur which have the same general strike. The serpentine belt strikes northwest and south-

east. About 70 tons of chrome ore of good quality was shipped from the property during 1916.

COPPER.

In this county, there are some very promising copper prospects, but owing to the ruggedness of the country and their distance from transportation they have been but little explored and only slightly developed. Just east of Porterville, there is an area of country fully five miles wide, and which extends north to the Yokohl Valley, in which small veins occur. This belt is most clearly defined and characterized by narrow diverging seams or stringers of copper-bearing minerals. The chief deposits are near the middle of the county, thirty miles or so east of Porterville, along the North Fork of the Middle Fork of the Tule River. Copper prospects of possible future value occur high in the Sierras located close to Kearsarge Peak, in the extreme northeastern corner of the county.

Annie Fox Mine. Situated in the Mineral King mining district, on the west slope of ridge east of the East Fork of Kaweah River. The following claims have been located in alternating strata of uptilted limestones and slates which are bent, crushed and twisted: Annie Fox, Gray Wolf, Galena Boss, Galena Boss Extension, Annie Fox Extension No. 1, Annie Fox Extension No. 2.

The ore zone occurs on contact between the limestone and slates and is from 5′ to 20′ wide, covered with an iron gossan capping. A series of prospect shafts and short tunnels have been driven along the outcrop. The ore occurs in the form of chalcopyrite associated with iron sulphides. The general strike of the veins is N. 30° W., with a dip of 70° NE. W. O. Clough and Judge W. B. Wallace, of Visalia, owners.

Barber Mine. Dr. Barber and Frank Witt, of Porterville, own some claims, on ridge south of North Alder Creek, 18 miles northeast of Springville. The ore zone occurs on contact of granodiorite and porphyry, which is mineralized with chalcopyrite and iron sulphides. The strike of the vein is east and west. There is a tunnel 50 feet long and a series of shallow open cuts on the vein.

Hamilton Mine. Situated on the Hamilton ranch, in Sec. 33, T. 18 S., R. 27 E., 5 miles east of Lindsay. Kidneys and stringers of copper ore occur along a shear zone in a formation of mica schist. This mineralized zone strikes NW.–SE. and dips 75° NE. A shaft has been sunk to a depth of 110 feet, on an angle of 75°. At the bottom of shaft the mineralized zone was crosscut for a distance of 10 feet on each side of shaft. The ores are oxides and carbonates. Idle. Jas. L. Hamilton, of Yokohl, owner.

Lion's Nest Mine. Situated in the Mineral King mining district, to the south of the Annie Fox Mine. Ore occurs on contact with limestones and slates in a belt of uptilted strata of limestones, slates and shales. The strike of this belt is N. 10° W. with a dip of 70° NE. A crosscut tunnel was driven 400 feet to cut the contact, but work was suspended before reaching that point. Mouth of tunnel covered with a slide. Idle. P. L. and M. E. Bozeman, of Exeter, owners.

Copper Mountain Mines. In Secs. 34 and 35, T. 14 S., R. 31 E., near Kearsarge Peak, there is a mineral-bearing belt a mile wide, running northeast and southwest. The ores are sulphides and carbonates, carrying from 2% to 25% copper. The deposits in the richer veins of this belt are opened by shaft 18′ deep, a tunnel 50′ long and an open cut 5′ deep, on the east side of Roaring River. On the west side there is an old shaft and drift. At the head of Cloudy River Cañon close to the Copper Mountain mines, there are some cuts and a tunnel 40 feet long. Quartz shows strongly in this tunnel. The decomposed limestone carries gold. The shaft shows a 3-foot ledge of carbonate ore. The vein matter is schist, diabase, and amphibolite. The claims are 1000 feet above timber line.

Bibl.: Bull. 50, p. 292.

Oakland Copper Mine. Eight claims have been located at the headwaters of Copper Cañon, about 12 miles north of Mineral King. A mineralized zone 80 feet wide occurs on the contact of limestone and syenite-granite. This zone strikes north and south. On the Oakland claim a shaft has been sunk on the contact to a depth of 80 feet, and a tunnel 70 feet in length driven on contact. In the mineralized zone on the Amador claim there is a tunnel 30 feet long and a series of open cuts five feet deep, which prove the zone to be mineralized for a width of 80 feet. The ores are bornite, chalcopyrite, associated with iron sulphides. Idle. D. Dawson, K. S. Castle, R. Weismer, and W. J. Martin, of Volcano, Amador County, owners.

Page Mine. It lies in a low ridge of hills, 7 miles NE. of Visalia. The vein is 4 feet thick and is filled with siliceous matter, impregnated with copper pyrite. Idle. J. Prothers, of Visalia, owner.

Bibl.: Reports XII, p. 297, and XIII, p. 64.

Powell Copper. Situated in Secs. 30, 32, 5, T. 19 and 20 S., R. 31 E., on the North Fork of Middle Fork of Tule River, 16 miles northeast of Springville, at an altitude of 5,100 feet. The ore occurs on contact between limestone and granite and schist. The immediate country rock consists of schist, quartzite, diorite and quartz porphyry. The ore-bearing limestone is about 250 feet in width. The sulphide ore bodies exposed are from 5 to 30 feet in width. There are three tunnels, and two shafts; one tunnel 70 feet long crosscuts 5 feet of ore. A crosscut

tunnel 175 feet long cuts 30 feet of low grade sulphide ore near the mouth, the remainder of the distance in slate and limestone. On the east bank of the river a tunnel has been driven crosscutting 20 feet of 5% copper ore. On the west bank of river, a tunnel has been driven parallel to limestone contact, a distance of 45 feet, showing 15 feet of sulphide ore, and a winze has been sunk to a depth of 15 feet all in ore.

The course of the vein is northeast and southwest. The ores are chalcopyrite, pyrrhotite, sphalerite, associated with iron sulphides, carrying from 2% to 5% in copper, with gold and silver values. The ore occurs in an actinolite, hornblende and feldspar gangue, which is very hard. The holdings consist of seven mining claims located along the contact in a northerly and southerly direction. Three men are employed on development work. Mrs. Monte Powell, L. M. Powell and R. G. White, of Visalia, owners.

Bibl.: Bulletin No. 50, p. 290.

Round Valley Mine. It is a prospect situated on C. H. Cannon's ranch, on a small hill in Round Valley, 2½ miles east of Lindsay. The ore occurs on a serpentine and granite contact. A small vein occurs on this contact carrying oxidized ores with a little bornite and chalcopyrite. A shaft is being sunk on this vein. Three men are employed. Under lease to Frank Childs and W. R. Livingston, of Lindsay.

GEMS.

At different places all along the foothills of the Sierra Nevada, across Tulare County, chrysoprase outcroppings occur; and associated with it are a number of other forms and varieties of siliceous minerals capable of use in the arts for ornamental purposes, such as rose quartz, chrysopal, etc., besides several species of garnet. Another interesting stone found in this section, on the borders of Tulare and Fresno counties, named *californite*, is a compact green variety of vesuvianite, that perfectly resembles the celebrated ornamental stone known as jade, so much prized in the Orient for elegant art work. Chrysoprase has been found and mined in the following locations: Venice Hill, Stokes Mountain, Tule River, Deer Creek, and one mile east of Lindsay.

In the past a very active interest was taken in mining chrysoprase, but of late years there has been less demand than formerly because the stone is not now the fad in jewelry that it was at one time. Chrysoprase was first discovered in Tulare County in 1878 by Mr. Geo. W. Smith, of Visalia. Deposits of feldspar occur at Three Rivers. Rose quartz of fine quality and suitable for making ornaments, is found in Yokohl Valley. The **Summer Rose Quartz Claim** of W. D. and George W. Parson is about 8 miles southeast of California Hot Springs, near the Kern County line. Beautiful specimens of rose quartz can be

obtained from this prospect.[1] Rhodonite has been found near Lemon Cove.[2]

Deer Creek Chrysoprase Mine. Situated in Sec. 20, T. 22 S., R. 28 E., 5 miles southeast of Porterville. On a small hill south of Deer Creek are found some narrow veins of chrysoprase 2″ to 3″ thick occurring in a jaspery rock. Much of it was evidently flawed but a great deal of choice material has been taken out. The color varies from greenish to blue, some of it being a beautiful light green. Workings consist of three open cuts on the south slope of the hill; the main open cut is 150′ long by 30′ deep. The top of hill is covered with a massive outcrop of jasper, in which seams of chrysoprase occur. Idle. T. T. Sullivan, Tulare, owner.

Stokes Mountain Deposits. Small seams of chrysoprase occur in a red jasper rock on Stokes Mountain in Secs. 9 and 10, T. 16 S., R. 26 E., 3 miles southwest of Auckland.

Venice Hill Deposits. Situated 10 miles northeast of Visalia in Secs. 4, 5, and 8, T. 18 S., R. 26 E., outcroppings of chrysoprase extend along the southeastern slope of Venice Hill and through Secs. 8, 4, and 5. Here it occurs in small irregular veins, which range from mere seams to veins of two and three inches in thickness in a somewhat altered red jasper.

FELDSPAR.

Carter Deposit. There is a deposit of feldspar ½ mile east of Three Rivers, on the ridge east of the Kaweah River, about 12 miles from the railroad. White crystals of orthoclase occur in a pegmatitic granite in seams and kidneys 6″ to 18″ in width. In the past quite a tonnage was shipped from the property. Idle. F. M. Carter, of Three Rivers, owner.

On the **Britton Ranch** at Three Rivers in Secs. 23, 24, 25, T. 17 S., R. 29 E., there are a number of massive croppings of feldspar of good quality. No development has been done on the property owing to the distance from railroad transportation. Mrs. Eureka Williams and Mrs. Nellie Britton, owners, care Noel Britton, Three Rivers.

Goodale Deposit. C. E. Goodale of Lemon Cove, has been shipping feldspar from his deposit near that place, for several years past.

The **Honora Realty Company,** Adolph Levis, president, Visalia, has a deposit of feldspar on NE¼ of NE¼, and SW¼ of SW¼, of Sec. 15, T. 18 S., R. 27 E., M. D. M., 1½ miles from Lemon Cove, which is their shipping point. The product is sold mainly to porcelain manufacturers.

There are some deposits of **feldspar** in the Yokohl Valley, from which shipments have been made occasionally, by leasers and owners,

[1]See Mineral Resources of United States, U. S. Geol. Survey, 1911, p. 1062.
[2]See Mineral Resources of United States, 1911, p. 1063.

among whom may be mentioned: Alvah Joyner, Exeter; C. F. Dougherty, Strathmore; Geo. Gassenberger, Yokohl via Exeter; Fritz Mehrten, Exeter.

GOLD.

The only productive area where gold mining has been carried on to any extent is in the White River mining district, situated 15 miles southeast of Porterville. Some promising prospects are also being developed on Cow Mountain in Sec. 31, T. 21 S., R. 30 E. In the Globe district, 12 miles east of Porterville, on the Middle Tule River, some prospecting has been done on narrow veins of quartz carrying gold values.

White River mining district.

Geology. The country rock is principally granitic with one or more streaks of crystalline limestone. These streaks have a northeasterly and southwesterly trend. Accompanying the limestone are copper bearing rocks. The auriferous veins traversing the granite are fissure veins and the prevailing dip is northwesterly. In the western portion of the district the veins extend into a formation of micaceous slate with the same general strike and dip as in the granite. The first discovery of gold at White River was made by D. W. C. Biggs and A. J. Maltley in 1853. First location was made as Keys claim. It is reported $150,000 was taken out of property to a depth of 300 feet. The output of the camp is reported to have been in the neighborhood of $750,000. Mining operations in the camp were more or less active until 1906, since which date only a small amount of work has been done. During the past year there has been a renewal of mining activity in this camp, and the prospects appear bright for the reopening of the Bald Mountain, Eclipse, Josephine and Last Chance mines.

Bald Mountain Mine (Quartz). It is 1½ miles southeast of White River, at 2,000′ altitude. Holdings consist of the following claims: Bald Mountain, Richelieu, Ninety-nine, English, Keys, Bald Mountain Extension, Keys Mill site, Gold Nugget Placer mine, controlling 220 acres, with 6780 feet on the lode. The Bald Mountain vein is a true fissure cutting the granite. Strikes E.–W. and dips 80° N. Width varies from 14″ to 4′, with 4″ to 12″ of pay ore. With the same general course there is a series of narrow parallel veins to the main Bald Mountain vein. There are two shafts on the property: Bald Mountain shaft, 262 feet deep, and Keys shaft has been sunk to a depth of 200 feet. The principal workings are from the former shaft. Three levels were driven from this shaft on the vein at depths of 157′, 190′ and 257′. On the 157′ level a drift has been driven 200′ east of shaft, on the 190′ level there is a drift 200′ east; on the 257′ level, drift 220′ east. South of shaft a crosscut tunnel has been driven north 400′ to vein, which it cut 100′ east of shaft, and the vein was drifted on 1,700′ to the west.

This tunnel intersected the shaft at a depth of 120′. From the tunnel level the ore has been stoped at intervals to surface. The ore is free milling with 2% pyrite, and is reported to have values from $12 to $40 per ton. Equipment: 2 compartment vertical shaft (4′ x 4′) (4′ x 4′), 30 h. p. boiler, 25 h. p. single drum hoist. Idle. W. Tate Young, Corinth, Mississippi, owner.

Bibl.: Report XII, p. 295; XIII, p. 469.

Barton Mine (Quartz). It is on Rattlesnake Creek, 2½ miles west of Auckland, at an elevation of 1600 feet. The vein is 3 feet wide, and consists of a mineralized zone with free gold in a decomposed granite. It strikes N.–S., and dips 75° E. The development consists of two tunnels. No. 1 is 350 feet long and a winze has been sunk on the vein from this tunnel to a depth of 100 feet; No. 2 tunnel has been driven on the vein for a distance of 220 feet. Idle. H. B. Barton, of Auckland, owner.

Bibl.: Report XII, p. 295; XIII, p. 469.

Cherokee Mine (Quartz). It is 2 miles southeast of Mineral King, on ridge east of the East Fork of Kaweah River, at an elevation of 10,600 feet. Vein strikes NW.–SE., dips 60° NE., width 12 inches. The vein carries arsenical pyrites, reported to carry high gold values. There is a shaft 20 feet deep, and a tunnel 25 feet long. Idle. Arthur Crowley, of Mineral King, owner.

Creeks Mine (Quartz). It is situated on the northeast slope of Cow Mountain, 13 miles east of Porterville, at an elevation of 2680 feet. A series of narrow parallel veins of quartz occur in granite, striking N. 45° W., and dipping 40° SW. The veins have been prospected by a number of short tunnels and shallow shafts. One man employed. Robert Creeks, of Porterville, owner.

Eclipse No. 2 Mine (Quartz). Situated 2½ miles southwest of White River, at an altitude of 1,750 feet. Holdings: Eclipse No. 2, Eurilda, Willie T., Gray Eagle, and Hillside Millsite, all patented claims; with a length along the lode of 5000 feet. There are two parallel veins: Eurilda and Eclipse, most of the development having been done on the latter. The vein strikes N. 70° E. and dips 60° NW. The Eclipse vein is 2 feet wide with 8″ to 12″ of quartz. The vein occurs in granite east of shaft and at the shaft it passes into a micaceous slate, which is the formation to west of shaft. The vein is strong and continuous in both the granite and slate.

At a depth of 620 feet the vein is faulted 27 feet to the south. The ore is free milling with 2% iron-sulphides. The mine has been developed by a series of tunnels and a shaft 700 feet deep, sunk on an angle of 60 degrees. East of shaft, a crosscut tunnel was driven 100′ to vein, then drifted on the vein 215′ west, intersecting incline shaft at

a depth of 200′. At a depth of 260′, a level was driven 90′ east, which shows 2′ of ore in face. On the 700′ level, a drift was run 80′ east and 50′ west, in the east drift there is 3′ of quartz. The ore has been stoped out from tunnel level to surface and is reported to have milled from $12 to $20 per ton. Equipment consists of a head-frame, blacksmith shop and tools. Idle. W. Tate Young, Corinth, Mississippi, owner.

Bibl.: Report XII, p. 296; XIII, p. 470.

Florence G. Mine (Quartz). It is located on the northeast slope of Cow Mountain, in Secs. 30, 31, T. 21 S., R. 30 E., 14 miles east of Porterville, at an elevation of 3300 feet. Holdings: Florence G., Florence G. Millsite, and Black Bear group. Series of parallel, true fissure veins occur in granite. The veins strike N. 45° E. and dip 35° E.; width 12″. The quartz is free milling with 2% iron sulphides. There are two tunnels on Florence G. claim; one is 140 feet long, the other 150 feet long. The ore is treated in an arrastra. Two men employed. E. J. Garvin, of Porterville, owner.

Homestake Mine (Quartz). It is 2 miles southwest of White River, at an altitude of 1200 feet. Property has been taken up as a homestead. J. McCann, of White River, owner.

Bibl.: Rep. XII, p. 297; XIII, p. 570.

Josephine Mine (Quartz). Situated 3 miles northwest of White River, in Secs. 31, 32, T. 24 S., R. 29 E., at an elevation of 1580 feet. Holdings consist of 200 acres of patented mineral land. Claims: Josephine, Last Chance, Royal, Gold Dollar, Margaret, Josephine Extension, Jackson, Woody, New York and Kentucky; with 4500 feet on the lode. The Josephine and a series of parallel veins strike N. 70° E., dipping 55° NW., occur in a micaceous slate. The only extensive development has been on the Josephine vein. On this vein an incline shaft has been sunk to a depth of 300 feet, on an angle of 55°. Three levels have been driven on the vein at depths of 100′, 200′ and 300′. On 100′ level drift E. 200 feet, W. 200′. On 200′ level drift E. 100′ and W. 100′. On 300′ level drift E. 40 feet and W. 36′. The vein shows an average width of 4′ of quartz. It is free milling with 2% iron sulphides and some galena. Ore reported to have assay value of $13.00 per ton. Only small amount stoped. Equipment: 16 h.p. Union gas engine, single drum hoist, 20 foot head-frame. There is a pumping plant on the Woody claim 4500 feet southwest of mine. Water was pumped from three wells 18 feet deep by 12 h. p. Fairbanks-Morse triplex pump, and Rumsey 4 x 4″ triplex pump through 1½″ pipe line to mine under a lift of 320 feet. Idle. W. Tate Young, Corinth, Miss., owner.

Last Chance (Redfield) Mine (Quartz). Situated two miles west of White River, on the east bank of White River, at an elevation of 1000

feet. The vein is a true fissure in granite. Strikes E.–W., dipping 80° N.; width is 4 feet. The ore is free milling with 2% iron sulphides. The developments consist of a vertical shaft 265′ deep; with levels at 100′, 200′ and 265′. Equipment: 2-compartment shaft (4′ x 4′) (4′ x 4′) 20 foot head-frame, 30 h. p. boiler and 15 h. p. steam hoist. Idle. Redfield Mining Company, 1001 Mills Bldg., San Francisco, owner.

Bibl.: Rep. XII, p. 297; Rep. XIII, p. 470.

Minnie Ellen Mine (Quartz). Situated 8 miles southeast of Porterville. In Sec. 9, T. 23 S., R. 28 E. Vein strikes NW.–SE. in granite. Dip vertical. Width 5 feet. Shaft 123 feet deep. Idle. Truman Hart and John Hoxey, Fresno, owners.

Sandstone Mine (Quartz). It is situated on Blue Mountain, four miles southeast of White River. The ore occurs along a sheer zone in a quartz-granite, which strikes N. 75° E., dipping 75° NW. Width of mineralized zone being 4 feet. Three shafts from 25′ to 50′ in depth have been sunk on the vein. Two men employed. Henry Moore, of White River, owner.

Stencil Mine (Quartz). It is 1½ miles west of White River, at elevation 1150 feet. The vein strikes E.–W., dipping 80° N. Width 8 inches. The formation is granite. A tunnel driven 300 feet east on the vein. There are also a number of shallow shafts and open cuts along the outcrop. The ore was milled in an arrastra. Idle. John Flor, of Glenville, Kern County, owner.

Bibl.: Rep. XII, p. 298; Rep. XIII, p. 471.

Sunset Mine (Quartz). Situated 3 miles southwest of White River. A vein 12″ in width occurs in the slate, strikes N. 70° E. and dips 55° NW. Developments consist of a number of tunnels and shafts, the most extensive being a tunnel 175 feet long. Idle. Mike Mitchell, of Ducor, owner.

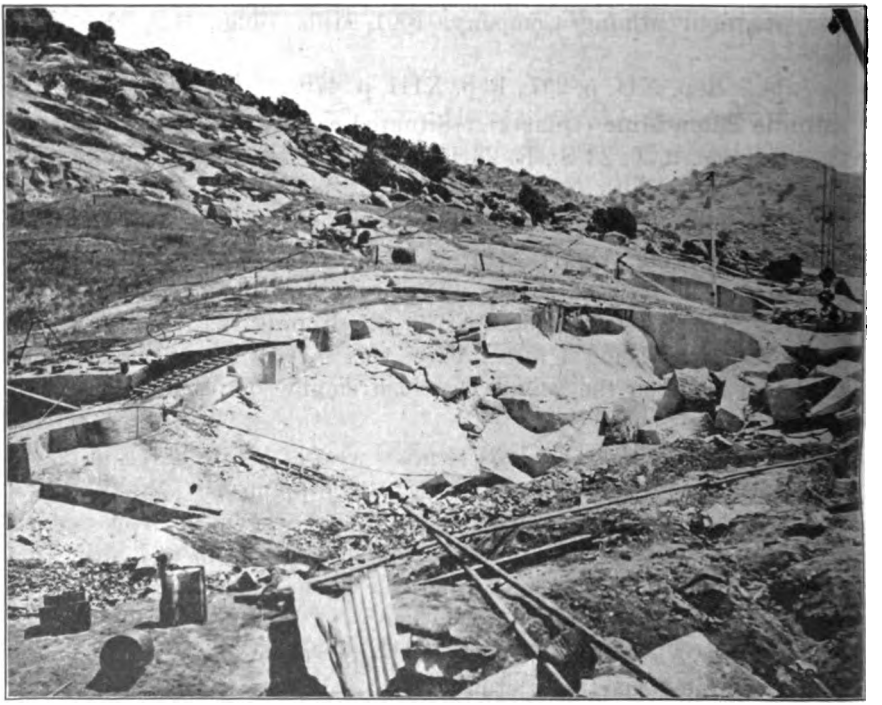
Bibl.: Rep. XII, p. 298; XIII, p. 471.

GRANITE.

In the foothills east of Porterville and Exeter there are extensive deposits of biotite-granite, which are suitable for building purposes. Up to the present time only a small amount of development has been done on these deposits.

California Granite Quarry. California Granite Company, 518 Sharon Bldg., San Francisco, owner; president, A. Pernu; secretary, A. Bocci; general manager, H. Beck. The quarry is situated 4 miles east of Porterville, in Sec. 27, T. 21 S., R. 28 E. Holdings consist of 100 acres. The biotite-granite is of medium coarse grain. Has a fairly straight cleavage and takes a good polish. The rock mass is

intersected by a great number of joint planes, hence does not occur in large dimensions, but blocks large enough for ordinary building purposes are obtained. The supply of granite is practically unlimited. Two quarry faces have been opened up on the southwest slope of the



Number 1 Quarry of California Granite Company, situated 4 miles east of Porterville. Photo by Walter W. Bradley.

hill. The general strike of the granite formation is NE.–SW. It is about one mile in width with serpentine on both sides. The rock weighs 180 lbs. to the cubic foot. The company also has a lease on 10 acres from C. A. Witt, on the Success and Porterville road where a small quarry has been opened on a diorite, locally called "black granite." Plant: 25 h.p. steam hoist, two derricks (10″ x 10″), Ingersoll-Rand compressor, also surfacing and polishing machines and air drills. Twenty-five men are employed.

Rocky Point Granite Quarry. Situated four miles east of Exeter. in Sec. 8, T. 19 S., R. 27 E., D. R. Griffith and R. H. Owen, of Exeter, owners. The granite is a gray, fine-grained rock of very uniform texture and color, which splits readily in any direction and takes a fine polish. It occurs in large detached masses and flattened beds, the pitch of the latter is a little east of north, at an angle of 30°. The beds or layers vary from 2′ to 25′ in thickness and are so situated that a

face of any required height may be obtained to quarry. The rift appears to be east and west. Any desired size of building stone can be obtained. Idle.

Bibl.: Bull. 38, pp. 55, 56.

Number 2 Quarry of California Granite Company.

GRAPHITE.

Deposits of graphite are found in Drum Valley, 6 miles north of Auckland, in Secs. 4 and 5, T. 15 S., R. 26 E., on the land of William Kincaid, of Dunlap, and another deposit on the Reeves ranch, 3½ miles west of Dunlap.

Bibl.: Rept. XIII, p. 642; Bulletin 38, p. 280.

GYPSUM.

California Gypsum and Mineral Co., J. M. Anderson, Tulare, owner. In Sec. 21, T. 30 S., R. 22 E.

Bibl.: Bulletin No. 38, p. 288.

IRON.

Franklin Cañon Iron Mine. Situated in Franklin Cañon, two miles SE. of Mineral King, at elevation of 10,000 feet. A deposit of pyrrhotite occurs on limestone and granite contact. The mineralized zone is 4 feet in width. T. J. Crabtree, of Porterville, owner.

Lady Emma Mine. It is located in Monark Cañon, two miles SE. of Mineral King, at an elevation of 10,100 feet. A shaft has been sunk on a limestone and granite contact, developing 4 feet of ore. The contact strikes N. 30° W., and dips 80° NE. Along the contact the limestone

is heavily mineralized and the adjoining country rock stained with iron for some distance. W. O. Clough, of Mineral King, owner.

LIMESTONE.

There are extensive deposits of limestone in the foothills and mountainous regions in the eastern part of the county. On the North and South forks of the Tule River there are large belts of limestone which have general northwesterly and southeasterly strike. Extensive deposits of limestone occur in the neighborhood of Three Rivers, and on the Middle, Marble and South forks of the Kaweah River in the Sequoia National Park.

In the Mineral King district at the White Chief mine there is an extensive deposit of crystalline limestone.

Britton Limestone Deposit. At Three Rivers, on the Britton ranch, in Sec. 23, T. 17 S., R. 28 E., a belt of limestone about ½ mile wide strikes across the ranch in a northwesterly and southeasterly direction. The rock is a blue crystalline limestone of good quality. Mrs. Eureka Williams and Mrs. Nellie A. Britton, of Three Rivers, owners.

Gill Ranch Limestone Deposit. In Sec. 13, T. 21 S., R. 28 E., on the Gill ranch, 10 miles northeast of Porterville. On hill north of Tule River there is a massive outcrop of coarse crystalline limestone.

In Sec. 12, T. 22 S., R. 28 E., 8 miles southeast of Porterville, there is a lens of limestone in a granitic rock, which strikes northerly and southerly, dipping at an angle of 60° E. It is a white, coarse crystalline limestone which disintegrates very easily. The lens of limestone is 300′ to 500′ wide and about 1500′ in length. Fred and William Gill, owners, Exeter.

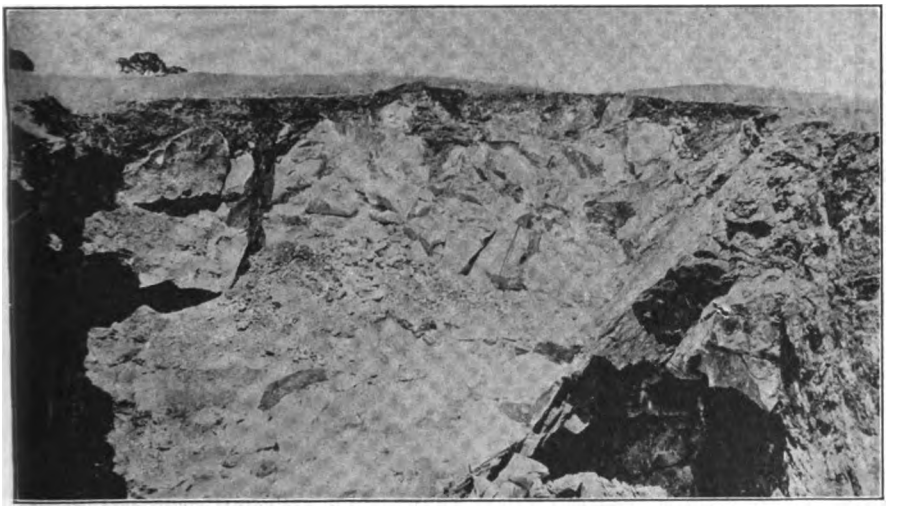
Holdridge Limestone Deposit. It is situated 10 miles northeast of Porterville, on Holdridge ranch, in Sec. 13, T. 21 S., R. 28 E. On hill north of house there is a massive outcrop of coarse crystalline limestone. The belt of limestone is about ½ mile wide, and can be traced for a distance of one mile. It has a north and south course. J. R. Holdridge, of Porterville, owner.

Lemon Cove Lime Quarry. The quarry is situated 1½ miles north of Lemon Cove, in Sec. 35, T. 17 S., R. 27 E. The limestone is a coarsely crystalline calcite and occurs in irregular pockets. The limestone extends for about 40 feet across the face with side walls of clay-shale which dip 65° N. A dike of schistose slate material 4 feet wide extends diagonally across the present face of the quarry. The quarry has a face 50′ high by 40′ wide.

The broken rock is trammed 100 yards to loading bins. Product is shipped to the sugar refinery at Visalia. Equipment: one (6″ x 6″) Gardner air compressor driven by 12 h. p. gas engine. Four men are

employed. Carle Roque, of Lemon Cove, owner. Under lease to San Joaquin Valley Sugar Company, Visalia.

Bibl.: Bulletin 38, p. 94.



Lemon Cove Lime Quarry. Near Lemon Cove, Tulare Co. Showing 40 feet of limestone with clay-shale walls.

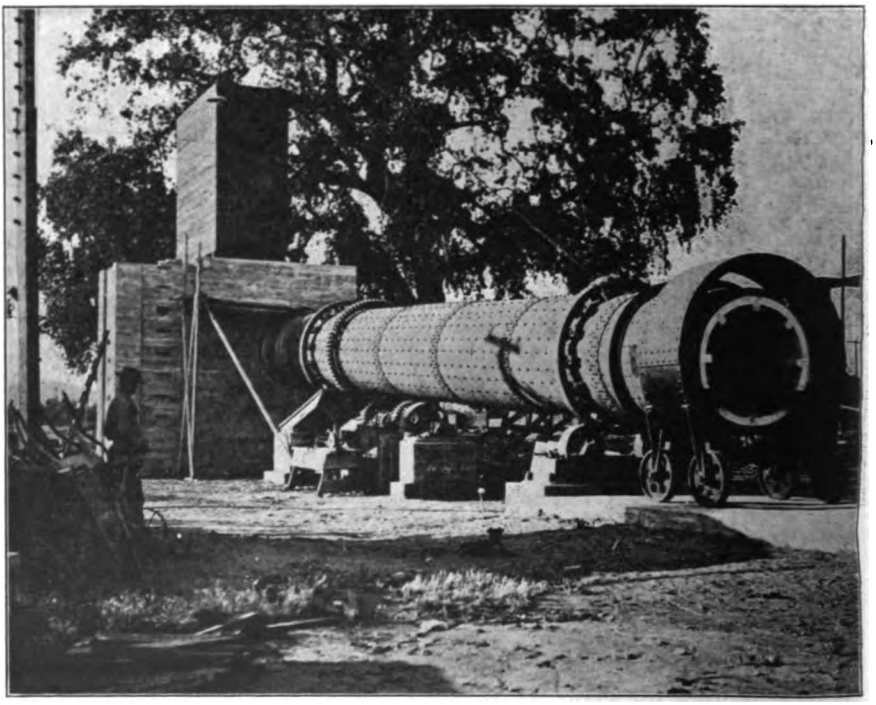
Morehouse Limestone Deposit. It is 14 miles east of Springville, on ridge northeast of South Fork of Middle Fork of Tule River, in Secs. 29, 30, 31, 32, T. 20 S., R. 31 E. Holdings consist of 780 acres. A belt of blue crystalline limestone about ½ mile wide by 7 miles long strikes NW.–SE. The croppings on the north side of the river are very prominent. Along the banks of the river are a number of soda springs from which thick deposits of calcareous tufa were noticed. Some of these deposits are quite extensive and have been developed by shafts and tunnels, showing in places a mass of material deposited by spring action over 100 feet thick. The limestone belt cuts through a formation of mica schist and granite. Riverside Portland Cement Co., 726 Mills Bldg., San Francisco, owners.

James Marble Deposit. It is in Sec. 6, T. 22 S., R. 29 E., 8 miles southeast of Porterville, on road to South Tule Indian Reservation. A dark gray marble is found on James ranch, which is suitable for building purposes.

MAGNESITE.

The entire domestic production of magnesite is from California and during 1915 the production was nearly double that of the highest previous year (*i. e.* 1910). The output of magnesite in Tulare County was in excess of any other county in the state, this county producing 11,574 tons, an increase of 1924 over 1914 production.

Due to the European war, in that ocean traffic with most foreign ports of supply is largely cut off, attention has naturally been directed to the California deposits. So far as quality and quantity alone are

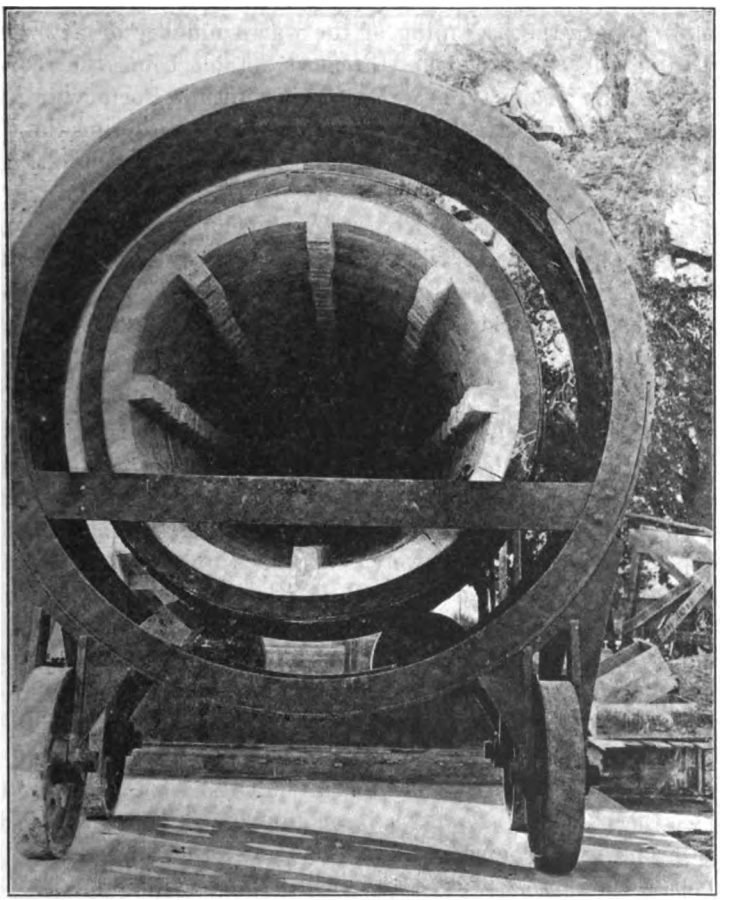


Rotary magnesite calcining kiln of the California Magnesite Co., at Porterville. Photo by Walter W. Bradley.

concerned, the California deposits, of which Tulare County is the largest producer, might readily supply the demand in this country for the purer grades of magnesite and such as are used for making cement, paints, fireproof and damp proof coatings and in the manufacture of paper and other products, but the California deposits are so far from the principal markets of the country that the overland freight rates prohibit their shipment under ordinary conditions. There has been much speculative inquiry as to California magnesite mines, the result being that a number of new deposits have been opened up in the field around Porterville, Success and Lindsay.

The California Magnesite Company early in 1916 operated several leases in the Porterville district, and commenced the erection of a large calcining plant. Their work was later interrupted by litigation. This plant has been recently purchased by the International Magnesite Company, of San Diego, who plan to complete the construction of the plant and operate on a large scale. The price of crude magnesite

during 1915 ranged from $7 to $12 per ton, f. o. b. San Francisco, or other California points. The value for the calcined product was from $25 to $30 per ton. The freight rates on magnesite ores from Porterville



Showing lining of rotary kiln for calcining magnesite, adopted by the California Magnesite Co., Porterville. Photo by Walter W. Bradley.

to Atlantic ports was $11 per ton. The rate on ores from Porterville to San Francisco is $4 per ton. The freight on magnesite ores from San Francisco to points on Atlantic seaboard through the Panama Canal is $7 per ton. In addition to the cost at the mine, the local freight rates from the mines to San Francisco have to be considered. The average cost of extracting magnesite from the different properties in the neighborhood of Porterville and placing the product on the cars on the railroad is about $6 to $7 per ton.

The Tulare Mining Company has been for some years the only large producer on the Pacific Coast. Almost the entire output of their mines

near Porterville was used by the Crown Willamette Paper Co., but during the past year a large tonnage has been shipped to the Eastern Refractories Companies. Aside from the output of the mines of this company, the production of magnesite for the last few years has been very small. Since the beginning of the war a number of new and old properties have been opened up, the most notable being the reopening of the old Harker property, near Porterville, by the Porterville Magnesite Company of San Francisco. A new property adjoining the Tulare Mining Company in the Success district has been developed by the Lindsay Mining Company of Porterville. On the Stewart Ranch north of Porterville large deposits have been developed by the Magnesite Mining Company of Porterville. East of Lindsay a number of new properties are being developed by leasers, while in the neighborhood of Deer Creek, south of Porterville, Messrs. Langley and Cook, of Los Angeles, have opened up some valuable deposits.

History.

The magnesite deposits 4 miles northeast of Porterville were discovered and first described by W. P. Blake, who passed through this region with the United States expeditions making explorations and surveys for a railroad in 1853. Mining operations were started on the Harker property in 1901 and were continuous until 1909. From 1902 these deposits were operated by W. P. Bartlett for the Willamette Pulp and Paper Co. In 1909 operations were suspended, until 1915, when the property was reopened by the Porterville Magnesite Company; now being one of the largest producers in the district.

An undeveloped deposit on South Fork of Tule River, 9 or 10 miles east of Porterville was opened up in 1907 by the Tulare Mining Company, of which W. P. Bartlett is superintendent. An extensive amount of ore has been developed and a large tonnage is being calcined and shipped from the property. A number of other mines are being developed in the districts north and east of Porterville.

Geology.

Large magnesite deposits occur on the first range of foothills of the Sierra Nevada Mountains, east and northeast of Porterville. The deposits have a general northwesterly and southeasterly strike, the southern limits being in Sec. 10, T. 23 S., R. 28 E., 5 miles east of Terra Bella, while some small deposits occur as far north as the St. John's River (see map, p. 165, shaded portions represent magnesite deposits, and darker portions represent holdings of the large operating companies).

The most extensive deposits are east of Porterville, Lindsay and Exeter. The magnesite occurs in a schistose serpentine mass which is impregnated with magnesite veins and contains some basalt and diabase intrusions. The country rock is a dull, brown serpentinized peridotite.

The rock is sheeted in places and contains great numbers of vertical, thin, parallel veins of magnesite. Crossing the vertical veins at a small angle is a second series of veins, and a third series crosses at right angles. According to Frank L. Hess,[2] of the U. S. Geological Survey, the veins are probably due to shearing, which produced cracks. These cracks then formed channels for surface waters and were filled with magnesite derived from the decomposition of the inclosing rock and brought by waters from a distance and precipitated. The veins are generally discontinuous and irregular and of narrow widths. Magnesite deposits in the neighborhood of Porterville and Success have been fully described by Frank L. Hess[3] and Hoyt S. Gale,[4] and we have made free use of the data contained in those publications.

Mines.

Adelaide Magnesite Mine. It is situated 6½ miles east of Lindsay, in Sec. 24, T. 20 S., R. 27 E., on the west slope of a hill. A tunnel 150 feet long has been driven on a vein of magnesite 2 feet wide. The vein strikes E.-W. and dips 40° N. Twenty men are employed. R. D. Cole of Lindsay, owner.

Alcorn and Prindle Lease. The property is situated 8 miles east of Porterville, in Sec. 31, T. 21 S., R. 29 E. A series of narrow, parallel veins have been developed by a number of open cuts. Holdings 160 acres. Recently purchased by the Rex Plaster Company of Los Angeles. Seeley Mudd, president. Philip Wiseman, secretary.

Avery Magnesite Mine. It is located 8 miles east of Porterville, in Sec. 6, T. 22 S., R. 29 E., on ridge SW. of South Fork of Tule River. A series of parallel veins with vertical dips and a number of flat veins have been developed on this property.

Developments: Tunnel No. 1 driven 75 feet on vein, striking N. 60° W., dipping 35° NE. Width 18″ to 2′. Above tunnel No. 1 there is a tunnel 100 feet long, on east and west vein, dipping south 25°, and having a width of 12″ to 2′. Also driving a crosscut tunnel to intersect veins developed on a higher level. Four men are employed. Under lease to G. D. Avery and W. W. Gallagher, of Porterville.

Bartlett Magnesite Lease. On or near the top of a serpentine hill about 1 mile south of schoolhouse at Simmons' Ranch, about 8 miles southeast of Porterville. There are a great number of comparatively thin veins of magnesite. The hill is a portion of the outside range of foothills of serpentinized rock. The country rock is a dull, brown serpentinized peridotite similar to that near Porterville. Some, but not many, of the magnesite veins reach 2 feet in thickness for short distances; generally they are discontinuous and irregular. A small

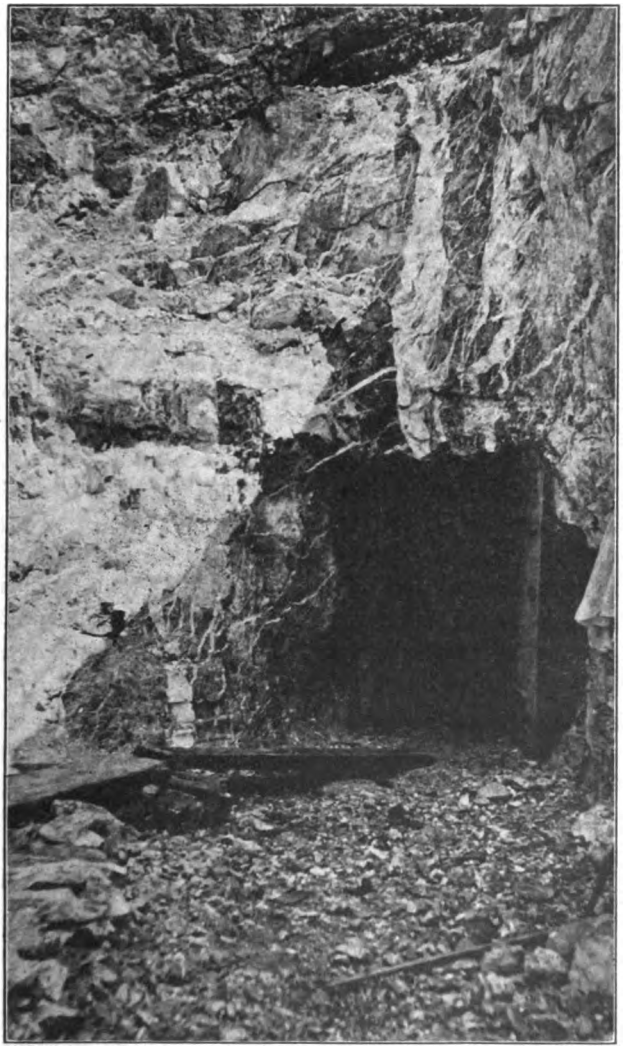
[2] U. S. G. S., Bull. 355, pp. 39-49, 1908.
[3] U. S. G. S., Bull. 540, pp. 509-511, 1914.

amount of magnesite of excellent quality has been mined on the west side of the hill from a nearly vertical vein running parallel to the course of the hill and ranging from 10″ to 18″ in thickness. On the east side, near the top of hill, other small deposits of magnesite occur. The veins are being developed by shallow open cuts and short tunnels. Twelve men employed. Owned by G. W. Simmons, of Deer Creek. Under lease to W. P. Bartlett, of Porterville.

Open cut. Blue Crystal Mine, near Lindsay.

Blue Crystal Magnesite Mine. Situated 6½ miles east of Lindsay, in Sec. 24, T. 20 S., R. 27 E. Four claims have been located on the western slope of a hill, on the east side of the mouth of Round Valley. A number of magnesite veins ranging up to 2 feet in thickness crop out on the southwestern face of the hill. The country rock is serpentine, similar in appearance to that of Porterville. The three parallel veins strike NW.–SE. and have steep dips. They are about fifty feet apart. The veins are strong and continuous, with widths ranging from 2′ to 3′. The quality of the magnesite is very good. The ore is extracted by means of open cuts and shallow tunnels, there being an open cut and

tunnel on the three main veins. Twenty men are employed. Philip Weisman, H. A. Sundin, of Lindsay, owners.



Burr Bros. Magnesite Mine, near Lindsay. Showing an exposure of vertical magnesite veins.

Bolam and Pinger Lease. Situated on Putnam and Gill ranches to the north of the Harker property, in Sec. 18, T. 21 S., R. 28 E., 4 miles northeast of Porterville. A series of parallel magnesite veins having a course of N. 50° W. and dipping 50° SE., with widths varying from 12″ to 2′, occur in a schistose serpentine mass. These veins have been developed by tunnels and open cuts. Ten men employed. Under lease to Robert S. Bolam and Leo Pinger, of Porterville.

Burr Bros. Magnesite Mine. Located 3 miles north of Lindsay, on Mrs. Florence Cross' ranch, in Sec. 19, T. 19 S., R. 27 E. On a low hill at the edge of the valley occur a large number of magnesite veins which are more or less parallel, with a general NE.–SW. strike, in a brown serpentinized peridotite. The veins are narrow and irregular, with steep dips, but do not show any continuity. A number of tunnels have been driven on the veins from 50′ to 100′ in length; also ore is being extracted along the outcrops in a number of open cuts. There are 26 men employed.

California Magnesite Company Lease (Camp 4). Situated in range of foothills 5 miles east of Strathmore, at an elevation of 1180 feet, on Lee Gill ranch. A number of veins of magnesite occur in a schistose serpentine. One series of veins strikes N. 35° E., another system has a course of N.–S., while a third system courses N. 30° W. At an elevation of 1,180 feet on the south slope of ridge a number of open cuts and short tunnels have been driven on a N. 35° E. vein, which dips 60° E., width of vein being 12 inches.

To the north of these workings, at an elevation of 1280 feet, a tunnel has been driven north on a N.–S. vein which dips 75° E., showing a vein varying from 12″ to 2′ wide. This vein is stoped to surface, a distance of 40 feet, also drifted on 150 feet. A 12-inch vein running N. 30° W. and dipping NE. intersects the N.–S. vein in the tunnel. There are also a number of narrow magnesite veins on the eastern slope of the hill. Idle. Lee Gill, of Porterville, owner.

California Magnesite Company Lease (Camps 2 and 3). This property is situated on the Lee Gill ranch, 4½ miles northeast of Porterville, in Sec. 18, T. 21 S., R. 28 E. A number of magnesite veins occur in brown serpentinized peridotite, on west slope of range of foothills which lies west of Frazier Valley. There are two general systems of parallel veins; one strikes N. 45° W., the other N. 10° W. On the west slope of hills two crosscut tunnels have been driven east, cutting N. 10° W. vein which dips 50° W. The veins have a width of 12″ to 2′. Idle. Lee Gill, of Porterville, owner.

Chamberlain Magnesite Deposits. These deposits are on the Chamberlain ranch, 8 miles southeast of Porterville, in Secs. 3 and 10, T. 23 S., R. 28 E. On west slope of a hill which runs in NW.–SE direction, there are numerous outcrops of narrow and irregular veins, with varying width of from 6″ to 12″. During 1916 the property was under lease to California Magnesite Company. Idle. Selah Chamberlain, of San Francisco, owner.

Davis Magnesite Lease. The property is on the P. J. Montgomery ranch, 6½ miles east of Lindsay, in Sec. 24, T. 20 S., R. 27 E., and is due west of the Blue Crystal mine at a lower elevation. A series of

parallel veins having general NW.–SE. strike occur in a schistose serpentine. The veins have a width of 18″ to 2′ and are continuous, showing great permanence and continuity. At an elevation of 1000 feet a tunnel has been driven 100 feet southeast on a N. 25° W. vein which dips 75° W. and has an average width of 18″. On a parallel vein, at an elevation of 900 feet there is another tunnel 150 feet long, developing a vein having an average width of 2′. Besides these workings there are a number of open cuts on the property. Twenty men are employed. P. T. Davis, of Lindsay, lessee.

Deer Creek Magnesite Mine. It is situated 8 miles southeast of Porterville, on the Carroll ranch, in Sec. 21, T. 22 S., R. 28 E. On the north slope of a hill which lies south of Deer Creek, there are a great number of comparatively thin veins of magnesite, cutting a dull brown serpentinized peridotite. The rock is sheeted in places and contains great numbers of more or less perpendicular parallel veins of magnesite. These veins range in widths from 10 inches to 2 feet. They are generally discontinuous and irregular. The veins are being mined by a number of open cuts and tunnels on both the east and west slopes of the hill. Tunnel No. 1 on west slope of hill is 200 feet long, driven on a N. and S. vein having a width of 18″ to 2′. On the east slope of the hill there is an open cut and tunnel 200 feet long, on a N. and S. vein; the vein is vertical, width 18″ to 2′. In south end of tunnel vein splits into three narrow veins striking N. 10° E., N. 20° E. and N. and S. Near mouth of tunnel a shaft is being sunk on the vein. Under lease to J. W. Langley and H. E. Cook, of Los Angeles. Chas. Carroll, of Deer Creek, owner.

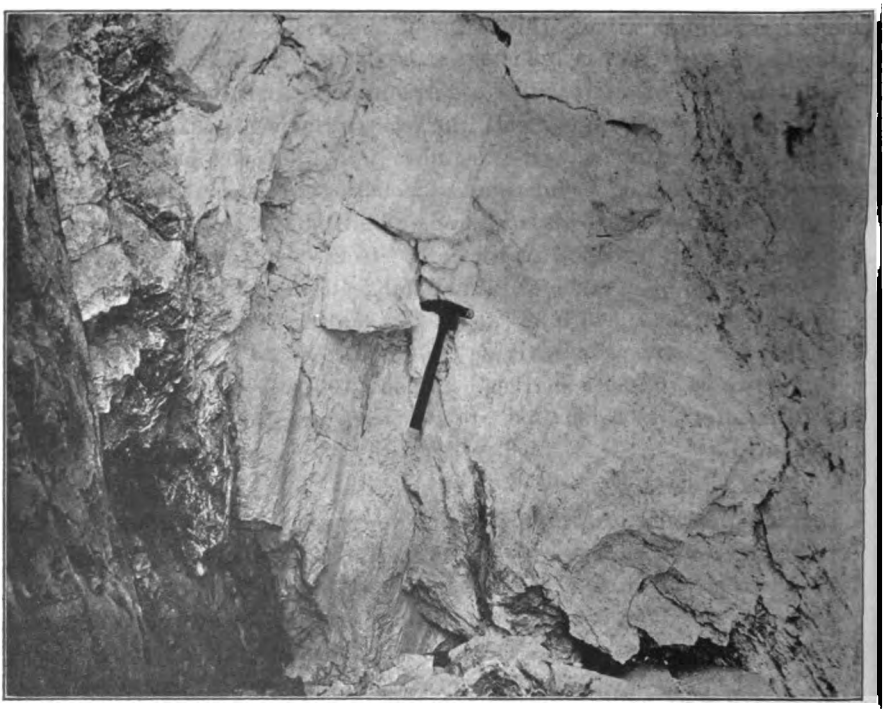
Bibl.: U. S. G. S., Bull. 355, pp. 39, 40.

Dumont Magnesite Mine. This property is situated on land owned by R. J. Dumont, in Sec. 10, T. 19 S., R. 29 E., about 5 miles east of Exeter. Near the top of a large hill in the foothills east of Exeter, a series of NE.–SW. veins of magnesite occur in a brown serpentinized peridotite. These veins are more or less parallel and have steep dips, with widths of 8″ to 12″. The magnesite is mined by means of open cuts and tunnels, there being 6 open cuts and tunnels on the west slope of hill. The ore is hauled with wagons to siding on Visalia Electric Railroad, five miles north of mine. Six men are employed. Under lease to Philip Weisman, of Lindsay.

Duncan Magnesite Mines. On ridge southeast of South Fork of Tule River, on the Duncan Ranch, in Secs. 25, 30, T. 21 S., R. 28 and 29 E., 6 miles east of Porterville, there are extensive outcrops of magnesite veins, on which some development was done by the California Magnesite Company. Idle. Claude Duncan and Mrs. Matilda Duncan, of Success, owners.

Fairview Magnesite Mines. It is situated in foothills, 5 miles east of Lindsay, in Sec. 30, T. 20 S., R. 28 E. Three mining claims have been taken up, namely: Fairview, Fairview No. 1 and Last Chance. On the west slope of hill at an elevation of 950 feet, a crosscut is being driven into hill to cut an east and west vein with a dip to the north. The vein varies in width from 12″ to 18″. On the east slope of hill a number of veins of magnesite outcrop, which are being developed by tunnels and open cuts. There are 4 men employed. R. R. Gilbert and W. F. Finley, of Strathmore, owners.

Hamilton Magnesite Mine. It is on a small hill running east and west in Yokohl Valley, on the J. C. Hamilton ranch, in Sec. 22, T. 18 S.,



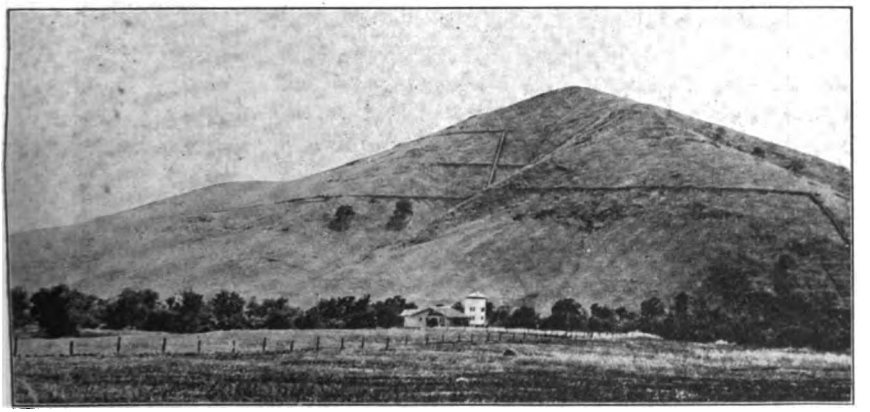
Magnesite vein 3 feet thick. No. 3 workings of Lindsay Mining Company near Success, Porterville district. Photo by Walter W. Bradley.

R. 27 E. A crosscut tunnel is being driven north on the south slope of hill, to cut series of N. 20° W. veins of magnesite that outcrop strongly on top of hill. The brown serpentinized peridotite is about 150 feet wide, with a general N. 20° W. strike and is intersected by a network of small veins 6″ to 12″ wide. There are 320 acres of patented agricultural land under lease to J. S. Johnson and Frank Carson, of Visalia.

Hawley Pulp and Paper Company's Mine. This company owns 40 acres of land in Sec. 36, T. 21 S., R. 28 E., on a hill east of the South

Fork of the Tule River, 6 miles east of Porterville. The property adjoins the Tulare Mining Company's property on the west. Five to six veins of magnesite have been developed which vary in width from 12″ to 8′. There are two systems of veins; one strikes N. 50° W., the other crossing E.–W., dipping at angles of 50° to 60° N.

Developments: No. 1 tunnel, or lower tunnel, is on the west slope of hill and is driven SE. on a 4-foot vein of magnesite which strikes N. 50° W. and dips 45° NE. The middle tunnel is 50 feet above No. 1

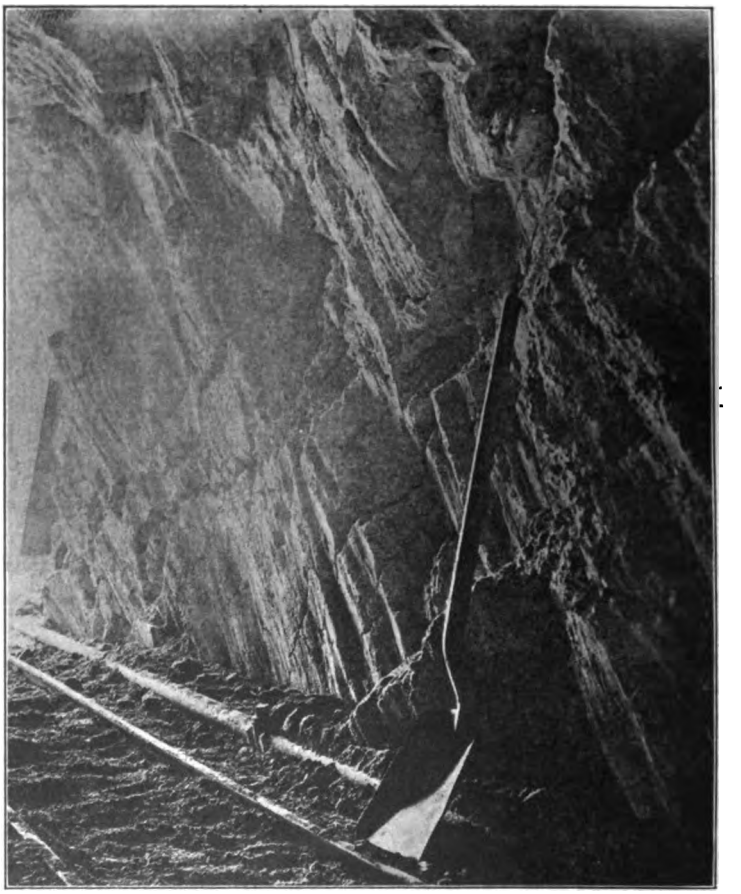


Magnesite mines of the Lindsay Mining Co., near Success, Tulare County, showing tramways and ore chutes.

tunnel and runs in a southwesterly direction on same vein, a distance of 50 feet. In the face the vein shows a width of 18 inches. The upper tunnel developed a parallel vein which has a width of 3 feet. Near the Tulare Mining Company's line a crosscut tunnel runs southwest into the hill, a distance of 225 feet, cutting the Tulare vein, which has a width of 20 feet, with an east and west strike, having an average dip of 60° N. A number of blanket veins were also cut in this tunnel. The ore is being shipped to the Pacific Carbonic Gas Company, of Berkeley, Cal. Ten men are employed. Hawley Pulp and Paper Company; president, W. P. Hawley; secretary, T. Osmond; home office, Oregon City, Ore.

Lindsay Magnesite Mine. It is situated just north of the Tulare Mining Company's mine, in Sec. 31, T. 21 S., R. 29 E., 8 miles east of Porterville. On a high hill on the southwest side of the South Fork of Tule River are a large number of magnesite veins with outcrops ranging in thickness from 12″ to 4′. The portions of the hill containing the magnesite are composed of a rock much more completely serpentinized than that nearer Porterville. On the southeast slope and the top of the hill, at an altitude of 1000 feet above the river, are a number of veins ranging up to 6′ in thickness. There are also hundreds of irregular

veins, which measure up to 12 inches or more in thickness and which in places form stockworks. The belt of serpentine carrying the magnesite has been crushed and sheeted in a northwesterly direction. There



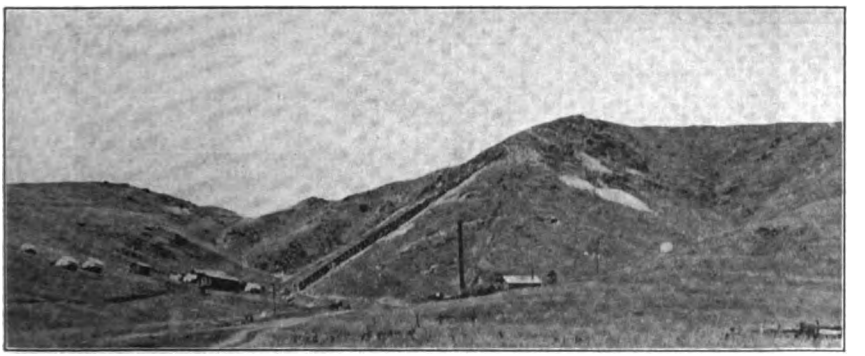
Slickensided magnesite, showing movement along the vein, in tunnel of the Lindsay Mining Co., near Success, Porterville district. Photo by Walter W. Bradley.

appear to be three main systems of veins which strike N. 35° W., N. 10° W., and N. 20° W., with vertical and steep dips. The vertical veins appear to be more regular and continuous.

At an elevation of 1,100 feet, a tunnel has been driven 300 feet on vein striking NW.–SE. with a vertical dip. This vein varies in width from 12″ to 2′. At an elevation of 1200 feet, No. 2 tunnel runs on a vein 12″ wide, a distance of 200′. In No. 3 tunnel, 1300 feet elevation, a N. 20° W. vein which has a slight dip to east, has been drifted on a distance of 200′. At a point 150′ from the mouth of tunnel there is a split in the vein striking N. 35° E. The vein so far developed has an

average width of 2′. No. 4 tunnel, elevation 1480 feet, is 100′ long, developing a 4′ vein which strikes N. 10° W. and dips 80° E. This vein lies 400′ west of No. 3 vein. Near the crest of the hill, at an elevation of 1500 feet, there is an open quarry on a stockwork of veins, the magnesite being blasted and hand picked at small expense.

By a system of tramways from the different workings the ore is trammed around the northeast slope of the hill, being dropped in chutes



Magnesite mines of the Porterville Magnesite Company, 4 miles north of Porterville, showing location of kiln and loading chute.

from one elevation to another until it finally reaches the loading bins on the railroad. (See photo.) Holdings consist of 170 acres. Twenty men are employed. Lindsay Mining Company, Porterville, owners. R. D. Adams, president and general manager; Arthur Delarey, secretary and superintendent.

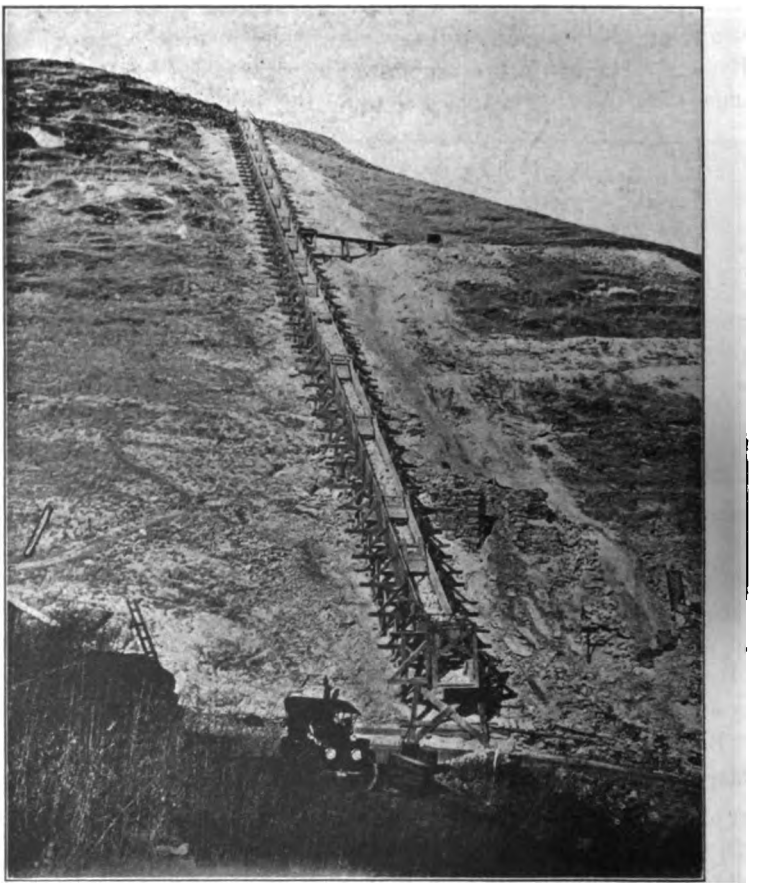
Bibl.: U. S. G. S. Bull. 540, pp. 510, 511.

Merryman Magnesite Mines. They are situated on the southwest spur of Rocky Hill, 2 miles east of Exeter, in Secs. 7, 12 and 31, T. 19 S., R. 26 and 27 E. On the hill there are a number of small veins of magnesite about 500 feet above the valley. These veins occur in the serpentine just west of the granite contact and have a general northerly and southerly strike. A tunnel has been driven on a vein striking N. 60° E., and dipping 40° SE. The vein varies in width from 12″ to 2′. About 200′ NW. of the tunnel there is an open cut on a stockwork of narrow veins. On the hill to the south a number of narrow veins are being worked by a series of open cuts and tunnels. Merryman Fruit and Land Company, Exeter, Cal., owners. Under lease to H. M. Hathaway, Porterville.

Bibl.: U. S. G. S. Bull. 355, p. 49.

Porterville Magnesite Mine (Harker Mine). It is situated in the outer range of foothills, about 4 miles northeast of Porterville, in Sec. 17, T. 21 S., R. 28 E. The magnesite veins stand out prominently on two rounded hills. One of the hills, which will be referred to as the northern

hill, runs a little east of north, and the other, which will be referred to as the eastern hill, about N. 60° E. At their junction is a saddle about 300 feet below the summits. The veins occur in a brown ser-

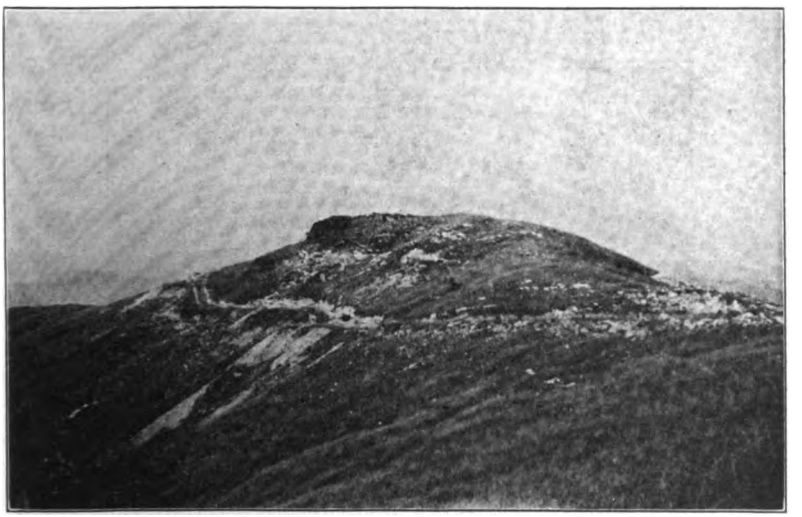


Loading chute of the Porterville Magnesite Company, showing system of bumpers. Photo by Walter W. Bradley.

pentinized peridotite having an apparent bedded structure. The serpentine forms part of a metamorphic complex consisting of a small amount of fine-grained quartzite, amphibolite schist, serpentine and other magnesian rocks, some of which are talcose and mica bearing. The rocks have a generally northerly strike, with a rather high (60°) easterly dip. They are cut off by a granitic mass on the south, a few hundred feet from the deposits. Several granitic dikes cut the serpentine and other rocks, but do not cut the magnesite veins, though basic dikes (amphibolites) of several varieties cut both country rock and the veins. The veins are here and there squeezed to a schist. Faulting is common but does not divide the serpentine into the small irregular

blocks which result in the serpentines of the Coast Range and many others, from the swelling of the rock as it changes its chemical and mineralogical form. However, movement is evident and the magnesite is invariably crushed in the larger veins.

To the east of the hill there is a tunnel 150 feet into the hill at an elevation of 1450 feet. In this tunnel a vein 8 feet wide of tufa-like magnesite was encountered. In this material there has been reformed



View showing outcrop of horizontal veins on Porterville Magnesite Company's property, near Porterville.

normal magnesite, which has been worked. These reformed veins follow no well-defined system. They occur at such points where the conditions were favorable. The tunnel is located near a granite intrusion on the eastern portion of the property, and therefore the veins probably lack continuity.

Magnesite veins on the western area of the property: On the south of the western hill, a main gash vein has been explored by a series of tunnels at different elevations, the main or lower tunnel being about 800 feet long. This vein ranges in thickness from 2′ to 8′, and strikes N. 45° W., dipping 65° to 70° NE. An amphibolite dike 2′ to 3′ thick has been intruded in the serpentine near the vein and follows it a short distance. About 100 feet from the southeast outcrop of the vein it is joined by another vein of about the same thickness, which has a strike of N. 10° W. These veins have been open-cut and stoped extensively. An interesting characteristic of the magnesite veins is noticed on this side of the hill, and that is that they are thicker underground than at the outcrop, and they widen out to an extent not to be anticipated by the thickness of the croppings; also that intersecting veins occur

underground whose presence is not at all indicated by any surface croppings. These interesting veins are usually smaller than the main veins, occur at smaller intervals and in some cases occur so frequently as to form a stockwork of veins.

The veins in this area are tilted at quite a steep angle—about 70°. Tunnels have been driven at an elevation of 1510′ and 1600′, with an

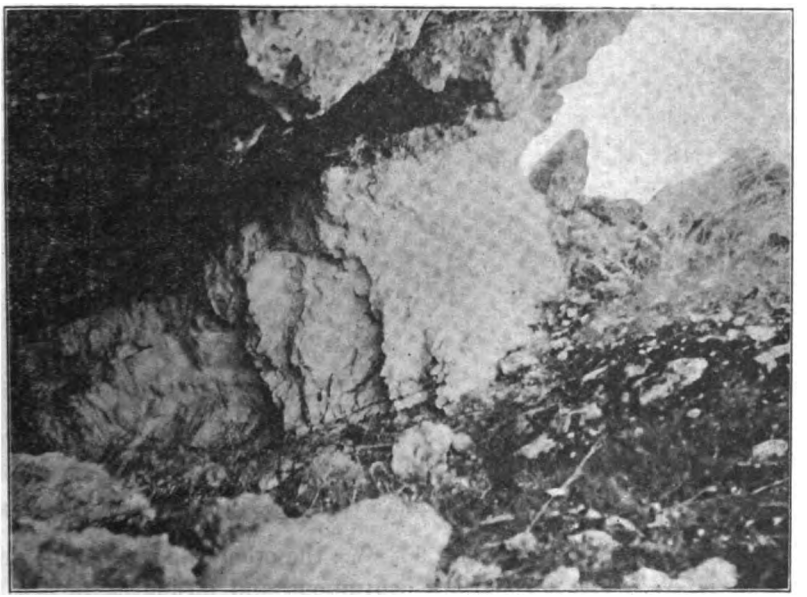
On the south of the Western Hill, of the Porterville Magnesite Company's property, showing main gash vein striking N. 45° W., dip 70° NE., width 2′ to 8′.

open-cut to left of tunnel. At the top of hill on the western slope there is a large area of croppings of magnesite veins, on which some development is being made.

To the north, on top of the hill, the principal veins take on a more or less horizontal bed and the exposures are quite easily traced on the surface. In this area above elevations of 1550 feet on the north end of the hill, three distinct veins dipping about 12° S. are found, while between elevations of 1550′ and 1500′ there is a very prominent vein parallel to the others. Intersecting veins more or less vertical are indicated over this entire area and are also intersected by present workings. The workings on the blanket veins consist of a series of tunnels and the magnesite is mined in similar manner to flat coal seams. The waste broken from stripping the vein is used to support the roof. A

main haulage way is used with different laterals run off at convenient intervals. These tunnels are driven through the hill on the horizontal veins.

To the north of this area on the north slope of hill and at a lower level there are innumerable outcrops of magnesite which are being developed by means of tunnels and open cuts. Some of these veins are from 2′ to 4′ thick. The blanket veins are from 1½′ to 3′ thick, and



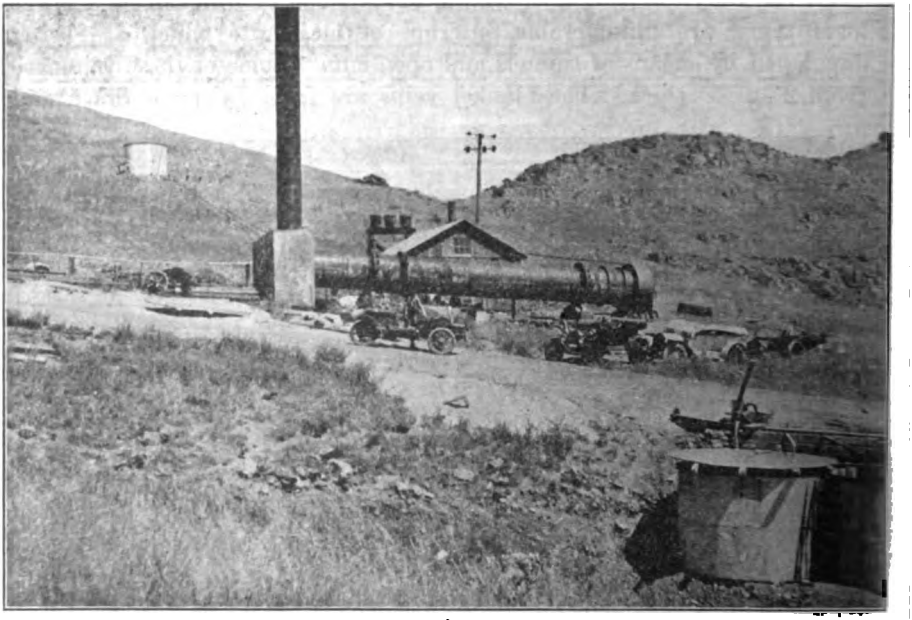
Magnesite vein dipping 12° S., 4′ wide, near top of hill on north end of the Porterville Magnesite Company's property, near Porterville.

the magnesite from them is of very fine quality. On the north slope of the hill, at an elevation of 1050 feet, a tunnel has been driven S. 40° E., 400′ on a vein from 2′ to 4′ wide. Vein dips 50° SW. This vein is being stoped from tunnel level to surface. The walls show a very strong movement with a drag to the southeast. Besides this vein there are a large number of strong croppings, which have a general northerly and southerly strike, with steep dips to the west. There is a rotary kiln 50′ long by 50″ in diameter on the property not yet in use. The ore is trammed from the different workings to an inclined loading chute, 433 ft. long leading to the loading bins, where the motor trucks take the product for haulage to Porterville.

There are 50 men employed. Porterville Magnesite Company, 391 Monadnock Bldg., San Francisco, Cal., owner; W. W. Kamm, president; P. S. Kamm, secretary; F. F. Parker, superintendent.

Bibl.: Bull 38, pp. 333–334. U. S. G. S. Bull. 355, pp. 40–46.

Stewart Magnesite Mine. Situated on low hill, 6 miles northeast of Porterville, in Sec. 12, T. 21 S., R. 28 E. On the east and west slopes of the hill there are two systems of veins, viz: one series of parallel



Rotary calcining kiln of the Porterville Magnesite Company, 4 miles north of Porterville.

veins striking N.–S. and dipping 60° W.; the other is a system of veins striking E.–W. The former are continuous and strong, with widths ranging from 2′ to 4′, while the latter are narrow and irregular.

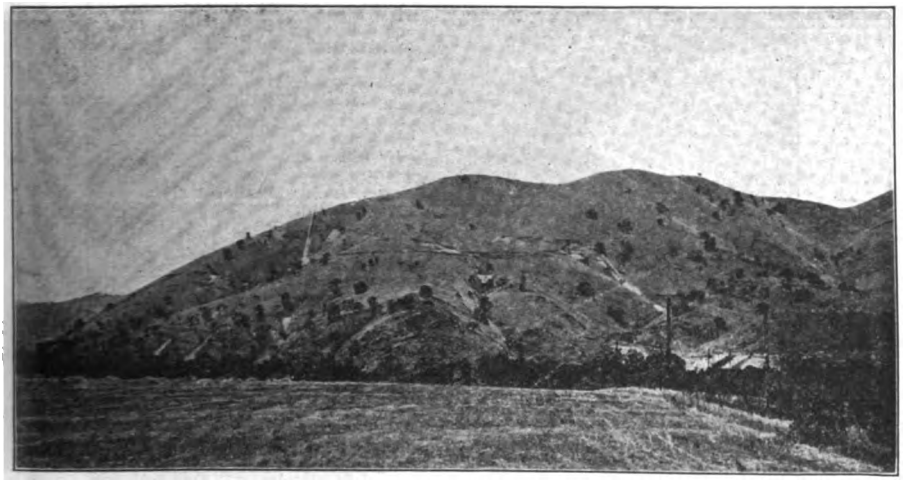
The north and south veins have been developed by a number of tunnels from 100′ to 200′ in length. A large tonnage is being shipped from the property. Forty men are employed. George W. Stewart, of Porterville, owner. Under lease to the Magnesite Company of Porterville; Robert Smith, president; H. A. Doyle, secretary and manager.

Headberg Magnesite Deposit. It is 4½ miles east of Lindsay, in Sec. 11, T. 20 S., R. 27 E., in foothills east of Round Valley. By means of an open quarry a stockwork of magnesite veins has been mined. Idle. John Headberg, of Lindsay, owner.

Tulare Mining Company. The magnesite veins of the Tulare Mining Company are situated on the north face of a high hill southwest of South Fork of Tule River, in Secs. 30 and 31, T. 21 S., R. 29 E., 10 miles east of Porterville. The portions of the hill containing the magnesite are composed of a rock very highly serpentinized. At the foot of the hill, along the edge of the narrow flood plain of the river, a magnesite vein running NW.–SE. and dipping 60° NE. has been extensively worked. The outcrop is from 3′ to 10′ thick and is exposed

prominently for a distance of about 500 feet. In places the vein contains horses of serpentine. The main tunnel has been driven 1400 feet along the footwall of this vein with crosscuts driven at regular intervals to the hanging wall. (See map.)

These workings have developed a mineralized vein from 10′ to 20′ in thickness, probably 40% of which is magnesite. A series of stopes have been run from the tunnel to surface. In stope A, about 400′ south of



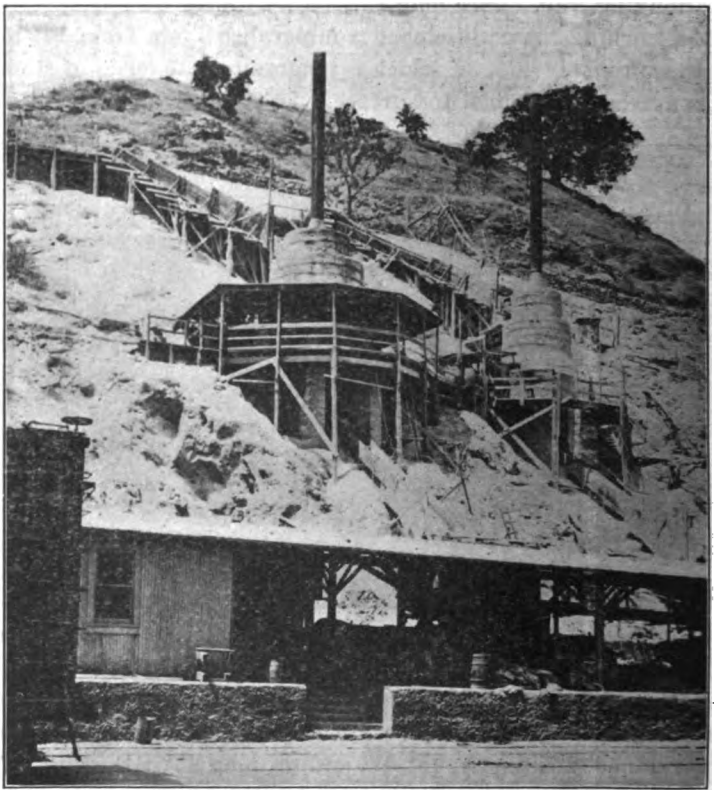
Magnesite mines of the Tulare Mining Company, near Success, Porterville district. Photo by Walter W. Bradley.

portal, 15′ of ore has been developed, showing stringers and veins of magnesite mixed with serpentine. About 200′ north a parallel vein has been developed, striking N. 45° W. and dipping 45° SE., with 12′ to 20′ of ore.

A crosscut tunnel 300 feet long has been driven near the western boundary line of the company's property, intersecting the main tunnel level. This crosscut tunnel cut a vein about 10′ wide, 110′ from the portal. The crosscuts have developed some large bodies of magnesite, and in places these bodies are mixed with the country rock or foreign matter that probably reduce the quality. The present developments have opened up a large reserve of ore. The method used in stoping this ore is by means of breaking down the magnesite from the roof of the far end of workings, allowing the waste to accumulate, so that the face of magnesite, which constantly retreats towards portal of stope, could be reached from the debris slope down which the magnesite was rolled and removed in cars from the foot of pile of debris.

South of the main tunnel a stockworks of magnesite veins is being mined in an open quarry, the magnesite being easily sorted out and trammed to kilns at small expense. On top of the hill, at an altitude of

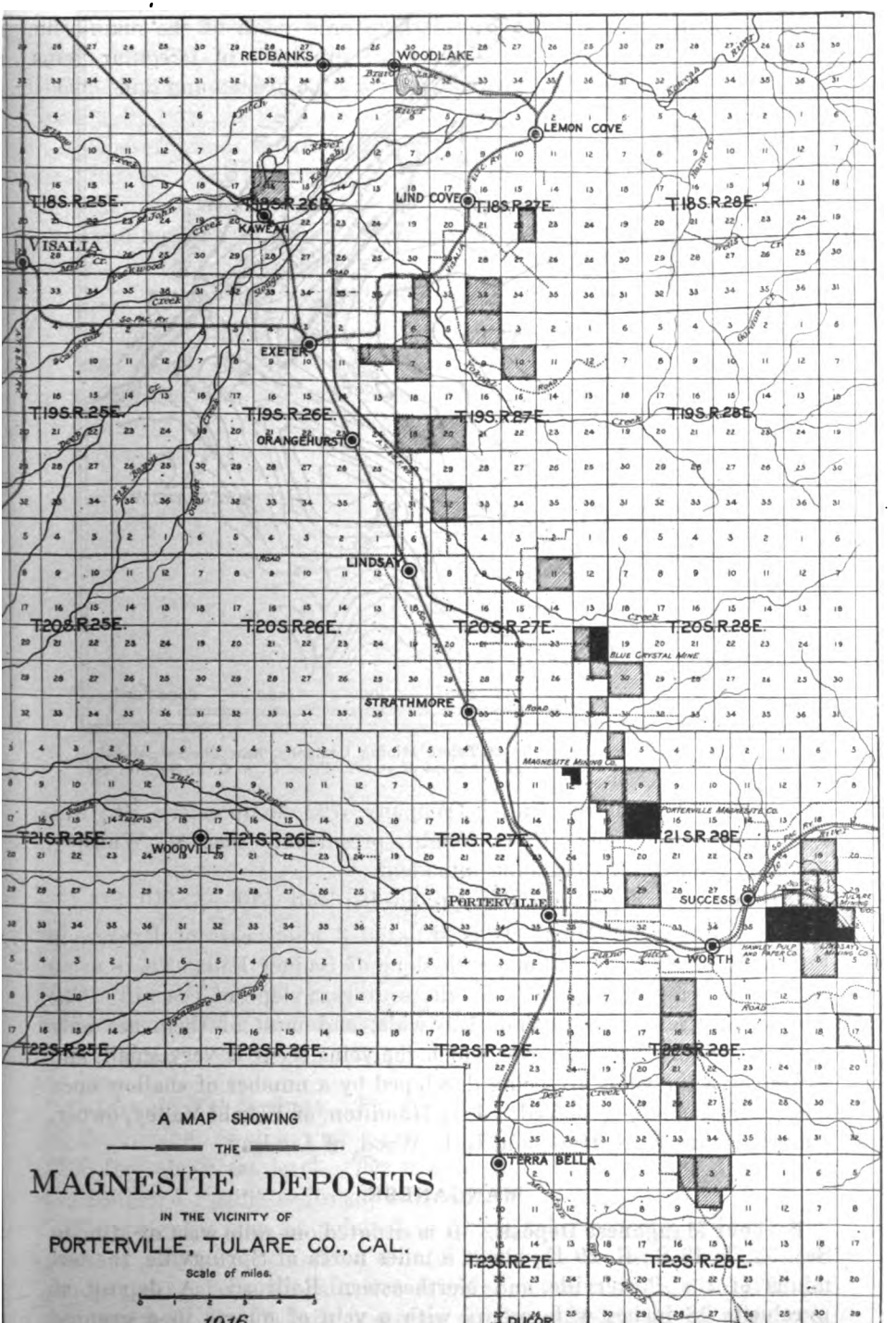
in thickness. These veins are nearly a mile south of the main vein, and in the intervening space there are hundreds of irregular veins, which in places forms stockworks that could be blasted and hand-picked



Magnesite calcining kilns of the Tulare Mining Company, near Success, Porterville district. Photo by Walter W. Bradley.

at small expense. The belt of serpentine carrying the magnesite has been crushed and sheeted in a northwesterly direction, and probably owes this structure to the forces that acted similarly on the magnesite-bearing serpentines nearer Porterville, which lies about 6 miles northwest.

The magnesite is trammed from the different workings, and the material over 4-inch size is broken by hand to 4-inch and finer, then calcined in two vertical kilns, which have a capacity of 40 tons per kiln, producing a calcined product of 36 tons. Some crude rock from the north end of the property is being shipped to the General Refractories Company. A small proportion of the calcined product is reground and shipped to different chemical companies. The remaining calcined product is shipped to the Willamette Pulp and Paper Company for the digestion and whitening of wood-pulp for paper. Fifty men



A MAP SHOWING

THE

MAGNESITE DEPOSITS

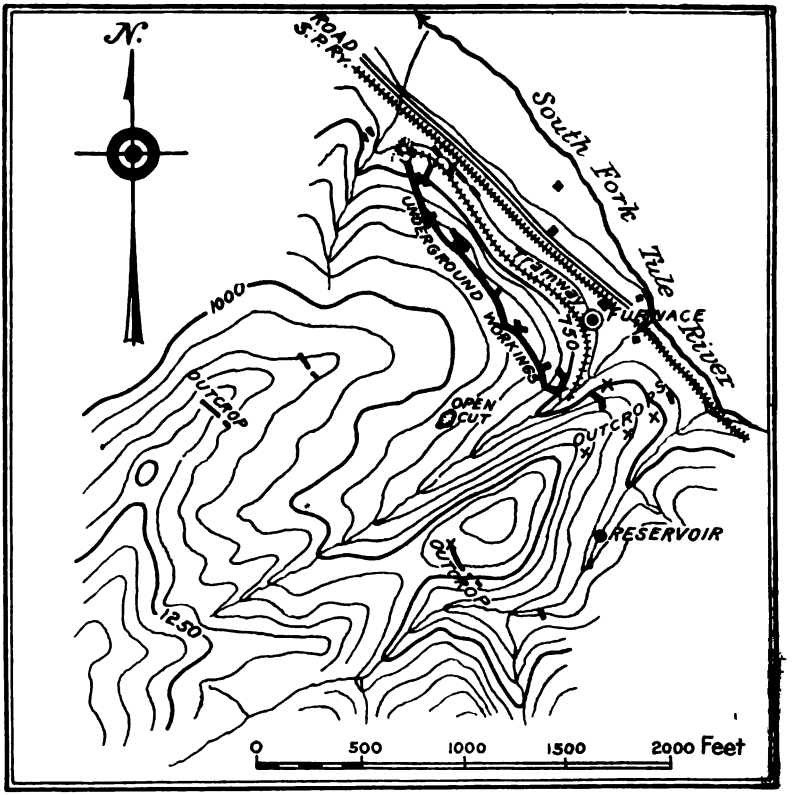
IN THE VICINITY OF

PORTERVILLE, TULARE CO., CAL.

Scale of miles.

0 1 2 3 4 5

1916



Sketch map of magnesite deposits of Tulare Mining Company, near Success, showing underground workings and principal outcrops of veins. From U. S. G. S. Bulletin 540.

are employed. Tulare Mining Company, 722 Montgomery St., San Francisco, Cal., owner; F. G. Wight, president; Chas. M. Whitney, secretary; W. P. Bartlett, superintendent.

Bibl.: U. S. G. S. Bull. 355, pp. 46–48; Bull. 540, pp. 510, 511.

Wood Magnesite Mine. It is situated 3 miles east of Exeter, in Sec. 6, T. 19 S., R. 27 E., on south slope of Badger Hill. There are a few small veins of magnesite on the southeast slope of the hill. The largest vein is not more than 12″ wide, and most of them are only 3″ to 6″ wide. The area over which the veins occur is very small, and in this area the veins are being developed by a number of shallow open cuts. Six men are employed. J. L. Hamilton, of Yokohl Valley, owner. Under lease to F. G. Hyde and L. L. Wood, of Lindsay.

MANGANESE.

Barbour Manganese Deposit. It is situated one mile west of Milo, in Sec. 33, T. 19 S., R. 29 E., about 8 miles north of Springville, the terminus of the Porterville and Northeastern Railroad. A deposit of pyrolusite 18 inches wide occurs with a vein of quartz in a granitic

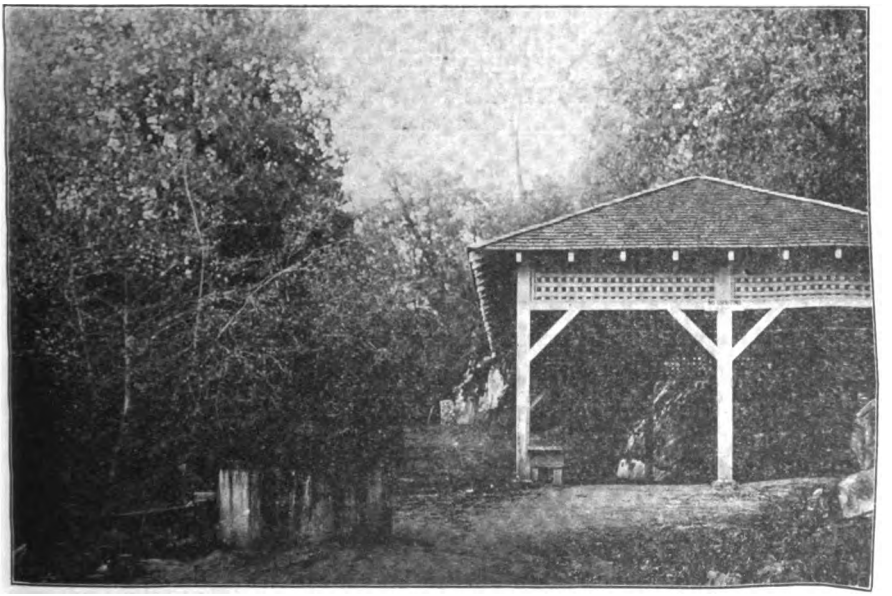
formation. A prospect shaft has been sunk to a depth of 10 feet. Idle. Frank Barbour, of Stockton, owner.

Cole Manganese Mine. Located 2 miles northeast of Lindsay, in Sec. 32, T. 19 S., R. 27 E., on small hill east of the valley.

A lens of jasper occurs in iron-stained shale which runs N.–S. and dips 75° W. The outcrop is 25 feet wide. A shaft has been sunk on the outcrop to depth of 30 feet, developing some low grade manganese ore running high in silica and iron. Idle. R. D. Cole, of Lindsay, owner.

MINERAL SPRINGS.

Throughout Tulare County in the Sierra Nevada are a large number of hot, warm and carbonated springs. The following enumerated springs have been described in "Water Supply Paper" 338, on "Springs of California," by Gerald A. Waring of the United States Geological Survey.



No. 1 Spring at California Hot Springs, 30 miles southeast of Porterville, Tulare County.

California Hot Springs. The springs are located 30 miles southeast of Porterville, on the west bank of Deer Creek, at an elevation of 3200 feet above sea level. The nearest railroad point is at Ducor, on the Southern Pacific Railroad, a distance of 22 miles.

Four springs issue at points 5 to 20 yards apart along the southern bank of Deer Creek Cañon, 20′ to 30′ above the stream-bed. This group yields about 35 gallons a minute of water of 120° to 126° in temperature. Half a mile upstream on the northern side of the creek

another group of one main and two minor springs discharge about one-half as much water at a temperature of 105°. All springs are noticeably sulphuretted, but they are not highly mineralized. Water from the upper springs is piped to a tank and thence to baths and grounds for a cool water supply, while pipes from the lower group conduct hot water about 300 yards to baths near the hotel. The springs from the lower group are also used for drinking and are

View of hotel at California Hot Springs, Tulare County.

easily reached by a footbridge and path along the cañon side. The springs issue from seams in coarse-textured gray granite, which is the country rock of the region. The water is of the sulpho-saline-alkaline variety, highly mineralized. There is a commodious hotel, together with its large annexes and tent rooms, capable of accommodating a large number of guests. Aside from hotel accommodations there are a number of furnished and partly furnished cottages with baths. There is a large bathhouse conveniently located near the hotel. California Hot Springs Company, owners. Mrs. J. H. Williams, president. L. S. Wingrove, secretary and general manager.

The following analysis was made by Curtis and Thompson of San Francisco, March 29, 1911:

Mineral Spring Water (Temp. 124° F.) No. 2, or House Spring.

"The analysis expressed in ions to hypothetically combine as follows:

	Parts per million	Grains per gallon
Ammonium chlorid (NH_4Cl)	0.915	0.051
Lithium chlorid (LiCl)	2.133	0.124
Potassium chlorid (KCl)	1.760	0.102
Sodium chlorid (NaCl)	39.325	2.295
Sodium nitrate ($NaNO_3$)	0.425	0.025
Sodium meta-borate ($NaBO_2$)	5.609	0.326
Di-sodium arsenate (Na_2HAsO_4)	2.280	0.133
Sodium sulphate (Na_2SO_4)	8.140	0.475
Sodium carbonate (Na_2CO_3)	61.500	3.585
Sodium bi-carbonate ($NaHCO_3$)	44.861	2.595
Magnesium bi-carbonate ($Mg[HCO_3]_2$)	1.128	0.066
Calcium bi-carbonate ($Ca[HCO_3]_2$)	6.910	0.403
Ferrous bi-carbonate ($Fe[HCO_3]_2$)	2.451	0.143
Silica (SiO_2)	58.800	3.135
Totals	230.088	13.409

"The water also contains traces of Potassium bromid (KBr), Potassium iodid (KI) and Calcium phosphate, $Ca_3(PO_4)_2$."

Sanitary analysis:

Total solids	210.344
Free ammonia (NH_3)	0.006
Albuminoid ammonia (NH_3)	0.064
Nitrogen (N) in nitrates	0.074
Oxygen consumed	0.150

Coburn Soda Springs. It is situated at Springville, on the north bank of the North Fork of Tule River, at an elevation of 1000 feet. The spring rises from a fissure in the granite, which has been walled up in a cement basin. The water has a temperature of 68° F. Much gas continually rises with the water, which is moderately carbonated, and stains its run-off channel with iron. The following analysis shows that the water is of a rather strongly mineralized, secondary alkaline and primary saline character:

Analyst and authority, C. H. Stone (1906).

Constituents are in parts per million.

Constituents	By weight	Reacting values
Sodium (Na)	589	28.43
Potassium (K)	19	.49
Calcium (Ca)	179	8.94
Magnesium (Mg)	52	4.25
Iron (Fe)	13	.48
Aluminum (Al)		
Sulphate (SO_4)	21	.45
Chloride (Cl)	618	17.45
Carbonate (CO_3)	618	20.60
Silica (SiO_2)	76	2.50
Carbon dioxide	2,185 Present	Present

The spring is the best known soda spring in this region. A. M. Coburn, of Springville, owner.

Doyle Soda Springs. They are situated 13 miles east of Springville, on flat on the west side of North Fork of the Middle Fork of Tule River. Two springs of moderately carbonated water issue from pools about 3 feet across, near the western bank of the river, within 15 yards of the stream. A third spring issues from a crevice in granitic-gneiss nearer the river. The waters are strongly carbonated and there is considerable iron stain near the spring vents. A small amount of carbonate of lime or magnesia is also deposited by the spray from the main springs, but the water is probably not highly mineralized. All the carbonated water probably issues from the gneiss, which seems to form a belt in the granitic rock. The springs are used as a camping resort. San Joaquin Light and Power Company, owner.

Little Yosemite Soda Spring. It is 65 miles north of Kernville, Kern County, in the Kern National Forest. The spring is about 2½ miles north of a small lake known as Kern Lake and 100 yards west of the river. The water rises in a rock-walled pool 3 feet below the normal ground surface, at the base of the bank in the meadow soil. The water is cool (51°), strongly carbonated, and deposits considerable iron. The following analysis shows that the water contains only a moderate amount of solids in solution, being essentially primary and secondary alkaline in character.

Analyst, Oscar Coew (1876).

Constituents are in parts per million.

Constituents	By weight	Reacting values
Sodium (Na)	109	4.76
Calcium (Ca)	64	3.20
Iron (Fe)	4.5	.16
Chloride (Cl)	28	.80
Carbonate (CO_3)	220	7.32
Silica (SiO_2)	73	2.42
	498.5	
Carbon dioxide (CO_2) in excess.		

Lloyd Meadows Springs. Situated in Lloyd Meadows, on the banks of Freeman's Creek, about 42 miles northeast of Porterville and about 9 miles east of Nelson's Camp by trail. A cool, carbonated spring, used by campers as a drinking spring. The yield of water is not large. The spring is within the boundaries of the Sequoia National Forest.

Soda Spring on Middle Fork of Tule River. A small carbonated spring is situated 6 miles east of Springville, on the northern side of

the Middle Fork of Tule River, and about 1½ miles below the junction of two main branches of the Middle Fork, at an elevation of 2400 feet.

Soda Spring in Monache Meadow. It is situated in Monache Meadows, 14 miles southwest of Olancha, at an elevation of 8000 feet. The spring issues near the east base of Monache Mountain, a rhyolite mass that towers above the meadow. The water is warm (100°) and is distinctly sulphuretted as well as carbonated.

Nelson's Soda Springs (Camp Nelson). These springs are 15 miles east of Springville, on north bank of the South Fork of the Middle Fork of Tule River, at an elevation of 4650 feet. Four carbonated springs rise in a region of granitic rock, but on the slopes above them are ledges of limestone that may account for apparent high amount of calcium in their waters. The limestone appears, possibly as included masses in the granitic rock. The lowest spring is on the southern bank of the stream ¼ mile southwest from the resort. It issues beneath an overhanging bank, in a small natural grotto of lime carbonate, and flows over an iron-stained terrace of the same material. The water is strongly carbonated. Temperature 69° F. A second spring rises ⅓ of a mile southeast of the resort, about 50 feet above and 50 yards from the north side of the river. It forms a small rock-walled pool. Water is strongly carbonated. Temperature 63°. About 75 yards east of this spring another carbonated spring issues on the low bank near the river in a deposit of lime carbonate that borders the stream for 200 yards. About ⅔ of a mile farther east a fourth spring rises in a little meadow. It yields effervescing carbonated water that is fairly cool, temperature being 63°.

The resort is used as a summer camping place, and is reached by trail from the San Joaquin power house, which is at the junction of the north and south forks of the Middle Fork of Tule River. Mrs. C. B. Smith and Carr Wilson, of Springville, owners.

Soda Spring Near Quinn Horse Camp. Quinn Horse Camp is in the southeast end of the Sequoia National Park, about 9 miles in a direct line west of Kern Lake, but 16 miles by trail over Coyote Pass, and is 71 miles northeast of Porterville. Near Soda Creek, which heads near the camp, there is a carbonated spring of considerable flow that is known to travelers over the trails in this region.

Soda Creek Spring. On the Nelson Camp trail there is a carbonated spring on Soda Creek 150 yards above the trail. It is 9½ miles east of Springville. The spring issues from granitic boulders at the eastern side of the creek. The water is strongly carbonated, tastes sweetish and deposits iron, but a noticeable amount of lime carbonate was not seen.

Soda Spring, on South Fork of Middle Fork of Tule River. It

Springville. A carbonated spring of unusually large flow rises on the northern side of the South Fork of Middle Fork of Tule River about 2 miles above the junction with the North Fork. The yield of the spring has been estimated at 25 gallons per minute. The water is warm (71°), strongly carbonated and tastes faintly sweetish, probably of iron. A deposit of lime carbonate that is much iron-stained extends to river's edge. The rock near it is granite.

Tule River Soda Spring. The spring is 16 miles east of Porterville, on the Tule Indian Reservation. It is situated about 200 yards southwest of an old schoolhouse, at the north edge of the South Fork of Tule River. The spring issues beneath a large granitic boulder, from crevices in gneiss that is similar to the rock at Doyle Soda Springs. The main spring rises in a rock-walled basin 2 feet square. The water is moderately carbonated and deposits considerable iron.

Soda Spring in upper Funston Meadow. The spring is in Upper Funston Meadow, about 13 miles by trail northward from Kern Lake, between two branches of Kern River, about 69 miles northeast of Porterville, in Sequoia National Forest Reserve. The water is cool, moderately carbonated, and seems to be similar in character to the one near Kern Lake.

STONE INDUSTRY.

Crushed Rock.

Grant Rock and Gravel Company's Quarry. The quarry is situated 8 miles northwest of Visalia on ridge north of St. John's River. A hard serpentinized peridotite is being quarried from an open quarry 350 feet wide by 80 feet high. The method used in breaking rock is to run a series of small parallel adits a distance of 50 feet in face of quarry. Then to drive drifts at right angles to main adit a distance of 30 feet, forming a **T**. The drift is loaded with 6 tons of explosive and hermetically sealed. The charge will bring down an immense amount of material. The broken rock from the face of the quarry is hauled a distance of 275 feet to crushing plant bins, in Kalvaugh New Model underslung carts—capacity 36 cubic feet. From bins the rock is crushed by two Austin No. 5 gyratory crushers, making a $2\frac{1}{4}''$ product. From the crushers the material is elevated to two rotary screens (18′ long x 48″ diameter) and screened to following sizes: $\frac{3}{8}''$ to $\frac{3}{4}''$, $1\frac{1}{2}''$ to $2\frac{1}{4}''$. All material over $2\frac{1}{4}''$ returned to Symonds disc crusher. The screens have a capacity of about 100 tons per hour. The product from Symonds crusher is re-elevated and screened. Four sizes of material are produced, namely:

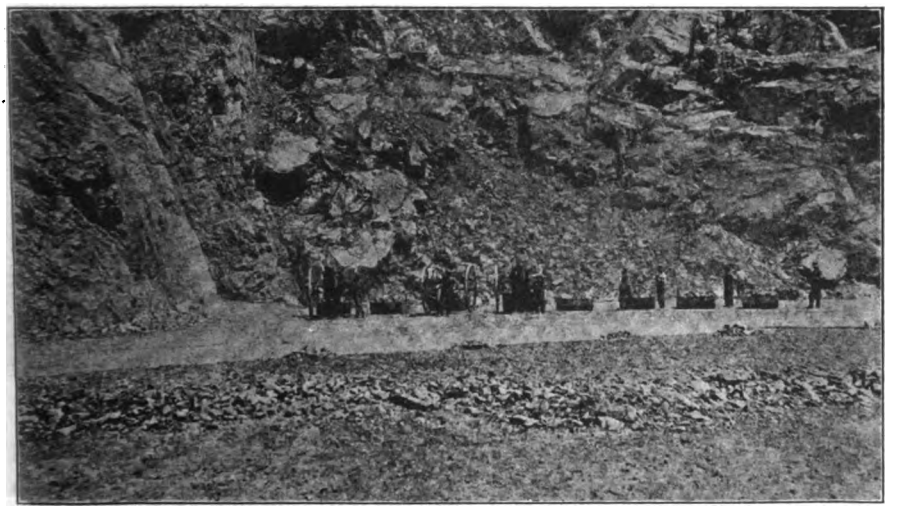
Screenings.
No. 1 product is $\frac{3}{8}''$ to $\frac{3}{4}''$.
No. 2 product is $\frac{3}{4}''$ to $1\frac{1}{2}''$.
No. 3 product is $1\frac{1}{2}''$ to $2\frac{1}{4}''$.

The capacity of the plant is 1200 tons per day. Thirty men are employed. Grant Rock and Gravel Co., Cory Bldg., Fresno, owner.

Kings County Rock Quarry. The Board of Supervisors of Kings County, J. M. McClellan, chairman, Hanford, has recently bought the NE. ¼ of NE. ¼ of Sec. 18, T. 18 S., R. 26 E., 2 miles northwest of Kaweah, with the intention of establishing a quarry for road metal. There are some outcrops of magnesite on the property, which are being developed by T. D. Hoyl, of Los Angeles, under lease.

Sand.

Parker Sand Plant. Eight miles northwest of Visalia, near Roche siding on the Southern Pacific Railroad, the Dorsey-Parker Company are extracting sand from the St. Johns River. The sand is extracted



Grant Rock and Gravel Company's quarry, northwest of Visalia.

from the river bottom by means of a drag-line scraper, and from hopper on river bank is conveyed by 12″ belt conveyor to railroad cars on the siding. The sand is used for road work and also by glass manufacturers.

ZINC-LEAD.

Mineral King Mining District.

It is situated about the headwaters of the Middle Fork of the Kaweah River, 60 miles northeast of Visalia, and 37 miles northeast of Lemon Cove, the terminus of the Visalia Electric Railroad. Located in T. 17 S., R. 31 E.

The village of Mineral King is in the bottom of a deep cañon, at an elevation of 7830 feet above the sea. All the country around here is chiefly granite. A short distance below the village the wagon road

passes by a heavy deposit of calcareous tufa. The granite varies a great deal in character. Some of it is porphyritic, with large crystals of feldspar, and is frequently traversed by veins of quartz and feldspar. The Mineral King mines are all in a belt of very highly metamorphosed calcareous slates and siliceous limestones which strike N. 30° W. and dip southeast at high angles varying from 60° upwards. The crystalline

View of Mineral King Mining District, looking east.

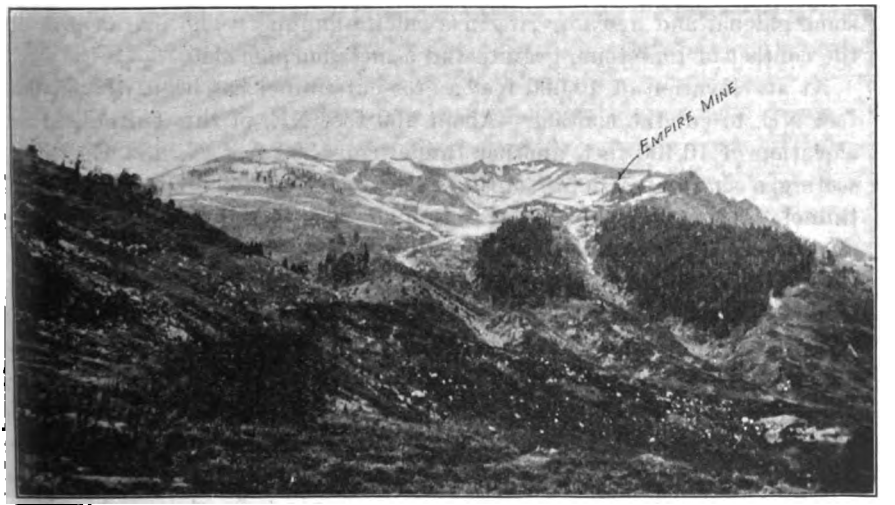
limestone seems to be irregularly distributed through the slates, and there are complex sulphides of copper, lead and zinc associated with arsenopyrite carrying silver values. These ores usually occur on contact of the limestone with slate or granite.

The Mineral King mining district was discovered on August 26, 1873, by J. A. Crabtree, A. Luke and S. Belden, of Porterville. The first discovery of ore was made on the White Chief claim about 2½ miles south of Mineral King. In 1879–1880 during the silver excitement there was a rush to this district. Owing to its inaccessibility and the distance from transportation, also to the complex character of the ores, only spasmodic attempts at mining have been made. The Empire mine was opened up in 1875, a tramway and ten stamp mill operated for a short time, in an attempt to extract the silver values from the ores by amalgamation, but with poor success. The mill and tramway have been carried away by snowslides.

On the McGuinnis, Empire, White Chief, Lady Franklin and Silver Lake claims there are valuable deposits of lead and zinc ores. Some

recent discoveries of zinc have been made on North Alder Creek, 16 miles northeast of Springville.

Chihuahua Mine. It is situated on ridge between Lake and Rock Gorge cañons, 2 miles east of Mineral King in Sec. 13, T. 17 S., R. 31 E., at an elevation of 10,500 ft. A vein 12 inches in width running



View of Mineral King Mining District, looking north.

NW.–SE. and dipping 75° SW. occurs on contact between limestone and slate. A crosscut tunnel 150 feet long has been driven to cut the contact. The quartz carries galena with pyrite. Idle. Arthur Crowley, of Mineral King, owner.

Comanche Mine. It is 1½ miles southeast of Mineral King in Sec. 22, T. 17 S., R. 31 E., on top of ridge between Eagle Lake and Mosquito Lake cañons, at an elevation of 9600 feet. The formation is slate. Vein 12″ wide strikes N.–S. and dips 80° W. The ore is zinc sulphide in an epidote gangue. Shaft 50 feet deep. Idle. Arthur Crowley, Mineral King, owner.

Crystal Mine. It is a prospect 2 miles northeast of Mineral King in Lake Cañon, at an elevation of 10,000 feet. Shaft 20 feet deep on 6″ to 12″ vein, which occurs on contact between slate and limestone. The vein strikes N.–S., and dips 75° W. The ore is a lead-zinc sulphide. Idle. T. J. Crabtree, of Porterville, owner.

Dolly Varden Mine. Situated 1½ miles southeast of Mineral King, on ridge between Eagle Lake and Mosquito Lake cañons, at an elevation of 10,000 feet. A vein of quartz 8″ to 12″ wide occurs in granite. Strikes N. 60° E., dipping at an angle of 65° NW. An incline shaft has been sunk to a depth of 25 feet. The ore occurs on a fault fracture which has been filled with quartz that is highly mineralized with lead

zinc sulphides and contains high silver values. Idle. Robert Johnson, J. M. Thompson, Visalia, owners.

Empire Mine. This property is situated 1 mile northeast of Mineral King, on the south slope of Empire Mountain, at an elevation of 10,400 feet. The claims embraced in the property are: Empire, North Empire, and Empire millsite. The ore is sphalerite associated with some galena, and arsenopyrite in a calcite gangue. The ore occurs on the contact of limestone, granite and a metamorphic slate.

At an elevation of 10,000 feet a crosscut tunnel has been driven 600 feet NE. to cut the contact. About 400 feet NE. of this tunnel, at an elevation of 10,400 feet, another tunnel runs 500 feet, N. 25° E., intersecting a shaft at a depth of 125 feet, about 400 feet from portal of tunnel. About 50 ft. above this tunnel, there is a tunnel 50 ft. long on a streak of ore which cuts the limestone. From this tunnel level, the shaft has been sunk to a depth of 125 feet, striking an open cave in the limestone which contained a deposit of lead-silver carbonate. The mineralized limestone from these workings was milled by a former company in 1879 for its gold and silver values. The ore streak in cave has a general N.–S. strike with a dip of 70° W. An epidote dike occurs on the contact with limestone and metamorphic slates. The calcite lens in which the cave occurs is 50 feet wide and dips 50° to the southwest. This lens is overlain by a capping of metamorphic slate.

The siliceous limestone is mineralized with sphalerite, galena and arsenopyrite. To the north of these workings along the epidote dike which cuts the limestone and has a general north and south course, there is a shaft 10 feet deep, sunk on a heavily iron-stained cropping, showing 6 feet of zinc sulphide ore in a calcite gangue. In this section the crystalline limestone seems to be irregularly distributed through the slates and there is no evidence of a well-defined vein on the Empire claim. Most of the gangue is limestone associated with crystalline quartz, which is coated with iron oxide.

The Empire mine was first discovered in 1875, and worked until 1880, when operations were suspended on account of the complex character of the ore. Idle. W. O. Clough, of Mineral King, owner.

Bibl.: Rep. VIII, p. 645.

Empire Extension North Claim. A patented claim and millsite to the northwest of Empire group. There is a short crosscut tunnel and number of shallow shafts on this claim. No ore developed. Idle. Arthur Crowley of Mineral King, owner.

Franklin Fair Mine. It is a prospect situated 1½ miles southeast of Mineral King, at the intersection of Fairwell Gap and Franklin Cañons. Idle. H. D. Sweet, J. E. Barton, Visalia, owners.

Iron Capping Mine. Sixteen miles northeast of Springville, on ridge north of the South Fork of Tule River, at an elevation of 7100

feet, 18 claims have been located on an iron gossan capping 200′ to 500′ wide. A number of prospect holes have been sunk through the capping from 4′ to 6′ deep, which have proven an ore zone beneath the capping containing complex sulphide ores of copper, lead and zinc associated with iron sulphides. J. Sub. Johnson, Frank Carson and Geo. McGeorge of Visalia, owners.

Lady Franklin Mine. It is situated 1½ miles southeast of Mineral King, on slope of ridge south of Lady Franklin Cañon, at an elevation of 9800 feet, in Sec. 25, T. 17 S., R. 31 E. Holdings consist of two claims, namely: Lady Franklin and Mohawk, giving 3000 ft. on the lode. It is in a belt of thin bedded limestone intercalcated between the slates, about 20′ to 40′ thick, which strike N. 50° W., and dip at 70° NE. The slates extend ¾ of a mile northeast from here to where the granite comes in.

The whole width of this belt of limestones is perhaps 2 miles long. The only productive layer is a stratum 3 feet thick on the footwall of the limestone. The ore is very heavy, containing lead, zinc, and arsenopyrite with traces of copper, also in places shows some antimony sulphide ore. On the southeast end of the Mohawk claim a prospect hole has been sunk to a depth of 10 feet, showing 2 feet of zinc sulphide ore.

About fifty feet southeast of this shaft in the Lady Franklin claim there is a prospect shaft which has opened up 4 feet of zinc sulphide ore in a calcite gangue, also an open cut showing 8 feet of mineralized schist.

At 300 feet southeast of these workings there is a prospect shaft 8 feet in depth which has 2 feet of antimony and zinc sulphide ore, in an epidote gangue. South of this shaft about 200 feet, a tunnel has been driven 50 feet on the contact developing 4 feet of zinc ore. There is about 200 tons of complex sulphide ores on the dumps from these workings. The ore zone is strong and continuous along the contact of the limestone and metamorphic slates, and there is a possibility of developing a large tonnage of ore on these two claims. Idle. T. J. Crabtree of Porterville, owner.

Bibl.: Report VIII, p. 647.

McGinnis Group of Mines. These mines are situated 1½ miles northeast of Mineral King, on ridge north of Monarch Cañon, elevation 10,600 feet. The following claims have been located: San Jose, McGinnis, Mankin, Aida V., and Zinc Blende, giving 3000 feet along the lode line.

Crystalline limestone seems to be distributed through the metamorphic slates and granites. The ore-bearing zone occurs along this contact, accompanied by an epidote dike. The ore is a complex lead-zinc sulphide, with an epidote gangue. San Jose-McGinnis vein is

from 18″ to 3′ wide and strikes N. 45° W., with a dip of 75° SW. A number of shallow shafts and short tunnels have been sunk along the outcrop of the vein. Shaft No. 1, near the NW. end line of the San Jose claim, is 25′ deep, developing a vein 2′ in width. About 100′ southeast, No. 2 shaft was sunk to a depth of 10′ on vein of high grade ore 18″ wide.

About the same distance to the southeast of these workings there is a prospect shaft 10′ deep on 3′ of high grade ore. About 150′ north an incline shaft has been sunk to a depth of 20′ which shows a vein 2′ in width. All these shafts are on the San Jose claim. The McGinnis claim joins the San Jose on the southeast and the vein is a continuation of the San Jose vein.

The northwest shaft on this claim is 25 feet deep on vein 3 ft. wide. About 50′ southeast of this shaft is another shaft 30′ deep showing 2′ of ore; 100′ north is another prospect hole 10′ deep on 3′ of ore.

On the southeast end of claim the metamorphic schist comes in contact with the granite. The Mankin is a parallel vein to the McGinnis; the ore is of the same character. This vein has been prospected by a number of shallow shafts and has a width of 12″ to 18″.

The Bessie V. vein runs north and south and intersects the San Jose-McGinnis vein on the claim. On this intersection a shaft has been sunk, which has developed a vein 12″ wide. Two men employed on development work. W. F. Cord of Porterville, owner.

Meadows Group of Zinc Claims. These claims are situated 16 miles northeast of Springville, on ridge north of North Fork of Alder Creek, at an elevation 5200 feet. Claims: Snow Storm, Holy Terror and Big Ledge. Vein strikes N. 40° W., dipping 45° NE.; width 3 feet. Sphalerite occurs in an epidote dike on contact of a lens of limestone with a mica schist. The vein has been prospected by a number of open cuts and a short tunnel. Idle. Raymond Meadows of Springville, owner.

Monarch Group of Zinc Claims. The claims are situated 16 miles northeast of Springville, on ridge north of North Fork of Alder Creek, at an elevation of 5000 feet. Claims: Monarch, Susan Jane, Two Pines, Sugar Pine, Big Ledge, Ben Hur, Hapgood, Sweet Marie. The ore is a zinc sulphide occurring along epidote dikes, which cut the limestone and schist. George McGeorge, J. Sub Johnson and Frank Carson of Visalia, owners.

Peach Dumpling Claim. A prospect 15 miles northeast of Springville, on ridge north of Alder Creek. The ore is a zinc sulphide occurring in an epidote dike. Idle. Jack Dodge of Springville, owner.

Silver King Claim. It is 2 miles southeast of Mineral King, in Franklin Cañon below Franklin Lakes, at an elevation of 10,000 feet.

Lead-zinc sulphide ore occurs on contact of siliceous limestone and slate. The general strike of the contact is N.-S., with a dip of 75° NE. Developments consist of a number of shallow prospect shafts sunk along the contact. Idle. M. C. Griggs of Three Rivers, owner.

Silver Lake Zinc Mine. It is 2 miles southeast of Mineral King, on the slope of ridge north of Lower Franklin Lake, at an elevation of 10,600 feet. There are two claims, namely: Silver Lake and Dry Bone, with 3000 feet on lode line. The ore occurs on limestone and granite contact, running N. 30° W. It also occurs along an epidote dike which cuts a wide belt of coarse crystalline limestone; the width of this dike in places is about 40 feet. There is an open cut on the dike which has opened up 4 feet of high grade sphalerite. The gangue material is epidote, hornblende and siliceous limestone. This limestone belt outcrops strongly on the north side of the cañon, being cut by a number of epidote dikes which have a northerly and southerly strike. Developments consist of a number of shallow open cuts, all of which show zinc sulphide ore. Idle. T. J. Crabtree of Porterville, owner.

Silver Queen Claim. It is a prospect 2 miles southeast of Mineral King, located in Franklin Cañon, at an elevation of 10,000 feet. The ore occurs on contact between a siliceous limestone and a metamorphic slate. Sphalerite and galena in an epidote gangue. Idle. W. R. Wood of Three Rivers, owner.

Thunder Shower and Buckhead Zinc Mines. They are 16 miles northeast of Springville, in Sec. 5, T. 20 S., R. 31 E., on ridge north of North Fork of Alder Creek. Zinc sulphides occur along a contact between the limestone and the mica schist, which strikes N. 40° W., and dips 40° NE. At an elevation of 5200 feet, a crosscut tunnel 208′ long intersects the contact 159′ from portal of tunnel. From 6′ to 8′ of ore was cut on the contact. The limestone occurs in irregular lenses in a formation of mica schist, and along the contact of these lenses of limestone there are strong mineralized outcrops, showing some good grade zinc ore. Three men are employed on development work. J. M. Aikin, W. A. Alesler, of Springville, owners.

White Chief Mine. Situated 2½ miles south of Mineral King, in Sec. 31, T. 17 S., R. 31 E., in White Chief Cañon. Claims embraced in property are: White Chief, Luke, Grace G., White Cap, Silver Queen; with 3000 feet on the lode line. The original discovery of ore in the Mineral King district was made on the White Chief claim in 1873. An attempt was made to smelt the complex ores from this claim in 1879 and 1880, but with poor success. At an elevation of 10,000 feet, a crosscut tunnel runs S. 80° W., 195′, the first 150′ of which is through solid marble and the last 45′ in granite, which contains considerable magnetic iron. The limestone belt is 100′ to 200′ in thickness and

strikes N. 35° W., its southwest wall being granite, while the northeast walls are slates standing nearly vertical. The surface contact between the limestone and the granite dips very steeply to southwest; it is in the limestone close to this contact surface that the complex ores have been found. The ore consists chiefly of galena and sphalerite carrying silver values. The ore croppings on the contact show a width of 6′ to 8′. A shaft sunk on the contact to a depth of 10′, about 150′ above the mouth of tunnel, has developed 5′ of ore, while only a narrow streak of ore was found on the contact in the crosscut tunnel. About 100′ south of this shaft there is a prospect shaft 18′ deep which has developed 7′ of ore. Further south on this contact is a shaft 100 feet deep which was sunk through the contact into the limestone; some ore occurs on the contact but no ore was found below this point in shaft. Besides these workings there are a number of shallow open cuts and shafts on the contact. There is about 200 tons of complex ore on the different dumps. Idle. T. J. Crabtree, W. F. Cord, of Porterville, owners.

Bibl.: Report VIII, p. 646.

White Horse Mine. It is a prospect 1½ miles north of Mineral King, in Sec. 11, T. 17 S., R. 31 E., on slope of ridge southeast of Timber Gap, at an elevation of 11,400 feet. The ore consists of sphalerite and galena, occurring on contact of limestone and granite. Developments consist of several short tunnels and shallow prospect shafts. Idle. E. H. Kemble of Tulare, owner.

Young America Group of claims. W. F. Cord, of Porterville, has located the following claims in Secs. 1 and 2, T. 17 S., R. 31 E., on Cliff Creek: Young America, Rothschild, and Zinc King. The ore is a complex zinc-lead sulphide, occurring on limestone-granite contact, which strikes NW.-SE., dips 75° SW.

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CALIFORNIA STATE MINING BUREAU
FERRY BUILDING, SAN FRANCISCO
FLETCHER HAMILTON — State Mineralogist
San Francisco — December, 1916

Mines and Mineral Resources

OF

Los Angeles County
Orange County
Riverside County

CHAPTERS OF STATE MINERALOGIST'S REPORT
BIENNIAL PERIOD 1915-1916

CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO
1917

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By FREDERICK J. H. MERRILL, Ph.D., Field Assistant

CALIFORNIA STATE PRINTING OFFICE
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PREFACE.

The reports presented herewith on the mines and mineral resources of Los Angeles, Orange and Riverside counties were prepared by Dr. F. J. H. Merrill from field observations during the summers of 1914 and 1915. As noted in the introduction to Riverside County, he was assisted in the latter part of the 1914 season by Mr. Clarence A. Waring of the staff of the Bureau.

We regret to announce that Dr. Merrill died in Los Angeles, November 29, 1916. He was a graduate of Columbia School of Mines, and was State Geologist of New York from 1890 to 1904. He was the author of the report of the California State Mining Bureau, 1914, on the Mines and Mineral Resources of Imperial and San Diego counties.

The counties covered in this present grouping—Los Angeles, Orange and Riverside—though possessing other and quite diverse mineral resources are important producers of two main items, namely: structural materials and petroleum.

Thanks are due to the many companies, owners and operatives in the territory concerned for their cooperation in furnishing data for this report.

FLETCHER HAMILTON.
State Mineralogist.

December, 1916.

LOS ANGELES COUNTY.

Field Work in 1915.

INTRODUCTION.

This report on the mineral resources of Los Angeles County is based on work done in past years by the State Mining Bureau and published in its reports Nos. VIII to XIII, as well as in several of its bulletins, and upon the personal work of the writer in visiting, so far as possible, the various mineral deposits and the persons controlling and operating them.

While there is no production of metals here, there is a great wealth of nonmetallic minerals, and their production, in 1914, amounted to $4,665,504. Further, the rapid growth of the city of Los Angeles, and its great consumption of industrial materials, especially those used in building, has led to the erection, within the city limits, of a number of manufacturing plants of much commercial importance, which convert raw materials into merchantable products. For much valuable information and guidance in the survey of this county, the writer wishes to give due acknowledgment to the Los Angeles Chamber of Mines and Oil and to its able secretary, Mr. G. M. Swindell.

It is peculiarly true of this county that the county seat is the center of accurate information concerning its resources, so that much detail was obtained in Los Angeles as to history and ownership, which could not be secured at the properties.

While diligent effort has been made to cover the field thoroughly, it can scarcely be expected that every deposit of every kind has been observed and noted, but it is hoped that the reader will make due allowance for unavoidable omissions.

ORGANIZATION AND BOUNDARIES.

This county, organized by act of legislature in February, 1850, lies between 33° 45′ and 34° 50′ of north latitude and between 117° 36′ and 118° 50′ of longitude west from Greenwich. Its general form is that of a quadrilateral, measuring about 70 miles from north to south and 65 from east to west.

It is bounded north by Kern County, east by San Bernardino and south by Orange County and the ocean, which, together with Ventura County, forms its west boundary, the ocean shore-line amounting to about ninety miles. It comprises five thousand six hundred square miles, or about three million five hundred and eighty-four thousand acres, a large proportion of which is mountainous, and, in the northeast, is occupied to the extent of about twenty townships, by the Mojave Desert, a flat sandy country with little water, cut up by ranges of low hills of Tertiary rocks.

BIBLIOGRAPHY.

Throughout the following report references are given to the publications of the State Mining Bureau, but, for convenience, in general reading, a list is here given of the publications of that bureau in which the minerals of Los Angeles County are described.

Report	Date	Pages	Authors
VIII	1888	336-342	W. A. Goodyear.
IX	1889	189-210	E. B. Preston.
X	1890	277-288	E. B. Preston.
XI	1892	243-248	W. H. Storms.
XII	1894	25 and 151-153	W. H. Storms.
XIII	1896	54, 202-206; 504; 614-5; 624; 629; 639; 643	Various.

Bulletins	Authors	Dates
11. Oil and Gas of Los Angeles, Ventura and Santa Barbara Counties.	W. L. Watts	1896
19. Oil and Gas of California	W. L. Watts	1900
23. Copper Resources of California	Various	1902
24. Saline Deposits of California	G. E. Bailey	1902
33. Structural and Industrial Materials of California	Various	1906
50. Copper Resources of California	Various	1908

PHYSIOGRAPHY.

The chief topographic features of this county are the mountain ranges, the valleys and the great Los Angeles plain which stretches from the foothills to the sea. Since the mountains are the most striking to the eye, they may well be first described.

Mountain ranges.

Chief among these is, in the east, the San Gabriel Range, which extends with northwest trend 45 miles from the Cajon Pass to the Soledad Cañon. It forms, on the north, a background to the landscape of Los Angeles and two of its peaks, Mounts Lowe and Wilson, respectively 5650 and 5700 feet in height, are very familiar to tourists, Mount Wilson being also the site of an important astronomical observatory under the supervision of the Carnegie Institution. Six miles southeast of Mount Wilson is Monrovia Hill, 5390 ft. Other prominent peaks near Mount Lowe are Mount Markham, 5760 ft. and Mount San Gabriel, 6152 ft. The foregoing are in the southern division of the San Gabriel Range, or in what may be termed its frontal portion. Immediately north of this, lie the cañons and gorges occupied by the West Fork of the San Gabriel River. Northeast of this deep drainage channel is the main portion of the range, which trends about N. 80° W., and contains all the highest peaks. On the east is Mount San Antonio, familiarly known as "Old Baldy," measuring 10,080 ft. and serving as a corner point in the boundary line between Los Angeles and San Bernardino

counties. Southeast of Mount San Antonio and near it are four other peaks, Telegraph, Sugar Loaf, Ontario and Cucamonga, which are grouped with it as the San Antonio Mountains. Four miles west of Mount San Antonio is Iron Mountain, 7517 ft. high.

About twenty miles northwest is North Baldy, 9389 ft. high, and five miles southwest of North Baldy is Mount Islip measuring 8240 ft. Five miles still farther southwest of Waterman is Pine Mountain, 5903 ft., six miles north of Pine Mountain is Pacifico Mountain, 7078 ft., and about six miles southwest of Pine Mountain is Strawberry Peak, 6150 ft. in altitude. Seven miles northwest of the last, is Mount Gleason, 6503 ft., this having been the center of an old gold mining district. The distribution and conformation of the peaks of the range are well shown on the U. S. Geological Survey topographic sheet known as Southern California No. 1, scale 1/125,000 or about four miles to one inch, and, on six of its component quadrangles on the scale of one inch to one mile, known, in this area, as Tujunga, Rock Creek, San Antonio, Pasadena, Pomona, and Cucamonga.

Loose usage has given to the San Gabriel Range the name of Sierra Madre, but, while this term has thus been freely used by inaccurate persons, it must be said that there is no justification, either geologic or geographic, for so applying the Spanish name of the long, broad and lofty Mexican mountain range, of which the two great branches parallel the coast lines of our sister republic and unite in the south, forming a rude V. The east branch of the Sierra Madre is cut by the Rio Grande near El Paso, Texas. The west branch is traversed by the international boundary near the southeast corner of Arizona and between it and the California ranges is the great depression of the Colorado Desert. Therefore, strictly speaking, the Sierra Madre Range does not occur at all in California and the name should not be used here.

Other ranges in Los Angeles County are the Sierra Santa Susana and the Sierra Santa Monica. The former, which is structurally the continuation of the San Gabriel Range, lies north of San Fernando Valley, its west extension in Santa Barbara and Ventura counties being called Sierra Santa Ynez, and the Santa Monica Range flanks the coast, extending from the ocean in Ventura County eastward to the Los Angeles River. The Santa Susana and Santa Ynez ranges are chiefly formed of tertiary sedimentary rocks but the San Gabriel Range is mainly crystalline, its central axis consisting of granite with gneisses and schists on its flanks.

Parallel with the San Gabriel Range, from which it is separated by the valleys called La Cañada and Tujunga and bordering, on the north, the east end of the San Fernando Valley, is the Verdugo Range, formed mainly of tertiary sedimentary rocks with some granite intrusions.

The sedimentary rocks are of relatively low altitude, the highest point in the Santa Susana Range being only 3756 ft., while the highest of the Santa Monica Mountains, Saddle Peak, measures but 2836 ft. and the highest point in the Verdugo Mountains measures but 3134 ft.

Rivers.

Los Angeles County has two principal rivers, San Gabriel and Los Angeles. The San Gabriel takes its source in San Gabriel Range, having two principal branches, of which the West Fork rises on the north slope of Mount San Gabriel in T. 2 N. R. 12 W., S. B. M., and the various creeks that form the east branch rise in T. 3 N. R. 8 W., S. B. M. The two branches unite in Sec. 29, T. 2 N. R. 9 W., S. B. M., and the stream, thus formed, flows thence southwest, reaching the ocean through Alamitos Bay. The river emerges from its cañon about one mile northwest of Azusa and its broad dry wash extends 8 or 9 miles southwest to El Monte, where, at its western margin, rises the Rio Hondo. This stream, paralleling the San Gabriel, flows seaward to a point three miles southwest of Downey and there unites with the Los Angeles River, receiving the flow of the latter and bearing its name in its course south to Long Beach Harbor.

The Los Angeles River rises in the Santa Monica Mountains, near Ventura County, and flowing thence through San Fernando Valley east and south, unites near Compton with the Rio Hondo, its waters emptying into Long Beach Harbor. Its principal tributary is the Arroyo Seco, which rises north of Pasadena, in the mountains west of Mount Lowe, and, as its name indicates, shows running water only after heavy rains.

The San Gabriel, in the upper part of its course, is torrential, contributing thereby largely to the topographic changes that take place on the mountain flanks and in the cañons, denuding large areas in one place and throwing up accumulations of wash and debris in others. During heavy rains in the cañons changes of water level of ten and twelve feet in less than half an hour are frequently recorded. Yet, notwithstanding the large amount of water that passes over this river bed for the greater part of the year, the water sinks beneath the surface before reaching the ocean.

GEOLOGY.

The first professional study of Los Angeles County in this branch of science was made in 1853–4 by Dr. Thomas Antisell, who accompanied the expedition sent by the U. S. Government, under Lieut. R. S. Williamson, to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean. The reports of this expedition were published at Washington as U. S. Senate Documents, in 1857. Doctor Antisell's Report is in Vol. VII.

In 1855 Dr. J. B. Trask, first State Geologist of California, spent some months in field work covering Los Angeles County and vicinity, his results being published in Vol. VII, No. 14, Sacramento, 1855, under the title of "Report on the Geology of the Coast Mountains, etc." In this report Dr. Trask discusses the structure of the San Gabriel and San Bernardino ranges and of the plain of Los Angeles, giving some attention to artesian waters.

In 1889, under the California State Mining Bureau, a study of the mineral resources of this county was made by Mr. E. B. Preston, his report being printed in the IXth Report of the State Mineralogist, pages 189–210. This supplemented the observations of W. A. Goodyear, made in 1872 and published in 1888, in the VIIth Report of the State Mineralogist.

In 1897 Mr. W. L. Watts made a study of the Los Angeles oil field and others adjacent, which was published in C. S. M. B. Bulletin No. 11, "Oil and Gas Yielding Formations of California."

A later study of this region, with special reference to petroleum, was made from 1901 to 1906 under the auspices of the U. S. Geological Survey, by Messrs. George H. Eldridge and Ralph Arnold. Their results are published in U. S. Geological Survey Bulletin No. 309.

A detailed discussion of the Geology of Los Angeles and vicinity, by Mr. Arnold, is given in Bulletin 309, on pages 143–157, and is illustrated by a geologic map, Plate XVIII.

A publication of the U. S. Geological Survey issued in 1915, Bulletin No. 613, Guide Book of the Western U. S., Part C., contains a very complete résumé of the local geology, along the line of the Santa Fe Railway, by Mr. N. H. Darton and others, and is made specially readable and instructive by a series of local maps.

To these volumes the reader is referred for details which are there more clearly presented than they could be in any abstract prepared by the present writer.

TOPOGRAPHIC MAPS.

The engraved topographic quadrangles of the U. S. Geological Survey, cover nearly all of Los Angeles County. Consequently, most of it is included in the sheets known as Southern California Nos. 1 and 3, on the scale of 1/250,000, or about four miles to one inch. Part of the county, at the west, falls within the Camulos and Tejon quadrangles, on the scale of 1/125,000 or two miles to one inch. The central, eastern and southern portions of Los Angeles County, are covered by the following fifteen quadrangles, on the scale of 1/62,500 or one mile to one inch; Santa Susana, Fernando, Tujunga, Rock Creek, San Antonio, Calabasas, Santa Monica, Pasadena, Pomona, Cucamonga, Redondo, Downey, Anaheim, San Pedro, and Las Bolsas. The extreme southeast

corner of the county falls within the Corona quadrangle, scale 1/125,000 or two miles to one inch. Several general maps of the county have been compiled but none of them deserves special mention.

MINERAL RESOURCES.

The mineral products of this county, aggregated, in 1914, nearly $5,000,000. The materials contributing to this aggregate, are wholly nonmetallic. In the following pages, are given, with all possible accuracy, the details of distribution and ownership concerning the various minerals which are discussed in the order given in the Table of Contents.

METALS.

The following metals occur in Los Angeles County: antimony, chromium, copper, gold, iron, lead, manganese, silver, and zinc.

Only one metal, gold, has been produced in Los Angeles County, in appreciable quantity. The traditions and records of placer mining show a substantial production early in the 19th Century but no other metal out of several which have been found here has ever attained any commercial importance. In the following pages the record has been made as complete as possible.

ANTIMONY.

This metal is extensively consumed in the alloy with lead known as type metal. It has never been mined commercially in Los Angeles County and but one occurrence has been recorded. This was at Lancaster[1] but no details are available and the locality has been forgotten. At the present time the high market price of this metal makes it a matter of much interest and its ores will, doubtless, be eagerly sought for by prospectors.

In the reference given below,[1] antimony is also noted as occurring seven miles from Los Angeles but no one now living recalls this discovery.

The **Western Metals Company**, M. Elsasser, manager, H. N. Simpson, secretary; with offices in the Security Bldg., Los Angeles, has an antimony smelter in operation at Harbor City in this county. The ores treated are derived from various sources along the Pacific Coast, including points in Alaska and South America. A small tonnage is being obtained at the present time from Californian mines, principally in Inyo and Kern counties. A high grade "star metal" is produced.

[1] C. S. M. B. Bulletin 38, p. 359.

ay		Sandstone and serpentine		Stone industry,[5] value	Miscellaneous and unapportioned	
	Value	Cubic feet	Value		Quantity and kind	Value
				$5,500	9,500 barrels lime	$10,800
				47,750		
		[4]1,500	$6,000	30,000		
		[4]2,500	2,500	30,625	5 tons infusorial earth	200
	$500	[3]10,500	5,250	32,500	2 tons sulphur	50
		[4]750	3,000			
		[3]6,000	3,000	112,001	1,600 cubic feet marble	2,000
	10,776	[3]7,500	3,750	24,352		
		[4]350	2,000			
	390	[4]89	90	94,229	10 tons soapstone	19
	890			105,047	100 tons mineral paint 14,400 pounds lead 60 tons infusorial earth	300 504 360
	115	[3]2,163	9,734	118,185	1,736 tons glass sand 219 tons soapstone	2,558 10,124
	5,000	[3]29,211	13,145	83,826	10,000 barrels lime 709 tons glass sand 228 tons soapstone	10,000 4,254 2,315
		[4]200	2,310			
	16,066	[3]8,784	9,950	69,021		
	34,250	[3]19,080	9,540	176,556	18,000 barrels lime 50 tons infusorial earth	18,000 200
		[4]847	1,694		849 pounds copper	169
	20,500	[3]21,196	19,076	36,904	1,000 cubic feet marble 25,000 barrels lime	3,000 25,000
		[4]1,000	3,000			
	55,274	[3]6,292	2,000	598,616	200 tons glass sand	8,000
	26,688			182,377	1,800 tons glass sand 2,000 cubic feet marble Unapportioned, 1900–1909	14,400 6,000 842,530
	800			324,091	40 tons infusorial earth 60 tons feldspar 80 tons glass sand 1,600 cubic feet marble	320 720 200 4,800
	41,025			553,076	1,100 cubic feet marble	3,300
	12,028			955,668	1,800 tons glass sand	1,800
	20,135			1,008,810	1,800 tons glass sand Other minerals	2,000 240,000
	14,566			953,434	13,203 tons borax 10 tons potash	349,669 460
	1,511			1,022,134	Other minerals[6]	330,020
	$260,514		$99,039	$5,561,711		$1,894,072

CHROMIUM.

Chromite, the common ore of this metal is but little known in Los Angeles County. Only two occurrences have been reported. One is one mile west of Harold Station on the S. P. R. R. in T. 5 N., R. 11 W., S. B. M. The owner of one claim located on the deposit is **Nick Evert**, 1027 W. 16th St., Los Angeles. Another is said to be quite close to the railroad station at Acton, T. 5 N., R. 13 W. The ownership of this is unknown.

Chromium compounds are largely used in pigments and dyes, the so-called chrome yellows and greens being familiar to all. Chromium salts are also used as mordants in dyeing. The metal is largely used in alloys with iron and steel on which it has a marked hardening effect, chrome steel being used for armor and projectiles. Another extensive use is in making refractory brick and furnace linings. The chief output of chromite for the United States is from California, in the counties of Siskiyou, Glenn, Shasta, Calaveras, and Fresno.

COPPER.

On page 346 of Bulletin No. 50 mention is made of some copper claims which were under development in 1908, when that Bulletin was issued.

None of them became a producer and they have been nearly forgotten. The descriptions given are copied here as a matter of history.

Palm Development Company. This company superficially developed some claims twenty-three miles northeast of Acton or 12 miles southeast of Palmdale and three miles southeast of Little Rock Creek, in Sec. 30, T. 5 N., R. 10 W., San Bernardino meridian. (See Rock Creek Quadrangle, U. S. G. S.). The ore occurred in a porphyritic dike, which averaged 180 feet in width. The mineralized zone may be traced for one and a half miles. Three shafts had been sunk. While some ore was encountered in these shafts, they failed to show any defined ledge or continuous deposit. The ore was chiefly malachite and carried gold and silver. The claims were leased to Messrs. Elliott and Leavitt, who erected a leaching plant. E. M. Ross and Joseph H. Call, of Los Angeles, owners.

An extension of the claims of the Palm Development Company was owned by William M. Van Dyke of Los Angeles.

Free Cuba. Half a mile south of the railroad station at Acton. This property was first worked about 1860, and abandoned. The old shaft was later cleaned out, and at the bottom, 200 feet from the surface, samples of native copper were found. The deposit is in a quartz vein, 23 feet wide in granite. Ira L. Houser of Acton, owner.

Mooney and Williams Claim. Two miles south of Acton. Men were at work developing the property, and, in the tunnel, some fair copper ore had been encountered. The character of the ledge was similar to that of the Free Cuba. Mooney and Williams of Acton, owners.

Between Acton and Ravenna, in 1889, were a group of copper claims worked by the **Emma Consolidated Mining Company**, concerning which Mr. E. B. Preston writes as follows:[2]

"This property consists of the following ledges: The Emma Ledge, four feet wide, ranging to the northeast and southwest, and dipping to the east very slightly, containing silver and copper in quartz. A shaft has been sunk to a depth of seventy-five feet, and a tunnel run in five hundred feet, but will have to be continued another one hundred feet to strike the vein, which it should do at a vertical depth of four hundred feet. The tunnel is six by eight feet with an air shaft. Wood and water are plentiful in the vicinity of the mine. The Bullion vein is situated on the same hill, and in close proximity to the Emma. It runs parallel with the Emma, and dips towards it. The ledges can be seen in a deep cutting with a width of eight feet. The ore carries gold, silver and copper.

"The Pacific is the extension of the Bullion on the same vein. The London crosses the other two veins, running almost east and west. They are four full claims and were located in 1888, but had been worked years before for a French syndicate. The Pacific has a shaft forty feet deep, showing a well defined, six-foot ledge containing gold, silver and copper ores. The London ledge is about three feet wide, containing copper and silver. It has an incline shaft forty feet deep, showing a well defined, six-foot ledge, containing gold, silver and copper ores. The London ledge is about three feet wide, containing copper and silver. It has an incline shaft seventy-five feet deep and a tunnel one hundred feet long, which will ultimately tap the ledge at a depth of about three hundred feet. The ores are carbonates and sulphides in quartz; the country rock is granite. The value of the Bullion and Pacific ores, from tests made, is $4.00 in gold and $15.00 in silver.

"The Emma vein contains 15 % copper and 15 ounces of silver. The Bullion and Pacific dip to the west, the Emma to the east and the London to the south. About two and one-half miles south of Acton, close to the railroad and at an altitude of two thousand two hundred feet, a shaft was sunk to a depth of thirty-five or forty feet on a strong vein of copper and silver ore; but, at that depth, the parties sinking, encountered so much water that they abandoned the property."

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[2]C. S. M. B., R. IX, p. 194.

GOLD.

While Los Angeles County, at this time, has no producing gold mine, this precious metal is rather widely distributed over its area and, at times in the past, has been recovered in substantial amounts, from some districts. Here, as elsewhere in the world, gold was first found in placer deposits and, in this class, there have been two principal areas of production.

The placers, which were early worked by priests of the Spanish Missions at San Fernando and San Gabriel, were in the Casteca[3] Cañon District northwest of Newhall, in Soledad Cañon northeast of Newhall, and farther eastward in the cañons of the San Gabriel River in the mountain range of the same name.

While these placer fields were once very productive, mining operations in them have been so long suspended that little information is to be had on the ground.

It seems best, therefore, to quote reliable data already published and the following descriptions are, in part, from the report of E. B. Preston,[4] in part from that of W. H. Storms[5] and in part, from a paper read in 1858 before the Pioneer Association of Los Angeles County, by W. W. Jenkins.

AURIFEROUS GRAVELS OF CASTECA, PALOMAS, AND SANTA FELICIA CAÑONS.[6]

(See Camulos and Tejon Quadrangles—U. S. G. S.)

Going northwesterly from Newhall about six miles to the crossing of the Santa Clara River at Casteca we enter the mouth of Casteca Cañon in which is a creek of the same name. Following up this creek about six miles, we find extensive deposits of auriferous gravel, northwest. Going northwest over the divide from Palomas Cañon we enter Santa Feliciana Cañon, where placer deposits were long ago worked.

In this region, about forty miles northwest from Los Angeles, were discovered, in 1934, the placers of San Francisquito, Placerita, Casteca, and Santa Feliciana, which were worked between the years of 1834 and 1838, by priests of the San Fernando and San Buena Ventura Missions, under the supervision of Francisco Lopez, for the San Fernando Mission, and Jose Bermudez for the San Buena Ventura Mission.

In the latter part of 1838, one Francisco Garcia was piloted to and shown by Francisco Lopez, the placer at Santa Feliciana.

Garcia went to Sonora, Mexico, in 1839 and in 1840 returned with 30 Mexican placer miners, and, during the latter part of 1840 and the first part of 1841, took from the Santa Feliciana Gulch, two hundred

[3]Sometimes spelled Castaic and Castac, but the form used above has the weight of priority.
[4]C. S. M. B., R. IX, p. 201.
[5]C. S. M. B., R. XI, p. 248.
[6]C. S. M. B., R. IX, p. 201.

and twelve lbs. of gold, avoirdupois weight, as weighed by D. W. Alexander, who, in 1855, made affidavit to this effect. At the time the above gold was taken from this gulch, it was named, by Garcia, Santa Feliciana,[7] and has retained this name to the present day.

After the rush during 1855 and 1856 to Kern River, Slate Range and Cerro Gordo, and what is now known as Randsburg, many of the people thence drifted into Santa Feliciana, Casteca and San Francisquito.

During the years 1857 and 1858 there were not less than six thousand people mining for gold in the last named places.

This territory was visited in 1872, by W. A. Goodyear and in 1889 by E. B. Preston, of the State Mining Bureau. Mr. Goodyear's description appears in Report VIII, p. 332, and that of Mr. Preston is printed on pages 201–203 of the IXth Report of the State Mineralogist. His statement is, in part, as follows:

"The richest part of the gravel is not exclusively on the bedrock, but in streaks in the gravel, that can be plainly distinguished by a heavy deposit of Iron Oxide. These lie, in places, considerably above the bedrock and sometimes above one another. The accounts of the yield from this gravel, which was worked years ago, are very conflicting. The Mexicans are said to have formerly taken out large sums, a statement which the extent of their workings, in some places, would seem to corroborate. Later workers on the ground put the yield, per cubic yard, rather low, but, even at their figures, if, as was thought possible, water could be brought from Piru Creek, all this immense tonnage of gravel could be made to pay something handsome above expenses. The height of the gravel is hard to estimate, it having been cut out so much. It has been given as averaging ninety feet, but that is probably rather high. Between these gravel hills and Casteca Cañon is a range of hills composed mostly of sandstones and cemented conglomerates, crowned beyond by a range of metamorphic rocks, which show some quartz veins that have been prospected by tunnel, but are now entirely abandoned.

"Crossing Casteca Cañon, opposite the mouth of Palomas, and going northeasterly up over the hills, we again find a large area of auriferous gravel on the other side of Charlie Cañon, that was once taken up by a New York company. Their ground comprised an area of nine thousand acres, extending up both sides of the Cañon La Dura. To work this ground by hydraulic method, the only way in which it could be advantageously disposed of, required the bringing in of a ditch from Elizabeth Lakes, a distance of four miles, in which a large fall would be obtained. The gravel here differs from that of Santa Feliciana, in that it is harder, more cemented with iron. The bedrock, where seen, is sandstone; the gravel is not as smoothly washed as in the other. A good deal of work has been done in these cañons by Mexicans and

[7] A Spanish name expressive of rejoicing.

Americans with pan and rocker. The gravel is about six feet thick in the cañons. The gold is not coarse as in Santa Feliciana Cañon.

A third company was organized, under the name of the Nevada Gold Mining Company, which claimed three thousand five hundred acres between Elizabeth Lakes and Casteca Junction. It held a water right of one thousand miner's inches out of the Casteca Cañon."

Mr. Goodyear writes of these placers as follows:

"The average elevation of this placer area is one thousand four hundred feet. This gold belt, which is about ten miles long from southeast to northwest and about eight miles in width, though chiefly sedimentary, is the northwest extension of the San Gabriel Range. The auriferous tracts are situated mainly in T. 5 N., R. 16 W., S. B. M., and the gravel averages ninety feet in depth. The surface slope from the highest to the lowest point of gravel averages one hundred and fifty feet to the mile. The gravel dips south with the bedrock. This deposit is cut through by numerous small gulches running in various directions, each gulch having been worked, off and on, in a small way, for some thirty years. A portion of this ground was purchased, about 1888, by an English syndicate."

As described by Mr. W. H. Storms, R. XI, p. 248, there were placers north of Newhall and northeast of Casteca in the gulches known as Dry Cañon, El Cañon de Los Muertes or Dead Men's Cañon, and, in the San Francisquito, all of which produced a large amount of gold. These Newhall placers were formerly worked systematically and cheaply, and, it is said, with good results.

The San Gabriel Mountain Placers.[6]

The southerly slope of this range was the site of a placer field worked by the priests of the San Gabriel Mission and also, by the native Californians prior to the discovery of gold at Sutter's Mill, and abandoned in 1848, in consequence of that event.

Later, placer mining was carried on along several gulches in that region, and generally with satisfactory results.

In 1889, a company, made up of residents of Redlands, expended quite a sum of money in the construction of a dam and a rim-rock tunnel, and in laying down eight hundred feet of sluice boxes for working a gravel claim located and owned by them in San Antonio Cañon. This tunnel cut what was evidently an ancient river channel, the contents of which paid beyond the company's expectations. Some drift operations have also been carried on at considerable elevations in these mountains, and along Lytle Creek, farther east, where placers have been worked ever since 1860.

[6]Xth Rep., p. 519.

Concerning the San Gabriel Cañon placers, Mr. W. A. Goodyear wrote as follows:[9]

"In September, 1874, the writer made a trip up the San Gabriel Cañon, some three or four miles above its mouth, and twenty-four or twenty-five miles from Los Angeles. The rocks here are all granitic. There is some auriferous gravel scattered about, high up on the spurs of this range, similar in its general character to that which forms the great hydraulic mines (now for some years utterly stopped by injunctions of the United States Courts) on the western flank of the Sierra Nevada, in the more central counties of the state.

"There is every reason to believe that these high and ancient auriferous gravels of the San Gabriel Range and also the great mass of the whole range itself, from the Cajon Pass west, nearly or quite to the Los Angeles River, belong to the same geological ages, and derived their origin from the same causes as those of the western slope of the Sierra Nevada. The amount of denudation which has taken place since these ancient gravels were deposited has, of course, been something enormous, and no man can measure it."

In the western part of this range, along the Soledad Cañon and northeast of Newhall, as well as between Lang and Ravenna, placers were reported in 1894.[10] At present, however, there is no production from these fields.

Besides these inland placers above described, deposits of auriferous sand have been found sparingly on the sea coast, and some years ago[11] a company was formed to recover gold from beach sands at Ballona, now known as Playa del Rey.

QUARTZ VEINS.

Vein mining for gold in this county has been practiced in several areas. They are all described in the early reports but all have been unproductive for some years.

In the northwestern part of the county were several gold districts which were reached from Acton Station on the S. P. R. R. One of them was Cedar Mountain District,[12] comprising parts of Townships 4, 5, and 6 North in Ranges 12 and 14 West. Much of this district lay north and west from Acton. The chief properties here were the Red Rover and New York mines. Now idle.

Southeast of Acton about seven miles, was the Mount Gleason District,[13] centering around the peak of that name in Secs. 25, 26, 35, 36, T. 4 N., R. 13 W., S. B. M. The chief mines here, in 1896, were the

[9] VIIIth Report, State Mineralogist, p. 340.
[10] R. XII, p. 152.
[11] R. XIII, p. 203.
[12] C. S. M. B., R. IX, p. 191.
[13] R. IX, p. 195; R. XIII, p. 204.

Padre, Mount Gleason, Kelly, Peerless, and the Casa Grande mines, named Gold Bullion, Log Cabin, Veteran, Golden Rule, and Old Town.

Sixteen miles southeast of Acton was the Monte Christo group of mines, comprising Dos Robles, Mikado, Monte Carlo, and Monte Christo and, near by, the Tujunga Group,[14] including the Baltic, Boston, California, Los Angeles, Nevada, and Pacific.

The mines of these groups have been idle for many years and little is remembered concerning them.[15]

Another region of gold-bearing quartz veins was in the San Gabriel Range, adjacent to the cañons of the San Gabriel River.

Here, on North Baldy Mountain, in Secs. 7 and 8, T. 3 N., R. 8 W., S. B. M., are the claims of the **Big Horn** and **Called Back Mines**.

These are now owned by the **Lowell and California Development Company**, 712 Story Bldg., Los Angeles, and are being developed under lease by Mr. Seeley W. Mudd, of Los Angeles.

The corporation holds fifteen claims and two mill sites, all of which are patented. The vein is described as twenty-five feet wide on a contact between gneiss and schist. The strike is N. 40° to 60° E. and the dip 20° NW. By isolated outcrops it has been proved for 2500 to 3000 ft. A 600-ft. tunnel cuts the vein 400 ft. below the outcrop. There is a ten stamp mill on the ground but no production has been achieved.

Other gold quartz veins, which have not lately been materially productive, are in the San Gabriel Cañons. One of these was the Kelsey Mine[16] near Fellows Camp, which is reached from Azusa. Nearby was the Allison Mine and the Victoria.[17] Still other veins in the San Gabriel Range, are noted in Report XI, p. 247.

Near Los Angeles two prospects have been opened but have never been producers. These were: **The Cahuenga Mine**,[18] described in 1896 as seven miles north of Los Angeles. This may have been in the hills of Griffith Park and near the Cahuenga Pass, but it has long been forgotten. There is, however, a tradition of an old prospect in Laurel Cañon near Hollywood.

The Dawn Mine. This is near the bottom of Millard Cañon on the southwest slope of Mount Lowe. The vein, which occurs in granitic rocks, strikes nearly east and west and its dip is nearly vertical. The mineralization is with iron sulphides, rich in gold. Considerable development work has been done by adits but no large body of ore has been opened. The foregoing data are from a report by Mr. J. Nelson Nevius of Pasadena. The owner of the property is Mr. M. T. Ryan, 4083 Moneta Ave., Los Angeles.

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[14] R. XIII, p. 204.
[15] R. VIII, p. 332; R. IX, p. 191; R. XI, p. 246; R. XII, p. 153; R. XIII, p. 204.
[16] C. S. M. B., R. XIII, p. 203; R. XI, p. 243; R. XIII, p. 204.
[17] R. XIII, p. 205.
[18] R. XIII, p. 203.

IRON.

Iron ores are rare in this county, but a few occurrences are noted in Bulletin No. 38, page 297. As a matter of history the record is copied here.

A deposit of magnetite lay within 200 yards of the Southern Pacific Railroad, at Russ Station (Soledad Cañon). Only a little development work had been done. Some years ago a small furnace, using oil as fuel, was erected at the deposit, but proved a failure.

The owners of this deposit in 1906 were John Carroll, Fourth and Junipero streets, Long Beach, and J. D. Rivard, 2915 Downey Avenue, Los Angeles.

Another deposit was called the Iron Mack; H. Reblick, Acton, and E. L. Baker, 713 West First Street, Los Angeles, owners. This was in Sec. 36, T. 6 N., R. 14 W., S. B. M. at the head of Mint Cañon, about ten miles northwest of Acton, and was described as a deposit of low-grade material, containing some small pockets of magnetite, accompanied by some manganese ore. From a pit less than 10 feet deep, some ore was shipped a few years prior to 1906.

The writer is informed, on reliable authority, that these ores proved to contain titanium and consequently were not of commercial importance.

LEAD.

This metal is not abundant in this county and its ores have not been mined commercially. Associated with silver it occurs sparingly at a few localities and as noted under Silver has been reported from the old Silver Mountain Mines[19] east of Casteca Cañon. This lies in T. 6 N., R. 16 W. A small production of lead from the Kelsey mine in San Gabriel Cañon, five miles from Azusa, was reported in 1892.[20] In association with silver and zinc sulphides lead in small quantities was reported from Santa Catalina Island in 1890.[21] It does not appear that any of these deposits have been developed or worked to any extent since they were originally reported to the State Mining Bureau.

MANGANESE.

But little of the ore of this metal is known in this county. The only reported deposit is one belonging to **A. Mayet,** 328 Higgins Bldg., Los Angeles. It lies four miles west of Palmdale, T. 6 N., R. 12 W., S. B. M. The holdings amount to nine claims. There is said to be seven feet of ore averaging 45 to 48% of MnO_2 with 8 to 10% of silica. No production is reported thus far.

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[19] R. IX, p. 203.
[20] R. XI, p. 245.
[21] R. X, p. 279.

SILVER.

This precious metal has been found at but few points in this county, only four localities having been recorded. These were (I) The Silver Mountain Mining District, east of Casteca Cañon, see Report IX, p. 203–4; (II) the San Gabriel Cañon, north of Azusa, see R. XI, pp. 243–6 and R. XIII, p. 204; (III) on Santa Catalina Island, see R. X, pp. 279–80, also R. XII, p. 25; (IV) in R. IX, p. 194, is mentioned the Emma vein, between Acton and Ravenna which, in addition to copper, was said to carry 15 oz. of silver. This ground is not now worked.

There is no record of productive operations in the Silver Mountain District, since 1889. The Kelsey Mine, five miles north of Azusa, in San Gabriel Cañon, has been idle since 1892; likewise the Sierra Madre Silver Mining Company's mine, since 1895; and the small veins once prospected on Santa Catalina Island have lain untouched so long that the most diligent search by the writer fails to find any man who worked on them when they were prospected in 1890. According to the statement in R. X, p. 279, on this island, the silver was contained in galena associated with zincblende.

It is rumored that a primitive form of smelting was formerly practiced here in small rude furnaces.

ZINC.

This important metal is in great demand to alloy with copper in making brass and is also much used in protecting iron from rust in the process known as galvanizing.

But little has been reported in Los Angeles County and at only two localities. One of these was the Kelsey Mine in San Gabriel Cañon five miles north of Azusa,[22] the other was on Santa Catalina Island,[23] on Black Jack Mountain and at the junction of Silver and Grand Cañons. At the time of Mr. Preston's visit to the second locality in 1890 but little development had been done and no production achieved, and since that time the deposits have been abandoned and forgotten, the Banning company, which owns the island, having devoted its energies to seeking income from other sources.

NONMETALLIC MINERALS.

The nonmetals are commercially the most important among the mineral products of this county. In 1914 their aggregate value was upwards of $4,000,000.

The presence here, of the metropolis of southern California, has developed a great demand for materials employed in the building trades

[22] R. XI, p. 243.
[23] R. X, p. 279.

and all important deposits of minerals used in the manufacture of structural materials have been energetically developed and worked. Los Angeles County, therefore, produces a large part of the nonmetallic minerals locally consumed and their record consequently occupies many pages and the larger portion of this county report.

The following nonmetals are found or produced in Los Angeles County: Abrasives—corundum;* barite; borax; building materials—building stone, granite, marble, sandstone, serpentine and steatite, trachyte, crushed stone and sand, lime, Portland cement, artificial stone; clays—brick and pottery; coal;* feldspar;* fuller's earth; gems; graphite; gypsum;* infusorial earth;* mineral paint; mineral water; petroleum and natural gas; potash; salt.

ABRASIVES.

Corundum. In San Antonio Cañon, about five miles above Uplands, is a large body of syenite containing ruby corundum. The rubies occur in small prismatic crystals, and might be utilized as an abrasive, if they can be concentrated economically out of the mass of the syenite.

BARYTES.

(Heavy spar.)

This mineral, in composition, barium sulphate, is comparatively rare in Los Angeles County. It has been reported from Azusa[24] but the locality is not well known. It is also found in the west fork of San Dimas Cañon, T. 1 N., R. 9 W., whence a small tonnage is reported to have been shipped recently. The owners of this latter deposit are C. V. Foresman, John Bradley, and Geo. Rogers of San Dimas.

Barytes or barite is chiefly used as a pigment and to a small extent in the manufacture of glass.

BORAX.

The production of this mineral in Los Angeles County amounted in 1914 to nearly $500,000. This was chiefly the output of the **Sterling Borax Company** of 320 Trust and Savings Bldg., Los Angeles, Thos. Thorkildsen, president, of which the mine is five miles north of Lang in Tick Cañon. This corporation controls some 1,200 acres and mines a large deposit of colemanite. In a mill on the property, the crude material is separated from such impurities as clay and shale, and calcium borate is shipped to Pittsburgh and Chicago to be refined into commercial borax.

The deposit is probably a tilted lake bed and is of great interest but the management request that no details be published.

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*Not produced.
[24]Bull. 38, p. 360.

At San Fernando is the manufacturing plant of the **Paradise Borax Mining Company,** which controls no borax deposit, and of which the product is chiefly mineral paint, sold under the trade name of Silumnia Kalsomine. Among the officers of this corporation are O. C. Gray, president, and W. S. Booher, secretary, both of San Fernando. This deposit will be further mentioned under "Mineral Paint."

BUILDING MATERIALS.

BUILDING STONE.

Not many years ago building stone or rock of attractive appearance and durable qualities which could be cut or dressed to a convenient form and size for building operations was a matter of much importance and a substantial asset to any state or county, but with the lapse of time and the development of new methods of construction, brick, terra cotta, and concrete have been so extensively substituted for cut stone, that the latter has become of minor importance and many deposits of material formerly available and in demand now lie unnoticed. In this report, space will be given only to building stones formerly worked or now in use for special purposes.

Among the building stones occurring in this county are the following, although they are not all produced commercially: granite, marble, serpentine, sandstone, volcanic tuff and trachyte.

Granite.

No stone of this class has been worked in this county except by crushing plants for concrete.

In Bulletin No. 38, p. 28, is the following description:

E. M. Ross, Glendale. On the Glendale ranch, Verdugo Cañon, 8 miles from Los Angeles, and three-fourths of a mile from the railroad is a body of very dark hornblende biotite granite, somewhat banded (gneissic), taking a very high polish, and very well adapted for monument work and for trimming the light-colored granites and marbles. No development work.

Much granite is exposed in the San Gabriel Range but the outcrops are high and inaccessible.

Marble.

No stone of this class has lately been worked in Los Angeles County, though there is a record of a Southern California Marble Company with a quarry operated near Neenach by John Rebman of Los Angeles. This record can not now be verified as Mr. Rebman has moved to Arizona.

Crystalline limestone, which, in some localities makes a high class marble, is described by W. A. Goodyear[25] as occurring in Pacoima Cañon near San Fernando. It does not appear, however, that this material has been used for other purposes than making lime.

Prof. R. T. Hill of the U. S. Geological Survey, states that on the southeast slope of the Tehachapi Range, and the northwest border of the Antelope Valley, limestone outcrops extensively with northeast and southwest strike, dipping steeply into the mountains. The strike of these beds should carry them into the northwest corner of Los Angeles County, but no record can be found that they are now worked there.

In Bull. No. 38, p. 100, is a record of this limestone belt as worked in Kern County[26] in 1906. On page 367 of the same bulletin are data suggesting that it was, at that time, worked in Los Angeles County. In R. XIII, 1896, p. 629, is a note of a marble quarry in Antelope Valley, forty miles northeast of Lancaster. This is clearly incorrect, as the limestone above mentioned lies northwest of Lancaster.

Sandstone.

Chatsworth Park Quarry: (see Bulletin 38, p. 128). This property comprises 160 acres in Sec. 13, T. 2 N., R. 17 W., S. B. M. It is about 1½ miles west of Chatsworth station, on the Southern Pacific Railroad and was formerly connected by a spur track with the main road. The locality is at the northeast end of the Simi Hills, a rugged range of sandstone strata, folded and faulted, their dip being plainly visible from the southward.

The stone of the quarry is arkose or feldspathic sandstone, rather fine-grained and heavily bedded. When fresh it is bluish-gray, but near the surface it weathers to a tawny color. This weathering extends to an irregular depth, but the demarcation between the weathered and fresh stone is very distinct. It is said, that when quarried for dimension stone, it can be split regularly along the run, but that when quarried for large blocks, as done for the substructure of the San Pedro breakwater, it breaks along uneven surfaces. As shown by some samples it usually resists exposure to the atmosphere in a satisfactory manner.

Near Garvanza, on N. Avenue 64, is the Church of the Angels, built in 1887, of the tawny-colored stone, which as yet shows no signs of deterioration.

In Los Angeles, corner of Fifth and Hill streets, is the house of the California Club, built of an olive-gray stone from the Chatsworth Quarry, but much stained by the leaching of soluble salts. Christ Episcopal Church, corner Twelfth and Flower streets, Los Angeles, is constructed of Chatsworth sandstone and also the city police station and jail on First Street, near Hill, and the Southern California Edison Company's building, East Fourth Street, near Main. A few private residences also have been built of this stone. At the shore end of the

[26]Bull. 38, p. 100; also, R. XIII, p. 629.
[26]See, also, Report on Kern County, 1915.

Southern Pacific Railroad pier at Santa Monica, some of this stone was used for rip-rap. Below high water level, where kept moistened by seawater, it remains quite hard, but above high-water mark, the exposed stone is rather soft and somewhat disintegrated.

The geologic age of the rock in this quarry is Upper Cretaceous or Chico, as mapped on Plate III of the folio accompanying Bulletin No. 69 of the State Mining Bureau.

The quarry was opened by the **California Construction Company,** which (about 1900) took the contract for building the San Pedro breakwater. At present the property is held by the Los Angeles Trust and Savings Bank as trustees for creditors of the California Construction Company, which has forfeited its corporate rights through nonpayment of taxes, but it is now represented by the president, W. N. Hamaker, care of First National Bank, Los Angeles.

No rock has been quarried here for years, the quarry having been dismantled and its equipment and spur track removed.

Judging from examples of this sandstone in use, it is an important building stone, and it is to be hoped that the quarry may again be opened.

Serpentine and Steatite.

(Report X, p. 280; R. XII, p. 402; R. XIII, p. 639; Bull. 38, p. 147.)

On Santa Catalina Island, which is owned by the **Banning Company,** 594 Pacific Electric Bldg., Los Angeles, is a deposit of serpentine, formerly worked commercially under lease by F. C. Carey, 772 San Fernando Street, Los Angeles. The deposit is about a mile from Empire Landing on the north shore of the island and in a depression known as Potts' Valley.

The rock is fibrous in structure but takes a fine polish. There are two varieties, hard and soft. The soft variety may be sawed into slabs of any length. The hard variety is worked with ordinary stonecutter's tools. This stone has been used in several buildings in Los Angeles for ornamental, sanitary and electrical purposes, also for lining fireplaces. The dark green columns at the entrance to the Henne Building are of this material. Sanitary slabs and electrical insulators manufactured from this stone are said to give great satisfaction. The soft variety was supplied in slabs one inch thick f. o. b. Los Angeles, for 75 cents a running foot. The hard variety was supplied in similar slabs at the rate of $2.50 a running foot. The quarry has not been worked since 1913.

Near the south side of the isthmus on this island there is also a large body of steatite. It is said that about 400 tons of this rock were supplied every year to plasterers, soap factories, druggists, and foundry-men, but it has not been worked for about eight years.

Trachyte.

This volcanic rock, consisting chiefly of orthoclase feldspar, has been quarried on Santa Catalina Island, between Avalon and Empire Landing, according to the following note[27] made in 1894.

"**The Lang Quarry** is situated on Santa Catalina Island. It is said that although this stone is admirably suited for building purposes, the greatest demand for it has been as rubble rock, for use in railroad construction and harbor improvements. It is stated that 150,000 tons of this rock have been used during the last fifteen years. This rock can be supplied f. o. b. at Los Angeles, at the rate of from $3.00 to $4.00 a cubic yard.

As stated in Bulletin 38, p. 155, trachyte from this quarry was used in the old breakwater between Terminal Island and Deadman's Island and, to a small extent, in the great government breakwater at San Pedro, but blocks of sufficient size were difficult to obtain.

Crushed stone and sand.

The extended and ever increasing use of concrete for buildings and pavements makes the supply of crushed stone a matter of great importance. The stone chiefly crushed in this county for concrete is granite, of which boulders and cobblestones, in immense numbers, are distributed widely over the river washes which form where the mountain streams emerge from their rocky cañons, bearing along, in their torrential flow, great quantities of fragments from the cañon walls. So, it has long been a custom to install crushing and screening plants on these river washes to separate the sand from the cobbles and crush the latter, thus providing two of the most important constituents of concrete. Such crushing plants are operated on the Pacoima, Tujunga, Arroyo Seco, and San Gabriel washes by various companies which will be mentioned in detail. The economy of this procedure is obvious, as the cost of quarrying the rock from its native ledge is wholly eliminated, the expense of handling small boulders and cobbles being very trifling.

Rock crushing plants.

The largest plants near Los Angeles are operated on the wash of the Gabriel River. Two of these belong to the **Pacific Rock and Gravel Company,** 498 Pacific Electric Bldg., Los Angeles, W. L. Hodges, president, A. C. Stone, secretary. One is west of Azusa, near the tracks of the Pacific Electric Railway where the company controls 2500 acres, and the other two and one-half miles southwest, near the tracks of the Santa Fe Railway. This last, which was erected and formerly operated by the San Gabriel River Rock Company, is now being dismantled owing to damage from the floods of January, '16, and is

[27] R. XII, p. 404. See, also, R. X, p. 279.

being reinstalled at a safer distance from the present river channel. A third plant is operated on the same wash near Baldwin Park (see Photo No. 1) by the **Russell-Greene-Foell Company,** of 814 Higgins Bldg., Los Angeles. This corporation also has a plant at Declez, San Bernardino County.

A few miles northwest of Los Angeles, in the San Fernando Valley, is the crushing plant formerly operated by the Tujunga Rock Company. This plant adjoins the tracks of the S. P. R. R., near Roscoe Station, in T. 5 N., R. 14 W. It is now controlled by the **Los Angeles Stone Company,** mentioned below. The output is sand, gravel and crushed stone, amounting to 1500 tons per day.

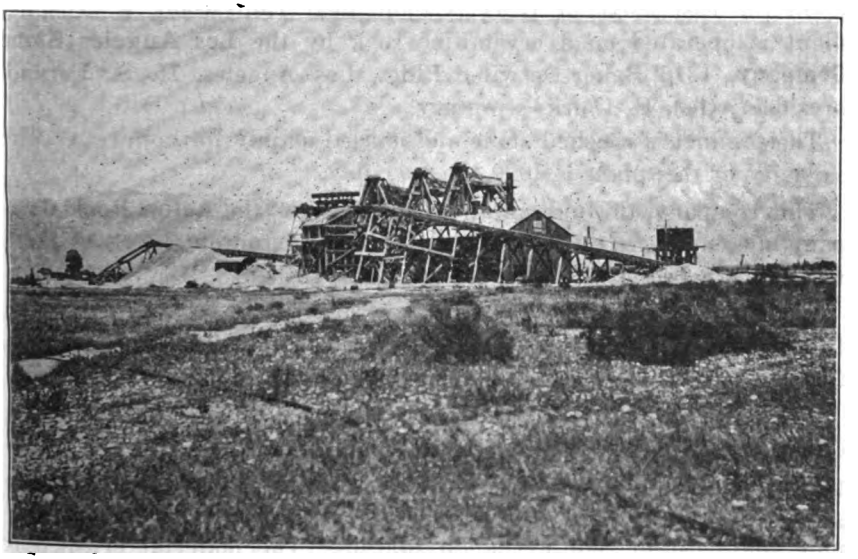

Photo No. 1. Rock crushing plant of Russell-Greene-Foell Co., in the San Gabriel River wash near Baldwin Park. Photo by Walter W. Bradley.

In Pasadena the **California Rock and Gravel Company** operates a crusher at Lester Ave. and Arroyo Seco. Quite near is the plant of the **Baldwin Construction Company.**

On the same arroyo in Pasadena, near the Ostrich Farm, is a small crushing plant operated by **W. W. McGregor.**

In Los Angeles a rock crushing plant is operated on the gravels of the Arroyo Seco by the **Los Angeles Rock and Gravel Company,** at Avenue 35 and Pasadena Ave.

Robert Beyrle formerly operated a crusher at 462 Avenue 20, and at N. Avenue 19 and Arroyo Seco, is a small crushing plant operated by the **City of Los Angeles** for street repairs.

At 26th and Alameda streets the **Consumers Rock and Gravel Company** produce sand and gravel from what was once a river bed. No crushing plant of importance is operated.

A similar business is conducted near by, at 2599 E. 26th Street, by the **Western Rock and Sand Company.**

Northwest of Glendale, between Montrose and La Crescenta, on a wash of granite boulders brought down by a stream, flowing from a cañon, in the San Gabriel Range, two miles west of the Arroyo Seco, is a crushing plant erected about 1914, but not now in operation.

Crushing plants operated in connection with quarries are few in this county. The following are, however, of consequence:

On the east slope of Brush Cañon, near Hollywood, a crushing plant is operated on a crystalline rock by the **Los Angeles Stone Company,** 1316 Baker-Detwiler Bldg., Los Angeles, H. S. Feraud, president, Geo. H. Clark, secretary.

The product is crushed stone and is used mainly for concrete. The capacity of this plant is 1000 tons per day.

This company, through an allied corporation, the **Acton Rock Company,** also operates an extensive plant near Acton on the S. P. R. R. where a crystalline rock is quarried and crushed.

At San Dimas a crushing plant was formerly operated by the San Dimas Rock Company, but this is now controlled by **Los Angeles County** and used to give employment to prisoners in the county jail.

The **San Fernando Rock Company,** unincorporated, 1006 Wright & Callender Bldg., Los Angeles, H. S. Wood, owner, operates a crushing plant near San Fernando on the wash of Pacoima Creek. The plant is on the northeast side of the S. P. R. R. tracks about one-third mile southeast of San Fernando Station. The material crushed is granitic boulders and cobbles brought down from Pacoima Cañon in the San Gabriel Range.

H. O. Richwine of Gardena has a gravel pit at Bixley, and a sand pit at Redondo, from which a small tonnage is taken annually for local use in concrete.

Lime.

Owing to the scarcity of limestone in this county, little of this building material has been produced and none is being made at present from local rock. One outcrop near Spadra was formerly worked and a lime kiln operated there, by the Pomona Lime Company, now defunct. Some lime has been made in Los Angeles from limestone brought in by the railroad.

In the VIIIth report of the State Mineralogist, pages 340–341,

printed in 1888, Mr. W. A. Goodyear, who wrote in 1872, described some occurrences of limestone near San Fernando as follows:

"In the Pacoima Cañon, on the northeastern side of the San Fernando Valley, some three and one-half miles from San Fernando Station, and eight hundred to one thousand feet above the valley, Dr. J. S. Turner has a limestone quarry in the granite. The lower foothills of the mountains are here unaltered shales and sandstone, dipping southerly. The limestone, at the quarry, is highly crystalline. It seems to vary much in purity, containing in places considerable disseminated epidote, and being also here and there irregularly and capriciously intermixed with granite. To produce a uniformly good quality of lime from this quarry will require a careful sorting of the rock. Yet, some of it seems very pure, and samples from the top of a freshly burned kiln slacked quickly and thoroughly, yielding, to all appearance, a beautiful quality of lime. There is no timber here, and the fuel hitherto used for burning the lime was sagebrush. The granite here also varies much in character. Some of it is very feldspathic, with very little mica, and much magnetic iron.

"Some three or four miles southeast from here, and only two miles northwest of Pacoima Cañon, are the limestone quarries of Mr. Wilson, who has been burning more or less lime here for a number of years. The limestone burned here is all crystalline and a heavy body of it is enclosed in mica schist and gneissoid rocks. The latter are often curiously intermixed with the limestone itself in ways not easily explicable, the whole being very highly metamorphosed. Neither epidote nor graphite was seen here." No lime has been made here for many years.

At the present time the demand for lime in Los Angeles is in part supplied by the Los Angeles Lime Company, H. de Garmo, president, and L. A. Stahl, secretary. This corporation has its warehouses at 1522 E. Scherer Street, Los Angeles, where they sell lime, made from limestone outside of the county. Three sources of supply are drawn upon: Grand Cañon, Arizona; Tehachapi, Kern County; and Colton, San Bernardino County.

Portland cement.

This important building material is not made in Los Angeles County. The great plants at Riverside, Colton and Oro Grande, make it unnecessary to establish a plant in this county. The County Board of Supervisors, however, controls the large plant built by the city of Los Angeles at Monolith, Kern County, to supply the construction of the new city aqueduct, and this plant is in operation at present.

Artificial stone.

As the methods of constructing buildings improve, much attention is given to replacing cut stone blocks and slabs by moulded blocks of artificial stone made of Portland cement and sand or crushed rock. Thus are made a great variety of articles used in building, bricks, ashlars, window sills, lintels, copings, columns, plinths, and many other objects of attractive appearance and durability, at a cost far below that of cut stone.

Color and texture is given to these building units by using suitable varieties of crushed rock, marble giving a white color, granite an agreeable gray and red jasper contributing a warm reddish color.

In Los Angeles, the chief manufacturers of such products are the **Stengel and Krebs Stone Company,** 252 W. Thirty-seventh St., and the **Tay-Mac Company,** 1313 E. First St.

At Long Beach are the **H. H. Hamilton Art Stone Company.,** 745 Obispo Ave., and **Harrison McLintick,** 1408 Hellman Ave.

The **Alpine Plaster Company** of 1503 Alameda St., makes a business of preparing the materials which are mixed with Portland cement to form artificial stone. At present this company grinds silica, granite, and marble, which are consumed in the foregoing industry.

A similar business is transacted by the **Pacific Mineral Products Company,** of 201 N. Avenue 19. This corporation grinds granite, jasper, silica and marble for artificial stone and manganese for glass making.

CLAYS.

Brick Clay.[28]

The brick clay deposits within the limits of Los Angeles and vicinity consist principally of loam (clay mixed with sand), which contains numerous inclusions of pebbles. These clays are mostly marine deposits of the late Pleistocene, formed when the land was depressed below its present level. In the northeastern part of the city, the clays are underlain by sand. East of the Los Angeles River, on Boyle Heights, near Boyle Ave. and Seventh St., clay forms an upper stratum, from 5 to 10 feet thick, containing numerous lenses of sandy material. It is underlain by sand and gravel. Northeast of this, near the corner of Stephenson Ave. and Mott St., a bank of clay 25 to 50 feet high, was formerly worked by the Southern California Brick Company. Southwest of the city, near Inglewood, is a clay, possibly of fresh water origin, containing lenses of sand and fine gravel, underlain by coarse gravel. On Pico Heights, in the western part of the city, is an extensive clay deposit, 25 feet thick, and once worked at several points. West of Los Angeles, in Santa Monica, about one mile

[28]Bull. No. 38, pp. 243–249.

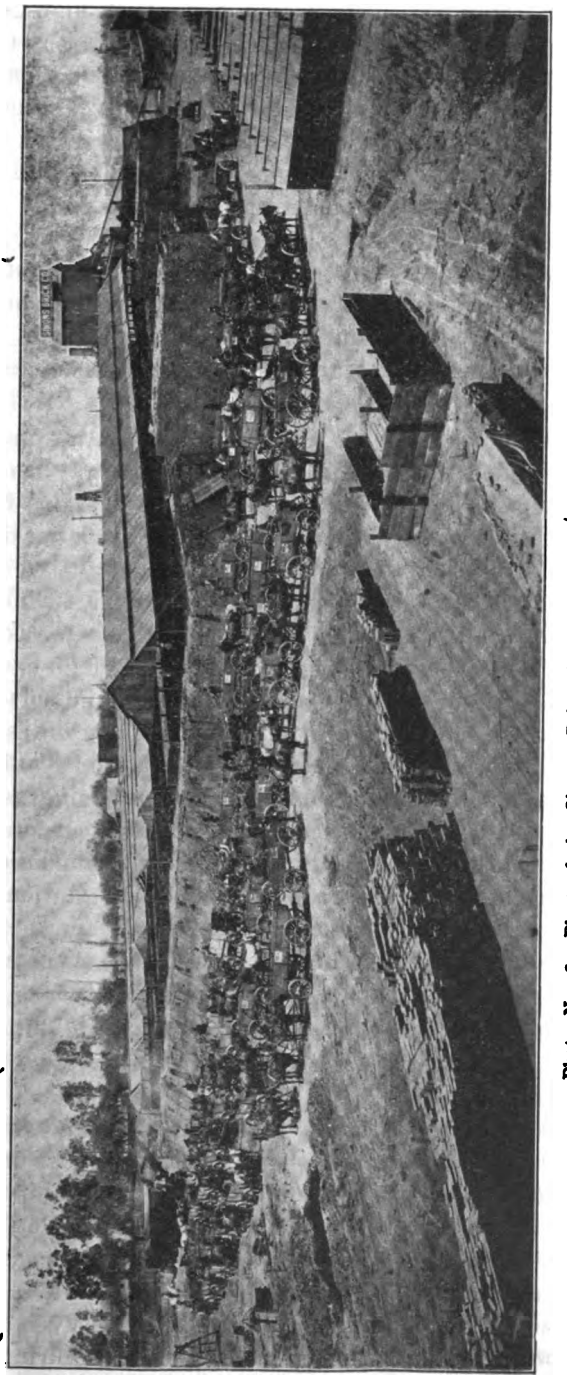

Photo No. 2. Plant of the Simons Brick Company, Boyle Heights, Los Angeles.

from the ocean shore, is an extensive deposit of high-grade clay, which is probably underlain by gravel. This is worked by the Simons Brick Company, and the Los Angeles Pressed Brick Company. In Chavez Cañon, north of Sunset Boulevard, a bank of Puente shale, over 100 feet high, is worked by the Los Angeles Brick Company.

This shale occurs in thin beds dipping south into the hill. Some of them are highly plastic, separated by thin beds of sand, and make very workable material.

The clay deposit near Inglewood is northwest of the Santa Fe Railroad station. It was formerly worked for brick by the Simons Brick Company and other corporations, but is now abandoned.

Among the leading manufacturers of brick in Los Angeles County are the following:

Simons Brick Company, W. R. Simons, president, L. Simons, secretary, 125 West Third St., Los Angeles. This company manufactures common building brick and pressed brick, and operates four brickyards, the combined capacity of which is 145,000 brick per day. From 175 to 200 men are employed.

One yard is at 1117 South Boyle Ave., Los Angeles (Photo No. 2). This occupies 24 acres. The clay bank worked here forms the upper portion of the Boyle Heights Terrace formation. It is excavated by a steam shovel. The bricks are made in stiff-mud and soft-mud brick machines, air-dried, and burned in open kilns, using oil as fuel.

Another yard of this corporation was formerly on South Franklin Ave., Pasadena, but this is not now in operation, being used only as a distributing plant. The largest plant of this corporation is at Simons' Station on the A., T. & S. F. Ry., about four miles south of Whittier. This occupies 150 acres. A shipping station is on W. Sixteenth St., near Arlington St., Los Angeles.

A third is operated in Santa Monica at Colorado Ave. and Twenty-sixth St., and a fourth at El Centro, Imperial County.

Los Angeles Brick Company, 503 Security Bldg., Los Angeles, M. S. Hellman, president; G. D. Cadwalader, secretary. This company has three yards.

One yard is corner of Mission Road and Marengo St., near the County Hospital. The clay is from 25 to 30 ft. thick, underlain by five or six feet of sand. It is ground in a pug-mill and then passes through a roller crusher. The bricks are made in a Potts' soft-mud machine, driven by electric power; air-dried and burned in a continuous kiln—an ellipse, 175 feet long and 52 feet wide; the outside ring, 12 feet wide, and the chambers (distance between the flues to the smoke-room near the bottom), 12 feet long; the firing flues 4 by 4 inches, are placed in rows 3½ ft. interdistant, five in a row. The

fuel used is fine coal. The bricks can be burned in from fifteen to seventeen days. Capacity 25,000 to 30,000 brick per day.

A second yard is in Chavez Cañon, west of Adobe St. Some years ago this company had two other yards here which have been dismantled. The clay used is the Puente shale forming the southwest bank of the cañon, as above described. This material is ground in a dry-pan grinder of special construction. The ground shale falls on a belt conveyor, passing under the center of the grinder and delivering it to another belt, which, in turn, conveys it to the brick machines. In this way the scrapers ordinarily used under the grinder are omitted, reducing the amount of power required and the cost of repairs in handling this rather stiff material. In one yard the bricks are made in a stiff-mud brick machine, having a 12-foot pug-mill combined with a 22-brick wire cutter. In the other two yards, the bricks were made in Potts' soft-mud brick machines. The bricks are dried in steam-heated driers, and burned in three continuous kilns and in open kilns. The motive power is furnished by steam. The capacity of this yard is 90,000 bricks per day.

The third yard, which is now idle, is on Seventh St., near Boyle Ave. The clay was obtained from the upper part of the Boyle Heights Terrace formation. The bricks were formerly made in a Potts' soft-mud brick machine, air-dried, and burned partly in open kilns, using oil as fuel.

Los Angeles Pressed Brick Company, Howard Frost, president, H. P. Potter, secretary, 145 South Broadway, Los Angeles. At Santa Monica (See Photo No. 3), the territory of this company covers about 60 acres, of which about one acre has been excavated. The clay deposit is from 10 to 36 feet thick, dipping northwest, and increasing in depth in that direction, presumably underlain by gravel. The clay is of better quality than in most of the deposits near Los Angeles. It makes good, hard brick, being treated in dry-pan crushers and a 14-foot pug-mill. The bricks are made in a special Giant, stiff-mud, 18-brick, wire-cutting machine. They are dried in tunnel driers, heated by the exhaust from the downdraft kilns 30 feet in diameter, with eight or ten firing flues, using oil as fuel; also in open kilns. The downdraft kilns will burn common bricks in six days and hard bricks in seven to eight days. This plant manufactures building brick, hard brick (vitrified), repressed brick, paving brick, paving blocks, and sewer pipe. The yard is equipped with a 300-h. p. boiler and a 250-h. p. engine. Its daily capacity is 90,000 bricks. (See also under Pottery.)

K. & K. Brick Company, Keller and Kubach, Room 731, Merchants National Bank Bldg., Los Angeles. Their clay bank covers 38 acres on Bishops Road. The bricks are made in a Raymond brick machine

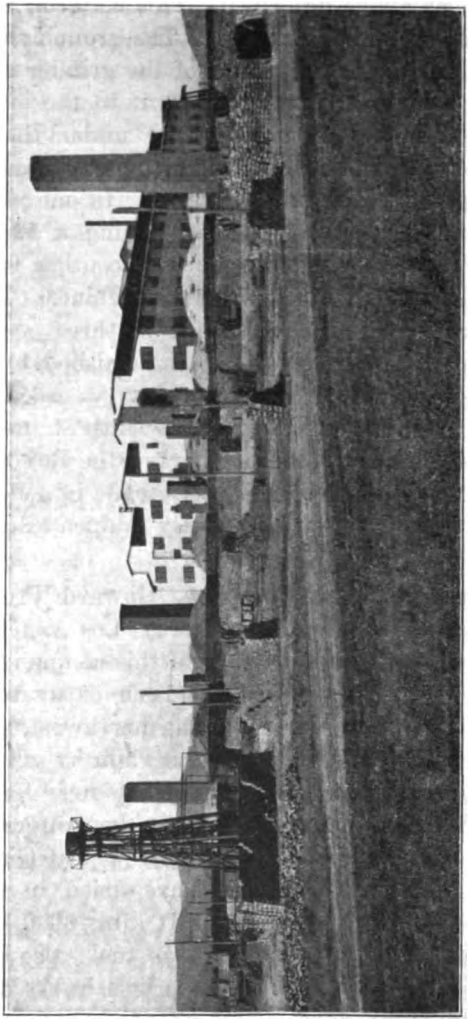

Photo No. 3. Santa Monica plant of Los Angeles Pressed Brick Co. Cut by courtesy of Los Angeles Pressed Brick Co.

and Tate wire-cutter, dried in a steam-heated drier, and burned in open kilns, using oil as fuel. The yard is equipped with a 250-h.p. boiler and 200-h.p. engine. Capacity 74,000 bricks per day. Employs 35 men.

Standard Brick Company, 101 and 102 Stimson Bldg., Los Angeles, R. G. Simons, president, H. W. Simons, secretary. This company manufactures common brick and repressed brick, at its plant east of the Los Angeles River, corner Soto and Lugo streets. The clay is ground in a dry-pan crusher. The bricks are made in a Potts' soft-mud brick machine, air-dried, and burned in open kilns, using oil as fuel. The yard is equipped with a 30-h.p. engine and boiler. Capacity 36,000 bricks per day. Thirty-five men employed.

Other brick makers formerly active in Los Angeles, but not now operating are:

Berg & Oby, College and New Depot Sts.

J. C. Hadacheck, 4144 W. Pico St.

Hubbard and Chamberlain, La Brea Ave. near Wilshire Blvd.

J. Jensen, W. Pico St.

Southern California Brick Co., Stephenson Ave. near Mott St.

Inglewood Brick & Tile Co., yard, Inglewood.

Furlow Pressed Brick Co., 2001 San Pedro St., Los Angeles. Sand-lime brick.

L. A. Paving Brick Co., yard at Montebello, but not in operation.

Mulford Vitrified Paving Brick Co., yard at Montebello. Idle.

Outside of Los Angeles City, but within the county, are the following brick plants:

Long Beach Brick Co., 215 E. First St., Long Beach. President, J. T. Parker. Yard at E. Seventh St. and Ximeno Ave. Idle.

Long Beach Brick Works, Masonic Temple, Long Beach. Richard Loynes, secretary, yard Fourteenth St., cor. Chestnut Ave. Idle.

Lordsburg Brick and Construction Co., J. D. McCoy, Mgr., Lordsburg.

Pomona Brick Co., W. W. McMullen, Mgr., Pomona.

Pacific Mfg. & Supply Association, P. McGaffey, secretary, 111 W. Sixth St., San Pedro. Idle in 1915.

Pottery clay.

But little of this material is known in Los Angeles County. In past years a plastic clay, burning red, and serviceable for making flower pots, ollas, and such products, was found on Boyle Heights near the intersection of Stephenson Ave. and Mott St. Clay from this deposit has been used in several small potteries (see C. S. M. B.

Bull. 38, pp. 213–217). At present the chief local supply of this material is from the pits of the Simons Brick Company, near Santa Monica, which adjoin the tracks of the so-called Santa Monica Air-line Ry.

The following are some of the chief manufacturers of clay products, exclusive of brick, in and near Los Angeles, though some use other than local clays.

Los Angeles Pressed Brick Company, Howard Frost, president; H. B. Potter, secretary. Offices 145 South Broadway, main works at Alhambra Ave. and Date St., Los Angeles.

This corporation has a large and well-equipped factory for making pressed building brick, roofing and other ornamental tile, fire brick, and refractory linings of different kinds. The Los Angeles plant has been in operation for several years, and the business has been constantly increasing from the start, as there is a very active demand for high-grade brick. Among the prominent buildings on the Pacific coast which are faced with this company's enameled brick are: Central, Los Angeles Investment, Federal Bank, Union Oil, Hollingsworth, Marsh-Strong and Washington Building in Los Angeles; American National Bank Building and St. James Hotel, San Diego; Hewes Building, San Francisco; and Hotel Utah, Salt Lake City. The company is meeting the demand for refractory furnace linings, caused by the increased use of oil fuel. They also make a radial interlocking brick for conduits. For refractory ware, the company at times uses a black flint fire clay from near Gypsum station, Orange County, similar to that from McKnight's clay pit near Corona. The bricks and tiles made from this clay are said to give good satisfaction. The building bricks, interior bricks, and sewer pipe, are made of white clay from the company's pits near Alberhill, Riverside County. This company has also a large plant mining local clay for the manufacture of common brick, hollow tile, sewer brick, roof tile, drain tile and sewer pipe, at Colorado Ave. and Twenty-fifth St., Santa Monica. The combined capacity of its two plants is 20,000,000 bricks per year. A third plant is in operation at Richmond, Contra Costa County.[29]

The Independent Sewer Pipe Company continues the business of the Western Art Tile Works, successor to the Pacific Art Tile Company. This company has a commodious and well-equipped factory on the Southern Pacific Railroad at Tropico, 6 miles north of Los Angeles, and has been in active operation since August, 1904, until quite recently, being at present idle.

The company manufactures floor, wall, mantel and art tiles; plain, ornamental, and embossed vitreous china, sanitary ware, plumbers'

[29] Since the above was written, a fourth plant is being built at Alberhill, Riverside County, *q. v.*

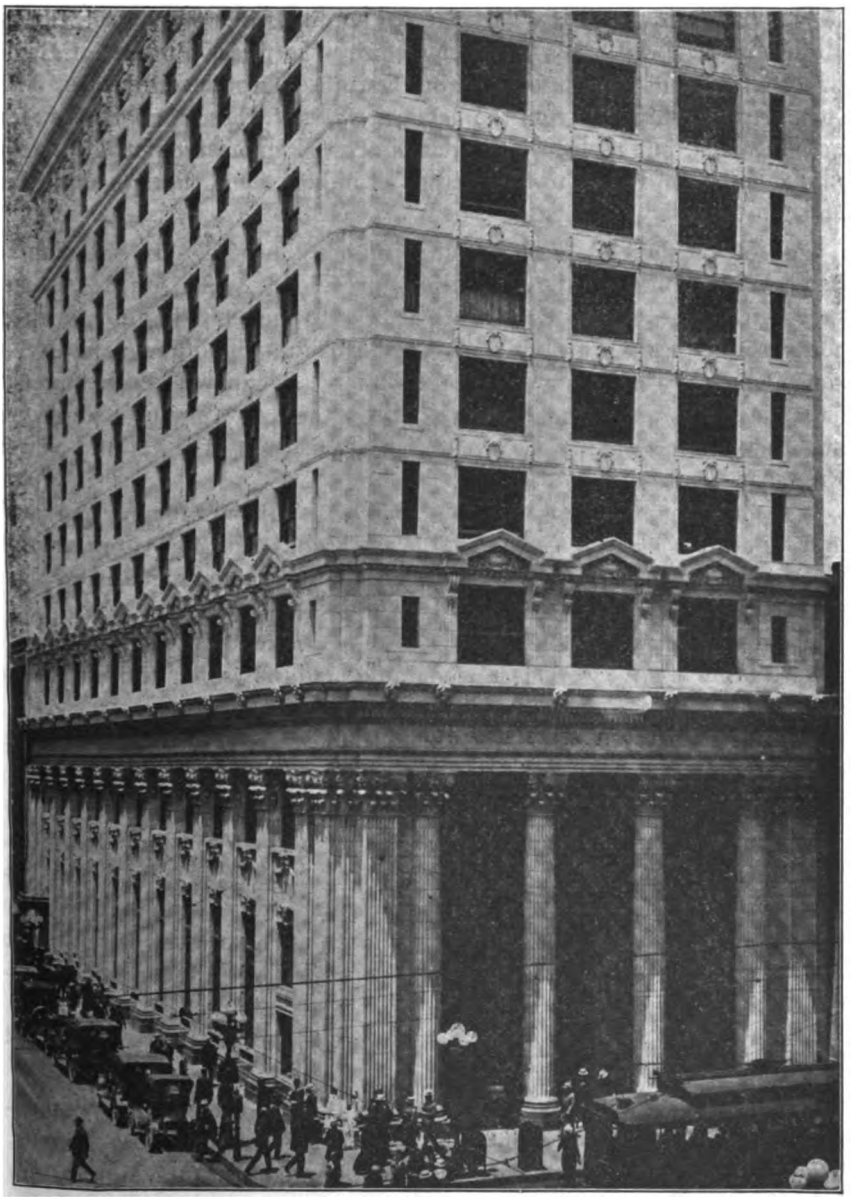

Photo No. 4. Los Angeles Trust & Savings Bank Building. Architectural terra cotta by Independent Sewer Pipe Co. Photo by Walter W. Bradley.

earthenware and other clay goods. The Los Angeles Trust & Savings Bank Building, cor. Sixth and Spring Sts., Los Angeles (Photo No. 4), is finished with architectural terra cotta from this plant.

The factory started about 1904 as the Pacific Art Tile Company and the works were closed for several weeks during the summer of

1904. It is said to be the only factory of its kind west of the Rocky Mountains. Many of its products require the finest quality of clays, which at present are imported from Europe. Ground silica and feldspar are also shipped from the eastern states. These materials occur in California, but the known deposits are so remote from the railway that it has been found to be cheaper to import them than to mine the home products.

One of the largest manufacturers of clay products is the **Pacific Sewer Pipe Company**, E. M. Durant, president, Arch Douglas, secretary, with offices at 825 E. Seventh St., Los Angeles. This corporation controls six plants, three in Los Angeles County and three in Riverside County. One plant is at 423–527 N. Avenue 26 Los Angeles. This was built and formerly operated by the Los Angeles Stoneware and Sewer Pipe Company, which was absorbed by the Pacific Sewer Pipe Company.

A second is on Central Ave., Los Angeles. This was formerly owned and operated by the California Clay Manufacturing Company of 235 Los Angeles St., and was purchased by the Pacific Sewer Pipe Company.

A third plant is at Los Nietos, about two miles SW. of Whittier.

Two other plants were at Corona, one being now dismantled, and a sixth is at Terra Cotta.

This corporation manufactures vitrified sewer and water pipe, drain tile, terra cotta chimney pipe, flue linings, enameled brick, pressed brick, fire brick, conduit, stoneware, etc.

St. Louis Firebrick and Clay Company, unincorporated, Jos. Mesmer, owner, —— Fuller, manager. Works, 2464 E. Ninth St., Los Angeles. Uses clay from McVicar's pit near Corona, Riverside County, in sec. 4, T. 4 S., R. 7 W. Manufactures pressed brick. The bricks are made in a 4-mold Berg brick machine, and burned in downdraft kilns, using oil as fuel.

Minor branches of the manufacture of clay products are conducted by the following:

J. A. Bauer Pottery Company, W. H. Brown, president, F. Anderson, secretary, 653 S. Griffin Ave., cor. Alhambra Ave., Los Angeles. They manufacture flower pots, ollas, etc., and use Santa Monica clay from Simons Brick Company.

Standard Pottery Company, W. H. Brown, president, F. Anderson, secretary, 653 S. Griffin Ave., cor. Alhambra Ave., Los Angeles. This company uses clay from Simons pits, Santa Monica. It manufactures flower pots, ollas, stove thimbles, etc. The clay is treated in a clay-grinder. The pots are made in a stamp pot machine, capacity

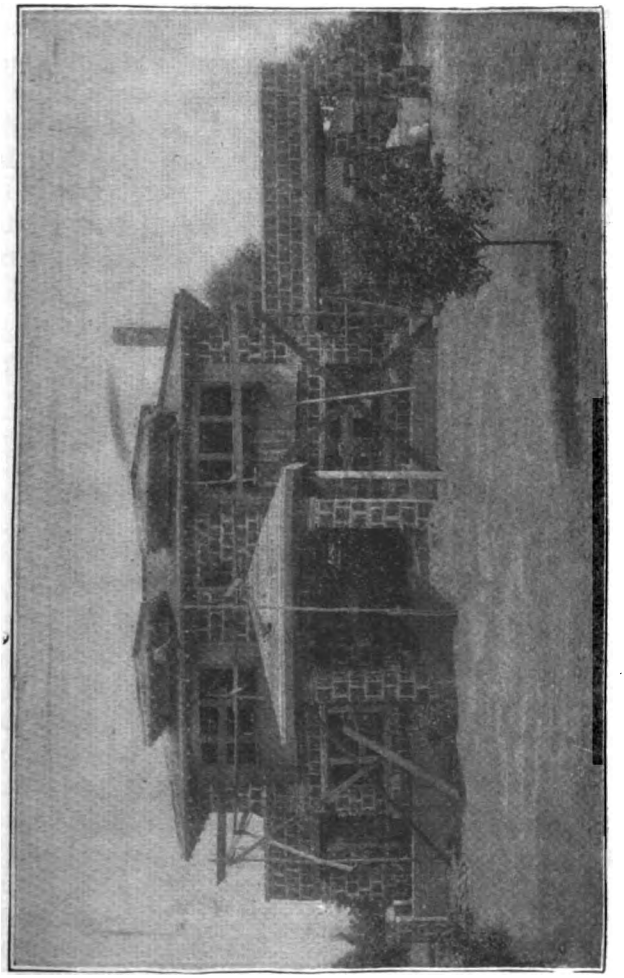

Photo No. 5. Hollow building tile used in wall construction. Cut by courtesy of Simons Brick Co.

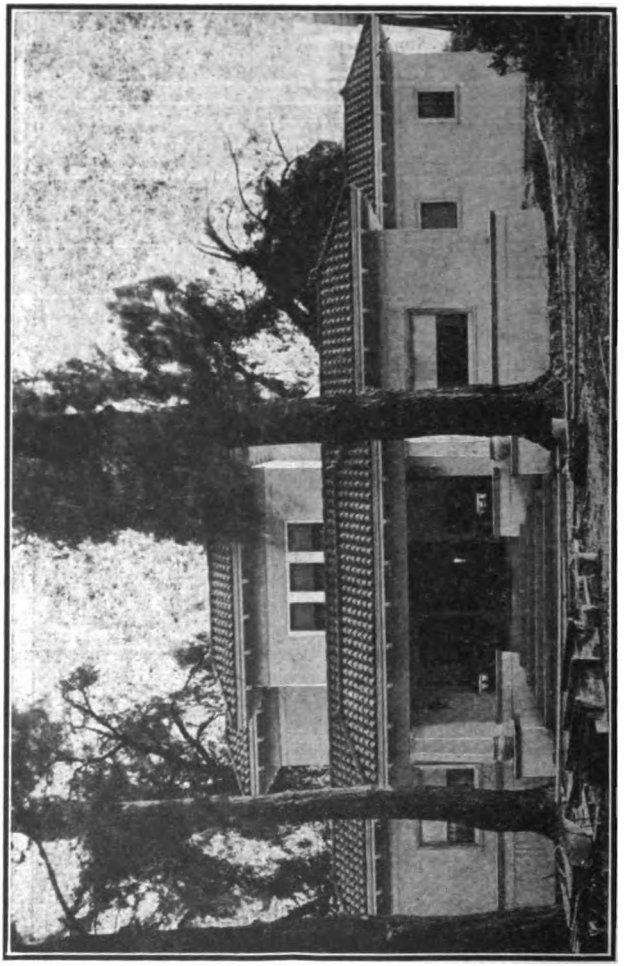

Photo No. 6. Mission style, burned clay roofing tile. Cut by courtesy of Simons Brick Co.

2000 pots per day. The plant is equipped with a 12-h.p. gasoline engine.

J. F. Tomaseck. Works, 882 E. Forty-eighth St., Los Angeles. Uses principally clays from Santa Monica. Manufactures earthenware, stove linings, flue thimbles, assayers' furnaces and muffles.

The **Simons Brick Co.**, described in the preceding pages under brick, also makes hollow building tile, roofing, and various other forms of ornamental tile. Photos Nos. 5 and 6 show the application of two of these products in structural work. The hollow building tile is fire-proof and makes a lighter weight wall than brick, and stated also to be both cooler in summer and warmer in winter than brick, owing to the interior air spaces. The mission style, burned clay roofing tile is not only picturesque and ornamental, but is peculiarly adapted to the climate of California, because of the absence of snow and frost.

COAL.

The only record of this fuel in Los Angeles County is found on page 204 of the Ninth Report of the State Mineralogist. The observer, Mr. E. B. Preston, in 1889, wrote as follows:

"About one and a half miles southwest from Newhall in some low-lying sandstone hills, a Mr. Brophy is mining for coal. He has started an incline shaft on one of the larger bituminous strata, dipping 25 degrees north. The strike is east and west. This stratum, in the end of the drift, is thirty-two inches thick, and above it is a layer of thirty inches of fire-clay. Toward the bottom of the drift the carbonaceous matter becomes more compact, assuming in places the appearance of lignite. They say they have had it tested and that it contains 72% of carbonaceous matter and 25% of ash."

No further work has been done on this deposit of carbonaceous material and it is probably of little value. The geologic formation at this point is the Fernando or uppermost member of the Tertiary as shown on Plate III of the folio accompanying Bulletin 69 of the State Mining Bureau.

No other occurrences of coal have been reported in this county, except in bluffs along the coast four miles west of Santa Monica where explorations were made in 1889.[30]

FELDSPAR.

A single deposit of this mineral has been reported. It lies three or four miles northwest of Acton and belongs to **Geo. Duerhren** of that place. It is an orthoclase containing up to 14% potash, but is not being used commercially.

[30] R. IX, p. 208.

FULLER'S EARTH.

This important material used for filtering and decolorizing oils, is a variety of clay and varies greatly in chemical composition.

It has not been found abundantly in Los Angeles County, and only one locality is known. This is six miles west of Saugus, in T. 4 N., R. 16 W. It is owned by R. E. Overman, 117½ Commercial St., Los Angeles.

GEMS.

Beach stones.

On some of the California beaches are found many interesting pebbles of whitish chalcedony that frequently have the appearance of a partial polish.

In Bulletin No. 37 of the State Mining Bureau, on page 71, Dr. Geo. F. Kunz described some occurrences in Los Angeles County.

About fifteen miles south of Los Angeles is Redondo, a well-known beach resort. Here are found many beautiful pebbles. It is the custom after each tide for visitors to search the beach in quest of these treasures, which are especially abundant north of the pier and as far as Playa del Rey. They are thought to come from a bed of sand and gravel in the vicinity. In 1901 several of these pebbles were found in an Indian grave near Redondo. Large quantities of these pebbles are gathered and sold to tourists. Chains are made by drilling the stones and stringing them on a flexible wire. They are also polished and set in rings, brooches, etc.

Besides the chalcedony pebbles are others in which red jasper is mixed with chalcedony. More striking than the others are the so-called flower stones. These appear to be fragments of a dark colored eruptive with very fine-grained or aphanitic base, in which feldspars have developed with a radical structure suggesting little flowers.

Another important pebble locality was formerly that known as Moonstone Beach, on Santa Catalina Island, but this is now exhausted. The pebbles were not moonstones but nodules of quartz weathered out of a rhyolite rock—composed of sanidine feldspar and quartz—while those of Redondo are agate and chalcedomy, and doubtless came from some amygdaloidal rock, a reef of which may outcrop in the beach below low water mark, the pebbles being washed up by the waves.

Beach stones are collected, polished, mounted and sold by the following dealers at Redondo: S. B. Clem, Wm. Kerrn, Square Deal Gem Co.

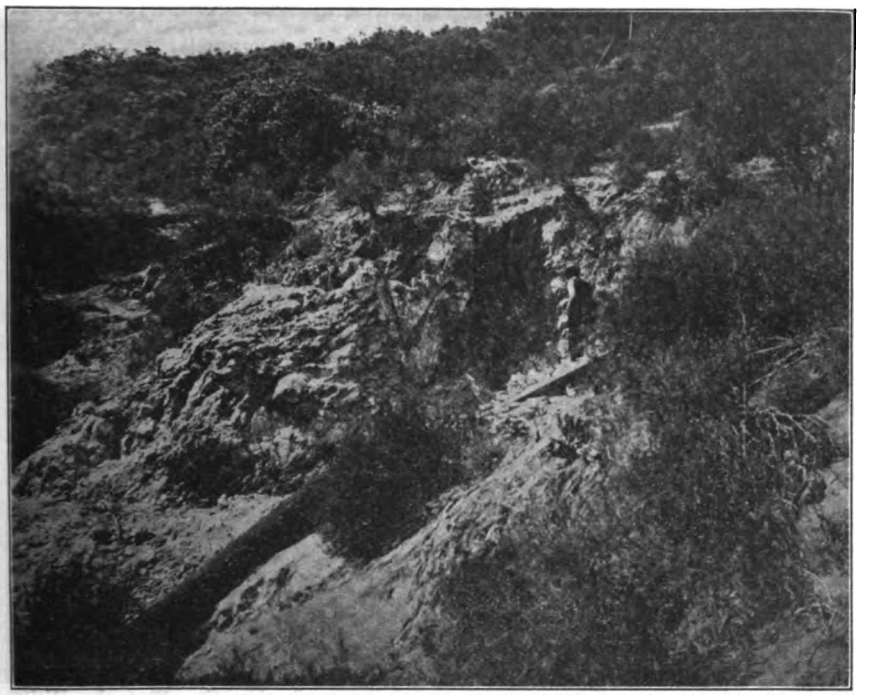

Photo No. 7. Outcrop of graphite vein on Prince No. 1 claim of California Graphite Co. Photo by Walter W. Bradley.

GRAPHITE.[31]

E. S. Bastin[32] has the following to say, in part, on California graphite:

"The graphite deposits of Los Angeles and San Diego counties resemble the characteristic deposits of New York, Pennsylvania and Alabama in that the graphite occurs as crystalline 'flakes' disseminated through a schist. The flakes in the California graphite schists are, however, much smaller than those in the eastern occurrences, most of them not exceeding 0.25 millimeter in diameter. For this reason the problem of their concentration is entirely different from that of the eastern deposits, nor would the concentrate be adapted for use in the manufacture of crucibles or other refractory products, in which a coarse flake is essential. On the other hand, the percentage of graphite in the California deposits appears to be nearly twice that of most of the eastern deposits of flake graphite. Another advantageous feature is the absence or great scarcity of mica, a mineral which, because of its flaky character, is particularly difficult to separate from flake graphite.

[31]See Bull. 38, p. 280; also R. X, p. 282.
[32]U. S. G. S., Min. Res., 1914, Pt. II, p. 164.

Photo No. 8. Tramway and graphite claims of California Graphite Co. Photo by Walter W. Bradley.

"The California properties present, therefore, a number of favorable features. The fineness of the graphite undoubtedly renders difficult its complete separation from the gangue minerals, but there should be no great difficulty in obtaining a partial concentrate sufficiently rich in graphite to serve for foundry facings, boiler 'compound,' and paint pigment, while at the same time conducting experiments with a view to securing a more perfect product. For the uses mentioned above the graphite would have to compete with Korean amorphous graphite, which can be bought in New York at from $22.50 to $25 a ton and on the Pacific coast at a still lower figure."

California Graphite Company, G. A. Skinner, president, P.O. Box No. 157, Saugus, Cal.; Los Angeles office, 506 Washington Bldg. This company has two groups of claims in Secs. 11 and 12, T. 6 N., R. 15 W., S. B. M., 18 miles from Saugus, in a branch of San Francisquito Cañon. The upper group consists of seven claims, named Prince No. 1 to No. 7, and a mill site, and there are two claims in the lower group. The vein as shown in the outcrop (Photo No. 7) is 8 ft. wide, striking north of east, and dipping at a rather steep angle. In Photo No. 8, this open cut may be seen at the head of the small ravine in the upper right-hand corner. This "vein" is in reality a graphite schist in a

granitic country rock; and is remarkably persistent in character and width. It was observed at points covering practically the full length of Prince No. 1 claim (1500 ft.), and is stated to be traceable throughout the length of five full claims, being opened up in a crosscut adit on No. 4, about 3000 ft. distant from No. 1. At one point there is a shaft down 64 ft., with a drift of 105 ft. The graphite on the upper claims is of the flake variety, while that on the lower group is amorphous.

According to Bastin:[33] "Microscopic study of samples from Prince No. 1 and No. 4 claims shows that nearly all of the graphite is in flakes 0.25 millimeter or less in diameter, although at the head of the wire tram on claim No. 1 schist carrying graphite flakes up to 1 millimeter in diameter was noted. The principal mineral of the graphite schist is a colorless amphibole, probably anthophyllite; other minerals in approximate order of abundance are quartz, feldspar, and pyrite, the latter in very small quantities. Determinations were made in the survey laboratory of the percentage of graphite in three samples collected by the writer from this property, with the following results:

Samples of Graphite Schist from Los Angeles County.

Sample	Percentage of graphite
Composite sample of graphitic schist from many different localities on Prince No. 1 claim	7.29
Composite sample taken at intervals of about 1 foot across 50 feet of graphitic schist exposed in crosscuts in tunnel on Prince No. 4 claim	12.00
Sample of richest type of graphitic schist from same tunnel as No. 2	17.48

"Large samples from Prince No. 4 claim sent to Germany for experimental treatment are said to have concentrated 6 into 1, yielding a concentrate of lubricating grade."

An aerial tramway, 1500 ft. long, with buckets 200 ft. apart, connects the open cut with the mill. It is operated by gravity, there being a difference of 500 ft. in elevation between the terminals. The mill, with a capacity to treat 10 tons per day, is equipped with a 30-h.p. gasoline engine, rolls, and two buhr mills. Several different methods of concentration were tried—water, air, and oil—with indifferent success until recently. The main difficulty seems to be the elimination of the fine clay. Mr. Skinner states that he has finally evolved a dry process which yields a very clean product (samples of which have been placed in the Museum of the State Mining Bureau); and he expects to resume operations by July 1st (1916). The haul to Saugus can be made for $2.50 per ton. There are several good, freshwater springs on the property.

[33] loc. cit., p. 165.

At one point on Prince No. 1 claim, an outcrop of magnesite about 3 ft. wide was observed. It appears to be in a local area of serpentine; but as no work had been done on it, its extent was not determinable at the time of our visit.

Graphite also occurs in several points in Los Angeles County, but not yet developed commercially. A deposit of crystalline graphite occurs in T. 7 N,. R. 15 W., S. B. M., near Elizabeth Lake.

In Sec. 4, T. 1 N., R. 13 W., S. B. M., in the Verdugo Hills, 12 miles northeast of Los Angeles, a stratum of graphite 20 ft. wide is found in mica schist. It is amorphous and soft, which renders the separation difficult and expensive. This soft graphite can only be used for paint or foundry facing (see XIth Report State Mining Bureau, p. 207).

Graphite occurs in Tujunga Cañon, four miles from its mouth, and is found also at the head of San Francisquito Cañon, in S. ½ Sec. 11, T. 7 N., R. 16 W. The vein runs across to Charlie Cañon.

GYPSUM.

(Hydrous calcium sulphate.)

The chief deposit of this material known in this county is near Palmdale on the S. P. R. R.

It was formerly worked by the **Alpine Plaster Company** of Los Angeles and Pasadena, and was thus described in Bulletin No. 38, pp. 284–286.

"The gypsum outcrops for several miles east and west of Palmdale, in the low foothills along the south side of the great Antelope Valley, interstratified with conglomerate, sandstone and shale. The general dip of the strata is to the south. So far as known, the total thickness of the gypsum beds has not yet been ascertained, but there is sufficient showing, on the outcrop, to promise a supply for many years to come. Part of the gypsum occurs in fibrous layers one-eighth to one-half of an inch or more thick, alternating with thin layers of clay and shale. The banded layers are in places rather sharply folded, and in places faulted. In other places, along the outcrop, the gypsum is more massive, shows little crystallization, and contains more or less white and yellow clay diffused through its mass."

The better grades of the gypsum quarried, it was stated, ran over 80% in calcium sulphate. The workable beds varied in thickness from 2 to 30 ft. or more. The quarry, in July, 1904, contained from 4 to 5 feet of commercial product, with almost no stripping. All of the quarrying so far has been done on the outcrop along the brow of a low hill. A dozen or more small quarry openings had been made. The gypsum was manufactured into plaster at the factory, which was located near Palmdale, on the Southern Pacific Railroad. The material was transported in wagons from the quarries to the mill.

The mill was in operation for three years, from 1901 to 1904, manufacturing two grades of plaster. No. 1, white for finishing; No. 2, wall plaster. The product was principally used in Los Angeles and Pasadena, and the demand was said to be steadily increasing. There were two pots in operation with a capacity of 40 tons of plaster per day, using oil as fuel. This is now dismantled. This company now has a plant at Fifteenth and Alameda Sts., Los Angeles, where it prepares material for artificial stone. (See also XIth Report of the Cal. State Mining Bureau, p. 248; XIIth Report, p. 324; XIIIth Report, p. 504.)

The Fire Pulp and Plaster Company, 750 South Alameda St., Los Angeles, formerly owned a gypsum deposit at the head of San Francisquito Creek, 13 miles from Casteca. The gypsum was of good quality; it occurred, however, in relatively small pockets and layers within the inclosing country rock. This company is now out of business. (See Bull. 38, p. 285.)

About two miles north of Lang, a station on the Southern Pacific Railroad, in Sec. 30, T. 5 N., R. 14 W., S. B. M., there was a deposit of gypsum nearly 8 feet wide and almost perpendicular. (See IXth Report State Mining Bureau, p. 195.)

In Bulletin 413 U. S. Geological Survey, pp. 29–31, is a detailed description of some of these deposits, written by Frank L. Hess, which is so complete that it is here given in full:

"At Palmdale, Los Angeles County, a station on the Southern Pacific Railroad, sixty-nine miles north of Los Angeles, both efflorescent and interbedded gypsum deposits are found, about 1½ miles southwest of the railroad, on a low ridge along which runs the line surveyed for the aqueduct to bring water from Owens River to Los Angeles. A considerably decomposed granite occupies a portion of the outer side of the ridge and on it, in places, is a basal conglomerate containing large boulders of granite. Over this is a series of gypsiferous soft sandstones and shales. With the shales thin strata of gypsum are interbedded, and, on these sediments, gypsite has formed in deposits similar to those farther north, along the Coast Range. The gypsum deposits occur through a length of about a mile or a mile and a half along the top and sides of the ridge. In places they have been washed down the sides of the hill, so that they cover the granite below. Two companies, the Fire Pulp Plaster Company and the Alpine Plaster Company, are working the deposits, and each has a plaster mill at Palmdale, to which gypsum is hauled in wagons.

"The gypsite is two to ten feet thick and is irregular in distribution and purity. At a number of places it occurs in small valleys in which it has been deposited by freshets and brought down from the low hills above. In places, it is much stained with iron, which has been brought in since the deposition of the gypsite, as shown by stains following

watercourses through the gypsite. The gypsite is ordinarily overlain by 6 inches to one foot of dirt, and excavations from which it is removed, cover from a few hundred square feet to an acre or more in extent. The thickest deposits are on the brows of spurs of the main hill, where they reach a thickness of nine feet. The gypsite is creamy white in color.

"A partial analysis by Geo. Steiger of a specimen from one of these deposits which was being worked February 1, 1907, gave the following results:

Partial Analysis of Gypsite from Alpine Plaster Company's Deposit, Palmdale, Cal.

Lime	22.8
Sulphur trioxide (SO_3)	45.2
Water driven off at 60° C.	.1
Water driven off at 300° C.	20.5
Chlorine (Cl)	.06
Iron oxide (Fe_2O_3)	.30

"This is apparently equivalent to about 77.3 per cent gypsum. The interbedded gypsum deposits also are worked by the Fire Pulp Plaster Company.[34] The beds are not at all uniform in quantity of gypsum carried, and can be worked only in places. The dip is uneven, but is about 45° W. The gypsum strata reach in places a thickness of 3 or 4 inches, and all contain more or less clay. The rock is shot down with dynamite and then handled with forks to separate the gypsum from the clay. Some hand picking also is necessary.

Partial Analysis of Rock Gypsum from Palmdale, Cal.

Lime	27.5
Sulphur trioxide (SO_3)	32.5
Water driven off at 60° C.	.8
Water driven off at 300° C.	15.6
Chlorine	Trace
Iron oxide (Fe_2O_3)	1.3

"The specimen apparently carries 72.1 per cent of gypsum.

"Similar beds outcrop at a point about ½ mile northwest of the workings just described. They have been worked to a certain extent and a face 25 feet high and 50 feet broad is exposed in an excavation in the side of the hill. The beds here dip northeastward. Other deposits of gypsum are said to occur in the higher hills 6 or 7 miles south of Palmdale. Similar interbedded gypsum deposits are reported to occur at Lang, southwest of Palmdale, and the deposits at Castaic are said to be in the same rocks."

[34] Now suspended.

INFUSORIAL OR DIATOMACEOUS EARTH.

(Bulletin No. 38, pp. 291–292.)

This important material is composed of the siliceous shells or outer skeletons of minute forms of vegetable and animal life which inhabit lakes and ponds and also the ocean, at the bottom of which extensive deposits are formed.

Its cellular and porous character gives it great absorbent powers and so it is used largely as an absorbent of nitroglycerine in making dynamite. As it mainly consists of silica it has some value as an abrasive and is used to some extent as a polishing material.

None has been produced commercially in Los Angeles County, but a few localities have been noted.

The Banning Company, 504 Pacific Electric Bldg., Los Angeles, which owns Santa Catalina Island, has there a deposit of infusorial earth 75′ thick, from which considerable amounts have been shipped. (See XIIth Report of the State Mining Bureau, p. 406; XIIIth Report, p. 643; Bulletin No. 38, p. 363.)

On the **Palos Verdes Ranch,** which includes the San Pedro Hills, are several exposures of infusorial earth of a very chalky character. None, however, has been developed to any extent.

At Point Duma, northwest of Santa Monica, there is said to be a large deposit of infusorial earth. (See State Mining Bureau IXth Report, p. 208.)

Another deposit, as yet unused commercially, is in the bluffs three miles south of Redondo as reported by Mr. E. B. Preston.[35]

Still another deposit of this material has been observed between Los Angeles and Pasadena near Bairdstown, but it is idle, commercially.

MAGNESITE.

(See California Graphite Co., under "Graphite.")

MINERAL PAINT.

Of this material there is no production in this county except as noted under Borax, but, as reported by Mr. E. B. Preston,[36] highly colored clays, fit for use as pigment, occur in the coast bluffs, two or three miles north of Redondo. These beds have never been worked commercially.

As noted under Borax, at San Fernando the **Paradise Borax Mining Company** manufactures a pigment called Silumnia Kalsomine, which is used in finishing plastered walls.

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[35] R. X, p. 231–2.
[36] R. IX, p. 208; also, Bull. 38, p. 338.

This material is made from a deposit lying north of San Fernando and about 1½ miles south of Humphrey's Station in the Santa Clara Valley. It is in sections 25 and 27, T. 4 N., R. 15 W., S. B. M. The mineral is a clay containing 9 to 15% boracic acid.

MINERAL WATERS.

While the curative effects of medicinal waters have long been known, there has been of late for some years, a constantly growing demand for bottled waters for table use. In this case, the chief requirement is purity. The sale of such waters is an industry of some consequence and, for Los Angeles County, amounted in 1914, to $8,025.

There are a number of mineral springs in Los Angeles County, some of them being within the city limits of Los Angeles. Of these the more important are **Bimini Springs**, Third St. and Vermont Ave., Bimini Water Company, owners, J. J. Warrick, manager baths and sanitarium.

Radium Sulphur Springs, 5663 Melrose Ave., near Gower St., and near the old village of Colegrove, G. P. Gehring, manager. Baths and sanitarium.

Rose Spring Mineral Water Company, 4835 Pasadena Ave., R. F. Smith, manager, 214 Van Nuys Bldg. Bottled for sale.

Elysian Spring Water Co., A. D. Pugsley, manager. Well and bottling plant, Valentine St., cor. Baxter. Bottled for sale.

Outside of Los Angeles are the following:

Santa Fe Springs, three miles southwest of Whittier.

Kentucky Springs, four miles south of Vincent Station, on S. P. R. R.

Several springs carrying sulphur have been reported from near **Chatsworth** as follows:

Mouth of Bell Cañon, five miles southwest of Chatsworth.

Santa Susana Mountains, five miles north of Chatsworth.

Santa Susana Mountains, one and a half miles north of Chatsworth.

Others occur on the **Tucker Ranch**, ten miles northwest of Santa Monica. These last records are from the U. S. Geological Water Survey, Water Supply Paper No. 338, by Gerald A. Waring, p. 380. To this valuable publication the reader is referred for further details.

PETROLEUM AND NATURAL GAS.

The subject of these important mineral fuels is in charge of a special division of the State Mining Bureau, and so the writer will not discuss them here. A recent publication, covering the subject is,

"Petroleum Industry of California," Bulletin, No. 69, by Mr. R. P. McLaughlin and Mr. C. A. Waring. Special publications on the several oil fields are Bulletins of the U. S. Geological Survey, Nos. 309, 317, 322, 357, 398 and 406, describing respectively, in much detail, the Los Angeles and Puente Hills fields, the Santa Maria District, the Coalinga District and the McKittrick-Sunset Districts. To these authoritative works, the reader is referred for full particulars.

In 1914 the production of petroleum in Los Angeles County was 3,558,690 bbls.; valued at $1,957,279.00 and gas production was 1,250,000 cu. ft., valued at $75,000.00.

POTASH.

While some production of this material is annually reported from Los Angeles County, no mineral deposits are known from which it could be produced.

On the coast near Point Fermin, are, however, very extensive growths of the seaweeds known as kelp, which contain a substantial percentage of potassium chloride and have been discussed in publications of the U. S. Department of Agriculture[37] as an important source of this material so valuable for the manufacture of fertilizer. On Long Beach Harbor is an extensive plant for the extraction of potash from kelp. This industry was undertaken some years ago by a corporation called the Coronado Chemical Company, operating at Cardiff, on the coast of San Diego County. About 1912, this was merged in a new corporation known as American Potash (Inc.), which began the construction of a plant on Long Beach Harbor, west of the city of Long Beach. After two reorganizations the title of the company has been changed to the **American Products Company**, which is now perfecting the plant (see Photos No. 9 and No. 10) and preparing to produce potash on a large scale. I. M. Naylor is president and manager. This plant in contradistinction from the usual practice, does not burn the kelp, but uses a wet, digesting method (the "Naylor" process), by which the potassium salts are extracted without destroying the other constituents, particularly the cellulose. This latter is to be used in the manufacture of handles for knives and other instruments. It is intended also to recover the iodine and bromine that may be present in the kelp. The potash is refined and shipped in the form of both the chloride ("muriate") and the sulphate. The kelp residue will be utilized for fertilizer mixtures.

The **Sea Products Co.**, Seventh St., Long Beach, Howard W. Judson, manager, has a plant north of the American Products Co. Their

[37] Senate Document No. 190, 62d Congress, 2d Session.

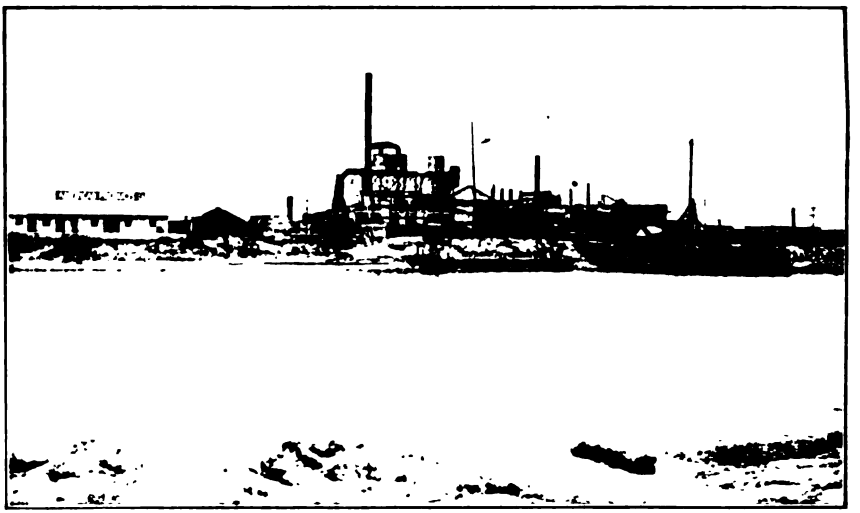


Photo No. 9. Potash plant of the American Products Co. at Long Beach. Photo by Walter W. Bradley.

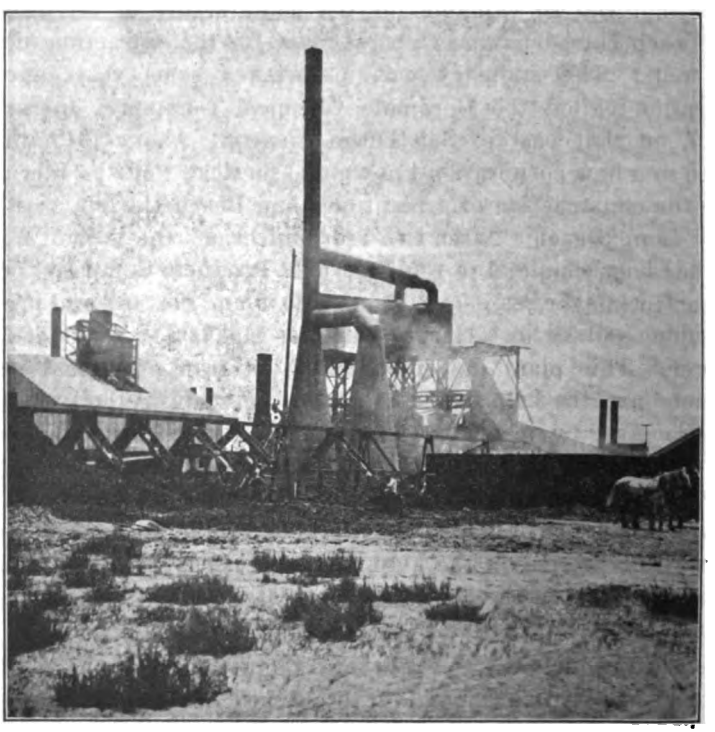


Photo No. 10. Kelp storage and furnaces in the plant of the American Products Co. at Long Beach. Photo by Walter W. Bradley.

practice is to burn the kelp and ship the ash to fertilizer manufacturers.

The **National Kelp Potash Co.**, A. C. Walker, manager, is building a plant near that of the Sea Products Co., and will dry (not burn) the kelp in a rotary kiln. The dried kelp will be shipped to fertilizer manufacturers.

Potash in Kelp.

The extraction of potash salts from kelp has so long attracted attention that it may be of interest to give here a few facts concerning the industry. One of the abundant and prolific species of kelp in this region is known botanically as *Macrocystis pyrifera* and the average of many analyses made in the laboratory of the U. S. Bureau of Soils shows a mean content of potassium chloride amounting to 23% of the dried kelp.

Kelp loses, in drying, 85% of its weight, and in extracting potash the evaporation of this large amount of water constitutes quite a factor in the expense of operation. The relation, however, of cost to selling price is such as would appear to make this industry very profitable under conservative management, especially in view of the present scarcity of German potash salts and the increasing demand for such material.

The **American Trona Corporation,** Alfred von der Ropp, president, with offices at No. 366 Pacific Electric Bldg., Los Angeles, is building a refinery for potash and other saline products at San Pedro. The crude materials will be shipped from their plant at Trona on Searles Lake in San Bernardino County, where only a rough or first concentration is to be made.

SALT.

The chief production of salt for domestic purposes in Los Angeles County, is by the **Long Beach Salt Company,** its production amounting to 10,000 tons per year. This plant, which recovers salt from sea water by solar evaporation is one-half mile south of the Anaheim road west of Long Beach. The holdings amount to 1200 acres of salt marsh which has been divided into shallow ponds for evaporation, by dredging and the construction of low dams.

The process of separating salt from sea water by solar evaporation is quite simple and was described in detail in connection with the Western Salt Company in the report on San Diego County.[38] This corporation has offices at 111 W. Third St., Long Beach. Its officers are S. Townsend, president, and C. J. Walker, secretary.

But one other salt manufacturing plant has been operated in this

[38]Geology and Mineral Resources of San Diego and Imperial Counties, 1914, pp. 33-36.

county. This was within the limits of Redondo Beach and was described as follows:

Lake Salinas, Redondo. In regard to this, Mr. E. B. Preston, writing in 1890, in Report X, p. 281, gave the following description:

"Within the limits of Redondo Beach, is a small salt-water lake, about three hundred yards from the ocean, and about five feet above high-water mark, which does not receive its water supply from the ocean, having an entirely different combination of salts, and possessing features that make it of much interest to the geologist and chemist.

"The lake is about half a mile long, and from four to six feet deep. At the south end is a large shallow basin separated from the main lake by gates. The banks are low and gradually sloping, a sand dune intervenes between the ocean and the lake, and the bottom of the latter is a bed of clay. Around this pond, on both sides, about thirty wells have been bored to an average depth of twelve feet into the clay that forms the bottom of the lake, and all of these yield good, soft drinking water. Between these sweet-water wells next to the ocean, and the ocean itself, near the top of the sand dune, a well has been sunk twenty-six feet, passing through the clay for a distance of ten feet. The water obtained in this well, is claimed to have medicinal qualities; it certainly tastes bad, if that is any criterion of its medicinal value.

"The lake water is a much stronger solution of salts than the water from the open ocean, containing a much larger proportion of magnesium chloride, but the statement to the writer, made by parties on the spot, that the water was ten times as highly saturated as sea water, is evidently erroneous, as such a solution would pass the point of saturation. How to account for the presence of these different qualities of water in their relative positions, is not plainly to be seen. The salt water could be accounted for in several ways as there are saliferous shales and sandstone in the neighborhood; also, there are magnesian rocks on the flanks of the hills surrounding the plain; but the fresh water in the wells surrounding the lake conflicts, from the fact that these wells, terminating in the clay, compel the assumption that the water in them is drainage water from the near vicinity."

Concerning this Salt Lake, Dr. Gilbert E. Bailey, in 1902, wrote in Bulletin No. 24, p. 122:

"Salt works were erected some years ago near Redondo, on a small lagoon about half a mile north of the town. The waters of this lagoon contain a strong brine, but the work of making salt was interrupted first by one misfortune, and then by another. The works were equipped with considerable machinery, that was taken down and removed in the fall of 1901; and the present operations are confined to vat work and solar evaporation on a small scale."

At the present time, this business has been suspended for at least ten years.

SILICA.

(Including glass sand.)

Silica occurs quite abundantly in this county and is worked to a moderate extent. Large quartz veins of high purity are frequent and one outcrop was worked in 1906 near Lancaster, as follows:[39]

"About four miles southwest of Lancaster, is a deposit from which quartz was formerly obtained for the glass works at Los Angeles. The quartz was hauled by wagon from the quarry to Lancaster, from which it was shipped by rail to the glass works. It was a white, milky quartz, quite free from impurities."

Another large deposit of vein quartz belonging to **Telfair Clayton** of Los Angeles, lies between Lancaster Station on the S. P. R. R. and Muroc Station on the Santa Fe Ry.

Not long ago the **Los Angeles Silica Corporation,** 309 Central Bldg., Los Angeles, was formed to work a deposit of quartz near Tujunga Cañon in the south one-half of the southeast one-fourth of Sec. 34, T. 3 N., R. 14 W.

This is probably a tertiary sediment, but proved to be too impure for a glass sand, though available as a filler in asphalt paving. The deposit has not been developed and the corporation is moribund.

In Bulletin No. 38, p. 277, is the following note made in 1906:

"C. E. Joslin, 900 Braly Bldg., Los Angeles, owns a quartz vein six miles northwest of Acton which has been opened during the present year. The vein is reported to be thirty feet thick. Analyses of two specimens gave, for one, 98.3 per cent of silica and 1.3 per cent of iron and alumina, and for the other 99.43 per cent of silica." At present this deposit is idle.

One-half mile south of Ravenna Station in the north one-half of Sec. 16, T. 4 N., R. 16 W., is a deposit of silica controlled and worked by the **Ohio Valley Construction Company,** John Schrader, manager, Marsh-Strong Bldg., Los Angeles. The holdings consist of eight claims called the Elizabeth group.

A deposit of siliceous sand between Polomas and Santa Feliciana Cañons was noted in 1889 by E. B. Preston.[40] This would be in T. 5 N., R. 17 W., but it does not appear that it has ever been opened commercially.

Glass.

Glass is a material so widely used in modern life that glass factories seem a logical appendage of every large city. While this industry

[39] Bull. 38, p. 277-278.
[40] C. S. M. B., R. IX, p. 202.

has been initiated in and near Los Angeles it is lifeless at present, though there is promise of a new plant of large size in this neighborhood.

In Bulletin No. 38, pp. 277–8, is the following record:

"**Southwestern Glass Manufacturing Company**, G. E. Bettinger, president, 301 North Avenue 19, Los Angeles, successor to the Los Angeles Glass Company, began operations in February, 1904. The company obtains its lime from Colton and its quartz from Lancaster. Bottles, Mason jars and packing jars are manufactured. The Mason jars are made by machine, but the bottles and small jars are blown in molds. The glass is free from iron color, but has a smoky tint that slightly mars its beauty. Located as it is in the midst of one of the greatest fruit districts in the world, this factory should have an extensive local trade in fruit jars and bottles."

This manufacturing enterprise has long been abandoned and its old factory is now occupied by the Pacific Mineral Products Company.

On the salt meadows west of Long Beach is a plant operated a few years ago by the California Glass Insulator Company. For some two years this has been idle.

Since January, 1916, a new plant is being erected under the following title:

The **Torrance Window Glass Company** (formerly Hurrle Window Glass Co.) manufacturers of window glass, Torrance, California. Office at plant, Torrance. C. L. Bisbee, secretary and treasurer, of the firm of Bisbee, Fishburn Company, Twentieth and Alameda Sts., Los Angeles.

The Torrance Window Glass Company is completing its plant of six buildings, which constitutes the first of four units, and will cost $40,000. The site covers a ground area of five acres. The first unit will employ 116 skilled workmen (blowers and cutters) and will operate day and night. The initial capacity of the plant will be 10,000 to 12,000 boxes of glass per month, each box containing 50 square feet of glass.

The company, while it has sufficient raw material to use, is in the market for soda ash, salt cake and pure silica sand in quantity, f. o. b. shipping point, provided these materials can be secured within a reasonable distance of their plant. At the present time, it is securing its silica from Monterey, California. The company is a close corporation, and other directors aside from those mentioned above are Julius Conrad, Arthur Asher, and Adolph Siorty.

ORANGE COUNTY.

INTRODUCTION.

In shape this county is nearly a rectangle, with the longer axis northwest and southeast. It is bounded on the east by Riverside County, north by San Bernardino and Los Angeles counties, west by the latter county and south by the Pacific Ocean. It contains 795 square miles, and was included in Los Angeles County when the latter was organized in February, 1850, but in March, 1889, Orange was separated into a distinct county. It has a shore line of about 40 miles.

About three-fifths of the area of this county is valley land and the remaining two-fifths is mountain and foothill land. The Santa Ana range of mountains is the line between Orange and San Bernardino counties at the northeast corner of the former county. It is also the dividing line between Orange and Riverside counties on the east. This range also sends up a line of foothills westwardly along the seashore nearly half way across the county. The highest point is locally known as Saddleback, or Santa Ana Peak. In an early day this was known as Santiago Peak, but in 1861 it was ascended by Prof. J. D. Whitney, then State Geologist, who named it Mt. Downey, in honor of J. G. Downey, Governor of California. He found the elevation to be 5,675 ft. above the sea level. All of the western portion of the county is included in the Santa Ana plain or valley. There are also several small valleys among the foothills and along the mountain streams. The Santa Ana plain is covered with a rich loam, and, with the exception of some patches of alkali, is very productive.

GEOLOGY.

The geology of Orange County was reported on by Dr. Stephen Bowers in the Xth Report of the State Mineralogist, pages 399 to 409, and later by Mr. Harold W. Fairbanks in the XIth Report of the State Mineralogist, pages 76 to 120. From each of these reports some descriptions have been abstracted by the present writer, and to them both the reader is referred for fuller details.

The results of an important study of eastern Orange County, which reviews the structural geology and describes the geologic horizon of the coal beds and some of the associated clay deposits are given in a paper entitled "The Martinez and Tejon Eocene and Associated Formations of the Santa Ana Mountains," by Roy E. Dickerson, University of California, Bulletin of the Department of Geology, Vol. VIII, No. 11, pp. 257–274–a.

MINERAL RESOURCES.

Orange County stood second in the list of mineral producing counties of California for the year 1914; due mainly to petroleum. Other items yielding in commercial quantities are: clay products, natural gas, and miscellaneous stone.

Orange County is well supplied with valuable minerals. There once were some apparently extensive silver deposits in the Santa Ana Range, and both gold and silver in some other portions. What were known as the Pellegrin or Alma "diggings" were on one of the branches of Santiago Creek; the veins cropped out on the side of the mountain; the upper portion composed of surface pockets and chimneys, with indications of fissure veins below. The elevation here is about 2300 ft. Several tunnels were excavated and much ore extracted. In 1894 the ore, after having been taken out, was sacked and carried on horseback 3½ miles, where it was loaded into wagons and hauled 18 miles to McPherson, from which place it was shipped to San Francisco. After paying all expenses, it was said to have netted over $41.00 per ton. Within 300 ft. of the tunnel referred to, was a stream of water.

On the opposite side of Santiago Cañon, is an elevation called "Carbonate Hill," which seemed to contain much valuable mineral. It is approached from the southwest along Weakly Cañon, and has an elevation of 2600 ft. above sea level. The most valuable mineral of this "hill" is lead carbonate. W. S. Morrow, who has taken up several claims, has made openings which expose the ledge for some 3000 ft., and it is said to run high in silver.

METALS.

GOLD.

As stated by Dr. Bowers, gold was found at a number of points in the Santa Ana Range. At present it seems to be mined at only one point. This is in Lucas Cañon, to the northeast of San Juan Capistrano. This is a placer deposit, of limited size, which has yielded some coarse gold. Actually, it lies in Riverside County, and so its discussion does not properly belong with Orange.

QUICKSILVER.

R. XI, p. 118.

"The ore of mercury formerly discovered is found about 2 miles east of Tustin, in an outlying hill of Tertiary sandstone, partly surrounded by the Santa Ana Plain, as described by Mr. H. W. Fairbanks. The hill rises 100 feet and is about 1000 feet long and perhaps half that in width. It is several miles south of the lava deposit near

ORANGE COUNTY—Table of Mineral Production.

Year	Petroleum		Natural gas, value	Brick		Clay		Stone industry, value	Miscellaneous minerals	
	Barrels	Value		M	Value	Tons	Value		Amount and kind	Value
1889									Gold	$6,262
1890									Gold	10,943
1892									Gold	9,470
1894									1,500 tons coal	6,000
1895									900 tons coal	4,000
									Gold	144
1897	12,000	$12,000								
1898	60,000	60,000		300	$2,400				800 tons coal	3,200
1899	108,077	108,077		200	1,600				600 tons coal	2,400
1900	254,397	254,397							25 tons gypsum	250
									240 cubic feet sandstone	120
									Gold	2,407
									500 tons coal	2,250
1901	302,652	181,591							300 tons coal	1,500
									Gold	4,000
1902	1,103,793	824,492							Gold	250
1903	1,355,104	1,016,285		1,634	13,000				Gold	150
1904	1,470,000	1,144,542		1,500	9,000				408 cubic feet sandstone	200
1905	1,510,900	711,633		118	11,800	10,500	$14,581		500 cubic feet sandstone	250
1906	2,888,000	1,194,000		1,365	13,500	7,740	12,900			
1907	2,426,750	1,456,050		3,176	26,000				964 pounds copper	198
									24,472 pounds lead	1,308
									33,546 pounds zinc	2,000
1908	3,376,689	2,532,517		4,050	20,450	9,000	18,600	$3,005	14,405 pounds lead	534
1909	4,270,967	2,690,709		4,090	20,650	2,617	26,170	23,665	Unapportioned, 1900-1909	72,586
1910	5,044,001	3,177,721		2,950	31,000	500	5,000	6,443		
1911	6,345,275	4,097,980		1,650	11,550	2,000	3,200	855		
1912	6,704,421	4,478,553	$5,250	1,300	9,100	2,100	3,400	21,248	459 tons glass sand	688
1913	9,485,362	6,867,402	9,612	2,100	14,000	15,500	20,666	36,815		
1914	12,758,678	8,612,108	112,040	1,333	19,300			88,315		
1915	12,715,457	6,510,314	81,753	1,280	16,000			9,027	364 pounds lead	17
									4 pounds copper	1
Totals	71,692,523	$45,930,371	$208,655	27,046	$219,350	49,957	$104,517	$189,373		$131,118

the entrance to Santiago Cañon. The sandstone dips north at a small angle, and consists of a loose aggregate of quartz grains cemented by a kaolinitic material. The whole hill has been affected by mineralizing agencies, and can be distinguished a long distance by its red color. Deep red tints and a bright yellow can be seen everywhere. No hardening or metamorphism of the sandstone has taken place. On the north side of the hill are one or more veins of baryta, or heavy spar, running in an east and west direction, and dipping south. They are usually not over a few inches wide. These carry in places the steel-colored metallic mercury, which on its surface presents a reddish tinge. This mineral is distributed in small masses, usually somewhat veinlike, in the baryta. It is not present in any great quantity. In places the ore appears in minute stringers in the somewhat indurated aluminous sandstones adjoining. A tunnel several hundred feet long was run into the hill from the south, but it encountered nothing but bright red and yellow sandstones. Another short one on the north met only some little veins of baryta. A short incline had been run down on the veins. Appearances did not indicate that the mineral was present in any quantity. Specimens were placed in the hands of Professor Dana, but no published analyses have yet been made, so nothing definite can be said about its composition. The deposit must be in some way related to a volcanic action a little distance north." It has never been opened for commercial purposes.

SILVER.

The old silver mines of Orange County are described by Mr. H. W. Fairbanks, R. XI, pp. 108–120. To this report the reader is referred for a record of these old mines in 1892. In Dr. Bowers' article, Xth Report, some earlier details will be found.

TIN.

From time to time in Orange County rumors of tin mining have been heard and at a point in the Santa Ana Range considerable money has been spent in development work and the equipment of a mill. The parties interested in this operation were Mr. Gail Borden of New York and Mr. L. C. Comer of Los Angeles. It does not appear that the enterprise was in any way successful, and, while assessment work has been done on a large number of claims and an application was made at the Land Office to patent some of these, the undertaking has not yet progressed any further.

NONMETALS.

CLAY.

On the west side of the Santa Ana range are deposits of clay which will probably be found to equal in geologic age and commercial properties those of the Temescal Valley. A deposit which has been opened and which is now regarded of commercial importance is one owned by the **Los Angeles Pressed Brick Co.** It is an important deposit of fire clay of high quality, lying a few miles south of the Santa Ana River. The material was formerly shipped to Los Angeles, by hauling it to Gypsum station on the Santa Fe railroad. This necessitated crossing the bed of the river which was only fordable for about 60 days in the year, and this period is entirely too brief to permit of a satisfactory stock of raw material to be stored at the factory for a year's work. Consequently this important deposit lies in abeyance awaiting the development of railroad transportation across the Santa Ana River.

La Bolsa Tile Company is manufacturing drain tile at its plant at Smeltzer, Orange County. A. N. Griffith, Huntington Beach, is secretary.

J. Wm. Sackman has a brick plant and kilns at Santa Ana, where he manufactures common red brick for local consumption.

COAL.

In the reports of Mr. Fairbanks and Dr. Bowers reference is made to several deposits of coal. But one of these is now receiving any attention and that is the old Santiago coal mine, which is operated by the **Orange County Coal Mining Co.**, a corporation, with offices in H. W. Hellman Bldg, Los Angeles, A. J. Padgham, Santa Ana, president. The production is small, although the coal has been used for domestic and other purposes.

GYPSUM.

United States Geological Survey Bulletin No. 223, pp. 120–121.

"**Gypsum Cañon.** A deposit lies in a small cañon, known as Gypsum Cañon, on the west slope of the Santa Ana Range, in Orange County. It is in the form of a bunchy vein in rocks of probably Upper Cretaceous age. The strata are chiefly sandstone. The deposit has a thickness of 8′ to 10′. The gypsum is white and crystalline and is almost as clear as alabaster. At one spot a mass of dolomite was found inclosed in it."

LIMESTONE.

The following is a synopsis of the limestone prospects in this county, which have been tested experimentally for their value in making lime and cement.

Capistrano. Sec. 31, T. 7 S., R. 7 W., S. B. M., R. Egan, Capistrano, owner. A deposit of fossiliferous limestone, used by the padres to burn lime for the mission buildings.

El Toro. A similar limestone was burned about 1888, but the kiln was abandoned after a campaign not lasting two years. Extensive beds of this fossiliferous limestone are found on **Moulton's Ranch**, south of El Toro. The following analysis of this limestone is reported: carbonate of lime, 96%; silica, 2.5%; alumina, 1%; iron oxide, 0.5%.

Some years ago tests in the manufacture of cement were made by using clay and the fossiliferous limestone found on the ranch of William L. Moulton, near El Toro. The product was of satisfactory quality, but the high cost of fuel at that time prevented the manufacture from a commercial standpoint. With the present supply of oil as fuel, cement could probably be produced commercially from the limestone and clay found on this property.

PETROLEUM and NATURAL GAS.

Orange County, as has already been stated, by reason of its yield of petroleum, stood second among the active mineral counties of California for the year 1914. The production amounted to 12,758,678 bbls., valued at $8,612,108. In addition to this, natural gas was reported to the amount of $112,040 in value. Natural gas accompanies to a greater or less extent, the petroleum in all of the oil fields of the state.

Petroleum has but recently been the subject of an exhaustive investigation by Messrs. R. P. McLaughlin and C. A. Waring, of the State Mining Bureau, and the results published as Bulletin 69. To this and the other published reports noted below, the reader is referred for full information.

The Orange County oil fields are also thoroughly discussed in Bulletin 309 of the U. S. Geological Survey, 1907, by G. H. Eldridge and Ralph Arnold.

References: Bull. 19, pp. 57–61, 79–82, 177, 180; Bull. 32, p. 20; Bull. 63, p. 334; Bull. 69, pp. 118, 308, 350, 366, 503.

STONE INDUSTRY.

Crushed rock, sand and gravel were reported by the county assessor as produced in considerable quantities in Orange County during 1914. The materials were used for concrete and road work.

The **Southern Pacific Railroad Company** from pits adjoining its right of way obtains sand and gravel for ballast and construction purposes.

OTHER NONMETALLIC MINERALS.

Several other materials of economic value have been found in Orange County, but they have not been developed or worked commercially so it seems inexpedient to give space to their discussion.

BIBLIOGRAPHY.

Reports of State Mineralogist:
X, pp. 399–409;
IX, pp. 76–120.
Bulletin 19, pp. 57–61, 79–82, 177, 180;
Bulletin 32, p. 20; Bull. 63, p. 334;
Bulletin 69, pp. 118, 308, 350, 366, 503.
United States Geological Survey, Bulletin 223, pp. 120–121.
University of California, Bull. Dept. Geol., Vol. VIII, No. 11, pp. 257–274a.

RIVERSIDE COUNTY.

INTRODUCTION.

The following report on the mineral resources of Riverside County is based on field work performed during the summer and early autumn of 1914.

The examinations of the mineral deposits in the desert section of eastern Riverside County, had, on account of the climate, been deferred until autumn, and it was at the inception of this work that, on November 11th, while at Mecca, the writer was stricken by an illness which terminated his field work for the season. Through the courtesy of the State Mineralogist, a well trained and efficient geologist, Mr. Clarence A. Waring, was detailed to complete the unfinished work in eastern Riverside County, and from his observations and written descriptions the new material relating to this area has been derived.

HISTORY.

Riverside County, organized by act of the state legislature on March 11, 1893, from portions of San Diego and San Bernardino counties, has an area of 7,240 sq. mi., and a great variety of agricultural and mineral resources. Further, from the diversity of its surface, it affords marked variations in climatic conditions, and, in many areas, offers to the tourist and health seeker, unsurpassed attractions in the several seasons of the year.

TOPOGRAPHY.

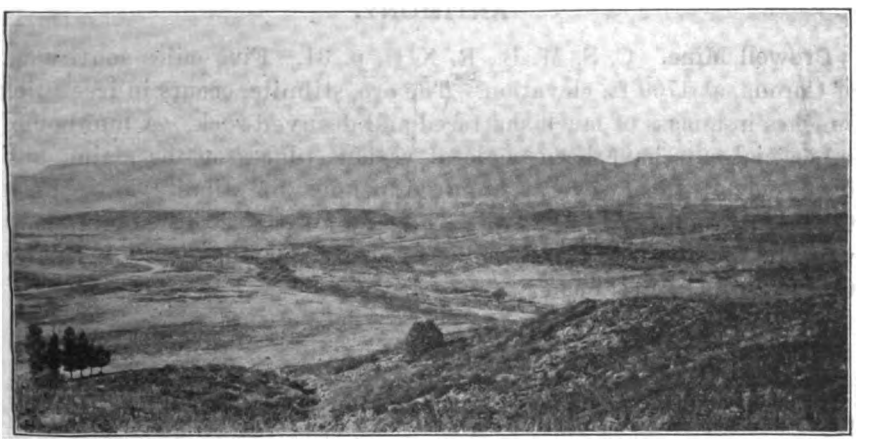
The surface of Riverside County, like that of much of southeastern California, is characterized by bare mountain ranges, separated by nearly level arid belts of varying width. The minor ranges of mountains rise abruptly from the desert plains, having the appearance of being the summits of larger ranges whose bases are buried beneath the loose deposits of the desert. The principal range of Riverside County is that known as the San Bernardino Mountains, the principal summits of which are San Bernardino and San Gorgonio, measuring respectively 10,630 and 11,485 ft. in altitude. This range is flanked on the southwest by the broad valley and plain of western San Bernardino County which terminates to the southeast in the narrow valley known as the San Gorgonio Pass, the summit level of which at Beaumont, measures 2570 ft. South of San Gorgonio Pass is the lofty range of southeast trend known as San Jacinto, with its lofty peaks, San Jacinto and Tahquitz, measuring respectively 10,805 and 8825 ft. in altitude. To the eastward the slopes of the San Jacinto Range decline rapidly toward

the plain known as the Coachella Valley and desert, Coachella being the corruption of the old Spanish name Conchilla. To the southeast, the Coachella Valley terminates in the Salton Sink, which has been carefully mapped by the U. S. Geological Survey and has been discussed in our report on Imperial County.

Central Riverside County is marked by several small desert plains. One of these, south of Riverside and west of Perris, is a striking topographic feature. This and others are clearly shown on the U. S. G. S. topographic map known as Southern California Sheet No. 1, to which the reader is referred for further detail.

GEOLOGY.

The geology of Riverside County has not yet been studied in detail. The first careful reconnaissance made through this region was in the latter part of the year 1853, when Professor William P. Blake, as geologist of the expedition under Lieutenant R. S. Williamson to determine a route for a transcontinental railroad, traversed the San



Santa Rosa volcanic plateau from Murrietta Hot Springs, Riverside County.

Gorgonio Pass together with the Coachella Valley and the Salton Sink. The important results of this work are published in Vol. V, of the reports of the expedition, issued as Senate Document 78, of the 33d Congress, 2d Session. But little geologic detail of interest escaped the notice of this keen observer. In 1892, Mr. Harold W. Fairbanks, under the auspices of the State Mining Bureau, made a careful geologic reconnaissance of San Diego and Orange counties, the former of which then included most of Riverside County. His results are published in the XIth Report of the State Mineralogist, pp. 76–120. To this report the

reader is referred for much interesting detail. See also "Guide Book of the Western United States," Part C, the Santa Fe Route, U. S. Geological Survey, Bull. 613.

MINERAL RESOURCES.

The mineral resources of Riverside County are varied and of material importance, having amounted in 1914 to $1,579,586.[1] But it has never been a large producer of metals, and, as the figures show, its chief mineral wealth lies in nonmetallic products. The details of the deposits from which these are mined are given in the following pages.

METALS.

The metals which have been produced in this county in sufficient quantity to be recorded in its statistics are gold and silver. Iron is known to exist in very large deposits, which could be mined successfully if industrial conditions were more favorable. Copper, manganese, and tin are also known to occur in limited quantities.

ANTIMONY.

Crowell Mine. C. S. M. B., R. XIII, p. 31. Five miles southwest of Corona, at 1700 ft. elevation. The ore, stibnite, occurs in irregular bunches in a mass of much shattered and decayed rock. A number of superficial cuts have been made at various places on the claim, and from one of them several hundred pounds of stibnite have been taken out. The workings had caved, and a satisfactory examination was impossible. The ore found was of excellent quality. J. Irving Crowell, of Corona, owner.

COPPER.

This metal is rather widely distributed in Riverside County, and the principal deposits, which lie well eastward towards the Colorado River, were briefly described in Bulletin No. 50, from which some of the following descriptions have been taken.

Thus far, there has been only a nominal production of copper, the total for 1914 aggregating but $4802.

Badger State Group. See Bull. 50, p. 337. Ten claims in the east slope of the Ironwood Mountains. Granite is the country rock. There are a vast number of stringers from 6″ to 4′ wide, the walls being of porphyry and limestone. The ore contains copper, gold and silver. There is much iron in these claims. About 300 feet of development work has been done in open cuts, shallow shafts, etc., which reveal

[1]See C. S. M. B., Bull. No. 70, pp. 98–99.

	Clay		Lime and limestone	
	ons	Value	Barrels	Value
18				
18				
18				
18	3,700	$4,230	24,000	$19,200
18	7,700	9,400	†10,000 20,000	10,000 20,000
18	22,019	22,750	†6,000 15,000	6,000 15,000
18	11,700	11,250		
18	9,500	10,450	8,000	7,000
18	14,900	16,800	13,476	13,476
19	24,560	18,089		
19	30,489	16,624	18,000	18,000
19	34,320	38,920	20,000	17,000
19	53,857	65,232	†9,000 25,000	8,500 21,250
19	41,966	49,232	20,000	20,000
19	49,720	67,970	20,000	20,000
19	60,123	57,712	14,000	20,000
19	87,260	174,713	6,000	6,500
19	71,231	89,752	†8,000 8,300	8,000 8,300
19	86,028	97,971	3,000	3,000
19	01,411	156,844	†141,722	120,889
19	67,295	79,961		
19	72,046	98,418	†90,881	63,582
19	88,986	89,968		
19	70,136	69,420		
19	59,514	54,840		
	68,411	$1,295,641		$125,697

	$1,640,700
	37,580
	77,811
	116,573
	122,476
	31,570
	1,340,473
	1,295,641
	425,697
	4,645,298
	59,750
	8,117,340
	$17,911,409

good ore. Owned formerly by S. P. Cressinger, Los Angeles, but now in the Crescent Group.

Randolph & Hamilton Claims. These consist of 2 groups and 7 claims in Santa Maria Mountains. The deposits consist of copper and chromic iron, and some gold, at an elevation of about 1750 feet. A shaft 21 feet deep has been sunk and 4 or 5 cuts made. The copper value is 7% to 8%. Iron largely predominates. There is much limestone as country rock, and some porphyry. Former owners, Randolph & Hamilton, Ehrenberg, Arizona. The claims are now held by Floyd Brown, Blythe City.

Anderson Claims. There are 26 claims in this group, located in the northern part of the county. The strike is northwest. The ore carries copper with a little silver and the veins vary from 2′ to 6′ in width. The hanging wall is granite. A shaft 80 feet deep has been sunk and a tunnel 100 feet long driven, with considerable other development work in shafts, etc. Six men were employed. Anderson & Co., owners. These claims are probably in the Monte Negro District. They lie in T. 2 S., R. 12 E.

IRONWOOD OR McCOY MOUNTAIN DISTRICT.

This district contains a mineralized zone of copper, silver, gold, and lead ores. High grade sulphide deposits exist, principally in the form of kidneys. Besides these, native copper is occasionally met with. The district is 22 miles from the Colorado River and about 20 miles southwest of Blythe Junction on the A., T. & S. F. Ry.

Crescent Group. Ironwood or McCoy Mountains, 17 miles from Blythe, Secs. 19, 20, 29, 30, T. 4 S., R. 20 E. Forty claims, 3000 feet of tunnels and drifts. A total of $35,000 expenditure, $6,000 spent last year. Owner, Harwood Robbins, Riverside. Mr. Robbins has incorporated under the name of the Ironwood Mountain Mining Co., but the corporation at present holds no claims.

Mountain King Group. See Bull. 50, p. 342. Three claims on the east side of Ironwood Mountains. The country rock is porphyry and quartzite. The ledge is said to be 30 feet wide. The strike is northwest and southeast, and the dip northeast. The ore, which is azurite and malachite, contains besides the copper, both gold and silver. A shaft 40 feet deep has been sunk, and four open cuts have been made, all revealing good ore. Elevation 1800 feet. Owners, formerly, Adams & Cressinger, Los Angeles; now in the Crescent Group of Harwood Robbins.

PALEN MOUNTAINS.

Orphan Boy Claims. See Bull. 50, p. 341. On the west side of the mountains, 2 miles south of Packard's well. Abandoned.

Fluor Spar Group. Bull. 50, p. 343. Three claims on the west slope of the Palen Mountains, one mile southwest of Packard's well. The country rock is largely porphyry and limestone. The ledge is said to be about 100 feet wide, and strikes northeast and southwest. The ore carries copper, gold, and silver. The copper occurs in azurite, malachite, and some cuprite. There are two open cuts 20 feet or more in depth. Elevation 1800 feet. The claims contain fluor spar, Iceland spar, and limpid quartz. Owner, Andrew F. Burleigh, New York.

Palen Copper Mines. C. S. M. B. Bull. 50, p. 341. Copper, Silver Glance, and Ophir claims. West side of Palen Mountains, 10 miles east of Palen well. Former owner, H. A. Adams, Los Angeles. Now abandoned.

Homestake Group. See Bull. 50, p. 341. There are 5 claims in this group, on the east slope of Palen Mountains, 8 miles northwest of McCoy Springs, at an elevation of 1600′ to 2350′, and 3 or 4 miles from the Orphan Boy and Ophir mines on the west side of the mountains. The claims are all on the same ledge, which is said to be 20′ to 50′ wide, and carries copper and silver glance, azurite, and malachite. The development work consists of two shallow shafts and three open cuts. Owner, Harwood Robbins, Riverside. Relocated, 1914.

Crescent Copper Group. Mr. C. A. Waring reports as follows: This group consists of five claims located in the north end of the McCoy Mountains in Secs. 29 and 30, T. 4 S., R. 20 E., S. B. M. About 50 claims were originally located but most of these have been abandoned. They are owned by Mr. Harwood Robbins, of Riverside. The claims are about 12 miles west of the main stage road from Blythe Junction to Blythe. Water has been obtained from the McCoy tanks which were supplied from Chandler's well. This well was dry when visited in November, 1914.

The copper is said to be present in the form of cuprite and chalcocite. The lode, varying in width from 4′ to 8′, pinches out in places. The country rock is schist. Considerable work has been done on the property, it being claimed that 3000 ft. of tunnels and drifts have been driven. It is said that in no place has work been carried to a greater depth than 160 ft. The assessment work is done by the two Goldburg Bros. of Blythe City. Although it is said that some of the ore ran as high as 35% copper, the average is rather low. Some coarse gold running as high as $8.00 to $10.00 per ton is said to accompany the copper values. The McClure claims in the Little Maria Mountains to the north are reported as showing a good grade of copper ore.

Other Prospects. Numerous low grade copper deposits are reported in the Big Maria Mountains, east of the United States Gypsum claims. Only prospecting and assessment work has so far been done in the region.

About 1½ miles south of the Crescent Group is the **St. John Mine,** owned by R. L. Kennedy, of Los Angeles. A 75 ft. incline shaft has been sunk. Some of the ore is said to have smelted 41% copper.

GOLD.

This precious metal is sparsely and widely distributed in Riverside County and many gold mining districts have been recorded, few of them, however, with any large production.

While the geologic occurrence of gold varies greatly in this county, the geographic distribution may be discussed under two principal heads.

I. The region near Perris and Elsinore.

II. The eastern desert area between the San Bernardino Range and the Colorado River.

PERRIS GOLD MINES.

Gold has been sought for and mined in this section of Riverside County since an early date, and there is evidence that Americans operated here in the early years of California's statehood.

Miners who worked here 40 years ago say that, at that time, in Cottonwood Cañon, was an old arrastra bottom in which was growing an elder tree 12 inches in diameter. On Redtop Mountain, in T. 6 S., R. 3 W., was found a location notice dated 1857.

In 1876 there was some excitement at Binkley's diggings in Sec. 2, T. 6 S., R. 4 W., near the junction of Cottonwood Cañon with that of the San Jacinto River. There was also activity at Tyler's diggings in Sec. 10. About 1880, Mexicans were working gold placers between the Good Hope Mine and the San Jacinto River.

W. H. Storms, who visited this region in 1894, writes as follows:* "An ancient river-bed may be traced for a long distance north and south in this vicinity. The source of this old channel, which bears gold, is to the north, but its exact locality is unknown. The main channel may, without difficulty, be followed from 2 miles north of the Good Hope Mine for several miles southward toward Elsinore."

Much work has been done at intervals in this area, but the production has not borne out the original promise.

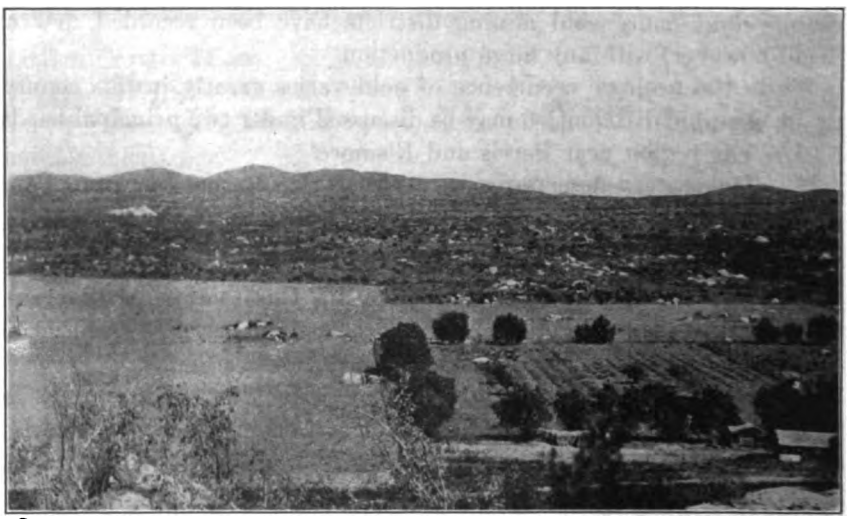
In the more systematic operations on quartz veins which followed, the Good Hope was the chief producer with a record of some $2,000,000. The Gavilan mines also achieved substantial production.

*C. S. M. B., R. XII, p. 220.

THE GAVILAN MINES.[1]

About 6 miles west of Perris, on the old Rancho El Sobrante de San Jacinto, owned by an English syndicate, is a plain some miles in area known as the Gavilan.

The country rock is diorite and is cut in many directions by intrusive dikes of pegmatite which contain little muscovite, but black tourmaline is abundant in them, and frequently was accompanied by the gold-bearing rock. Here, were many veins of moderate size, but of good grade, and, on these veins were the Gavilan mines which, years ago,



Gavilan Flat, looking north from Jumbo mine. Tailings dump of Gavilan mine to left in background.

produced considerable gold, the rock being crushed in numerous arrastras, of which the beds, to the number of 50 or more, were scattered about the neighborhood. It is said that the Mexicans, at one point, worked a large shoot down to water level, and judging from the old dumps, the old workings must have been of great extent. In later years, under American management, the ore was hauled to a stamp mill in the Pinacate District. At the time the ranch became the property of the San Jacinto Estate, Ltd., of London, nothing had been done here for many years. Between 1890 and 1892, the old workings were carefully examined and a company was organized at Riverside to operate some of them under lease. A new shaft was sunk 180 feet, and a substantial production was achieved. No work has been done here for some time, the old mill having been sold and taken to Mexico. The local representatives of this British syndicate have offices at Arlington.

[1]C. S. M. B., R. XI, pp. 336-337; XIII, p. 311.

PINACATE DISTRICT.

About 4 to 6 miles northeast from Elsinore, and about 5 to 8 miles west and southwest from Perris, on the A., T. & S. F. Ry., are the mines of the Pinacate District, named from a small settlement which, before the railroad was built, stood a little south of the site of Perris.

This is largely an area of granitic rocks, succeeded by diorites in the vicinity of the Good Hope Mine. Northeast and east of Elsinore are metamorphic rocks determined on an irregular east and west line by bodies of granite which inclose portions of the schists, and extend into the main body in long, dike-like spurs. In the vicinity of the Good Hope Mine, the metamorphic rocks inclosed in the diorite have a north and south strike, and are traceable for a mile or more.

There are numerous small springs in the district, but timber is very scarce.

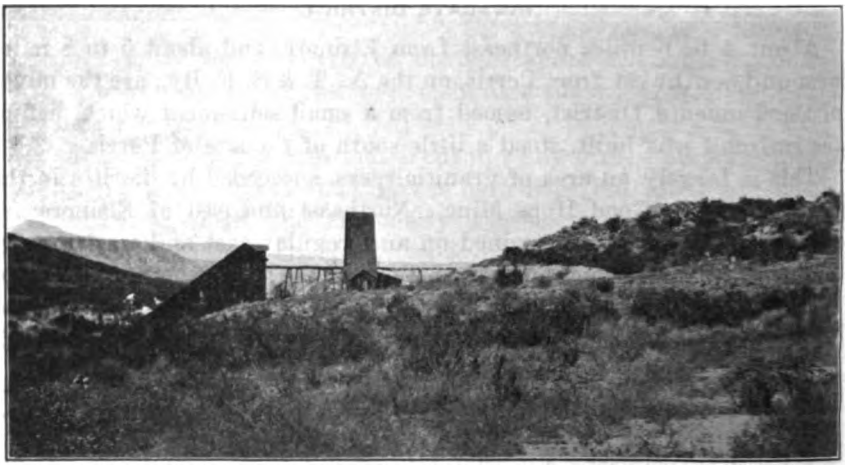
In early years this district produced a large amount of gold, the quartz having been worked in arrastras, of which over a hundred beds were formerly visible.

Between 1876 and 1882 much active mining was done here and a substantial production was achieved.

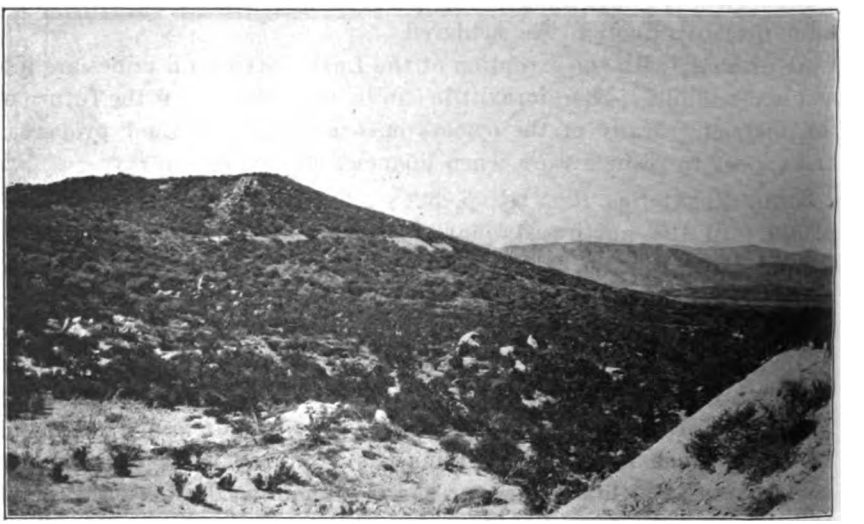
At present, with the exception of the Lucky Strike, all mines are idle and inaccessible. Therefore, little can be predicted about the future of this district. Many of the owners have full faith in their properties and expect to resume work when financial conditions improve.

Santa Rosa: See R. VIII, p. 526; XI, p. 385; XII, p. 225; XIII, p. 314. In the northwest quarter of Sec. 31, T. 4 S., R. 4 W., is the old Mina Rosalia, later called the Santa Rosa, which was opened along the surface by cuts and shafts for over 1000 ft. The upper portion of the vein is said to have been worked out many years prior to 1892, when new capital was interested and a new shaft was sunk at the north end of the property. The vein was about three feet wide and the country rock on either side of the vein was soft and decomposed, requiring much timber. The mine has produced a large amount of gold, extracted at first in arrastras, and later in a 20-stamp mill, which still stands at the mine, but in poor condition. It was understood that, at the north end, the shoot of pay rock was still intact, and it was to recover this that new work was inaugurated in 1892. The balance of the shoot to the south was said to have been worked out down to the water level, at a depth of about 200 ft. At present there is water in the mine and the workings can not be examined. Owners, Hook Bros., Perris.

Golden Chariot: See R. XIII, p. 311. South extension of Santa Rosa. Elevation, 2360 ft. Shaft, 310 ft. One level near bottom. Vein strike N. 10° W., dip 55° SW. Owners, C. L. French and J. M. Day, Redlands.



Santa Rosa Mine, looking west.



Santa Fe Mine, looking southwest from the Santa Rosa.

Jumbo: See R. XIII, p. 312. Here a 2200-foot vein, parallel to that of Santa Rosa, and 300 ft. east, strikes N. 10° W., and dips 80° SW. The workings consist of one 50-ft. shaft. Owner, E. A. Bethurum, Redlands.

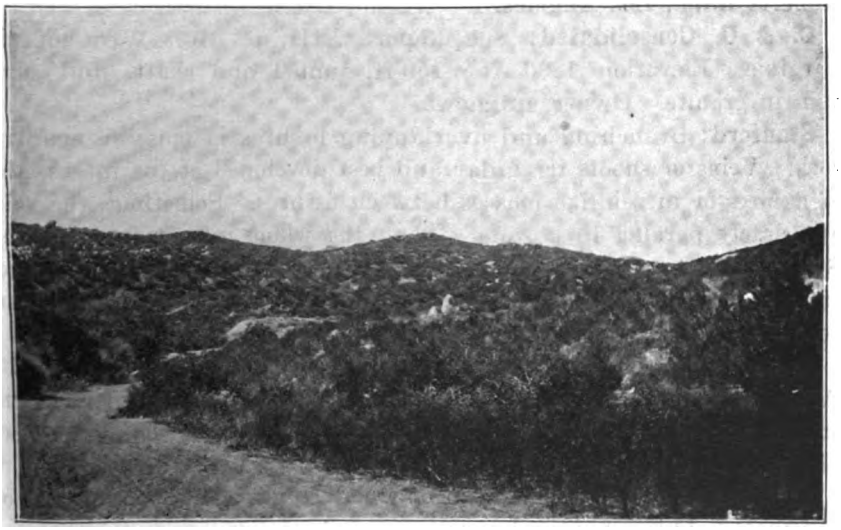
Santa Fe: See R. XII, p. 224; XIII, p. 314. One-third of a mile southwest from the Santa Rosa, is the old Santa Fe Mine, which in days past was a producer of gold, but its workings have long been

abandoned. The strike of the vein was nearly east and west. A crosscut tunnel was driven 700 feet into the hill to cut the vein, and apparently intersected the latter at about 500 feet. The 5-stamp mill, formerly in use, has been removed. Owners, R. Woods & Son, Auburndale.

Perris: See R. XIII, p. 313. Elevation 2200 feet. Sec. 31, T. 4 S., R. 4 W. Vein strikes W., dips 80° S., shaft 60 feet, 25-foot drift runs east from bottom of shaft. It is a heavy fissure in granite, accompanied by a dike, but carries little quartz. Owner, W. F. Dray, Forestville, Placer County.

Little Pete: See R. XIII, p. 312. Elevation 2000 feet. Near the Perris claim. Thirty-foot incline on a small east and west vein, containing arsenical pyrites. Owner unknown.

Indian Queen: See Report XIII, p. 311. NW. ¼ Sec. 32, T. 4 S., R. 4 W. Vein strikes northwest; dips 70° SW. Shaft, 65 feet. Owner, — Morrison, Goldfield, Nev.



Surface view of Indian Queen and Little Maggie claims.

Little Maggie: See Report XII, p. 223; XIII, p. 312. Adjoining Indian Queen on the southwest. On several small veins in diorite. Strike east; dip 45° S. Quartz high grade. Crosscut tunnel to cut vein at 40 feet. There are many other claims nearby on similar fissures. Formerly owned by — Hasson, of the Los Angeles Times.

Colorado or **Justice**: See Report XIII, p. 310. In SW. ¼ of Sec. 32, T. 4 S., R. 4 W. Vein small; quartz high grade. Owner, J. Boyer, Perris. The mine is on his ranch.

Steele Mine: See Report VIII, p. 527; XI, p. 284; XIII, p. 314. In SE. ¼ of Sec. 32, T. 4 S., R. 4 W., is the Victor Mine, formerly "El

The hanging wall is a dark gray diorite, quite fine-grained in texture, containing much hornblende. Small pegmatite dikes cut the formation in all directions. Black tourmalines are numerous in the pegmatite. The vein is described as a foot or more in width, of highly crystalline quartz, in which were disseminated small amounts of iron and lead sulphides and lead carbonate. The ore was quite rich in gold. A tunnel 900 ft. long was driven to develop the vein, on which an incline shaft had been sunk to a depth of 200 ft. Besides this work there are numerous superficial workings, in which quartz of good grade was exposed. No work has been done here for many years. Owner, un known.

Missing Link: (Virginia-Shay) See Report VIII, p. 526; XI, p. 385; XII, p. 225; XIII, p. 313. Six miles west of Perris, in NE. ¼ of Sec. 32, T. 4 S., R. 4 W. Several holes have been sunk on the vein but the workings are flooded and inaccessible. The quartz is said to have carried considerable gold. Owner, Hugh Duff, 626 Wesley Roberts Bldg., Los Angeles.

C. & C. Consolidated: See Report XIII, p. 310. West of the Virginia. Elevation 1800 ft.; 150-ft. tunnel and shaft, and small vein in granite. Owner, unknown.

Stanford: Branching and overlapping fissures in massive eruptive rock. Veins or shoots irregular and best developed at the intersection of fissures or in veinlike masses between fissures. Sometimes the veins are closely parallel in a zone. Then the whole mass may be mined. Shaft, 125 ft. A crosscut tunnel meets the shaft at 70 ft. from surface. Five-stamp mill. There are many prospects near the Stanford. Owner, Mark Herrin, Riverside.

Ophir Mine: Now Lucky Strike. See Report XIII, p. 313. After having lain idle for some years, work has been recently begun on this property. Owners. W. Newport and F. Whiting, Ethanac. See photo, p. 74.

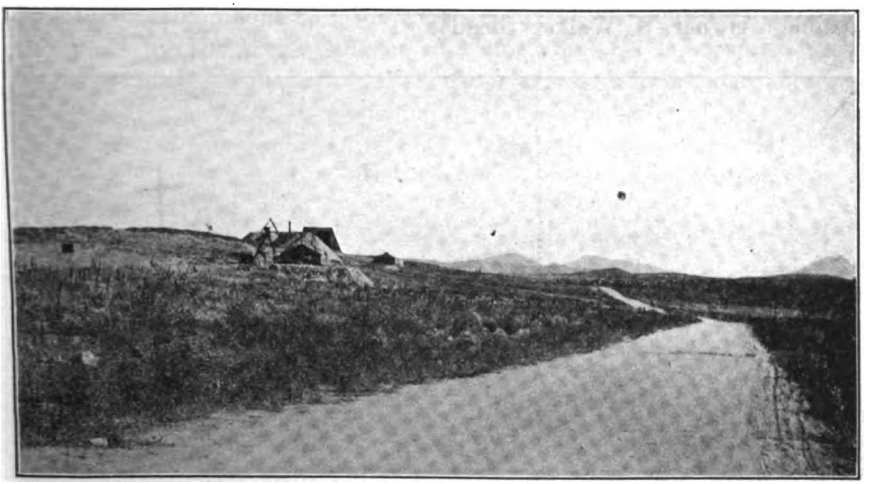
Gold Prince: North Extension of Good Hope. This property is of old record, but is now unknown.

Good Hope Mine: See Report VIII, p. 527; R. IX, p. 151; R. XI, p. 106; R. XII, p. 221 and R. XIII, p. 311. About 4½ miles southwest of Perris in NW. ¼ Sec. 15, T. 5 S., R. 4 W.

The veins of this mine strike N. 14° E., and dip 65° W. They are in a dike of light colored biotite gneiss. The mine is in gray diorite. The hanging wall is largely of mica schist. Near the surface are several veins from 3′ to 20′ apart. These, in depth, appear to unite. The fissure in places contains a heavy clay gouge, the result of continued movement and the crushing of the rock adjacent to the fault plane. The vein quartz shows clearly the effect of this movement by its fractured condition, and the subsequent infiltration of carbonate of

lime into the interstices thus formed. This renders much of the quartz friable, and it usually crumbles on exposure. The vein commonly appears as two separate bands of irregular width.

The fissure was a double one, a vein of quartz forming in each branch. The footwall vein at some points contains very high grade ore, carrying finely disseminated iron sulphide. The quartz was free milling, though ordinarily carrying more or less auriferous iron sulphide of high grade.



Good Hope Mine, looking north.

A 20-stamp mill was built here and operated, but only part of the equipment remains. This mine has not been actively productive for some years, though some work has been done within two years. Owners, Hook Bros., Perris. It is now under lease to the Good Hope Mines Co.; president, E. Groenendyke, 301 Story Bldg., Los Angeles; J. J. Abramson, secretary and manager, 612 San Fernando Bldg., Los Angeles.

Menifee Mine: See R. XI, p. 385; XIII, p. 312. Elev. 1500 feet. This mine is located about 8 miles south of Perris. The vein consists of quartz, gold-bearing in places. The footwall is chloritic schist, beyond which is diorite. The hanging wall is diorite, the hornblende having changed partly to chlorite. The vein is from 1 ft. to 30 in. wide, and strikes northeast, dipping 80° NW. to a depth of 40 ft., where it flattens out to 65°. The quartz is said to have milled about $15.00 per ton, and contained but a small percentage of sulphides. There are four shafts on the vein; 30′, 55′, 100′, and 125′, the main shaft being 5′ x 11′ with 2 compartments. There is a steam hoist and a 5-stamp mill. Owner, Tom Chaffin, at the mine.

Lucky Boy (Walker) Claim: See Report XI, p. 385; R. XII, p. 223; R. XIII, p. 312. On the Walker Ranch, 2 miles south of Menifee, and 1 mile northeast of the Menifee Mine. In 1892 a new quartz vein was discovered on a low mound at the base of low, rolling hills. The vein was 4″ to 1′ in width, heavily mineralized, but much broken. Two distinct faults occurred in a length of 90 feet, where the vein was exposed. Two shafts of 50′ and 60′ were sunk. The rock would pan out about $40.00 per ton, but too small an amount of work has been accomplished to make any estimate of the value of the vein possible. Owner, S. Walker (dead).

Lucky Strike Mine (formerly Ophir), looking south.

Alice: See Report XII, p. 221; R. XIII, p. 310. Altitude 1500 feet. A 12-ft. incline shaft cutting vein 20 ft. Five-stamp mill. Four miles south of Menifee. Estate of J. M. S. Egan.

Mammoth: See Report XIII, p. 312. Elevation 1600 ft. Nine miles south of Perris in Sec. 8, T. 6 S., R. 3 W. Vein averages 7 ft. in thickness, ranging from 4′ to 10′. Strike northeast, dip 15° NW. The croppings are exposed 400 ft. around the side of the hill. Superficial cuts were made at various points. At the end of a 100-ft. cut is a 200-ft. incline on the vein. Crosscut connects with air shaft, 60 ft. to surface. The country rock is grano-diorite. The quartz of the vein is evenly impregnated with pyrite and shows free gold. Owner, A. A. Adair, of Riverside.

Leon: See Report XII, p. 223; R. XIII, p. 312. On Briggs ranch in NW. ¼, Sec. 18, T. 6 S., R. 3 W. The ore is in a quartz vein 1′ to 2′ thick, strike northwest, and dip 85° SW. There is a shaft

150 ft.; also crosscut tunnel 25 ft. toward vein, lower down hill. This is a promising prospect. There is no mill. Owner, Chas. Briggs, Los Angeles, address unknown.

SAN JACINTO MOUNTAIN REGION.

Mr. C. A. Waring reports on this as follows:

The Hemet Belle Mine. The Hemet Belle mine is located at an elevation of 5000 ft. in the San Jacinto Forest Reserve, in Sec. 31, T. 6 S., R. 4 E., S. B. M. It is accessible by automobile road from Hemet to Kenworthy, about 25 miles. The mine is at present worked part of the year by Mr. E. E. Chilson, of Kenworthy. It is equipped with a 5-stamp mill. Water is obtained from a mountain spring. The gold is in quartz veins in gneiss which occurs in contact with granite. The veins are seldom more than 6″ to 8″ wide, and the average value of the ore is $15.00 to $20.00 per ton. Some high values are said to occur in pockets.

GOLD MINES OF THE EASTERN DESERT.

The desert area of central and eastern Riverside County has an average length from west to east of about 100 miles and a width from north to south of about 45 miles.

In many of the mountain ranges which, here and there, rise above the desert wash, which has filled the intervening valley, are exposed metalliferous veins carrying gold, copper and silver-lead. Gold is the more frequent metal in its occurrence and is found at many points, though, up to the present time, no great production has been achieved.

The mineralized areas or districts, which have been worked at times, are as follows, it being remembered that a mineralized area is necessarily in a mountain range.[3]

Piñon Mountain.
Monte Negro or Twenty-nine Palms District.
Eagle Mountain.
Chuckawalla or Hathaway Mountains, Chuckawalla District.
Hodges Mountain or Palo Verde Mountains.
Palen Mountains.
Ironwood or McCoy Mountains, Ironwood District.
Santa Maria Mountains.
Arica Mountain District.
Riverside Mountains, Bendigo District.

PIÑON MOUNTAIN DISTRICT.[4]

The mines are 12 to 14 miles northeasterly from Indio, about 5000 ft. above sea level. The more prominent veins have a northwest strike and variable dip. They are in branching fissures of a type common in

[3] A number of the properties mentioned in the Reports of the State Mining Bureau as being in this region have long been abandoned and are now forgotten.
[4] R. XII, p. 224; XIII, p. 313.

massive rocks such as granite.[5] From the several claims of this group some very high-grade rock has been taken, which was crushed in a 2-stamp mill a mile from the mines. The deepest work on these veins is 70 ft. from the surface. Tingman, of Indio, owner.

The Hexahedron Mine: See Report XII, p. 223; XIII, p. 311. Seven miles northeast of Piñon Mountain, 25 miles northeast of Indio. The ore is in a mineralized felsite dike, which strikes nearly east and west. At the west end it is small (not over 4 ft.), but widens toward the east. The ore shoot lies in a hillside. It is 75′ long, 15′ to 20′ wide, and dips 45° N. At the place where gold was found, it lies exposed along the north slope of the hill, the overlying rock having been eroded. Dikes of green diorite, much decomposed at the surface, cut the felsite and adjacent rock irregularly and, in this vicinity, the felsite contains gold. Iron oxide, copper carbonate and dendritic infiltrations of manganese oxide are the indications of mineralization. Portions of the rock are spangled with small points of gold. In the vicinity of this mine are some prospects on which a few holes have been sunk. Owner, Indio Mining and Milling Company; president, J. S. Garrison, Victorville; Roy Garrison, superintendent at mine.

Lost Horse Mine (Field No. 24): See Report XII, p. 223; XIII, p. 312. This property is in Sec. 31, T. 2 S., R. 9 E., 19 miles north and a little east of Indio in a direct line, and about 28 miles by wagon road and seven miles north of Piñon Mountains, at altitude 5000 ft. The vein strikes east and west and dips 85° N. It cuts through laminated micaceous quartzite, which strikes north and south. Occasional dikes of granite are present, but the vein cuts all the other formations. It is exposed at several points for a distance of 800 ft. along its course. Its width varies from 6 in. to 5 ft., and exhibits an overlapping tendency, the footwall becoming the hanging wall of the next shoot below. The workings consist of an 80-ft. tunnel, a 50-ft. winze and a 50-ft. drift, east from the bottom of the winze. Most of this work is in good rock. There is also a vertical shaft 235 ft. deep. Between 1890 and 1900 about $350,000 were produced. With more abundant water and a larger mill, this property, which consists of two claims, might become a large producer. Owner, J. D. Ryan, Union Oil Bldg., Los Angeles.

MONTE NEGRO DISTRICT.[6]

This is near the north boundary of Riverside County, in R. 12 E. This mining district was organized about 1890 and considerable development work was accomplished by the claim owners. At present little if anything is being done.

[5] W. H. Storms, Bull. 18, pp. 22–26; Min. & Sci. Press, May, 1906, p. 348.
[6] R. XI, p. 368; XII, p. 224; XIII, p. 313.

The Monte Negro camp was on the south side of the range of hills 45 miles northeast of Mecca Station, 20 miles north of Eagle Mountain, and about 6 miles south from Virginia Dale. It is 35 miles south from Cadiz Station on the Santa Fe. The mineral belt is about 1½ miles wide and 5 miles long; the veins trending north and south.

This district has attracted much attention through the discovery, on one of the claims, of masses of gold-bearing quartz of extreme richness.

From Mecca Station, 189 ft. below sea level, the road ascends till, in 27 miles, a divide is reached near Cottonwood Springs, at an altitude of 3157 ft. Thence it again descends 19 miles to the foot of the wash, which extends 2 or 3 miles from the base of the mountains, where the altitude is 1300 ft. The altitude at the camp is 1520 ft. The mines lying back in the mountains are at higher, though varying altitudes, the greatest elevation being 3500 ft., at the Ramona or Ingersoll mine. Neighboring peaks rise from 200′ to 800′ higher.

The rocks exposed in the Monte Negro uplift are chiefly eruptive, diorite, quartz porphyry and fine-grained porphyritic rocks, cut by later dikes of felsite and a dark green or black eruptive.

Epidote occurs abundantly throughout the region, usually associated with micaceous iron ore, which occurs everywhere in veins and bunches. This iron ore contains no precious metals, and is of no economic importance.

The region although entirely eruptive and in part volcanic (large fields of basalt occurring on the western slope) is in the immediate vicinity of a mountain called Pinto, or Painted, composed of metamorphic strata, chloritic and hornblende rocks, quartzite and mica schist predominating.

The mineral veins of the Monte Negro District are all of the fissure type, and are simple in form. The gangue is quartz, carrying iron and copper sulphides and their secondary products, iron oxide and copper carbonate, together with gold and silver. No lead or zinc was observed. The value of the ore lays in its gold content, silver occurring very sparingly and the bullion from this ore was worth about $17.00 per ounce. The ore ranged in value from $20.00 to $100.00 per ton.

Wood was not obtainable in the vicinity of the mines and water was scarce, but was obtained by sinking a well in a basin near Virginia Dale, a few miles north, where there are 2 mills. In the wash, 3 miles south of the most southerly Monte Negro mines, a shaft was sunk 140 ft., but no water was obtained. Bedrock was not reached at that depth, and it is probable that water may be secured by continuing this shaft downward. On the south, the nearest water is 22 miles away at Cottonwood Springs, where the ore has been worked in an arrastra.

The principal mines of this district which is now idle, were the Great Eastern, Venus, Columbus, Summit, Porcupine, Schiller, Hillerman, Annie Rooney, Ethel, Republican, Ramona, McKinley Bill and Revenue. Few men now remember these properties.

Ingersoll (Ramona): See Report XIII, p. 313. Vein stated to strike north and south, nearly vertical, and 1′ to 3′ wide. Shafts 40 ft. and 80 ft. deep. Former owners, Elser Ingersoll et al., San Bernardino. Not known at present.

O. K. (McKinley Bill): See Report XIII, p. 313. Vein in diorite, 1′ to 4′ wide. Two shafts, 30′ and 40′ deep. Ore hauled to Virginia Dale mill. Owner, Elser Ingersoll et al. of San Bernardino. An old mine now forgotten.

S. S. Mine: See Report XII, p. 224; XIII, p. 314. This was in the Monte Negro region, 4 miles south of Virginia Dale, discovered during 1894. It has produced some very high grade ore. T. R. Lyon, of San Bernardino, former owner. Now forgotten.

Gold Galena Mining Co. Near the south boundary of San Bernardino County, is the property of this company. They have offices at 230 Douglas Bldg., Los Angeles; president, F. C. Longnecker, 6016 Romaine avenue, Los Angeles; secretary, B. A. Straus, and manager, C. E. Stead. The properties are nine claims in Secs. 4, 8 and 9, T. 3 S., R. 9 E., S. B. M. The feature of this ground is a vein of substantial width which contains galena carrying gold. The workings are down from 70′ to 100′. There is no mill and no bullion has been produced up to date.

New El Dorado Consolidated Mining Co. This comparatively new company is operating in Sec. 17, T. 3 S., R. 10 E., S. B. M. Little more than assessment work has been done and no production has been attained. The company has an office in the Central Building, Los Angeles. Mr. Fred Vaile is manager.

CHUCKAWALLA DISTRICT.

The Chuckawalla Mountain Range lies in T. 5 to 8 S., R. 15 to 19 E., S. B. M. It was formerly known as the Hathaway Range, and is so named in the early reports of the State Mining Bureau. Its present name is a corruption of Chuckwalla, the Indian name of a lizard which frequents these hills. In its northwest portion lying in T. 5 to 7 S., R. 15 and 16 E., S. B. M., is a mineralized area in which gold, copper and silver-lead occur and where prospecting and mining have been conducted on a limited scale for many years. It was once known as the Pacific Mining District and, in the Xth Report, pp. 900–901, are some notes on it by C. R. Orcutt, made during a visit in 1888, at which time it was in San Diego County. In these notes are mentioned

a number of properties, and Mr. Orcutt's descriptions are here given in abbreviated form, though the claims are mostly forgotten:

"**Sunnyside**: Ore iron-stained quartz, with argentiferous galena, said to have average $50.00 per ton in gold and silver. A 20-ft. shaft was sunk on the vein. The mine was owned by Hendsch & Frederick, of San Diego, but it is now abandoned.

"**Opulent**: An extension of the Sunnyside. From this mine came the first specimens of wulfenite, recorded from San Diego County. A little galena occurs here. Once owned by Milton Santee, of San Diego, and W. F. Hendsch.

"**Golden Rule**: A claim worked years ago with good results; 50 ft. shaft. Malachite and chrysocolla occur here.

"**Red Cloud**: So named from the abundance of cuprite. A 30-ft. shaft was sunk, and a tunnel commenced.

"**Alice**: Ore contains an abundance of chrysocolla. It was said to carry both gold and silver in paying quantities. Owned by Santee and Hendsch.

"**Champion**: A blind lead of good promise. It yielded gold, silver and lead in paying quantities. Argentiferous lead ores and also wulfenite were characteristic here.

"**Great Western**: A ledge 50 ft. or more in width yielding an average of $20.00 per ton in gold, with a trace of silver. The Keystone, Blackbird and Monarch claims are on similar veins."

In the southern part of T. 6 S., a cañon traverses the range from southeast to northwest. In and near it are a number of mining properties, and 3 miles from its northwest end are Mill Springs, near which are several of the claims described by Orcutt. About 10 years after his visit, some 40 claims in this area were taken over by the Red Cloud Mining Company, of which S. P. Cressinger was president. Several of these are now held by J. M. Huston, of Los Angeles, under the name of the **Redhead Group**, which includes the Great Western, White Wing, and Red Head.

Sterling: See Report XIII, p. 314. Considerable superficial work, and a 10-stamp mill. Former owner, Sterling Mining Company, Los Angeles. This was once a part of the Red Cloud Group. The mill was later moved to the Lost Horse Mine, in the Piñon District.

About 2 miles from the east portal of the cañon are the well known **Corn Springs**, at present held under a placer location by J. M. Huston, of Los Angeles. About 2 miles south of Corn Springs is the Bryan Mine, which was operated from 1898 to 1900 by Adams & Pickering, the ore being treated in a two-stamp mill at Corn Springs. It now belongs to J. M. Huston.

One and a half miles southwest of Corn Springs are claims once operated by the **Happy Jack Mining Company** and the **Chuckawalla Mining Company**, and now controlled by Dr. Wood, of Long Beach, and H. I. Seward, of Los Angeles. The ore from these properties was treated from 1896 to 1898 in a small rotary mill. Development here reached a depth of 300 ft.

Coffee: See Report XIII, p. 310. Chuckawalla Mountains, 4 miles west of Corn Springs. The vein strikes northwest. Shaft, 56 ft. on 18 in. vein at northwest end of claim. This was worked jointly with the Richey Mine. Former owners, Coffee & Co., Salton.

Bankers Group: About one mile south of the Coffee and Richey mines are the claims of the Bankers Mining Company, of Los Angeles. President, A. A. Irish, 402 Grosse Bldg., Los Angeles.

Near the northwest extremity of the mountain range, in Sec. 35 or 36, T. 5 S., R. 15 E., is the **Granite Mine**, on a vein trending north and south. This mine, having been worked at intervals for several years and having passed through the hands of several owners, now belongs to Silas Marsters, of Riverside.

A few miles east, on the north slope of the mountain, some surface springs have been gathered into what is known as the Granite Tanks.

San Diego: See Report XII, p. 224; R. XIII, p. 313. This mine is on the same vein as the Granite adjoining it on the southeast. The rock is of high grade, heavily oxidized. Former owner, E. E. Bowles, of San Diego.

Boulder: See Report XIII, p. 310. This claim is in the Chuckawalla Mountains, at 2000 ft. altitude, about one mile west of the Granite Mine. The veins strike north and south and dip nearly vertical. There are three shafts: 30′, 50′ and 100′, also a tunnel 200′ on the vein, and open cuts. Formerly owned by the Boulder Mining Company, of Los Angeles. This mine gave its name to the Boulder well in Sec. 31, T. 4 S., R. 16 E., S. B. M., now held by the Southern Pacific Railroad.

Lane: See Report XIII, p. 312. A prospect on Chuckawalla Mountain, with superficial development. It lies between Granite Mine and Corn Springs, about 4 miles northeast of the latter. The quartz was treated in an arrastra. Former owners, Lane & Son, of Salton.

Throughout the rest of the Chuckawalla Range, in a distance of some 20 miles, no deposits of any interest have been opened.

HODGES MOUNTAIN.

The next mineralized area to the southeast is in Hodges or Palo Verde Mountain, which lies in T. 7 and 8 S., R. 21 E.

The following properties are in this mountain:

	Owner.
Double Eagle	Justus Smith, Palo Verde
Palo Verde Group	Justus Smith, Palo Verde
Punch	A. P. Wiley, Palo Verde
Senate Mine	A. P. Wiley & L. A. Stanchfield, Palo Verde
American Flag M. & M. Co.	C. A. Ludden, Pomona

No production has been reported, and probably only assessment work has been done.

Dos Palmas, Gold Prospect near: See Report XII, p. 221. There are several gold claims 18 miles north of the old Dos Palmas stage station, which have been described as valuable prospects. The veins are of good size, and the ore of good grade. Water is obtainable within 6 miles of Cañon Springs. One of the claims is described as being on a ridge between two cañons 1500 feet apart. The vein is 3′ to 6′ wide, and the pay shoot 1′ to 3′. Two tunnels, one of 90′ and the other of 190′, have been driven on the vein.

Free Coinage and **Charity Mines**: See Report XII, p. 221; XIII, p. 311. There are two locations, made in 1893. They adjoin, about 5 miles north of Cañon Springs, 12 miles northeast of Dos Palmas, and 18 miles north of Durmid Station. The Free Coinage vein had 28″ of free-milling ore and a 6″ vein of quartz, containing galena and carbonate of lead, which carry some silver. E. E. Bowles, of San Diego, owner.

Fish: See Report XII, p. 221; XIII, p. 311. Six miles northeast of Dos Palmas and 12 miles northeast of Salton. Elevation 1000 feet, 90 feet of tunnel and other superficial work on a quartz vein. Two-stamp mill with gasoline engine at Cañon Springs, 6 miles from mine. Owner, A. C. Fish, San Bernardino.

Messenger: See Report XIII, p. 312. Eagle Mountain, 40 miles northeast of Mecca, vein 3′ to 4′ wide; shaft 100 ft.; drifts 50 ft. north and south. Owner, W. H. Bradley, Boyle Heights, Los Angeles. This is in the Iron Chief Group of claims.

ARICA MOUNTAIN DISTRICT.

Mr. Clarence A. Waring writes as follows:

The Gray Mine is located in Sec. 7, T. 2 S., R. 10 E., about 6 miles southwest of Blythe Junction, at an elevation of about 1500 feet. It is accessible by a rather sandy automobile road from Blythe Junction. When visited during the latter part of November, 1914, the mine was leased to "The Assets Realizing Mines Company," the president of which is Mr. J. V. Priest, Los Angeles Investment Bldg., Los Angeles.

The mine is being actively worked with 10 men and preparations were being made to ship ore.

Work is being done on 2 different parts of the property. The upper workings consist of a 340-foot vertical shaft with about 700 feet of drifts along the strike of the quartz ledge which is N. 20° W. These workings are equipped with one 60 h.p. and one 25 h.p. Fairbanks gas engine, an air hoist and a 4-drill compressor. Compressed air is piped from this plant to the lower workings where 2 drills are used in drifting. It is said that these workings consist of about 300′ of drifting and crosscutting and a 227′ winze.

The ledge on which the work is being done varies from 6″ to 2′ wide, and the average assay is said to be about $8.60 per ton. The ore is free milling down to 150 feet, below which sulphides predominate. The hanging wall and footwall are both of schist. Water is pumped from Brown's well about 4½ miles to the southwest. This well is 328 feet deep and is on the stage road from Blythe Junction to Blythe City.

The Brown Mines. Located on the same ledge as the Gray mine, the Brown mines adjoin it to the north and south. Mr. Floyd Brown's mine to the south has a three-stamp mill, and some of the free milling ore on the surface has been worked. Mrs. Floyd Brown's mine is located north of the Gray mine. The work at both the Brown mines has consisted mainly of assessment work. Mr. Floyd Brown resides at Blythe City.

SANTA MARIA MOUNTAIN DISTRICT.

A few gold prospects are reported in the Santa Maria Mountains. Between the "Little Marias" and the north end of the McCoy Mountains in the NW. ¼ of Sec. 8, T. 4 S., R. 20 E., some placering was done by the Crescent Copper Company in the early days.

THE BENDIGO DISTRICT (RIVERSIDE MOUNTAINS).

Mr. C. A. Waring reports as follows: The formations exposed in the northern part of the Santa Maria and Palen mountains are said to recur in the Riverside Mountains to the northeast. The latter mountains are said to consist of schists and limestones, which are folded and faulted to a considerable extent. They are said to be more mineralized than the mountains to the south.

The following groups are known:

Calzona Mines. The Calzona mines property, formerly known as the McKesson Group, was discovered in 1898, and includes 12 claims and 13 mill sites. These are located mainly in the S. ½ of Sec. 31, T. 1 S., R. 24 E., and in the SE. ¼ of Sec. 36, T. 1 S., R. 23 E. The names of the claims are the Sanborn, Contact, Golden Gate, Burke, Burke Extension, Saddle Rock, Copper Reservation, Globe, Copper Belt, Black Butte, Riverside, and Blackwell. The property is owned by Dr. Robert

M. Vermilyea, of Redlands, president; F. C. Lee, of Vista, secretary-treasurer, and A. W. Martin, of San Diego.

In February, 1914, it was reported that 4 men were employed in mining on the property, and that several tons of ore had been shipped. The ore is said to have brought $60.00 per ton. The values of gold and copper are said to be in limestone along its contact with schist. The ledge is pockety and possibly the values represent picked ore. The ledge is faulted down against schist at a depth of about 1500 ft. The ore is mined by an 800-ft. tunnel and a 200-ft. shaft. Water is pumped about 2½ miles from the Colorado River to the east. The nearest railroad station and post office are at Vidal, about 6½ miles to the northeast. Good automobile roads lead from the mines, which are at an elevation of about 1200 ft., to the railroad stations at Vidal and Calzona.

The Jackknife Group. This group of claims owned by Messrs. Cal Morgan and H. D. Bradley, of Calzona, is located principally in Sec. 1, T. 2 S., R. 23 E., and Sec. 6, T. 2 S., R. 24 E. It includes the Combination, Combination Fraction, Jackknife Extension, Jackknife Nos. 1, 2 and 3, Margie, Single O, Betsy and other claims to the southwest in Sec. 1, T. 2 S., R. 23 E. They are at an elevation of about 1200 ft. and about 6 miles southwest of Vidal, the nearest post office and railroad station.

In February, 1914, it was reported that four men were employed, and that several tons of ore had been shipped to date, and that the ore brought $66.00 per ton. It is said that the gold is now recovered by chloriding. The values in gold and copper are in pockets along the contact of limestone and schist, which strikes N. 55° E., and dip about 50°. Probably the material shipped was selected ore which would account for the high average value. The ledge on which the Morgan and Bradley mines are located is over 1000 ft. lower in the formation than that on the Calzona property. The ledge is faulted down against schist at a depth of about 1700 ft. Water is pumped about 3 miles from the Colorado River to the east. A 6 h.p. Fairbanks-Morse gasoline engine is installed on the property.

The Steece Mines. The Steece property is located southeast of the Jackknife Group, principally in Sec. 6, T. 2 S., R. 24 E. It includes the Ruby, Washington, Bluebell, and Black Warrior claims, and 8 others. It is owned by Richard Silliland and Ed. Arnold, of Calzona.

It is said that the main shaft is down about 500 ft., and that water is pumped from the Colorado River. The ore body follows the contact between schist on the south or footwall side and limestone on the north. The ledge strikes N. 55° E., and dips at an angle of about 50°. The ledge is about 1800 ft. lower in the formation than that on which the Jackknife Group is located. The ledge is faulted down against schist at a depth of about 3700 ft.

The Gold Dollar Group. This group consists of eleven claims, Gold Dollar Nos.-1 to 10, and Gold Dollar Fraction, in Secs. 35 and 36, T. 1 S., R. 23 E., and Sec. 1, T. 2 S., R. 23 E., S. B. M. They are owned by Messrs. Ware and McMillan, of Calzona. Only assessment work so far has been done.

The Oxbow Group. This group consists of the Oxbow, Oxbow Nos. 1 to 6, and the Oxbow Fraction claims near the center of Sec. 36, T. 1 S., R. 23 E., S. B. M. The claims are owned by Messrs. John and Dennis Burke, of Calzona. Only assessment work has been done.

Alice Group. This group consists of 8 claims in Secs. 25 and 36, T. 1 S., R. 23 E., S. B. M. The names of the claims are the Lucky Boy, Comet, Good Enough, Fraction, Longworth, Homestake, Alice, and Mineral Hill. The group was formerly known as the Pipinco Group, and is owned by Mr. B. L. Vaughn, of Needles, California. The mines, at an elevation of 1600 ft., are 6 miles south of Vidal, the nearest railroad station. Water is pumped about 5 miles from the Colorado River. In February, 1914, it was reported that 3 men were working at the mine, and that 90 tons of ore had been shipped to Needles. The gold is said to occur in schist.

Meek and Sass Mines. Messrs. Meek and Sass of Los Angeles hold the Earnie and Melville claims and others in Sec. 1, T. 2 S., R. 23 E., adjoining the Morgan and Bradley claims.

Four **placer claims,** namely, the New Moon, Sunset, Riverside and Midnight, have been taken up in Secs. 20, 29, 30, 31 and 32, T. 1 S., R. 24 E.

IRON.

This most important metal is found in this county in a deposit of great importance, which lies in the desert region of Riverside County, T. 3 S., R. 14 E., forming part of an elevation known as Eagle Mountain. It also occurs in Turtle Mountains near the county line of San Bernardino.

IRON ORES OF EAGLE MOUNTAIN.

The important iron ore deposits of this area are large and valuable and when commercial conditions improve and proper fuel becomes available they will form the basis of an important industry for the Pacific Coast.

A careful study of this region was made for the U. S. Geological Survey in 1909 by E. C. Harder and J. L. Rich. The results of that work are published in U. S. G. S., Bull. No. 503, accompanied by colored geological maps and sections; and to which the reader is referred for full details.

These deposits are in the northern part of the Eagle Mountains, central Riverside County, T. 4 S., R. 14 E., about 40 miles northeast of

Mecca, on the Southern Pacific Railroad, 45 miles south of Cadiz, on the main line of The Atchison, Topeka and Santa Fe Railway, and 50 miles southwest from Blythe Junction on the Phoenix Branch of the latter railway. This recently completed branch connects with the main line at Cadiz, passing about 35 miles northeast of the Eagle Mountains.

The area is best reached from Mecca, on the Southern Pacific Railroad, by about 50 miles of road. The Iron Chief mine may also be reached from Dale, San Bernardino County, about 20 miles north. Dale is 45 miles from Amboy, on the Santa Fe Railway, with biweekly stage service. The east end camp may also be reached from Parker or Blythe Junction by wagon.

These deposits are considered the largest in the southern section of the state.[7] "The iron ores with associated metamorphic minerals occur as replacements in the dolomite. Locally, as at the east end of the area, they have replaced the entire series of dolomite lenses, leaving the associated quartzite but little altered. Elsewhere they occur within the dolomite lenses or beds, in bands or as irregular masses roughly parallel to the bedding. * * * The trend of the iron-bearing belt along the north limit is approximately N. 70° W., its extent in this direction being about 6½ miles. Its width of outcrop varies from 500 feet to 2500 feet. * * * The ore is predominantly hematite, but here and there consists of masses of magnetite. Much of the hematite contains disseminated magnetite, making it slightly magnetic, but probably less than 10% of the entire quantity of ore is magnetic. A considerable percentage is very pure and of high grade, containing between 62% and 67% metallic iron and less than 0.06% phosphorus. Much of the ore, however, is mixed with gangue material, such as metamorphic minerals and unreplaced rock. The principal minerals occurring with the ores and metamorphosed dolomite are serpentine, mica, amphibole, garnet, epidote, pyroxene, and titanite."

Several groups of claims have been located on these deposits, and a relatively small amount of development work done. These claims are described in detail in the bulletin referred to above.

MANGANESE.

Ore deposits of this important metal, so necessary in the manufacture of steel, are found at several points in Riverside County, but only one has as yet been developed into a producing mine. This is known as the **Black Bird Mine**, and is in the McCoy Mountains, 12 miles west of Mineral, a station on the Southern California Railroad, the new railroad now being constructed from Blythe Junction to Blythe. It is said that 1000 tons of manganese were shipped from this deposit during the spring of 1916 and that it is now exhausted.

[7] E. C. Harder, op. cit.

One locality, long ago known and located, is northeast of Elsinore. in Secs. 23 and 24, T. 5 S., R. 4 W.

The following description of the exposures has been written by a Los Angeles mining engineer, F. E. Fielding, and partly verified under the present writer's direction:

One group, of 6 locations, lies west of The Atchison, Topeka and Santa Fe Railway, the other group, of 9 locations, lies on the east of the railroad about ½ mile farther north; one portion of the property reaches the railroad, while the farthest point of any location is less than 1½ miles distant. For convenience in description the 6 locations west of the railroad may be designated as West Group and the 9 locations east of the railroad as the East Group.

(Sec. 23.) On the **West Group** was visited what was pointed out as the principal vein, though another parallel vein is said to exist. This vein outcrops at the top of a hill some 1500′ to 2000′ distant from and approximately 400′ to 500′ above the railroad. Here is an outcrop of 3 ft. wide, upon which a hole 3 ft. deep has been sunk. Some 75′ to 100′ distant, toward the railroad, a 10-ft. shaft has been sunk showing the vein to be 4 ft. wide at the surface. Below this point is a tunnel 20 ft. in length driven in the footwall so the width of the vein is indeterminable.

(Sec. 24.) On the **East Group** are three parallel veins, outcropping at intervals for several hundred feet in length. The central vein outcrops show an indefinite width, being considerably broken and covered with detritus. This vein may be 16′ to 20′ in width, as the distance from the apparent foot to hanging wall would indicate. The width can only be determined by trenching.

The following report on manganese in eastern Riverside County is by Mr. C. A. Waring:

M'COY MOUNTAINS.

The Schellenger Claims. On the north end of the McCoy Mountains in Secs. 13 and 24, T. 4 S., R. 19 E., Mr. E. E. Schellenger, of Blythe, has 4 manganese claims. The deposits, which are from 4′ to 8′ wide, have a northwest strike. A 20-ft. shaft, sunk to one side of the outcrop, has so far failed to strike the ledge and it is thought by Mr. Schellenger that the ore body may dip rather steeply. The deposit is said to be in a region of faulting. The manganese ore is said to carry considerable barite and fluorite.

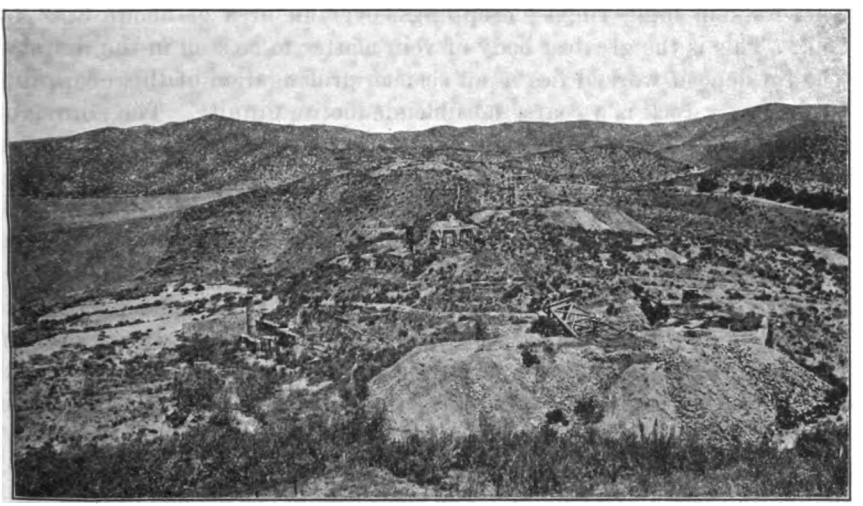
Prospects of manganese are also reported in the region southeast of McCoy Mountains, on the **Patterson ranch,** where considerable lime accompanies the deposit. Not enough work has been done to determine the importance of these deposits.

Palo Verde Region. Messrs. Lugo and Justice Smith have done assessment work on some manganese claims northwest of Palo Verde.

TIN.

The Temescal tin deposit was discovered about 1853 and in 1860 a company was formed to work the mine. The outbreak of the Civil War, the following year, caused operations to be suspended and nothing further was done until about 1880.

The earliest description of this deposit in 1884 by Henry G. Hanks, State Mineralogist, will be found in Report IV, p. 120. Other references to it will be found in Mineral Resources of the United States, U. S. Geological Survey, 1882, p. 434; 1883, p. 434; 1891, p. 161. Also, in U. S. G. S., Bulletin 260, and in U. S. G. S., Sixteenth Annual Report, 1894, Part III, p. 536.



Temescal (Cajalco) Tin Mine, looking northeast, Riverside County, California. Photo by Gerald A. Waring, July, 1916.

This deposit was carefully described in 1892 by H. W. Fairbanks, R. XI, pp. 111–113. Also, by the same author in the American Journal of Science, 4th Series, Vol. IV, pp. 39–42. For the position of this mine, see Elsinore Quadrangle, U. S. G. S.

From the data in the XIth Report, by H. W. Fairbanks, the following description is abridged:

"The Temescal tin mine is located in the western part of the Sobrante de San Jacinto grant, and about 5 miles southeast of Corona. This portion of the grant consists of rolling hills. On the west is a large body of porphyry, extending nearly to the Temescal Creek.

"The rocks exposed along the road to the mine east of Temescal Creek are mostly felsites and porphyries. These rocks are soon replaced by granite, in which are dikes of fine-grained, highly quartzose granite. A half mile south of the road is a cañon. Here the porphyry is seen extending up to the granite, which is greatly broken near the contact and, though there is no blending of one into the other, there is a confused mixture of broken portions of both rocks. Bunches and dike-like bodies of granite are enclosed in the porphyry. Small black veinlets of tourmaline aggregates are very numerous in the granite, extending through all the rock up to the porphyry, with a northeast strike. The material of these veinlets constitutes the gangue of the tin veins. The veinlets of tourmaline are aggregates of needle-like crystals and seem to have replaced the feldspar and mica of the granite, leaving the quartz. The veins grow larger toward Cajalco Hill. Just west of the works is a great mass of the black veinstone, the gangue of the tin ore. This rises in high, rugged croppings, over an area of about 300′ by 250′. This is the greatest body of vein matter to be seen in the district. The tin deposit worked lies in an eastern prolongation of this cropping. The country rock is a coarse hornblende-biotite granite. The course of the vein is N. 45° E., dip 65° to 70° NW., and it has the usual character of such deposits, swelling at times to a width of 8 feet, and again contracting to much less. The highest grade of ore is found in the narrow portions, where it is sometimes almost pure tin oxide, running as high as 70%. The vein matter does not wholly consist of tourmaline, but contains quartz grains scattered through it in about the same proportion as in granite. Tin is not found to any extent in the quartzose part of the gangue, but occurs in bunches and stringers, or disseminated in the irregular veinlike bodies of tourmaline, which lie in the quartzose gangue. This is particularly the case where the width of the vein is 6′ to 8′. Where it pinches, the whole vein sometimes consists of the tourmaline aggregate and tin ore. The vein usually has clay gouges on both walls; sometimes it is frozen to one wall; wherever the walls come together and cut out the vein matter, the gouges remain.

"There are here two varieties of tin ore: the yellow, occurring in thin layers in an uncrystalline form, and the brown, in granular form in the massive specimens, or in small, clear, reddish brown crystals lining cavities. In the later case it forms handsome specimens. A small amount of arsenopyrite is present at places in the vein, and pyrite in the granite. The quartzose portion of the vein matter often often blends into the granite walls, and there are bodies of evidently granitic origin wholly enclosed in the vein matter. A careful study of the vein matter, and its relation to the walls, shows that it is a portion of the granite, in which tourmaline has been substituted for the feldspar and for the dark silicates, hornblende, and mica. The

quartz has the same character and color as that in the granite, and many transition stages in the process are shown. Where the action has been more intense, near and along the fissures, the quartz also has been wholly removed and the tourmaline deposited, together with the tin. Cajalco was the center of this action. The veins decrease in size farther away."

At the time of Mr. Fairbank's visit in 1892 the mine had been opened up to a depth of 180 feet, by two working shafts. The total length opened on the vein was 300 feet. Two levels had been driven and work was in progress on a third. The main ore body lay in the center of the workings and extended downward in the dip of the veins. The ore milled averaged 5% of tin oxide, though large portions, as before stated, were of very high grade. The company prospected Cajalco Hill by a tunnel and by open cuts, and one or more of the veins south by shafts. At the time of the visit two of Husband's pneumatic stamps were in operation. They weighed 900 pounds each and dropped 135 times per minute.

South and southwest of the works are many bunchy veins of the black vein matter. They often carry considerable iron. They extend, generally, nearly parallel, in a northeast and southwest direction. Some appear as mere bunches on the surface. These veins closely resemble the main vein at Cajalco Hill, and are due to the same action, and it is supposed that many of them will be found to carry tin, though it does not appear on the surface. About 2 miles south the granite is replaced by a banded prophyry, which cuts off the tourmaline veins. The granite about the works, and especially toward the contract with the prophyry, is cut by many dikes of fine-grained granite, having an excess of quartz and feldspar. Associated with the porphyry are metamorphic strata of a hard, dark, quartzose character. A quarter of a mile northwest of the mine is a bunch-like outcrop of porphyry, carrying silver and copper carbonate. The black veins outcrop for a distance of 2 miles northwest from the mine, extending into the porphyry, which replaces the granite in that direction. The granite extends eastward for many miles.

In brief, the general geologic features here are: A semicircular area of granite over 2 miles in diameter, surrounded on the northwest and south by porphyries and adjoining on the east a great body of granitic rocks extending indefinitely in that direction. Around the border of this granite boss are many dikes of fine-grained granite. Cutting through the granite in a northeast and southwest direction are black tourmaline veins, which form the gangue of the tin ore when it is present.

Tin occurs here under conditions different from those in any other known deposit. Tin veins are almost always found in granitic rocks, but so extensively developed a tourmaline veinstone is remarkable.

The direction of the fissure system shown here is uncommon in California. The veinstone, together with the associated metals, has probably resulted from a process of sublimation along line of fracture, removing those portions of the granite easily affected, over a large area, as at Cajalco Hill, and in the immediate contact completely replacing it with the massive aggregate of minute tourmaline crystals.

NONMETALS.

Under this head are included the more valuable of this county's mineral products. Clay alone aggregated in 1914 a total of nearly $70,000 and the other nonmetallic minerals amount in value to a very substantial sum.

The principal materials under this head are Clay, Gypsum, Cement, Stone, Magnesite, and Gems.

ASBESTOS.

About 15 miles in an air line S. 14° E. of Palm Springs are the old workings of an asbestos mine, now held by **Frank H. Jackson** of Los Angeles. It is most easily reached from the railroad at Hemet, whence there is a good wagon road as far as Kenworthy. The road from Kenworthy to the workings is very rough but passable with a team and a buckboard. The topography of the region is mapped on the San Jacinto and Indio special maps of the United States Geological Survey.

The picture, Fig. 4, was taken from the road looking northward toward Palm Springs, lost in the haze to the left, and Asbestos Mountain to the right. The cross marks the location of the asbestos workings, a portion of which is shown in Fig. 5.

The country rock exposed in the Santa Rosa Mountains is chiefly granite. About ¼ mile southwest of B. M. 3871, southwest of Piñon Flat an area of metamorphic limestone with surface exposure about ½ mile wide (see Fig. 4) strikes N. 45° W., with a dip of 50° NE. This limestone overlies the granite unconformably and is overlain by a coarse granitic gneiss which is well exposed in Omstott Creek and on the southwest side of Piñon Flat. The gneiss contains a great deal of biotite with some orthoclase.

The asbestos occurs in veins as slip-fiber traversing a granular dull green cortlandite (olivine-hornblende) rock carrying some secondary magnetite. It is the amphibole (tremolite) variety and in places along the larger veins aggregates of the acicular gray crystals can be obtained two feet or more in length. The hardness is about six and the crystals fiberize with difficulty. After the asbestos has been exposed to the weather it softens up into a loose white fiber. Owing to the fact that the fibers are quite brittle and rather easily fusible probably the best

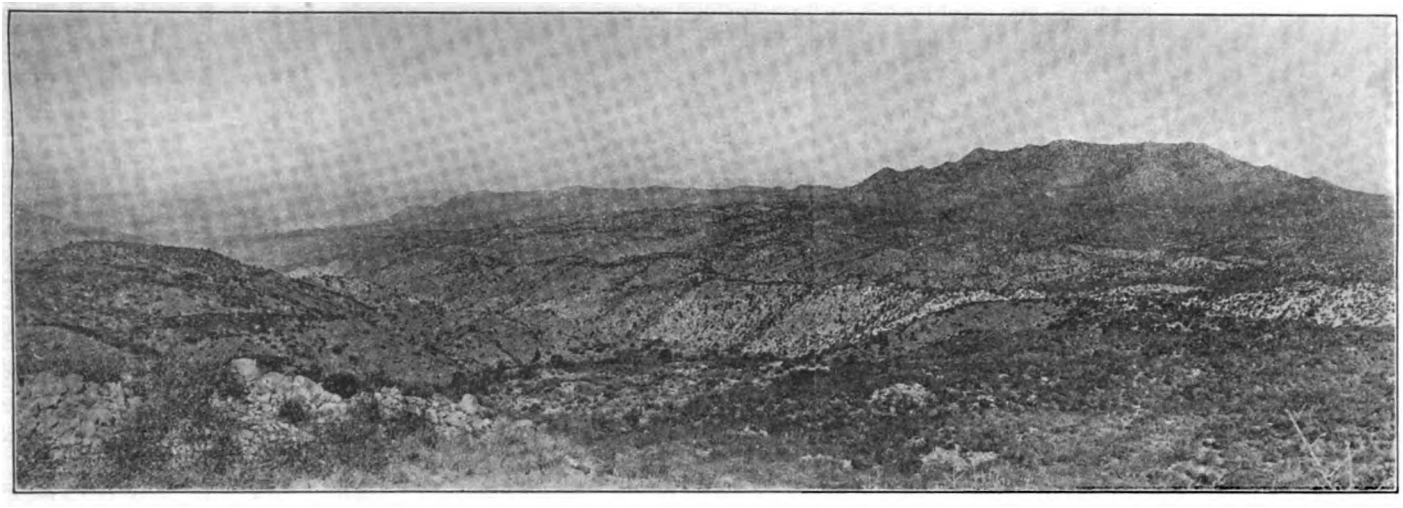


Fig. 4. View northward from head of Palm Cañon, Asbestos Mountain to the right. The cross marks the mine workings. The streak of white cutting across the head of the cañon is limestone. Photo by C. A. Waring.

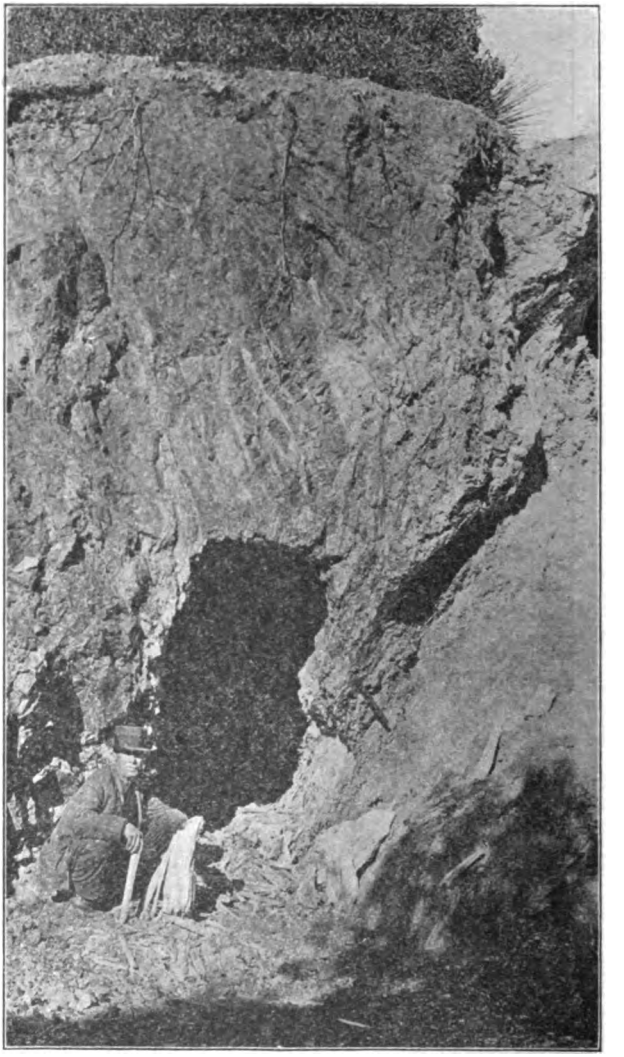


Fig. 5. Face of cut where asbestos has been mined, Riverside County. The prospector's pick marks the main ledge of asbestos, and small stringers appear throughout the mass of cortlandite. Photo by C. A. Waring.

use to which the product could be put would be as a protector against acids.

The largest vein of asbestos seen in the mine was two feet thick and below it were about three feet of talc. Both hanging wall and footwall are cordlandite. The deposit has been opened up by means of tunnels and open cuts. The first product of the mine, in the early days, was packed out as far as the head of Vandeventer Flat and shipped to San Diego where it was used in mineral paint. Only assessment work is

at present being done, and about thirty tons of asbestos are piled ready for shipment. Seven claims have been located along the deposits. The natural point of shipment at the present time would be from some point along the Southern Pacific Railroad about fifteen miles to the northeast. The claims are owned by Mr. E. E. Chilson, of Kenworthy.

CEMENT.[8]

Cement, as used in building, is a compound of lime, alumina, and silica that hardens in contact with water. It differs from quicklime in that it does not slake, expand, crumble, nor give off heat when wet, but chemically combines with part of the water into a firm, artificial stone. There are two principal classes of cements: the natural rock, or Rosendale cement; and the artificial product or Portland cement, to which may be added a third, the Pozzuolana or slag cement.

NATURAL ROCK CEMENT.

A limestone which in nature contains sufficient clay or other aluminous material, mixed with the carbonate of lime, so that it requires only burning and grinding to form a cement, is called a waterlime, or natural cement rock, and the product is natural or Rosendale cement, sometimes called Roman cement. Natural cement rock was discovered in the United States near Chittenango, N. Y., in 1818. Later it was found in large quantities elsewhere in New York and in Pennsylvania, Indiana, Kentucky and other states. Ulster County, New York and Louisville, Kentucky, were for a long time the center of this important industry. Natural cement is generally inferior to Portland, and in most places, its market has been taken by the artificial product.

In California such a natural cement rock occurs in Orange County, where, near El Toro, a deposit, claimed to be of good quality, is found. In 1860 and for several years following a natural hydraulic cement was obtained at Benicia, Solano County, and utilized in building operations in San Francisco.

PORTLAND CEMENT.

Portland cement is a compound consisting chiefly of silicates and aluminates of lime, produced by the calcination to incipient vitrification of a mechanical mixture of calcareous and argillaceous materials, the clinker thus produced being subsequently ground to a fine powder. Its chemical composition varies considerably, the principal constituents being lime, silica, alumina, and oxide of iron, which are apparently in the following proportions: lime, 60% to 64%; silica, 20% to 24%; alumina, 6% to 10%; iron oxide, 3% to 5%. These constituents, as a rule, amount to about 96%, the remainder consists of small quantities of sulphuric anhydride, magnesia, alkalies, etc.

[8] Bull. 38, pp. 171–173.

The use of Portland cement is principally based on its characteristic quality of hardening rapidly under water or in a moist atmosphere.

Portland cement was first manufactured in England, and so named in 1824 by Joseph Aspdin, of Leeds, who patented a calcined mixture of limestone and clay. The name was based on a resemblance of the set cement to the famous Portland limestone used in building. The growth of the industry was at first slow. Not until 1851 was it brought prominently before the world, and, soon after, its manufacture began in Germany, France and elsewhere on the continent. The increase in output was rapid from this time, especially in Germany and England, which exported large quantities to the United States.

In America, the first Portland cement was manufactured in 1875 by Mr. Saylor, at Siegfried, in eastern Pennsylvania. Soon after, a second factory was established in western Pennsylvania. For nearly twenty years the growth of the industry was slow, but during the last decade of the nineteenth century there was a phenomenal increase in the product. This was due to the greatly increased use of cement, which, without marked decrease in importation, increased the home product in one decade more than 1200 per cent.

The enormous increase in the domestic production of Portland cement is a matter of much interest, yet, when one considers the varied uses to which it is put, and the many other ways in which it might be used, it will be a matter for great surprise if the increase in production does not continue for many years.

Uses of Portland Cement.

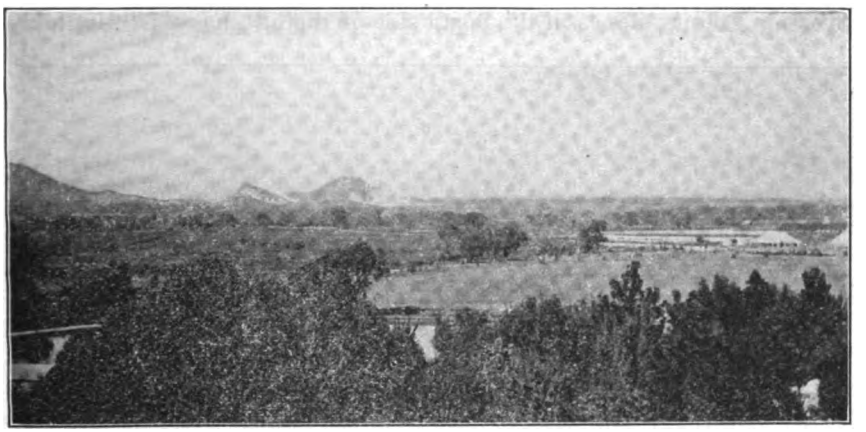
Because of the ease with which it can be moulded or formed into desired shapes, its hardness and durability when set, and its resistance to moisture and vermin, Portland cement will increase in importance in structural and engineering work. It has not only replaced ordinary lime mortar in masonry, especially in foundations, but in the form of concrete is replacing stone and brick and, for many uses, wood and iron in building.

Cement is used in the manufacture of artificial stone, and in concrete, which is used for monolithic structures, in walls, foundations, bridge construction, reservoir dams, etc.

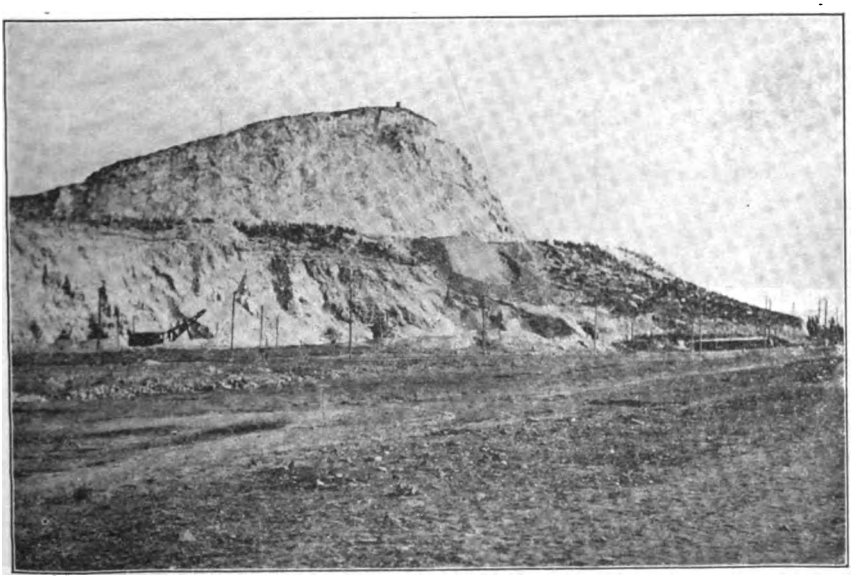
The composition of Portland cement is already given above. Variations in the different constituents influence the character of the cement to a certain extent. Cements rich in lime set more slowly, but harden better than those poor in lime. Cements rich in silica set more slowly than those rich in alumina, but they are better for use under salt water. The addition of 0.33% to 0.75% of fluorspar is helpful in making the materials clinker more easily. Gypsum or sulphate of lime in small quantities somewhat delays the setting of the cement and

adds to its final strength. More than 4% or 5% is injurious, and many specifications require that less than 2% be added.

Riverside Portland Cement Co., Tyler Henshaw, president; W. H. Metcalf, secretary; corporation office, Mills Bldg., San Francisco, Cal.; John Treanor, manager; business office, Trust Ins. Bldg., Los Angeles.



Riverside Portland Cement Co. plant as seen from Fairmount Park.

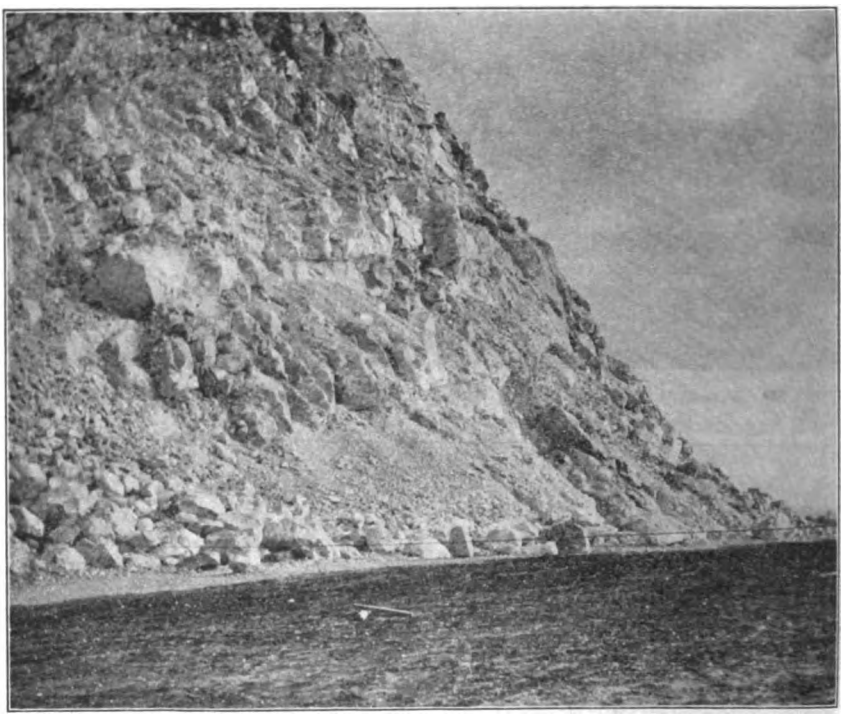


Quarries of Riverside Portland Cement Co. Upper quarry, limestone; lower quarry, diorite.

Quarry and works at Cement Plant near Crestmore, F. F. Parker, superintendent.

This company was organized in October, 1909, and its quarry and plant are about 5 miles northwest of Riverside, in Secs. 2 and 3, T. 2

S., R. 5 W., S. B. M. The limestone which is coarsely crystalline, is quarried in a butte similar to many which occur in this region, but which are generally of granite. This limestone butte near Riverside, in some respects, resembles Slover Mountain southwest of Colton, which is the source of limestone for the California Portland Cement Company. Both show mixtures of blue and white calcite, but the Riverside County stone, on the north side of the hill, has a particularly



Limestone Quarry of Riverside Portland Cement Co.

rich blue color. The limestone is in two beds separated by quartzite. The strike is northeast and the dip is 25° SE. On the west side of the mountain the limestone is underlain by mica diorite, an intrusion of which has caused the local uplift and tilted the sedimentaries toward the southeast. Above the limestone is micaceous quartzite, in turn overlain by another bed of limestone.

This limestone was formerly quarried by the Blue Sky Marble and Onyx Company,[9] of Riverside, some of it being used for building purposes in Riverside and Los Angeles, and some for ornamental purposes in San Francisco. There were, also, two kilns at the quarry; the product having been put on the market under the name of "Lily White" lime. About 75,000 barrels of lime were burned at the quarry.

[9]Bull. 38, pp. 75–76.

Analysis of Riverside Blue Marble.[10]

Lime	55.85%
Equivalent to lime carbonate	99.73%
Magnesia	0.30%
Iron	Trace

This analysis shows it to be a remarkably pure carbonate of lime.

The mass of igneous rock beneath the limestone on the west is a very fortunate occurrence for the cement company since it supplies the aluminous material needed to complete the mixture. Lithologically the rock is a mica diorite. It is coarse in texture and so far decomposed that it is excavated with an electric shovel.

When this decomposed diorite is pulverized and mixed with the limestone the raw mixture has the following composition:

Silica	15.18%
Iron oxide and alumina	5.00%
Lime	76.34%
Magnesia	2.90%
Total	99.48%

After burning and grinding, the finished cement gives the following average analysis:

Silica	22.98%
Iron oxide and alumina	8.80%
Lime	63.10%
Magnesia	2.42%
Sulphuric anhydride	1.42%
Total	98.72%

The raw materials are passed through Gates' crushers which reduce them to 3 inches and under, and then are dried separately in rotary driers. They then pass to ball and tube mills for grinding and after mixing are burned in 18 rotary kilns 8 ft. in diameter, 10 measuring 100 ft. in length and 8 measuring 120 ft. From the kilns the clinker passes on conveyors to piles for cooling. In these piles it remains two or three weeks. From these piles it is taken to be ground in ball and tube mills, and thence to a Bates automatic weighing machine for packing. The McCaslen system of conveyors is used throughout.

Riverside Portland Cement Manufacture.

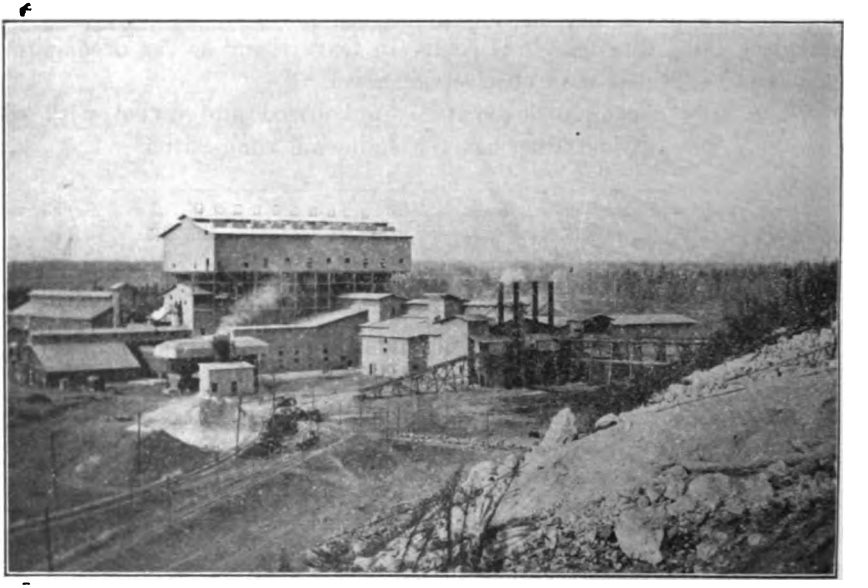
The limestone used is of exceptionally high grade, running 98% pure. Clay materials of the ordinary type of composition, consisting mainly of silica, iron and alumina, are also used. The particular clay material used carries approximately 8% of lime.

These materials are quarried in the usual manner and brought into the mill separately, each being ground so that approximately 40% will pass a 100-mesh screen, and 100% pass a 10-mesh screen, at which

[10]Analysis furnished by the Sky Blue Marble and Onyx Co., John A. Wessener, analyst. See Bull. 38, p. 75.

fineness a blend is made of the material, making what is commonly known as the "raw mix."

This material is then ground, from 96% to 97% passing 100-mesh screen before burning. No calcining whatever is done in the drying, simply subjecting the materials to sufficient heat to drive off free moisture. This material is then burned in the usual manner in rotary kilns, being subjected to sufficient heat to combine the two materials



Cement plant of Riverside Portland Cement Co.

thoroughly, forming what is commonly known as clinker, ranging from the size of peas to 2 inches in diameter. It then passes through rotary coolers, where it is sufficiently cooled for regrinding.

At this point it is weighed and 3% of gypsum added, the latter being added to regulate the setting time of the finished product. The clinker is then ground so that 96% to 97% passes a 100-mesh screen, and 80% to 82% passes a 200-mesh screen. It is then conveyed and stored in what is known as cement storage, from which point these materials are drawn and sacked according to the demand, the Bates type of automatic machine being used for packing.

Dust Precipitation.

The dust-laden gases from the kilns pass up through the stacks which are at present capped on top. Gases leave the stacks at a point about 80 feet above the ground, and pass horizontally through dust precipitation apparatus. Each kiln has a separate "treater" and electrical apparatus. The treater consists of a box about 30 feet long on each side of the stack. Each box contains rows of plate electrodes 15 feet long

vertically and one foot apart. Between these rows of plates are placed the discharge electrodes which consist of fine wires hung vertically 1 foot apart, and 6 inches from each plate electrode. As the plates and electrodes are vertical, the gases pass at right angles to the plates and wires. At the end of each treater farthest from the main stack, the gases discharge into a short outlet stack.

Below the plates and wires each treater has hoppers and once each hour the dust is shaken from plates and wires with small air hammers. This operation requires about a minute. The dust falls into the hoppers and then into cross conveyors. It then passes to a main conveyor and out of the building either to the dust packing plant or to storage.

The original installation comprises 10 sets of these treaters, one for each of the original 10 kilns. The volume of gases to be handled averages about 50,000 cu. ft. per minute per kiln and each treater catches 5 to 10 tons of dust per day. The dust precipitation takes place at a voltage of about 50,000. This is a uni-directional discharge produced by rectifying a high voltage (50,000 volt) alternating current by means of a simple mechanical rectifier. Each treater requires about 3½ kilowatts for its operations.

The original installation has been running about two years without depreciation and with an average efficiency of over 95%. A short time ago an additional kiln was installed at the plant and this has been fitted with a slightly different type of treater in which the gases pass through vertical pipes, 1 ft. in diameter, with a discharge wire in the axis of each pipe. In this new kiln the company is now producing cement from the dust caught in the treaters on its original ten stacks. The average potash content of the dust is about 2% and in the new kiln this potash is concentrated so that the average potash content in the dust resulting from the burning of dust is about 20%. A portion of this potash-bearing dust is being sold to fertilizer manufacturers.

CLAYS.

Brick clays, in this county, as elsewhere, occur locally at many points and are not of great commercial importance, but the most prominent member of the nonmetallic group is found in the plastic clay of the Temescal Valley.

PLASTIC CLAYS OF RIVERSIDE COUNTY.

In western Riverside County extending along the Temescal Valley for 10 miles from Elsinore on the southeast to and beyond Corona on the northwest is a zone of plastic clays of superior quality. In many places they resemble the important white, gray, black, red and variegated Cretaceous clays of New Jersey and eastern Pennsylvania, and like the latter, the Temescal clays vary locally in thickness, color and other properties, consisting at different points of white, red, and

mottled plastic clay, and gray and black flint fire clay. The extent and thickness of these clays, together with the great plasticity of some and the highly refractory qualities of others, give them much importance and these deposits will grow in commercial prominence as the population of southern California increases, and transportation lines are farther developed. Many openings have been made in these beds at different points from which, during a number of years, clay has been taken for the factories at Elsinore, Corona and Los Angeles.

GEOLOGY OF THE TEMESCAL VALLEY CLAYS.

The valley in which these extensive deposits lie was in Tertiary time an arm of the sea opening northward into the valley of western San Bernardino County, and extending southerly to Temecula. Its width is from one to two miles, but the depth is unknown, as, at the terra cotta works near Alberhill a drill hole was sunk over 600 feet without reaching the bottom of the basin.

These clays are of a great variety of colors. They are in various conditions of consolidation, and some are chalky in appearance, and there are thick beds of loosely cemented argillaceous quartz sand. These deposits dip westward from the Temescal Range, and instead of also dipping away from the Santa Ana Mountains, at many points they dip west into the latter range. Three miles south of Corona the dip of the beds is 5° to 10° SW. and, as the Santa Ana Mountains are approached, the dip increases, and at distance of a fourth of a mile up to the metamorphics, it varies from 45° to vertical. At the California Clay Manufacturing Company workings the dip is eastward.

Poorly preserved fossils are found in places. Near the southeastern corner of the Hoag Ranch is a hill with hardened concretionary sandstone outcropping around it. Nearly every portion of this contains fragments of bones supposed to be cetacean.[11] Two miles south of the old Temescal post office is an outcrop of soft sandstone, dipping 30° southwest and carrying Miocene fossils.[12]

In the region between Corona and Alberhill, at various points, the clay deposits are overlain by debris of disintegrated granite, varying from a few inches to many feet in thickness, but south of Elsinore the Tertiary deposits are now covered by Quaternary gravels.

CLAY AND CLAY INDUSTRIES.[13]

Clay can not accurately be defined in technical terms and yet the name has been adopted into technical literature as a convenient word. It is a substance varying so widely in its chemical and physical properties, that it is difficult to frame a definition that will include them all.

[11] H. W. Fairbanks, Report XI, p. 111.
[12] H. W. Fairbanks, Report XI, p. 110.
[13] R. IX, pp. 240–261—Pottery. Mrs. Linna Irelan; pp. 287–308. Clays, W. D. Johnston; and Bull. 38, p. 190 *et seq.* For convenience much of the discussion on Clays is abridged from Bull. 38.

It is sometimes defined as an earthy substance composed essentially of the mineral kaolin, a hydrous silicate of alumina. But it has not been proved that kaolin is the essential base, or that it is always present.

Clay is also described as an earthy substance in which silicates of alumina predominate, thus excluding any large proportion of siliceous sand, calcareous or magnesian matter, and oxides of iron and manganese.

One definition includes in clay "all earthy and stony substances which are or may be used in the manufacture of clay wares."

The report of the U. S. Census Office, "Mines and Quarries," 1902, p. 861, gives the following definition of clay: "Any earthy substance which, if mixed with water and moulded, will retain its shape after drying, and which upon subjection to high temperature loses its plasticity and becomes hard and brittle."

ORIGIN OF CLAYS.

The source of the silicate of alumina, which is an important part of all clays, is found in the aluminous minerals of crystalline rocks, especially in feldspars. In weathering, the alkalies are separated, combine with carbonic or other acids, and are carried away in solution. The alumina and part of the silica frequently combine with water, forming kaolin.

The hydrous silicates of alumina are very stable compounds at ordinary temperatures. The constituent elements may not always combine in the same ratio as in crystalline kaolinite, but they are present in some form and constitute an important part of all clay, shale and slate depcsits, and hence form a very material portion of the surface rocks of the earth.

When hydrous silicate of alumina or similar clayey material is segregated and forms a considerable portion of any deposit, the product is called clay, but it occurs also in large quantities mixed with other materials in other rocks, as with sand in sandstone, with gravel in conglomerates, and with carbonate of lime in limestone. When clayey limestones disintegrate by the action of carbonated waters dissolving the calcium carbonate and carrying it away in solution, the insoluble aluminum silicate is left behind as residual clay. Disintegration of sandstones and shales forms a mixture of clay and sand, which, when carried away by rain and streams is frequently separated into sand and clay deposits.

Thus clays may be divided, on the basis of origin, into residual clays, or those occurring in the place of the original rocks from which they have been formed, and transported clays, which have been deposited by water which has transported them from their original position.

Glacial clay (boulder clay or till) is a special class of transported clay in which the agent has been ice. Besides the clay of disintegration

that has been picked up by the glacier, glacial clay consists in part of a finely-ground fresh-rock material, which was formed by the boulder-shod mass of ice pulverizing the rocks over which it passed.

Chemical Composition.

"Kaolinite, which is the basis of all clay, is a hydrous aluminum silicate (Al_2O_3, 2 SiO_2, $2H_2O$). All clay in its natural state contains impurities, the kind and quantity of which determine its character; from the purest varieties, called kaolin, clays range through all stages of impurity down to a material which contains so little kaolinite that it can not be classified as clay."

"The foreign material of clay is frequently divided into fluxing and nonfluxing constituents, depending upon whether or not they increase the fusibility of the clay. The most common fluxing constituents are lime, magnesia, potash, soda, lithia, iron, and manganese. The fusibility of the clay is affected by the condition of the fluxing constituents as well as by their quantity. For instance, a small percentage of iron oxide, finely divided and intimately diffused through the clay will prove a more active flux than twice the amount scattered through it in coarse grains. The common nonfluxing constituents are silica and organic matter, but this statement is not wholly exact, as silica may slightly increase the fusibility. These constituents may be present in quite a variety of forms.

Physical Properties of Clays.

Some of the qualities which make clay valuable are: (1) plasticity and mobility when wet; (2) retention of the molded form when dry; and (3) hardness and durability when burned. Plasticity when wet is a property common to all clays but flint fire clay.[14]

Plasticity is a result of the microscopic texture of clay. (See Report IX, California State Mining Bureau, p. 287). Kaolinite, which is formed *in situ*, and composed of crystalline scales, is only slightly, if at all, plastic, while kaolin, which has been transported, and is composed of infinitesimal globular particles, makes a highly plastic clay. Flint clay becomes plastic when finely ground.

In drying, clay loses part of its interstitial water, and in burning, loses the remainder and part of the water of crystallization. The hardening of clay from the action of high temperature is permanent, the nature of the material is changed, and it no longer becomes plastic on the addition of water.

Shrinkage. All clays that are molded wet, shrink on drying (air shrinkage) and undergo further shrinkage when burned (fire shrinkage). This shrinkage is due, in great part to loss of water, which

[14]Possibly some persons would add Fuller's Earth to the exceptions, but it need not at all be classified with the clays.

exists in clay as water of crystallization, and as a film around the particles or inclosed between them.

Air shrinkage is largely due to the loss of water of the second class, as indicated by the fact that the shrinkage is from 2% to 10%, while it takes from 14% to 35% to make the clay plastic. The difference indicates, in a general way, the volume of the interstices.

Clays differ greatly in the amount of their shrinkage. In general, the more plastic and purely argillaceous clays, shrink more than sandy, siliceous ones. Hence, if the brickmaker has a clay that is too "fat," he adds sand to it. Clay that has once been burned undergoes no further shrinkage on subsequent burning, hence burned clay is frequently used as a "grog" to lessen shrinkage, especially in refractory products, where sand might lower the fusing point.

Fire shrinkage is caused, in part at least, by the loss of water of crystallization along with the remaining interstitial water. It is also affected by the amount of organic or other volatile matter present. Moreover, some substances which expand on heating, if present in the clay, may more than counterbalance the shrinkage of the argillaceous part.

It is important to know the shrinkage of the clay that is to be used for products of definite dimensions, so that the mold may be made of the proper size. Laboratory tests made on a large number of different kinds of clay gave the following results. each being the average of several specimens of that kind:

Laboratory Test on Shrinkage.[15]

	Air shrinkage, average	Fire shrinkage, average
Flint fire clay	8.5%	9.9%
Kaolin	5.0%	8.8%
Potter's clay	7.0%	5.4%
Brick	5.5%	4.5%
Shales	6.0%	4.6%
Gumbo	9.0%	1.5%

Fusibility of clays. The clay manufacturer must necessarily know the fusing temperature of the clay he is using, in order that he may not injure or destroy his ware by overburning or underburning. The term "fusibility" applied to clays has a significance different from that of the same word applied to metals. When clay is heated beyond a red heat, it shrinks and becomes close-grained and harder. It finally reaches a point where shrinkage ceases and it becomes very hard and strong, and the individual grains are no longer recognized. This is called complete vitrification, although the clay still retains its form and shape.

[15]Bull. 38, p. 193.

If the temperature is further increased, the clay begins to warp and sag, and blister, and becomes scoriaceous, which stage may be called scoriaceous vitrification. A further increase in temperature may produce a complete vitrification to a molten stage, from which it cools to a hard, glassy, rock-like slag. The temperature at which the various stages of vitrification occur are different for different clays, and are largely functions of the chemical and physical composition of the clay.

Clays which resist vitrification at high temperature are called fire clays or refractory clays, but the line of separation between refractory and nonrefractory clays is an arbitrary one. (See Fire Clays.)

Color. Clays may be white, black, red, yellow, brown, blue, or variegated. White clays are free from metallic oxides, and frequently occur among the purest forms of kaolin. Black clays are generally colored by carbonaceous material diffused through them, and are frequently made white by burning. The yellow, brown, red and frequently the blue colors are due to iron in some form. In yellow clay the iron is in the form of the hydrous sesqui oxide, the common bog ore; in the red, the color is due to anhydrous sesqui oxide, or hematite; the blue color may be caused in part by iron carbonate, silicate, or sulphide, and sometimes wholly or in part by organic matter.

The color of clays after burning is frequently different from that before burning. They may be divided into those which burn white, buff and red.

The color of the burned clay is influenced not only by the amount of iron in the clay, but also by the physical and chemical condition of the iron, the other elements associated with the iron, the temperature and length of time in burning, and the character of the gases in the kiln. The color of the burned product is thus very largely influenced by the skill of the burner.

In the finer grades of ware, the desired color or colors are obtained by mixing the proper pigments. Almost any desired color or shade of color, except white, can be obtained in this way. For white wares, clay free from metallic oxides is necessary.

POTTER'S CLAY.[16]

Potter's clay is a term rather loosely used. The usual idea conveyed by the term, probably, is that of a smooth, plastic clay, too fusible for highly refractory purposes and containing less iron than ordinary brick clay. It is adapted to the manufacture of stoneware, earthenware, terra cotta, and sewer pipe. Wares manufactured from potter's clay are usually light buff in color, and when burned to incipient vitrification are strong and slightly porous, requiring a glaze to

[16]Bull. 38, pp. 196–197.

render them impervious to liquids. The stoneware glazes are commonly either salt glaze or one formed from slip clay. Much stoneware is made with a brown slip glaze on the inside, and a blue-gray salt glaze on the outside.

The requisites of a good stoneware clay are: (1) It should be extremely plastic, so that it may be easily moulded and turned into the thin walls of the vessels required and yet retain its shape without injury. To mold readily, it should be high in clay base, that is, a "fat" clay; (2) It should be low in iron, as a light-colored ware is desirable; (3)It should be free from coarse sand or other coarse material. It is frequently necessary to remove such material by a process of washing, in which the coarse materials are separated by gravity. The washing process will remove the iron if it should be present in crystals or lumps, the condition in which it causes the greatest injury; (4) It should be fusible enough to vitrify at a moderate temperature, less than 2000° F. If the vitrifying point should be too high, the burning would be too expensive; (5) The clay should have a range of at least 200°, and better 300°, between incipient and complete vitrification, as it is not easy to control the temperature of the furnace within narrower limits, and all the ware in the kiln would pass the stage of incipient vitrification, but should stop short of complete vitrification. If it has not reached the first stage it will be soft, porous, and lacking in strength, and if completely vitrified it would be glassy and brittle, and probably be out of shape; (6) It should be capable of drying at a moderate speed without checking or cracking, otherwise there will be increased storage and drying room required, increased stock, and therefore more capital and greater expense; (7) It should be free from salts that are liable to cause blisters in burning.

Yellow or Rockingham Ware is a class of pottery differing from stoneware in the manner in which it is burned. In stoneware, the burning is complete in one operation, while yellow ware is first burned in the biscuit kiln to form the body, and then burned again to develop the glaze. A less refractory clay may be used in the yellow ware but, since the glazes fuse at lower temperatures, the same clay may be used for either stoneware or yellow ware.

Earthenware is the lowest form of pottery, and can be made with proper precautions from almost any common yellow clay. It is softer and more porous than stoneware or yellow ware.

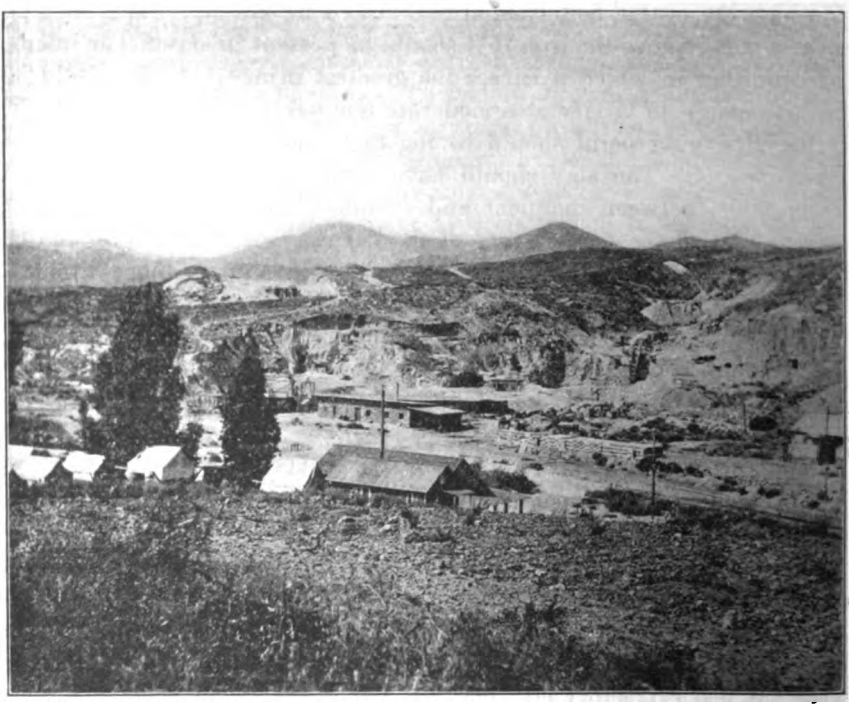
SLIP CLAY.

Slip clay is a variety that runs low in fusibility, and is used in forming the glaze on stoneware and earthenware. The following analysis of a slip clay shows the composition of one of the best known and most widely used clays of this class in the United States:

Albany Slip Clay.

	Per cent
Silica (SiO_2)	56.75
Alumina (Al_2O_3)	15.47
Iron (Fe_2O_3)	5.73
Lime (CaO)	5.78
Magnesia (MgO)	3.32
Alkalies	3.25
Water	8.57

Much of the slip clay used in California is obtained from Albany, N. Y.



Clay pits of Alberhill Coal and Clay Co., at Alberhill.

FIRE CLAY.

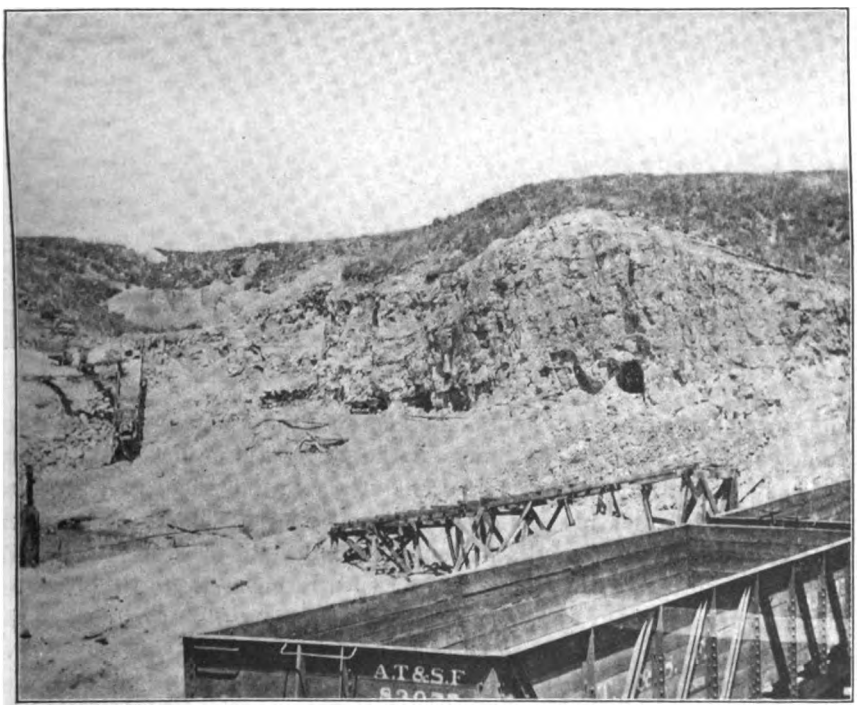
Fire clay, as the name signifies, is one that resists high temperatures, and hence is more refractory than the common clays. It has a lower percentage of the fluxing substances, such as alkalies, iron and manganese. It is commonly associated with coal beds or other vegetable deposits and it is thought, in some instances, to owe its qualities to the action of vegetation or vegetable matter which has extracted from the clay the fluxing constituents, such as iron alkalies and alkaline earths.

There are two classes of fire clays: The soft or plastic, and the hard or flint. The latter occurs in hard rock masses, does not slake in water,

and is not plastic in its natural condition. Fire clays are used for making fire bricks, stove and furnace linings, gas retorts, glass pots and for other refractory purposes. They are also used for making high-grade building bricks, and some low-grade fire clays are used for making paving bricks.

List of Los Angeles Manufacturers Using Riverside County Clay:

Simons Brick Company, 128 West 3d St., uses Ione (Amador County) clay also.
Pacific Sewer Pipe Company, 825 East 7th St.
Los Angeles Pressed Brick Co., 404 Frost Bldg.; uses Ione (Amador County) clay also.
Independent Sewer Pipe Co., Tropico. Suspended in 1915.
St. Louis Fire Brick and Clay Co., 2464 East. 9th St.
Ramona Tile Co., Van Nuys Bldg.
Consolidated Pacific Cement and Plaster Co., San Fernando Bldg.
Acme Plaster Co.
Inglewood Brick Co., Washington Bldg., also make sand-lime brick.
California China Products Co., National City, San Diego County.



Alberhill Coal and Clay Co., pit at Alberhill.

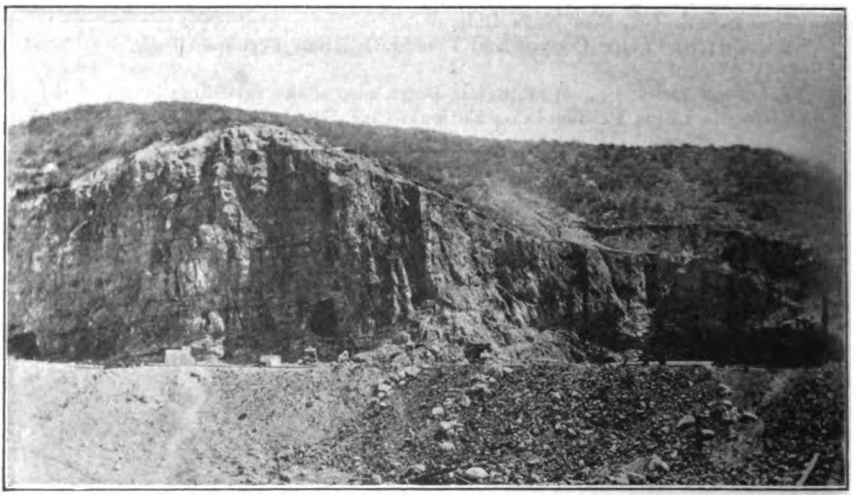
OPERATING COMPANIES.

The Alberhill Coal and Clay Company, 430 Union Oil Bldg., Los Angeles, ships clay from several openings at Alberhill, the terminus of the railway spur from Elsinore. This company is the largest producer of clay in the Temescal Valley. The holdings are in Secs. 15, 22, and 23, T. 5 S., R. 5 W. At the tipple of the abandoned coal mine is a large

clay pit. The upper portion of the deposit consists of 10 ft. of red and gray variegated clay, underlain by 6′ to 8′ of a mixed fire clay and granitic sand, and in turn underlain by gray to black clay with thin streaks of coal, and at the base, underlying the coal seams is a bed of blue plastic fire clay, with 3′ to 4′ exposed.

About half a mile southeast of the pit and about 200 ft. higher on the hill, is another pit, from which the clay is hauled by wagon to the railway. Here, a high-grade fire clay is obtained.

Harrington Clay Pit, in Sec. 35, T. 4 S., R. 6 W., leased to M. W. Findley, president of the Independent Sewer Pipe Company, and by



Clay pit of Alberhill Coal and Clay Co., at Alberhill.

him formerly sublet to the Pacific Sewer Pipe Company, is in the Temescal Cañon, about 10 miles southeast from Corona. It lies on the east side of the valley, about 300 ft. above its floor. A section of the face of the pit shows several varieties of clay, as follows: At the top 2′ to 6′ of sand and boulders, underlain by from 10′ to 20′ of red and white mottled plastic clay. Beneath this are 4′ to 10′ of white plastic refractory clay, and at one end of the quarry is a red clay with pisolitic structure resembling a ferruginous bauxite.

The clay from this pit is hauled in wagons to the Chase railroad spur south of Corona, for shipment to Los Angeles.

Pacific Sewer Pipe Company, 825 E. Seventh street, Los Angeles; E. M. Durant, president; Archibald Douglass, secretary. This company, formed by the consolidation of several others, controls clay beds at Corona and Alberhill and at intermediate points. At present it is shipping clay from Alberhill only. Part of its raw material is bought

from the Alberhill Coal and Clay Company. A little clay is used from Antelope Valley north of Rosamond, Kern County.

This company owns the pit three miles southwest of Corona, formerly owned and operated by Mr. McKnight. It produces a black flint clay,

Clay pit of Alberhill Coal and Clay Co., at Alberhill.

besides some blue refractory clay. This clay lies on the top and south side of a low hill in a bed dipping 35° S., and has been mined by tunneling at the base of the hill. The black flint clay is about 20 ft. thick, overlain by 10 ft. of blue clay and about 20 ft. of reddish plastic clay, capped by coarse, granitic sand. Large quantities of highly refractory clay are obtained here.

This company also owns a large pit in the valley about a mile southwest of the Harrington pit. The clays are similar to those in the latter, but occur in different order. At the surface there is an overburden of from 5′ to 25′ of sand and boulders. At one side of the pit the sand is underlaid by white plastic clay from 15′ to 25′ thick, underlain by red mottled clay; at the opposite side of the pit the clay rests on red mottled clay, of which a portion has a pisolitic structure. Both the red and white clays are smooth and plastic but, in places, contain diffused quartz grains, which prohibit their use in fine ware, unless the clay be carefully selected, or the coarse particles removed by some system of washing.

This company also operates the clay pit at Alberhill, near Elsinore, formerly owned by W. G. McVicar.

This company controls six manufacturing plants.

No. 1. At Terra Cotta, three miles northwest of Elsinore, formerly owned by the California Fireproof Construction Company, and previously by the Dolbeer Estate of San Francisco. This was used for making

Plant No. 1 of Pacific Sewer Pipe Co., at Terra Cotta.

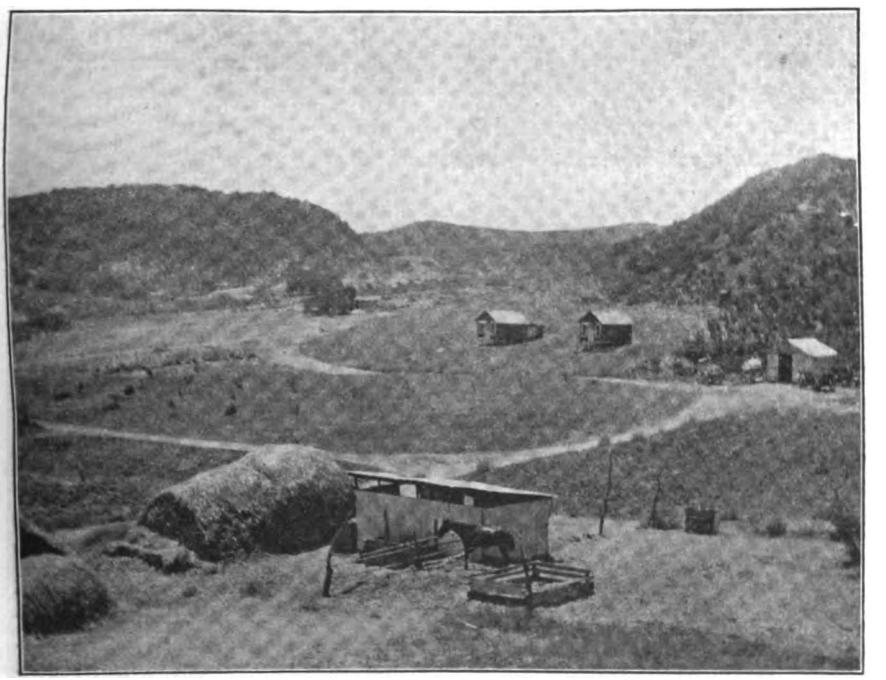
sewer pipe, earthenware, and hollow bricks, sewer pipe being the chief product, but it is now idle. The clay was procured from Alberhill. On the hillside near the factory are two clay pits from which clay was formerly mined.

No. 2. Half a mile west of Corona, on the south side of the Santa Fe Railway, formerly belonging to the Corona Pressed Brick and Terra Cotta Company. This plant has been dismantled.

No. 3. These works are one mile west of Corona, on the north side of the Santa Fe Railway. Formerly owned by the Pacific Clay Manufacturing Company. Here are made sewer pipe, both salt-glazed and unglazed tiles, flue linings, chimney pipes, fire bricks, conduits for electric wires, and terra cotta. The Acorn brand of fire brick is made here from the refractory clay of the McKnight quarry, previously described. The different kinds of pipe, etc., are made of clay obtained 10 miles

south of Corona. The factory is well equipped with machinery. There are eight round, downdraft kilns in use, heated with oil fuel.

No. 4. At 423 North Avenue 26, Los Angeles. Formerly operated by the Los Angeles Stoneware and Sewer Pipe Company. This is used for stoneware, Terra Cotta flue lining, fire brick, pressed brick, enameled brick, drain-tile, sewer pipe. Here are manufactured all kinds of stoneware, earthenware, fire brick, vitrified, salt-glazed sewer and water pipe, from 3″ to 36″ in diameter; conduits for underground electric wires, Terra Cotta chimney pipes, flue linings, etc.

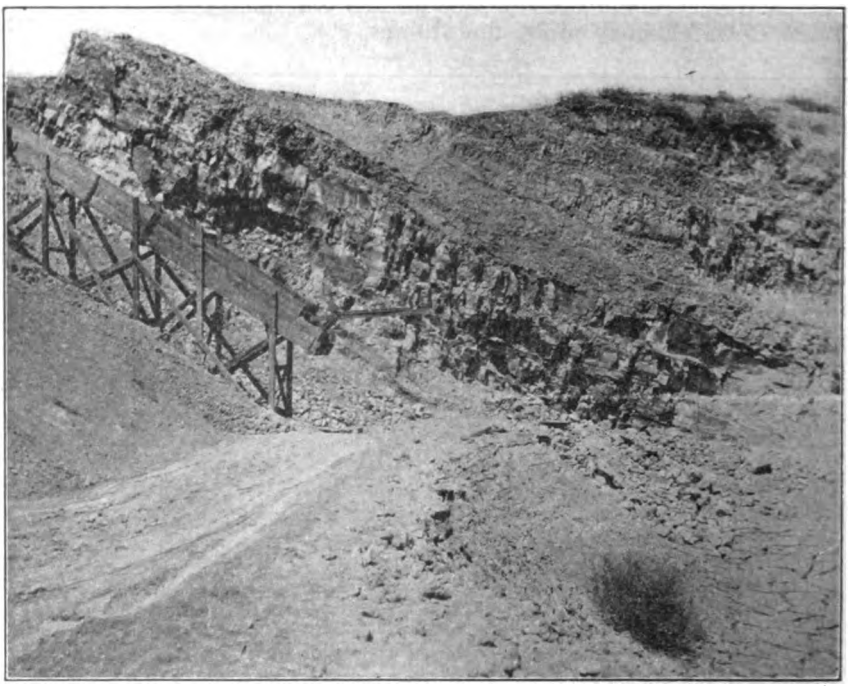


California Clay Mfg. Co. pits near Alberhill.

The following materials are used at this plant for stoneware: clay from the Alberhill Coal and Clay Company, Alberhill; and kaolin from Rosamond, Antelope Valley, Kern County. For sewer pipe: clay from Alberhill Coal and Clay Company, and local clay from the northeastern part of Los Angeles City. For fire brick: fire clay from Alberhill Coal and Clay Company. For flower pots: local clay. For glazing: slip clay from Albany, N. Y. and from Michigan; also, imported feldspar, flint, china clay, and English ball clay.

The clay, duly mixed, according to the product to be manufactured, is passed through a dry-pan crusher, then washed, blunged and pressed through a press filter. The fire brick material passes through a pug-mill, a Giant auger, 12-brick wire cutter, and an Eagle represser. The sewer

pipe material passes through a wet-pan crusher, and two presses, according to the dimensions of the pipes, one making those from 3″ to 16″ in diameter, and the other those from 18″ to 36″ in diameter. The pottery material goes to the pottery pug-mill, where it is brought to the required plasticity. The green products are dried in large rooms, slightly heated by the exhaust from the kilns. The time required for drying depends upon the weather: in summer from 8 to 10 days are sufficient.

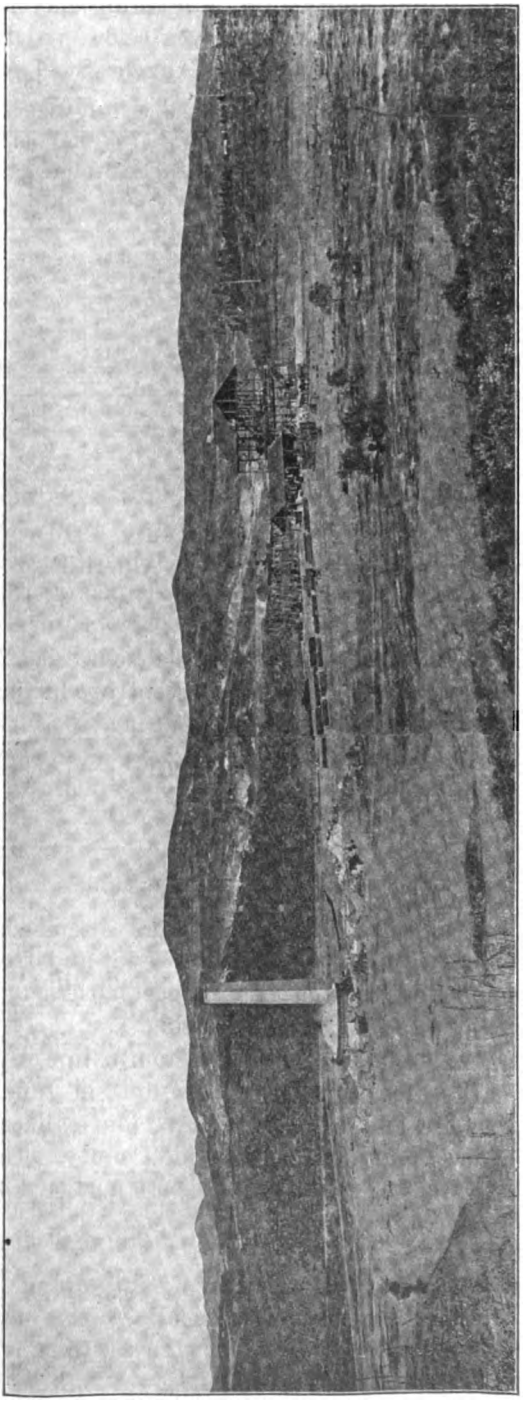


California Clay Manufacturing Co. pit near Alberhill.

The plant has seven downdraft kilns, using oil as fuel: three of 30 ft. diameter; one of 25 ft. diameter; two of 20 ft. diameter; and one of 12 ft. diameter. Power is furnished by a 250 h.p. boiler, using oil as fuel, and a 200 h.p. engine.

No. 5. McKinley and Slauson avenues, Los Angeles. Formerly owned by the California Clay Manufacturing Company. Used for sewer pipe and vitrified conduits. The works are equipped with Brewer wet-mud brick machines, and a Berg press for dry-pressed brick, each with a daily capacity of about 20,000 bricks; a Barber pipe press, and 8 downdraft kilns, varying from 16′ to 30′ in diameter, using oil as fuel. About 30 men are employed.

No. 6. At Los Nietos. Used for sewer pipe and drain-tile.



Panoramic view of new works of Los Angeles Pressed Brick Company, at Alberhill, Riverside County. Photo by Gerald A. Waring, July, 1916.

California Clay Manufacturing Co. is working clay pits near Elsinore, analyses of their materials being given below. Alexander Caskey is manager, with offices at 235 South Los Angeles St., Los Angeles.

Analyses of Clays from the Mines of the California Clay Manufacturing Co.

Analysis	No. 20. Color, gray, fuller's earth, per cent	No. 23. Whitish, tile clay, per cent	No. 25. Color, gray, fire clay, per cent	No. 26. Color, white, China clay, per cent	No. 26. Color, white, plastic, per cent	Fire clay, hard and sandy, per cent	Red clay, pipe, per cent
Silica (SiO_2)	62.14	68.16	61.02	42.54	43.70	54.8	61.20
Alumina (Al_2O_3)	23.84	20.54	21.42	38.48	39.09	37.1	26.10
Iron Oxide (Fe_2O_3)	2.24	1.76	4.00	2.40	2.50	.7	15.00
Titanic Oxide (TiO_2)	1.00	.70	.20	1.12	----	----	----
Lime (CaO)	.74	.46	1.68	.22	.40	.6	.60
Magnesia (MgO)	.22	.45	.76	.12	Trace	----	.09
Alkalies (K,No)$_2$O	.82	.55	1.02	.70	----	----	----
Sulphuric Anhydride (SO_3)	.11	----	.25	----	----	----	----
Ignition loss	9.10	7.62	10.08	14.80	15.10	----	13.00
	100.21	100.25	100.43	100.38	100.79	93.2	98.08

Analyses by Smith, Emery & Co.

The **Los Angeles Pressed Brick Co.** is (July, 1916) building a new plant for manufacture of clay products at Alberhill.

COAL.

Alberhill Coal and Clay Company shipped some coal from its holdings at Alberhill several years ago. No recent production of the coal. Work confined to the clay pits. See under Clay.

FULLER'S EARTH.

(See California Clay Mfg. Co., under Clays.)

GEMS.

TOURMALINE.

The tourmaline mines of this county were discussed in detail by Dr. Geo. F. Kunz in Bulletin No. 37, pp. 57-58, and from this publication the following descriptions are in part abstracted with added data contributed by Mr. Clarence A. Waring.

"The first discovery of the colored gem tourmaline in the state goes back as far as 1872, when Mr. Henry Hamilton, in June of that year, obtained some very fine and handsome colored tourmalines on the southeast slope of Thomas Mountain, in Riverside County. This was known as the Columbia Mine, and is one of the most northern occurrences in the state."

[17]Dr. Kunz also says:

"In 1893, near the crest of the San Jacinto Range, in Riverside County, loose or 'float' crystals of tourmaline were observed, chiefly black, but some finely colored—red, rose, green, blue, etc. [18]In some

[17]U. S. Geol. Survey, Min. Res. 1892, p. 12 (reprint).
[18]Bull. 37, p. 57.

cases the green crystals were found to have red centers—a type long known from Brazil. Some large crystals were obtained and a number of gems were cut from them. The indications were promptly followed up, and several mining claims were located and worked. One of them, opened near the summit of the range by three prospectors, Messrs. Dwight Whiting, F. M. Speer, and F. H. Jackson, was called the San Jacinto Gem Mine. It was reported that more than a bushel of red and green crystals was found during the first season's operation, one of which measured 8 inches in length and several inches in diameter. This was purchased by Harvard University, with other crystals several inches long and two inches in diameter. One of this size had a dark green basal termination showing a red center on the fracture at the other end of the crystal."

Other very fine specimens are in the American Museum of Natural History in New York.

Dr. Kunz continues, Bull. 37, p. 21:

"Tourmalines have been mined in Riverside County, California, at the California Gem Mine, the San Jacinto Gem Mine, and the Columbia Gem Mine. These claims are situated at the foothills of the San Jacinto Range, overlooking Hemet Valley and the Coahuila Valley, and about 27 miles southeast from the San Jacinto branch of the Santa Fe railroad. The crystals occur in veins from 40′ to 50′ wide, running nearly north and south through the crystalline rocks of the mountain range. These veins in places consist of pure feldspar, or of feldspar with quartz; in others wholly of mica, and in others of rose quartz and smoky quartz. The tourmalines vary in size from almost micrograins to crystals 4 inches in diameter. They are most plentiful in feldspar, but are found in other portions of the vein, sometimes in pockets and sometimes isolated. The larger crystals generally have a green exterior and are red or pink in the center. Some crystals contain green, red, pink, black, and intermediate colors; others again are of uniform tint—red, pink, blue, or colorless. Associated with the tourmalines are rose-quartz, asteriated quartz, and fluorite, and some of the quartz is penetrated with fine, hair-like crystals of tourmaline, strikingly like the similar occurrence of rutile.

"Associated with the tourmaline from Coahuila have been found yellow beryls, closely resembling those from Sarapulka in the Ural mountains, also, others that are pale green, pink, and colorless. Some of the yellow crystals are finely formed and others show remarkable instances of etched faces, while others are almost as delicate as a darning-needle.

"Elegant specimens were made from some of the large crystals of this type by cutting and polishing sections across the prism, showing the rich green exterior, then a narrow zone of white, and within that

the red central portion—a beautiful contrast of colors, suggesting a slice of watermelon. Some of these were as much as three inches in diameter. A few years later, remarkably fine crystals of colorless tourmaline (achroite) were reported from this locality by Mr. Dwight Whiting.

"There were, at one time, several mines in operation in the San Jacinto district, which gave a valuable output for several years. The one that has been most prominent of late is that known as the **Fano Mine** (formerly the Simmons), discovered and located in 1902, by Mr. Bert Simmons, but now owned by Mr. E. A. Fano, of San Diego. This was in the name of the Fano-Kunzite Tourmaline Mining Company, on the north side of Coahuila Mountain, at an altitude of some 4500 feet, about a mile south of Bautista Creek, 4 miles west of Ramona Indian Reservation, and 3 miles north of Coahuila Indian Reservation. This mine consisted of 4 claims. The nearest post office is Hemet. After some preliminary surface work a tunnel was driven 300 feet from the summit of the hill, to cross-cut the ledge, which was found about 20 feet from the surface. The parties then continued the tunnel until, at a distance of 176 feet, solid blue diorite was reached. The tunnel was then abandoned, and since that time work has been confined to the surface.

"The dike is about 5 feet wide, with a northwest and southeast strike, and dips southwest about 17°. The pegmatite is finely crystallized, and resembles that of the other tourmaline and kunzite mines in San Diego County.

"The output so far has been 25 pounds of kunzite, white; 1 pound of kunzite, pink; and 25 pounds of all classes of tourmaline, mostly blue and green; about 250 pounds of beryl have also been taken out, but only 5% of it available for gem purposes. Two hundred pounds of very fine quartz crystals also have been sold, and about a ton of lepidolite and 30 to 40 pounds of amblygonite; also flake mica has been discovered large enough for commercial purposes.

"There is a spring near the property, on land rented by the owners of the mine; also, plenty of oak timber for mining purposes. Considerable money has been expended here without much result, but for the work actually done on gem pockets, this mine has been a splendid producer.

"Several tourmaline mines were also located by **Mr. Bert Simmons**, north and east of Coahuila, from which some large gems have been obtained."

Columbia Gem Mine. "This, the oldest tourmaline mine in the state, is on the site of the original discovery of colored tourmaline in this county, made by Mr. Hamilton, in 1872, and was owned by Messrs.

H. C. Gordon, P. E. Johnson, J. C. Connell, and William Dyche, but other parties have claimed it under the name of the April Fool Mine.

"It is on Thomas Mountain near Coahuila, at 5000 feet elevation, about ½ mile northwest of the road leading from Coahuila to the Hemet reservoir, and near the summit of the divide crossed by this road. The property has produced many beautiful gems, but nothing except assessment work has been done on it for many years. The pockets worked, at one time, seem to have been exhausted, and nothing important has recently been found. The pegmatite dikes are of very fine grain, and both sides of the pocket material seem to be of the same character, thus differing from the other gem-bearing dikes of California. There is no water or timber available."

Mr. C. A. Waring contributes the following additional matter on this property:

California Gem Mine: "It is located at the east end of Thomas Mountain, on Nigger Jimmy Hill. Yielded rose quartz and black and green tourmaline. It is said that $10,000 worth of gems were taken out about 1894. Some pink, green, and dark red tourmaline is said to have been taken out also. It is said that $300 worth of rose quartz has been taken out recently. The workings consisted of a cut 60′ long and 15′ deep, with, also, a few scattering prospect holes. The product is reported to have been sold to Messrs. F. A. Marcher, Whiton, Bradley, and Saxon, of Los Angeles."

In November 1914 no other tourmaline mine than this described by Mr. Waring was known in this region. The two others described by Dr. Kunz have been forgotten.

GYPSUM.

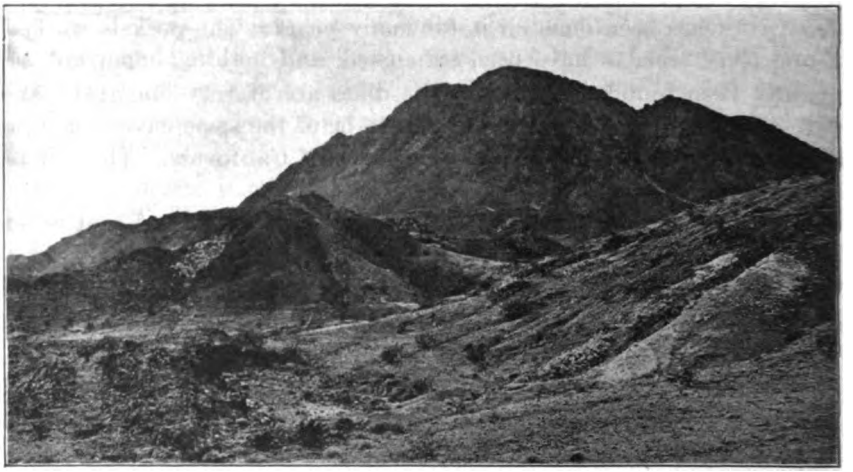
This material, the hydrous calcium sulphate, or sulphate of lime, is of much importance in construction since the calcined product, plaster of Paris, is the base of nearly all wall plasters for interior work. It also forms the base of the material known as staff which is so extensively used in the construction of temporary buildings for exposition purposes. Gypsum is also important as a fertilizer in supplying lime and in correcting alkaline soils. In small quantities, it is used in the manufacture of Portland cement to retard its setting.

The principal deposits of gypsum in this county are near Corona and in the eastern desert section. Mr. C. A. Waring reports on the latter as follows:

United States Gypsum Company, 200 Monroe St., Chicago, Ill.; president, S. L. Avery. The gypsum claims of this company are in the southwest corner of T. 3 S., R. 21 E., and the northwest and southeast corners of T. 4 S., R. 21 E., S. B. M. Most of the prospecting has been

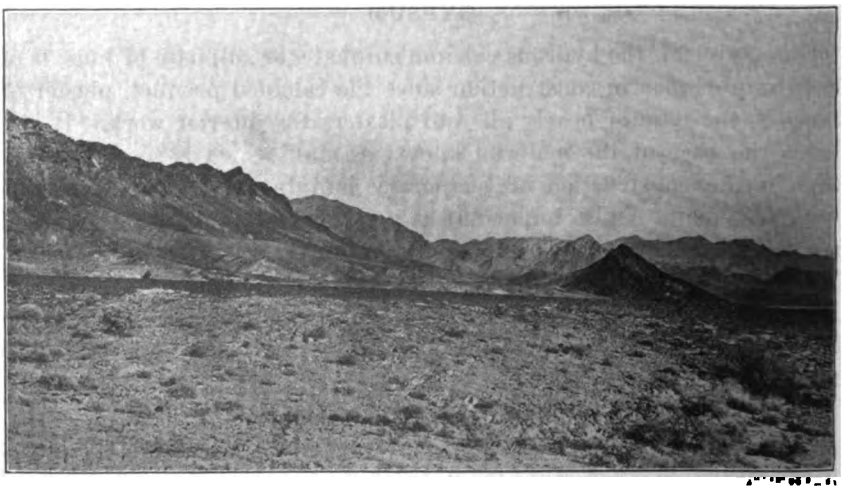
carried on in a cove on the south side of the Santa Maria Mountains, 2 miles west of the stage road from Blythe to Blythe Junction. (See upper photo.)

The gypsum beds on the north side of this cove strike N. 50° W., and dip 55° to the north. They are in places 150 ft. thick and consist



Looking N. 50° W., along strike of gypsum deposits, Santa Maria Mountains. Prospects of the United States Gypsum Co. Photo by C. A. Waring.

of fine, white, compact crystals of pure gypsum. The same gypsum beds occur on the south side of the cover with somewhat similar strike but with a southerly dip. The center of the anticline has been faulted and eroded away, leaving the gypsum exposed on either flank. The



Looking eastward along the strike of the gypsum beds, Santa Maria Mountains, from the United States Gypsum Co. prospects shown in view above. The intense folding and faulting of the schists is well exposed in the Big Maria Mountains in the distance. Photo by C. A. Waring.

beds on the southern flank dip into the plains to the southeast. (See lower photo, p. 118.)

The gypsum strata are interbedded with a pale greenish amphibolitic quartzitic schist which weathers to a glossy brown in the desert climate. In places limestone occurs interbedded with the gypsum.

Only prospecting in the nature of cuts and trenches has so far been carried on. Water has been developed in a 585 ft. well on the north side of the mountains in Sec. 19, T. 3 S., R. 21 E.

These gypsum deposits are quite extensive and claims have also been located about 4 miles east of the main U. S. Gypsum deposits. Assessment work has been done on the claims of **Mr. Schellenger,** of the **Riverside Gypsum Company,** and of the **Consolidated Gypsum and Plaster Company,** on the west side of the Little Maria Mountains.

Gypsum is said to occur at the north end of the Palen Mountains, about three miles north of Packard's well.

CORONA DEPOSITS.

In the range of hills west and southwest of Corona are deposits of gypsum, which are somewhat unique, in that they contain besides the calcium sulphate, iron sulphate and some lime. This combination is stated by the orchardists of the district to be particularly valuable, not only as a fertilizer, but also for preventing disease and parasites. For the latter purpose, they dig around the trunk of the tree and put the gypsum near the roots.

Among the larger orchard properties which have their own gypsum deposits are:

El Cerrito Ranch, W. C. McCully, superintendent.

W. H. Jameson Company, J. G. Jameson, manager.

The Natural Fertilizer Co., near Corona, is quarrying gypsum on its property and has a grinding mill in which the mineral is prepared for fertilizing purposes. Ten men are employed.

The Soil Tone Co., W. L. Brown, manager, Corona National Bank Bldg., Corona, is working a gypsum deposit near Corona and shipping a considerable tonnage.

W. C. Barth, Corona, has a gypsum deposit near Corona on which some development work has been done.

George W. Lord, Corona, has been shipping small amounts of gypsum from his deposit near there. He also has ochre suitable for paint.

MAGNESITE.

The chief deposit of this material in Riverside County, is near Winchester, and is carefully described in the U. S. G. S., Bull. 355, pp. 38–39.

This deposit has been opened for commercial use, but without success, for the serpentine matrix dominates to such an extent that it

from the enclosing rock. At present no use is made of the deposit. It is now controlled by **W. H. Daum,** Equitable Bank Bldg., Los Angeles[19].

Magnesite is important commercially as a source of carbon dioxide gas used in making soda water and similar aerated beverages. It is also used in refractory linings for metallurgical furnaces.

One of the chief uses is in cement for flooring bath-rooms, and similar purposes, for which tile and marble have long been employed.

There is also a limited use of magnesia as a medicine. A very thorough discussion of this subject will be found in Mineral Resources of the United States, 1913, Part II, pp. 445–449. See also our Bull. 71, pp. 47–53.

MINERAL SPRINGS.

Among the natural resources of Riverside County, which are of commercial importance, must be reckoned its mineral springs. Their importance lies in their curative properties which attract hundreds of persons to the hotels operated in connection with them. Many of these springs have been known and used for many decades, and their popularity is still noteworthy.[20] Some of the most noted of these are on the fault line of Temescal Valley. These are the well known springs of Glen Ivy, Elsinore, and Murrietta. At Elsinore, there were originally several thermal springs containing a small amount of sulphur. Some of these were absorbed in establishing water supply for the city of Elsinore, and there remain those used for their curative properties in connection with the Lakeview Inn and Bundy's Hotel. The analyses of these waters are as follows:

Analyses of Water From Lakeview Inn Hot Springs.

	Original Hot Springs, grains per gallon	White Sulphur Springs, grains per gallon
Total residue by evaporation	19.82	19.40
Soluble in water after evaporation	13.12	11.88
Insoluble in water after evaporation	3.79	5.24
Organic matter and chemically combined water	2.91	2.28
The soluble parts consist of—		
Sodium and potassium sulphates	7.07	4.09
Sodium chloride (common salt)	3.38	5.07
Sodium carbonate (sal soda)	2.67	2.67
The insoluble parts consist of—		
Calcium sulphate (gypsum)	1.92	2.33
Calcium and magnesium carbonates		
Silica	1.87	2.91

[19]Since the above was written, W. Wells & Company of New York have taken over the magnesite property between Hemet and Winchester, formerly operated by the Magnesco Refractory Products Co. Shipments of crude magnesite are being made, and construction of a calcining plant begun. E. G. Kleiner, Hemet, is superintendent. (Nov., 1916).

[20]The most elaborate discussion of this subject thus far issued will be found in U. S. G. S. Water Supply Paper No. 338, by Gerald A. Waring, 1915.

A partial analysis of the waters of *Bundy Hot Springs*, made by the California State University, is as follows:

Partial Analysis of Water From Bundy Hot Springs.

	Grains per U. S. gallon
Sample clear, with taste of sulphuretted hydrogen.	
Sodium and potassium sulphates (Glauber's salt)	5.02
Sodium chloride (common salt)	1.64
Sodium carbonate (sal soda)	6.19
Calcium and magnesium carbonates and calcium sulphate	2.04
Silica	3.51
Organic matter and chemically combined water	.88

Temperature 112° F.

Murrietta Hot Springs. The largest and hottest spring is at Siloam. It will boil an egg in ten minutes. Its waters are 170° F. The analysis of the waters from this spring, by Prof. C. E. Wagner, a chemist of Saxony, Germany, shows the following:

Analysis of Water From Murrietta Hot Springs.

	Constituents per 100,000	Grains per gallon
Sulphate of lime	2.14	1.25
Carbonate of lime	.69	.40
Carbonate of magnesia	Trace	Trace
Iron	.52	.30
Soluble silicate	6.00	3.50
Chloride of sodium	60.10	35.00
Carbonate of sodium	2.83	1.65
Hydrogen sulphide and carbonic acid	5.15	3.00
	77.43	45.10

Some twelve miles northeast of **Elsinore**, along the western base of the San Jacinto Range, is another fault, along the line of which are several thermal springs, notably Eden Hot Springs, San Jacinto or Relief Hot Springs, and Richey or Soboba Hot Springs. On the eastern base of the same range occur the Palm Springs. All of these springs are well known locally and they are well described in the Water Supply Paper above mentioned, to which, for information about these and other springs in this county the reader is referred.

SALINE DEPOSITS.

Bibl.: Bull. 24, pp. 54, 69, 89, 102, 107, 122–126.

BORAX.

A large portion of the eastern end of Riverside County is occupied by the Colorado Desert, which was once the basin of the ancient lake

which has been named Lake Coahuila.[21] Salton Sea, in the lowest portion of this basin, is crossed by the boundary line between Riverside and Imperial counties. While no borax is at present being worked in this county, its presence is known to prospectors at a number of places in the Colorado Desert.

Borate of lime has been found in the foothills of the San Bernardino Range northeast of Salton Sea in Riverside County. The borders of this old lake offer a promising field to the prospector for borates, and lime borates should be especially looked for.

Boric acid exists in a number of springs on San Felipe and Carizzo creeks in San Diego County. Dr. Veatch[22] in his search for borax in the early days, found boric acid in some quantity in the mud volcanoes and on Carizzo Creek. It has also been discovered in Agua Caliente Springs, on Warner's Ranch, San Diego County. Borax associated with salt and carbonates and sulphides of soda, are found in many of the playa lakes of the Colorado Desert. No locations for borates have been made in this district.

Borax: Native borax or biborate of soda. One of the main sources of borax in the state. Boric acid, 36.6%; soda, 16.2%; water, 47.2%. Color, white, sometimes grayish, bluish or greenish. Hardness, 2 to 2.5. Specific gravity, 1.69 to 1.72. Luster, vitreous to resinous, sometimes earthy. Translucent to opaque. Taste, sweetish alkaline, feeble. Soluble in water. In blowpipe fuses to "borax glass."

POTASH.

(See Riverside Portland Cement Co., under "Cement.")

SALT.

In 1884, the **New Liverpool Salt Company** began work on the salt beds of Salton Sea, producing some 1500 tons.[23] From that time progress was rapid until the submergence of the salt beds in 1903 by the inundation of the basin, when the company stopped work. Prior to the inundation, the basin was being constantly supplied by numerous springs in the adjacent foothills, the water from which flowed into the basin and quickly evaporated, leaving a deposit of pure salt varying from 10 to 20 inches in thickness.

Borings made at Salton give the following section:[24]

1.	Salt crust	10 to 20 inches
2.	Mud	6 inches
3.	Crust of chlorides of sodium and magnesium	7 inches
4.	Black ooze containing 50% of water and carrying chlorides and carbonates of sodium and magnesium	22 feet
5.	Hard clay with a few streaks of cement	275 feet 5 inches
	Total	300 feet

[21]See Wm. P. Blake, Pac. R. R. Reports, Vol. V.
[22]Bull. 24, p. 55.
[23]Bull. 24, "Saline Deposits of California," by Gilbert E. Bailey, pp. 122-126.
[24]Op. cit., p. 126.

Published analyses of the natural crusts from Salton show that the salt was very pure, as follows:

Sodium chloride	94.68	97.76
Sodium sulphate	.68	.70
Calcium sulphate	.77	.38
Magnesium sulphate	3.12	----------
Water	.75	.96
Insoluble	----------	.20
	100.00	100.00

This salt remained dry in any ordinary atmosphere, and was free from organic matter.

The salt was loosened by cable plows, that cut, in the salt, furrows 8 ft. wide and 6 inches deep, each plow harvesting over 700 tons of pure salt per day. On a moveable railroad track the salt was conveyed to the works.

The workmen were Indians of the Coahuila tribe, large, well developed men, not affected by the dazzling sunlight, and able to work 10 hours a day with the thermometer registering 150° in the sun. As solar heat alone was necessary at this locality, the mill plant consisted only of machinery for grinding and bagging the salt for shipment.

As described by Professor Bailey, the sight of the salt works was an interesting one, for thousands of tons were piled up in heaps like snow drifts, and a large force of men was busy preparing and packing for market, salt of the various grades.

One observer has said:[25] "As one approaches the Salton Sea, it looks like an immense crystal lake, and the houses and sheds of the salt works appear suspended in the air, in mirage. As far as the eye can see the white and dazzling field of salt extends towards the horizon."

STONE INDUSTRY.

BUILDING STONE.

That there is a great wealth of valuable stone in California has been known for years. It is equally well known that much of it is undeveloped, a considerable portion of the building and ornamental stone used in this state being imported from other states and from Europe.

Uses of Stone.

Stone is used in substructures very extensively. Wood, concrete, brick, and iron are frequently used as a substitute in superstructures, but where first cost can be subordinated to architectural effect, stone will, in most cases, be used.

For funeral monuments there is no satisfactory substitute for stone, and for this purpose it is often shipped long distances, in order to get

[25]Bull. 24, p. 124.

one that has an established reputation. Many of the monuments in this state are of stone from New England, Indiana, Georgia, or Europe, and often a large part of the cost of the monument is in railroad and water freight.

Some other uses of stone are in the construction of breakwaters, bridge abutments, culverts, curbing, fences, flagstones, hitching posts, macadamizing, paving blocks, piers, retaining walls, reservoirs, sewers, sluiceways, etc.

Classification of Building Stones.

Rocks are commonly divided into two, sometimes three, great classes: the unstratified, or igneous; and the stratified, or sedimentary.

The first class may be subdivided into the granitic or crystalline rocks, and the volcanic or partially crystalline rocks. The granitic class includes granite, syenite, etc., the volcanic class includes basalt, trachyte, tuff, etc.

The sedimentary rocks include those formed in water, such as sandstone, limestone, etc.

The third class includes the metamorphosed forms of the other two classes. They may be formed from the igneous rocks, as gneiss, some of the schists, serpentine, and talc; or from the sedimentary rocks, such as marble, which is a metamorphosed limestone; quartzite, which is a metamorphosed sandstone; or slate, which is a metamorphosed clay or shale.

GRANITE.

This stone is widely distributed over Riverside County. It has been quarried on a large scale at Casa Blanca for rubble used in the San Pedro breakwater, and for building and ornamental purposes at Corona, Riverside, and Temescula. At Porphyry and Riverside it has been quarried for broken stone. The Casa Blanca quarries have long been idle.

Besides its use for paving, the Corona granite is used to some extent for building stone, and in considerable quantities for monuments in Los Angeles, Riverside and other places in southern California.

The monument dealers in southern California nearly all speak highly of the Corona granite for monuments, thus giving it a reputation in that field. Its nearness to Los Angeles and Riverside also favors the use of this stone for "Belgian" (paving) blocks.

Corona. East of Corona, one mile north of the Santa Fe Railway, in Sec. 16, T. 3 S., R. 6 W., are several productive granite quarries. A number of rounded hills or buttes occur at this place, over the tops and slopes of which the granite outcrops in rounded ledges in the midst of a multitude of large rounded boulders. Many of the boulders, as well as the projecting ledges, have a smooth, hard, firm surface. Some of them have been polished by wind carrying dust, which has worn away

the disintegrated surface as fast as it has been formed. A large part of the granite has been quarried here from the boulders, as these are more easily worked into dimension stone than the massive bedrock. The boulders are especially available for making Belgian paving blocks, which are produced here in large numbers.

Sierra Grande Quarries. M. J. Mayer, lessee. Sec. 16, T. 3 S., R. 6 W., S. B. M. The quarry is in the low foothills, close to the track of the Santa Fe Railway, near Porphyry Station, about 2 miles east of Corona. Here are made large numbers of Belgian blocks for Los Angeles streets; also, considerable granite is shipped to monument dealers in different towns. Mr. Mayer in several places is working the outcropping granite boulders into paving blocks. Under the microscope the granite from Mayer's quarry at Corona is seen to consist of orthoclase feldspar, with a little microcline and albite, quartz, biotite, and muscovite.

The stone from all the quarries is hauled by wagon to the railroad at Hammer switch, about a mile east of Porphyry station.

Corona Rock Company, 516–17 Pacific Electric Building, Los Angeles. The quarry is in Secs. 8 and 17, T. 3 S., R. 6 W., S. B. M. This is a contracting company, using large quantities of building granite, as well as paving blocks, and broken stone for ballast and concrete. Besides the granite quarries north of Hammer switch, this company operates a large quarry at Porphyry Station. The stone is used for concrete, macadam, and railway ballast.

Bly Bros. & McGilliard Stone Co., 678 S. Utah street, Los Angeles. This firm operates two quarries: One in the NW. ¼ of Sec. 1, T. 2 S., R. 6 W.; the other in the SE. ¼ of the same section. These are in the Jurupa Mountains, which are formed by a granite intrusion.

These quarries produce a large quantity of fine granite used for building purposes in Los Angeles and vicinity. This firm has in Los Angeles one of the best equipped stone yards for handling and dressing stone that there is in southern California. There are saw gangs for sawing stone, as they handle consider sandstone and marble in their contracts. They have stone planers, steam drills, pneumatic drills, and surface tools. There is always a large force of stonecutters, as much of the cutting and finishing is necessarily done by hand. The annual production is 120 carloads (40 tons) dimension stone (5% of this is used for monuments), and 1200 carloads of riprap. Twenty men are employed at the quarry, and 20 men at the yard.

Lane Bros. Monument dealers, 833½ S. Figueroa St., Los Angeles, Cal. This firm formerly worked a granite quarry 3 miles east of Corona, loading at Alvord Station on the Santa Fe Railway. This quarry is now idle, and the stone used is purchased from various

quarries. This firm operates a stone cutting yard on Santa Fe avenue, Los Angeles.

Elsinore. Near this town there are two granite quarries which have produced paving blocks in moderate quantities. One is operated by **P. H. Coogan** in Sec. 2, T. 5 S., R. 4 W. The product is chiefly derived from surface boulders; the rock is a gray diorite. The other quarry is controlled by **Connolly Bros.** and is now idle.

Temecula. Two granite quarries have long been worked about two miles south of this place. They have lately been operated by **M. Machado** and **Joseph Winkles,** but were formerly worked by other persons.[26]

Perris. Between this place and Elsinore are some quarries in diorite controlled by **La Borde Bros.** of Perris.

CRUSHED ROCK.

Temescal Rock Quarry. The quarry is owned by the Temescal Rock Company; office, 603 Central Building, Los Angeles; A. B. Filch, president; H. S. Cook, secretary. The company has about 200 acres of mountain land lying in Sec. 4, T. 4 S., R. 6 W., S. B. M. The quarry is located in Temescal Cañon, 4 miles southeast of Corona. The material that is being crushed is a rhyolitic porphyry and is very hard and sharp. The mountain side where the rock is being quarried slopes steeply and has an elevation of 1000 to 1200 feet above the cañon.

The company has nearly four miles of its own tracks which connect through the cañon with the main line of the Santa Fe Railroad. The plant has a capacity of 1500 to 2000 tons of crushed rock products per day. Besides crushed rock products, an incline tramway has been installed to load massive rock material up to 10 tons in weight, for riprap and sea wall construction.

The quarry extends along the mountain side south of the head of the crushing plant, this quarry floor being 180 feet above the floor of the cañon. It is so arranged that while one end of the quarry is being drilled and blasted, the broken rock on the other end is being loaded into cars and hauled to the crusher. A Marion steam shovel, model 100, loads the broken rock into all-steel dump quarry cars, which have a capacity of 8 tons. The drilling is done by two Star drills, by means of which a line of holes are drilled from a bench and then blasted at one round. Trojan powder is used in the blasting operations. The quarry dump cars are operated by electric motors, receiving the current from a third rail. By a system of levers in a tower over crusher in the crushing plant, operated by one man, an empty car is sent to the steam shovel, when loaded brought back and spotted at

[26]Bull. 38, pp. 42–47.

chute before large crusher. By means of another lever controlled by the same operator, the load is dumped into a Blake Jaw type of crusher, size 84″x66″, and capable of handling a rock 5′x6′x10′. The crusher is driven by 300 h. p. motor. The capacity of this crusher is rated at 600 tons per hour.

The material from this crusher will pass through a 10″ ring. The product from the crusher passes through revolving screen (5′ in diameter by 12′ in length), where the fine dirt material is screened out. The over-size runs down into a No. 9 McCully gyratory crusher and is reduced to 3½″ maximum pieces. This crusher is driven by 150 h. p. motor. The material is then conveyed by belt conveyor to two revolving screens (size 5′ in diameter by 12′ in length) which take out all rock more than two inches in diameter. The over-size material is conveyed to two 48″ Symons Disk crushers, where it is reduced to 2″ or less. The finished product is carried by means of a belt conveyor from the scalping screens and disk crushers to a sizing screen over storage bins, where it is separated into five different sized products. Those sizes of smallest volume are conveyed by chutes direct into the bins nearest the screen, and those of larger volume are carried by shuttle belt conveyors to bins farther away.

The storage bins have a capacity of 5000 tons of crushed rock. Supplies and material are hoisted from the main railroad tracks over a standard gauge track to the quarry floor by means of 75 h. p. Lidgerwood electric hoist. Another 50 h. p. Lidgerwood electric hoist operates cars over incline to load riprap material.

The following new concern was beginning operations in May, 1915:

B. R. Davison Construction Co. of Monrovia, opening up a quarry near Banning to supply crushed rock for highway work between Banning and Palm Springs.

Riverside Portland Cement Co. (See also page 95), in addition to its output of limestone quarried for use in the cement plant, also offers for sale the crushed crystalline limestone for use in concrete and road work.

SAND.

Sand for building is necessarily in demand at every city, town and settlement, where building operations are conducted. The material occurs abundantly in all stream belts or washes, and needs only an inexpensive treatment by screening to prepare it for use. The only substantial plant observed in Riverside County was 1½ miles east of

Whitewater Station on the Southern Pacific Railroad. From this point sand and gravel are shipped to El Centro and other cities.

This plant is controlled and operated by **M. R. Kane** of Snow Creek post office.

The following persons reported in 1914 the production of sand and gravel from local sources:

J. F. Atkins, 1393 W. 6th St., Riverside.

F. S. Ramsey, 1159 11th St., Riverside.

M. I. Wheeler, 245 Colton Ave., Riverside.

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XI, pp. 76–120, 284, 336–337, 368, 385;
XII, pp. 60, 220–225, 325, 393;
XIII, pp. 31, 54, 60, 310–315, 639, 645;
Bulletin 24, pp. 54, 69, 89, 102, 107, 122–126;
Bulletin 37, pp. 21, 57–58; Bull. 38, various pages;
Bulletin 50, pp. 337, 341–343; Bull. 70, pp. 98–99.

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Mineral Resources, 1882, p. 434; 1883, p. 434; 1891, p. 161; 1892, p. 12;
Water Supply Paper, 338, pp. 387 *et al.*

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CALIFORNIA STATE MINING BUREAU
FERRY BUILDING, SAN FRANCISCO
FLETCHER HAMILTON State Mineralogist

San Francisco December, 1916

Mines and Mineral Resources

OF

Alpine County
Inyo County
Mono County

CHAPTERS OF STATE MINERALOGIST'S REPORT
BIENNIAL PERIOD 1915-1916

CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO
1917

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Mines and Mineral Resources

OF

Alpine County
Inyo County
Mono County

By ARTHUR S. EAKLE, Ph. D., EMILE HUGUENIN, R. P. McLAUGHLIN, and CLARENCE A. WARING, Field Assistants.

CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO
1917

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MONO COUNTY.

PREFACE.

The group of counties here presented lies southeast of Lake Tahoe along the eastern boundary of California. They flank the Sierra Nevada Mountains to the east and southeast and include Mono and Owens lakes.

Of the three counties, Inyo is the best provided with transportation facilities and power. The southeastern and central portions of Mono County are fairly well served, but Alpine County has neither railroads nor power lines and is only partially served by roads.

The counties present a diversity of mining interests and offer inducements to those who are used to mining under difficulties. High transportation costs, high wages, and high general operating expenses all tend to discourage the operation of low grade properties.

Acknowledgment is made of the courtesies extended by the mine owners and operators throughout the region, whose assistance made this report possible.

ALPINE COUNTY.

By ARTHUR S. EAKLE, Ph.D., Field Assistant.
Field work in July, 1914, and July, 1915.

INTRODUCTION.

Mining began in Alpine County over fifty years ago, and during the first twenty years a large amount of ore was taken out.[1] Long and expensive tunnels were run which never paid for themselves, and the ore that was obtained could not be successfully treated at the mine, although much money was expended in mills, roasting and amalgamating plants. The mines were for the most part abandoned as unprofitable and towns of several thousand inhabitants completely disappeared so that not a vestige of them remains. Alpine County at the last census contained but 300 inhabitants and it has but one town—Markleeville—which is the county seat. The abandonment of the mines of the county was not due to exhaustion of ore, of which there is an abundance, but rather to the fact that the average value was low, and being mostly a base ore requiring special smelting with smelters far distant and no adequate method for good concentration, it could not be handled at a profit. Very little of the ore was free milling and mills were built for this kind of ore. In fact the county contains evidences of reckless expenditure of capital in erecting plants which were absolutely worthless. For a long period of time there has been no mineral returns from the county, and the only mining that has been done has been in the line of development work and proving up the value of the properties.

[1] Min. Res. W. of Rocky Mts. 1871, pp. 51–53; 1873, pp. 11–16.

Table of Mineral Production of Alpine County, 1880-1915.

Year	Gold	Silver	Copper		Miscellaneous	
			Pounds	Value		
1880	$17,133	$24,146				
1881	2,000	2,100				
1882	20,000	10,000				
1883	10,000	5,000				
1884	5,000	4,000				
1896	400					
1897						
1901	23,568	2,860	8,377	$1,319		
1902	10,359	3,770				
1903	2,701	146				
1904	4,827	145				
1905	575					
1909					Unapportioned, 1900-1909	$5,465
1913	537	4				
1914						
1915						
Totals	$97,100	$52,171	8,377	$1,319		$5,465

Totals.

Gold	$97,100
Silver	52,171
Copper	1,319
Unapportioned	5,465
Grand total	$156,055

After the Comstock strike, the county was prospected pretty thoroughly and there are plenty of tunnels and holes to testify to the work done. Practically nothing so far has been published about the ore bodies which are so extensively indicated by outcrops. The Eighth Annual Report of the State Mineralogist, William Irelan, Jr., published in 1888 gives the best description of the mines and what was being done at that period. The bullion output at that time was very little, and in fact it has never been in any way proportionate to the amount of ore extracted. In the above-mentioned report, Mr. Irelan predicted that the output of bullion from the county would probably increase to much larger proportions and perhaps in a short time. It is now nearly thirty years since that prediction was made and it has not been fulfilled, yet the prediction was justified, and the present writer has no hesitancy in repeating it with the belief that it will soon be a reality.

GENERAL FEATURES.

Practially the entire area of the county is occupied by mountain ridges and peaks. It is crossed by the great granite mass of the Sierras and flanking the granites on the east are flows and eruptions of Tertiary volcanics, largely andesites. The ridges and peaks of granite and of andesite attain an elevation between 7000 and 8000 feet, while some of the peaks rise to the height of over 10,000 feet. Deep cañons dissect the ridges, breaking up the country into hills and crags. There are

a few valleys, mostly above 5000 feet in elevation, and as the county is well watered these valleys serve as grazing land for stock. Little agricultural work is done, but wheat and alfalfa can be grown. The summer season is naturally short with liability to heavy frosts at any time, so general produce raising is not undertaken and all supplies have to be brought into the county.

The principal streams are the two forks of the Carson River. The East Fork, or East Carson, has its rise in the south central part of the county and flows northward through its cañon across the state line into Nevada, watering the broad and fertile Carson Valley. The West Fork, or West Carson, rises in the western part of the county and flows through Hope Valley and then eastward through its cañon and also helps water the Carson Valley. There are many important creeks flowing into these main streams, some of which furnish a permanent supply of water, like Markleeville Creek, Silver Creek, Wolf Creek, Silver King Creek and Monitor Creek. The Mokelumne River has its source in the southwestern part of the county on the western side of the divide. Besides the flowing streams, there are several lakes, and the Blue Lakes are the most important and used for water supply. The county is well watered and well timbered. Two good highways make the county accessible. The main road connects Markleeville with Minden and continues south through the East Carson Cañon to Silver Creek Cañon and thence westerly over the divide into Calaveras County through Big Trees. Minden is the southern terminus of the Virginia and Truckee Railroad, a short road running south from Reno, and all supplies and mail are brought to Markleeville by daily stage from this station. At Woodfords a branch road forms the second highway. This runs westerly through the West Carson Cañon and down through Hope Valley to the Blue Lakes region. A road connecting with this goes to Lake Tahoe, and auto tourists make the trip from the lake by the Alpine scenic roads through the county and over the pass to Angels.

A short road goes from Markleeville to Grover Hot Springs. Off from the few roads the country is accessible only by trail.

MINING DISTRICTS.

So many claims were located in the early days that the county was pretty well divided up into districts. Most of the claims were never worked and few of the districts ever produced any bullion. The records of these old districts have become a matter of history and tradition. The old districts described in the 8th Annual Report above referred to were the "Monitor," the "Mogul," the "Silver Mountain," the "Silver King" and the "Hope Valley" and "Blue Lakes" districts. The records of these districts are mostly of tunnels run so many feet into the mountains and then abandoned.

The Monitor and Mogul districts have been the most important and more recent work has been done in them. The others have been deserted for years.

This report is mainly devoted to the two principal districts, for any future mining in the county will probably be chiefly done in them.

THE MOGUL AND MONITOR DISTRICTS.

These two districts are contiguous and the claims border respectively on the Mogul and Monitor cañons, which are about one and a half miles apart. The districts are some six miles south of east of Markleeville, and a road branches off from the main highway and follows up the Monitor cañon to the mining sections of the districts. Loope, or Monitor, as it was first called, was the mining camp for the Monitor district, and was once a thriving town with a post office and daily stage; now only a more or less dilapidated hotel building remains to mark the spot. The road from Loope ascends in the cañon between Colorado Hill and Morning Star and other hills on the east, and taps the Mogul district. The two principal hills from which ore has been formerly mined are the Colorado Hill, on which many of the claims of the Monitor district are located, and the Morning Star Hill, which contains the principal claims of the Mogul district. The accompanying maps of claims (Plates I and II) will give some idea of their situation in the two districts.

The Curtz Consolidated Mines Company with office in Oakland own seventeen claims in the Mogul district and tunnels exist on some of them. There are several groups of claims in the Monitor district, those owned by the Hercules Consolidated Mines Company of Reno being the most important. Other groups are the Lincoln, the Globe and the Flint. Very few of the claims of either district have been patented. The Morning Star Mine of the Curtz Company and the Colorado No. 2 of of the Hercules Company are the two most famous mines of the county and both have produced considerable bullion.

ROCK FORMATIONS OF THE DISTRICTS.

This particular section of the county is wholly volcanic and the rock is andesite of Tertiary and later eruptions. The main country rock forming the hills containing the ore bodies is a compact and somewhat porphyritic andesite from an ash-gray to practically black color. The volcanic rock of the region varies greatly in texture, and eruptions have apparently succeeded eruptions and flows. Much of the rock is very coarse breccia or agglomerate with large fragments of grayish andesite cemented by ash and cinder, forming coarse tuff-breccias. The main rock is a hornblende-biotite andesite, but the magnesian silicates are not prominent in most of the rock. Feldspars or the phenocrysts and

groundmass of the rock and the feldspar phenocrysts show characteristic albite twining and are labradorite. The feldspar of the base shows much calcite with epidote and chlorite stains as alteration minerals. Small grains of magnetite and pyrite can be seen in the thin section. Occasionally the mass of rock shows a flow structure and in its weathering a banded or schistose effect is produced. Slate-like and schist-like outcrops of the weathered rock occur in Monitor cañon. Black basaltic masses occur exposed along the highway which seem to be a basaltic phase of the andesite rather than true basalt. This black rock is finer grained, but still retains the porphyritic structure of the andesite. The groundmass contains granular augite, but the phenocrysts are feldspathic.

The only other volcanic rock in the immediate district is a glossy perlite or obsidian. It occurs on Morning Star Hill in an outcrop of light gray translucent lava and appears to be a later dike intrusion in the andesite. The dark andesite masses forming the wall-rock of the cañons is continually breaking off into angular, sharp-edged fragments, forming a sharp shingle. The rock is full of incipient fractures and joints, and disintegration more than decomposition is the result, especially from the freezing and thawing action of winter.

SILICIFICATION OF DISTRICTS.

There is no other section of California in which silicified bodies of rock more or less mineralized have been formed on a scale of such magnitude as occur in this region. Huge outcrops of cherty and jaspery rock jut above the surface of the hills and extend in some cases several thousand feet with a width of thirty or more feet. They appear as ridges and isolated jagged bodies above the till covered hills, owing to their hard siliceous nature and weathering action has tended to leach out much of their feldspathic material, leaving practically chalcedonic and jaspery silica masses. The oxidation of their iron and manganese contents have given them shades of pinks, reds, yellows, browns and blacks, as surface colorations. There is a wall-face exposure of beautifully painted rock in tints of golden yellow and pink and red on the Flint group of claims in the Monitor district. These silicified outcrops cut across the hills in differing directions, and cross cutting in the mines has shown the presence of others not perceptible on the surface, so there is no common strike for them, although the main ridges in the Mogul district have a north and south direction of elongation. On the Morning Star Hill the outcrops appear as separate isolated patches, and in order to connect them up into one zone of silicification, considerable displacement by faulting must be assumed. The small sketch (Plate I) of the outcrops of this district made by J. O. B. Applegreen shows how

these outcrops may have become displaced, yet there is no actual proof that these bodies originally formed one continuous zone.

The dip of the outcrop on the Morning Star Hill appears to be to the south and as much as 45°, but the dip is deceptive and judged by the enclosing andesite. Tunnels into the side of the hill below the outcrops have shown this and probably most of these silicified masses stand practically vertical. While the exposed portions of these silicified bodies are hardened siliceous rock, beneath the surface the bodies are softer and in general quite friable, easily crushed and altered. Much of it is granular quartz intermixed with feldspathic material. Hard masses of grayish flint are occasionally encountered surrounded by softer material. The only accessible tunnels in the Mogul districts are high up and in the zone of constant oxidation and alteration, consequently the whole mass is bleached white and kaolinized, with frequent seams of white clay. Much of this condition has been brought about by acidified surface waters, and it is quite impossible to say how much has been due to ascending solutions. These silicified zones are prevalent in the andesites flanking the Sierras on the east and extending over Nevada.

Origin of the silicification.

The formation of these great bodies of silicified rock has been due to ascending hot solutions, altering and silicifying the andesite. These hot waters have coursed upward through channels, fissures and pores of the volcanic rock, entirely changing its character by dissolving and leaching of much of the feldspathic and silicate contents of the rock and leaving or precipitating a silico-feldspathic mass with seams of chalcedony and clay. Some of the channels have extended for long distances and the siliceous material forms a long outcrop, such as the "Great Mogul Ledge," as it is called. Other channels have been short, causing the formation of isolated bodies. It is quite possible that the Kennebeck Mountain and some of the outcrops on the hills may be of this character.

The bodies are considered as lodes in the districts, but they are not fissure-fillings and do not in general have well-defined walls. Of course, there are cases where the former fissures may have become filled with the altered rock and thus forming veins, but the general mass has its origin in impregnation of porous andesite rock by the hot solutions. The solutions were the magmatic waters associated with the volcanic eruptions of the andesite, welling up through the rock and transposing it. The depth to which these bodies may attain is only surmisable. They may run down the full depth of the andesite in a wide body or they may pinch out. Just how deep the andesites are can not be determined. Solutions may traverse a fissure until a porous, easily affected mass of

the rock is encountered, with the result that the silicified mass is simply an enclosed body. Only the upper portions of these bodies have so far been penetrated. There has been no attempt to drill or go down directly on one of them to prove its downward direction or size. Long tunnels have been run from the sides of the hills to strike them, without sufficient accurate data concerning them, and in this way money has been expended without returns.

THE ORE DEPOSITS.

All of these silicified bodies are mineralized, and at the present time of profitably working very low grade rock, all of them can be classed as ore bodies. Mineralization accompanied the silicification and alteration and probably the minerals were precipitated from alkaline solutions. These solutions must have had a complex composition. In addition to being sulphide solutions they contain arsenic and antimony, with the result that the sulphosalts are quite prominent in the ores as well as the common sulphides, such as pyrite, chalcopyrite, chalcocite, galena, sphalerite, etc. The sulphosalts occur probably in the higher portions of the deposit with the sulphides predominating below, but this is a hypothetical statement. Silver and copper are the principal metals, although gold forms an important part of the ores. The silver and copper as minerals appear to be present as sulphantimonites and sulpharsenites rather than as simple sulphides. The mining that has been done indicates that a marked difference exists in the ore deposits of Colorado Hill from those of the Morning Star Hill. The andesite rock occurs in various phases of structure, but there is nothing to prove different periods of eruption or different periods in the formation of the silicified bodies. There is, however, a difference in the minerals. The Morning Star deposits are essentially copper, the chief mineral besides pyrite being the sulpharsenite enargite, whereas the deposits of Colorado Hill are essentially silver, with lead and zinc and but little copper. Furthermore, the zones in the western side of the districts bordering the Carson River Cañon have much free gold associated with silver minerals, and this occurrence appears to be quite local. Gold and silver occur throughout the whole section, but the first not in free state and the second not always as a recognizable silver mineral. Arsenic appears more abundant in the Mogul district and has consequently caused the formation of enargite rather than chalcopyrite, which latter is the copper mineral of the Monitor district. Also manganese appears to be more abundant in the Monitor district and the black oxides coat the walls of the tunnels. However, not enough underground work has been done to justify conclusions about the relative abundance of the various minerals.

THE MINERALS OF THE ORES.

Pyrite is the commonest of the sulphides. It is disseminated in crystals and grains throughout much of the rock and also has been found massive. It contains gold, but only in small amounts. The assays of the outcrops in the Mogul district show values in gold from one to five dollars and this has been derived largely from the oxidized pyrite. Enargite appears so far to be limited to the Morning Star Hill of the Mogul district. It was first struck in 1863 by running a tunnel into the hill to pierce an outcropping body of rock. Very rich masses of it were found and assays showed values up to $300 per ton. An analysis of the enargite was made by E. W. Root in 1868, which gave

Sulphur	31.68%
Copper	47.21
Arsenic	14.06
Antimony	6.19
	99.14%

Photo No. 1. Curtz Consolidated Mines Co. Showing mountain of gold-bearing outcrops on north side of Mogul Valley coursing north and south across valley. Outcrops course also east from mountain.

Antimony apparently replaces the arsenic to a considerable extent and the mineral is grading toward famatinite. The sulphantimonite, enargite, is black while famatinite is reddish brown, and this latter color is seen in some of the ore. The analysis takes no account of the gold and

silver which it carries. One ounce of gold and 100 ounces of silver have been obtained. Wherever the enargite occurs the ore becomes high grade, averaging $50 to $100 per ton. It is not disseminated evenly in the deposits, but rather as pockets. It is intimately associated with pyrite and the two minerals seem to have been crystallized together. There is no indication that any of it occurs other than as a primary mineral of the deposit. Its composition would indicate that it belongs to the upper zone of the deposits and may be succeeded lower down by the sulphide of copper. At present the lowest level is 480 feet and it is present on this level in abundance.

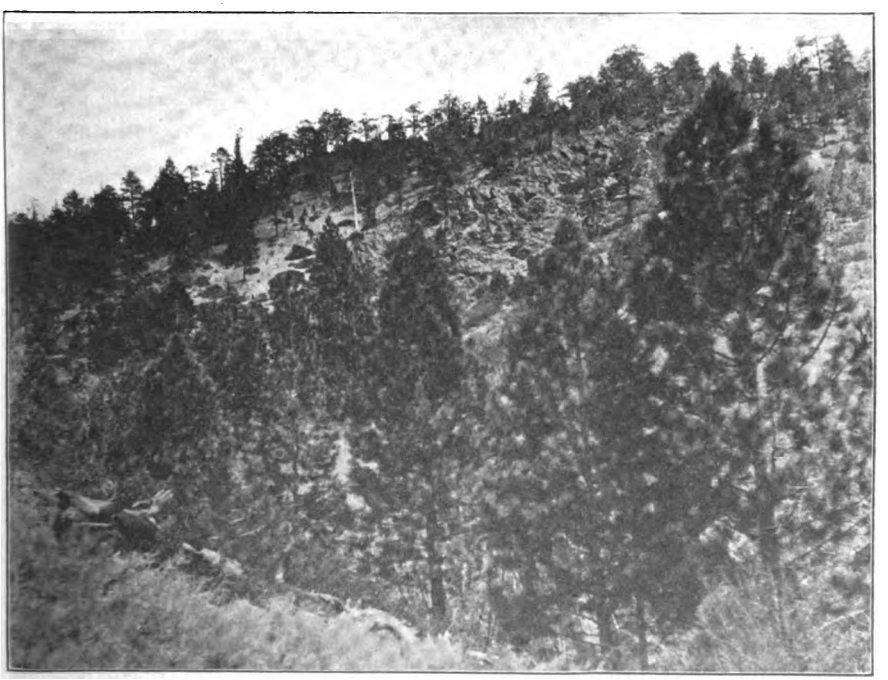


Photo No. 2. Curtz Consolidated Mines Co. West side of outcrop on south side of Mogul Valley showing site of proposed tunnel which will cut the lode 500 feet below surface. The feasibility of quarrying the whole mass from this point, 3000 feet in length, under mountain of outcrop seen in Photo No. 1, will be noted.

It is difficult to differentiate the silver minerals, and it is only in the ore from the mines in the Monitor district that we see them. Much of the richer siliceous rock has gray metallic granular sulphides blotching the rock. Argentite, polybasite, pyrargyrite, stephanite, stromeyerite and argentiferous galena and tetrahedrite have been observed. Perhaps argentite, polybasite and tetrahedrite are the main silver minerals. Gold as already stated occurs free in some portions of the districts and it can be panned from the ore of the Alpine Mine. It is present in the ore of all the mines presumably in the pyrite and other

sulphides and in the enargite. Tellurides are said to have occurred in the Colorado No. 2 mine. Streaks of pyrite and of clay and silica are occasionally encountered which assay several ounces in gold.

Practically all of the minerals cited in Bulletin No. 67 of this Bureau for Alpine County came from these districts.

Amount of ore.

Silicification has taken place on such a colossal scale that it leaves no question about the amount of available rock. There are millions of tons of it. The only question that can arise concerns its grade; whether it is sufficiently mineralized and carries values enough for profitable working. With our present facilities for handling very low grade ore, it does not seem that there should be any difficulty here. The pyrite is low grade but the ore does not depend upon the pyrite for its average. The mining that has been done in the past has conclusively proved the existence of high grade ore, some of it very high grade, and it has proved further that these high grade bodies are likely to be encountered frequently, and raise the general average value of the ore considerably above the safety margin. Much rich ore has been taken from these mines, mostly during the first twenty years after discovery, but the deposits have scarcely been touched.

THE MINES.

The two principal companies controlling the properties of these districts are the Curtz Consolidated Mines Company with an office in Oakland, and the Hercules Consolidated Mining Company with headquarters in Reno, Nevada. Besides these, there are individual claims, some with old tunnels, but all of them idle. Neither of the companies has done active mining for some time and their properties are for sale.

The Curtz Claims lie mostly in the Mogul district and the holdings consist of seventeen claims, on some of which old tunnels exist. The most famous ground controlled by the company is the old Morning Star Mine. On the hill above the workings several outcrops of the brown stained jasper rock occur, and in 1863 a tunnel from the north side of hill was run to cut one of these outcrops. At a distance of 775 feet from portal a large body of pure enargite mixed with pyrite was encountered, the mass ranging from 10′ to 15′ thick and 20′ to 30′ long. It was very rich ore, but at that time arsenical copper ores were a metallurgical problem to treat. Some of the ore was sent to Swansea, Wales, for smelting, after long hauling across the Sierra to the coast, but of course this could not be done with the average ore and consequently little has been done with any but the highest grade. The tunnel was continued through the hill and connected with a shaft at a distance of 922 feet from portal, and then was further continued

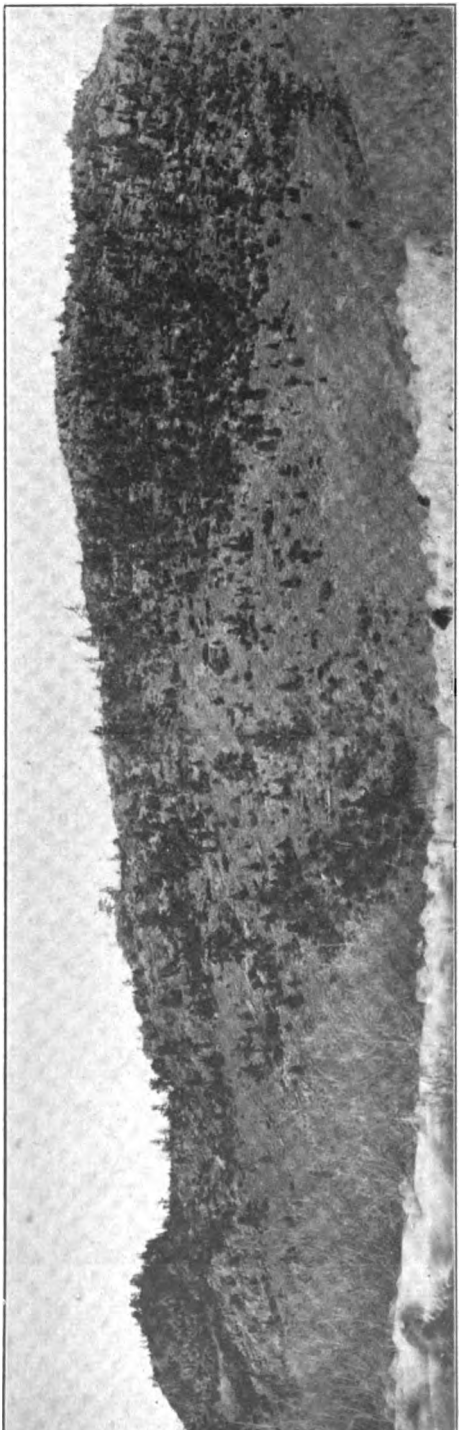


Photo No. 3. Curtz Consolidated Mines Company. Showing Great Mogul Lode coursing northeasterly and southwesterly into the lode shown in Photos No. 1 and No. 2. All of these outcrops are gold-bearing.

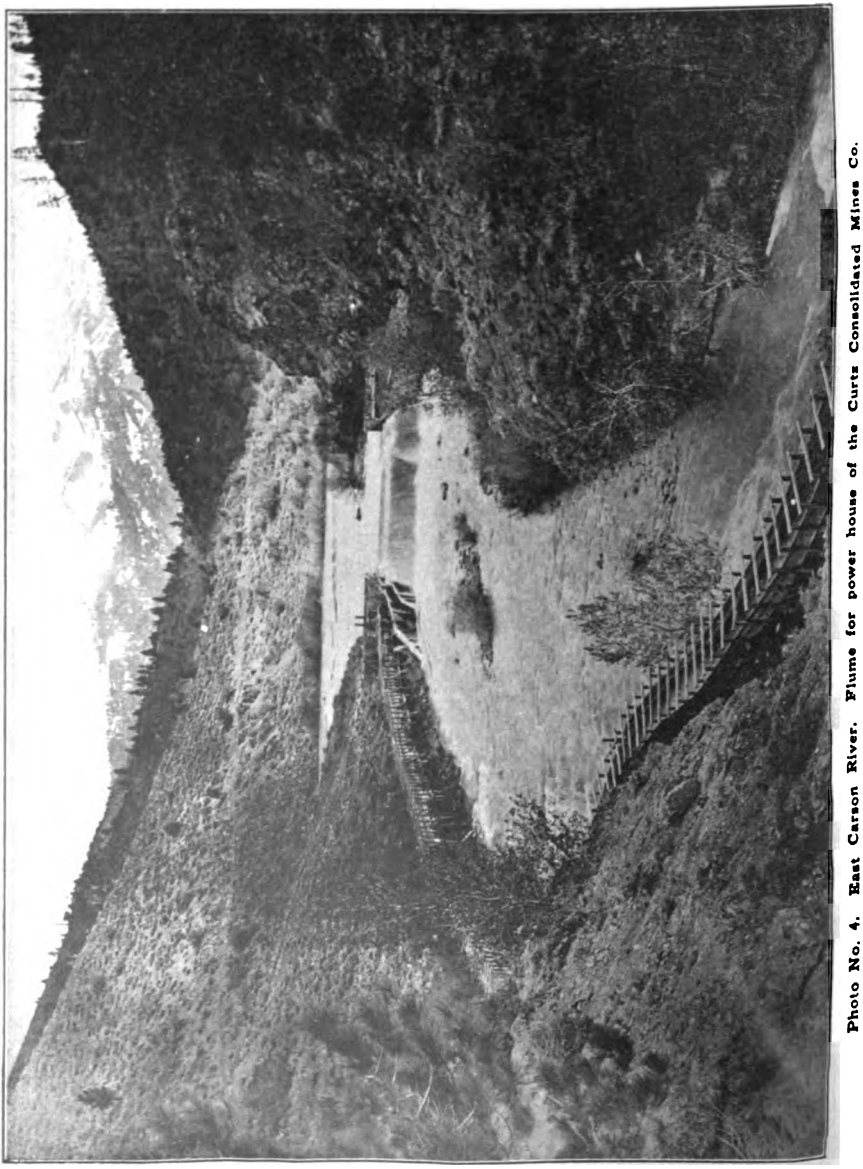


Photo No. 4. East Carson River. Flume for power house of the Curtz Consolidated Mines Co.

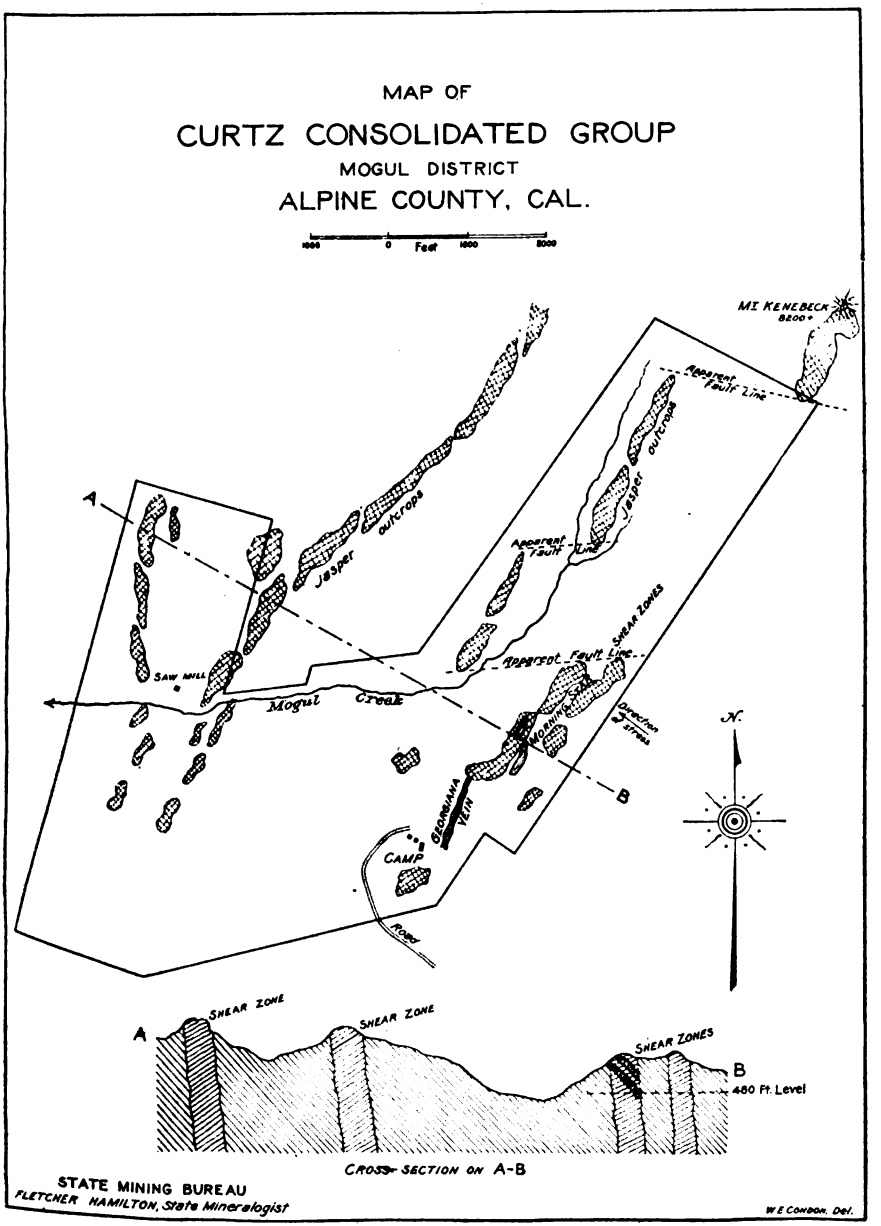
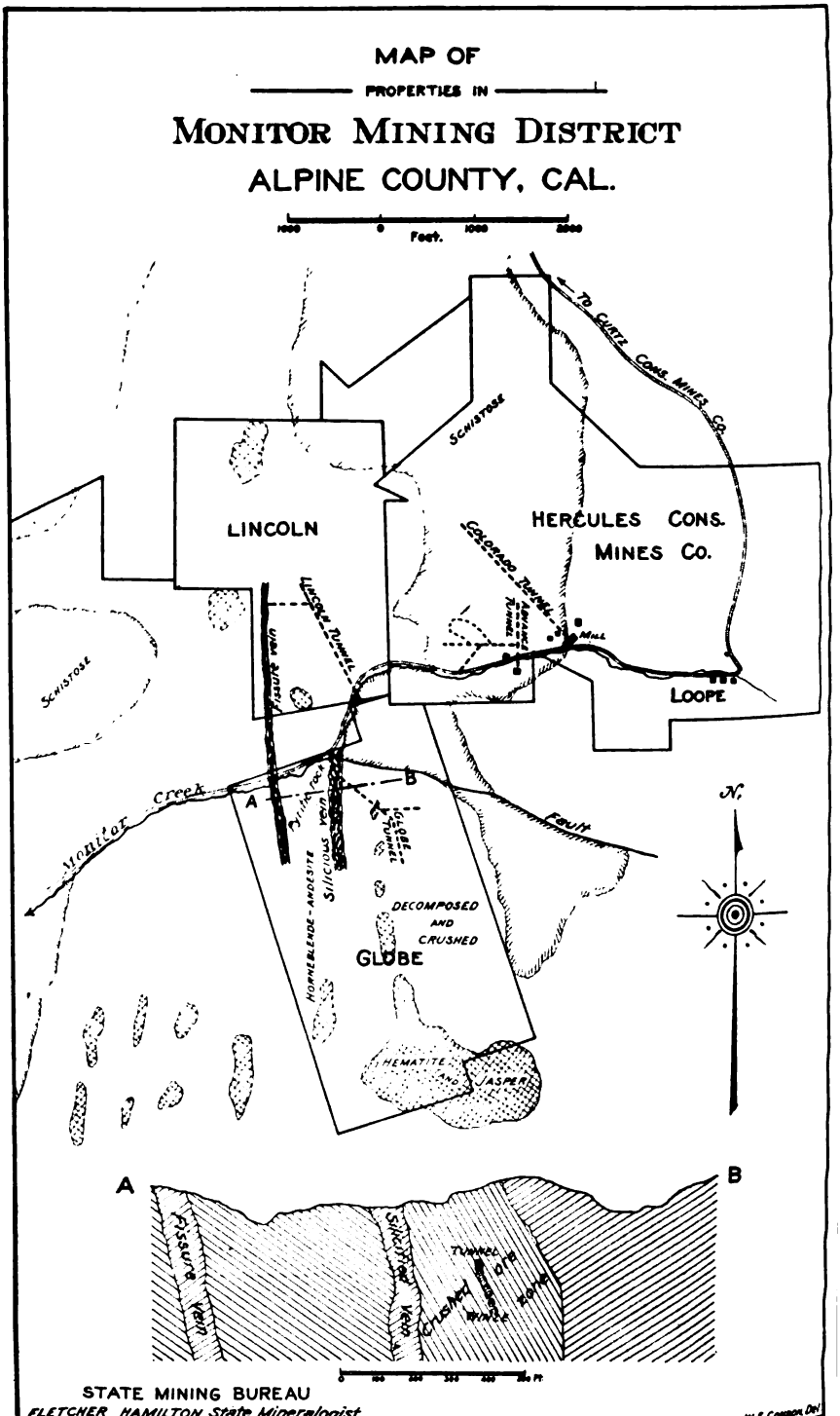

MAP OF
CURTZ CONSOLIDATED GROUP
MOGUL DISTRICT
ALPINE COUNTY, CAL.
1000 0 Feet 1000 2000
MT. KENEBECK 8200'
Apparent Fault Line
Jasper outcrops
A
B
Saw Mill
Mogul Creek
Apparent Fault Line
Shear Zones
Direction of Stress
Georgiana Vein
Camp
Road
N.
A
Shear Zone
Shear Zone
Shear Zones
B
480 Ft. Level
Cross-section on A-B
STATE MINING BUREAU
FLETCHER HAMILTON, State Mineralogist
W. E. Condon, Del.

Plate I.


MAP OF
PROPERTIES IN
MONITOR MINING DISTRICT
ALPINE COUNTY, CAL.
Feet.
TO GURTZ CONS. MINES CO.
SCHISTOSE
LINCOLN
HERCULES CONS. MINES CO.
COLORADO TUNNEL
ADVANCE TUNNEL
MILL
LOOPE
LINCOLN TUNNEL
OPEN CUT
SCHISTOSE
MONITOR CREEK
A
B
C
GLOBE TUNNEL
SILICIOUS VEIN
HORNBLENDE-ANDESITE
DECOMPOSED AND CRUSHED
GLOBE
FAULT
HEMATITE AND JASPER
N.
A
B
FISSURE VEIN
SILICIFIED VEIN
CRUSHED ZONE
Tunnel No. 2
STATE MINING BUREAU
FLETCHER HAMILTON State Mineralogist

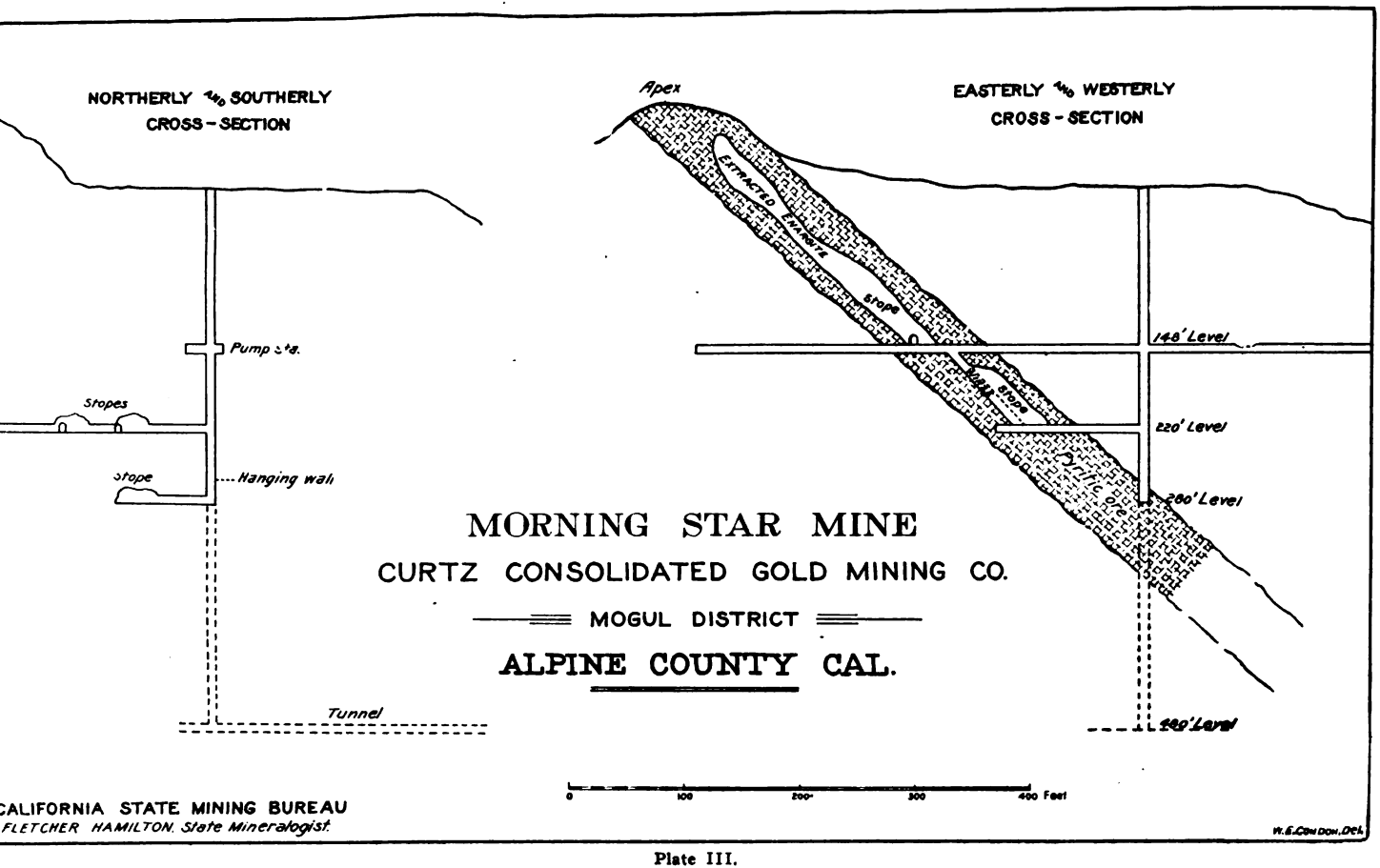

NORTHERLY AND SOUTHERLY
CROSS-SECTION
Pump Sta.
Stopes
Stope
Hanging wall
Tunnel
Apex
EASTERLY AND WESTERLY
CROSS-SECTION
EXTRACTED
Stope
148' Level
220' Level
280' Level
320' Level
MORNING STAR MINE
CURTZ CONSOLIDATED GOLD MINING CO.
MOGUL DISTRICT
ALPINE COUNTY CAL.
0
100
200
300
400 Feet
CALIFORNIA STATE MINING BUREAU
FLETCHER HAMILTON, State Mineralogist.
W. E. Condon, Del.

Plate III.

to opening on the south side of hill, but this was never finished. Drifts were made from this level and ore was encountered in various places which carried good values. In the large chamber from which the enargite was stoped, a winze was sunk to the 225-ft level and a tunnel connection made with the shaft. Not much work was done on this level. The shaft was continued down to 280 feet. All of the lower level is apparently flooded and much of the main tunnel of the mine is now inaccessible, although it can easily be cleared out. The draining off of the water below is more of a problem. In order to unwater these lower workings and at the same time prove up ore-bodies at a lower depth, the present company after it obtained control began a new

Photo No. 5. Old Alpine Mill, on East Carson River, now used for power house by the Curtz Consolidated Mines Co.

tunnel at the 480-ft. level on the southwest side of hill in the Georgiana claim, and this tunnel has been run some 2000 ft., but work has ceased and the connection with an extension of the old shaft of the Morning Star Mine has not been made. In their new tunnel good enargite has been encountered and assays have yielded over $50 per ton for the ore.

The lowest workings in the hill are therefore only 480 feet deep from surface. How far down the enargite may continue is problematical. There is a strong possibility that bodies of chalcocite may occur due to secondary enrichment of the sulphide. Plate III shows vertical section

of the Morning Star. As only ore of the highest grade could be profitably shipped in those early days, it is quite probable the dumps may yield much payable ore.

The Alpine Mine also belongs to the Curtz Company. It occurs in the extreme western part of the Mogul district and the two or three adit tunnels are just at the head of a short cañon opening out into the Carson River Cañon. It is so conveniently situated above the river that an aerial tramway has been constructed to send down the ore to the mill

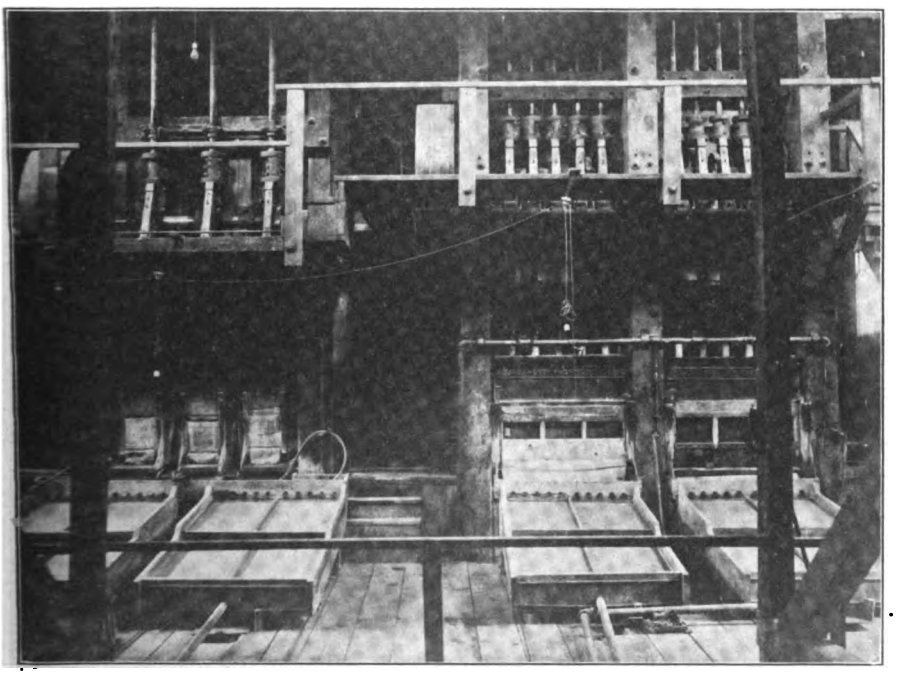


Photo No. 6. Stamp batteries in the old mill of the Curtz Consolidated Mines Co.

below. This mine was believed to be rich in free-milling gold and the stamp mill below was constructed to treat it. The workings are inaccessible and only a little of the ore from the mine can be seen. Some of it sent down to the Panama-Pacific International Exposition assayed over $100 per ton in gold and silver, amalgamating over $50 in gold. How the ore averaged is not known by the writer. This mine occurs in the Colorado Hill on its northern side. The ore is largely flint and chalcedony in a softer iron stained clay-like material and the siliceous mass has gray granular silver minerals in it. The ore is amenable to amalgamation and cyanidation.

The Orion Mine has its two tunnels a little distance to the west of the Morning Star and lower down the hillside, the lower one near the floor of the Mogul Cañon. Five hundred or more feet of tunnel were con-

structed and a vertical shaft 110 feet deep. The upper tunnel was 200 feet and the lower 300 feet. It is said a body of ore was struck in lower tunnel some 6 feet wide which assayed $212 silver, $25 gold and 50% lead. Ore from the upper tunnel ran 10% copper, $15 silver and $5 gold. These figures do not of course represent the average ore. They may be all right for samples.

These four mines of the Curtz Company represent all that has been done in underground work in the district, and this work to a large extent was done from 30 to 50 years ago. The district has been a long time sleeping, but is destined to be awakened suddenly.

Equipment: The Curtz Company owns the old 35-stamp mill on the Carson River which was built to treat the Alpine ore. It is useless as a stamp mill, but could be utilized, if necessary, for the Alpine ore if the tailings were impounded. However, it has been converted into an electric power house and the present equipment can develop 250 h.p., which can be increased to any desired capacity.

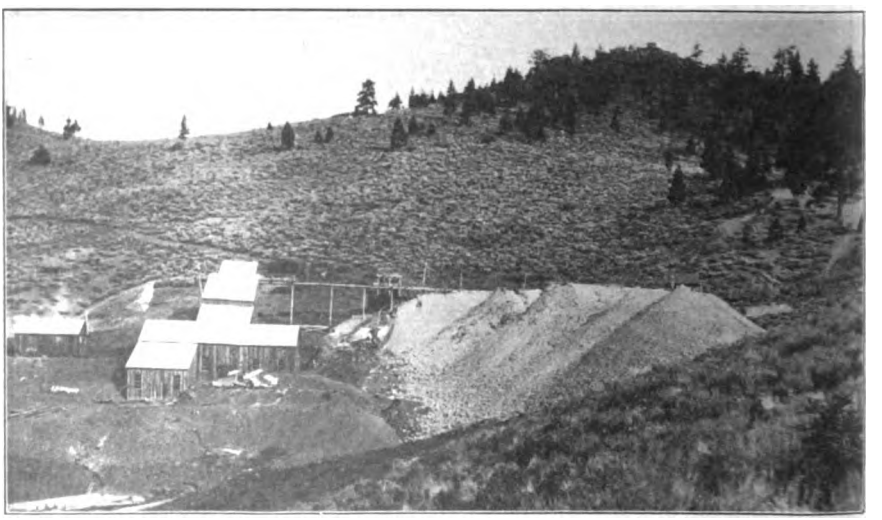


Photo No. 7. Curtz Consolidated Mines Co.'s ore dump at Curtz Tunnel, and 50-ton concentrating test plant. Showing south end of outcrop of Morning Star Lode. Georgiana Lode courses toward and cuts out Morning Star Lode at end of outcrop on summit.

The company has recently built a new mill on the hill near the Georgiana tunnel. This is equipped with a Huntington rotary mill capable of crushing 100 tons daily—four concentrators and three slimers. The mill machinery is run by electric power. Water for concentration is conserved in two large tanks and sufficient water can probably be developed on the hill for concentration. The present method of water concentration for this ore is not economical, as less than 60% is saved. Concentration by flotation will have to take its

place and the mill equipped for this method. A boarding house and assay office complete the equipment.

The Hercules Company owns claims situated wholly in the Monitor district. Their mines are the Colorado No. 2 and the Advance, both of which have their adit tunnels near the bottom of the Monitor Creek Cañon. The mines are in the Colorado Hill on its south side and the ore extracted has been largely silver ore.

The old Colorado No. 2 was the best mine of this district and statistics show that it was a good producer. There are two tunnels to this mine

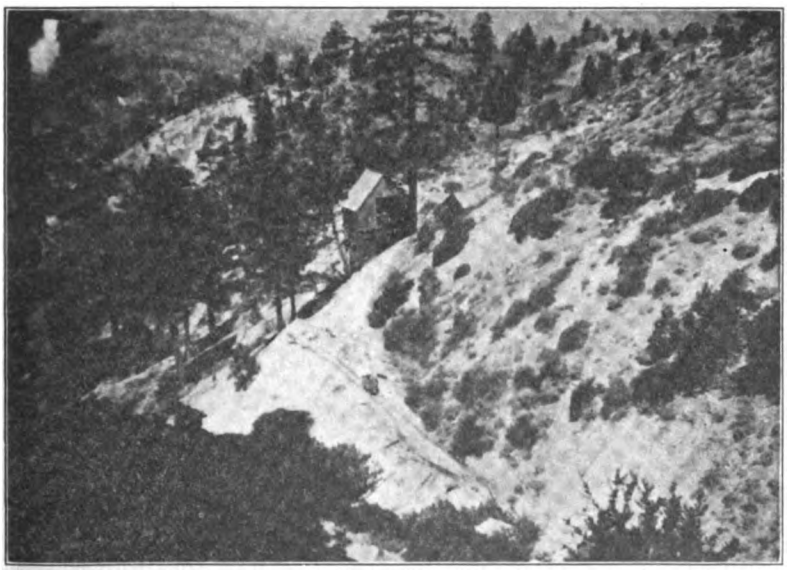


Photo No. 8. End of aerial tramway, Alpine Mine.

connected by a winze. The upper or Tarsus tunnel is 500 feet long and the lower tunnel, the Colorado No. 2, is 1400 feet in length and lies 325 feet below the upper and 600 feet below the surface of the hill. It is said that $625,000 was taken from this mine in a comparatively short time, the ore averaging $12 per ton. The ore is also in a siliceous gangue and the outcrop is seen above. It is an ore of mixed sulphides and sometimes lead and zinc are very prominent as sulphides. The rock is mainly low grade, but rich streaks are found which raise the general average. The rich streaks have shown ruby silver, argentite and polybasite or stephanite. According to old reports of this district there were no walls for the ore bodies. It is a case of silicification and impregnation of the rock, and definite walls are not likely to exist.

The Advance tunnel is a few hundred feet west of the Colorado No. 2 and about 100 feet lower. It is headed to connect eventually with the Colorado No. 2 by shaft and also strike the same body of ore

Photo No. 9. Mill of the Hercules Consolidated Mining Co., Monitor District, Alpine County.

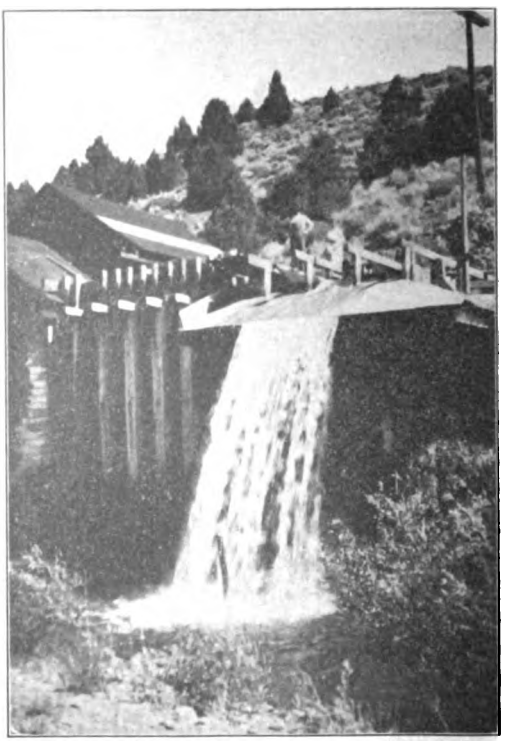


Photo No. 10. Power plant of the Hercules Consolidated Mining Co.

at a lower depth and the estimated distance still to run is about 300 feet. Some recent mining has been done and the tunnel is now about 2000 feet long. The concentrates of the ore have been shipped by hauling to Minden. The average is low, but streaks of good ore occur. One now in sight is a thin seam of rhodochrosite containing blackish silver minerals. Manganese is a characteristic of the ore bodies in this districts and some of the tunnels have black coatings of the oxide on the walls. The other tunnels in the immediate vicinity are the Lincoln and the Globe. These are owned privately, and no ore has been produced from them for years. The Lincoln is in the Colorado Hill, a short distance west of the Advance and is about 2000 feet long. The Globe is further down the creek and on the south side of the cañon.

The sketch of the claims in the Monitor district shows the position of the principal tunnels.

The Hercules Company has an electric power house on the Carson River about one mile below the Curtz Mill, and it can develop all the power necessary to mine and mill the ore. At the mine there is a 20-stamp mill and 10 Frue vanners run by electric power. These concentrators also are inadequate, not making a clean concentration and probably flotation will have to be introduced. The Monitor Creek furnishes abundant water for concentration. All the mining in the two districts has been done by hand drilling. The cost of mining and milling can be reduced to a very low figure. The bodies of ore are easily reached by comparatively short tunnels from the sides of the hills. Much of the ore is quite friable and easily crushed. Electric power is installed and electric drills can materially increase the daily tonnage of ore extracted. An equipment by either company which would mine and crush from 500 to 1000 tons a day, together with a good concentration process would permit of working with profit a very low grade ore, lower probably than what the average ore of the district yields. There is a haul at present of about twenty-six miles to railroad, but with active mining resumed on a large scale, there are possibilities of the railroad being extended to the districts. Preliminary surveys have already been made for the extension from Minden. Not much can be said of the other mining districts which once had active camps. They are desolate and deserted.

SILVER MOUNTAIN DISTRICT.

This district is about five miles southwest of the Monitor district. The main highway leaves the Carson River and follows up the Silver Creek, passing through the mining district at the base of Silver Mountain. About thirty years ago, Silver Mountain City existed with a population of 4000. The only sign of a former town is the stone wall

of a small jail. This district has the I.X.L., the Exchequer and Pennsylvania mines, and these produced ore once. The principal mines of the district were owned by the **Isabel Mining Company** of London, with Louis Chalmers as mine manager. Judging from the wreckage of old mine buildings, this company must have expended a vast amount of money in experimental plants for treatment of the ore. Roasting plant, amalgamating plant, mill and other buildings have gone to ruin. A tunnel called the Isabella was run into the base of the mountain to strike the body outcropping some 2000 ft. above. The tunnel was made wide with double track after 4400 feet of fruitless tunneling was done. The work was abandoned, as this apparently ended mining in the district. The ore occurs in siliceous bodies in the volcanic andesite. Silver Mountain is a volcanic peak with these same siliceous and mineralized bodies.

Photo No. 11. Dump of the old Isabella Mine, Silver Mountain District, Alpine County.

SILVER KING DISTRICT.

This district lies about fifteen miles south of the Monitor district and is reached by trail through Bagley Valley. In this section the volcanic andesites disappear and are succeeded by granite and metamorphics. Some of the granite ridges are capped with later volcanics. Mining was started in this district, but was not carried very far, as the ore proved too low grade to work in that isolated region.

It seemed to be an auriferous pyrite disseminated in a schist. Work was started here and considerable money spent because assays which were erroneous showed high gold content.

MINERAL WATER.

Grover's Hot Springs, Mrs. H. A. Grover, Markleeville, owner, are about 4 miles west of Markleeville near the southern extension of the Sierra Valley fault, and on the south side of Markleeville Creek. There are 10 or 12 springs and seepages in two marshy areas about 100 yards apart at the edge of a meadow. The temperature ranges from 128° F. to 146°. The place is used as a camping resort, and there is a pool for bathing.

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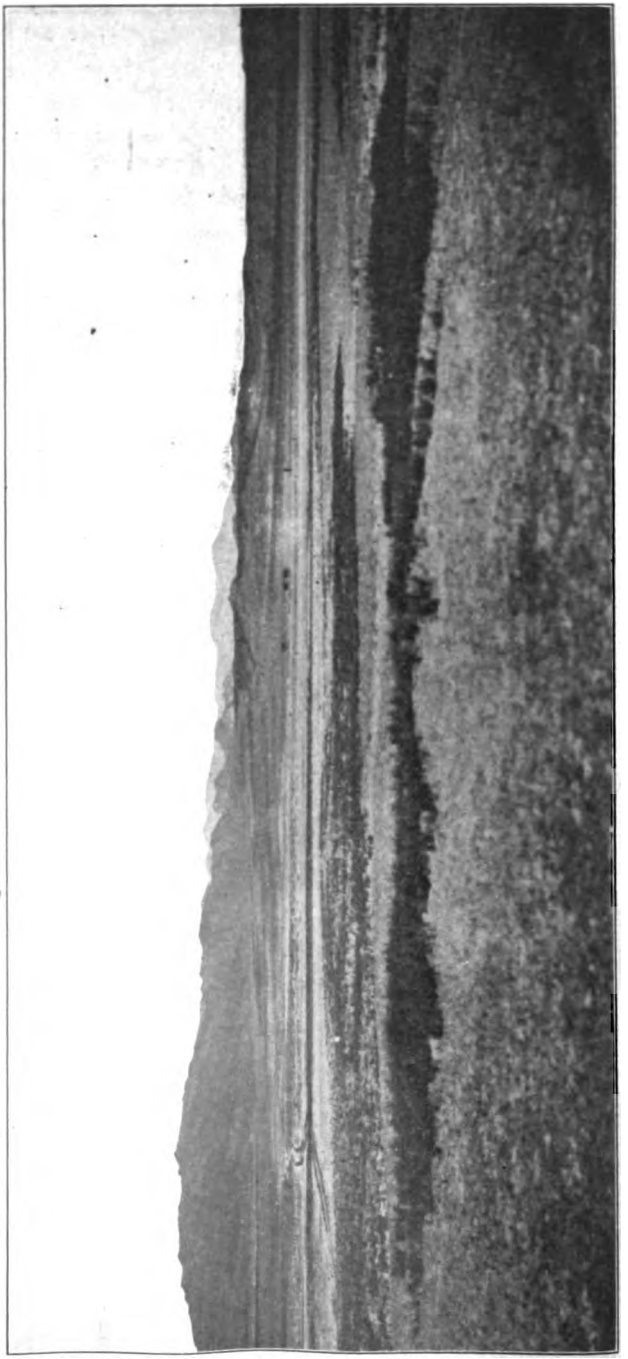


Photo No. 1. "The Desert Rat" or prospector, crossing the Amargosa Valley, Inyo County.

INYO COUNTY.

By CLARENCE A. WARING and EMILE HUGUENIN, Field Assistants.
With Mining and Geologic Reconnaissance Map by CLARENCE A. WARING.

INTRODUCTION.

The field work for this report was carried on during the months of March and April of the year 1916. The expedition made use of a light automobile, which proved a very rapid and efficient instrument for covering the great wastes of desert gravel and sand, as well as the steep mountain roads.

The writers devoted most of their attention to the mines in operation throughout Inyo County, but endeavored to obtain reliable information concerning the many prospects and claims which hold considerable promise. The geologic map is partly a compilation, with additions and alterations introduced from personal observations.

Appreciation is expressed for the uniform courtesy and helpfulness tendered by the owners and operators of the mines.

LOCATION AND DESCRIPTION.

Inyo County lies along the eastern border of California and is bounded to the north and south by Mono and San Bernardino counties respectively. The western boundary extends to the Sierran divide. The county has an area of 10,224 square miles, being the second largest county in California. Independence is the county seat, while Bishop, with about 2000 inhabitants at present, is the center of population. Since the great increase in mining activity during the last year the population has increased considerably, so that at present there is probably an average of one inhabitant to each square mile of territory. Within the borders of the county are both the highest point and the lowest point in the United States. Mount Whitney has an elevation of 14,501 feet, while the lowest point in Death Valley, at Salt Flat, is 280 feet below sea level.

HYDROLOGY.

CLIMATE AND WATER SUPPLY.

The climate of Inyo County is controlled principally by the Sierra Nevada Mountains, which cause the moist, cool winds to precipitate practically all their moisture on the high mountains, or on their west side. The winds are thus dry after they pass the Sierras and tend to absorb moisture from the soil and vegetation of the already desiccated country.

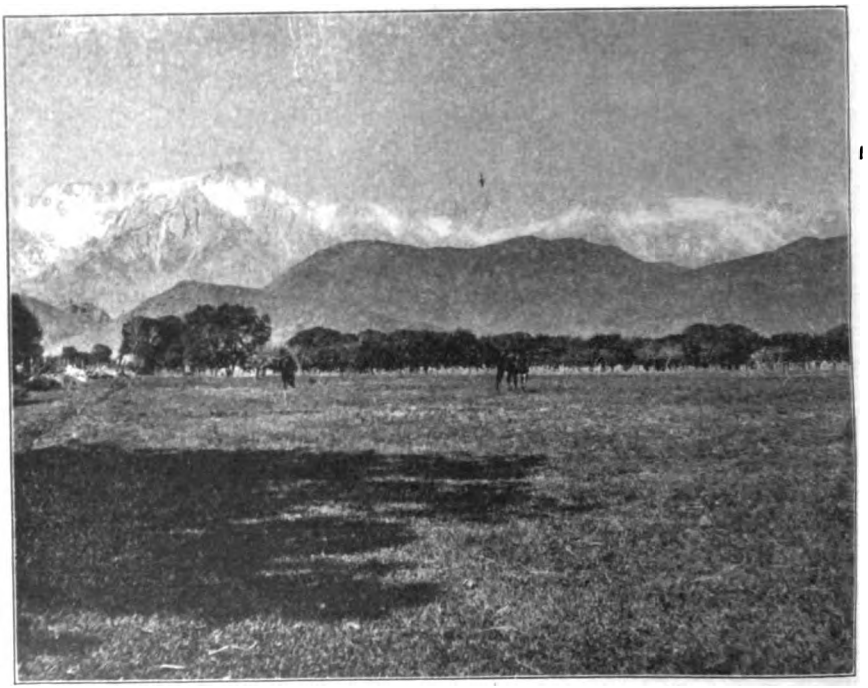


Photo No. 2. Mt. Whitney, the highest point in the United States. Elevation 14,501 feet. Viewed from Lone Pine, Inyo County.

Photo No. 3. Furnace Creek, or Coleman Ranch and Salt Flat, the lowest point in the United States. Elevation —280 feet. Viewed from the mouth of Furnace Creek.

The average rainfall in the Owens Valley region is between three and four inches, while there is no appreciable rainfull east of the Inyo and White mountains. The melting snows of the Sierras furnish Owens Valley with an abundance of water, but the snowfall on the peaks of the desert region and the slight rainfall usually evaporate without entering the soil and furnish only a temporary water supply to the miners, who must melt the snow over fires, or use the water that accumulates in natural "tanks" or rock bowls. The whole region, however, is subject to electrical storms, which often cause temporary local floods.

Only two rivers receive sufficient water to extend beyond the base of the mountains. The others sink at once into the desert gravels or settle in playas. The water of Owens River is now partially used for the Los Angeles aqueduct and the balance flows southward into Owens Lake, where it evaporates. The Amargosa River rises in springs north of Beatty, Nevada, and flows southward, intermittently, across the Amargosa Desert and through Franklin Lake to Resting Springs Lake. It enters a narrow cañon south of Tecopa, between Black and Kingston mountains, and there spreads out, forming a great dry wash, where it is joined by the South Amargosa, which rises in Silurian Lake. The river takes a broad turn to the westward around the south end of Black Mountain and enters Death Valley flowing northwestward in the region of Saratoga Springs.

The headwaters of the Amargosa are fine fresh water, but it becomes briny with salt, borax and niter in the region of Resting Springs Dry Lake, and leaves salt patches along its course all the way into Death Valley.

Many of the springs are fed, only temporarily, by local precipitation, and dry up during the summer. The main dependable springs, however, such as Furnace Creek and Grapevine Springs, arise along fault lines across Paleozoic rock strata and are fed from great distances by rainfall or snowclad peaks. Although many of the springs, in the valley especially, are highly charged with the sulphates of sodium and magnesium, making them unfit and harmful for drinking purposes, one can probably not go anywhere in the region where he will be over 30 miles from potable water. Boiling of somewhat stagnant water of the springs, kills all minute animal and vegetable life and renders it safe for drinking purposes. It is not only lack of water that is fatal to prospectors in the region, for the intense heat and aridity have exhausted and stifled the life of prospectors when their canteens were full. The temperatures in Death Valley have been known to run as high as 140° F.

On account of the generally poor quality of water in the region, it is well to drink freely at the good springs and very little of the poor spring water. In place of drinking during the day, a small pebble carried

under the tongue creates sufficient irritation to cause a flow of saliva to keep the mouth moist. A generous supply of canned fruit and vegetables among the provisions often furnishes enough solution for the system without much water.

When traveling in the desert, free use should be made of a map and compass, and landmarks noted along the way, which will enable the traveler to locate himself approximately on the map. With the north star at night and the sun in the day one should have no serious trouble in keeping his directions straight. If lost, however, it is best to retrace one's steps or build a signal fire.

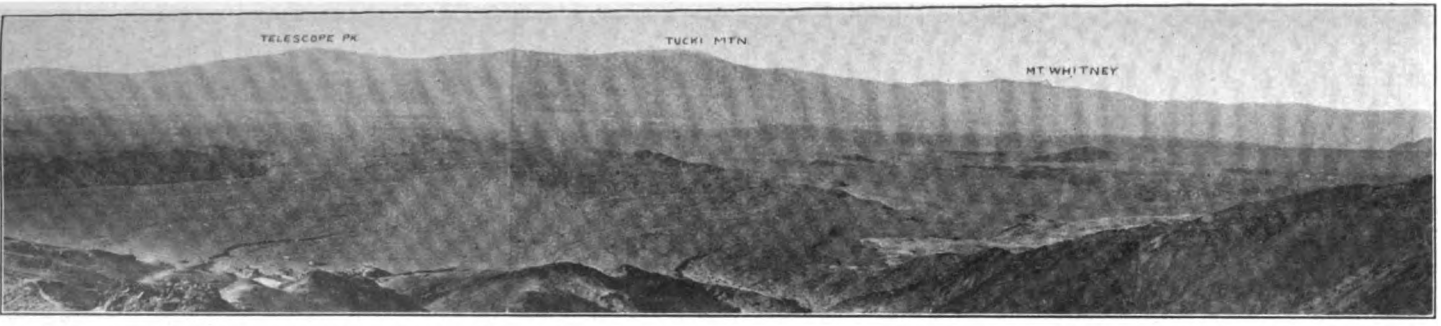


Photo No. 4. View westward from trail to Keane Wonder Mine, showing Keane Wonder camp, Death Valley and Mt. Whitney in distance—lowest and highest points in United States.

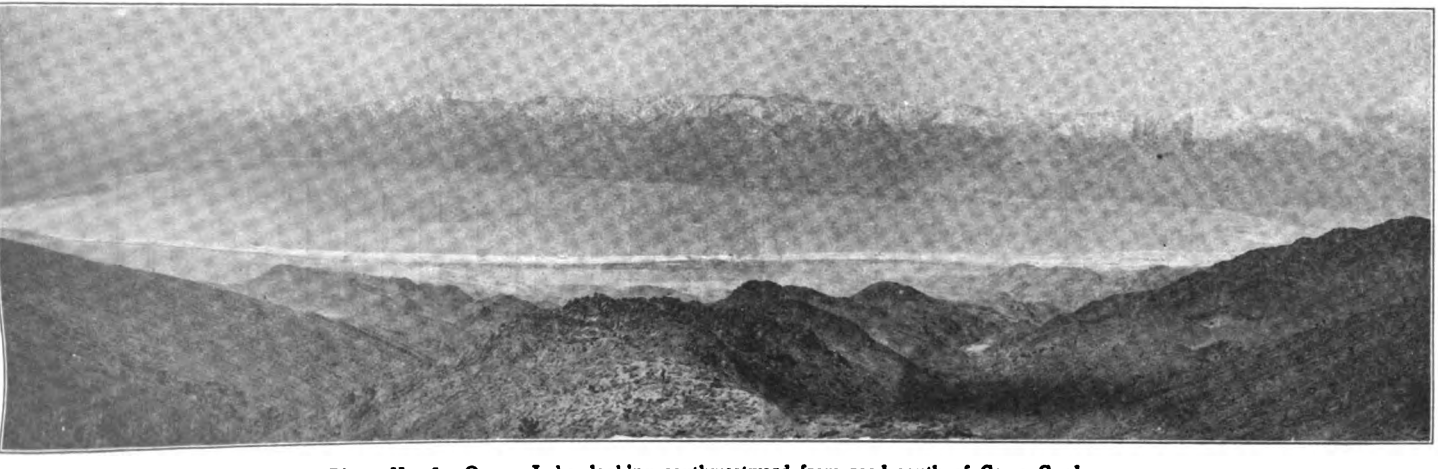


Photo No. 5. Owens Lake, looking southwestward from road south of Cerro Gordo.

WATERING PLACES IN INYO COUNTY.[1]

[1]The following list of watering places has been compiled from notes taken in the field, together with springs listed by Messrs. W. C. Mendenhall and Gerald A. Waring, in U. S. Geol. Survey Water Supply Papers Nos. 224 and 338. The list has also been reviewed and added to by Mr. A. M. Strong, of Los Angeles, former Inyo County Surveyor.

Name of spring or well	Location	Character and quantity of water
Antelope Springs	SW. edge Deep Springs Valley	Small; good water.
Arab Spring	See Centennial Springs.	
Argus Spring	8 miles NE. of Darwin on road to Panamint Valley.	Good; small supply.
Barrel Springs	In Mazourka Cañon, 10 miles NE. of Independence.	Good.
Bennett's Wells	20 miles S. of Furnace Creek Ranch, in Death Valley.	Brackish; obscured by sand; tules.
Bird Spring	See Dodd's Spring.	
Black Mountain Springs	Several on W. side of Black mountains.	Small seasonal springs.
Borax Well	At old Amargosa borax works, 1 mile SW. of Zabriskie.	Well; flowing water into trough.
Bradbury Spring	10 miles W. of Zabriskie	Good; supply limited.
Burro Spring	6 miles in air line S. of Tin Mountain.	Good; supplies 3 bbls. a day.
Centennial Springs	9 miles NW. of Coso	Plenty of good water.
Cerro Gordo Water Supply	Springs 5 miles N. Cerro Gordo.	Small; piped to mine.
China Ranch	See Morrison Ranch.	
Coleman Springs	See Furnace Creek Springs.	
Confidence Springs	7 miles NW. of old mill in S. Death Valley Narrows.	Good; small amount; left hand trail.
Coso Hot Springs	15 miles NE. of Little Lake	Large medicinal hot springs.
Coso Well	At Coso, 8 miles SW. Darwin	Good water; plenty.
Cottonwood Creek	14 miles NW. of Skidoo	Good, clear water; plenty.
Cow Creek	8 miles NE. Furnace Creek Rch.	Good; plenty.
Crystal Springs	4 miles NW. Coso; 2 miles NE. Coso Peak.	Good water. Plenty; piped to Darwin.
Daylight Springs	Head of Boundary Cañon; 8 miles N. of Keane Wonder.	Good water; 8 bbls. per day.
Death Valley Junction	On T. & T. R. R., 50 miles S. of Beatty, Nevada.	Good water; pumped.
Deep Springs	S. end of Deep Springs Valley, 18 miles NE. of Alvord.	Plenty of good water.
Dodd's Springs	7 miles S. of Ubehebe Peak	Good water; supply limited.
Emigrant Springs	In Emigrant Cañon; 4 miles W. of Skidoo.	Good water in two springs.
Fountain Springs	6 miles N. Furnace Creek Ranch	Fair water; small quantity.
Franklin Well	10 miles N. Death Valley Jct.	Fair water; old well seldom used.
Furnace Creek Springs	E. edge of Death Valley, near mouth of Furnace Creek.	Good water; large quantity.
Goldbelt Spring	9 miles SE. of Ubehebe Peak	Good water; 20 bbls. per day.
Grapevine Springs	E. side Death Valley; 3 miles W. of Stainінger's Ranch.	Good; large supply from bench.
Greenwater Spring	3 miles SE. of Greenwater	Fair; small supply.
Hairwee Springs	3 miles N. of Coso Hot Springs.	Large supply of good water.
Hole in the Rock Spring	In Boundary Cañon: 5 miles NW. of Keane Wonder.	Good water; small seep in a hole.
Homestead Cañon	NW. edge of Saline Valley	Good supply.
Hot Springs	3 miles SE. of Zabriskie	Used for bathing and railroad.
Hunter and Keynot Cañons	E. face of Examiner Peak, W. of Saline Valley.	Good supply; used for mine and mills.
Indian Springs	W. edge of Death Valley; NW. of Mesquite Flat.	Fair; uncertain quantity.
Junction Springs	15 miles S. of Darwin	Good supply; piped to ranch.
Keane Spring	4 miles NW. of Chloride Cliff	Good water; 30 bbls. per day.
Lane Pump	See Willow Springs.	
Lead Cañon	NW. edge of Saline Valley	Good supply.
Mesquite Well	On SW. edge of Mesquite Flat; often obscured by sand.	Fair; uncertain quantity.
Mesquite Spring	In Death Valley wash: 6 miles SW. of Stainінger's Ranch.	Fair; uncertain quantity.

Watering Places in Inyo County—Continued.

Name of spring or well	Location	Character and quantity of water
Morrison Ranch	4 miles SE. of Tecopa	Excellent water; large supply.
Mountain Spring	W. slope Argus Range; 20 miles E. of Little Lake.	Good water; plenty.
Oasis (Mono County)	30 miles NE. of Alvord Station Big Pine.	Springs and wells; good; plenty.
Owens Lake Springs	Scattered along SE. edge of Owens Lake.	Brackish but usable; plenty.
Poison Spring	11 miles NE. Furnace Creek Ranch.	Poor, but usable in small quantities; seep; dangerous.
Rest Spring	7½ miles in airline S. of Tin Mountain.	Good; supplies 3 bbls. daily.
Resting Springs	5 miles NE. of Tecopa	Upper springs good for drinking.
Ring or Ruiz Well	On Mesquite Flat, 2 miles SW. of Surveyor's Well.	Brackish water; 4-foot well often obscured by sand.
Rose Spring	2½ miles S. of Lower Haiwee Dam, ¼ mile W. of road.	Small; little used.
Saline Valley Springs	1 mile W. of Salt Lake, Saline Valley.	Fair quality; good supply.
Salt Creek Wells	Near Salt Creek, 6 miles SE. of Stovepipe Wells.	Brackish water; 2 shallow wells.
Salt Well	N. end Salt Flat, Death Valley.	Very salt; used for stock only.
Sand Springs	In N. end of Lost or Death Valley; mouth of Tule Cañon.	Strong sulphur.
Skidoo Water	Pipeline from Telescope Peak to Skidoo, via Harrisburg.	Excellent snow water from Telescope Peak.
Stainінger's Ranch	In Grapevine Cañon: 12 miles NE. of Tin Mountain.	Excellent water; large supply.
Stovepipe Wells	SE. edge of Mesquite Flat	Brackish water; two 5-foot wells; large supply.
Surveyor's Well	NE. corner of Mesquite Flat	Good water; 5-foot well; camp.
Tecopa Well	At old smelter, 8 miles SE. of Tecopa.	Excellent water; plenty.
The Tanks	6 miles N. of Trona on Searles Lake.	Good water piped from tunnel near mouth of Argus Cañon.
Toll House Spring	12 miles E. of Big Pine on road to Deep Springs Valley.	Small; used for watering stock.
Triangle Spring	3 miles SE. Surveyor's Well	Good water; small quantity.
Tule Spring No. 1	1¾ miles SE. of Thimble Peak, 10 miles NW. Keane Wonder.	Good water; limited supply.
Tule Spring No. 2	3 miles NE. of Tecopa	Fair; 2 barrels daily.
Tule Springs	15 miles S. of Furnace Creek Ranch, Death Valley.	Brackish water; small supply.
Warm Spring	On NE. edge of Saline Valley	Plenty of good water.
Waucoba Springs	On road to Saline Valley, 25 miles N. of Salt Works.	Small; used for watering stock.
Wildrose Spring	In Wildrose Cañon, on road to Skidoo.	Excellent water; large flow.
Wildrose Spring No. 1	At antimony mine camp, Wildrose Cañon.	Good water; large flow.
Willow Spring	3 miles E. Thimble Peak; 10 miles N. Keane Wonder.	Good water; 10 bbls. daily.
Willow Springs	4 miles NE. of Darwin in Darwin Cañon, at Lane Pump.	Excellent water; plenty.

On the east side of Death Valley several springs, such as those at Furnace Creek and the Grapevine Springs, arise along faults and furnish a constant water supply. On the west side of Death Valley, water is found at Blackwater Spring, Death Valley Cañon, Hanaupah Cañon, Hungry Bill's Ranch, Arrastra Springs and Anvil Springs.

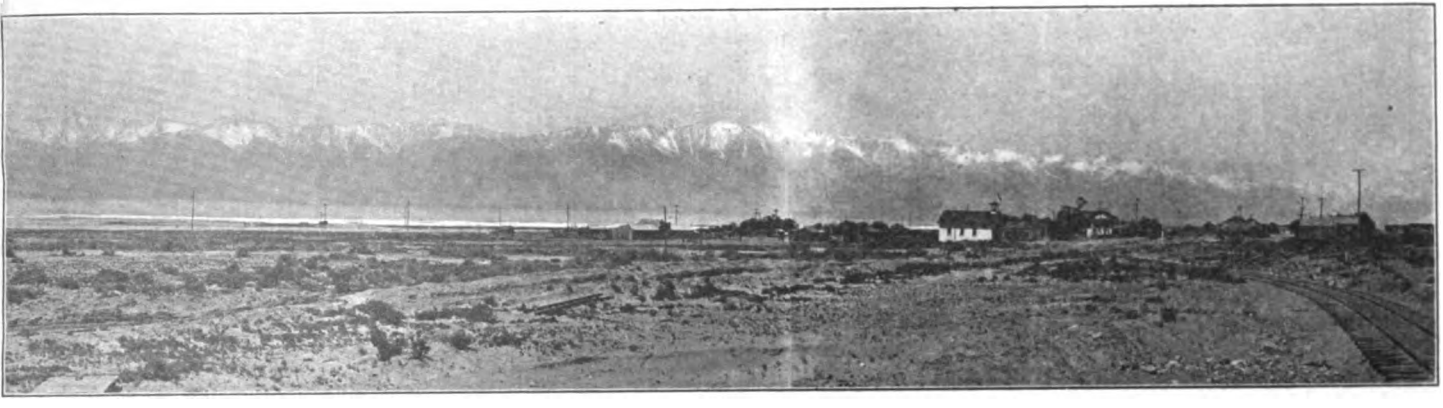


Photo No. 6. Town of Keeler and Owens Lake. Mt. Whitney range in the distance.

Photo No. 7. Mt. Whitney and the Plateau from Lone Pine.

In the Panamint Valley Drainage all the large cañons on both sides contain springs or small living streams. On the east side from north to south these are Mysterious Cañon, Wildrose Cañon, Tuber Cañon, Jail Cañon, Hall Cañon, Surprise Cañon, Pleasant Cañon, Middle Park Cañon and South Park Cañon. On the west side from north to south they are Mill Creek, Darwin Wash, Modoc Cañon, Snow Cañon, Wood Cañon, Knights Cañon, Revenue Cañon, Shepherd Cañon and Water Cañon.

In the Searles Lake Drainage there are a number of small springs on the west side which are used as a water supply for the works at Trona. These are designated by the names of the cañons in which they occur as follows: Bruce Cañon, Parson's Cañon, Argus Cañon and Joe Peterson's Cañon, respectively 10, 8, 6 and 4 miles north of Trona. Most of these springs are connected with the water system and furnish about 15 miners inches.

In the extreme southeast portion of the county there are some wells and springs along the Amargosa River and in the Kingston Mountains.

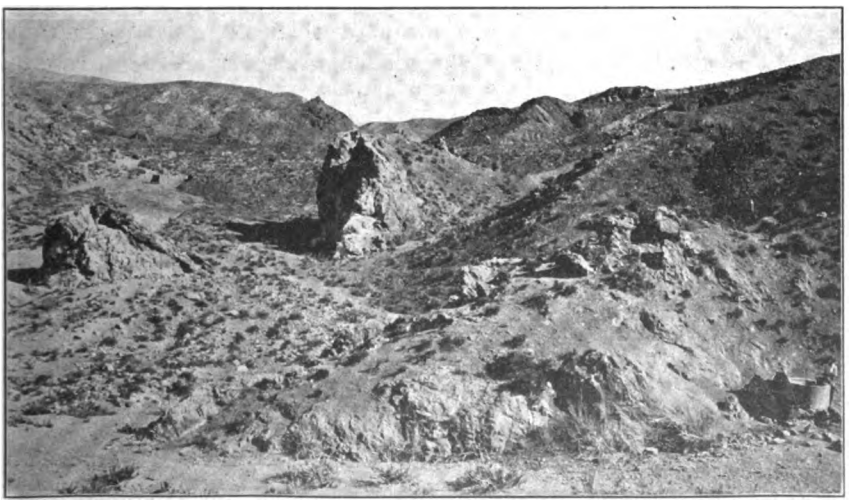


Photo No. 8. Emigrant Spring, in Emigrant Cañon, on road from Mesquite Flat to Harrisburg, Inyo County.

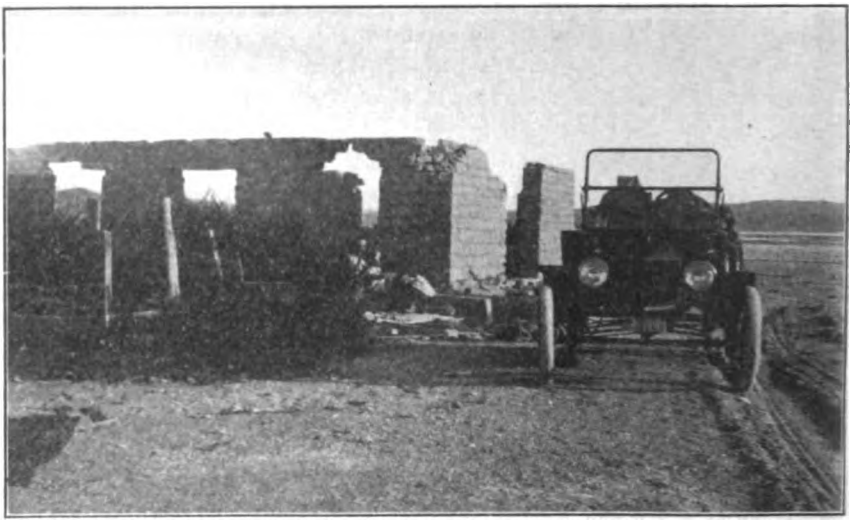


Photo No. 9. A Sunday bath at the old Amargosa Borax Works well, south of Zabriskie, Inyo County.

TOPOGRAPHY AND DRAINAGE.

The main mountain ranges of Inyo County, without exception, run in a northwest-southeast direction, parallel to the Sierra Nevadas. From west to east the series of elevations and depressions is as follows: Sierra Nevada Mountains; Owens Valley; White and Inyo mountains with the Argus Range; Eureka, Saline and Panamint valleys; Panamint Range; Death Valley; Amargosa Range; Amargosa Valley and Nopah Range.

Owens River empties into Owens Lake, which at one time no doubt overflowed southward past Little Lake and through China Lake and

Photo No. 10. View of Silver Lake, San Bernardino County, after the flood by the Mojave River, January, 1916. The water tank to the extreme right marks the old location of the depot and townsite.

Salt Wells Valley into Searles Lake. These latter lakes are at present dry and receive only a slight drainage from their surrounding mountain ranges during occasional desert storms.

The Panamint Valley is the settling basin for any waters falling on the west slope of the Panamint Range and the eastern slopes of the Argus and Slate ranges.

Death Valley receives all drainage from the Amargosa River and may, at times, have received waters from the Mojave River. During the winter of 1915–1916 waters from Mojave River flooded the town and railroad at Silver Lake, and a rise of a few feet in the water level would have carried water into Silurian Lake and into Death Valley.

The mountain ranges as a rule are steep and rugged, due to the desert erosion of the hard metamorphic strata and volcanic rocks, and to faulting. The bases of the mountain ranges are well defined, and long gentle slopes of wash gravels and sands extend, often for miles, to the rims of the flat alluvial settling basins.

CULTURE.

MODE OF TRAVEL AND ROUTE.

The expedition which sought information for this report, started from San Francisco on March 8, 1916, and entered the county at Tecopa, by way of Fresno, Bakersfield, Mojave, Atolia, Pilot Peak and Riggs. Death Valley was crossed from Owl Hole to Saratoga Springs. From Saratoga Springs, Tecopa is accessible by machine by way of the Ibex mine and Zabriskie. A blind road following around the eastern side of the hills north of Saratoga Springs escapes the dune sand encountered on the west side road to the Ibex. The sand and gravel of the Amargosa Valley east of Saratoga Springs is very deep, and the road from Riggs to Tecopa along the Tonopah and Tidewater railroad is impassable by machine.

From Tecopa the lead-silver mines in the Nopah Range were visited. From Zabriskie side trips were made to the Ibex, Carbonate and Golden Treasure mines, and then to the old Greenwater camp and the borax works at Death Valley Junction, with quarries at Ryan. Death Valley was again entered by way of Furnace Creek, and the road along the east side of the valley was followed to the Keane Wonder mine. A good road from Keane Wonder to Beatty, Nevada, was found and followed northward to Bonnie Claire, from which place a tractor road was followed into the Ubehebe district. On the return to Beatty, a trip was made to Chloride Cliff and then a crossing of Death Valley made up the Salt Creek road, along the south end of Mesquite Flat and southward up Emigrant Wash, to the old Harrisburg camp. After visiting Skidoo, the region about Ballarat and the Slate Range, north of Trona, was covered and a return made to Wildrose Cañon and across the north

end of Panamint Valley to Darwin. From Darwin, trips were made into the Coso region and on to Keeler and Cerro Gordo. Owens Valley was worked from Lone Pine to Bishop, and side trips were made into the Inyo and Deep Springs mountains, and Round Valley. The return to San Francisco was made by way of Little Lake, Mojave, Los Angeles, Tejon Pass, Bakersfield and Fresno. About 2700 miles were traveled during the ten weeks spent in the field.

HINTS FOR TRAVELERS IN MACHINES.

Since so much prospecting is now being done in automobiles, it is deemed fitting to include a few suggestions which may be of help in desert regions.

The best months for traveling in eastern Inyo County are from March to June, inclusive. During the summer months the heat is intense, water scarce and the sands dry and loose. The winter months are very cold and storms sudden and severe, but the sands are often moist, or wet, and hard. When traveling, even in a light machine, one should have a helper, and carry extra water, gasoline, oil, casings and inner tubes. For the tool kit, a small shovel and a set of differential pulleys, such as the "Pull-U-Out," is often a "life-saver" when attached to a "dead-man" or plank 2″x 6″x 5′ long, buried in a trench 2 feet deep. For deep sand or gravel, soft or deflated tires often enable the machine to pull through, or twigs of brush laid across the sand to corduroy the road are often essential. When the machine is stuck in the sand, it may be cranked out, if the spark plugs are removed to relieve the cylinder compression, and the low gear used.

Water, Gas and Oil. While covering this territory, the writers found that a 5-gallon can each of gasoline and water, a 5-gallon and a

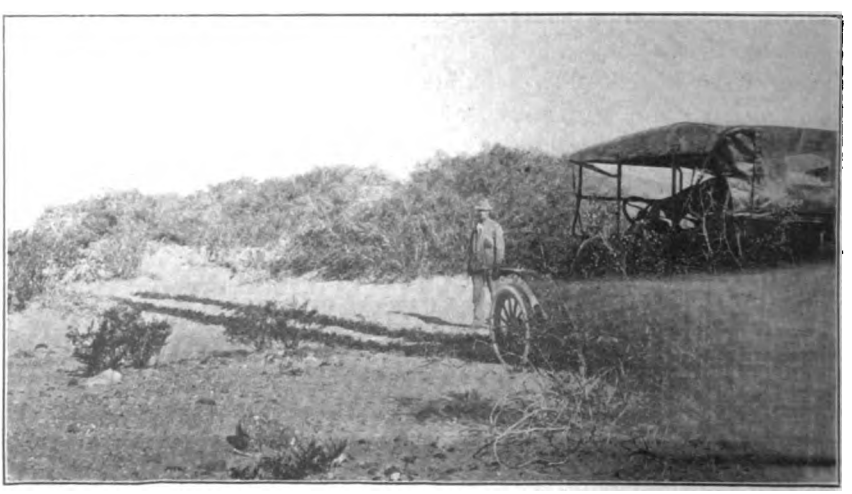


Photo No. 11. A corduroyed road. Mesquite Flat, Death Valley.

Photo No. 12. Using a "Pull-U-Out" attached to a "deadman," Amargosa Flat, near Saratoga Springs, Death Valley.

2-gallon desert water bag, and 6 quarts of lubricating oil were not too much for the necessarily long runs between supply stations in the Death Valley region, especially since several side trips had to be made.

Water. Good water should be obtained at Mojave, Granite Wells at Pilot Knob, Furnace Creek Ranch, Keane Spring, Daylight Spring (on the road from Keane Wonder to Rhyolite), Harrisburg (from the Skidoo pipeline), Skidoo, Wildrose, The Tanks (north of Searles Lake), Darwin and in Owens Valley. The water at Owl Hole Spring is very alkaline and that at Saratoga Springs, Tecopa, Zabriskie, Death Valley Junction and Stovepipe well only less so.

Gas and Oil. Gasoline and oil are very high-priced in the eastern part of the county but may be purchased at Mojave, Atolia, Tecopa, Zabriskie, Death Valley Junction, Beatty (Nevada), Trona (San Bernardino County), Darwin, Keeler and any of the towns in the Owens Valley. In some cases it may be necessary to use distillate, which can often be purchased from those operating motor trucks or tractors at Riggs, Zabriskie and Bonnie Claire.

Outfit. It is always well to carry provisions enough for a few days longer than it is expected the trip will take. A folding canvas bucket, fry pan, long-handled 2-quart stew kettle, can opener and paper towels are all the cooking utensils needed. The eating utensils should include plates, saucers, cups, knives, forks, table and teaspoons. A convenient table can be made of cushions or suitcases set on boxes or boulders. Warm sleeping bags made of a double thickness of all wool comforters and sheet, inclosed in canvas, or their equivalent, should be

provided. Linen mesh or other good absorbent underwear, with both thin and wool shirts and both khaki and wool suits, and an overcoat, should be provided for the extremes of temperature from day to night and extremes of elevation from 250 feet below sea level, in Death Valley, to 9000 feet above at Cerro Gordo. A panama hat or other similar shape, with shading and light weight qualities, furnishes good protection. Ordinary heavy top shoes are sufficient, unless considerable walking on side trips is to be done, when hob-nailed top boots should be used. A large sheet of khaki canvas 9′ x 16′ is very useful for machine cover or to spread on the sand under beds.

Provisions. Along the principal routes of travel at railway and stage stops and at the larger mines, eating and lodging can usually be obtained. In desert travel, away from these scattered points, a supply of provisions should be taken sufficient for the entire journey. Where a machine is used, canned goods are not burdensome and are quickly prepared, and provide an excellent variety. A varietal selection from the following list will be found satisfactory, allowing for a hearty meal at night and a lunch at noon:

Meats, etc.	Cereals	Vegetables	Fruits	Miscellaneous
Bacon.	Grapenuts.	Potatoes for baking in fire.	Apples.	Wrapped bread.
Eggs.	Corn flakes.	Onions for baking in fire.	Oranges.	Soda crackers.
Canned tuna.	Cream of wheat.	Baked beans.	Lemons.	Sweet cookies.
Canned tongue.	Germea.	Canned asparagus.	Canned pears.	Coffee.
Canned roast beef.	Rolled oats.	Canned spinach.	Canned peaches.	Tea.
Canned corned beef.	Flap jack flour.	Canned string-beans.	Canned apricots.	Sugar
Canned oysters.		Canned tomatoes.	Canned cherries.	Salt.
Canned milk.			Crabapple jelly.	Matches.
			Maple syrup.	
			Grape juice.	

Fuel. The roots of dead sagebrush, often partially buried in sand, usually furnish sufficient fuel for camp fires, but a small "sterno," or "Canned Heat" outfit, is very compact and convenient for a quick lunch. Vacuum bottles are also great time savers for hot lunches.

Roads and Routes. The map accompanying this report shows the main roads and thoroughfares. As a rule, the roads in the west side of the county are fairly well kept up, while practically no work at all is done on roads in the eastern part of the county. Where mines are working, the necessary road work to get to and from the mines is done by the owners or operators of those mines. In most cases only a small amount of work is necessary to make the desert roads passable, but a freshet may undo the results of the labor in a very few hours. In a county so large, it could hardly be expected to keep all the roads up, but there seems no legitimate reason for not keeping at least four good thoroughfares open across the county, especially since it would be the best means

of fostering the mining industry, which is the sole industrial hope of all the region east of Owens Valley. Furthermore, such thoroughfares should be provided with water stations, which could be done by cleaning out or developing existing springs along the routes.

At present two routes are open:

1. The Midland Trail, or Deep Spring Valley Toll Road, starts from Big Pine and Alvord and passes through Payson Cañon, Deep Spring Valley, Oasis, Palmetto and Lida, to Goldfield.

2. Another leaves the main Owens Valley Midland Trail at Lone Pine and passes through Swansea, Keeler and Darwin, and thence northeastward over a 20% grade in the Argus Range and down into Panamint Valley, thence up Wildrose Cañon to Harrisburg, and down the long, deep gravelly Emigrant Wash and across the sandy Mesquite Flat and Salt Creek into Death Valley, thence up Keane Wonder Wash, where a good road is found leading from the Keane Wonder Mine to Rhyolite, Nevada.

Both these routes could be kept easily passable with a reasonable amount of work and the lowering of a few grades.

Two other routes could be opened up with a few connecting roads:

1. The Big Pine and Saline Valley road leaves Big Pine and Alvord and passes up Waucoba Cañon and down Marble Cañon to Saline Valley. This road is hardly passable between Marble Cañon and Saline Valley, and has *no* connection with the Ubehebe road past Ubehebe Peak, Tin Mountain and Staininger's Ranch to Bonnie Claire, Nevada. Were the two roads connected and kept in repair, many of the mines might be opened up and made producers by interested capital. The Waucoba Cañon–Eureka Valley road is open only as far as the Loretto Mine. This road, with a small amount of work, could be made passable to Palmetto, by way of Willow Creek.

2. The Darwin–Ballarat road, by way of Shepherd Cañon and south from Ballarat through Wingate Pass to Death Valley, where it connects with the road past Bradbury Spring to Zabriskie. The grade through Shepherd Cañon was impassable in the spring of 1916, but this route, with proper attention, should offer additional inducements to the opening up of many mines which are dependent on transportation facilities.

Railroads. As yet Inyo County is only partially served by railroads. The Southern Pacific company has a broad-gauge line from Mojave to Owenyo, where it connects with their narrow-gauge line from Keeler to Tonopah Junction, Nevada. The latter should be broad-gauged to reduce freight rates. This line serves the Owens Valley, and with a branch from Searles to Trona, serves fairly the Panamint Valley. With a spur from a few miles northeast of Spangler, San Bernardino County, around the south end of Slate Range into Panamint Valley, a very rich district would be quickly opened up.

The Tonopah and Tidewater railroad, which follows the Amargosa River through the extreme eastern part of the county, serves with spur tracks the Tecopa lead-silver mines and the Furnace Creek borax mines. A proposed spur track from Valjean, to tap the nitrate deposits in the region of Saratoga Springs, is a move in the right direction to get a railroad on into Death Valley, to make accessible and economically valuable the many gold, silver, lead, manganese, gypsum and borax deposits lying idle in the immediate vicinity.

VEGETATION.

In the well-watered Sierran foothills, on the west side of Owens Valley, willows and locust trees thrive, and fruit trees, such as stand the extremes of heat and cold, do fairly well. Alfalfa grows rapidly, and stock raising is becoming an industry of considerable proportions. Piñon pine and juniper trees are found above the dry timber line, on the mountains, even in the arid eastern part of the county, and furnish fuel and timber for the mines. The piñon cones bear excellent nuts, which are gathered in the fall by the Indians for winter food.

Desert yuccas, or "Joshua trees," are abundant in the upper alluvial wash slopes, and their trunks are used in many mines for light timbering and logging. Barrel cactus, the prickly pear and several branching cacti are usually associated.

Mesquite grows usually in the well-watered sandy flats and furnishes good shade. Sagebrush usually covers the dry mountain slopes and flats, while creosote brush and desert holly occupy the lower alluvial slopes. In the spring months from March to July, California wild flowers are quite abundant on the slopes and washes. Among those noticed in April and May, in all the mountain ranges east of Owens Valley, were the evening yellow primrose, blue larkspur, yellow dandelion, pink and white geranium, yellow poppy, sage, sunflower, purple asters and heliotrope, cream cup, bluebirds' eyes, baby blue eyes, yellow marianas, white forget-me-nots, fringed white gilia, false mallow, yellow and white daisies and yellow buttercups.

Green spots about the springs are usually marked by cottonwood, willow, oak, wild rose, cane, grasses or berry vines. Forage grasses are usually to be found on the upper alluvial slopes.

ANIMAL LIFE.

Native wild mountain sheep roam the Inyo, Panamint and Amargosa ranges. Coyotes and jack rabbits are found on the plains. A few cottontail rabbits and birds are usually found near the springs. Prairie dogs and lizards are abundant everywhere, with but few rattlesnakes. Chuckawallas are abundant on the rocky slopes. Ants, scorpions and tarantulas are common. Mosquitoes are found near the water holes and in the vicinity of melting snows.

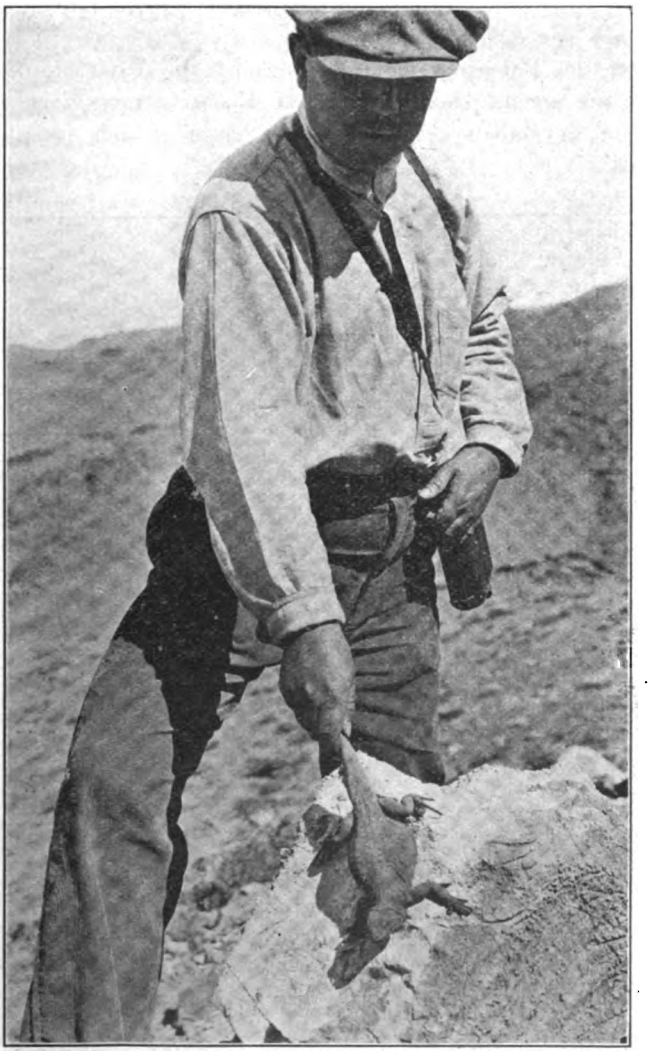


Photo No. 13. Chuckawalla at Chloride Cliff. An inhabitant of rocky places.

GENERAL GEOLOGY AND HISTORY.

DISTRIBUTION OF IGNEOUS AND SEDIMENTARY ROCKS.

The entire western side of the county presents the steep eastern slope of the Sierra Nevada mountains (see photo No. 7), which are made up of granite. This rock also forms the backbone of the Inyo and White mountains and of the Panamint Range.

East of Owens Valley, old Paleozoic metamorphic sediments, consisting of limestones, quartzites and schists make up most of the mountain

ranges. These are badly folded and faulted, due principally to granitic intrusions.

Overlying the Paleozoic metamorphics of the Inyo Mountains, in places, are an unconformable series of Mesozoic metamorphic rocks, consisting of crystalline limestone, and slates which in places are fossiliferous.

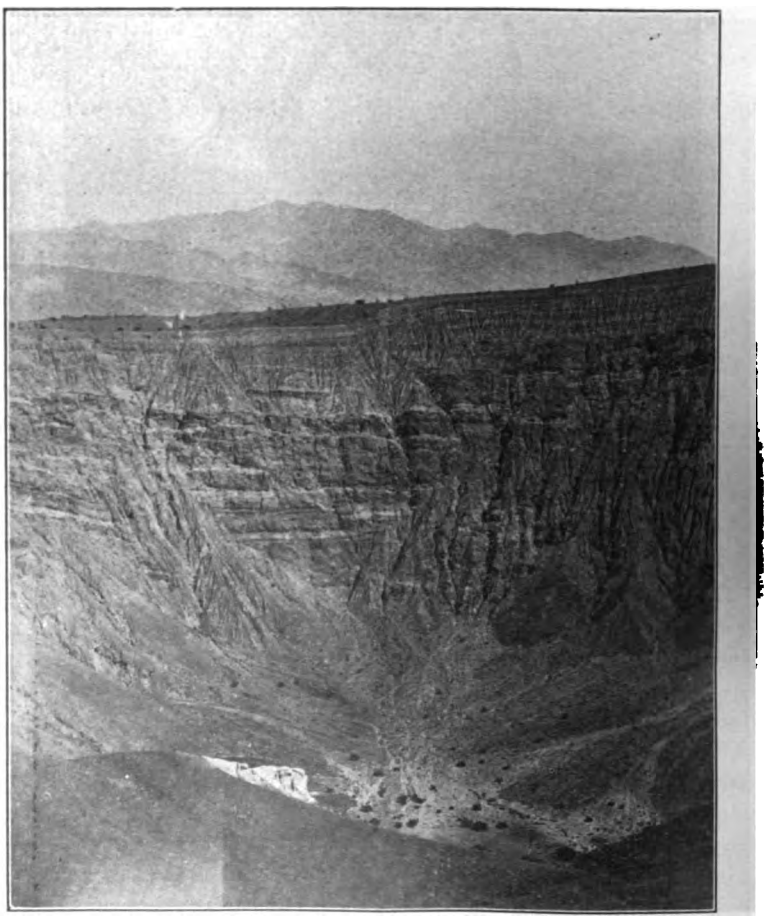


Photo No. 14. Late Tertiary cinder cone north of Tin Mountain, Inyo County, which has broken through Miocene-Pliocene sandstones and covered them with loose volcanic material.

The post-Jurassic (middle Mesozoic) uplift in this region was accompanied by granitic intrusions and the great fault along the east face of the Sierras; also by mountain-making to the eastward, at which time, or following, the Inyo-White, Panamint and Amargosa mountain ranges were formed more or less parallel to the fault line.

Intrusions of porphyry and diorite followed, with outbursts of rhyolite, andesite and basalt. A large area of volcanism was formed in the Coso Mountains, and lava broke out along fractures on both sides of Death Valley and eastward. Molten rock also flowed from the main fault along the Sierras, eastward across Owens Valley south of Big Pine and north of Bishop.

In the meantime early Tertiary sediments were being deposited in the Death Valley region, and Saline deposits were forming from the evaporating sea water.

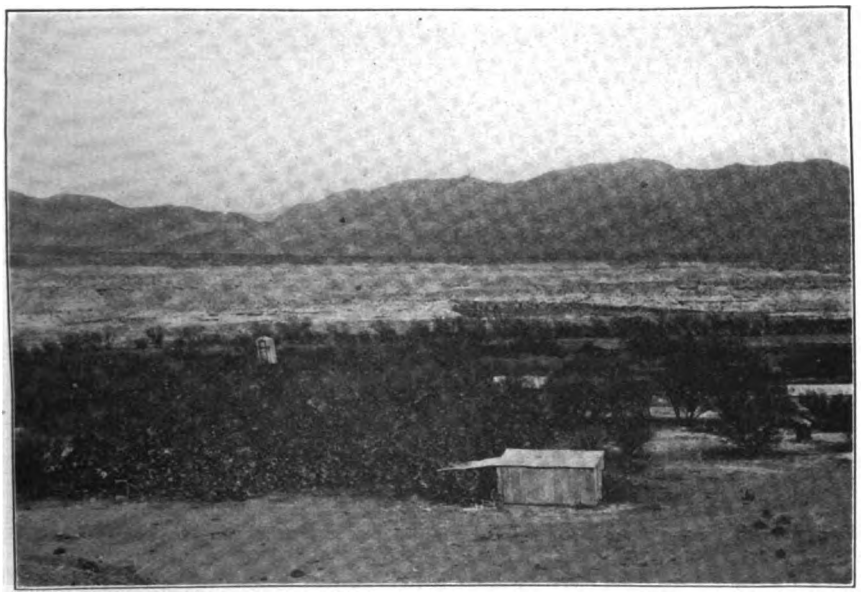


Photo No. 15. View eastward from Shoshone, across Amargosa Valley, showing old Cambrian metamorphics in the background and terraces of Pleistocene gravels and clays, largely volcanic material, in the foreground.

Smaller uplifts and earth movements took place during the readjustment of the cooling mass, and Pleistocene lake deposits were laid down in several of the large inclosed basins, such as in the lower Amargosa and Waucoba cañons.

Slight elevations since have been recorded by terraces, and the lowering of the elevation at which the recent sediments are now being deposited.

FOLDING AND FAULTING.

The Paleozoic and Mesozoic metamorphic strata are everywhere intensely folded and fractured, and displacements of several feet are common. Faults have had a great deal to do with the formation of ore bodies since they have provided fissures for the deposition and migration of mineral bearing solutions; not only that, but they have in places cut

off ore bodies and so displaced them that it makes the mining industry one which has need for scientific investigation and help by the geologist. Since all the mines east of the Owens Valley are dry, the ores have been oxidized to great depth, and no sulphide enrichment has apparently taken place. On the other hand enrichment has taken place rather from an oxidation and leaching process which has slowly broken down the sulphides. The Tertiary strata are as a rule gently folded, except in areas where they have been intruded by later volcanic rocks. The Pleistocene sediments are practically horizontal and occur as terraces along the rims of the older strata.

Photo No. 16. Folded borax beds at Biddy McCarty Mine, south of Ryan, Inyo County, capped by late Tertiary volcanic rock.

EROSION.

The hard granite and metamorphic rocks resist desert erosion to such an extent that they stand out, as a rule, and present very steep, rugged surfaces. Where faulting and fracturing has occurred, it permits of the loosening of large angular rock fragments, which are easily picked up by the torrential storms and carried down into the lowlands. The finest sediments are carried down in suspension, by the water, to fill the low basins, where they are deposited as mud, often over large areas. The "Racetrack," (see Photo No. 18), in the Ubehebe district, is an example of the latter process, which has formed a large level mud-flat about a grandstand of granite. This track was used by the Indians for horse races, and during the Greenwater "boom" was used for automobile races.

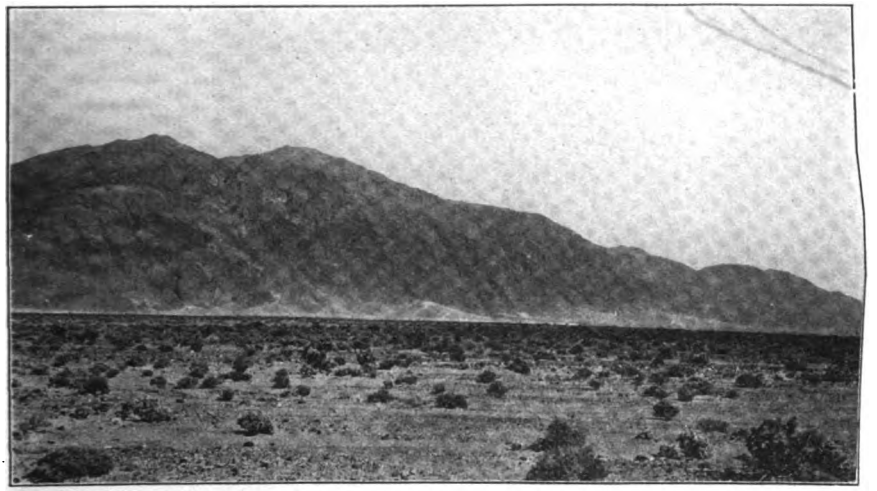


Photo No. 17. View eastward of Mormon Point, Death Valley, showing alluvial cones built up of rock fragments, brought down from the hard Cambrian metamorphic rocks by torrential waters.

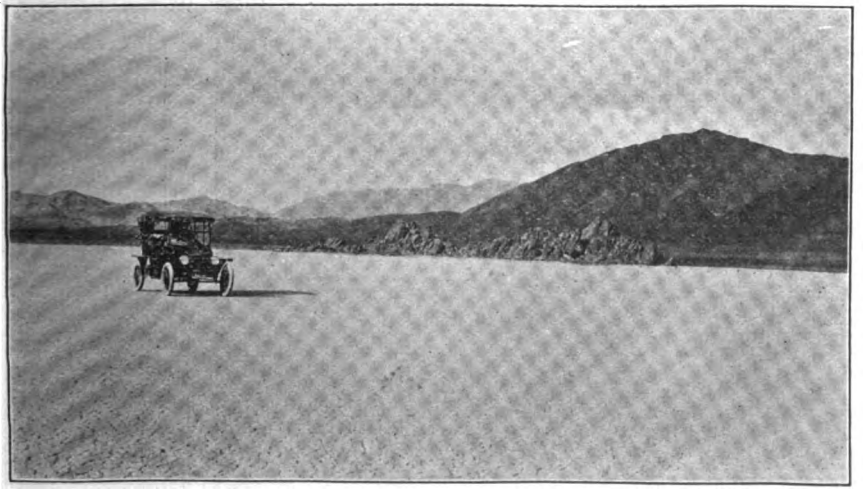


Photo No. 18. "The Racetrack," Ubehebe district, Inyo County. View northeastward towards Tin Mountain, Panamint Range.

In the regions of Miocene-Pliocene and Pleistocene sediments and volcanics, erosion is much more rapid, and the cañons present almost vertical faces of only partly consolidated material.

Windstorms (see photo No. 20) are a common and characteristic occurrence in the desert. They are severe and often last for several days, carrying sands and loose material for thousands of feet into the air and often depositing it miles away. Bushes and brush (see photo No. 23) tend to hold the sand and prevent its shifting, often causing the sand to pile up several feet high, as on Mesquite Flat, Death Valley.

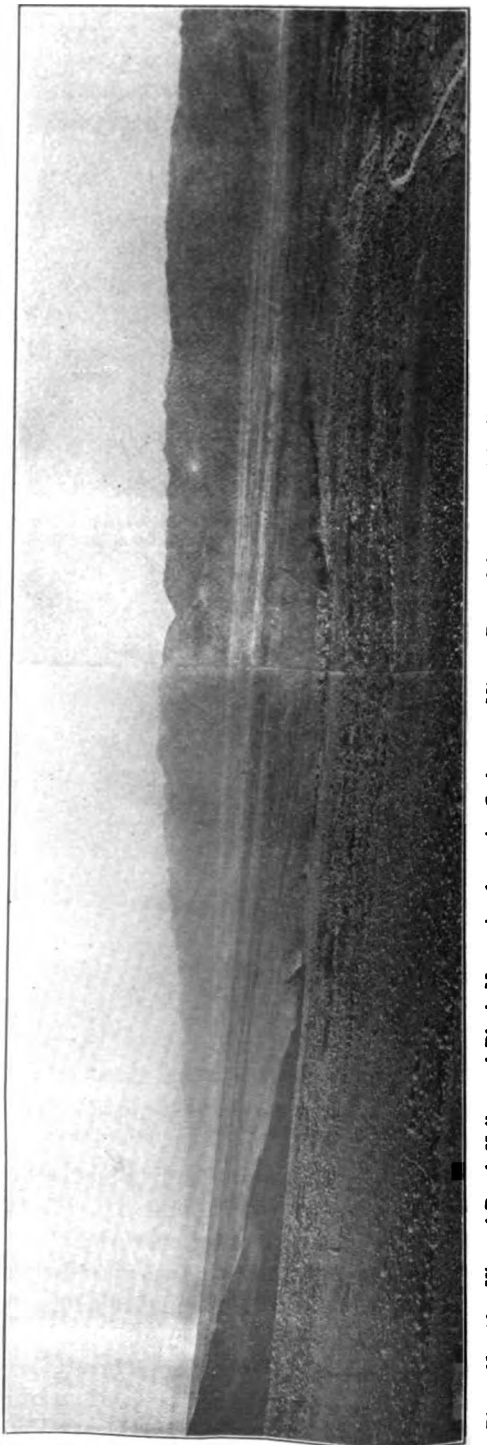


Photo No. 19. View of Death Valley and Black Mountains from the Carbonat e Mine. Part of lowest land in United States. Note the long gentle alluvial slope to the left.

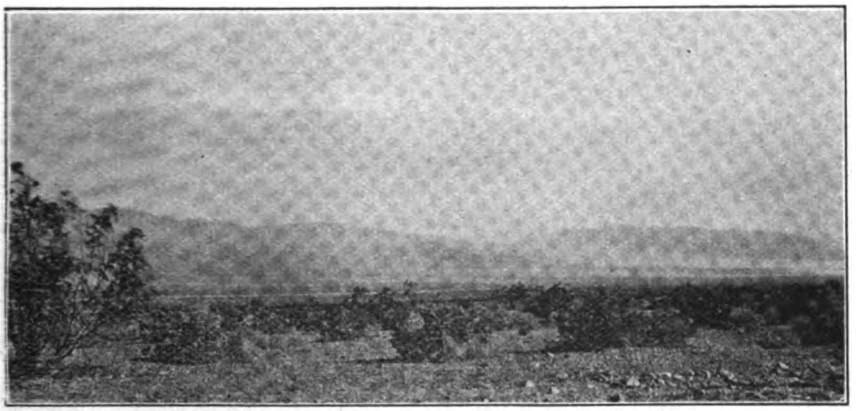


Photo No. 20. Wind storm carrying sands from Searles Lake northeastward into the Slate Range, Inyo County.

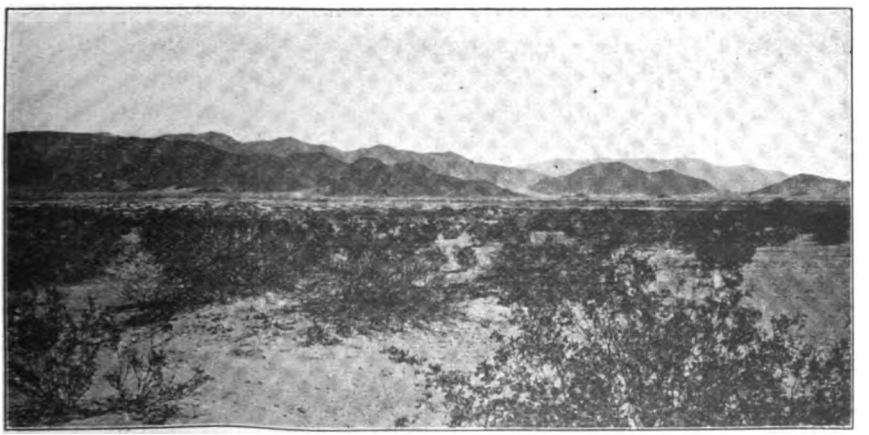


Photo No. 21. View eastward, across Death Valley, towards Saratoga Springs, showing wind-blown sands, which fill the valleys along the west slope of the Black Mountains.

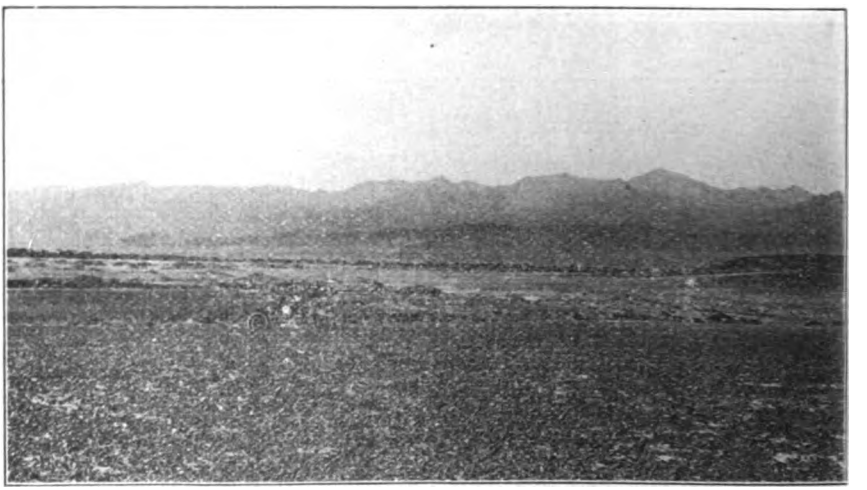


Photo No. 22. View northward of Mesquite Flat. Grapevine Mountains in the distance.

Photo No. 23. Mesquite Flat, Death Valley, showing character of wind-blown sands and the influence of mesquite bushes in preventing their drifting.

GEOLOGICAL FORMATIONS MAPPED.

CAMBRIAN SYSTEM.

The oldest rocks known to be exposed in the county are the Cambrian metamorphics, which have been altered and fractured by the underlying granite. They are found in all the main mountain ranges east of Owens Valley.

The basal member consists of highly folded and contorted limestone and slate which are overlain conformably by a considerable thickness of bluish dolomite marble. This marble was found to contain unidentifiable circular fossil remains, where exposed in the Estelle tunnel and at the Santa Rosa mine in the Inyo Range. Massive limestone overlies the marble and in places is perhaps over 2000 feet thick. A fine-grained dark quartzite overlies the limestone and is interstratified with slate and argillaceous material. These are overlain by from 2000 to 3000 feet of coral limestone and shale. Sandstones and slates complete the series. Arenaceous limestones of these upper beds carry *trilobites* in places.

The following fossil localities are reported[2] by Mr. R. B. Rowe of the U. S. Geol. Survey to have yielded Cambrian fossils:

1. Three and one-half miles east of Twelve Mile Springs. Trilobites of Trenton or Lower Cambrian.

2. Seven miles east of Resting Springs, 1500′ from the top of a 4000′ section of Lower Cambrian. The trilobite *Hyolithes* and a brachiopod were found.

3. In the pass east of Resting Springs. Cambrian fossils 800′ beneath dark blue limestone.

4. On the road from Pahrump Ranch to Furnace Creek along the north edge of Kingston Range. Lower Cambrian fossils from gray shaly sandstone.

SILURIAN.

Silurian metamorphic limestones and quartzites overlie the Cambrian in portions of the Inyo, Panamint and Grapevine mountains. In the Grapevine Mountains they have been mapped by Ball[3] as the Ordovician, or Lower Silurian, and the Upper Silurian. The Lower Silurian consists of 2700′ ± of banded Pogonip limestone overlain by a considerable thickness of Eureka quartzite. An unconformity separates these from the Upper Silurian, Lone Mountain gray limestone, which is about 400′ thick in the Amargosa Range.

In Mazourka cañon, on the west flank of the Inyo Range, the Ordovician is well exposed. The lower beds consist of 3600′ ± of heavy bedded limestone, while above are 800′ of quartzitic shale, and limestone

[2]U. S. Geol. Surv., Bull. 208, pp. 196-198, 1903.
[3]U. S. Geol. Surv., Bull. 308.

which is, in places, fossiliferous. On the east flank of the Inyo Mountains these strata are intensely folded, faulted and brecciated.

DEVONIAN.

The Devonian metamorphics lie unconformably on the Silurian, and their basal member is a conglomerate. On the west flank of the Inyo Mountains, between Citrus and Aberdeen, the formation consists of about 1400′ ± of impure limestone, which is cherty in part and in places carries fossils. Considerable Devonian may be included in the area east of Pyramid Peak, northwest of Death Valley Junction, mapped as Silurian.

CARBONIFEROUS.

The Carboniferous is exposed along the southwestern part of the Inyo Mountains, where sections have shown it to be 3000′ thick. It rests with angular accordance with the underlying Devonian, but a basal conglomerate suggests a slight unconformity. The strata consist of a succession of heavy bedded limestone and about 2000′ of interbedded limestones and slates, which weather in brilliant tints and in places carry *Fusulina*. A massive conglomerate made up of chert fragments usually caps the formation. Considerable Carboniferous may be included in the area east of Pyramid Peak, northwest of Death Valley Junction, mapped as Silurian.

TRIASSIC.

Lower or Middle Triassic metamorphics are exposed along the southwest flank of the Inyo Mountains from the Reward Mine southward to Swansea. They consist of about 5000 feet of thin bedded limestone and calcareous slates, together with some hard, massive, black shales. The strata weather to brilliant tints, buff and terra cotta prevailing. They lie in apparent conformity with the Carboniferous, save where brought into contact by faulting.

The following localities are reported[4] by Dr. Jas. P. Smith to have yielded Triassic fossils:

1. Lower Triassic in the Inyo Range on the east side of Owens Valley, 1½ miles east of the Union Spring near the McAboy trail over the Union Wash leading into Saline Valley. The locality is 3 miles east of Skinner's Ranch and 15 miles SE. of Independence. Fossils occur in gray limestone not over 12 feet thick that outcrops on the south side of the cañon near the trail.

2. Middle Triassic in the same region as locality 1 is one mile east of Union Spring on the south side of McAboy trail leading over Union Wash to Saline Valley. Fossils occur in a bed of dark limestone not over 4′ thick and 800′ stratigraphically above the stratum of fossil

[4]U. S. Geol. Survey, Prof. Paper No. 40, p. 20, 1905.

bearing Lower Triassic. The calcareous shales in which the fossil bearing limestone occurs are apparently conformable with the Lower Triassic beds.

MIOCENE-PLIOCENE.

Lake beds, bordering the Black and Funeral mountains, carrying colemanite in places, are thought to be of Miocene–Pliocene age. They consist of over 1,000 feet of white, yellow and green consolidated clays, friable sandstones, with ironstone concretions, rounded and subangular gravels and thin limestone lenses.

The nitrate bearing beds south of Tecopa, in the Owl Mountains, and along the east side of the narrows of Death Valley, near the old Confidence Mine, are thought to be of Pliocene age. They consist of 800′ ± of soft clays of a creamy, yellow color.

QUATERNARY.

The gently tilted conglomeratic beds in the region of Shoshone, in the Amargosa River valley; on the west side of the Coso Range and south of Owens Lake; and in the Waucoba Cañon, east of Big Pine, are believed to be Pleistocene lake beds. They consist of up to 150 feet of sands, conglomerate and agglomerate, or volcanic materials.

Recent gravels and sands make up the washes, while the finer sediment settles in the basins and many undrained valleys. Recent sedimentation in places is over 1000 feet deep.

IGNEOUS ROCKS.

Granitic rocks form the cores of most of the mountain ranges, where they were intruded during the post-Jurassic, or Sierran, uplift. These intrusions were followed by magmatic segregations and intrusions of porphyritic and quartzitic rocks.

During Tertiary sedimentation volcanic rocks were exuded and cover large areas in the Black Mountains, Coso Range and the tableland north of Bishop.

ECONOMIC GEOLOGY.

During the year 1915, the following minerals were being produced in Inyo County: antimony, borax, copper, dolomite, gold, gypsum, lead, marble, pumice, silver, zinc, salt, soda, talc, and tungsten. Deposits of iron, molybdenum, niter, potash, quicksilver, and silica also occur but have not as yet been developed.

The following table shows the mineral production from the year 1880 to 1915, inclusive, and the development of the mining industry.

HISTORY OF MINING DEVELOPMENT.

Mining began in 1861 with the establishment of the Russ mining district east of Independence. There was considerable activity from 1869–1877, when the Cerro Gordo and Darwin districts yielded base bullion. The Southern Pacific narrow-gauge railroad to Keeler, from

Nevada, stimulated the industry somewhat, but the low price of silver did not encourage the industry. In 1907 a revival of interest took place when the footwalls of the old Cerro Gordo mine were found to carry large amounts of zinc. The industry has increased steadily since, and the call for minerals during the European war has stimulated prospecting and the opening up of many old mines. Never was the industry in a more prosperous condition than at present.

ECONOMIC CONDITIONS.

TRANSPORTATION.

Mines located in the region of Owens and Amargosa valleys are easily accessible from the Southern Pacific and Tonopah and Tidewater railroads. Roads and trails make the interior of the county accessible, but hauling is difficult because of steep grades and deep sands.

POWER.

Electric power, generated in the Sierras west of Bishop, is available in the northern and western parts of the county. The eastern, southeastern and central portions of the county are dependent on internal combustion engines, and these are often prohibitive because of high freight rates.

Two companies at present have hydroelectric plants on Bishop Creek. The Nevada-California Power Co., owning three plants, confines its

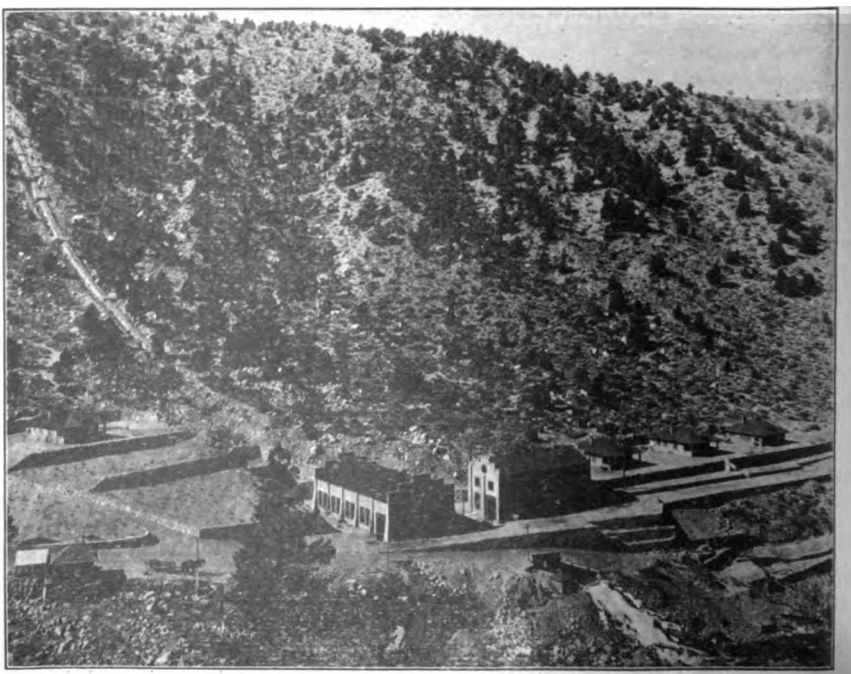


Photo No. 24. View of Power Station No. 2 and pipe line of the Nevada-California Power Co., on Bishop Creek, Inyo County. Generates 6000 k.w. Courtesy of Mr. P. R. Ferguson.

Soapstone and Talc		Marble		Miscellaneous and unapportioned	
Tons	Value	Cubic feet	Value	Kind	Value
		12,500	$62,500		
		10,000	50,000		
		3,000	24,000		
		4,000	12,000		
				20 tons antimony	$700
		20,000	20,000	300 tons salt	2,400
		3,000	3,000	400 tons salt	800
		17,000	17,000		
		1,200	4,800		
		1,000	4,000		
				Unapportioned, 1900-1909	1,417,217
				45,000 tons rubble	31,500
				46,450 tons rubble	32,555
				Gems	174
1,050	$5,250			Rubble	648
1,000	4,400	3,200	11,500	Rubble	835
				13,500 tons salt	54,000
390	2,060	3,500	10,500	13,500 tons salt	54,000
1,513	14,000			Other minerals†	80,430
3,953	$25,710	78,400	$219,300		$1,695,259

operations exclusively to the state of Nevada. Plant No. 2 generates 6000 k.w.; No. 3, 6750 k.w.; and No. 4, 6000 k.w.

The Southern Sierras Power Co., has two hydroelectric plants on Bishop Creek and leases No. 3 of the Nevada-California Power Co. Plant No. 5 generates 1500 k.w., and No 6, 2000 k.w. Their lines extend from the plants on Bishop Creek down the Owens Valley, with branch to Keeler; to Big Pine; to Palmetto, Nevada, with branch to the Loretto Mine; and northward to Lundy, Mono County.

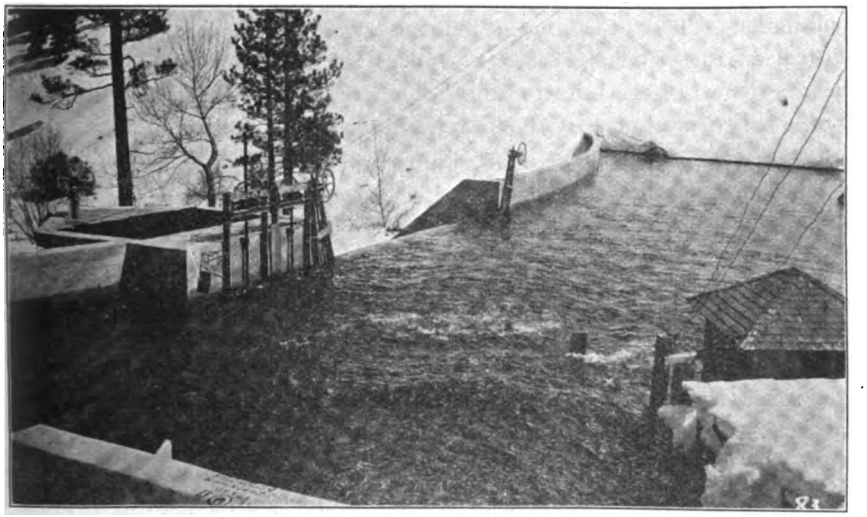


Photo No. 25. Dam for Station No. 3 of the Nevada-California Power Co., on Bishop Creek, Inyo County. Leased by the Southern Sierras Power Co. Courtesy of Mr. P. R. Ferguson.

Photo No. 26. General view of Station No. 5 of the Southern Sierras Power Co., on Bishop

GENERAL CHARACTER OF THE ORE DEPOSITS.

The deposition of minerals took place principally during the post-Jurassic and pre-Tertiary period and again during the Tertiary period.

POST-JURASSIC AND PRE-TERTIARY DEPOSITS.

Deposits in, or in Contact with, Granite.

1. *Pegmatite dikes*, carrying small amounts of gold, copper, hübnerite or scheelite, associated with garnet, epidote, magnetite, muscovite or hornblende. These are found at Tungsten, 8 miles west of Bishop; near Goldbelt spring, Ubehebe district; and at the tungsten properties, two miles southwest of the Loretto mine. They often occur along contacts of granite with limestone. Values are usually in tungsten.

2. *Quartz veins*, filling fissures, joints and brecciated zones, carrying predominantly pyrite and chalcopyrite with gold and copper, or galena and sphalerite with silver. Molybdenite is also found occasionally. Impregnations of the minerals sometimes occur in the wall rock. Values are usually in gold, silver and copper; *e. g.*, the Loretto Copper Mine.

Deposits in Limestone and Other Paleozoic, or Mesozoic, Sediments.

1. *Quartz veins*, filling faults, fissures, joints, bedding planes or brecciated zones, usually in the neighborhood of granitic intrusions. Original sulphides, pyrite, chalcopyrite, or galena. Values usually in gold and silver; *e. g.*, Chloride Cliff and Golden Treasure mines.

2. *Irregular masses* and veins, occupying faults, joints, bedding planes and brecciated zones. Original sulphides, galena and sphalerite. Calcite or fluorite commonly associated. Carbonates of lead, zinc and copper, zinc silicate, copper and lead sulphates, lead molybdate, or native silver often present. Oxidized zone deep. Value usually in lead, silver, zinc. Antimony ores occur similarly; *e. g.*, Cerro Gordo and Wildrose mines.

3. *Replacement deposits*, or deposits formed by metasomatism, where acid mineral bearing solutions have migrated upwards, acted upon the limestone and deposited their mineral. This process is no doubt going on continuously and accounts for the enlargement and enrichment of the ore bodies in the upper levels in many of the mines, *e. g.*, silver-lead mines, throughout the eastern part of the county.

4. *Contact veins* between limestone, or other metamorphosed sediments, and porphyry dikes. Mineralization probably accompanied the intrusion of the dikes. Values in gold, silver, copper, lead or zinc; *e. g.*, Keane Wonder Mine.

TERTIARY DEPOSITS.

1. *Quartz veins* in volcanic rock, carrying gold, silver and copper. *e. g.*, Coso Mountains and Greenwater.

2. *Gold and copper* ores along contacts of Tertiary lavas with Paleozoic limestone.

3. *Sedimentary deposits* interbedded with clays and sandstones, secondarily fill fractures in sedimentary deposits, *e. g.*, Colemanite, nitrate and gypsum deposits.

QUATERNARY DEPOSITS.

1. *Soda and salt deposits* formed by Pleistocene and recent evaporations of inclosed lakes.

MINING DISTRICTS, METALS AND SHIPPING POINTS.

Table of mining districts in Inyo County, with location of same with reference to nearest shipping point and the predominating metals in each:

District*	Metals	Location and nearest shipping point
Beveridge	Gold	Summit of Inyo Mts., 10 miles NE. Mt. Whitney Station; S. P. R. R.
Big Pine	Lead, silver, gold	Western flank of Inyo Mts., E. and SE. of Zurick Station; S. P. R. R.
Bishop Creek	Gold, tungsten	Eastern foothills of Sierras, 10 miles SW. of Laws Station; S. P. R. R.
Cerro Gordo	Lead, silver, zinc, copper, gold.	Western slope of Inyo Mts., 5 miles east of Keeler; S. P. R. R.
Chloride Cliff	Gold, lead, copper, quicksilver.	Summit of Funeral Mts., 18 miles SW. of Rhyolite, Nevada.
Darwin	Lead, silver, copper, gold.	Western slope of Darwin Hills, 24 miles SE. of Keeler.
Daylight	Gold, silver, copper, lead.	Eastern slope Funeral Mts., 15 miles SW. of Rhyolite, Nevada.
Deep Springs	Copper, gold, lead, silver.	Deep Springs Valley, 20 miles E. of Laws; S. P. R. R.
Echo Cañon (Schwab)	Gold	Funeral Mts., 10 miles NW. of Death Valley Junction; T. and T. R. R.
Emigrant	Gold	Panamint Range, 60 miles N. of Trona; S. P. R. R.
Furnace Creek (Greenwater)	Copper	Amargosa Range, 60 miles N. of Trona; S. P. R. R.
Goldbelt	Copper, gold, tungsten.	Western flank of Panamint Mts., 30 miles E. of Keeler; S. P. R. R.
Grapevine Cañon	Gold, silver	Western slope of Grapevine Mts., 24 miles SW. of Bonnie Claire, Nev.
Harrisburg	Gold	Panamint Range, 55 miles N. of Trona; S. P. R. R.
Independence (Waucoba)	Lead, silver, gold	Inyo Mts., 10 miles NE. of Kearsarge; S. P. R. R.
Kearsarge	Gold, silver	Eastern flank of Sierras, 14 miles W. of Kearsarge Station; S. P. R. R.
Kelley	Gold, silver	Western slope Argus Mts., 20 miles NE. of Brown Station; S. P. R. R.
Lee	Lead, silver, zinc, copper, gold.	Eastern spur of Inyo Mts., 30 miles SE. of Keeler; S. P. R. R.
Lee's Camp	Gold, silver	Eastern slope of Funeral Mts., 6 miles W. of Leeland; T. and T. R. R.
Lone Pine	Gold	Alabama Hills, 4 miles W. of Mt. Whitney Station; S. P. R. R.
Lookout (Modoc)	Lead, silver, zinc	Eastern slope of Argus Mts., 30 miles N. of Trona; S. P. R. R.
New Coso	Lead, silver, copper, gold.	Eastern slope Coso Mts., 30 miles SSE of Keeler; S. P. R. R.

*U. S. Geol. Surv. Bull. 507, pp. 115–120.

District*	Metals	Location and nearest shipping point
Panamint (Ballarat)	Lead, silver, copper	Eastern slope of Panamint Range, 25 miles N. of Trona; S. P. R. R.
Poison Spring	Gold	Death Valley, 16 miles W. of Leeland; T. and T. R. R.
Russ	Lead, silver, gold	Western flank of Inyo Mts., 15 miles NE. of Mt. Whitney Station; S. P. R. R.
Saratoga (Tecopa Mt.)	Lead, silver, zinc, copper, gold.	Tecopa Mt., 7 miles E. of Tecopa; T. and T. R. R.
Sherwin	Gold	Eastern flank of Sierras, 25 miles W. of Laws; S. P. R. R.
Skidoo	Gold	Panamint Mts., 60 miles N. Trona; S. P. R. R.
Swansea (Keeler)	Lead, silver, gold	East side of Owens Valley at Keeler; S.P.R.R.
Tibbets	Gold, silver	Inyo Mts., 13 miles N. Kearsarge; S. P. R. R.
Timemaha (Fish Spring)	Gold	Fish Spring Hills, 10 miles S. of Zurich; S. P. R. R.
Tucki Mountain	Gold	Tucki Mt., 66 miles N. of Trona; S. P. R. R.
Ubehebe	Lead, silver, copper, gold, tungsten.	Ubehebe Peak and vicinity, 52 miles SW. of Bonnie Claire, Nev.
Union	Lead, silver	Eastern flank White Range, 12 miles SSE. of Laws, S. P. R. R.
Wildrose	Antimony	Eastern flank of Panamint Mts., 40 miles N. of Trona.
Willow	Gold, silver	Amargosa Range, 15 miles NW. of Zabriskie; T. and T. R. R.

*U. S. Geol. Surv. Bull. 507, pp. 115–120.

ANTIMONY.

Wildrose Mine. Wildrose district. Lies on the western flank of the Panamint Mountains, south of Wildrose Cañon and 45 miles by road north of Trona. Elevation 5000 feet. Irregular veins of stibnite, varying in width from a few inches to over a foot, are deposited in schist. The general trend of the stringers is E. and W., and their outcrops can be traced for several thousand feet along the ridge. Large boulders of the stibnite, which on the periphery have been oxidized to a yellowish oxide of antimony, are found near the surface. Mined by open cuts and narrow drift tunnels. It is impossible to estimate the amount of workings, as many of the tunnels are filled with waste or are caved. Mined intermittently since the early nineties. Taken over by present company January, 1915. Present work consists of hand drilling and picking in open cuts, and sorting ore from old dumps. All work done by contract with Mexican labor; 30 men employed. The ore, averaging 35% or over in antimony, is hauled to the railroad at Trona by five 2½-ton Moreland auto trucks. Round trip made in 2 days. The ore is shipped to the company's smelter at San Pedro, Cal. Owned by the Western Metals Co., Security Building, Los Angeles, Cal. M. Elsasser, manager; E. T. Hager, mine superintendent, Trona, Cal.

Bibl.: Rept. XII, p. 21.

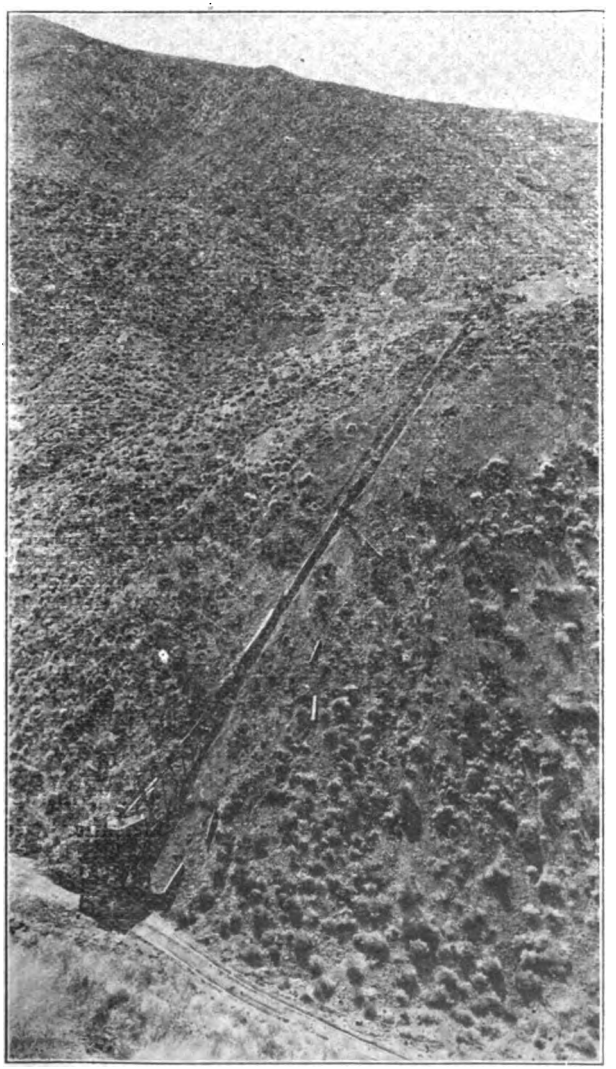


Photo No. 27. Burro train, ore chute and ore bin at Wildrose Cañon Antimony Mine.

Photo No. 28. Camp at Wildrose Cañon, showing trucks used for hauling antimony ore to Trona.

Williams and Johnson Prospect. Located on the eastern slope of the Argus Mountains, between Revenue and Shepherd cañons, 18 miles by road north of Trona. The deposits of stibnite are said to outcrop at intervals over a distance of 1500 feet. An analysis of samples taken from croppings averaged 37% antimony. Located April, 1916, by Ralph Williams and George Johnson, of Bishop, Cal. Reported to have been recently sold to some mining men of Los Angeles, who are to begin immediate development.

Large deposits of **antimony** are said to occur in the east flank of the Panamint Mountains, near the summit of the ridge. As these deposits are very inaccessible, they have never been worked and little is known concerning them.

BORAX.

Borax was first discovered in Inyo County in 1874, in the playa deposits of Saline Valley. A "boom" immediately followed, and over a hundred quarter-sections of land were entered as borax land at the United States Land Office at Independence. The crust containing borax was said to be from 6 inches to 2 feet thick. Considerable borax was produced from this deposit up to 1895.[5] A few years following the discovery in Saline Valley, the marshes in the vicinity of Resting Springs and of Death Valley, north of Furnace Creek, were found to contain borax crusts. Plants were erected for dissolving the impure crust in boiling water and re-crystallizing the borax. The borax was hauled, by the much advertised 20-mule teams, over the desert 165 miles to Mojave.

[5]See Bull. 24, p. 49; Rept. XIII, p. 46.

Since much has been written concerning the working of these old deposits, no further detail will be entered here. The marsh deposits were abandoned about 1890, due to the discovery of bedded deposits at Borate, 12 miles northeast of Daggett, San Bernardino County. These were found to be quite extensive and much purer than the playa deposits.

The value of the Daggett deposits led to extensive prospecting, and development of the colemanite deposits in Inyo County resulted. The production of borax and boric acid is now derived wholly from colemanite. The deposits of Inyo County occur in the foothills of the Black Mountains east of Furnace Creek. They extend in a narrow belt for many miles, and are owned by the Pacific Coast Borax Co. The

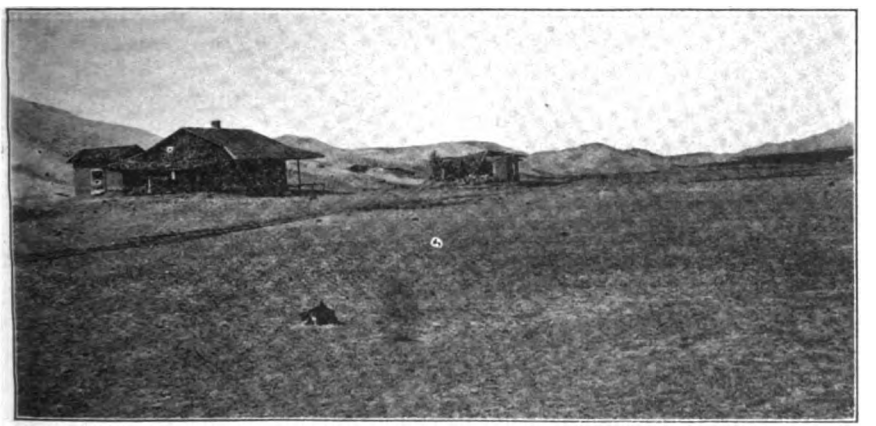


Photo No. 29. Old Amargosa Borax Works, south of Zabriskie. Worked in 1876.

southernmost deposit was located 7 miles southwest of Death Valley Junction and known as the Lila C. mine. This mine was a continuous producer from 1907 to December, 1914, at which time it had been completely worked out. (For description of the Lila C. mine, see U. S. Geol. Surv., Mineral Resources of the U. S. 1911, p. 861.) Abandoned January, 1915, and camp moved to undeveloped deposits in the same belt, 12 miles northwest of the Lila C. The concentrator was removed to Death Valley Junction and a narrow-gauge railroad was built from the Junction to the new camp of Ryan.

The **Pacific Coast Borax Company** is at present the only producer of borax in Inyo County and is mining colemanite at four adjacent properties, namely: The Biddy McCarty, Grand View, Lizzie V. Oakley and Played Out mines. The main camp, called Ryan, is at the Biddy McCarty mine, 20 miles north of west of Death Valley Junction. The Death Valley railroad, a narrow-gauge road controlled by the same company, connects Ryan with Death Valley Junction. Gasoline trains

are used for hauling ore from the outlying mines to the storage bins at Ryan.

The borate-bearing beds of this vicinity are part of a series of Tertiary lake beds, which consist of thin-bedded light-colored shales.

Photo No. 30. Old Coleman Borax Works, 2 miles north of Furnace Creek Ranch.

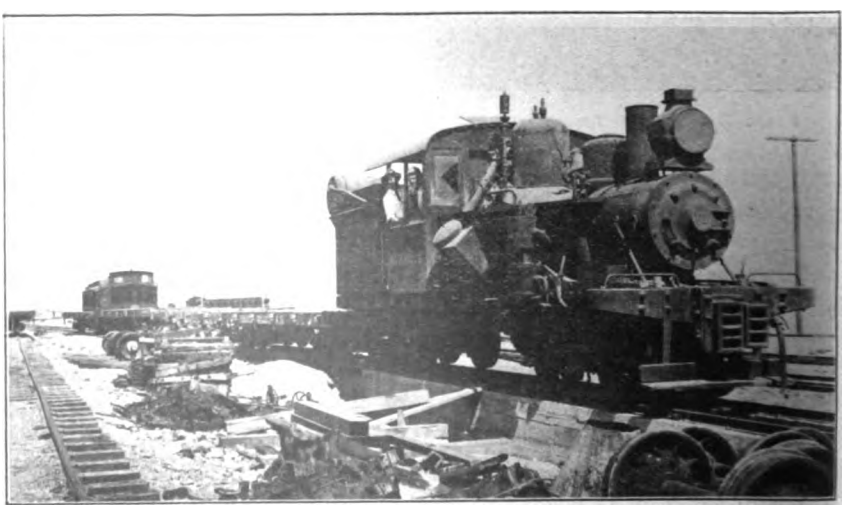


Photo No. 31. First locomotive used to haul borax out of Death Valley, at Death Valley Junction. Photo by H. Knight.

Underlying these shales are thick beds of coarse sandstone and tuff. The sandstone exposures form conspicuous bluffs at the camp of Ryan, below the Upper Biddy workings. The borate-bearing beds are capped with basalt, which forms the crest of the ridge back of the mine. The

colemanite deposits are distinctly bedded and vary in thickness up to 70 feet. The strata have been considerably faulted so that there is no great regularity to the deposits.

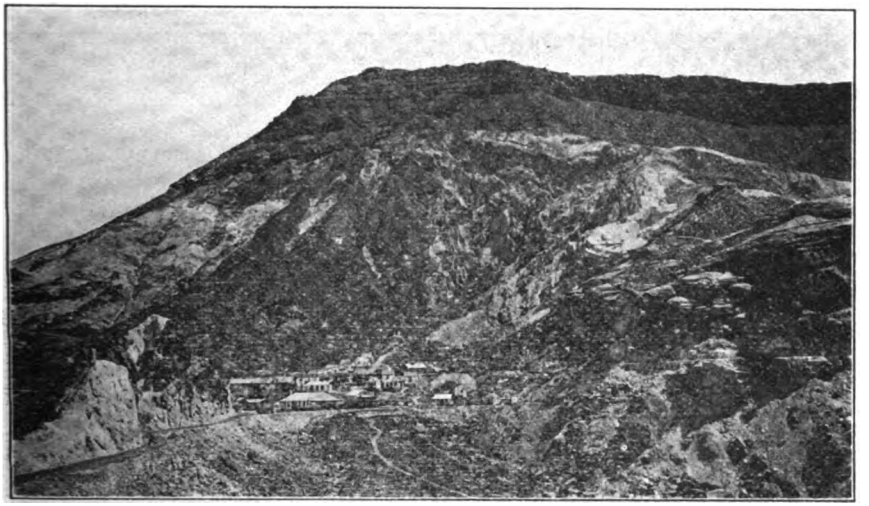


Photo No. 32. View eastward, showing borax formation at Biddy McCarty Mine, and lava capping at Ryan.

The purest deposits are usually found nearest the capping. The heaviest beds so far uncovered are found at the Upper Biddy workings. They are from 20′ to 70′ thick and are worked by quarrying. A tunnel 190 feet long connects the quarry with a gravity tram, by which the

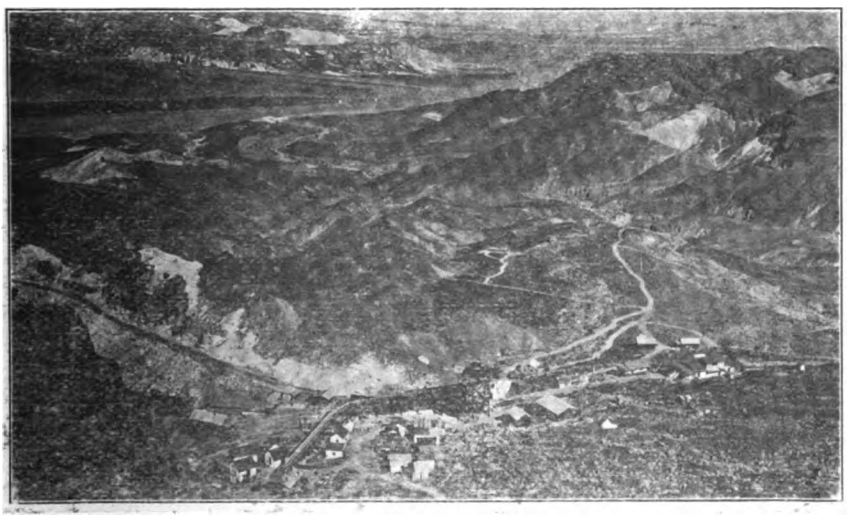


Photo No. 33. Ore bins and town of Ryan, looking northwestward down Furnace Creek.

ore is dumped to the storage bins at the railroad. This is largely first-class ore, being practically pure colemanite. The colemanite occurs massive and more or less crystallized. The crystals occur both in prismatic form, varying from minute size up to a couple of inches in

Photo No. 34. View northwestward, showing method of mining colemanite at Biddy McCarty Quarry. Lower Biddy McCarty Mine in the distance.

length, and in radiating or plumose structure in the beds. Underlying the purer beds, colemanite is found as stringers in the shale, due to leaching and recrystallization of the upper beds. It is also found mingled with shaly matter which ore is necessarily concentrated. The

Photo No. 35. Hauling borax with gasoline train from Lizzie V. Oakley Mine to Ryan for shipment. Train is just rounding curve to the right.

second-class, or mill ore, is mined by tunnel and stope. The main working tunnel of the Upper Biddy, through which the second class ore is trammed, is 210 feet long. It is connected by chute to upper drifts and stopes that lie below the quarry.

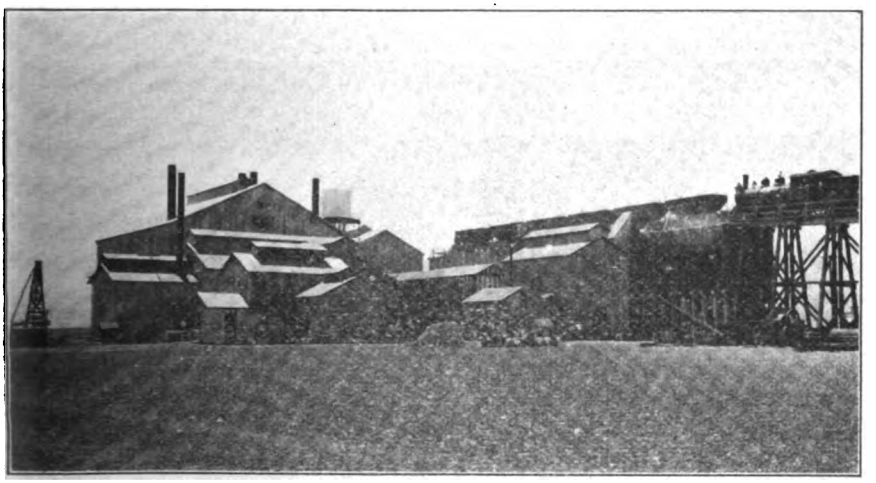
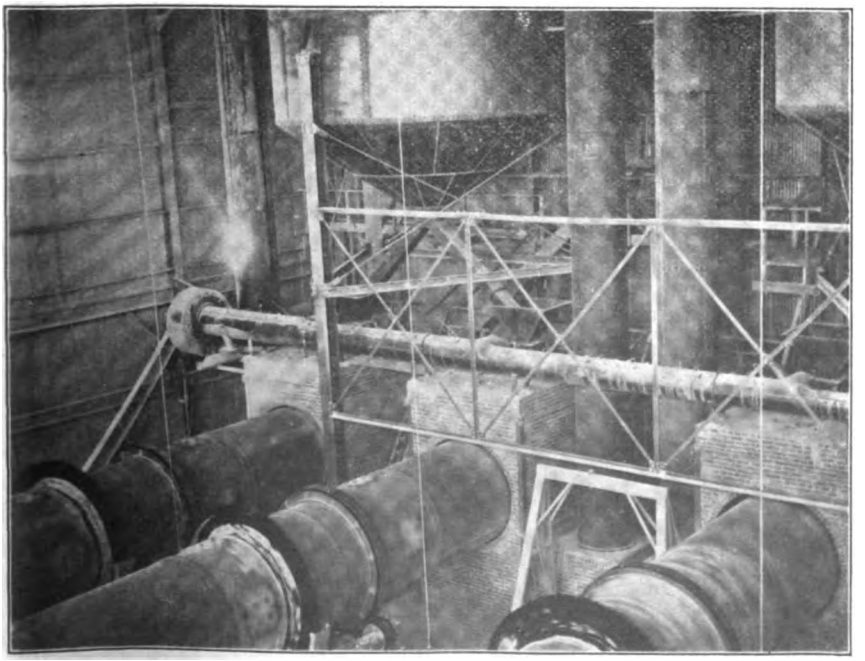


Photo No. 36. Concentration mill of the Pacific Coast Borax Company at Death Valley Junction, Inyo County, California.



The mining is all done by hand drilling, as the colemanite is very friable. About 150 men are employed at the group, producing 50 tons of first-class ore and from 150 to 200 tons of second-class ore. The first-class ore is shipped directly to the refineries at Alameda, Cal., or Bayonne, N. J. All second-class ore is concentrated at Death Valley Junction.

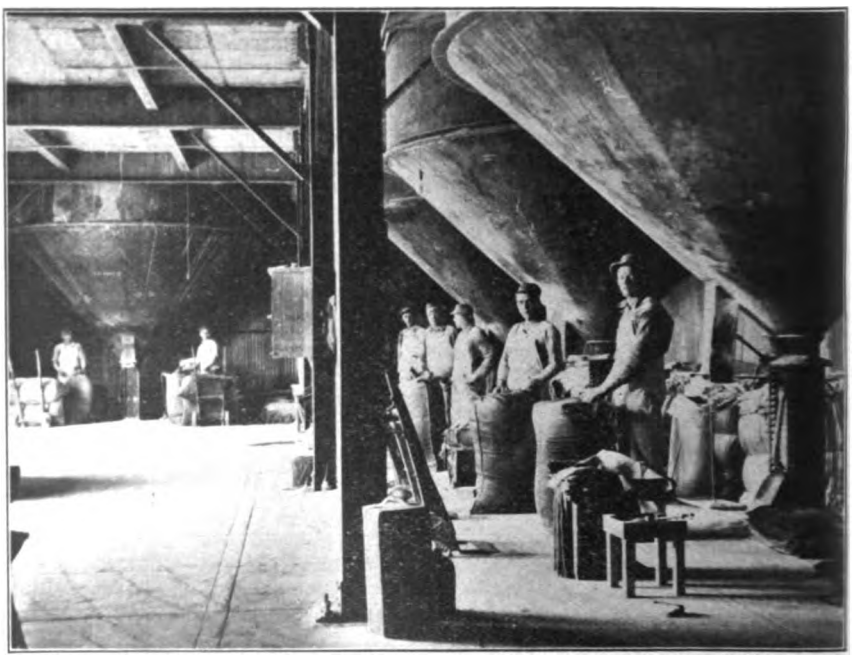


Photo No. 38. Sacking concentrates at the plant of the Pacific Coast Borax Company, Death Valley Junction.

Concentration process: The ore is fed into a No. 5 gyratory crusher and passed through rolls, spaced so as to crush to $\frac{3}{4}$" size, or finer. A belt-conveyor elevates the crushed ore to 2 large steel storage tanks from which it is automatically fed to four 6'x50' rotary roasters. The roasters are fitted with inner chambers which carry the ore so that the flame does not come in direct contact with the ore. Crude oil is used for fuel. The roasting temperature is 1300° F. The colemanite decrepitates to a fine white powder and is separated from the shaly particles and impure portions which do not break down by passing over 24-mesh shaking screens. The powder, averaging 42% B_2O_3, is sacked upon cooling and shipped to the refineries, for the manufacture of boric acid and borax products. The mill makes a 44% recovery. Thirty tons of dust, averaging 45% B_2O_3, are recovered each week. The dump averages 4% B_2O_3. A 280-h.p. Diesel engine supplies power

for operating the mill. Thirty men employed. Pacific Coast Borax Co., owner, Syndicate Bldg., Oakland, Cal. R. C. Baker, president; W. F. Wempahl, secretary; John Ryan, general manager; H. W. Faulkner, mine superintendent; F. W. Corkill, mill superintendent.

COPPER.

Although there are deposits of copper in many localities in Inyo County, there has been very little production from ore bodies that contain copper as the predominating metal. The greatest production has been that in association with gold, silver and lead ores containing small percentages of copper. The present high price of copper has done much toward the development of some old properties and the prospecting for new. After the failure of the Greenwater district in 1908, practically all copper mining ceased until the rise in the price of that metal during 1915. At present there is considerable activity in the Ubehebe district.

Districts.

The **Ubehebe District** is located northeast of Keeler, embracing that territory bounded on the west by Saline Valley, on the south by spurs of the Inyo Range extending to Hunters Mountain, on the east by the continuation of the Panamint Range, and on the north by the Last Chance Mountains, comprising an area about 15 miles long and nearly as wide. Ubehebe Mountain is the most conspicuous topographical feature of the district, rising to an elevation of 5570 feet. The mountains are composed of granite, quartzite and lime, with occasional diorite dikes. The ores are found mostly in the limestone, on the contact with the granite, or close to it. The veins are generally well defined and wide, the gangue rock consisting of siliceous iron, quartz and calcite. The ores are principally the oxides and carbonates of copper, with some chrysocolla and occasionally sulphides.

Due to its inaccessibility and lack of water, the district suffers a great disadvantage. The only available water is that at Dodd's Springs and Quartz Springs, 6 miles north and southeast, respectively, of Ubehebe Mountain.

Bibl.: Bull. 50, pp. 301–315.

The **Darwin, or New Coso District,** lies 24 miles southeast of Keeler, along the western slope of the Darwin Hills, which trend in a northwest direction. The length of the range is approximately six miles. This region is composed of limestone overlying granite, intruded by numerous porphyritic and dioritic dikes. As in the Ubehebe district, the veins are found along the contact, or in the lime, close to the contact, but are not known to occur in the granite. The vein matter consists of siliceous iron, quartz and massively crystalline calcite, carrying the

oxides of copper and iron, galena and carbonate of lead, silver and a little gold.

Water is piped by gravity from the Coso Mountains, a distance of 8 miles, to Darwin, and sold for mining purposes. The Darwin Development Co. has a well at the lower end of Darwin Wash that is ample for mining and milling purposes. The ore is hauled by motor trucks and teams to the railroad at Keeler, at a cost of $6.00 to $7.00 per ton.

The **Greenwater District** is located on the eastern slope of the Black Mountains south of Furnace Creek and north of 36° N. latitude. It is about 15 miles by road southwest of Death Valley Junction, a station on the Tonopah & Tidewater Railroad. This district came into

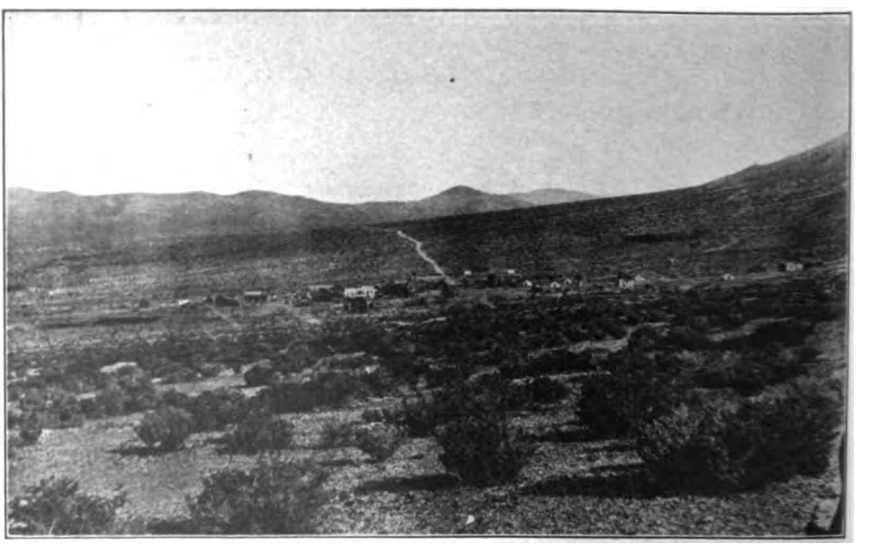


Photo No. 39. Darwin, looking northward.

prominence in 1906, when Charles Schwab and associates became interested. Many claims were taken up, and the town of Greenwater was established. The life of the camp, however, was very short, and one deserted cabin is all that remains of the old town.

The ore, consisting of oxides of copper, principally malachite, chrysocolla, azurite, cuprite and melaconite, occurs in dikes of siliceous iron in eruptive rocks, largely andesites and rhyolites. Shafts were sunk to 500 feet on the veins, but no sulphides were encountered. Very little ore was shipped from this district, as most of the work was development. All work ceased when the price of copper fell during the panic of 1908. Practically no work has been done in this district since.

Bibl.: Bull. 50, pp. 317–324.

Mines.

American Mine is situated 12 miles west of Zabriskie, a station on the Tonopah and Tidewater Railroad, on the eastern slope of the Black Mountains and four miles south of Sheephead Springs. The ore occurs in a vein of barytes in a laminated schist along the contact of monzonite and granite. The vein is said to average from 18″ to 2′ wide, carrying sulphides of copper with some silver and gold. The mine was located in 1902, and from 1906 to 1914 is said to have produced $10,000. Ore shipped averaged 4% copper, 15 ozs. silver, and $4.00 in gold per ton. Development consists of a 50-foot incline shaft on the vein, 175-foot tunnel, and 80 feet of drifts. This property has recently been purchased by J. J. Rodgers, of Zabriskie, and C. B. Zabriskie, of the Pacific Coast Borax Co., who are now developing it.

Anton and Pabst or **Inyo Mine.** Lee district, 16 miles in air line east of Keeler. This property recently leased to "Tex" Hall, of Keeler, who has twelve men working. Ore hauled about 30 miles to the railroad at Keeler. John C. Anton, Jr., and David Pabst, Lone Pine, Cal., owners.

Bibl.: Bull. 50, p. 306.

Blue Jay Mine, Ubehebe District. Located on the east side of Saline Valley. Tunnel 100 feet, winze 35 feet deep, crosscut 25 feet. Ore: malachite and chalcocite. Outcrop 60 feet wide and 500 feet long.

Bibl.: Bull. 50, p. 310.

Butte Group, consisting of 6 claims in the Ubehebe district. Located midway between the Racetrack and Dodd's Spring. Wagon road to property from Bonnie Claire, Nevada, 65 miles. One hundred tons of ore, averaging 24% copper and $10.00 in silver and gold per ton, were shipped in 1912. Development consists of three tunnels on the vein, totaling 300 feet in length. The greatest vertical depth below the outcrop is 150 feet. Assessment work only. Owners, R. C. Spear, E. L. Spear and B. R. Hunter, Lone Pine, Cal.

Copper King Group. A group of claims in the Ubehebe district are reported to belong to Jack Salsbury, San Francisco, Cal.

Copper King Mine, Ubehebe district, 2 miles south of the Racetrack. Sixty miles by tractor road to Bonnie Claire, Nevada. Elevation 4000 feet. Water must be hauled over trail from Dodd's Spring, 4½ miles south. The ore, consisting of oxides and occasional sulphides of copper, occurs in a vein along the contact of lime and granite.

Strike is E. and W.; dip, S. Outcrops for 1500 feet along the contact. Development consists of two 40-foot tunnels and 50 feet of drifts. No production. Idle. Owners, R. McMahon, C. W. Bretz, G. K. Collins, Bishop, Inyo County, Cal.

Copper King and Star Mines, Ubehebe district. Idle. See Bull. 50, pp. 309–310.

Coso Copper Company (Ridgeway Mine) in New Coso district, 1 mile southeast of Darwin and 25 miles, by road, southeast of Keeler. Elevation 4850 feet. Fissure vein in the limestone, averaging 4 feet in width. The vein matter, consisting of siliceous iron, quartz and calcite, carries oxides of copper and iron, silver and gold. Strike N. 45° W., dip 65° SW. Opened by a 120-foot shaft on the vein, with short drifts at 20-foot and 45-foot levels. Stoping on both drifts. A 4 h.p. gas engine hoist used for hauling ore. Fifty tons of ore shipped from this property during April, 1916, by the lessees, Chas. Grimes and Harry Long, of Pasadena. Nine men employed. John H. Thorndike, manager.

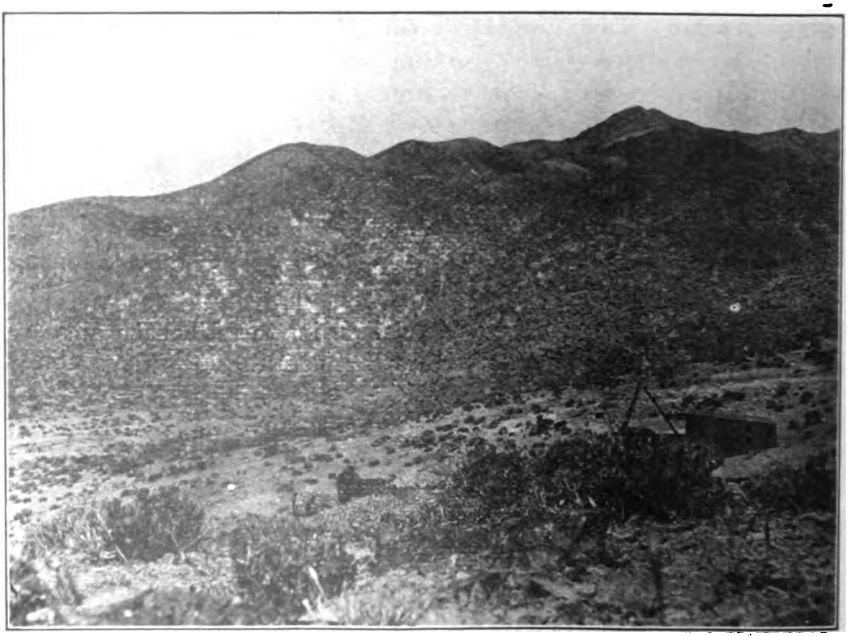


Photo No. 40. Coso Copper Company Mine, Darwin.

Coso Copper Claims, Coso district, 30 miles, by road, SE. of Keeler. Contact vein 6′ wide on limestone hanging and granite footwall, carrying oxides of copper and iron. Four men employed sinking shaft on vein. Owners, Dr. I. J. Woodin, Walter Moore and Adolph Rominger, Independence, Cal.

Green Monster Mine. Seven miles east of Independence on west flank of Inyo Range. Idle. Recently bonded to Thomas F. Butler, San Francisco. Owned by Martin Luther, San Jose.

Bibl.: Bull. 50, p. 306; U. S. G. S. Bull. 540, p. 120.

Greenwater Mine, Greenwater district, 15 miles southwest of Death Valley Junction. Ed Bahten, of Silver Lake, holds lease on property and is working in open cut above old shaft. Vein exposed 10 feet wide, carrying malachite, azurite and chrysocolla. One carload shipped early in March, 1916. Owned by Greenwater Death Valley Copper Company.

Bibl.: Bull. 50, pp. 317-322.

Inyo Copper Mines and Smelter Co. has 19 claims in lime and quartzite in the Ubehebe district. Ore on 12 claims is reported to vary from 4% to 41% copper with some gold and silver. Idle. R. G. Paddock, manager, 2257 Union street, San Francisco.

Jumbo Mine, Cerro Gordo district, 7 miles southeast of Keeler on west slope of Inyo Range. Elevation 5790 feet. The ore occurs in irregular lenses in limestone, with well-defined hanging but indistinct footwall. The strike of the hanging wall is N. 25° W., dip 68° W. Development consists of two tunnels and an open cut. Lower tunnel 240 feet, upper tunnel 150 feet; 40-foot winze in upper tunnel. Work at present confined to stoping ore bodies in the two tunnels. Seven men employed. Ore is packed by burros 1 mile to camp and hauled 7 miles to Keeler. Shipping approximately 4 tons daily. Said to average 8% Cu, 15% Pb, 4 ozs. Ag. Owned by the Darwin Development Company, No. 71 Broadway, New York. F. N. Weeks, consulting engineer.

Loretto Mine. Located on the western slope of Eureka Valley, 28 miles due east of Big Pine. Elevation 5200 feet at camp. A fairly good wagon road from Big Pine to the camp. Water is hauled 15 miles from Willow Spring. The ore body is in granite. The present company took over the property in 1907 and sunk an 1800-foot shaft on vein, with the hope of reaching the sulphide zone. A large body of low grade oxidized copper ore was disclosed, but it was found that the vein apparently did not continue with depth. Operations on the property were therefore discontinued in September, 1915. It is possible that they may be renewed later if a satisfactory method is found for treating the low grade oxidized ores. No production. Owned by the Loretto Mining Company; president, Thos. A. McDonald, No. 111 Broadway, New York; general manager, J. G. Kirchen, Tonopah, Nevada.

Mountain Copper Group. A group of claims in the Ubehebe district are reported to belong to Mr. Jack Salsbury, San Francisco, Cal.

Navajo Chief Mine. Ubehebe district. Idle. See Bull. 50, pp. 303-304.

Oasis Copper Mine, Deep Springs district. Thirty miles northeast of Big Pine and about 2 miles south of Oasis. The ore, oxides of copper principally, occurs in veins in limestone about 50 feet from the granite contact. There are three veins exposed on surface for 50', 1000'

and 3000', respectively, each averaging 4' to 5' in width. Developments consist of open cuts and a 50-foot shaft. A 25-h.p. gas engine hoist is used at the shaft. Water is hauled 2 miles from Deep Springs Ranch. Six men employed to carry on development work since December, 1915. Owned and operated by the Oasis Copper Corporation, 25 Broad St., New York; F. N. Weeks, consulting engineer.

San Rafael Prospect, Wildrose district. Located on the west slope of the Panamint Range, one mile north of Tuber Creek and forty miles by road north of Trona, the nearest point on railroad. Quartz ledge, said to be 12 feet wide on contact of schist and porphyry. Samples recently taken from outcrop are said to have assayed 21% lead, 7% copper, 4 ozs. silver and $0.85 in gold. Recent location, no development. Owned by Y. Ruiz and L. C. Julian, Lone Pine, Cal.

Settle Up Prospect, Ubehebe district. Five miles south of Dodd's Springs and 60 miles by road southwest of Bonnie Clare, Nev. Elevation 4000 feet. Water is hauled from Dodd's Springs 5 miles southeast of the mine. The oxidized ores of copper with some chalcopyrite occurs along a contact between lime and granite. The vein material is mostly calcite and is said to outcrop for several thousand feet. Some 18 short prospect tunnels have been driven at various intervals along the outcrop, but no ore has been shipped. Two men employed. Located January, 1916, by W. S. Ball, J. T. Bradbury and Harry Klein, Venice, Cal.

DOLOMITE.

Badgley Quarry, Swansea (Keeler) district. Four miles north of Keeler, at the western base of the Inyo Mountains. Eighty acres patented, formerly owned by the original Inyo Marble Company (see Inyo Marble Co.). The marble beds here are folded and shattered. Quarried for use as dolomite. Hand drilling; one man employed. Spur track of the California and Nevada railroad to quarry. Approximately forty tons of dolomite per week are shipped to the California Iron and Steel Company at Los Angeles, Cal. Owned by W. O. Badgley, Monadnock Bldg., San Francisco, Cal.

Natural Soda Products Company, of Keeler, are shipping about 20 tons daily of the pure white dolomite from the quarries of the Inyo Marble Company to their soda plant south of Keeler. Seven men employed at $3.00 per day. The dolomite is used for generating carbon dioxide. An analysis of this material determined at the State Mining Bureau (Report X, p. 218) follows:

Carbonate of lime	54.25 per cent
Carbonate of magnesia	44.45 per cent
Iron and silica	.60 per cent
	99.30

GOLD.

Actual gold mining in Inyo County started with the establishment of the Russ mining district, in the Inyo Mountains east of Independence, in 1861. At about the same period the Kearsarge district was established on the eastern flank of the Sierras below Kearsarge Peak at an altitude of from 8000 to 10,000 feet. The ores of the latter district were predominantly silver, having a low gold content.

Placers were worked for several years in Mazourka Cañon. This cañon is on the western slope of the Inyo Mountains, east of Independence. Dry washers were used. The ground was practically exhausted, and placer mining in Inyo County ceased.[6]

The gold deposits of the Inyo and White Mountains have, thus far, been the principal producers, although they are now mostly idle. The gold ores, which are oxidized and vary in value from low to high grade, are found in narrow quartz veins. The veins occur along the borders of granitic intrusions or in the surrounding country rock.[7] The Beveridge district, situated along the summit of the Inyo Mountains east of Lone Pine, was the most important gold producing district. It can be reached only by trail, and until adequate roads are constructed, there is little hope for any further development of that district.

In recent years gold mining in Inyo County has been principally confined to the few scattered mines of the Funeral, Panamint and Argus mountains.

Black Eagle Mine (Quartz). Union district. Situated on the west flank of the Inyo Mountains, four miles east of Kearsarge station. Elevation 8300 feet. Idle. Owned by George Lewis, Independence, Cal.

Bibl.: U. S. G. S. Bull. 540, p. 116.

Burgess Mine (Ironside Mine) (Quartz). Beveridge district, 10 miles northeast of Mount Whitney station. Trail to mine from Mount Whitney station. Elevation 9200 feet. Idle. Owned by Mrs. Kate Wells, Lone Pine, Cal.

Bibl.: U. S. G. S. Bull. 540, p. 119.

Cashier Mine (Lode). Wildrose district. Fifty-five miles north of Trona and 9 miles south of Skidoo, at the old town of Harrisburg. Elevation 5000 feet. Located in 1905 and worked continuously from 1906 to 1909. Taken over by the present owners in 1910. The ore, free milling gold, occurs in an irregular lens-shaped body, varying from 6″ to 12′ in width, in limestone. A 400′ incline shaft has been sunk on the ore body and levels driven at 100′, 200′, 300′ and 400′. Considerable drifting has been done on the 1st, 2d and 3d levels. The 100-foot is the main working level and connects with the surface at 350 feet from the

[6] See Rep. XIII, p. 182.
[7] Adolph Knopf—Mineral Resources of the Inyo and White Mountains, U. S. G. S. Bull. 540, p. 112.

shaft. The mine is said to have produced 15,000 tons of ore, which average $20.00 per ton, practically all of which was taken from the first level and above. No ore has been found below 140 feet in the shaft, where the ore body appears to pinch out entirely.

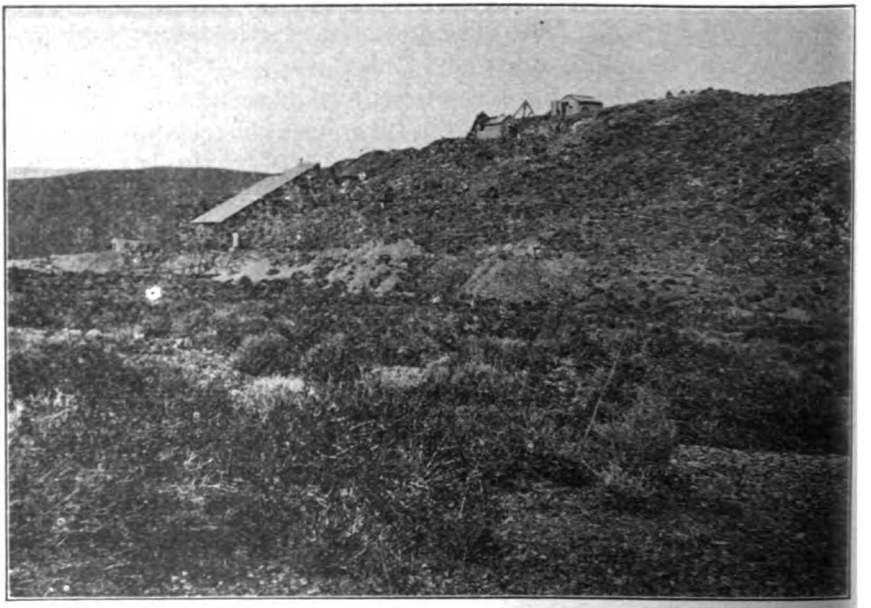


Photo No. 41. Cashier Mine, Harrisburg.

The ore is treated in a 5-stamp Joshua Hendy mill. The pulp is run over amalgamation plates and the tailings cyanided. Capacity of mill 20 tons per 24 hours. Water is piped to the mill 2 miles from the Skidoo pipe line. A distillate engine furnishes power to the plant. Property under lease to P. R. Turner and Robert Weir, who are stoping on the 100-foot level. They intend to run about 50 tons of ore through the mill before the expiration of their lease in October, 1916. Owned by the Cashier Mining Company, 809 Hollingsworth Bldg., Los Angeles, Cal.

Cecil R. Mine (Quartz). South Park district. Five miles south of Ballarat, on the west slope of the Panamint Mountains. Elevation 1250 feet. Well defined quartz vein in schist. Strike N. 6° W., dip 21° W. Varies from 18″ to 5′ in width. Free milling. Development consists of three tunnels on the vein, 126′, 177′ and 147′, respectively. No equipment. Idle. Owners, the Cecil R. Mining Company, 1008 Baker-Detwiler Bldg., Los Angeles, Cal.

Chloride Cliff Mine (Quartz). In Chloride Cliff district, 18 miles west of Rhyolite, along summit of Funeral Mountains. Elevation 5300 feet. Good auto road from Rhyolite or Beatty to the mine. Quartz

limestone along contact of quartzite. Said to average $23.00 per ton. The formations have been considererably folded and faulted. There are 5 well defined veins, each averaging from 3′ to 3½′ in width. Their trend is NE.–SW. Development consists of 7 tunnels, the longest of which is 400 feet and the shortest 100 feet. The greatest length driven on the vein is 320 feet. Greatest vertical depth below outcrop, 800 feet. No production. Development work only. Purchased in 1908 by the present owners. Mill erected April 1916, consisting of 7-foot Lane mill, Deister concentrators and small cyanide plant. Operated only a few days, due to shortage of water; 60-foot well sunk one mile from mill pumped dry. Idle. Owned by J. Irving Crowell, Donald Finley and Chas. Parsons, Rhyolite, Nev.

Bibl.: U. S. G. S. Bull. 285, pp. 72, 73.

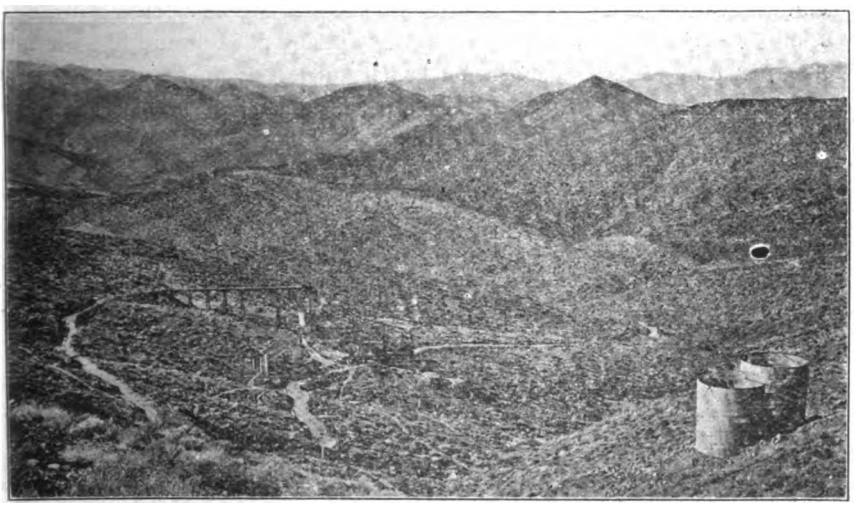


Photo No. 42. View, looking northeastward, of mill and tanks at Chloride Cliff Mine, Funeral Range, Inyo County.

Coso Milling Company are erecting a custom mill at the Marigold Mine, 7 miles south of Darwin. The mill consists of two 1000-lb. triple discharge stamps, 1 concentrator, 15 h.p. Fairbanks-Morse gas engine for power. Pumping plant installed in creek 1500 feet below mill. Expect to start milling in June, 1916. Will charge flat rate of $10.00 per ton. Manager, J. O. Lee, Darwin, Cal.

Eureka Mine (Quartz). Situated in the Inyo Mountains, 9 miles northeast of Independence. Elevation 4000 feet. Idle.

Bibl.: U. S. G. S. Bull. 540, pp. 115, 116.

Gold Spur Mine (Quartz). South Park district, approximately 15 miles south of Ballarat. The ore occurs in gneiss. A 300-foot chute

averages 4 feet in width. Outcrops on surface 1000 feet. Said to average $9.00 per ton. Owned by F. W. Gray and Mr. Thurman of Ballarat.

Golden Eagle Group (Quartz). Located in the Beveridge district. Development consists of a 200-foot and a 60-foot winze; 100 tons of ore hand-sorted and treated at the Keynote mill are said to have averaged $100.00 per ton. Idle. Owned by John C. Anton, Lone Pine, Cal.

Golden Treasure or **Ashford Mine** (Quartz). Situated in the western slope of the Funeral Mountains, 30 miles, by road, due west of Zabriskie. Elevation 2000 feet. Wagon road to mine. Free milling gold is deposited in fissure veins in gneiss. There are four veins on property, the main one, the Golden Treasure, varies from 30″ to 4′ in width, and carries some chalcopyrite. Occasional specks of free gold can be seen in the quartz. Said to assay up to $325.00 per ton and to average $40.00 per ton. A 180-foot tunnel has been driven on main vein and 50-foot winze in tunnel. Greatest vertical depth below outcrop 2000 feet. Over 2000 feet of tunnels and drifts on the four veins. Mine

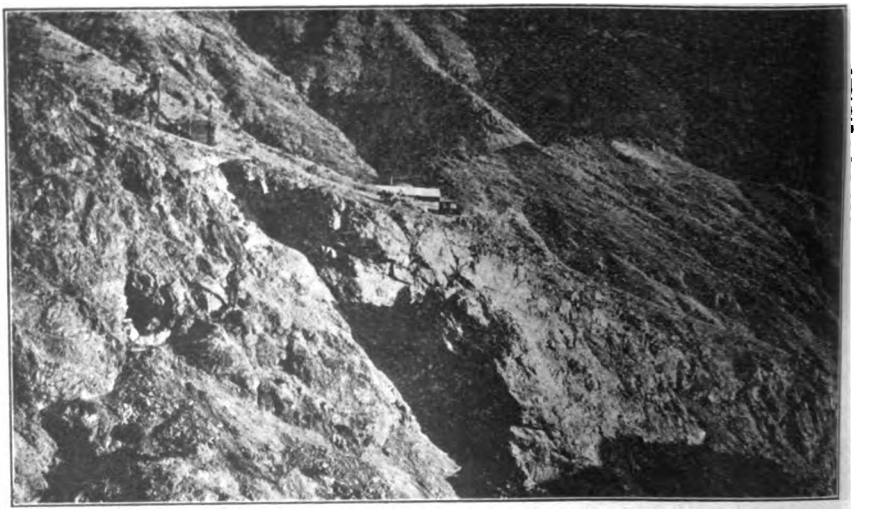


Photo No. 43. Golden Treasure Mine and camp. East side of Death Valley, 30 miles west of Zabriskie.

located in 1906. Development work only until 1914. In November, 1914 it was taken under bond and lease by B. W. McCausland, who erected a mill 5 miles below mine, in Death Valley. The mill included: a jaw crusher, 10-foot Lane mill, 1 Wilfley table, 1 Deister slime table. Well sunk in Death Valley to furnish water for mill. Ore hauled by motor truck from mine to mill. Ceased operations, September, 1915, and property reverted to original owners, due to failure to make first payment

under terms of lease. No records available as to production during this period. Owners, Henry J., Lewis R., and Harold Ashford, Zabriskie, Cal.

Harrisburg Mine (Quartz). Located in the Wildrose district, 55 miles north of Trona, and adjoins the Cashier mine. Quartz vein on contact of lime and granite. Strike N. and S., dip E. Development consists of a 40-foot crosscut tunnel and several shallow pits. Ten tons of ore treated at Cashier mill yielded $50.00 per ton. Owned by J. P. Augerebery, Harrisburg, Cal.

Holy Roller Prospect, South Park district. Ore said to average $4.90 per ton. Twenty-foot flat deposit in limestone, near schist; 5000 tons in sight. Water available. Idle. Owned by A. C. Porter of Ballarat.

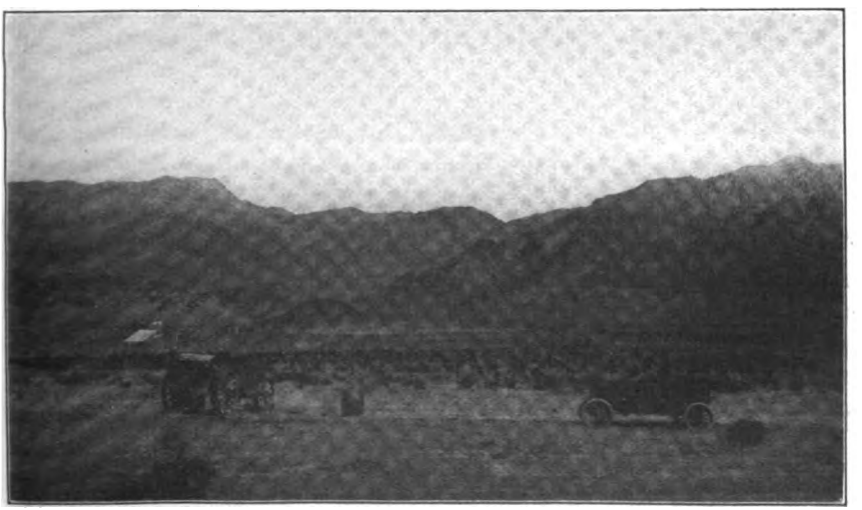


Photo No. 44. McCausland Mill, in Death Valley, 5 miles below the Golden Treasure Mine, in the Amargosa Mountains.

Keane Wonder Mine (Quartz). South Bullfrog district, is in Sec. 6, T. 29 N., R. 1 E., 22 miles by auto road west of Rhyolite, on the west slope of Funeral Mountains, at an elevation of 3400 feet. Two lenticular ore bodies in schist lie almost parallel, about 100 feet apart. The quartz lenses vary up to 30 feet in width and have been stoped to the surface. They lie almost flat. The ore carries very little pyrite, and averages $8.00 per ton. Worked through two main tunnels. Impossible to estimate extent of work as the stopes are caved. Mined with air drills. Ore hauled to mill by gravity aerial tramway, which operates a jaw crusher at mine bin. Ore is crushed to 2″ size before being sent to mill.

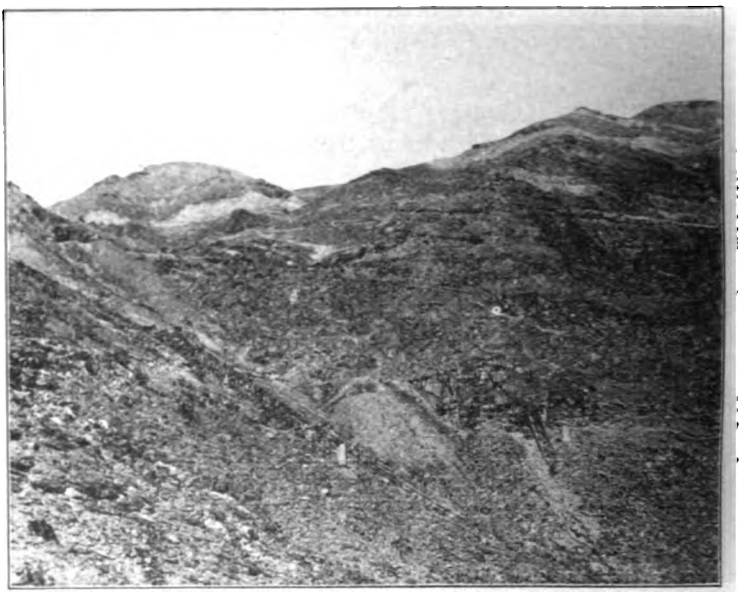


Photo No. 45. Keane Wonder Mine, and head of tramway.

The mill is located at edge of Death Valley at an elevation of 1100 feet. It consists of 20 stamps and amalgamation plates. Crude oil is used for fuel for steam power plant to operate the mill. The tailings are treated at the cyanide plant below mill. The leaching cyanide process consists of a six-day treatment beginning with 3% KCN sol. Zinc boxes used for precipitation. Bullion runs 400 to 500 fine in gold and silver. Ratio of gold to silver 1½ : 1. Mine said to have produced

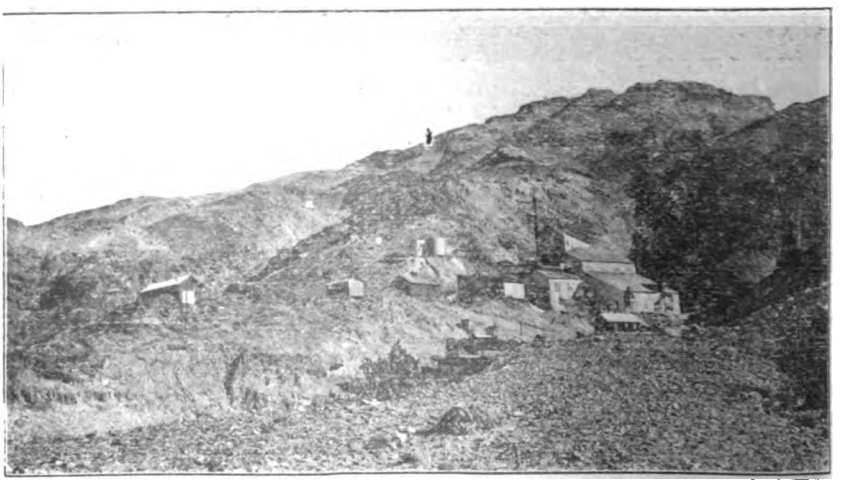


Photo No. 46. Keane Wonder Mill. View northeastward.

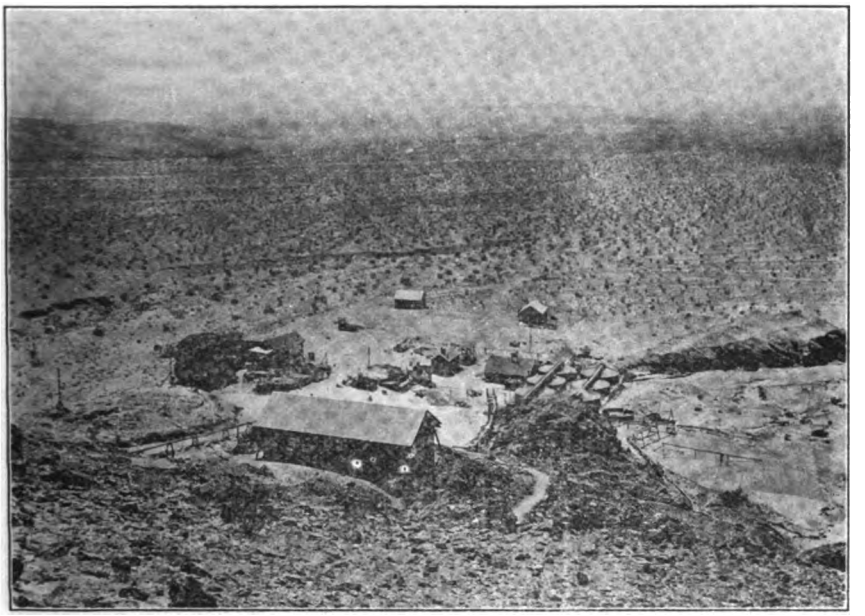


Photo No. 47. Keane Wonder Cyanide Plant. View southwestward.

$1,100,000. Closed down, May, 1916, as the developed ore bodies were worked out. Company to be organized before doing any further development. Owned by the Francis Mohawk Mining and Leasing Co., B. H. Tatem Estate, and State Bank and Trust Co., of Carson, Nevada. Agent and manager, F. N. Fletcher of Reno, Nevada.

Keynote Mine (Quartz). Beveridge district, 10 miles NE. of Owenyo, a station on the California and Nevada Railroad, on the east slope of the Inyo Mountains. Elevation 7500 feet. The vein follows a granite and porphyry contact. Strike N.–S., dip 42° W. Development consists of 7 tunnels, varying from 150′ to 750′. Tunnels connected by winzes and raises. Greatest vertical depth below outcrop 1800 feet. Ore free milling. Formerly treated in arrastra and later in 5-stamp mill. Water piped from Hahns Creek, 3 miles south. Worked continuously from 1878 to 1886, then periodically up to 1907. Assessment work, only, since. There is said to be over 20,000 tons of ore, that will yield $8.00 per ton, on dumps. Owned by O. S. Williams, 318 West Ave. 53, Los Angeles, Cal.

Bibl.: Rep. of the Director of the Mint upon Production of Precious Metals in U. S., 1883, p. 159; U. S. G. S. Bull. 540, p. 112; Register of Mines, Inyo County, 1902.

Lost Burro Mine (Quartz). Ubehebe district, 55 miles SW. of Bonnie Claire, Nevada, in Panamint Range. Elevation 5350 feet. Fissure veins in granodiorite, striking N.–S., slight dip to east. Veins

vary from 4′ at outcrop to 6″; appear to pinch out with depth. Several short tunnels driven along vein. Ore said to average $25.00 per ton. No production. Excavation made for 5-stamp mill and cyanide plant, that were never erected. Water to be piped 8 miles from spring on Tin Mountains. Idle. Owned by Lost Burro Mining Company, Los Angeles, Cal., W. H. Blackmer, president. Reported sold to the Montana-Tonopah Mines Company, Chas. E. Knox, Berkeley, California, superintendent and manager. According to reports in January, 1917, a mill is under construction.

Marigold Mine (Quartz). Coso district, 7 miles south of Darwin and 30 miles southeast of Keeler, on east slope of the Coso Mountains. Elevation 6000 feet. The vein is in granite. Width 6″ to 4′; 7 tunnels totaling 2000 feet driven on vein. No stoping. Said to be 200 tons of ore on dumps that will average from $30.00 to $40.00 per ton. Ore to be treated at custom mill, now being built by the Coso Milling Company. Are to begin stoping in mine upon completion of mill. Owned by J. O. and L. W. Lee, Darwin, Cal.

Merry Christmas Mine (Quartz). Modoc district. Situated in Snow Cañon, 28 miles north of Trona on the east slope of the Argus Range at an elevation of 3700 feet. The deposit consists of 4 quartz veins following a contact between andesite and granite. The main vein is 4′ wide. Ore is base, carrying about 1½% lead and some copper. Said to average $11.00 per ton. A 700-foot tunnel driven on main vein. Greatest vertical depth below outcrop, 325 feet. The mill equipment consists of five 1000-lb. stamps, 1 Wilfley table, 25 h.p. Western gas engine. H. E. Robertson has bond and lease on property, employing 5 men. Owned by Snow Cañon Mining and Milling Co., Dallas, Tex.

Mountain View Mine (Quartz). Beveridge district. It adjoins the Keynote Mine on the west slope of the Inyo Mountains. The ore body consists of a well defined quartz vein 3 feet in width, carrying rusty gold and chalcopyrite. Assays of some hand samples showed 4 ozs. gold per ton and 18% to 30% copper. Tunnel driven on vein 165 feet. No production. Company now being organized to develop property, to be known as North American Metal Mines Company. S. R. Brough, I. W. Hellman Bldg., Los Angeles, trustee.

O. B. J. Mine (Quartz). South Park district. Situated in Tuber Cañon, 15 miles north of Ballarat. The ore is free milling quartz, said to average $7.00 per ton. Main tunnel 1000 feet. Six stamp mill and amalgamation tables. Water piped 2½ miles from spring. Ten men employed. Owners: Clair Tyler, J. P. Flint and J. C. Kennedy, Los Angeles, Cal.

The **Pine Mountain Group** of seven gold claims is reported to have been leased by Chas. W. Alvord. A quartz ledge in granite is said to

average 4′ in width and to assay $20.00 per ton. The property is located about 2 miles north of Payson Cañon on the toll road to Deep Springs Valley.

Radcliff Mine (Quartz). South Park district, east of Ballarat. Quartz vein. Strike NW. and SE., dip 60° W. Inclined shaft 500 feet. Sulphides in lower workings. A 20-stamp mill and steam power plant; 12,000 tons of tailings stored for future treatment. Idle since 1903. Owners: Craig Grocery Co., Los Angeles. Tax title owned by W. D. Clarke, Los Angeles.

Bibl.: Reg. of Mines, Inyo, Co., 1902.

Reward* and Brown Monster, or Eclipse, Mine (Quartz). Russ (or Independence) district, 2 miles east of Manzanar station. Idle.

Bibl.: Rep. VIII, p. 263; Rep. XII, p. 136; Rep. XIII, p. 180; Reg. of Mines Inyo Co. 1902; REP. OF THE DIRECTOR OF U. S. MINT, 1883, 1884, p. 160; U. S. G. S. Bull. 540, pp. 116–118.

Skidoo Mine (Quartz). Wildrose district, 65 miles by auto road north of Trona. Elevation 6500 ft. Two systems of quartz veins occur

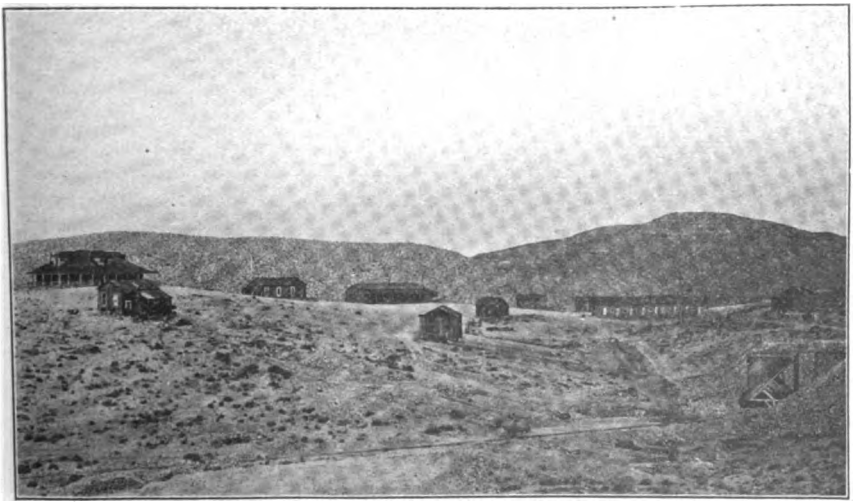


Photo No. 48. Camp at Skidoo, on west side of Tucki Mountain, Inyo County.

in a pegmatite granite. The main vein system strikes N.W.-S.E. and dips from 30° to 40° S.W. The other system, E.-W., dips 60° N. Veins average from 18″ to 2′ in width, with a maximum of 4′. The ore is free milling and values average about $15.00 per ton. Outcrops of eight veins are now being mined making a total of 2000 feet. There is a 300-foot incline shaft on the E.-W. system and a 300-foot vertical shaft on the main system. Greatest depth on vein, 240′ with over one mile of tunnels and drifts. Ore is hauled to the mill through tunnels.

*Reported to have been recently opened up and running a mill and oil flotation

The mill equipment consists of: ten 850-lb. stamps, five 1150-lb. stamps, and amalgamation tables. Table tailings run to cyanide plant, leached 9 days and precipitated in zinc-boxes. Mill operated by water power, conveyed in 8" pipe line 21 miles from Telescope Peak. Pipe line installed at a cost of over $200,000; 35 men employed at the mine, 6 at mill. Property located in 1906; mill erected 1907. Mill burned down and reconstructed in 1913. Total production to date over $1,500,000. Owner, Skidoo Mines Co., Skidoo, Cal. C. W. Cross, president; L. W. Orynski, superintendent.

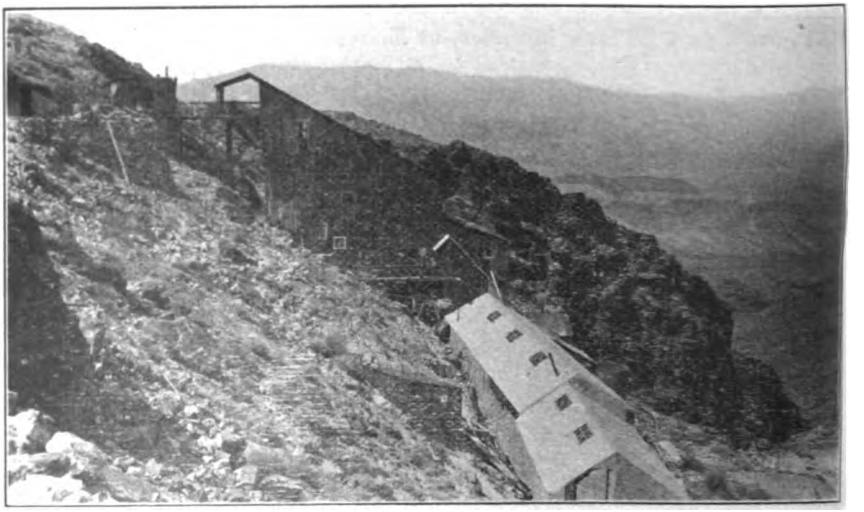


Photo No. 49. Mill and Cyanide Plant at Skidoo Mine, Skidoo, Inyo County.

Union Mine (Quartz). Russ district, Sec. 14, T. 14 S., R. 36 E., M.D.M., 3 miles NW. of Owenyo, near base of Inyo Mountains. Elevation 5500 feet. Wagon road to property. Well defined quartz vein, averaging 5 ft. in width, in metamorphosed lime. Outcrop can be traced several thousand feet. Strike E.-W., dip N. 65°. Low grade ore carrying some galena and silver. Average value, gold $3.00, lead 3%, silver 5 ozs. Development consists of 5 tunnels, driven on vein, totaling approximately 2000 feet. Greatest vertical depth below outcrop, 1900 feet. There is said to be sufficient water in the lower three tunnels for all mining and milling purposes. A 6" pipe line from creek, 4500 feet, to mine. Mill on property: 7"x9" Blake crusher, 12"x20" Allis rolls, 15 h.p. distillate engine. Development work only. No production. Idle. Owners, W. L. Skinner, C. B. Skinner, R. Volmer, Lone Pine, Cal.

Bibl.: Reg. of Mines, Inyo County, 1902.

Wilshire-Bishop Creek Mine (Quartz). Bishop Creek district, 22 miles SW. of Laws. Good wagon road to mine. Eastern flank of Sierras. Elevation 8500 feet. Inaccessible during winter and spring due to heavy snowfall. Since the property was idle and the mine flooded, it was not visited. Mine is said to have produced 5000 tons of ore, which averaged $11.00 per ton. Equipment consists of a 10-stamp mill and an all-sliming cyanide plant. Capacity 50 tons per 24 hours. Treatment as follows: Ore crushed in weak KCN solution by ten 1250-lb. stamps, concentrated on double-deck Deister table. Concentrates shipped to smelter. Table tails passed to 5′x16′ tube mill and crushed to 150 mesh or finer. Tube mill discharge thickened in 24′ Dorr thickener and passed to four agitation tanks. Pulp elevated to Portland filter and pregnant solution precipitated in zinc boxes. Electric power used, supplied by the Southern Sierras Power Co. Mine shut down October, 1915, as company was unable to operate at a profit. A new company, to be known as the Consolidated Wilshire Mining Co., is being organized to take over the stock of the old company on an assessment of 6 cents a share; this to be used to double capacity of present plant. The promoters think that by doubling the mill capacity, the cost per ton will be sufficiently reduced to show a profit. Owner, Rocky Point Consolidated Mines Co.; president, Gaylord Wilshire, Hollingsworth Bldg., Los Angeles.

Wonder Mine (Quartz). Saratoga district, north of Ibex mine. Quartz vein said to carry gold and copper. Two 75-foot shafts on vein. Old mill at property. Idle. Recently purchased by S. F. Brock, manager of the Ibex mine. Equipment to be installed at Ibex mine.

Yucca Mine (Quartz). Coso district, 8 miles by road south of Darwin. Elevation 6000 feet. Highly oxidized quartz veins in granite. Vein matter and granite soft and decomposed. Width 2″ to 18″. Strike N. and S., dip 30° E. Outcrops 300 feet. Two incline shafts on vein 200 feet deep, connected by levels at 120 feet and 165 feet. Numerous shallow shafts 8′ to 20′ deep, from which good ore has been shipped. Mined by auger drills and picks. During 1915 shipped over 20 tons averaging $136.00 per ton. Will haul second-class ore 2½ miles to mill of Coso Milling Co., upon completion of mill. Worked continually since 1908 by the owner, L. D. Owen, Darwin, Cal.

GYPSUM.

Acme Cement and Plaster Co. Large deposit of gypsum on China, or Morrison Ranch, 1 mile northeast of Acme station on the Tonopah and Tidewater Railroad. Spur track to mine. Worked by open cut and tunnels. Shipping 1000 tons per month to plaster plant at Los Angeles. Company manufactures hard (wall) plaster only. Treatment

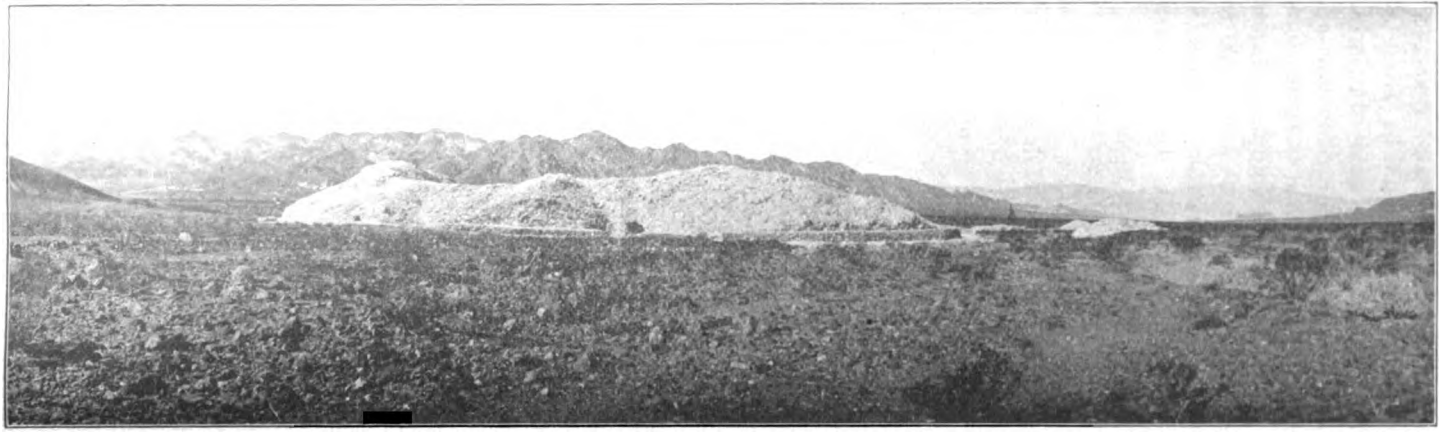


Photo No. 50. Gypsum deposit of the Pacific Coast Borax Company near Ryan, Inyo County.
Courtesy of Mr. John Ryan of the Pacific Coast Borax Company.

consists of grinding to 100 mesh and calcining. Crude oil used for fuel. Sixteen men employed. Home office No. 750 S. Alameda St., Los Angeles, Cal. F. A. Brown, superintendent.

Pacific Coast Borax Co., owns an extensive deposit of gypsum in the foothills of the Black Mountains, 1 mile from the Death Valley railroad. Undeveloped. Company anxious to lease deposit for freight charges. Mr. John Ryan, Syndicate Bldg., Oakland, general manager.

IRON.

J. C. Roper and **John Amick**, of Independence, own a deposit of iron in Inyo Mountains, 7 miles east of Kearsarge Station. Ore is specular hematite, said to carry $4.96 in gold. Tunnel and shaft on property. No production. Idle.

Coso Copper Claims. Large deposits of iron ore, formerly used for flux at the Darwin smelters, occur on the claims of Dr. I. J. Woodin, Walter Moore and Adolph Rominger. Idle.

LEAD, SILVER, ZINC.

These three metals are grouped under one heading as they occur closely associated in many of the mines.

The earliest mining in Inyo County was that of the lead-silver ores in the southern part of the county, by Mormon colonists, previous to 1859. In 1860 Dr. French started in search of the celebrated "Gunsite" lode. He entered the Coso and Darwin cañons, making many locations, and penetrated as far as Furnace Creek, where were found the old furnaces used to reduce the lead-silver ores.[8] The famous Cerro Gordo district was discovered between 1862 and 1866. Zinc ores were first mined in 1907, with the discovery of large bodies of smithsonite in the old lead stopes at Cerro Gordo.

The remarkable increase in the value of the metals during 1915 has caused a general revival of the mining industry, with the result of reopening old mines and developing many new properties. The Cerro Gordo district is said to have yielded a total to date of over $15,000,000, and the Darwin district approximately $3,000,000.

Districts.

The **Cerro Gordo District** is in the southern part of the Inyo Range, embracing Cerro Gordo Peak, 5½ miles in an airline east of Keeler. It is reached by wagon road from Keeler. The ore bodies form irregular lenticular masses inclosed in limestone. The ores are principally argentiferous galena, cerrusite, and zinc carbonate, or smithsonite. The deposits were first worked by the Mexicans on a small scale in 1866 and the ores smelted in vassos. In 1869 they were taken over by American

[8]Report of the Director of the Mint upon the Production of Precious Metals in

interests and a period of great activity followed. Two smelters were erected at Cerro Gordo, and a third one near the shores of Owens Lake. Scarcity of water and fuel, combined with high transportation costs, made mining and smelting costs prohibitive. The mines were shut down in 1877, as the large, rich bodies of argentiferous galena had been worked out. The completion of the railroad to Keeler in the early eighties revived interest, and the mines were worked periodically for many years. The two most famous mines of the district, the Santa Maria and Union, were consolidated in 1876, and are now known as the Cerro Gordo mine. Having been described in other publications, no further details will be repeated here concerning this district.

Bibl.: MIN. RES. WEST OF THE ROCKY MTS., R. W. Raymond, 1870, pp. 17–19; 1873, pp. 18–22; 1876, pp. 30–32. REPORT OF DIRECTOR OF MINT upon the Production of Precious Metals for year 1883, pp. 161–163; 1884, pp. 102, 103. REP. OF THE STATE MINERALOGIST, 1890, pp. 213, 214. U. S. G. S. Bull. 540, Adolph Knopf, pp. 95–110.

The **Darwin District,** briefly described under the heading "Copper," is essentially a lead-silver district. The ore deposits, principally bodies of argentiferous galena and its oxidation products, range from contact metamorphic deposits to fissure veins in limestone. The gangue is calcite and fluorite, often coarsely crystallized. The district was most active from 1875 to 1877, during which period three smelters were erected. Slag dumps mark their locations. At that time all freight had to be hauled by team across the desert, 275 miles, from Los Angeles. The richer and more easily mined ore bodies were soon exhausted, and the expense being very high, mining subsided and the district lay dormant for many years. The recent activity of the Darwin Development Company in reopening a group of the old mines has revived interest in the district. Should their "oil concentration" mill now being erected prove thoroughly successful, it will undoubtedly increase the general development of the whole district. Considerable low grade ore is exposed in the workings of many of the old properties. A full description of this district is given by Adolph Knopf, "The Darwin Silver-Lead Mining District," U. S. Geol. Surv. Bull. 580-A.

Mines.

Baxter Mine (Lead-silver). Resting Springs district. Four miles east of Evelyn, a station on the Tonopah and Tidewater Railroad, and on the western slope of Resting Springs Mountain. The deposit is a lenticular ore body inclosed in limestone. Development consists of two shallow shafts and a short tunnel. One man working. Ore hauled in 4-ton wagon to railroad. Total production about 200 tons. Owner, J. P. Madison, Shoshone.

Blue Dick Mine (Lead-silver, Zinc). Located in the Kingston Mountains, near the San Bernardino County line, southeast of Tecopa. Ore is said to be deposited in a fissure vein in limestone. Several carloads shipped during 1914. Analysis of ore shipped: Lead, 32% to 55%; zinc, 6%; silver, 6 to 12 ozs.; gold, a trace. About 500 feet of tunnels and drifts on the property. Idle. Owner, Henry Lang, Tecopa.

Carbonate Mine (Lead-silver). Carbonate district, 42 miles northwest of Zabriskie. Near base of east slope of Panamint Mountains, at western border of Death Valley. Elevation 1200 feet. Water is hauled to mine from Zabriskie. The country rock is limestone, which has been greatly faulted. Diabase occurs as dikes intruding the limestone; basalt

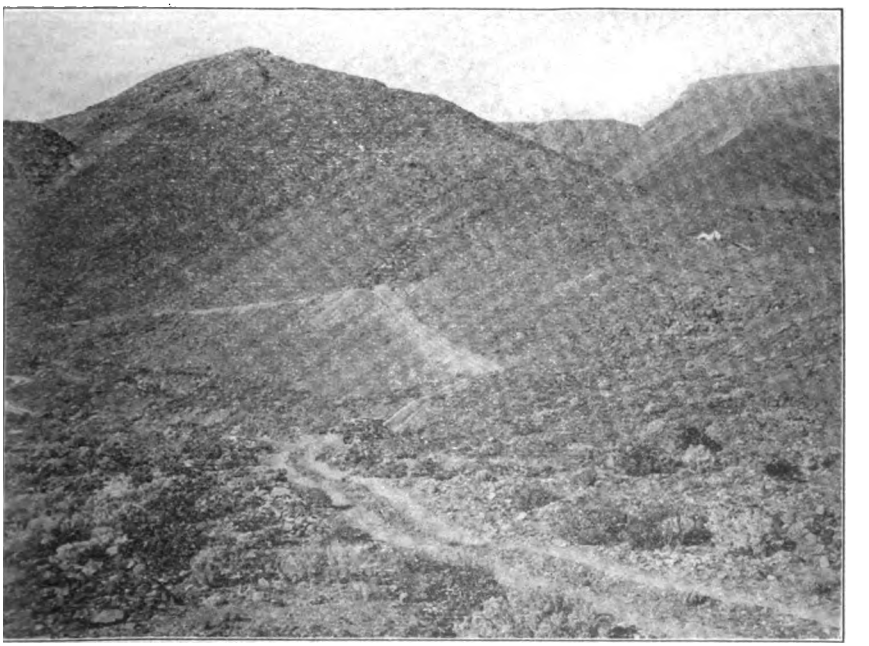


Photo No. 51. Carbonate Mine and camp in Panamint Range, on the west side of Death Valley.

s surface flows. The ore, principally carbonate of lead, is deposited n irregular lenticular masses along a fault-plane. Width of ore body, ′ to 15′. Trend N. 10°-30° E. The greatest vertical depth below apex, 75 feet. Development consists of three tunnels, driven on the ore ody. Upper tunnel 100′ long, 60′ below apex. Second tunnel 50′ long, 30′ on dip of vein (45°) below first. Lower tunnel (main orking tunnel) 400′ long, 100′ below second. Ore is dumped into eserve bin below third tunnel, from which it is loaded into trucks. Iauled to Zabriskie in 4-ton motor trucks, at a cost of about $15.00 per

ton. The trucks proved unsatisfactory and Holt caterpillar-type tractors have replaced them, at a lower hauling cost. About forty tons per week shipped to United States Smelting and Refining Company, Salt Lake. Ore shipped averages 35% to 40% lead, carrying ½ oz. silver for each 1% of lead. Worked continuously since 1914; four men employed. Owned by the Carbonate Lead Mines Company; president, John Salisbury, Hotel St. Francis, San Francisco; manager, R. M. Jones, Zabriskie.

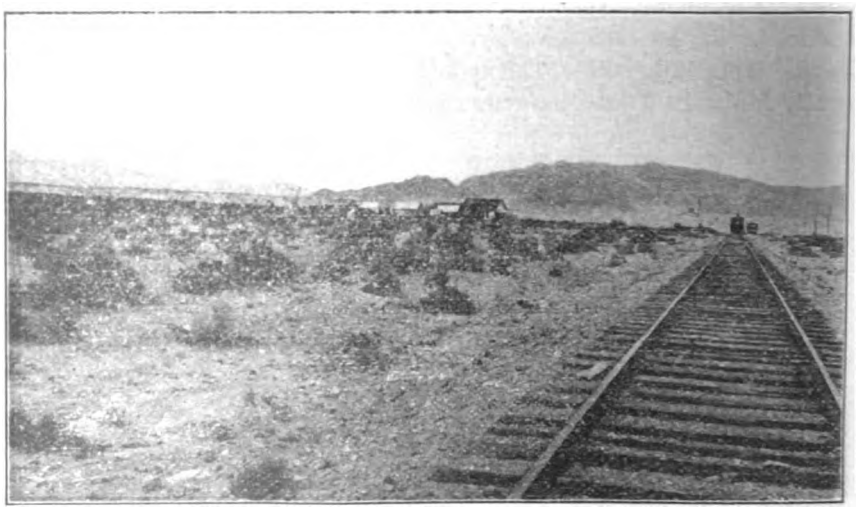


Photo No. 52. View of Zabriskie looking northward. Shipping point for Carbonate and Ibex Mines.

Cerro Gordo Mine (Lead-silver, Zinc). Situated near the summit of Cerro Gordo Peak, 8 miles by road east of Keeler. Elevation 8500 feet. As noted under Cerro Gordo district, the mine is a consolidation of the old Santa Maria and Union mines. Worked continuously from 1869 to 1876, and periodically up to 1907. Subsequently taken over by the Four Metals Mining Company, which erected a smelter east of Keeler and built an aerial tramway from the mine to the smelter. Company went into insolvency and litigation followed. In 1911, L. D. Gordon was granted a lease on all zinc deposits in the mine, and exploitation of the large zinc ore bodies on a commercial basis followed. The Gordon lease was operated continuously until September 18, 1915, and resulted in a large production of zinc ore. Upon the expiration of Mr. Gordon's lease it was taken over by the company and has been operated continuously since.

The country rock at the mine is fine-grained white marble, associated with some inter-stratified slate and a number of diorite and porphyry dikes. The lead-silver ore bodies are lenticular masses enclosed in marble near the contact with the dikes and occasionally have a slate

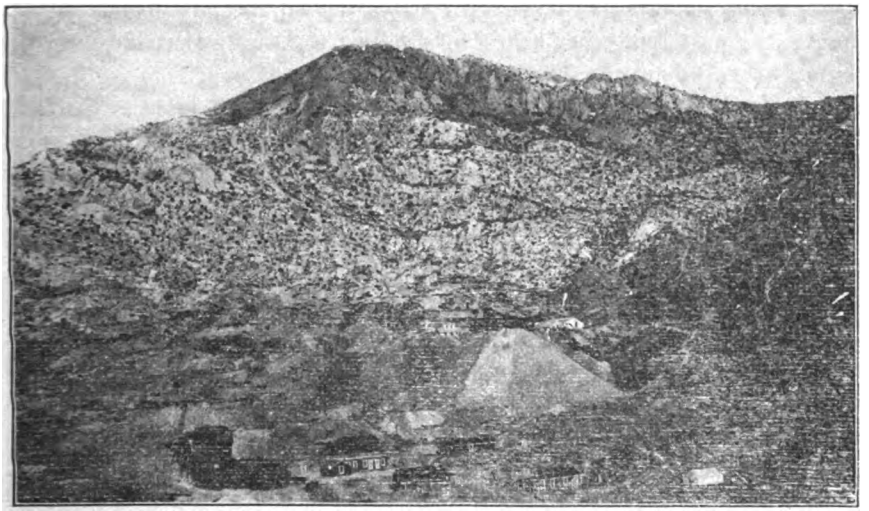


Photo No. 53. Hoisting plant and head of aerial tram of Cerro Gordo Mine, Inyo County.

footwall. They trend in a general NE. direction, dipping SE. 70° to 80°. The San Felipe vein, containing tetrahedrite, azurite and malachite, in a gangue of quartz and barite, cuts across the lead-silver ore bodies, trending N. 20° W. and dipping 70° SW. The zinc ore, smithsonite, forms irregular masses along the limestone footwall of the old lead stopes. Its presence was unsuspected until its discovery in 1907.

Development: There are said to be over 28 miles of tunnels and drifts in the Cerro Gordo mine. The ore now mined is worked through the Belshaw shaft, 900 feet deep, with levels at 200′, 400′, 550′, 700′ and

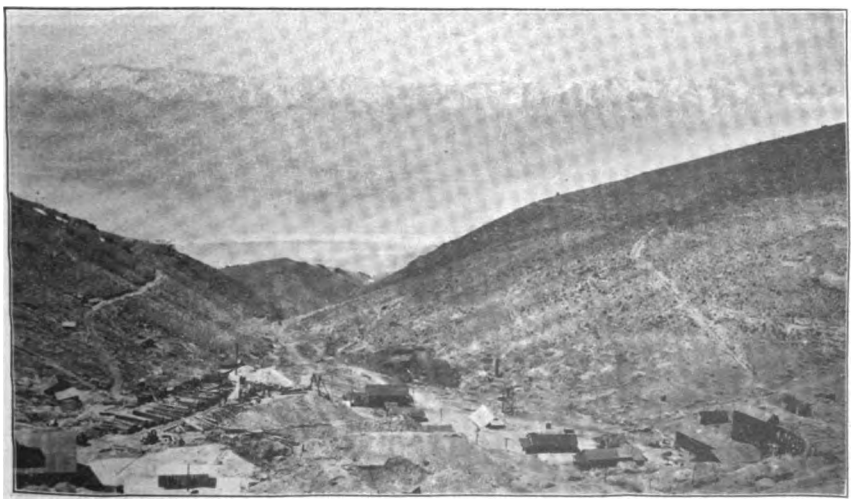


Photo No. 54. View westward from Cerro Gordo Mine, showing camp, dump, head of tramway, and old slag dump. Owens Lake and Mt. Whitney Range in the distance.

900′. From the 900-foot level a winze was driven 250 feet deep. Work during the past few years has been confined to mining the zinc ores in the old stopes above the 500-foot level.

Net earnings of the company for a period of five months ending February 29, 1916, amounted to $40,260, according to the report submitted to the stockholders. This is said to have been made principally from shipments of zinc.

A large body of zinc ore has been opened up above the 200′ level since the mine was visited in May, 1916.

Electric power was installed at the mine in January, 1916, supplied by the Southern Sierras Power Company. Equipment consists of a 100 h.p. electric hoist, Ingersoll-Rand compressor of 640 cubic feet capacity, and 100 h.p. oil-burning boiler to operate old steam plant in case of breakdown of power line. A Leschen aerial tramway, 29,560 feet long, carries the ore to the railroad at Keeler. Capacity of tramway 16 tons per hour. Twenty tons of ore, averaging not less than 28% zinc (no lead or silver), are shipped daily to United States Smelting and Refining Company at Salt Lake. Sixty men are employed. Owned by the Cerro Gordo Mines Company, First National Bank Bldg., San Francisco; L. D. Gordon, vice president and general manager; J. C. Climo, superintendent.

(See Bibl. Cerro Gordo District.)

Christmas Gift Mine (Lead-silver). Darwin district, 2 miles north of Darwin. Elevation 5300 feet. Adjoins the Lucky Jim Mine. Idle. Owner, L. D. Skinner, Lone Pine, Cal.

BIBL.: Rept. VIII, p. 226; Rept. X, p. 211; REPT. OF THE DIRECTOR OF THE MINT, Precious Metals in U. S., 1883-1884; U. S. G. S. Bull. 580-A, pp. 10-12.

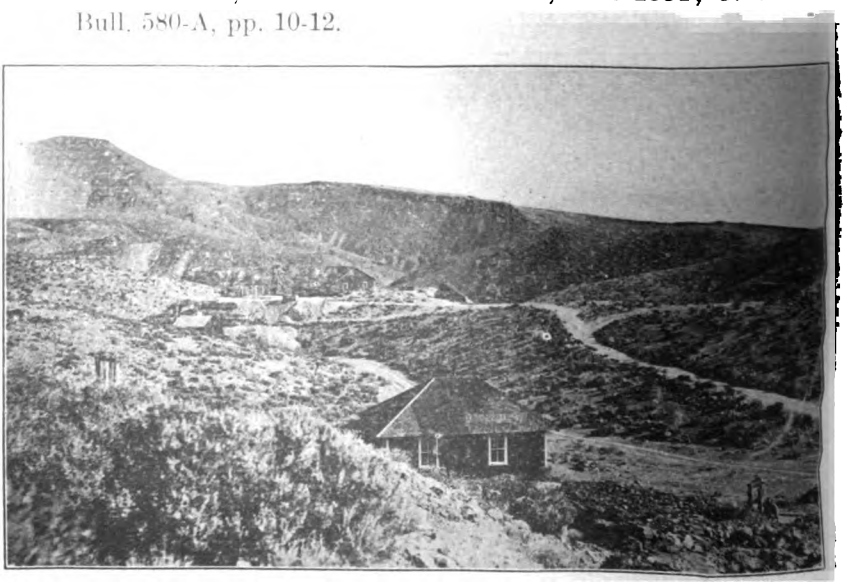


Photo No. 55. Christmas Gift Mine, near Darwin.

Cliff Mine (Silver). Kearsarge district, 12 miles west of Independence. Elevation over 8500 feet. Inaccessible 6 months during the year. No work done for forty years. Owned by John Naylor of Independence. For details of the Kearsarge district, see Ross Brown's Report in Mineral Resources West of Rocky Mts., 1868, p. 177, and Report of Director of Mint, 1883, p. 157.

Cliff Mine. Deep Spring district. A silver mine 5 miles south of Oasis, Mono County, but in the White Mountains of Inyo County, is reported to have been leased to Ed. J. King and J. C. King of San Francisco. The mine includes a large acreage and a large dump of good ore. It is reported that considerable ore has been blocked out by the old workings. It is proposed to haul the ore to Coaldale, Nevada, by motor trucks.

Columbia Mine (Lead-silver). Darwin district. Idle for many years. Recently taken over by the Darwin Development Co., which is to develop it in connection with their other properties in that vicinity.

Bibl.: Adolph Knopf, U. S. G. S. Bull. 580, pp. 17, 18.

Custer Mine (Lead, Silver, Gold). Darwin district, 1 mile east of Darwin. Elevation 4100 feet. The ore, principally lead carbonate and

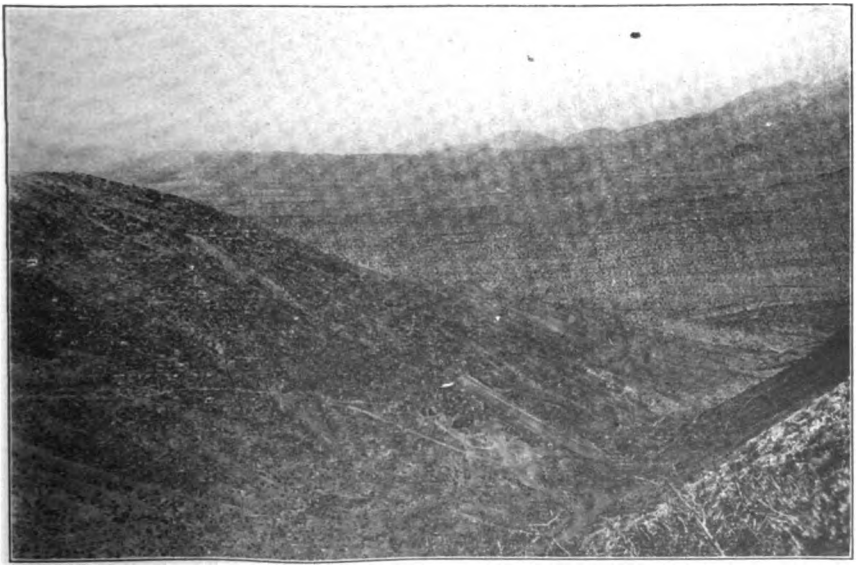


Photo No. 56. Custer Mine, Darwin.

galena, is found in bunches in a large irregular body of coarsely crystalline calcite. Fluorite occurs associated with the ore, or in the vicinity of the ore pockets, and its presence serves as a guide in the exploration for ore. Pyrite occurs in the calcite, and on the 400-foot level large bunches of it are exposed. The development consists of a 400-foot incline shaft, with levels at 100', 200', 300', and 400'. Equipment con-

sists of a 15 h. p. gas engine hoist and a 3-drill air compressor. The mine is said to have produced over $250,000 on ore averaging 30% lead, 150 to 200 ozs. silver and $4.00 in gold. Three men employed. Drifting is being carried on along the 400-foot level. The mine is under lease to Frank H. Long and Charles Grimes, of Pasadena; John H. Thorndike, manager.

Bibl.: Reg. of Mines, Inyo County, 1902; Adolph Knopf, U. S. G. S. Bull. 580, pp. 15, 16.

Daisy Mine (Lead-silver). Twenty-six miles south of east of Big Pine in the Waucoba unorganized district. On the east flank of Inyo Mountains. Elevation 7575 feet. Auto road to mine from Big Pine

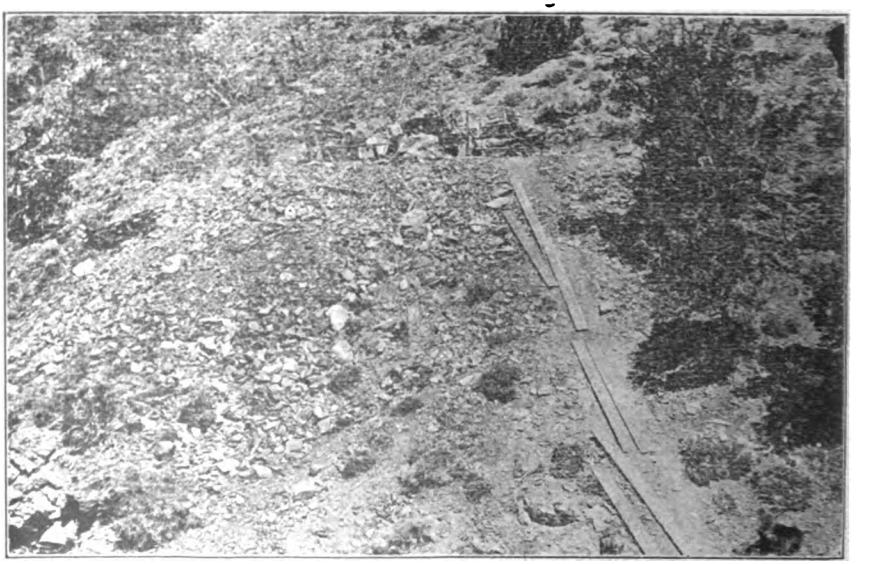


Photo No. 57. Shaft at Daisy Mine on the east flank of the Inyo Mountains.

(Saline Valley road). Fissure vein in limestone, varying from 6" to 2' wide. The ore is essentially coarsely crystallized galena and some lead carbonate, in a quartz and quartzite gangue. Vein strikes N. and S., dips steeply to the west. Sinking shaft on vein to a depth of 100 feet. Several prospect tunnels driven on vein, which can be traced along surface for several thousand feet. Hand drilling. Four men employed. Development work only. Owners, Hercules Mining Company, (Incorporated for 1,000,000 shares (@ 10¢ share), Wallace, Idaho. Manager, D. T. Bedell.

Defiance Mine (Lead-silver). Darwin district. Idle since 1910. Owned by Patrick Reddy Estate, Wm. Metson, Monadnock Bldg., San Francisco, trustee.

Bibl.: Rept. of the Director of the Mint, Precious Metals in U. S., 1883–1884; Rept. VIII, p. 226; X, p. 211; XII, p. 24; U. S. G. S., Bull. 580-A.

Gibraltar Mine (Lead-silver). South Park district, SE. of Ballarat in the Panamint Mountains. Elevation approximately 7000 feet. Ore occurs in lenses in limestone; 30% lead-carbonate ore, carrying 20 ozs. silver. Shipped by way of Trona by the Trojan Mining Company of Seattle, who formerly owned the mine. Owned by Domingo and Clairen, Ballarat, Inyo County, Cal.

Gunsite Mine (Lead-silver). Resting Springs district, 7 miles east of Tecopa. Elevation 2350 feet. Spur track, of the Tonopah and Tidewater Railroad, to the mine from Tecopa. The country rock is dolomite,

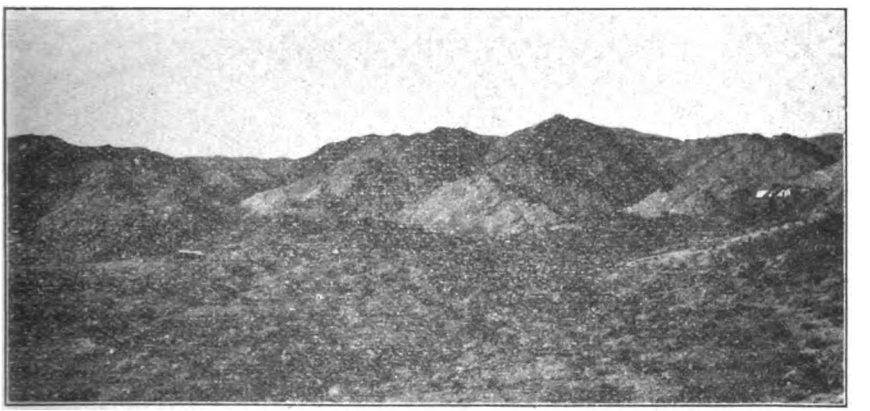


Photo No. 58. View eastward of Gunsite Mine and camp of Tecopa Consolidated Mining Co., 7 miles southeast of Tecopa.

overlaying quartzite. The ore is deposited in a vein, varying up to 20 feet in width, in the dolomite. Strike N. 45° W., dip N. 35°-50° E. The ore is principally carbonate of lead, with occasional stringers of galena. The vein matter is decomposed lime and iron oxides which are very easy to mine by hand work. A 1000-foot incline shaft has been sunk on the vein, with levels every hundred feet along the incline. Considerable drifting has been done on the 4th and 7th levels. The 4th level connects with the surface and is at present the main working tunnel. Equipment consists of a 73 h.p. gas engine and 15 h.p. Fairbanks-Morse hoist. The company owns and operates a locomotive for hauling ore and supplies from the mine to Tecopa. The ore averages from 7% to 12% lead, 7 to 12 ozs. silver, $1.50 in gold, and is shipped to the smelters at Salt Lake. A 75-ton concentration mill is being installed near the Amargosa River, just south of Tecopa and includes a Ball mill, tube mill, jigs and Wilfley tables. A distillate engine supplies power. The mine was discovered and first worked in 1865. A smelter erected in the district a few years later now lies in ruins. Idle for many years.

Taken over and operated continuously since 1912 by the present company; fifteen men employed. Adjoins Noonday Mine, owned and operated by same company. Owners, Tecopa Consolidated Mining Company, L. D. Goodschall, vice president and general manager, Tecopa, Cal.

Bibl.: REPT. OF THE DIRECTOR OF THE MINT, Precious Metals in U. S., 1883, p. 166.

Photo No. 59. Main working level of Gunsite Mine.

Hiram Shaw is working a lead-silver prospect 15 miles northeast of Shoshone in the north end of the Nopah Range. No production.

Ibex Mine, or Arcturus (Lead-silver. Zinc). Situated in the Black Mountains, 16 miles southwest of Zabriskie and 6 miles north of Saratoga Springs. Elevation 1300 feet. Although this property is recorded in Inyo County, it is actually located in San Bernardino County.

The deposit is a vein, averaging 3′ to 5′ wide, in dolomite. Strike N.-S., dip E. The vein can be traced on the surface along its strike for 1800′. The ore is argentiferous galena and carbonates of lead and zinc. Occasional bodies of anglesite and linarite are associated with the galena. Shipping ore is said to have averaged 44% lead, 33% zinc, 16 ozs. silver and $16.00 in gold. Development consists of 4 tunnels, the longest being 100 feet on vein. Mining at present is confined to gouging out rich ore bodies near the surface; 19 men employed at $4.00 per shift. Ore is sacked at the tunnels and packed on burros down to the camp where it is transferred to a 4-ton Kelly quad motor truck, which hauls it to Zabriskie. From 7 to 8 tons are produced daily. Located September,

1914. Worked since January, 1916, by the Ibex Spring Mining Company, of which S. F. Brock is manager. Property recently reported purchased by the Goodsprings Mining Co., of Nevada.

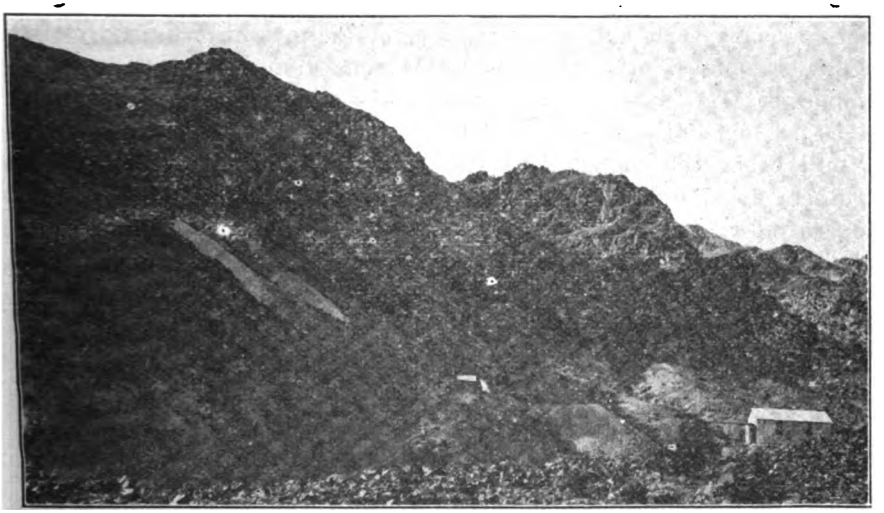


Photo No. 60. Mine dumps and compressor plant at Ibex Mine, 15 miles west of Zabriskie, in Amargosa Range.

Ignacio Mine (formerly Saint Ignacio), (Lead-silver). Cerro Gordo district, 6 miles by road east of Keeler. Elevation 7800 feet. The deposit is a well-defined quartz, fissure vein in limestone. Strike N.–S., dip E. Average width 8′ to 10′. The ore is essentially argentiferous galena, which in places is oxidized to the carbonate. Linarite, the double

Photo No. 61. Ignacio (in foreground) and Ventura Mines in Inyo Mountains, 1 mile below the Cerro Gordo Mine.

sulphate of lead and copper, is occasionally found with the galena, but not in commercial quantities. Development consists of a 500-foot shaft and a 2000-foot main working tunnel. Considerable drifting and stoping has been done. The mine was first worked from 1867 to 1882 but has been idle for many years and was taken over by the present owners in 1915. Work is confined to stoping above the main tunnel; and 7 men are employed. The first-class ore is hauled by team to Keeler, at a cost of $2.50 per ton, and shipped to Salt Lake. Second-class ore is trammed to a mill below the tunnel. The mill consists of one 9″ x 15″ Blake crusher; five 750-lb. stamps; one Wilfley concentrator; one Robertson concentrator; three separate gas engines used to operate makeshift plant. Mill operated one shift daily, crushing 6 tons. Concentrates shipped to smelter. Owned by the Ignacio Mining Company; president, P. M. Price, San Diego, Cal.; superintendent, F. C. Everett.

Bibl.: R. W. Raymond, MIN. RESOURCES W. OF ROCKY MTS., 1870, p. 17; S. M. B. Reg. of Mines, Inyo County, 1902.

Independence Mine (Lead-silver). Darwin district, adjoins the Defiance Mine and is of the same ownership, the Estate of Patrick Reddy. Idle.

Bibl.: REPT. OF DIRECTOR OF MINT, Precious Metals in U. S., 1883, p. 164; 1884, p. 163. STATE MINERALOGIST REPT., VIII, p. 226; X, p. 211; Reg. of Mines, Inyo County, 1902; U. S. G. S. Bull. 580, pp. 14, 15.

Lane Mine (Lead-silver). Darwin district, Sec. 13, T. 19 S., R. 40 E., M.D.M., 2 miles NE. of Darwin, on east flank of Darwin Hills. Elevation 4100 feet. Well defined vein, inclosed in lime, varying up to

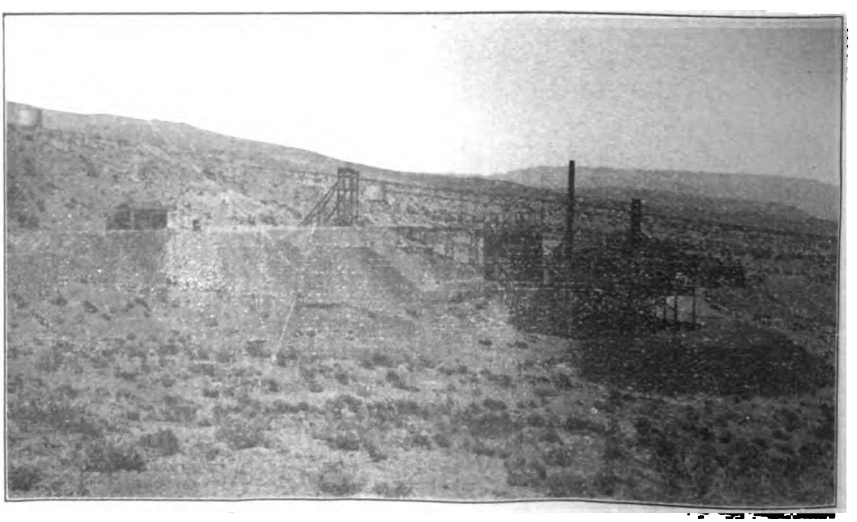


Photo No. 62. Old smelter and hoist at Lane Mine near Darwin. Property of Darwin Development Co.

20 feet in width. Strike N. 65° E., dip 80°–85° N. The ore, galena and lead carbonate, occurs in bunches in the vein. Gangue, fluorite and calcite. Some veinlets of chrysocolla are exposed in the lowest workings of the mine. Mine is opened by two shafts, 300 feet apart, 750′ and 725′ deep, respectively. Levels at each 100 feet in depth connect the shafts. There are over 2000 feet of drifts in the mine. A 12 h.p. gas engine hoist is installed at one shaft and a 30 h.p. steam power hoist at another. A 25-ton capacity single stack, water-jacket blast furnace erected here several years ago; operated only a few months. A Murex

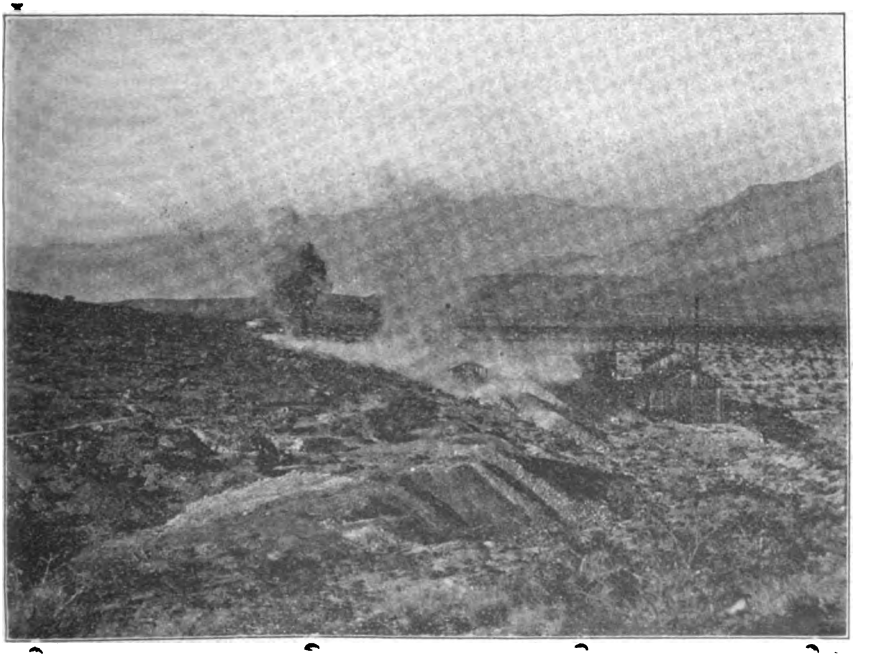


Photo No. 63. Excavating for Murex Concentration Mill at Lane Mine, near Darwin.

oil concentration mill is being installed to treat second-grade ores of the group of mines operated by this company. The capacity of this mill is said to be 25 tons and will be ultimately increased to 250 tons.

The mine is said to have produced $500,000. Actual development will be undertaken upon completion of the mill. Owners, Darwin Development Co., 71 Broadway, New York; F. N. Weeks, consulting engineer.

Bibl.: Rept. XII, p. 24; Rep. XIII, p. 32; U. S. G. S. Bull. 580-A.

Lee Mine (Emigrant Mine), (Lead-silver, Zinc). Lee district, east of Cerro Gordo, 26 miles by auto road from Keeler. Said to have produced lead ore rich in silver. Under lease to J. R. LeCyr, of Lone Pine,

who is working two men on a zinc deposit exposed in old workings. Owned by Dr. I. J. Woodin and William Skinner of Independence, Cal.

Bibl.: REPT. OF DIRECTOR OF MINT, Precious Metals in U. S., 1883. p. 163.

Lucky Hike Prospect (Lead-silver). Located in the Waucoba unorganized district, 28 miles east of Big Pine. Elevation 7060 feet. Some large bunches of galena found in quartz croppings along top of low hogbacks. Country rock, calcareous slate and schist. Formations shattered and quartz does not appear to be in place. Driving crosscut

Photo No. 64. Lucky Jim Mine, near Darwin.

tunnel at base of hill, hoping to strike vein in place; 3 men employed. Owners, Lloyd Bedell, F. M. Bedell, V. Richardson, Big Pine, Inyo County, Cal.

Lucky Jim Mine (Lead-silver). Darwin district, 2 miles north of Darwin, adjoins the Christmas Gift Mine. Good auto road to Keeler, 24 miles distant. The country rock limestone intruded by a porphyry dyke. The vein cuts across lime beds striking N.–S. and dipping 65° to 80° W. The ore consists principally of the oxidized ores of lead carrying a little silver but no gold. Galena occurs in bunches in the vein. The mine is operated by a 300-foot vertical shaft, and a 300-foot incline shaft 600 feet from the bottom of the vertical shaft. Drift levels are driven

about every hundred feet. Considerable stoping on the vein has been done above the 300-foot level. The ore body is now being stoped below the 300-foot level. It is the intention of the company to sink the vertical shaft to the 600-foot level, or deeper, to avoid handling ore twice in hoisting. The vertical shaft is equipped with a hoist run by a distillate engine. Incline shaft from 300-foot level equipped with compressed air hoist; 25 h.p. Diesel type engine to operate 32 h.p. compressor. Machine drills are to be installed in mine. Some 30 men are employed. From 8 to 10 tons of first-class ore (averaging $40.00 lead and silver) are hauled daily, with Knox tractor, to Keeler. The ore is shipped to Salt Lake. An aerial tramway is to be built to the Lane mill, where the low-grade ores will be concentrated. The mine was located in 1874 and taken under bond and lease by the present company in December, 1915. Said to have produced $1,500,000. Darwin Development Co., 71 Broadway, New York; F. N. Weeks, general manager; J. E. Rea, Superintendent.

Bibl.: MIN. RES. W. OF ROCKY MTS., 1876, p. 25; REPT. OF DIRECTOR OF MINT, Precious Metals in U. S., 1883, p. 163; STATE MINERALOGIST REPT. VIII, p. 226; X, p. 211; XII, p. 24; Reg. of Mines, Inyo County, 1902; U. S. G. S. Bull. 580, pp. 12, 13.

Minneatta Mine (Lead-silver, Zinc). Located in the Lookout (Modoc) district 28 miles north of Trona. East slope of Argus Mountains. Elevation approximately 3000 feet. Under lease to Grim and Sexton, of Los Angeles, Cal. Present work confined to mining zinc carbonate exposed in old stopes. Ore hauled to Trona in 2½-ton motor truck, making one trip daily. Twelve men are employed. Owned by J. J. Gunn, Independence, Cal.

Bibl.: R. W. Raymond, MIN. RES. WEST OF ROCKY MTS., 1876,; p. 32; Rep. X, p. 212.

Modoc Mine (Lead-silver). Lookout district, 30 miles north of Trona, 2 miles north of the Minneatta Mine. Elevation 3500 feet. Idle for many years.

Bibl.: Rept. XII, p. 24; Rept. XIII, p. 32; Reg. of Mines, Inyo County, 1902; REP. OF DIRECTOR OF MINT, Precious Metals in U. S., 1883, p. 164; 1884, p. 104.

Monster Mine (Lead-silver). Situated on the east slope of the Inyo Mountains, northwest of the Saline Valley. Located in 1907. Large body of argentiferous galena mined. No work for several years. Relocated January 1, 1916, by Frank Butler and Sam Watson, of Big Pine, Inyo County, Cal. Idle.

Bibl.: Adolph Knopf, U. S G. S. Bull. 540, p. 111.

Montezuma Mine (Lead-silver), is 10 miles by road southeast of Big Pine on the western slope of the Inyo Range. Elevation 4700 feet.

The country rock is limestone and slates, which have been greatly shattered and faulted. The vein follows the trend of a major fault, NW.–SE. The ore is chiefly lead carbonate, in a gangue of iron oxide and decomposed lime. Galena in a quartz gangue is also encountered. Development consists of two tunnels, the lower driven to crosscut the vein. Greatest depth on vein 240 feet. The ore is trammed to a reserve bin at the camp in 1-ton cars, operating on a 3-rail gravity tramway 1000 feet, on a 30° incline. Teamed to Elna, a station 2 miles east of the mine on the California and Nevada railroad. Four trips are made daily carrying 2½ to 3 tons per load. A furnace erected at Elna in the early eighties has been dismantled. The ore is shipped to the Salt Lake smelters. Ten men are employed at $3.50 per day. The mine is bonded to John Mitchell, Lone Pine, Cal.

Bibl.: Rept. of Director of Mint, Precious Metals in U. S., 1883, p. 158; 1884, p. 100; S. M. B. Rept. XIII, p. 32; Reg. of Mines, Inyo County, 1902; U. S. G. S. Bull. 540, pp. 109, 110.

Nancy Hanks (Lead-silver). Located in the Waucoba unorganized district, 28 miles by road southeast of Big Pine, on east flank of Inyo

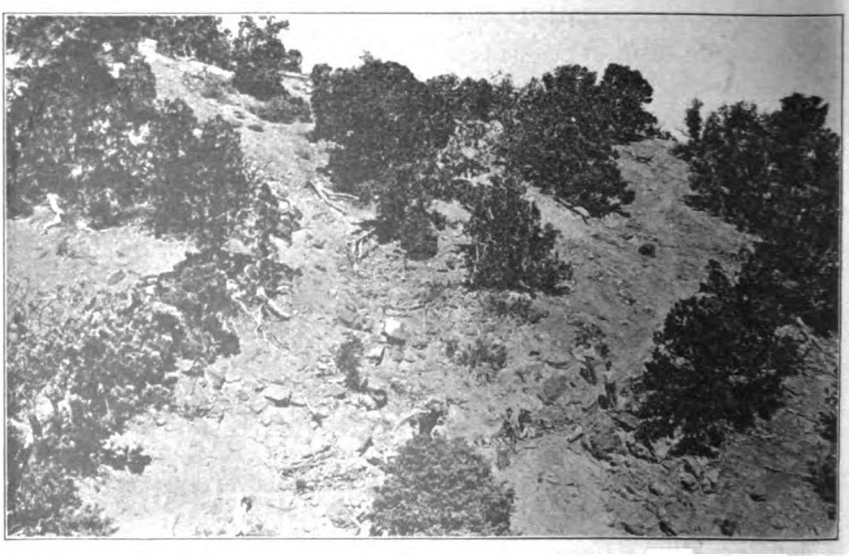


Photo No. 65. Entrance to Nancy Hanks Mine, on the east flank of the Inyo Mountains.

Mountains. Elevation 8250 feet. The ore is a quartz vein, carrying bunches of coarsely crystalline galena, in a formation of limestone and shale. The country rock, as exposed in a 60-foot tunnel driven on the vein, is crushed and shattered and the vein does not appear to be in place but lies flat along this crushed zone. The property is difficult of access and is reached by the Big Pine road to the Daisy mine and by

trail from the Daisy mine two miles up a ridge. Located January, 1916; started development April 1, 1916. There were 3 men employed. Owned by George B. Warren, Big Pine, Cal.

Noonday and **Grant Mines** (Lead-silver, Zinc). Located in the Resting Springs district, 9 miles southeast of Tecopa and 2 miles southeast of the Gunsite Mine. Elevation 2880 feet. Railroad spur to Noonday Mine. The deposit is a continuation of the Gunsite vein, striking N. 40° W., dip 45° NE. The ore is in general the same as that at the

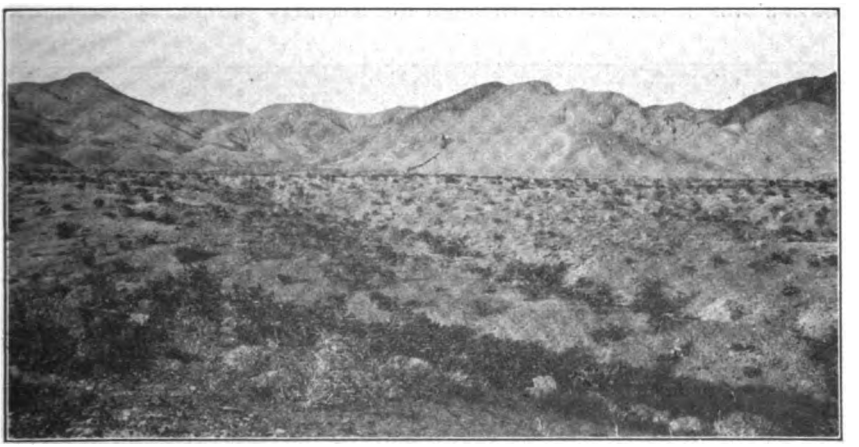


Photo No. 66. Noonday Mine, Tecopa Consolidated Mining Co.

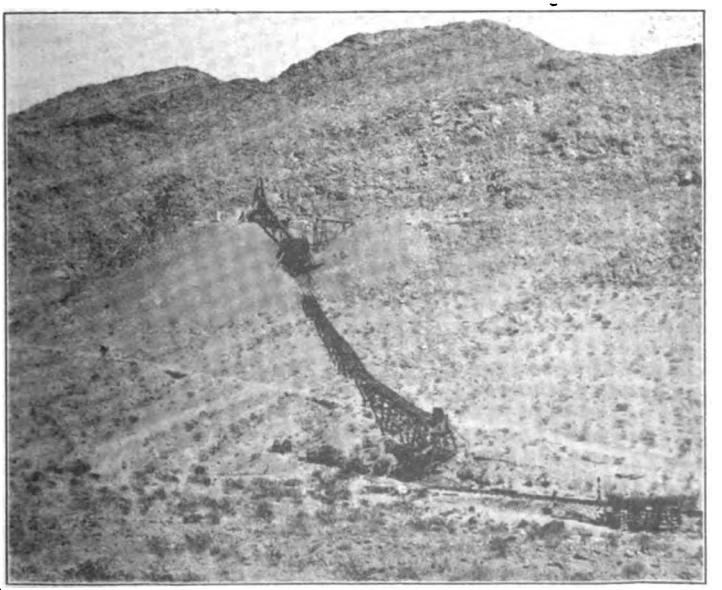


Photo No. 67. Gravity tram and ore bin at Noonday Mine.

Gunsite mine, but some zinc carbonate is found in the upper tunnel. The mine is opened by a 400-foot incline shaft and 3 tunnels. Upper tunnel, called the surface tunnel, at collar of shaft, is 400 feet long. The second tunnel on the 100-foot level is 400 feet. The main working tunnel, or 200-foot level, is 200 feet in length. The main working tunnel is driven through the hill to connect with the Grant Mine. The latter is situated 900 feet across a gully from the south portal of the main tunnel. A 60-foot shaft has been sunk at the Grant and drifting has been done along the vein at the bottom of the shaft. Ore is trammed to storage bins at the railroad through the Noonday tunnel. Fifteen men

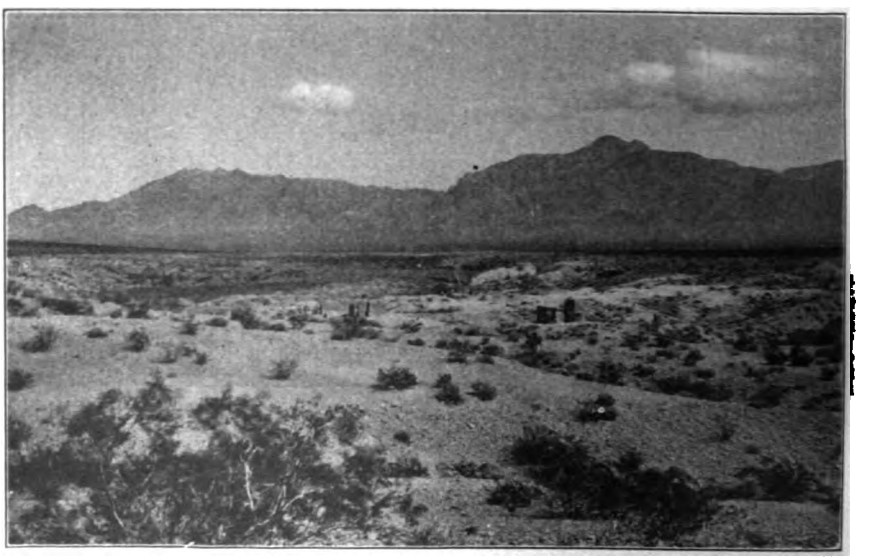


Photo No. 68. Old Tecopa Smelter, south of Noonday Mine. Kingston Range in the distance.

employed at $3.50 per day. From 500 to 1000 tons of ore have been shipped to a Salt Lake smelter from the group of mines operated by the Tecopa Consolidated Company since 1912. Second-class ore (lower than 6% Pb) will be concentrated upon completion of the mill. (See Gunsite Mine).

Opal Mine (Lead-silver). Waucoba unorganized district, 26 miles southeast of Bishop and adjoining the Daisy Mine. Elevation 7160 feet. Two parallel veins, about 100 feet apart, striking N. 20° W., dip 30°, are inclosed in limestone. The veins are 18″ wide and carry galena. Development consists of four 30 foot to 50 foot shafts sunk on the two veins. Idle. Worked for assessment only. Owned by Walter Bird and Russel Steward, of Big Pine, Cal.

Ophir Mine (Lead-silver, Zinc). Situated 10 miles northeast of Trona, at the base of the Slate Range. Elevation 2100 feet. The ore body consists of a vein, varying in width from 6″ to 4′, inclosed in limestone. The vein material is highly oxidized, containing essentially carbonates of lead. Galena occurs occasionally as bunches in the vein. Zinc carbonate occurs in the walls, but mining has been chiefly carried on in the lead ores. The ore is said to average 40% Pb, with a few ozs. of silver. The mine is opened by a 120-foot 60° incline shaft

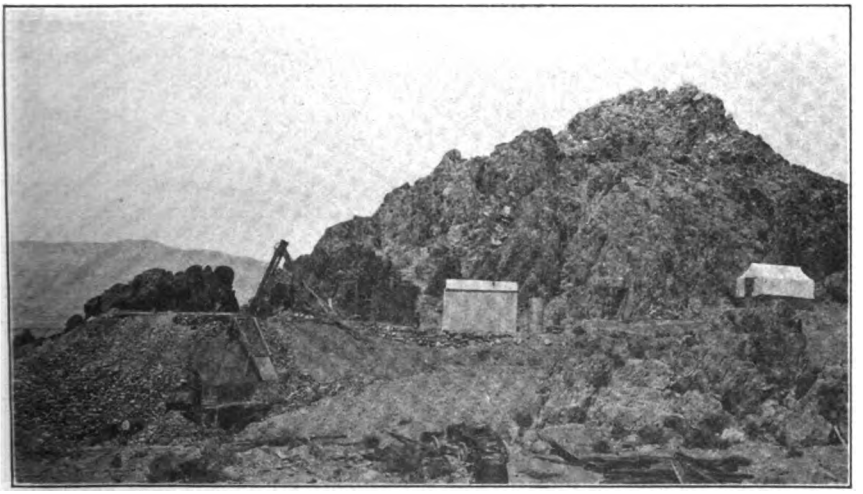


Photo No. 69. Ophir Mine, 4 miles east of The Tanks, southern Inyo County.

on the vein. Drifts are being driven at the 60-foot and 100-foot levels. The shaft is equipped with a 12 h.p. gas engine hoist. Mining with auger drills; 4 men employed. Opened November, 1915, and worked continuously since. Ore is hauled to Trona in three 2½-ton motor trucks, making two round trips daily. Owners, T. Thorkildsen and T. H. Rosenburg, 320 Trust and Savings Bldg., Los Angeles, Cal.

Promontory Mine (Lead-silver). Located in the Darwin district, 1½ miles south of Darwin. Elevation 5000 feet. Wagon road to mine. The ore body is highly oxidized and inclosed in lime. Strike N. 20° W., dip 30°. The ore consists of lead carbonate and galena. Opened to a depth of 320 feet on the vein by an inclined shaft. Five levels. It was impossible to estimate the amount of work done, since the shaft is caved below the 180-foot level. Present work is confined to drifting on the 180-foot level. The hoist is run by a 6 h.p. gas engine. The mine was first worked in 1874 and taken over in December, 1915, by the present

company, which is developing it in connection with their other mines. Four men working. Darwin Development Company, 71 Broadway, New York.

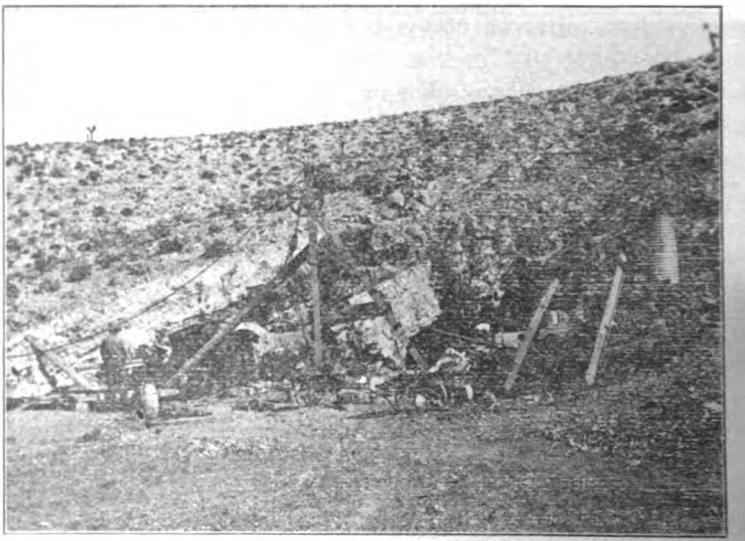


Photo No. 70. Promontory Mine, near Darwin. Darwin Development Co.

Raven Mine (Lead-silver). Ubehebe district, 60 miles southwest of Bonnie Claire, Nevada, and 5 miles north of Dodds Springs. Elevation 3800 feet. A tunnel is being driven in hard white limestone, to cut a vein which outcrops on the mountain several hundred feet above. The tunnel was 300 feet long when visited. Over 1500 feet of tunnels, mostly crosscuts. Several stringers of good ore encountered. Thirty tons of ore, averaging 60% lead, ready for shipment. Two men working. Owned by J. Crook and A. Farrington of Big Pine, Cal.

Redwing Mine (Lead and Zinc). Resting Springs district, 4 miles northeast of Shoshone, on west slope of Resting Springs Mountains. Vein, containing carbonates of lead and zinc, inclosed in limestone. Opened to a depth of 99 feet, on 45° incline. Drifts east and west of shaft at 20-foot level. Formerly mined only for lead. Now being mined for zinc ores by R. M. Jones of Zabriskie. Owned by R. J. Fairbanks of Shoshone, Inyo County, Cal.

Royal Group (Spear Mine), (Lead, Silver and Zinc). Cerro Gordo district, 1 mile north of Cerro Gordo Mine, along top of ridge 8 miles east of Keeler. Elevation 8400 feet. Claims: Lead King, Lead Queen, Lead Prince, Princess, Dutchess, Czar, Bluff. Development consists of a 100-foot incline shaft with 100′ drift on 50-foot level and 175′ drift on

100-foot level. Equipped with 6 h.p. gas engine hoist. Fifty-foot winze sunk from 100-foot level, and 75′ drift from bottom of winze. The ore occurs as galena, lead carbonate and zinc carbonate as replacement along contact of limestone with diorite dikes. Said to have produced 1000 tons of lead-silver ore that averaged 35% to 40% lead, 35 to 40 ozs. silver, $2.00 to $3.00 gold. The zinc ore runs 40% and over. The ore body varies from 1 to 15 feet thick and strikes NW.–SE. Idle. Worked for assessment only. Owned by R. C. Spear of Lone Pine, Cal.

Santa Rosa Mine (Lead-silver). Lee district, east of Cerro Gordo and 26 miles by road from Keeler. Elevation 7000 feet. The country rock is limestone, intruded by coarsely crystalline porphyritic dikes.

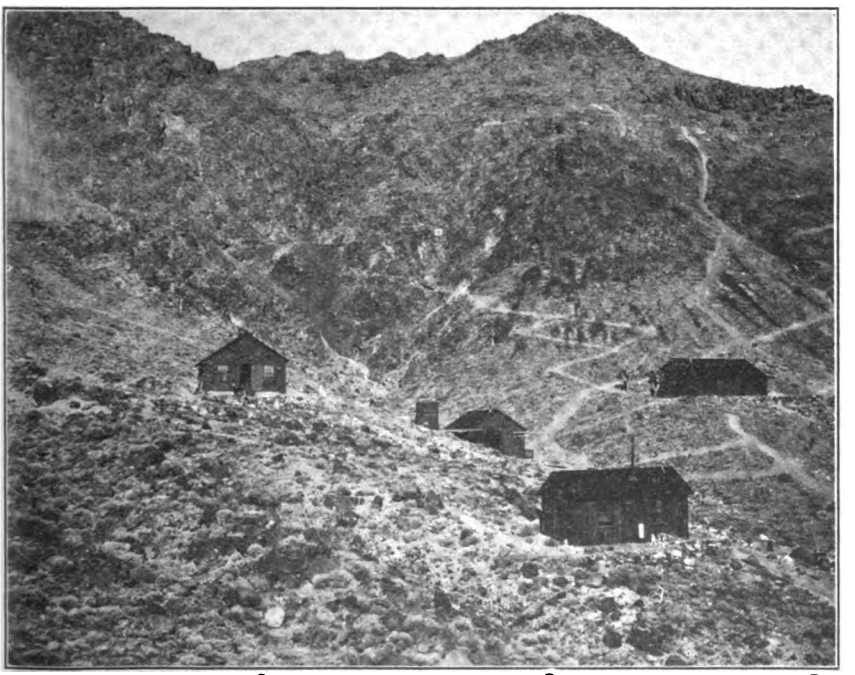


Photo No. 71. Santa Rosa Mine.

The ore is deposited in veins along the limestone and igneous contacts. There are two systems of veins, the principal one trends N.–S. and the lesser one E.–W. Average width 4 feet. Ore is galena, with its oxidation products, chiefly lead carbonate. The E.–W. veins carry oxides of copper in small amounts, as well as lead. The many excellent outcrops of rich ore bodies would indicate a high degree of mineralization; however, the ore bodies are apparently superficial. Many shafts have been sunk

on the different outcrops, but the values do not continue with depth. The mine is opened by a main tunnel 200 feet long, 240 feet below a very promising outcrop. Many drifts, crosscuts and upraises were driven from the tunnel, but the rich ore was in all cases found close to the surface. Mine idle for several years, reopened April, 1916. The dump below the main tunnel is said to average 13% lead, with 1 oz. silver for each 1% of lead. Work consists of hand-sorting the ore from the old dumps and doing some drifting in the main workings; 4 men employed. Ore hauled to Keeler, at $6.50 per ton, and shipped to smelter. J. H. Price, superintendent. Owners: Independent Lead Silver Mining Company, Syndicate Bldg., Oakland, Cal.

Silver Reef Prospect (Lead-silver). South Park district, 6 miles east of Ballarat, near summit of Panamint Range. Ore is said to vary from 2% to 18% lead and carries from 12 to 98 ozs. silver. Development consists of 16 open cuts, one 16-foot shaft and a 26-foot tunnel along the vein. Idle. Owner, J. A. Gilliam, Ballarat, Cal.

Silver Rule Mine (Lead-silver, Zinc), recorded in Inyo County, is actually in San Bernardino County, about ¼ of a mile south of Inyo County line. Seventeen miles east of Morrison's Siding, on the Tonopah and Tidewater railroad, on the north flank of the Kingston Mountains. Elevation 4600 feet. Ore body contains carbonates of lead and zinc. Opened by two tunnels, the upper 220 feet, the lower 120 feet. Formerly worked for the lead-silver ores. About 140 tons shipped during 1910, which averaged 48% lead, 26 ozs. silver, $0.60 gold per ton. The unsuspected zinc ores were thrown on the dumps. Three men employed sorting the zinc ore from the old dumps. Packed on burros to camp at Crystal Springs, at $3.00 per ton and hauled by team to railroad at $5.00. About 30 tons ready for shipment. Owner, John Chambers, Tecopa, Cal.

Troeger's Tunnel, Cerro Gordo district, is 4.7 miles by road east of Keeler, on the west flank of Inyo Mountains, below the Cerro Gordo Mine. Elevation at tunnel 6010 feet. The tunnel, started in 1909 and now 6700 feet long, is being driven to crosscut the San Felipe vein, which outcrops 2500 feet above. Strike of tunnel N. 57° E. Formation, limestone. At 3700 feet from the portal a fault zone about 150 feet in width was encountered. This zone is traversed by numerous quartz stringers, which contain small amounts of tetrahedrite, galena, sphalerite and pyrite. Drifts were driven for several hundred feet both N. and S., from the tunnel, along this zone. At 6000 feet from the portal a narrow quartz vein was encountered carrying sulphides of copper and lead. The owners expect to cut the San Felipe vein within another 100 feet.

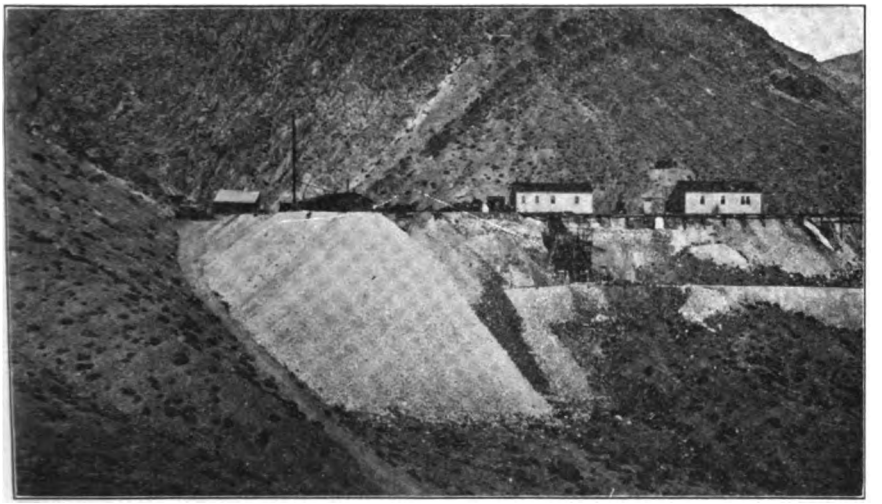


Photo No. 72. Troeger Tunnel of the Estelle Mining Co., east of Keeler.

Equipment consists of 32 h.p. distillate engine, air compressor and machine drills. Water is piped by gravity, 10,000 feet, from mountain springs to the plant. No production; 4 men employed. Owned by the Estelle Mining Co., 310 South Grand St., Los Angeles, Cal., R. C. Troeger, general manager and secretary.

Bibl.: Adolph Knopf, U. S. G. S. Bull. 540, p. 110.

Ubehebe Mining Company (Lead-silver). Ubehebe district, 52 miles by road southwest of Bonnie Claire, Nevada. Elevation 3930 feet. The country rock is limestone, intruded by diorite dikes. The deposit is an irregular lenticular replacement in the limestone, varying up to 15 feet in width. The ore consists principally of oxidized ores of lead, carbonate and lead sulphate, with occasional bunches of galena. Development consists of two tunnels, the upper 60 feet long and the lower, connected by a 50-foot winze, 100 feet long. No ore has been encountered in the lower tunnel. The upper tunnel is in an ore body which appears to have been faulted from the main deposit, croppings of which appear along the summit of a low ridge several hundred feet above the mine. Some ore was shipped from these main upper deposits after the mine was visited. The displaced ore body was being worked when visited, and was practically worked out. Ore is hauled by contract to Bonnie Claire; two Yuba tractors of 10-ton capacity were being used. Round trip made in 52 hours. Said to haul the ore at a cost of $8.00 per ton. Mine worked since November, 1915. Up to April the mine had produced 200 tons of 60% lead ore. Three men employed. Owner, W. W. Waterson, Bishop, Cal.

Photo No. 73. Ubehebe Lead Mine, and tractor for hauling ore 52 miles to Bonnie Claire, Nevada.

Ventura Mine (Lead-silver). Cerro Gordo district, 6½ miles by road east of Keeler. Situated on the western flank of the Inyo Mountains, below the Cerro Gordo Mine. Elevation 7800 feet. The country rock is limestone and diorite and the ore body is deposited along a fault plane in the limestone. The limestone beds strike N. 80° W. and the ore body strikes N. 35° W. The mine is opened by a 150-foot vertical shaft and a main working tunnel cutting the shaft at the 100-foot level. The main tunnel runs N. 35° E., then swings N. 35° W., and follows 125 feet along the fault. The ore is mainly lead carbonate and silver. Some zinc carbonates have been left unworked. The property was taken under 3-year lease on April 1, 1916, by H. G. Eldridge who is shipping

about 20 tons of ore per month, said to average 48% lead and 20 ozs. in silver per ton. Two men working. Owned by the Ventura Mining Company of New York.

MARBLE.

The marble deposits of Inyo County occur on the southwestern flank of the Inyo Range and extend for about 6 miles northeastward from Swansea station. The mountain range here consists of folded and faulted sediments of Carboniferous and Triassic age, altered by regional metamorphism to slates, quartzites and marbles, intruded by occasional basic dikes. The marble outcropping along the base of this range shows a thickness of at least 500 feet. The beds are tilted at a high angle, dipping northwestward into the mountain. They are fractured and faulted, so that the marble is considerably shattered at the surface. The marble is dolomitic, generally fine-grained, hard, and very resistant to weathering, as indicated by the sharp corners and fresh surfaces of the talus blocks. Three varieties are found, a pure white marble, a beautiful yellow marble and a variegated marble of white ground mass, penetrated by dendridic markings of manganese. The white marble is the one upon which most of the quarrying has been done. This takes a beautiful polish, as is exemplified by its use in the Mills Building, of San Francisco.

These deposits were first quarried in 1888 by the original Inyo Marble Company, of San Francisco, of which M. J. McDonald was president. The quarries lay idle for a number of years due to the shattered condition of the marble and the expense in obtaining large blocks. Assessment work was not kept up and the claims were relocated by the present owners, now known also as the Inyo Marble Company.

Inyo Marble Company, D. H. Dunn et al., of Los Angeles, have filed locations on twenty-four 160-acre claims, along the total length of the marble outcrops, including the property of the old Inyo Marble Company. A spur track of the California and Nevada Railroad runs to the quarry. Water for working purposes is obtained from artesian wells. There are three openings along the outcrop, the largest and most important of which produces the white marble. When visited, large talus blocks of this white marble were being hand broken and shipped 7 miles south to the plant of the Natural Soda Products Company for generating carbon dioxide. (See Dolomite.) A number of large blocks of the white marble were lying at the base of the quarry, ready for shipment, but no further work was being done.

Bibl.: Rept. X, 215; Rept. XII, 392; Rept. XIII, 628; Bull. 50, pp. 99, 100; MINING AND SCI. PRESS, July 20, 1912.

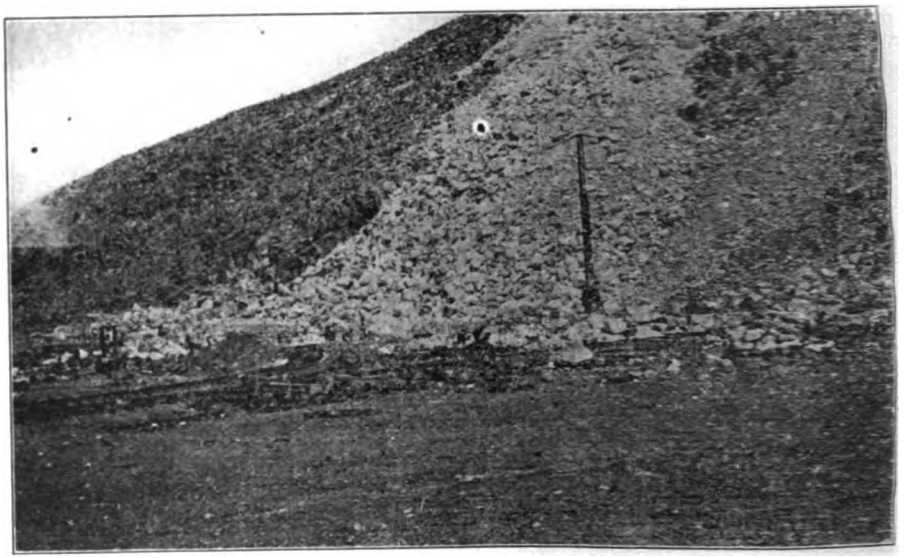


Photo No. 74. Marble Quarry of the Inyo Marble Co., north of Keeler.

MINERAL SPRINGS.

The descriptions of the mineral springs of Inyo County are here quoted from the report of Mr. Gerald A. Waring, "Springs of California," Water Supply Paper 338, issued by the U. S. Geol. Surv., 1915.

A few saline waters that are obtained from wells and lakes have become known as mineral-spring waters and therefore may be mentioned among the saline springs.

Castalian Mineral Water, which has been sold for medicinal use, has been obtained either directly from Owens Lake, in Inyo County, or from springs close to its shore. An analysis that is thought to represent the bottled water is here tabulated with analyses of water from Owens Lake. The analyses indicate that the waters are similar in character, if not identical, being primary saline and alkaline:

Analyses of Castalian Mineral Water and Water From Owens Lake, Inyo County, California.

(Constituents are in parts per million.)

	1		2		3		4	
Properties of reaction:								
Primary salinity		56		57		55		54
Secondary salinity		0		0		0		0
Tertiary salinity		0		0		0		0
Primary alkalinity		44		43		45		46
Secondary alkalinity		Trace		Trace		Trace		Trace
Tertiary alkalinity		(?)		(?)		(?)		(?)
Constituents	**By weight**	**Reacting values**	**By weight**	**Reacting values**	**By weight**	**Reacting values**	**By weight**	**Reacting values**
Sodium (Na)	29,300	1,273.5	21,660	941.7	26,840	1,167.0	81,180	3,530.0
Potassium (K)	1,188	30.4	2,750	70.4	1,548	39.6	3,448	88.2
Lithium (Li)			Trace	Trace			57	8.2
Rubidium (Rb) and caesium (Cs)			0	0			Traces	Traces
Thorium (Th)							Trace	Trace
Calcium (Ca)	Trace	Trace	Trace	Trace	13	.7	34	1.7
Magnesium (Mg)	Trace	Trace	Trace	Trace	4.7	.4	15	1.2
Iron (Fe)	Trace	Trace			9.2	.3		
Aluminum (Al)			Trace	Trace	12	1.3	(a) 48	5.3
Sulphate (SO_4)	7,530	156.9	9,360	194.8	7,065	147.2	21,170	440.7
Nitrate (NO_3)			Trace	Trace			948	15.3
Chloride (Cl)	20,200	569.7	13,440	378.9	18,220	514.0	52,900	1,492.0
Bromide (Br) and Iodide (I)	Traces	Traces						
Sulphide (S)	325	20.3						
Carbonate (CO_3)	16,710	557.0	13,152	438.4	16,500	549.9	(b) 48,880	1,607.0
Metaborate (BO_2)	Trace	Trace	Trace	Trace	190	4.4	329	7.8
Arsenate (AsO_4)							156	3.4
Phosphate (PO_4)	Trace	Trace	Trace	Trace			238	7.5
Silica (SiO_2)	245	8.1	164	5.4	207	6.9	297	9.7
	75,498		60,526		70,608.9		209,700	

(a) Iron and aluminum oxides expressed as aluminum. (b) Calculated.

1. Castalian mineral water. Analyst, Thomas Price (1880). Authority, U. S. Geol. Survey, Bull. 32.
2. Owens Lake. Analyst, Oscar Loew (1876). Authority, Wheeler report.
3. Owens Lake. Analyst, T. M. Chatard (1883). Authority, U. S. Geol. Survey, Bull. 60.
4. Owens Lake. Analysts, C. H. Stone and F. M. Eaton. Authority, Am. Chem. Soc. Jour., p. 1109, 1906.

Coso Hot Springs. Near the southwest corner of Inyo County there is a group of hot springs that are especially remarkable because of the acid character of their water. They have long been known as Coso Hot Springs, as they are on the eastern slope of the Coso Range. The main group is about 12 miles east of Haiwee railroad station, and is beside a road that leads eastward to Coso and other mining camps. The rocks of the region are largely granite, but this material is covered in some places by lava and lava craters of a recent geologic period of eruption.

At the principal spring, which is in granite material, in a pit about 50 feet by 100 feet in diameter and 10 feet deep, vapor and hot, sour

water rise through a white mud that is apparently formed by the decomposition from the rock. In summer the water in this pit is low, but in winter, as a result of increased condensation and decreased evaporation due to cooler weather, it is nearly half full.

The following analyses show that it contains unusually large amounts of sulphate of iron and aluminum, and silica. The most remarkable feature, however, is the high tertiary salinity. The discordance of the two analyses is apparently due, in part at least, to a change in the character of the water. In connection with the large iron and sulphate content, it is of interest to note that minute crystals, apparently of pyrite (iron sulphide), collect as a film on the water and also form on the clay at the side of the pool.

Analyses of Water From Coso Hot Springs, Inyo County, California.

(Constituents are in parts per million.)

	1		2	
Properties of reaction:				
Primary salinity		5		13
Secondary salinity		5		18
Tertiary salinity		90		69
Primary alkalinity		0		0
Secondary alkalinity		0		0
Tertiary alkalinity		(?)		45
Constituents	By weight	Reacting values	By weight	Reacting values
Sodium (Na)	49	2.13	81	3.52
Potassium (K)	11	.29	12	.31
Lithium (Li)	Trace	Trace		
Ammonium (NH_4)	Trace	Trace		
Calcium (Ca)	45	2.25	59	2.84
Magnesium (Mg)	2.4	.20	34	2.80
Iron (Fe)	122	4.98	83	2.97
Aluminum (Al)	201	22.22	56	6.20
Hydrogen (H)	16	15.98	12	11.67
Sulphate (SO_4)	2,308	48.05	1,400	29.18
Nitrate (NO_3)	Trace	Trace	0	.00
Chloride (Cl)	Trace	Trace	40	1.13
Carbonate (CO_3)	0	.00	0	.00
Metaborate (BO_2)			0	.00
Phosphate (PO_4)	Trace	Trace	Trace	Trace
Silica (SiO_2)			411	13.59
	2,754.4		2,188	

1. Main spring. Analyst, Oscar Loew (1876). Authority, Wheeler report.
2. Main spring. Analyst and authority, F. M. Eaton (1910).

The place has become a camping resort for people afflicted with rheumatism, which is said to be relieved by baths in the hot mud. Bathing pits are dug in the cooler mud near the spring, and the material is worked up to the desired consistency. Close to the main spring is an area of steam vents, about 25 by 50 yards across, which contains several pools that furnish clear water for washing and cooking. This area also

furnishes sufficient heat for cooking, kettles containing food being placed in shallow pits, covered with sacks, and allowed to remain until the food is done.

Another area of hot vapors and mud in a ravine northwest of the main spring has been filed on as a placer claim for mining medicinal mud. The material at this place is somewhat finer in texture than that at the main spring.

Hot Springs near Tecopa. About 2 miles north of Tecopa railroad station two hot springs issue on alkaline slopes that border the eastern side of an alkaline marsh along Amargosa River. The springs rise in pits that have been dug about 10 yards apart, and their combined flow is about 225 gallons a minute. The observed temperatures were 108° and 109° F. Near the springs are heavy alkaline deposits of soda and common salt, and the water tastes noticeably, though not disagreeably, of the alkalies. In 1908 the water was piped to a railroad watering tank half a mile westward. It has also been used to some extent for bathing at a pool near the springs.

The water issues at the southwest base of a steep hill of quartzite that dips about 15° NE. The structure suggests that the hill forms part of a range that has been faulted and tilted in the manner characteristic of the Basin ranges and that the springs rise along the zone of fracture. Other warm seepages rise in marsh land a mile southward and probably have the same origin.

Hot Spring South of Bishop. At the base of the Sierra, about 8 miles south of Bishop a spring of considerable flow that is utilized for domestic supply and also for dipping sheep has a temperature of about 130°. Like the springs farther north, in Long Valley, its water has no distinctive taste nor odor and is probably mineralized in only small amount.

Volcanic rocks are present a few miles north of Bishop, and lava cones border the valley several miles south of the spring; but its water issues from granitic rocks, and the unusually high temperature seems more probably to be caused by rising from a considerable depth along a fault zone than by contact with masses of lava that have not yet cooled.

Poison Spring. This spring is on the western border of Death Valley, 7 miles northwest of the Furnace Creek ranch. It yields salty water that probably also contains sulphates, whose sickening effect on thirsty travelers has given the spring its name.

Salt Springs North of Furnace Creek Ranch. The sink or lowest portion of Death Valley, in the eastern part of the state, is crusted with impure salt, and at several places along its borders small springs issue whose waters are strongly saline. One group of springs of this character, is situated about 10 miles north of the Furnace Creek ranch

at the northeast border of Death Valley, where a slight amount of salty water issues.

Salt Springs South of Furnace Creek Ranch. About 4 miles south of the Furnace Creek ranch saline water forms a small wet area at the east edge of Death Valley. The flow is slight, and the water is too salty to be drinkable.

Vapor Vents West of Coso Hot Springs. Along the branches of a ravine 3 miles west of Coso Hot Springs there is an area several acres in extent in which much vapor issues, and the ground is impregnated with sulphur and alum, but in 1908 no water was flowing. A temperature of 203°, which is probably the boiling point at this elevation (about 4300 feet), was recorded in the vapor vents. These vents are in an area of lava where there are a number of small volcanic craters, and the surface is partly covered with fragments of pumice and obsidian. At the vapor vents the rock has been extensively altered by solfataric action and reduced to a siliceous sinter, but a mud similar to that at the Coso Springs was not observed. The difference is probably due partly to the fact that there is not sufficient water at the vapor vents to form a mud, and partly because they issue through lava, which does not become kaolinized as readily as does the granitic rock at Coso Hot Springs.

Warm Spring Near Little Lake. A small amount of lukewarm odorless water issues in a spring about 300 yards from Little Lake and near the base of a lava bluff 25 or 30 feet high. The spring has not been developed nor used to any extent during recent years and is known only locally. Perhaps the chief point of interest concerning it is its position with respect to the lava bluff. The primary alkaline and saline character of the water is shown by the following early analysis:

Analysis of Water From Warm Spring, Near Little Lake.
(Constituents are in parts per million.)

Properties of reaction:	
Primary salinity	31
Secondary salinity	0
Tertiary salinity	0
Primary alkalinity	51
Secondary alkalinity	15
Tertiary alkalinity	(?)

Constituents	By weight	Reacting values
Sodium (Na)	328	14.21
Potassium (K)	Trace	Trace
Calcium (Ca)	48	2.40
Magnesium (Mg)	Trace	Trace
Sulphate (SO_4)	54	1.13
Chloride (Cl)	163	4.60
Carbonate (CO_3)	327	10.91
Silica (SiO_2)	Trace	Trace
	920	

Analyst, Oscar Loew (1876). Authority, Wheeler report.

Warm Springs in Panamint Valley. About 4 miles north of Ballarat, on the eastern edge of Panamint Valley, is a spring similar to the one in Saline Valley. Its water is tepid and is noticeably sulphuretted, and its yield is only about 40 barrels a day (1 gallon a minute). It forms a small watering place on a road leading northward from Ballarat.

Warm Spring in Saline Valley. There are a few thermal springs of minor importance in the desert region of eastern California. One of these springs is at the northeast side of Saline Valley, about 25 miles in a direct line east of Independence. It yields a small flow, and its water is not of high temperature. There are several cool springs a short distance westward from it and also to the southeast that form watering places in this part of the desert.

MOLYBDENUM.

Lucky Boy Prospect. Union district, 7 miles east of Kearsarge station on the east flank of the Inyo Mountains. Elevation 7000 feet. Molybdenum occurs scattered through a quartz vein along a contact between granite and limestone. A 15″ vein can be traced for 500 feet along surface. The ore is said to contain 2.5% molybdenum. No production. Located April, 1916, by H. M. Myers and J. E. Brown, of Independence, Inyo County, Cal.

Molybdenum claims have recently been staked out by F. A. Campbell in the upper part of Lone Pine Creek. The molybdenite occurs as small flakes in a quartz gangue. The extent of the deposit is not yet known, as it is covered by snow during part of the year and has not been prospected.

NITER.

The existence of niter in the low, rolling hills along the Amargosa River has been known since the early eighties. The niter beds are situated in the southeastern part of Inyo County, extending across the boundary line into the northern part of San Bernardino County. The niter hills have a soft rounded surface and vary in size from 50 feet in height and covering a few acres, to several hundred feet in height and covering many acres.

Geology: The underlying rocks of the district are slates and schists of the Jura-Trias period, highly metamorphosed. Next above are early Tertiary clays, deposited during a long period of subsidence. The clays are bedded, on the upturned edges of the older rocks, in horizontal strata for a thickness of 800 feet. The formation of the niter-bearing hills occurred in the early Tertiary period and are the result of sedimentary marine deposits slowly accumulating in thin layers. These beds have been worn by erosive agencies into soft rounded hills and knobs.

The hills are covered with a crust or surface coating which is comparatively smooth and follows the contours of the hills. The crust, varying from a few inches to over a foot in thickness, is termed "caliche." The "caliche" contains the salines which have been concentrated on the surface as a "result of the upward capillary flow of water from below, induced by the constant and rapid evaporation at the surface in a comparatively rainless region."[9] The niter is a very soluble white crystalline salt that readily permeates the clay. While the "caliche" contains a higher percentage of the niter, the clay layers underlying this crust also contain niter. This is due to the process of erosion and the wearing away of the clay beds by rains and floods. The niter is readily taken into solution and held by the underlying strata.

With the niter are associated sodium chloride, sodium sulphate, calcium sulphate, and magnesium sulphate. The proportions of the various salts vary as is shown in the following table, taken from Bull. No. 24.

	1	2	3	4	5
Niter	7.28	14.50	27.40	46.50	61.20
Sodium chloride	6.36	7.56	21.15	25.30	16.40
Sodium sulphate	.60	.70	2.05	5.30	3.10
Calcium sulphate	.20	.10	1.04	.30	.20
Magnesium sulphate	1.30	2.80	2.00	1.20	1.20
Insolubles	84.26	74.34	46.36	21.40	17.90
	100.00	100.00	100.00	100.00	100.00

The average from 104 samples of caliche taken from 104 claims in this vicinity was 9.54% niter.

Bibl.: Bull. No. 24, "The Saline Deposits of California," issued by the California State Mining Bureau.

Confidence Beds, consisting of 2400 acres, are situated along the south side of Death Valley at the "Narrows," northwest of Saratoga Springs. Analyses of caliche, as given by Gilbert Bailey, in Bulletin 24, show the highest per cent in niter to be 1.90 and the lowest as 0.76. An average of four samples was 1.7%. Undeveloped. These beds are held by the owners of the Valley, Round Mountain, Owl, and Saratoga Beds, of San Bernardino County. Owners, California Nitrate Development Company, 40 California St., San Francisco.

Bibl.: Bull. 24, pp. 165, 174.

[9]Gilbert E. Bailey, Bull. 24, p. 160.

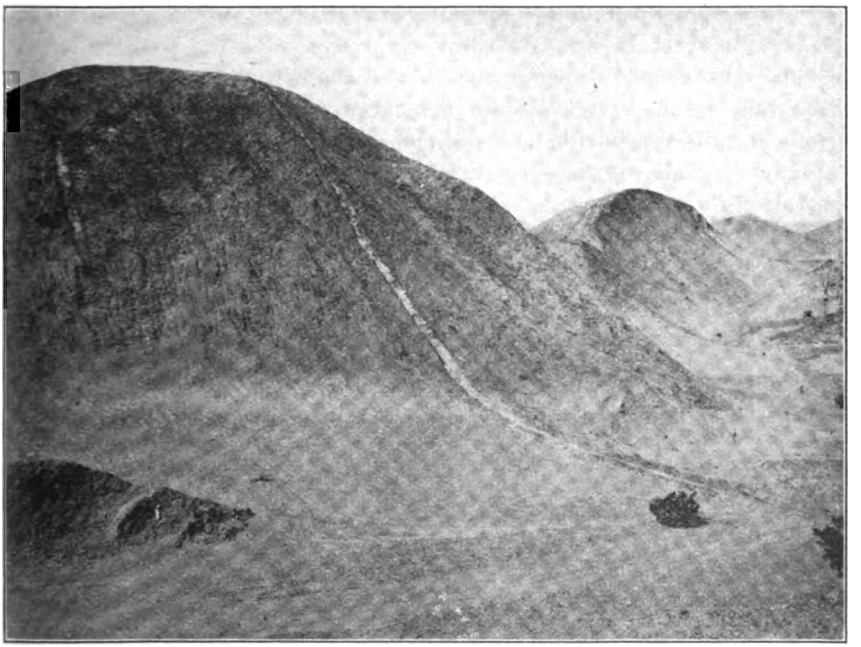


Photo No. 75. Niter beds south of Owl Springs, showing method of prospecting and doing assessment work. The beds strike N. 74° E.

Upper Cañon Beds. Resting Springs district. Situated along both sides of the Amargosa River on the Morrison Ranch and extending into San Bernardino County. These beds are easily accessible, as the Tonopah and Tidewater Railroad traverses the claims. Water for working purposes can be obtained in sufficient quantities from the Amargosa River. Beds prospected by digging trenches in the caliche, which varies from 6″ to 18″ in thickness. Present development shows from 5% to 10% niter. From 14 to 18 miles of trenches dug.

Gross tonnage as shown by trenches	328,500
Reduced to tons commercial	118,000
Value at $50.00 per ton	$5,900,000

Owned by the Pacific Nitrate Company, Consolidated Realty Bldg., Los Angeles; president, Walter R. Fales.

Bibl.: Bull. 24, pp. 165, 170–172.

POTASH.

The production of potash upon a commercial basis in Inyo County in the immediate future is probably assured, after much experimental work on the waters of Owens Lake. The composition of salts dissolved in waters of the lake was determined periodically from 1866 to 1914, under the direction of the United States Geological Survey. The

percentage of potash in the anhydrous residue of the salts is about 2.00 (See U. S. G. S. Bull. 580, p. 258).

Potash also occurs in small amounts in the saline deposits of Death Valley and Saline Valley. These deposits were prospected at different periods and often reported as being rich in potash. During 1912–1913, Mr. Hoyt S. Gale, of the United States Geological Survey, directed a series of tests of these saline deposits. The results of the tests of the Death Valley deposits are as follows:

Analysis of Surface Salt From Death Valley.

(George Steiger, Analyst.)

NaCl	94.54%
KCl	.31%
Na_2SO_4	3.53%
$CaSO_4$ $2H_2O$	.79%
Moisture	.14%
Insoluble residue	.50%
	99.81%

Quoting Mr. Gale, "The solid material of the deposits underlying the lowest part of the valley to a depth of 100 feet may be assumed to average about 19% moisture, and after this has been dried out, the dried material averages about 65% of soluble salts. Of these soluble salts, only about 0.72% has been shown to be potash, or 1.13% potassium-chloride, the form in which the salt is doubtless present in this deposit." (For further detail on this deposit, see U. S. Geol. Surv. Bull. 540, pp. 407–415.)

The results of the tests for potash in the salt deposits of Saline Valley were practically negative, varying from .05% to 1.29% potash of total salts. (See U. S. Geol. Surv. Bull. 540, p. 420.) This low content does not warrant the production of potash upon a commercial basis.

Inyo Development Company erected an experimental plant during 1915 for the manufacture of potash salts, at its soda plant on the shores of Owens Lake. The process was described in detail by Mr. Carl Elschner, chemist of the company, in the Mining and Scientific Press, issue of January 29, 1916. Briefly, it is as follows: The brine resulting from the precipitation of the sodium carbonate is concentrated in solar evaporating vats. In the vats it is exposed in layers of a few inches. The vats are arranged in such a way that the liquid, after partial evaporation, can be withdrawn from the crystallized salt crusts. The purpose of the evaporating and crystallizing process is to enrich the mother liquor with potash, and get out the other salts as free from potash as possible. Impure carbonate of sodium is first crystallized, and the solution drawn to another vat. The crystallization of NaCl

follows, and the liquid is drawn off again. Sudden precipitation, from oversaturated solutions, makes the process a complicated one, and care is necessary to see that no potash precipitates. The final solution contains sulphuric, carbonic, some boric, chlorine, potassium, and sodium ions. It is evaporated to dryness and the salt crusts resulting dried out and ground. The whitish potash fertilizer salts represent a mixture of the carbonates, sulphates, and chlorides of potash and soda, in varying proportions.

The first run of the experimental plant produced salts running 20.41% KCl; 2d run, 29.40% KCl; 3d run, 34.05% KCl. The plant is expected to be operating on a commercial basis within the year.

Natural Soda Products Co., have been experimenting on their brine, and are erecting a plant for the extraction of potash. We are not informed as to their "vacuum" process, which is a secret one, developed by Mr. Noah Wrinkle, secretary of the company, but await the results with interest.

QUICKSILVER.

Chloride Cliff Mine (see page 72). A vein in limestone containing cinnabar and metacinnabarite was recently discovered on one of the claims of this gold mine. A tunnel 80 feet deep driven on the vein exposed some fairly rich ore. No production. Idle. Owned by Crowell, Findley and Parsons of Rhyolite, Nevada.

SALT.

Sodium chloride is deposited as the major ingredient in the saline crusts of Death Valley, Saline Valley, and Salt Wells Valley, and in the waters of Owens Lake. It occurs in smaller amounts in the niter beds that border the Amargosa River. Salt was formerly produced as a by-product at the borax works of the Salt Wells Borax Company. The only production in the county is now from the Saline Valley deposits.

Bibl.: Bull. 24, "The Saline Deposits of California."

Owens Valley Salt Company has under lease from the Saline Valley Salt Company, 2000 acres in the lowest depression of the Saline Valley. It is 12 miles in an airline northeast of Swansea, where the company's mill is situated. The deposit is very inaccessible, but is usually reached from the railroad by trail over the Inyo Range. The Saline Valley road from Alvord up Waucoba Cañon is rather poor and roundabout.

The salt is deposited in an old lake bed covering several square miles. Of this area about one square mile is composed of a smooth, white salt

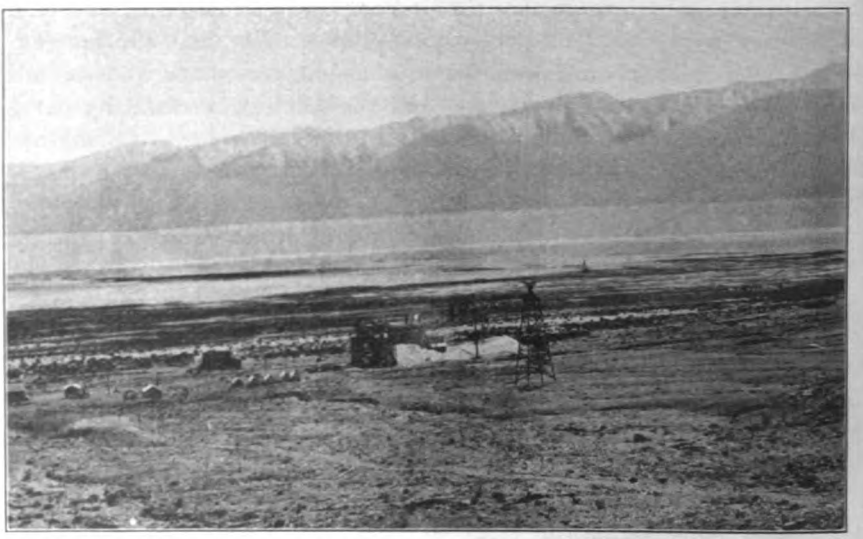


Photo No. 76. Mill and tramway terminal of Owens Valley Salt Company, 3 miles north of Keeler.

Photo No. 77. Sacking salt at plant of Owens Valley Salt Co.

crust, formed by dissolving the surrounding impure salt crust with water from a nearby spring, and recrystallizing it by solar evaporation. The recrystallized salt is said to 99.32% NaCl. It is harvested during the summer months and shipped, over an aerial tramway 13¾ miles in length, to the mill. The tramway, built by the Trenton Iron Works, is equipped with 800-lb. buckets, and is operated by electric power, as is the mill, supplied by the Southern Sierras Power Company. There are five stations along the line at which the buckets are automatically changed. Seventeen men are required for the tramway. Operated only during the summer months.

The mill treatment is as follows: The salt is shovelled into a bin which automatically feeds into a large rotary, oil burning, drying furnace. Subsequently elevated to rolls, where the salt is crushed to the desired sizes and passed over shaking screens to classify the different sizes. Five classes of salt are produced, varying from the natural crystallized rock salt to pulverized table salt. Approximately thirty tons are produced daily at a cost of $2.75 per ton, segregated as follows:

Gathering salt in field	$0.50
Tramming	1.50
Milling	.75

Forty men are employed in Saline Valley during harvest season, April to December. Thirty men are employed at mill throughout the year. Operated since May, 1915, by leasing company. Manager, W. J. Savage, American Bank Bldg., Los Angeles, Cal. Superintendent, John A. Lewis.

Bibl.: U. S. G. S. Bull. 540, pp. 416–420.

SODA.

The only soda produced in California is derived from the waters of Owens Lake. This lake lies between the Sierra Nevada Mountains on the west and the Inyo Range on the east and has no outlet. It covers an area of 97.2 square miles. The water is a dense brine, containing common salt, soda, borax, and other soluble salts. These soluble salts were evidently derived by the slow accumulation and concentration of the waters of the Owens River, which enters this basin from the north.. A typical analysis of the composition of the salts dissolved in the lake

waters, as determined under the direction of the U. S. Geological Survey, is as follows (calculated to percentage of anhydrous residue):

SPECIFIC GRAVITY 1.195.

Cl	24.82
SO_4	9.93
CO_3	24.55
PO_4	.11
B_4O_7	.14
NO_3	.45
Na	38.89
K	1.62
Li	.03
Ca	.02
Mg	.01
SiO_2	.14
Al_2O_3 / Fe_2O_3	.04
As_2O_3	.05

Total anhydrous salts, percentage of original sample 21.37.

Bibl.: Bull. 24, pp. 94–98; U. S. G. S. Bull. 580, pp. 252–264, The Owens Basin.

Inyo Development Company has operated a soda plant, on the shores of Owens Lake, 1 mile north of Keeler, since 1885. The process is briefly as follows: The lake water is pumped into large clay vats, vary-

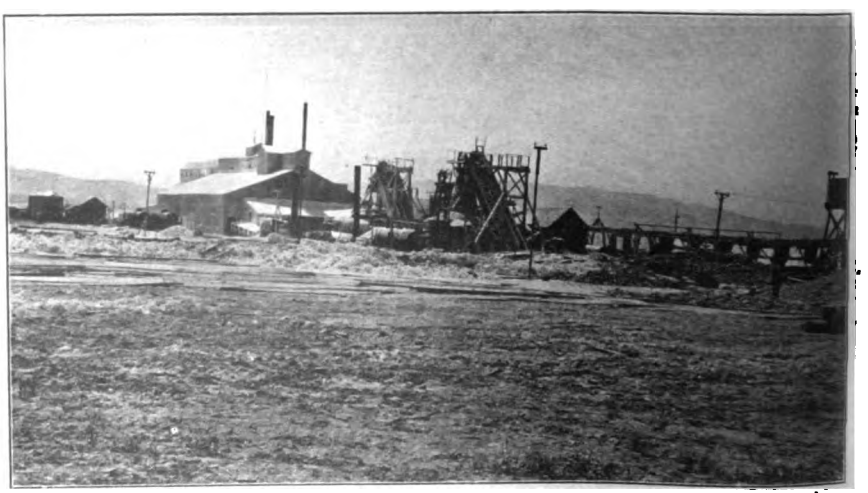


Photo No. 78. Soda Works of Inyo Development Co., north of Keeler.

ing in size from one acre to 20 acres, to a depth of from 6″ to 8″. It is concentrated by solar evaporation until the carbonates are precipitated. The mother liquid, containing potash, sulphates, chlorides, etc., is drawn into other vats, where the solution is further concentrated for the production of potash (see Potash). The trona (hydrous carbonate of soda)

orms in a crust about ¾" thick and is gathered once a year. The crust washed free of impurities and introduced into an oil-burning furnace, here it is reduced to the carbonate. An air blast, at the furnace discharge, cools the ash, which is then conveyed to rolls and pulverized. lant operated by electric power supplied by the Southern Sierras ower Co. From 18 to 20 tons, of heavy ash only, are produced daily. he trona is gathered during October, November and December of each ear, employing over a hundred men during that period. Mexican labor employed at $2.50 per day. The mill is operated from June 1st to ecember 31st with twenty men employed. Home office, 218 Mills Bldg., an Francisco, Cal., A. B. Davis, vice president and general manager.

Bibl.: Rept. VIII, p. 226; Rept. XII, p. 409; Rept. XIII, p. 646.

Natural Soda Products Company. Plant situated on east shore f Owens Lake, 2 miles south of Keeler. This company is producing icarbonate of soda, as well as soda ash. Their process is radically ifferent from that of the older company.

Photo No. 79. Natural Soda Products Co. plant south of Keeler.

The lake water is concentrated in clay vats by solar evaporation and hen pumped to two 1000-gallon settling tanks. Subsequently pumped o eight 15,000-gallon tanks. Carbon dioxide, generated from dolomite, is passed up through the bottom of these cylindrical tanks, into which are introduced a series of screens to break up the CO_2 gas. The carbon dioxide precipitates the soda, and the latter is drawn from the bottom of the tank and passed through an Oliver filter; then introduced into furnace and reduced to ash. The tailing solution (mother brine) is to be used for the extraction of potash (see Potash). Daily production

approximately thirty tons. Company reorganized 1915 and have produced steadily since. Home office, Keeler. President, W. W. Waterson, Bishop; superintendent, E. W. Walter.

SULPHUR.

Small deposits of sulphur are reported one mile southwest of Coso Hot Springs and in the mountains east of Big Pine.

TALC.

California Mineral Corporation, formerly known as the Pacific Mineral Products Co., owns a deposit of talc 8 miles southwest of Zabriskie. Auto road to the deposit. The talc is pure white, occurring along the contact of limestone and diorite. The deposit is irregular and varies up to 12 feet in width. Mined by open cuts and tunnels. Worked intermittently since 1912. Shut down September, 1915, due to litigation over ownership. Company recently reorganized, and expects to resume operations shortly. President, G. F. Eisenmayer, Citizens National Bank Building, Los Angeles, Cal.

Simonds Talc Mine. Darwin district, 17 miles by road southeast of Keeler. Elevation 5850 feet. The deposit occurs in a crushed zone in limestone over a width of 70 feet. Strike of deposit N. 45° E., dip vertical. The talc varies in color from gray to pure white, and is

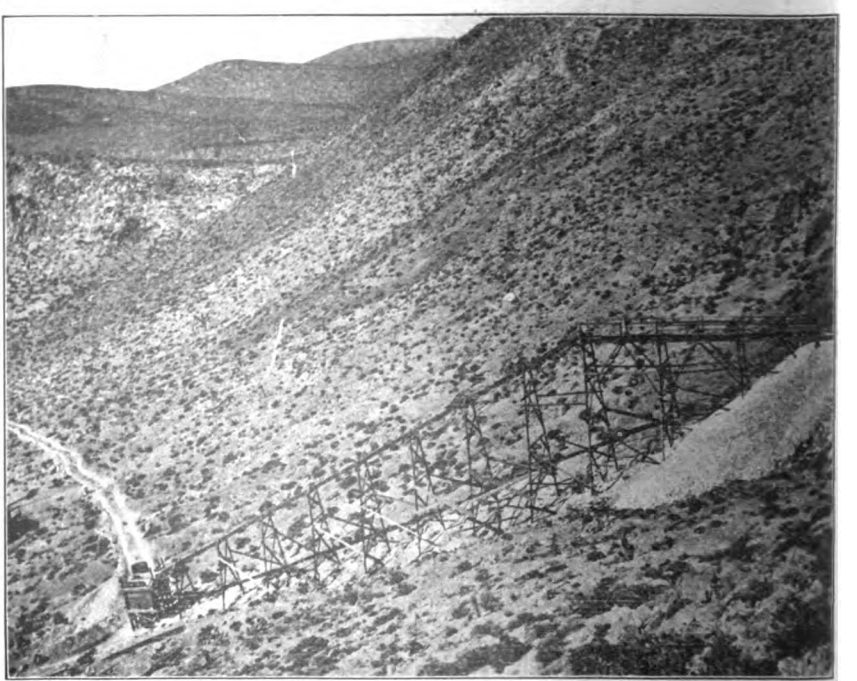


Photo No. 80. Simonds Talc Mine. California Talc Co.

hard and slippery. It is foliated and shattered, as is the inclosing limestone beds. Suitable for grinding purposes only. Very free from grit. Worked by open cuts and tunnel. Working tunnel 140 feet long, cutting talc beds 70 feet wide. Connected by raise to open cut above. Trammed

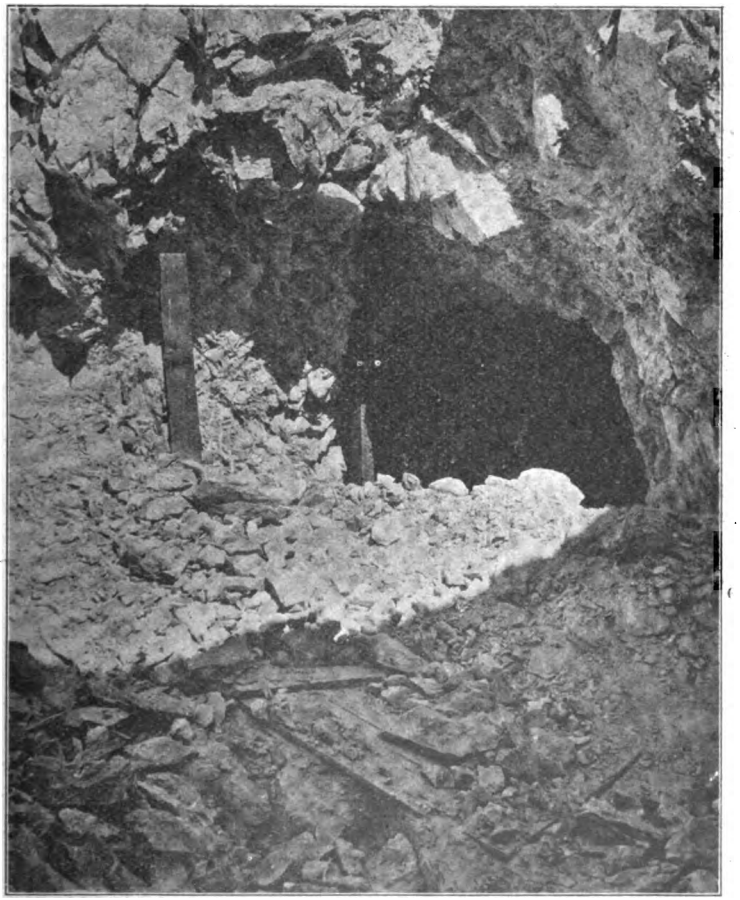


Photo No. 81. Open cut and tunnel at Simonds Talc Mine, southeast of Keeler.

to wooden chute to bin. Truck loaded from bin. Hauled to Keeler in 4-ton auto truck. Two trips daily. Shipped to grinding plant, 175 Hooper Street, San Francisco. Two men employed. Owners, California Talc Company (formerly Groah Mineral Company), 3075 Army St., San Francisco. Superintendent, E. E. Simonds, Keeler.

Tramway Talc Mine (Hoff and Mayes Mine), is situated 3½ miles northwest of Keeler, at the base of the Inyo Mountains, near the mill of the Saline Valley Salt Company. Elevation 3860 feet. Irregular deposit of talc along fault plane in metamorphosed limestone. The talc varies in color from grayish green to black. Very hard and slippery, and said

Asbestos Co., of Oakland, in 1915, was the only production. Idle. Owners, J. A. Mayes et al., Keeler, Inyo County, Cal.

Photo No. 82. Tramway Talc Mine, north of Keeler.

TUNGSTEN.*

The enormous increase in the price of tungsten during the early part of this year has been responsible for extensive prospecting in Inyo County. Before the European war, the average price was $7.00 per unit (a unit is each 1% in tungsten trioxide). In February, 1915, the price was $40.00 per unit. It had risen to $50.00 per unit in February of 1916 and then jumped to $105.00. That was the highest price reached. It dropped to $80.00 per unit in March, and since then has gradually decreased. The quotation at the time of this writing is from $30.00 to $40.00 per unit, with indications pointing towards a further decrease.

The tungsten ores thus far discovered in Inyo County are mainly confined to two districts, namely: in the vicinity of Bishop, and in the Ubehebe district south of the Racetrack. One small occurrence was also noted northeast of Big Pine.

*Since this report went to press, a report on the "Tungsten Deposits of Northwestern Inyo County" by Adolph Knopf, has been published by the U. S. Geol. Survey as Bull. 640-L. The Nobles, Boyd and Welch, Chipmunk, Mineral Dome and McVan prospects, located after the field was covered by the writers, have been described. The Nobles property, now called the Last Chance, has recently been reported as being opened up with a tunnel by Cooper Shapley, superintendent of the Round Valley Tungsten Company, who expect to install a mill.

Districts.

Bishop District. The tungsten mines of this district are located west and south of Bishop, in the low foothills bordering the Owens Valley. The country rock is granite intruding limestone. The ore is deposited in garnetiferous dykes or ledges along the contact of the limestone with the granite, and was probably formed at the time of the granite intrusion. The dyke rock or ledge matter consists essentially of small crystals of scheelite, garnet, epidote, pyrrhotite, pyrite, magnetite, rose quartz, and biotite. The character of the ore varies, and crystals that are prominent in one portion of the dyke may be entirely lacking in other portions. Malachite is occasionally found in the ore, close to the lime footwall. The percentage of scheelite in the ore varies, but in general is very low, less than 1%. Rich pay streaks, said to run up to 30%, are occasionally encountered. The dykes are massive, varying in width up to 60 feet.

Ubehebe District. The tungsten claims of the district are located south of the Racetrack, in the vicinity of Dodds Spring and Goldbelt Spring. Keeler is the nearest shipping point. An auto road runs from Keeler to Lee's Pump, approximately 30 miles. Trail from Lee's Pump to the locations. The district might also be entered by road from Bonnie Claire, Nevada, by way of the Lost Burro Mine; but about 5 miles of new road would have to be constructed.

The tungsten ores of this district are deposited in narrow veins in granite, close to limestone, or at the contact of the granite and limestone. The ores are scheelite and hübnerite. They are not found associated in the same vein, but occur separately. Scheelite is found in the footwall side of copper veins deposited along granite and limestone contacts. The first discoveries of its existence in the district was on the dumps of old copper prospects. Hübnerite has been found in well-defined fissure veins in the granite, close to the limestone contact. The discovery of tungsten in this region is very recent, so that very little work has as yet been done to determine the extent of the veins. "Shorty" Harris, of Keeler, shipped out a few hundred pounds of high grade scheelite from the vicinity of Hunters Mountain, early in March. This led to extensive prospecting, but to date we have no record of any further production.

Mines.

Aeroplane Mine. Bishop district, 8 miles by road due west of Bishop. Elevation 5800 feet. This property was purchased by the present owners early in 1916, and actual development commenced in April, 1916. The ore body is irregular, varying from 10′ to 40′ in width. It outcrops near the summit of rugged mountains, 600 feet in elevation above the mill site. A trail has been built up to the workings from the mill. Mined by quarry and tunnel. The tunnel is about 50 feet below the quarry, and a raise has been driven to connect with the quarry,

Photo No. 83. Aeroplane Mine at Tungsten, 8 miles west of Bishop, Inyo County.

through which the ore will be handled. A rich streak of ore, said to run 30% scheelite was encountered in driving the tunnel. When visited, a 75-ton concentration mill was being installed. It was planned to crush to about 10 mesh, using rolls to avoid sliming, and concentrating on tables. Mill ran one month on ore that is said to average over 2 per cent. Power supplied by the California and Nevada Power Company.

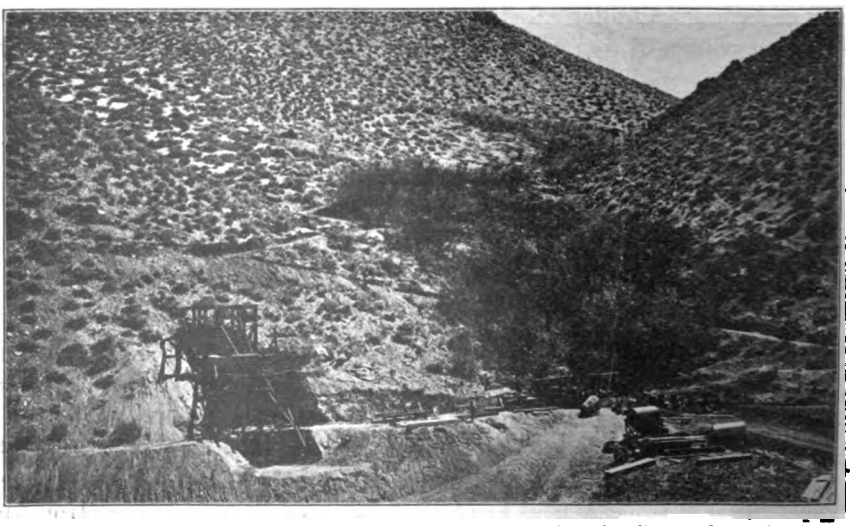


Photo No. 84. Seventy-five ton roller mill being constructed to handle ore from the Aeroplane Mine, near Bishop, Inyo County.

Water is obtained from springs and creek below mine. An aerial tramway is to be built from the mine to the mill. Thirty men employed. Owners, The Standard Tungsten Co., H. W. Hellman Bldg., Los Angeles, Cal. L. E. Porter, superintendent.

Alvord Group. Ubehebe district, 60 miles southeast of Bonnie Claire, Nevada, and 5 miles west of Goldbelt Springs. Scheelite occurs on the footwall of ledge containing copper and iron, on contact of limestone and granite. Ledge said to be 10 feet wide, and outcrops for 300 feet. No development. Located April, 1916, by William Elliot, Ray Spear, and Ross Spear of Lone Pine, Inyo County, Cal.

Buckshot Prospect, Bishop district, is 12 miles by road due south of Bishop, at foot of eastern flank of the Sierras. Elevation 4700 feet. The ore body outcrops in a large lens-shaped mass on a granite and limestone contact. Over 4000 tons of ledge matter exposed on surface, which, it is estimated, will average about 1% scheelite. Up to the time it was visited, only a shallow pit had been sunk on the ore. Recently taken under bond and lease by Charles W. Alvord, of Bakersfield, Cal.

Monarch Tungsten Mine, Ubehebe district, approximately 35 miles north of east of Keeler, between Dodd's Springs and Goldbelt Springs. Road from Keeler to within 4 miles of mine. The ore is hübnerite, occurring in bunches in a fissure vein in granite. Average width of vein 22". Strike NW., dip almost vertical. A 50-foot shaft has been sunk on the vein, with two 50-foot drifts driven from bottom of shaft.

The hübnerite played out at the 50-foot level, but the vein continues. Are sinking shaft with expectations of finding the hübnerite with depth. Located July, 1915, by the Monarch Tungsten Company, Denver, Colorado; president, Fred C. Allen; secretary and manager, Frank D. Allen.

Scheelite Group is 25 miles northeast of Big Pine on the road to the Loretto Mine and Eureka Valley. Northeast flank of Inyo Mountains, overlooking Eureka Valley. Elevation 6700 feet. The country rock is granite and limestone. Scheelite is found on the footwall side of a copper-bearing vein. The vein is in granite, about 100 feet above a limestone contact. Exposed by three shallow cuts, spaced about a hundred feet apart, along the strike. Width of vein 12". At the time visited, the scheelite had only been found in one location on the vein. Considerable development work must be done before it can be determined whether the scheelite occurs in sufficient quantities to mine on a commercial basis. S. G. Drouillard claims to have taken out 400 lbs. of ore which averaged 40% scheelite, while exploiting the vein for copper nine years ago. No production since. Now being developed by the owners, S. G. Drouillard, Frank L. Over and W. H. Leffingwell of Bishop, Inyo County, Cal.

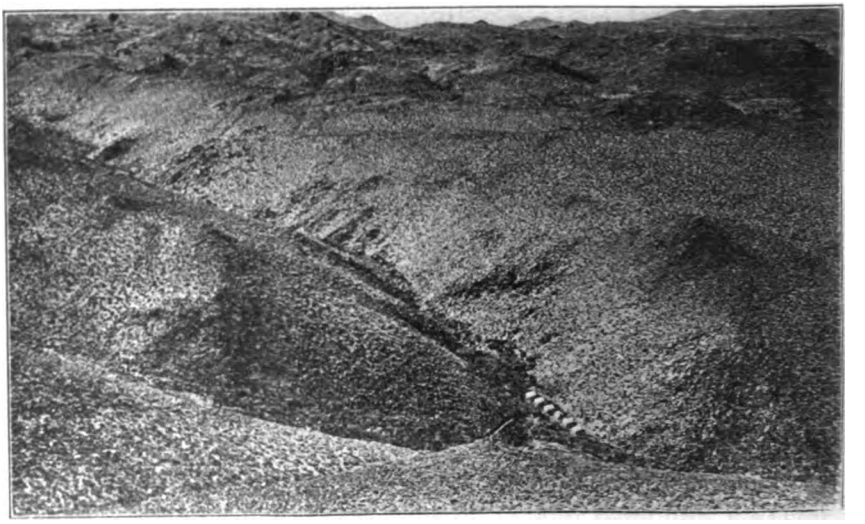


Photo No. 85. Little Sister Ledge, to the left, and camp of the tungsten miners at Tungsten, 8 miles west of Bishop, Inyo County.

Photo No. 86. Looking northward towards town of Tungsten, and mill site of the Tungsten Mines Co., 8 miles west of Bishop, Inyo County.

Tungsten Mines Company, Bishop district, owns a group of claims adjoining the Aeroplane Mine, 8 miles west of Bishop. The development to date is confined to the Little Sister claim. The garnetiferous dyke outcrops on this claim for 375 feet, over top of hill. It is at least fifty feet in width. This ore body is said to average 0.6% scheelite. A tunnel is being driven 165 feet below the outcrop to cut the dyke. Machine drills are used. At the time visited, owners were excavating for the erection of a 300-ton concentration mill, to be located a few hundred feet below the Standard Company's mill and southwest of the Jackrabbit claim. An aerial tramway is to be installed from the Little Sister tunnel to the mill. Expect to employ at least 150 men upon completion of the mill. L. L. Stevens, of Bishop, general manager.

A townsite, to be known as Tungsten City, was surveyed in the cañon below the properties of the Standard and Tungsten Mine companies. When visited it had somewhat the appearance of a "boom" camp, as great activity was manifested in the erection of tents, boarding houses, offices, etc.

VOLCANIC ASH, OR PUMICE.

A bed of tuff is deposited in the Pleistocene sediments of the Amargosa Valley at Shoshone. The bed is impure, carrying some lime with the tuff, and is not adaptable for use in the manufacture of glass. R. J. Fairbanks, of Shoshone, shipped several carloads of this silica to a San Francisco firm, to be used for scouring soap, etc., No recent production. Idle.

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MONO COUNTY.

By ARTHUR S. EAKLE, Ph.D., and R. P. MCLAUGHLIN, Field Assistants.
Field work in 1914 and 1915.

INTRODUCTION.

Mono County was created April 24, 1861, and consists of 3030 square miles. It is bounded on the north and east by the state of Nevada, on the south by Inyo County, and on the west by Madera, Tuolumne and Alpine counties. The county is extremely mountainous, the western portion lying among the Sierra Nevada Mountains, whose principal peaks rise to elevations of over 13,000 feet. The greater portion of the county, in its larger features, is a broad table land at an altitude of from 5000 ft. to 7000 ft. above sea level, traversed by a series of approximately parallel ranges running northerly and southerly which rise several thousand feet above the plateau. Quoting from the report of H. A. Whiting,[1] "These ranges have been determined by those grand displacements which characterize the Great Basin structure. They are, therefore, like the Sierra Nevada itself, orographic blocks bounded by faults and so tilted that their upturned edges form mountain crests with a steep descent on one side and more gentle slope in the opposite direction. Among such ranges two grand mountain masses are preeminent rivaling the Sierra Nevada in height and majesty; they are the Sweetwater Mountains, along the eastern border of the county in its northern portion, and the White Mountains, crossing its extreme southeast corner."

In the high Sierras glaciers exist. These are the remains of "glaciers of large size which formerly flowed down the high Sierras and deposited moraines of great magnitude, on which terraces of the quaternary lake that formerly filled the Mono basin to a depth of nine hundred feet, are distinctly traced."[2]

Mono Lake is the remainder of this great inland sea, and is the only large body of water in the county. It lies ten miles south of Bodie at an elevation of 6426′ above sea level (October, 1909, U. S. G. S.), with an approximate area of 1100 square miles. This lake is of the same character as Owens Lake, described in our Inyo County report, containing the carbonate and sulphate of soda, sodium chloride, etc. For a detailed description of this lake the reader is referred to the account cited in the footnote.[2]

Owens River, in the south, which takes its rise in a high peak of the Sierras and flows southward emptying into Owens Lake, and Walker

[1]State Mining Bureau, Report VIII, pp. 353–354.
[2]U. S. G. S., Monograph XI, p. 267.

River, which flows northward into Nevada, are the principal streams; however, the numerous large streams which flow down the east flank of the Sierras furnish excellent water power during the greater portion of the year.

Mining is the principal industry of the county, although at present very little work is being done. Its period of greatest activity was during the late seventies and early eighties, when the population increased from about 400 to over 7000. The population is now about 2000. This county suffers the disadvantage of being very inaccessible. The only railroad in the county is the Nevada-California Railroad which cuts the southeast corner for a distance of 68 miles. The greater portion of the county is reached by stage lines from Nevada. With increased transportation facilities there will undoubtedly be great mining activity, as there are many highly mineralized vein systems that under present conditions can not be profitably worked.

The following description of the mining districts and mineral resources of Mono County have been written by Arthur S. Eakle, Ph.D., and R. P. McLaughlin, who spent several months in the field in preparation for the same. Dr. Eakle made a trip through the northern portion of the county in the Antelope Valley region during the summer of 1915 to supplement and complete the report of R. P. McLaughlin previously prepared, on the older mining districts, principally the Bodie and Masonic districts.

Bibl.: In addition to the references given in the text of this report, the following give some account of the earliest history of mining in Mono County: Min. Res. W. of Rocky Mts., 1868, pp. 177–179; 1871, p. 28; 1873, p. 16; 1874, pp. 22, 27; 1876, p. 32.

Year	Gold, value	Silver, value	Pounds	Value	Barrels	Value	Amount and kind		Value
1880	$2,407,236	$582,905							
1881	3,385,000	300,000							
1882	2,200,000	380,000							
1883	1,750,000	290,000							
1884	1,000,000	285,000							
1885	482,860	91,840							
1886	439,558	163,502							
1887	382,498	118,945							
1888	297,000	75,000							
1889	193,264	86,827							
1890	144,180	52,293							
1891	302,415	18,983							
1892	396,296	271,058							
1893	293,637	11,401							
1894	358,824	11,549	50,000	$1,500					
1895	552,690	84,910	94,400	2,926			800 cu. ft.	Onyx	$8,000
1896	451,553	82,283	73,500	2,205	500	$2,000	3,000 cu. ft.	Onyx	24,000
1897	520,101	72,491	32,000	1,088	1,200	4,800			
1898	446,017	66,667	75,000	2,737	3,000	4,000			
1899	607,060	47,547	28,000	1,190	1,200	3,750			
1900	670,260	75,921	50,000	2,000	1,100	4,000			
1901	493,355	25,091	29,000	1,160	2,000	3,000	1,988 lbs.	Copper	305
1902	510,596	36,548	4,400	154	2,000	2,000			
1903	334,713	20,067	1,000	36	1,818	5,000	1,600 lbs.	Copper	208
1904	268,930	2,955			215	850			
1905	308,884	11,240							
1906	338,698	13,151							
1907	383,971	29,737							
1908	413,946	26,134					7,100 gals.	Mineral water	5,575
1909	354,909	37,792					Unapportioned, 1900-09		106,772
1910	435,724	9,391							
1911	261,232	35,508	37,000	1,665					
1912	377,518	70,602	23,936	1,077	4,961	3,721	8,179 lbs.	Copper	1,3[illegible]
1913	147,271	23,263			2,135	1,600	79,319 lbs.	Copper	12,294
1914	7,000	10,000					1,000 lbs.	Salt	150
1915	107,302	1,923						Other minerals	20[illegible]
Totals	$22,114,447	$3,522,593	498,236	$17,738	20,129	$34,721			$158,854

Totals.

Gold	$22,114,447
Silver	3,522,593
Lead	17,738
Lime	34,721
Miscellaneous	158,854
Grand total	$25,848,353

ANTELOPE VALLEY REGION.

The area of Mono County which is chiefly described under this heading is situated in the eastern side of Antelope Valley in Townships 8 and 9, Range 23 East, adjacent to the California-Nevada state line. Antelope Valley extends south from the state line for a distance of ten miles and is about four miles wide near the state boundary. A good stage road connects the valley, with Minden, the nearest railroad station and this road continues south through the valley and central portion of Mono County to Bridgeport and beyond. Topaz, in the west-central part of the valley, and Coleville, three miles further up the valley, are two small settlements containing postoffices. The valley land is mostly owned by the Antelope Valley Land and Cattle Company, and has been converted by irrigation into a fine afalfa and stock ranch. The West Walker river flows northerly through the valley and furnishes plenty of water for irrigation. Much of the low land of the valley is often inundated by the river overflowing its banks, making marshes and sloughs. The valley is 5000 feet in elevation, and practically nothing but alfalfa can be raised.

The valley lies between high ridges of granite and metamorphic gneisses and schists, which cover the larger part of Mono and Alpine counties, these ridges being a portion of the series of metamorphics on the east flank of the Sierras. The valley on its western side is faced by a high escarpment of gneisses, schists, and granites and these ridges rise to a height of 7000 and 8000 feet. The west side is almost a continuous wall, broken near Coleville by a smaller side valley, known as Little Antelope Valley. This valley has the appearance of an amphitheatre perched several hundred feet above the main valley. The floor of this valley is composed of the till and wash from the mountains back of it. Roderique Creek flows through this valley and a branch road follows up this creek and cañon, past the Golden Gate mine and over the ridges into Alpine County connecting with the road through Monitor Cañon. At present this road is unimproved and not much more than a trail.

The eastern side of Antelope Valley is in marked contrast to the western in topography, and in character and composition of the hills. At the extreme southern end or apex of the valley the granitic ridges on both sides of the valley converge and leave only a narrow cañon through which the West Walker river rushes into the valley. The granitic ridges strike northeast from this point and have in their west flank a series of lower ridges and hills of metamorphic limestone and volcanic andesite. These hills border the valley and present weathered and rounded surfaces with sloping sides.

Character of the rocks.

Gneisses and schists are the prominent rocks which form the scarp in the west. The gneiss is a light gray, hornblende-biotite rock and shows its banded character very plainly on the wall faces along the valley. The schist is the common, dark gray, muscovite-biotite schist, easily splitting along its schistose cleavage. This schist is abundant at the head of Little Antelope Valley, forming high ridges along Roderique creek. The wall of rock at the head of the valley is granite and this massive igneous rock covers much of the country to the south. It is mostly a light gray, hornblende-biotite granite with white feldspars but occasionally the feldspars are colored reddish, imparting a pink color to the granite. The rock is very uniform in structure and would make excellent building and ornamental granite.

The hills on the eastern side of the valley are of greater mineralogical interest and importance because of the presence of crystalline limestone and contact deposits of minerals.

A limestone belt borders the valley and forms a wall for a few miles. It strikes north and south and its southern end probably rests against the granitic or gneissic hills, while its northern end terminates at Lobdan cañon. This belt of limestone is approximately 3000 feet wide but has been intersected by intrusive masses and dikes of diabase and covered by gravel and conglomerate in portions of it. A section up White Way cañon shows solid limestone for about 700 feet followed by an intrusive mass of diabase 300 feet, and then a covering of coarse gravel conglomerate and till for 1000 feet until the limestone again appears forming the eastern part of the belt. The limestone has all been metamorphosed into a crystalline limestone and marble by the general metamorphism of the original sedimentary rocks of the region and has been further and more intensely metamorphosed locally by the diabase and andesite intrusions. East of the limestone belt porphyritic andesite occurs followed by schist and granite. The main deposits of minerals in the limestone have been near and along the contact with the andesite. The mineralized portion of the belt is perhaps 750 feet thick and the adjacent andesite has also been altered and mineralized.

The Minerals.

Prospectors have been over the ground in this district and left their traces in small holes and claim monuments but no work has even been done which would prove the existence of any deposits large enough to warrant the investment of capital. Small outcrops of minerals occur and the general indication is that the deposits are pockets in the limestone and it is problematical if they are of large size. The remoteness from a railroad precludes the shipment of any but high grade ore and the district will probably remain idle until good bodies of such ore are

found. The district is known as the West Walker River Mining District and it contains gold, silver, lead, copper, zinc, cadmium and iron minerals, and barite, marble and building stone.

Gold occurs in the disseminated pyrite and also as free gold. The porphyritic andesite which occurs in contact with the limestone has been altered and mineralized by solutions so that it appears as a soft, friable mass of white and iron-stained, kaolinized feldspathic rock, containing seams and veins of white clay and porous silica. These seams occasionally run quite high in gold as shown by panning and assays, but all of those exposed in the pits are mere streaks and soon pinch out. The rock containing these richer streaks is too low grade for working so the value of the claims depends upon the frequency and grade of the veinlets. On the western slope of Round Mountain some prospect holes show seams which readily pan gold and run as high as $300 per ton. Only shallow pits have been dug which do not prove the value of the claims. This mineralized and silicified porphyry is quite extensive in the region and may contain rich pay seams.

The only gold produced in the district has come from the **Golden Gate Mine,** in the hills in the western side of the valley. This mine is located in Roderique Cañon at the head of Little Antelope Valley, about three miles from Coleville. This mine has changed hands several times since its discovery in 1898 and is now owned by Brown & Donovan. It is for sale or lease and no ore is being mined. The property consists of fifteen claims on the hills enclosing the cañon. The ore is free milling gold ore and auriferous pyrite. Veinlets and stringers of quartz and lenticular bodies of sulphides occur in a ferruginous schist at its contact with diabase. The steep sides of the cañon permit of adit tunnels at different levels and the present workings consist of five of these levels with three adits. There is an abundant supply of water for milling furnished by the creek and the owners have erected a 10-stamp mill in the north side of the cañon and an aerial tramway to connect the mine and mill. The mill is at present idle. There are no concentrators and the owners depend on the mill for returns. Four men are at present employed in development work. All work is done by hand drilling. This mine has also been described by R. P. McLaughlin.[3]

This section also contains the famous "White Metal" which is so hard and tough that it can not be broken or flattened by hammer blows. A short distance up an adjacent cañon which opens into Little Antelope Valley, the writer was informed that a deposit occurred which produced this white metal when fused. A climb to this deposit for specimens showed it to be a ledge of white granular quartzite in

[3]See p. 161, *post.*

which pyrite grains and crystals were thickly disseminated. It is said that London mining men after seeing specimens came over to inspect the deposit but nothing ever resulted from their visit. The "white metal" was obtained by heating the pyrite in a forge where the charcoal contaminated the iron, reduced it and converted it into a steel button. The pyrite is auriferous, assaying $9.00 per ton.

Silver and lead occur in the limestone as argentiferous galena. No silver minerals have been found and it is probably associated with the lead and copper sulphides. There are pockets of galena in the rock assaying several ounces of silver, but these pockets can not be depended upon as a silver proposition. In some of the calciferous altered porphyritic rock iron and lead carbonate have resulted by oxidation and may carry a few ounces of silver as shown in Round Mountain. Copper outcrops in several places show malachite and azurite as stains and good specimens. The original mineral is chalcopyrite which is associated with garnet, most of the outcrops being garnetiferous rock. They are not presumably of importance as copper deposits.

The district shows much iron and the hills are stained yellow and red by the alteration of the iron minerals, especially pyrite. Pyrite is common in porphyry and to some extent in limestone. On one of the claims, known as the South 40, there is an outcrop of massive magnetite associated with a black hornblende rock containing tourmaline. An old tunnel run into the hill to top this deposit has revealed a large body of magnetite as a contact deposit. This magnetite contains a small percentage of zinc and cadmium as sulphides intimately mixed with the magnetite. Attention was first called to this deposit by specimens of the magnetite coated a bright lemon and orange yellow with the rare sulphide of cadmium, greenockite. The cadmium is evidently associated with the zinc, and while of some value as specimens, it has little or no commercial value. An analysis of the magnetite shows the amount of the two sulphides to be very small, about one per cent. The amount, however, would probably vary.

At the northern end of the limestone belt a deposit of barite occurs and outcrops of the mineral indicate that a large deposit of the mineral occurs. Specimens obtained from a small hole show it to be a massive white pure barite. This deposit may prove of value in the future and several claims have been located on it.

Some of the limestone has been metamorphosed into pure white marble and there is an old marble quarry in White Way Cañon which is now owned by Ed. Davis. The marble was quarried from the bed of the creek and some large blocks have been taken out by drilling and used for monumental work. The marble has a decided rift and appears somewhat columnar in its structure instead of homogeneously and uniformly granular; consequently crushing strength and perhaps

its durability would not be equal to that of a fine-grained compact marble. The quarry has long been idle as the long haul to the railroad and shipment to a market render transportation charges prohibitive.

This section of Mono County has not been thoroughly prospected and it presents some attractive features for the investment of a little capital to open up some of the ore outcroppings.

The main road follows the western edge of the valley at the foot of the western granitic walls and enters the cañon of the river and continues due south along the banks of the river to Hardy Station or Blackburn. The cañon is narrow with sheer walls and precipitous sides of granite for the greater part of the distance. Near the Tollgate the granites on the east have a capping of black volcanic rock and as the road turns east from Blackburn it passes through a region of later eruptive rock.

At **Fales Hot Springs,** obsidian, pitchstone, tuff and old travertine deposits occur. The more recent volcanic activity, which is evidenced by the high volcanic peaks south of the springs and the pumice and obsidian boulders, is still further in evidence by the boiling water of this spring. If the county were well-populated this would undoubtedly become a well patronized resort. The volcanic character of this section is seen on the road to Bridgeport. About one mile southeast of the town of Bridgeport about one-half mile east of the road to Bodie, the large deposit of travertine occurs which has been described in former reports of the bureau and which McLaughlin mentions.[4] The travertine or lime carbonate occurs in several ridges of varying lengths, the longest several hundred feet. These ridges are somewhat covered and stand ten to fifteen feet above the surface, with an elliptical form generally, being slightly higher than the diameter of the base. It seems probable that this section was formerly occupied by pools which were fed by hot springs at the bottoms, the waters being charged with lime and soda carbonates held in solution. As the water trickled over the edges of these pools, the carbonates were precipitated by evaporation, forming a vein with fluted surfaces. With the cessation of spring flows and drying up or breaking of the walls, the pools became emptied leaving these veins standing. Most of the material is gray, discolored by iron and of very poor quality as a marble. In some portions the iron oxides have stained the travertine deep red and brown and a quarry was opened in 1895 and slabs of the material were used in the old City Hall in San Francisco. Some pieces could be obtained which would make good slabs marked by pleasing designs, but the most of the material is pitted and unfit for use. Not much of the material was ever quarried. There still remain small hot springs charged with the bicarbonates, and the bottoms of the pools are coated

[4] See p. 169, post.

white with the alkalies. Some attempt was formerly made to extract soda from the pools. All of the elliptical ridges are split asunder along their central line leaving a cleft several feet deep and a foot or more in width. It seems probable that on the release of water pressure and settling of the base these cracks were brought about. The rock is not very coherent and a little movement of the base on one side could easily account for the breaks. The section between Bridgeport and Bodie and around the latter town has been well covered by R. P. McLaughlin who gives descriptions of the mines in the following chapters.

BODIE AND MASONIC REGION.

Geology.

The mineral resources of this region can best be understood by a brief description of the geologic features which are shown on the accompanying map, upon which the section lines correspond to those shown upon the Bridgeport Topographic Quadrangle of the U. S. Geological Survey. It should be remembered that the geologic work was hurriedly done, being simply a reconnaissance.

The oldest rock in the region is the metamorphic series which consists of schist, quartzite, altered slate and similar rocks. It possibly belongs to the same series as the so-called slate, extending along the eastern flank of the Sierra Nevada and which is mentioned later. One of the most prominent exposures of this series is in the vicinity of Rough Creek, about 4 miles north of Bodie, where it consists of some large croppings of chalcedonic quartzite, dark, almost black quartzite, showing contorted lines either of bedding or flow under pressure. In other places as near the state line T. 5 N., R. 27 E., the quartzite has scarcely lost the appearance of a fine, hard sandstone with gently dipping beds and also varies to the appearance of black flint and white porcelain. Cinnabar in a 2-foot vein of chalcedony is located in this vicinity,[5] and some work was done many years ago. None was observed during this visit.

That portion of the series near the town of Masonic consists mostly of fine grained mica schist. That portion of the series on the wagon road about six miles south of Masonic shows light colored, slightly altered shale. The small areas in Sec. 34, T. 5 N., R. 26 E., are interesting on account of their isolation and small extent. Most of this rock is breccia and a light colored tuff or altered sandstone. Faulting is evidenced by slickensided exposures. Some prospect work has been done for quicksilver, but none was observed by the writer.

As seen from the above brief notes the series is very complex, probably having originally consisted largely of sediments which have been altered by heat and pressure during the upheaval of the Sierra Nevada Mountains and the accompanying granitic intrusion.

[5]Annual Report State Mineralogist, 1888, p. 356.

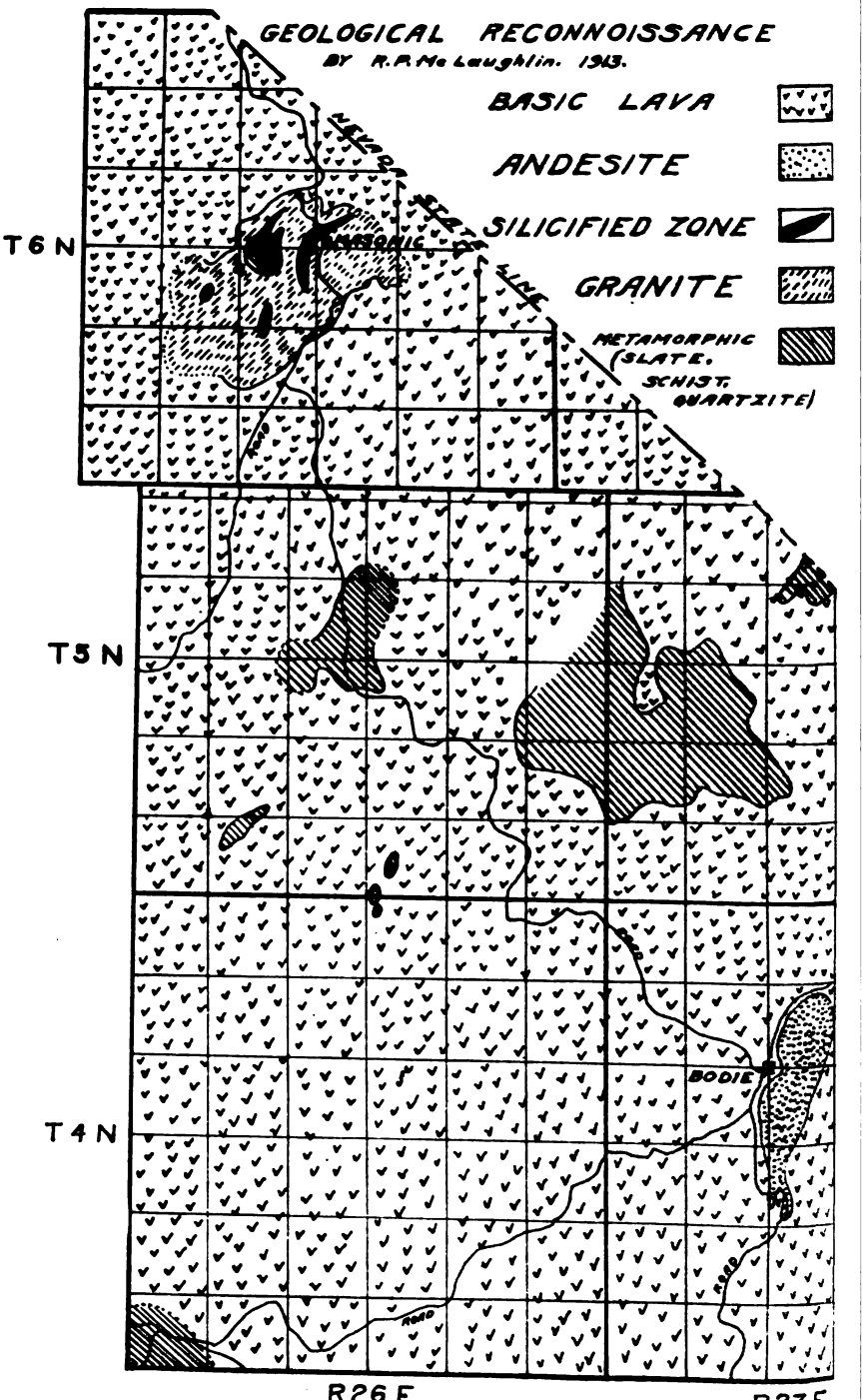

Plate I. Map of Portion of Mono County, California.

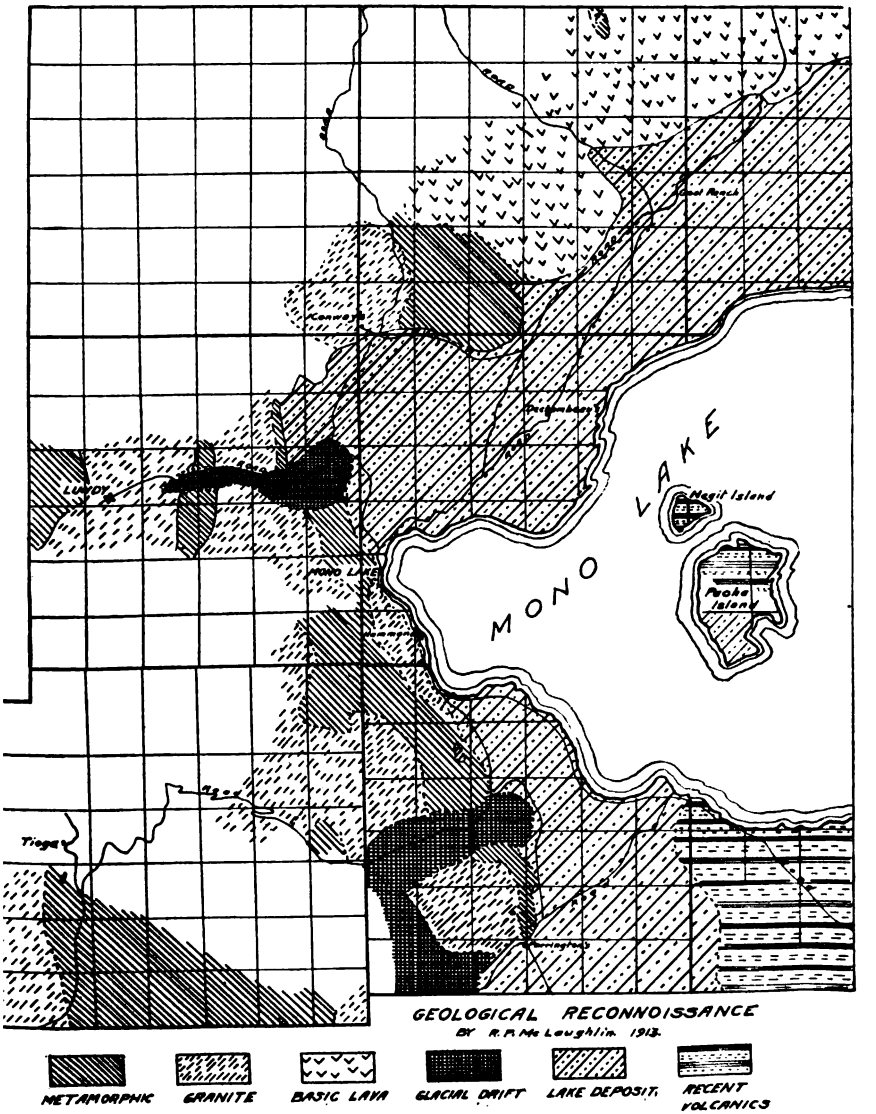

Plate II. Map of Portion of Mono County, California.

Upper end of Green Creek Cañon, as seen from head of northeast lateral moraine. A beautiful example of a U-shaped glacial cañon. The sides and floor of the cañon are granite. Green Creek is the source of water for the hydroelectric power plant of the Standard Consolidated Mine, Bodie. Photo by Walter W. Bradley.

The *granite* shown around the town of Masonic varies in different portions of the area, but is usually coarse grained, showing feldspar crystals frequently a half inch long. It is broken by several series of joint planes. To the north of town their strike is northeast and southwest, dipping about 60° towards the northwest, while south of town the most prominent fractures strike nearly east and west and dip northward. Probably the entire mass has been subjected to severe strains and movements, causing some of the more prominent jointing planes. Along the southern and eastern borders of the *metamorphic* area, one-half mile west of Masonic, the relation of the two series is plainly seen. That the granite is the younger is shown by its intrusion as dikes, several feet wide, for a distance as much as 50′ into the schist, which is generally laminated parallel to the contact line between the two formations.

The silicified zones are among the most important features shown on the map, as in them occur most, if not all, of the ore bodies of the Masonic district. North of the main road through the district, in Section 15, is a bold quartz or quartzite outcrop several hundred feet wide and over one hundred feet high, being one of the most noticeable portions of the silicified areas. These zones doubtless exist in places where considerable fracturing and possibly movement has taken place in the granitic country rock.

As shown on the two accompanying maps the zones correspond closely with the general direction of the jointing planes in the granite. It is also suggested by some observations, notably about 200′ SE. from the Serita shaft, that there may have been intrusions of igneous dikes along some of the fractured areas. In general the rock in these zones is quartz, but not in the usual vein formation. It is usually dark colored or rusty in appearance and the walls of the zone are not clearly distinguished, especially upon the surface of the ground. It is made up of large quartz boulders, silicified granite, breccia and some clay as from decomposed country rock. The ore of the district has an open or porous appearance and consists of light colored chert and coatings of chalcedonic quartz accompanying breccia of light colored angular fragments cemented in a dark brown groundmass. Its appearance is unusual as compared with other ore bodies of the surrounding country, which doubtless accounts for its comparatively recent discovery. It indicates that after quartz began to be deposited there were many disturbances in the channels, opening, closing, and crushing. Irregular shaped ore bodies are to be expected.

The rock immediately east of Bodie has been described as hornblende *andesite* and that immediately surrounding it (mapped as basic lava) is also andesite, but of a much coarser texture. Their difference in color is marked, the outlying rock weathering to a pink while the

Glacial striæ or scoring on bedrock (metamorphic) above East Lake at head of Green Creek, Mono County. Photo by Walter W. Bradley.

Glacial moraines on Green Creek, Mono County. View looking down creek from below mouth of cañon proper. The two ridges on either side are lateral moraines, which at their upper end are 500 feet high. The meadow in the middle-ground is due to silting up of the lake which was formed by the terminal, glacial moraine whose position is marked by the line

hornblende andesite weathers to a reddish brown. The surrounding lava flows lap onto the andesite, which was probably standing as a hill long before the volcanic flows occurred. There is some evidence, such as occasional inclusions of chert at a depth of about 500′, in the mines, that the older andesite broke through the underlying metamorphic rocks. The relation between the andesite and overlying andesite can be seen east of the Standard mill and more plainly at Sigourney Flat, where the sharp hill, around which the wagon road winds (SW. ¼ of Sec. 21, T. 4 N., R. 27 E.) consists mostly of the lava capping, the contact dipping southward.

The andesite is a most important rock economically as it contains all the quartz veins of the Bodie district. These veins are a most interesting feature, geologically, which has been fully described, as hereafter noted. The most northern exposure of quartz veins in the Bodie andesite is at the Syndicate Mine and extends south more or less continuously for three miles to Sigourney Flat. Only the northern half of these croppings have been productive.

The rocks mapped as *basic lava* are of several varieties and may include some which would not strictly fall under that name. Along the road a mile and a half south of Masonic it is basalt. About three miles south of Bodie it is bedded volcanic tuff and also tuff composed of angular boulders of various sizes cemented by the finer tuff, while occasional dikes of dark igneous rock are plainly seen protruding through and above the tuff. About two miles north of Bodie on Table Mountain the most recent lava is seen having flowed out from the cone-shaped crater known as Beauty Peak, which is situated on the Nevada-California boundary line. The original smooth surface of this particular flow is but little disturbed, while the older flows are much eroded. The entire mass has a characteristic and monotonous appearance, forming pink or dark brown rounded hills. The formation possibly attains a maximum thickness of 500′ in some places. Along the road in Cottonwood Cañon, 3 miles south of Bodie, the volcanic breccia or conglomerate has a damp appearance and is frequently referred to as an oil seepage. Its appearance is really due to magnesium salts which are hydroscopic.

In the following descriptions many old, idle or abandoned properties, are omitted as nothing could be added to previous reports.

BODIE DISTRICT.

This mining district has been and still is the most important in Mono County. Up to the end of 1888 it had produced $18,097,922 in gold and silver and from that time until the end of 1912 over $6,150,000 has been produced. The district was organized in 1860 and in 1863 a New York company began mining operations on the property later

known as the Syndicate, now the New Bodie, but failed and the di
was practically idle and deserted until 1872, when rich ore wa
covered in one of the old claims and milled in arrastras on R
Creek. In 1876 a San Francisco company began mining on wh
now known as the Standard property, less than half a mile fro
ore bodies discovered some 16 years previous. In two years rich s
created great excitement and much development work was carri
by about 50 companies, however, expectations were not realized
about 1880 the camp declined. The above facts and a descripti
the geological occurrences to which little can, even now, be added,
set forth by H. A. Whiting in 1888.[6]

Subsequent history of the camp is interesting principally on ac
of the long period of activity upon lower grade ore deposits all w
the early defined limits. A recital of developments of new mining
particularly metallurgical methods in this district gives an outli
the advance of knowledge of gold mining in California, as many
methods have seen early trials here under managers who have
achieved world-wide fame.

About 1890 concentration with Frue vanners was tried as an e
ment and leaching of tailings valued at $7 to $8 per ton at a co
$3.50 was an innovation. In 1892–1893 a hydroelectric plant wit
miles of transmission line was built under direction of Mr. T. H.
gett, to economize in milling, as wood at $10 per cord had been co
$2000 per month to crush 50 tons per day in a 20-stamp mill.[7] Su
ful operation reduced milling cost to $1.46 per ton.

Standard Con. Mining Co. For many years, only this concern
been operating in a large way and as similar methods are like
be applied to any of the remaining ore bodies worked in the futur
following data from the company's annual reports, kindly furnish
C. E. Grunsky, Jr., formerly superintendent[8], are interesting.

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[6]Report VIII, pp. 382 to 401.
[7]Report XII, p. 419.
[8]Mr. Grunsky was succeeded by Chester A. Allen, who continued as superint
to February 23, 1915, when the property was transferred to J. S. Cain of Bodie
tailings ponds were exhausted in October, 1913, since which, until October,
the slime plant has not been in operation. No ore was treated during 1914,
the early part of 1915, but development was continued.
Under date of October 16, 1916, Mr. Cain writes that good ore is being obtai
leasers on several levels of the mine, from small veins, assaying from $100
per ton, and that the mill is crushing ore from the 318' level yielding $250
on the plates. Also, they are hoisting ore averaging over $200 from the 52
from a point 1000' east of the Standard shaft. Good ore is being opened up
350' level south of the Bulwer tunnel, about 50' west of the Standard shaft;
the 200' level of the Bodie tunnel, 400' south of the Syndicate ground. These
veins were found by crosscutting. The slime plant is again in operation t
tailings from the mill direct. The Lent shaft is being unwatered, and it is in
to unwater the Standard to at least below the 800' level, as it is claimed that
is silver ore on that level. The photograph of the mine map reproduced he
was obtained through the courtesy of Mr. Cain.

ures 1877, 1878, 1879 from Annual Report State Mineralogist, 1888. †Earlier figures not available. ‡Dry tonnage from 1911; wet tonnage previously.
e property comprises about 200 acres. Besides the original Standard claims, the following old companies were absorbed in 1895: Bodie, Bulwer, Mono
Summit and the Bodie tunnel was purchased in 1901; practically all the land between the New Bodie (Syndicate) and the Southern Consolidated.

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Record of Production, Dividends ...

Year	Production	Dividends	Tons of ore	Value per ton	Tons of waste	Development in feet	Cost mill per ton	Cost mining per ton	Per cent saved in mill	Total per cent saved	Remarks
1877*	$784,522 80										
1878*	1,025,383 35	$890,000 00	†		†	†					
1879*	1,448,845 47										
1880	1,398,884 62	550,000 00	†		†	†					
1881	1,952,843 55	950,000 00	†		†	†					
1882	2,049,621 53	975,000 00	†		†	†					
1883	1,175,728 01	675,000 00	†		†	†					
1884	1,064,934 46	375,000 00	†		†	†					Assessment of $25,000.
1885	242,093 74	50,000 00	†		†	†					
1886	226,988 86		†		†	†					
1887	228,821 00		†		†	†					
1888	302,207 80	30,000 00	†		†	†					
1889	127,340 94	40,000 00	†		†	†					
1890	134,900 82		†		†	†					Assessment of $75,000.
1891	84,622 26		†		†	†					
1892	237,995 78	18,902 80	†		†	†					
1893	239,381 70	28,354 20	12,420		7,017	†	$3 78	$6 02	74		Electric power introduced.
1894	171,535 79	18,902 80	6,950	$28 46	8,094	5,363	4 42	9 85	79		
1895	195,907 50	37,805 60	10,111	16 63	7,342	4,334	3 42	7 31	70		
1896	234,617 99	18,902 80	10,160	20 40	13,057	4,413	3 12	8 90	65		
1897	294,278 97	35,678 80	12,967	22 57	9,527	6,407	2 92	7 56	66		
1898	261,750 43	35,678 80				6,026					
1899	445,179 98	53,518 20	12,358	38 71	10,605	5,282	2 22	8 11	72		
1900	425,613 78	71,357 60	17,883	26 06	15,928	6,761	1 80	8 08	67		
1901	351,804 05	71,357 59	20,675	19 14	16,775	7,961	2 17	7 48	66		
1902	360,775 40	71,357 60	18,047	18 48	18,355	7,504	1 98	7 93	68		
1903	309,425 76	53,518 20	14,736	20 70	16,863	6,106	2 59	9 05	66		
1904	221,870 03		17,734	18 56	20,954	6,049	2 24	8 33	62		
1905	273,018 91	17,839 40	10,210				1 69	5 97			Slime, cyanide plant began operation.
1906	323,069 05	44,598 50	18,240	19 77		5,437	1 60	6 26			
1907	284,047 36	35,678 80	16,021	17 15	9,167	3,654	1 43	6 92	42		
1908	253,272 02	35,678 80	14,229	16 36	8,179	3,282	1 35	7 22	28	90	
1909	226,404 08		11,732	14 16	14,784	6,087	1 63	8 79	28	88	
1910	267,935 39	17,839 40	13,138	14 38	13,432	4,460	1 28	7 55	38	88	
1911	235,476 81	17,839 40	‡8,798	14 74	15,077	6,254	2 02	12 67	41	91	
1912	188,992 34		8,150	11 72	14,749	6,216	1 92	10 71	46	90	
1913	132,943 60	44,598 50	6,342	13 06		2,846	1 64	10 50	48	90	Mill and slime plant closed October to end of year.
Totals	$18,202,855 62	$5,264,407 79	260,901		219,905	104,442					

*Figures 1877, 1878, 1879 from Annual Report State Mineralogist, 1888. †Earlier figures not available. ‡Dry tonnage from 1911; wet tonnage previously.

The property comprises about 200 acres. Besides the original Standard claims, the following old companies were absorbed in 1895: Bodie, Bulwer, Mono and Summit and the Bodie tunnel was purchased in 1901; practically all the land between the New Bodie (Syndicate) and the Southern Consolidated.

The veins at present being worked are small, probably averaging about a foot in width, most of them having a dip of over 70°. The great number of veins in the property is indicated by the fact that during the year 1912 development work was done on 35. Probably there are several hundred within the area of the company's ground.

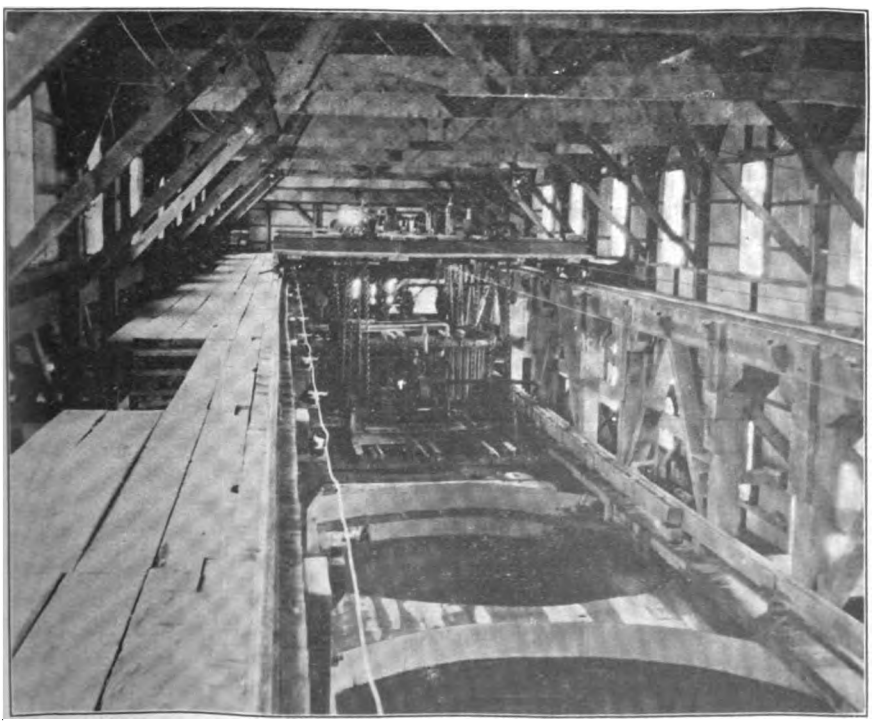
The veins are nearly parallel, having a north and south direction and the distance between them probably averages 30 feet. All mining is hand work, either drills or "picker bars" being used to put in powder. Mule trains deliver the ore in one ton cars from underground ore chutes through adits to the 20-stamp mill. No mining below about 500′ from the surface of the ground has ever been profitable and nearly all the ore extracted in the district has been from above the water level, which is now 521′ in the Lent shaft. Pumping from the mine is only to supply the mill and cyanide plant.

During the years 1911 and 1912 mining costs per ton of ore have been as shown by the following subdivision:

	1911		1912	
Development—				
Labor	$4.304		$3.701	
Supplies	1.077		1.089	
Power	0.038		0.067	
		$5.419		$4.857
Stoping—				
Labor	$4.735		$4.335	
Supplies	2.478		1.448	
Power	0.042		0.078	
		7.255		5.861
Totals		$12.674		$10.781

Ore is crushed in a 20-stamp mill and the cyanide treatment of the tailings consists of sliming in a tube mill and filtering by vacuum filter.

Mill of Standard Consolidated Mine at Bodie. Incline at left is for ore cars. High-line flume conveys tailings to cyanide plant. Photo by Walter W. Bradley.



Moore vacuum filter and tanks in cyanide plant of Standard Consolidated, Bodie. Photo by Walter W. Bradley.

Results of Stamp Milling.

Year	Ore: Tons milled	Ore: Value per ton	Saved by mill	Ounces amalgam	Value tailings per ton	Stamp duty
1911	8,798	$14 74	$59,381 03	15,876	$7 99	25
1912	8,150	11 72	48,252 13	12,537	5 80	23

Cost Per Ton Milling, 1912 (8,150.38 Tons).

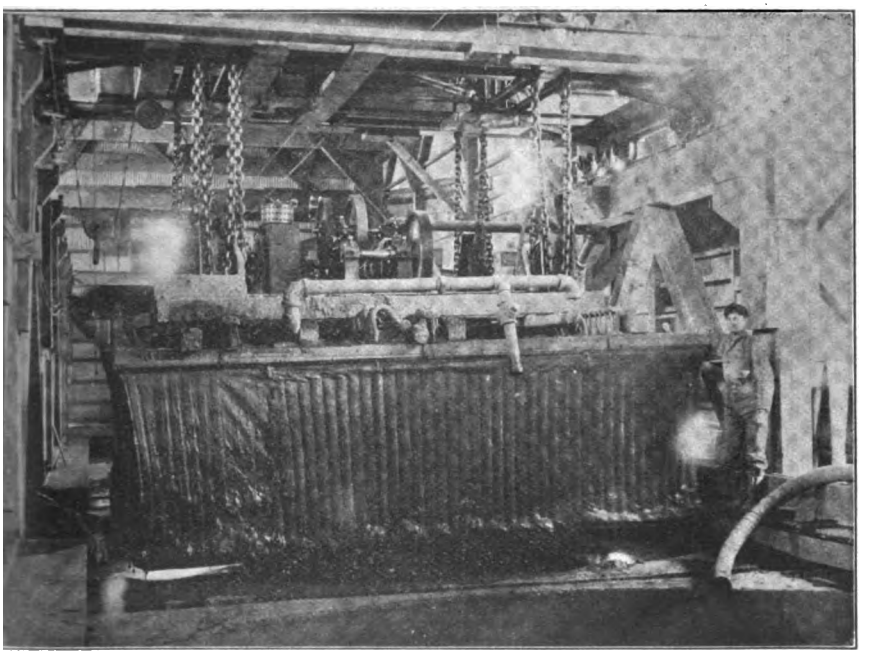
Labor	$1.926
Supplies	
2 battery shoes	.029
62 battery dies	.057
2 boss heads	.001
Liners	.011
320 screens	.012
6 mill plates	.004
1,777 ounces quicksilver	.031
Belting	.009
Fire wood	.020
Sundries	.034
Bullion charges -	
Express	.002
Treatment	.020
Distribution accounts--	
Bullion room	.003
Stable	.009
Yard	.000
Power plant	.265
Assay office	.041
Blacksmith shop	.033
Machine shop	.042
Total	$1.922

Previous to 1905 cyanide treatment had been applied only to such tailings as could be leached with the consequence that over 100,000 tons of tailings valued at about $5.00 and consisting of about 75% slime had accumulated. In that year the slime plant, erected under the superintendence of T. J. Hoover, began treating the accumulated tailing and also that delivered from the mill. Some of the results of the slime plant are here shown.

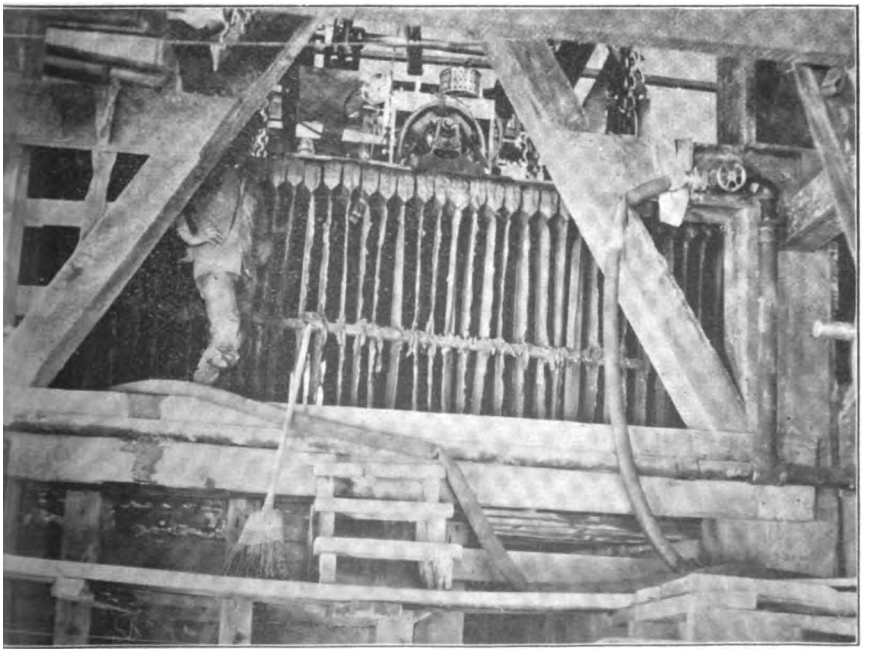
Results of Slime Treatment.

Year	Tons treated besides mill runs	Extraction (per cent)	Cost per ton
1906	7,527	89.4	$2 43
1907	8,557	88.6	2 75
1908	12,667	90.0	2 48
1909	19,538	87.7	2 71
1910	21,073	88.2	2 61
1911	15,916	90.7	2 06
1912	16,560	80.7	1 39

About 1910 the filter baskets were changed from the Moore to the Butters type of arrangement.



Raised, with cake on, ready to wash.



End view.
Moore Filter Basket, in cyanide plant of Standard Consolidated, Bodie.
Photos by Walter W. Bradley.

Pouring a 2300-ounce bar of gold-silver bullion at Standard Consolidated Mine, Bodie. Photo by Walter W. Bradley.

Some further details of the slime treatment during 1912 are as follows:

	Assay Per Ton.		
	Gold	Silver	Total
Tons from mine, 8,024	$5 43	$0 35	$5 80
Tons from ponds, 16,508	4 83	80	5 63
Tails	61	15	76

Number of tanks charged	617
Per cent moisture	71
Per cent on 100 mesh	31
Tons solution handled	101,919
Cyanide, pounds per ton, solution	1.5
Lime, pounds per ton, solution	.36
Filtering hours—	
Cake, hours	2.3
Wash, hours	2.6
Hours, cycle	121
Cake thickness, inches	.79
Tube mill, running hours	2,666
Value zinc room solutions, heads	$1.62
Value zinc room solutions, tails	.03

Consumption 1912.

	Total, pounds	Pounds per ton ore
Cyanide	25,270	1.0
Lime	359,870	14.6
Lead acetate	2,298	.1
Zinc	11,616	.5
Pebbles	24,700	1.0

Cost Per Ton, Slime Plant, 1912 (24,593.36 tons).

Labor	$0.854
Supplies—	
Cyanide	.209
Lime	.192
Zinc	.078
Pebbles	.020
Lead acetate	.013
Belting	.007
Wood	.031
Sundries	.100
Bullion charges—	
Express	.052
Treatment	.019
Distribution accounts—	
Bullion room	.059
Stable	.117
Yard	.035
Power plant	.081
Assay office	.024
Blacksmith shop	.026
Machine shop	.053
Total	$2.10

Interesting, as showing the closeness with which old deposits are now worked, it may be noted that in 1913 lessees were profitably sweeping the top crust from the tailing discharged from the slime plant. The tailing bed was about 10 ft. deep of an average value of $0.75 per ton, having stood four years. A concentration of values in the top crust, probably by capillary attraction and evaporation, had caused about ¼ inch to have a value of about $15.00 per ton. Four men carefully swept up about 10 tons of this crust per day, which was then run through the company plant.

The future of this property, and to some extent the district, is shown by the following facts. Most of the veins pinch to mere seams at a vertical distance of 500′ to 700′ from the surface and lose their value

at a depth of 400′ to 500′, particularly the north and south
Deep workings establishing these facts are at the Lent shaft
deep and the Standard shaft 1200′ deep, the collar of the Lent
about 200′ vertically lower than the Standard.

Lent shaft explorations, in which water now stands at the 521′
are as follows:

800′ level	600′ of drifts.
1,000′ level	1,000′ of drifts; 1,100′ of cros
1,200′ level	1,100′ of drifts; 1,000′ of cros

This shaft when operated required pumping from 800,000 to 90
gallons per 24 hours.

Standard shaft explorations are at present partly open above th
level, below that point the following work was done:

700′ level—980′ cross cuts east, 500′ crosscuts west, about 1,000′ of dr
barren ground.
1,000′ level—1,140′ crosscuts east, 300′ crosscuts west, and over 1,000′ o
work.
1,200′ level—500′ crosscut east.

Bibl.: Reports VIII, p. 385, XII, p. 183, XIII, p. 231; Rep
Director of U. S. Mint, 1883, pp. 173–175.

Southern Consolidated. This property adjoins the Standard
solidated on the south and comprises the following old comp
Noonday, Red Cloud, Addenda, Oro, and Defiance (in all 12 clai
which 9 are patented).

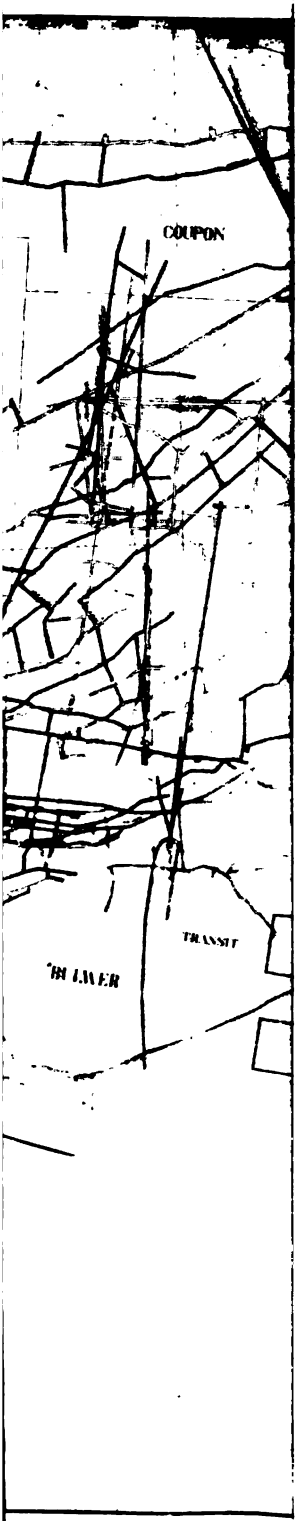
Only development work has been done since 1882. At the Noo
Oro, and Red Cloud there are steam hoists at the shafts, each of
has three compartments. The Red Cloud shaft is about 900′
water now standing at 490′. The formation is the same as i
Standard Mine, namely many steep-dipping parallel veins in and
making a description of the underground works almost impossible,
if data were at hand. It is stated that about five miles of work has
done.

In the workings at present open, there are several unstoped
2′–3′ wide said to carry from $10.00 to $15.00 per ton in gold
silver. Doubtless mining of these ore bodies will take place at
future time.

Production of the property[9] from 1877 to 1888 was,

Noonday	$1,023,2
Red Cloud	10,0
Oro	14,1
Addenda and Defiance	
Total	$1,048,3

[9]Report VIII, 1888, p. 397.



courtesy of J. S. Cain.

The fineness of the Noonday bullion varied. The highest percentage f gold by weight being 18.5 in 1880, falling to 8.6% in 1882, the emainder being silver.

Ownership rests with the Southern Cons. Mining Co. J. S. Cain of odie, president.

Bibl.: Reports VIII, p. 396, XII, p. 182, XIII, p. 230.

New Bodie Mine (formerly known as the **Syndicate**). This property adjoins the Standard on the north, many of the veins continuing cross the line and the same underground conditions prevailing. It was ere that the previously mentioned work was done in 1863. There are 3

New Bodie (old "Syndicate") mill and tailings ponds, near Bodie.
Photo by Walter W. Bradley.

patented claims. For many years the mine has been and is now worked principally by leasers whose ore is crushed and leached, during the summer months, at a 20-stamp, steam power, mill on the property. The work has been profitable (leasers usually making fair wages), by opening up new veins near the surface and of comparatively short extent. A number of adits open the ground, the lowest being about 700′ vertically below the croppings. A quotation from H. A. Whiting[10] shows some of the conditions—"Not only have these younger lodes their largest development in the Standard Mine, but they have there been the most productive. North of that they are more numerous, but

[10]Report VIII, p. 388.

smaller. In the Syndicate mine, on the extreme north end of the mineral belt, the veins become unproductive at a horizon about 50 feet below the Osceola tunnel; or, about 250 feet below the croppings on Bodie Bluff. This mine has been thoroughly prospected east and west at two localities, over its whole width of 1200 feet, by crosscuts from the Syndicate tunnel which is 500 feet below the Osceola tunnel. Numerous small veins of quartz are met with in these crosscuts, but they are all barren of ore, or so nearly so as not to repay extraction."

At the end of 1888 a total production of $584,711.21 was reported, dividends having been $48,308, and assessments $38,728.75. Percentage by weight of gold in the bullion varied from 33 to 45. From 1892 until 1906 the production is said to have been about $30,000 per year from ore averaging $12.00 per ton.

Bibl.: Reports VIII, p. 387, XII, p. 184, XIII, p. 232; Report of the Director of the U. S. Mint, 1883, p. 175.

MASONIC DISTRICT.

This district lies about 16 miles, by wagon road, northwest of Bodie and about two miles distant from the California–Nevada boundary line, at an elevation of about 8,000′. It is the most recent camp in the country where any considerable amount of work has been done, and this together with the fact that ore of high grade has been mined makes its description important.

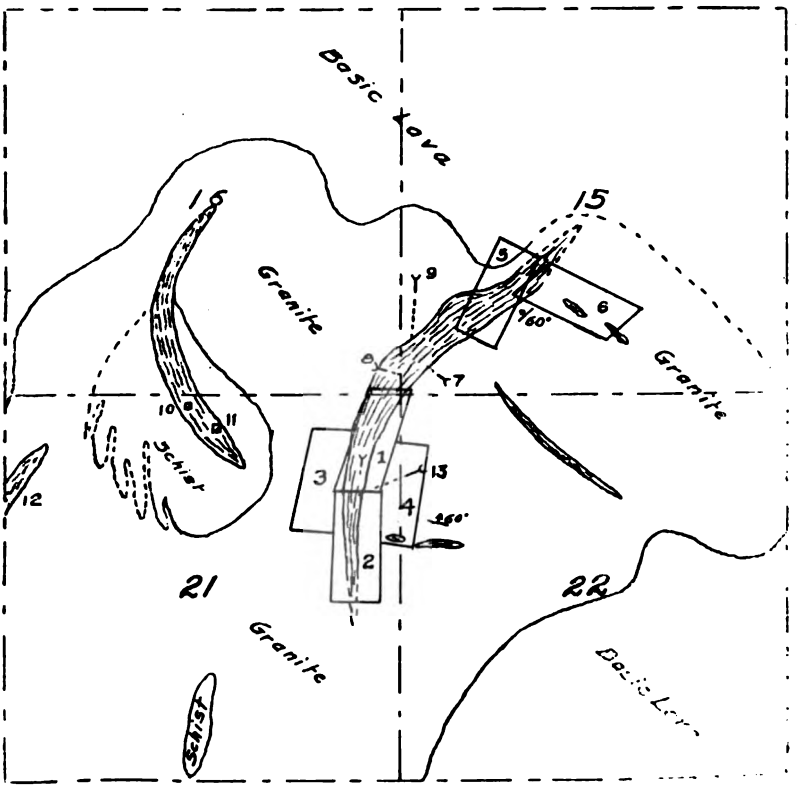
Masonic and the neighborhood has been known slightly for many years and some prospecting had been done, but discovery of valuable ore took place August 1, 1902, when J. M. Bryan, Kaleb Dorsey, and J. S. Phillips made locations on what has since been called the Pittsburg-Liberty Mine. They had followed numerous croppings of white ("bull") quartz veins, in the granite, without good results and finally panned some of the dark porous croppings prominent in the neighborhood with encouraging results. The three partners were old-time miners who regularly spent a portion of their time working for wages and the remainder in prospecting.

Not until three years after the locations were made was ore in workable quantity or value found, and no considerable production was obtained until 1907 when they shipped to the Selby smelter near San Francisco, a car load of ore (17 tons) which netted them $1040 per ton. This was the product of five men's work during the summer and at a depth of only 15 feet. An option was given to George Wingfield and a payment of $47,000 received. The option resulted in sinking a 100′ shaft and driving a 47′ crosscut. However, title did not pass from the locators due to their not consenting to alteration of terms and they, upon taking charge of the property, again shipped ore to the

amount of three carloads, the poorest of which gave them a profit of over $700 per ton.

The **Pittsburg-Liberty Mining Company** was formed and a 10-stamp steam power mill was erected about a mile down the cañon. The mine, operated until 1910, reported production being $600,000 to $700,000 and has since been idle. No very large profit is said to have resulted and the corporation is at present bankrupt. This is remarkable when it is considered that the maps show only about 6000′ of drifts and crosscuts.

Plate IV. Masonic Mining District, Mono County.



Sections 15, 16, 21 & 22
T6N-R26E-M.D.

1. Pittsburg claim.
2. Liberty claim.
3. Liberty No. 2 claim.
4. Pittsburg No. 2 claim.
5. Hermine claim.
6. Jump-Up-Joe claim.
7. Rough and Ready adit.
8. —— adit.
9. Home View adit.
10. New York shaft.
11. Sarita shaft.
12. Lost Horse shaft.
13. Pittsburg-Liberty adit.

Several veins or zones were stoped, most of them dipping at angles from 70° to 90°. The greatest depth stoped below the croppings was about 150′. The lower works being obstructed at the time of this examination no observations could be made as to the geologic reason

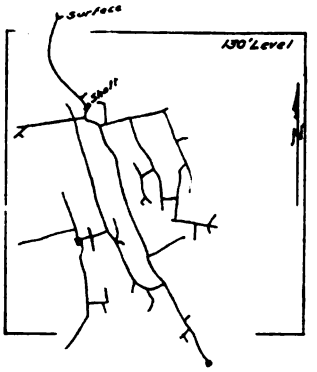
for loss of value. Assay plans show very irregular shapes and values of the ore bodies. Most of the value is gold, some ore running as high as $300 per ton and from inspection of assay plans it seems probable that the average value was about $20. No machinery was used in the mine. Stopes and drifts were supported by nut pine timber from the surrounding hills. Chutes to the lower adits furnished outlet to the wagon road running to the mill. Timber is cut under permit from the U. S. Forest Service at an average price of $1.75 per cord. The accompanying sketch shows the amount of underground work on the four principal levels. Some of the most noticeable facts indicated by the map are: five veins striking N. 25° W. and dipping to the east, developed upon the upper or 130′ level; three of them developed on the second or 172′ level; exposure by one crosscut under the entire group of veins on the third or 271′ level; and the lower tunnel or 413′ level cuts almost all of the mineral zone about 100′ south of the most productive portion. An area 300′ square covers most of the workings.

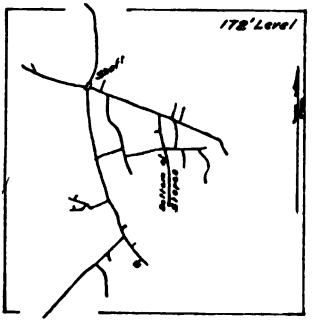
The east wall of the silicified zone, according to description by J. M. Bryan, is shown on the map of the 413′ level. North of the main tunnel the general dip is said to be toward the east while on the south side of the tunnel the dip is westerly. Horses, of granite are said to have been common in the mineralized or silicified zone.

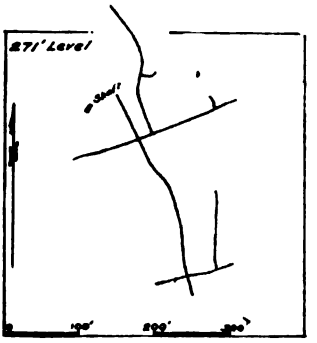
Possibility of extension of known ore bodies or other finds is the most important economic question relating to the district. The geologic features and positions of some of the prospecting works are shown on the accompanying map of the district.

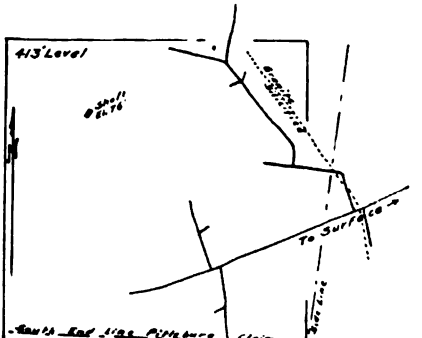
The **Serita Mine** is a property upon which recent interest has centered. It lies almost a half mile west of the Pittsburg-Liberty, and is owned and operated by F. W. and Geo. C. Stall. A vertical shaft 218′ deep and two crosscuts, 100′ north and 80′ south, on the 100′ level are the principal workings. A gasoline hoist with buckets constitutes the equipment. The ore, as seen in the shallow surface cuts, is porous chert and chalcedony accompanied by breccia similar to the Pittsburg-Liberty ore. Walls are indistinct and difficult to identify but there seems to be from 4′ to 10′ of ore which is said to carry free gold from $3 to $40 per ton. North from the Pittsburg-Liberty the following work has been done along the silicified zone:

Jump-Up-Joe Mine. This property is owned by the **Field of Gold Mining Co.**, of which W. A. R. Loose of Bodie is manager. The croppings of close-grained brown and black quartzite carry considerable coarse gold, readily distinguished by the naked eye. An adit of about 100′ length runs southwesterly into the silicified rock with a winze about 50′ deep near the entrance. Little or no work has been done since the early days of the camp. No considerable production by the company is reported.


Surface
130' Level
Shaft


172' Level
Shaft


271' Level
Shaft


413' Level
Shaft
To Surface

Hermine claim is owned by August Seiler. A number of short adits and shafts have been opened by the owner and other parties working under option. The prominent croppings of quartzite previously mentioned contain most of the surface works on this claim. Little or no ore has been extracted.

Rough and Ready Mine. An adit in search of a northward extension of the Pittsburg ore, stands open for a distance of about 300′ running N. 55° W. Only granite is exposed with the exception of a 10′ dike of dark fine grained rock, dipping N. 65° W. at an angle of 48° at 180′ from the entrance. There is no evidence of alteration or movement except a clay seam on the west side. Adjoining the Rough and Ready but on the opposite side of the hill near the summit, an adit runs in S. 70° E. a distance of 350′ all the way in the silicified rock.

Home View Mine. Near the west side of the silicified zone but in the granite the Home View adit was run in a southerly direction about 900′. No ore is reported to have been encountered and the appearance of the dump indicates that most of the work was in granite or blue clay gouge.

It will be seen that a northward extension of the ore bodies has not as yet been exposed.

Toward the south the zone does not extend much beyond the Liberty claim, gradually dying out in the granite. Numerous surfaces trenches in this vicinity have not developed ore.

To the east of the Pittsburg-Liberty zone there are numerous smaller silicified zones having an easterly and westerly strike in the granite. Several of the larger ones are shown on the map. Considerable work in this area has been done without favorable results.

New York Mine. This claim is near the Serita in the same zone. A shaft was sunk about 50′ and some surface work done. Spots of ore of good value have been reported.

Lost Horse Mine. This claim is situated on one of the smaller but prominent zones shown on the map. A great deal of trenching was done and a shaft sunk about 50′. No important results are reported. The croppings are of quartzite and breccia very much stained with iron. The marked difference in appearance from the payable ore on nearby claims is the absence of chalcedonic quartz.

There are similar geologic occurrences farther toward the west, in Sec. 20. Locations have been made which are said to show some ore. Among the more prominent are the two following:

Lake View Mine. The claim is situated west of the center of Sec. 20 on the west hill slope. Development work consists of an adit 176′ long with various winzes and raises, all in silicified rock. There is 25′ of ore exposed on the surface said to average $4 per ton. J. M.

Bryan is one of the owners. It is contemplated that a small mill will soon be built.

Red Rock Mine. In the northern part of Sec. 20, on one of the silicified zones. A 50′ shaft, and several adits about 25′ long comprise the work done. There is said to be some pay ore exposed at present. Owner, Jas. Logan.

Several properties at various points in the northern portion of the county have been developed and merit description. Most of them were visited previously by the writer.

Golden Gate Mine. Situated near Coleville, in Sec. 26, T. 8 N., R. 22 E. Formerly owned by Golden Gate Mining Co., of which Joe A. Brown was president. Two veins dipping S. 60° W. in schist and slate at an angle of 38° have been stoped for distances of 105′ and 160′ for a height of 60′ at an average width of 4′. Five adits furnish entrance to the mine. Their lengths in order from the lowest to the uppermost are 1800′, 640′, 1200′, 300′, and 100′. Equipment comprises a 10-stamp mill, without concentrators, operated by water power. Water available is said to be 33 miner's inches with a fall of 538′. An aerial tramway 2300′ long carries ore from the mine down to the mill. The property has been operated several times under option to purchase. The last results of such operations, from Sept. 1, 1912 to April 13, 1913, are reported by the owner as follows: Tons crushed 6848, yielding $33,646.47 at a cost for tramming and milling of 42¢ per ton.

Operations are expected to resume shortly.[11]

Al Mono Mine is 3 miles southeast of the Golden Gate, working three men, adit 800′ long, ledge said to be 2′ wide and in 1902 to have yielded $300 per ton on a three-ton shipment. Operators afterward relinquished their claim to the property. Present owners, J. A. Shirley et al. Ore carrying gold, silver, and lead is reported of recent discovery by Ed. Davies of Topaz, near the summit of the Sweetwater Range and about two miles northeast of the old Lindsey marble quarry.

About two miles southeast of the Golden Gate mine Dr. O'Connor of Coleville has recently been engaged in opening an adit on a prospect.

PATTERSON DISTRICT.

The district was active from 1880 to 1884 over an area extending about six miles north and south, (between Frying Pan and Sweetwater Cañons) and three miles east and west having produced about $500,000.[12]

Among the properties in the Patterson district are the following upon which information has been obtained:

Silverado Mine is situated on the west side of the Sweetwater Valley, about three miles from the Nevada-California boundary line

[11] See also p. 136, *ante*.

in Sec. 19, T. 7 N., R. 25 E. The property comprises 8 unpatented claims owned by Columbia Cons. Mines Co., John J. Phelan, Pres., 123 Sanford Bldg., Bridgeport, Conn. The ledge dips westerly at an angle of about 30 , having a width of from 2′ to 5′. There are three adits on the vein, the upper being 150′ long, the middle one 800′, and the lower 600′. Values are in the form of silver chloride occurring in spots. It is said that previous to 1896 there was a total production of $20,000, the ore being packed out on mules, and that since then possibly $5,000 has been produced. During recent work under an option, which lapsed, sampling results showed 28 inches of ore running between $15 and $30, about 500 tons of sorted ore on the dump averaging $25. Smelter assay certificates dated 1911 showed the following results:

Sorted ore, 0.29 oz. gold; 241.01 oz. silver. Concentrates, 0.47 oz. gold; 1484.18 oz. silver.

The equipment consists of a 10-stamp, steam power mill and percolation cyanide plant.

Bibl.: Rep. of Director of U. S. Mint, 1883, p. 176.

Star and Great Western Claims. Situated in Sec. 14, T. 7 N., R. 24 E. near the summit of the Sweetwater Mountains at the head of Sweetwater Cañon. Two patented claims, owner Martin Jones, 634 Ashbury street, San Francisco. No production is reported but a mill test of five tons of sorted ore from the last-mentioned claim is said to have returned 47 ounces of silver per ton (85% extraction). The vein is said to be 4′ to 11′ wide cropping for 700′ dipping N. 76° E. An adit 135′ on the vein and 9 open cuts, 75′ apart, constitute the development. On the Star are two veins 3′ wide and said to assay about 20 ounces in silver per ton. An adit 85′ on the vein and a 35′ winze are the developments in ore.

Summers Consolidated Mine is near the head of Ferris Cañon. Four patented claims owned by Mrs. Jas. Acheson of Sweetwater, Nev. A 5-stamp mill was operated until October, 1885. Reported production about 5100 tons of ore yielding $254,446. Several adits were opened, the longest being 1240′ and the vein was developed for 700′ on the dip (dip 65° except in lowest works where it is steeper). Two shoots each about 125′ long and 3′ wide were opened. Ore was packed to the mill, nothing less than $18 (silver at $1.29) was taken. These figures were kindly furnished by Mr. Martin Jones who was superintendent during final operations.

On the eastern flank of the Sierra Nevada Mountains at an elevation of about 9000′ are two properties upon which some work has been done as follows:

Dunderberg Mine. Situated a mile south of Green Creek, Sec. 19, T. 3 N., R. 25 E. Patented, recently sold to the state for unpaid taxes.

Two crosscut adits were run, one being about 900′ long and 200′ above the other which is 1700′ long. A winze 100′ deep was sunk from the lower adit and a great deal of drifting was done on the vein in various places. An adit was started on Green Creek about 800′ lower, to tap the vein but was run only 500′. The ledge dips westerly about 45° having a width of 3′ in the upper tunnel and 9′ in the lower. Some of the ore near the surface is said to have carried values in gold as high as $20 to $40 per ton. A great deal of iron sulphide was encountered (said to be over 50%), and a heavy flow of ice cold water.

A 20-stamp mill, driven by water power, with 5 Frue vanners and a chlorination plant, were erected. No work has been done since 1902.

Bibl.: Reports XII, p. 178; XIII, p. 227; Min. Res. W. of Rocky Mts., 1873, p. 16.

Ward Mine. One mile south of the Dunderberg; Sec. 30, T. 3 N., R. 25 E. The vein is 16″–24″ wide, in granite and dips 60° south. Work done is as follows: 210′ incline shaft; adit 210′ long at the 100′ level, where there are drifts 150′ and 100′ west and east respectively, each showing ore for about 40′ from the shaft. A 4-stamp water power mill is on the property. Ownership has changed frequently, the last relocator being E. L. Page.

Bibl.: Report XIII, p. 232.

MONO LAKE, WEST SHORE AND VICINITY.

This very interesting region has been thoroughly described by Israel C. Russell[13] and only slight mention will be made of the various formations as shown on the accompanying map.

A portion of the *Metamorphic* series and all of the *Basic Lava* formations are extensions of the areas in the Bodie and Masonic region and are described under that head. The most noticeable feature in the metamorphic series as seen in the region now under consideration is that the sedimentary origin is clearly shown. In some places, as west of Lundy, it distinctly shows stratification and yet is so dense and fine grained as to resemble an igneous rock. About a half mile east of Lundy are seen large conglomerate boulders containing pebbles, mostly quartz or quartzite, from ¼″ to 8″ in diameter cemented in a ground mass which is entirely schistose. The pebbles are mostly oblong in shape but show little fracturing. Along the steep hillside north of the mouth of Mill Creek Cañon the series contains hard bedded limestone. In Levining Creek Cañon, about four miles from the mouth, is coarse crystalline calcite and on Williams Butte near Crater, is an outcrop about 50′ long of white quartzite, closely resembling

[13]U. S. G. S., 8th Annual Report, Part I, pp. 261–394.

marble. The *metamorphic* series has in places been found to contain gold bearing veins.

The *granite* which contains a number of gold bearing quartz veins varies from coarse-grained, light-colored to fine-grained, dark-colored granodiorite. It is frequently intruded by dikes. The contact between the granite and metamorphic is usually sharp and distinct but in some places particularly in Levining Creek Cañon they are in a confused condition.

Glacial drift is chiefly composed of granite boulders and sand of all sizes indiscriminately piled together. Near the mouth of Mill Creek Cañon, near the center of Sec. 13, T. 2 N., R. 25 E., an unsuccessful attempt was made to wash this glacial gravel with hydraulic giants for its supposed gold content.

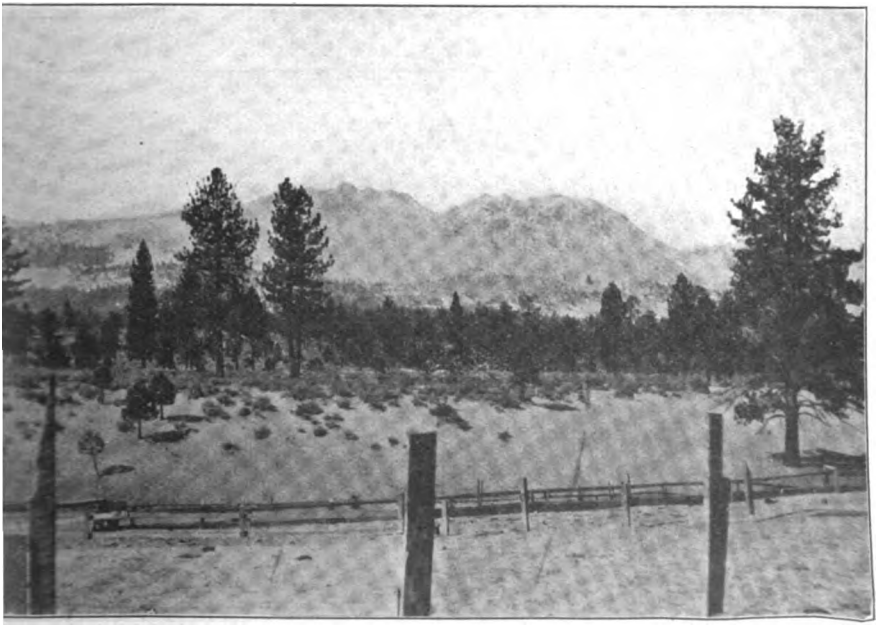
The *Lake Deposit* varies considerably from place to place. According to Russell it contains marl, clay, and diatoms in many places, more particularly on the eastern side of Mono Lake. Along the western side of the lake it contains more sand, gravel, and volcanic ash. He mentions measurements of exposures 200′ in thickness and states that the total thickness must be much greater. The margin of the deposit as shown on our map follows closely the old shore line of Quarternary times, when the surface of the water was over 700′ above its present position. During 1908 two efforts were made to obtain oil by drilling in this formation. One well near Dechambeau's ranch is about 900′ deep and one near the southwestern shore of Paoha Island is about 1500′ deep. Both struck hot water. The only indication of oil in the region, so far as known to the writer, is a spring near the eastern shore of Paoha Island, and the negative evidence afforded here is shown by a quotation from Russell[14] "On the west shore of Hot Spring Cove another thermal spring, called Petroleum Spring, on account of its odor, rises at a point a few feet above the lake margin and discharges a few gallons of water a minute. Its temperature is 96° F. A partial analysis of its water shows that it contains 0.8775 grams of solid matter to the liter, consisting of carbonates, chlorides, and silicates of calcium, magnesium, sodium and potassium." Such a careful observer would scarcely have omitted to mention the fact had there been any evidence of oil other than the odor. There is little or no reason to suppose that any other drilling in the basin would give more satisfactory results than obtained at the two wells mentioned.

The most important mineral product found in the *Lake* deposit is lime. At many points it occurs in the form of tower-shaped deposits around old springs. Along the lumber railroad running to Bodie are

[14]U. S. G. S., 8th Annual Report, Part I, p. 289.

several such deposits. One of them has been quarried for many years and burned in a kiln. It has supplied practically all the lime used in the cyanide plants of the surrounding country. Owner, T. Moyle of Bodie.

The isolated position of the lake and its seldom visited islands have, since the time of "Mark Twain's" earliest writings, afforded ample opportunity for fiction regarding their rare mineral deposits. Occasionally the fiction is intended for that large class of readers classed as investors.



Mono Craters, Mono County, from east side. Photo by Walter W. Bradley.

The *Recent Volcanics* are composed of basaltic lava flows, cones or craters of volcanic ash, as in the Mono Craters, or pumice and accompanying flows of obsidian or volcanic glass, all of which have been minutely described by Russell. No economic importance attaches to these at present, with the possible exception of the vast supplies of pumice which may at some time be called upon for structural or other purposes. Pieces of almost any density, from the glassy form to the porous, which is lighter than water, can be obtained in sizes ranging from dust up to several feet in diameter. The finer fragments form part of the soil along the southern shore of the lake, which produces hay and similar crops upon being irrigated.

The waters of the lake are strongly alkaline, containing about 5% of salts, principally sodium chloride, carbonate, and sulphate. Several

tons of this salt are reported being obtained annually by evaporating over fire. The reported price paid at the point of production was $0.10 per pound, to be used for medicinal purposes.

In former times the salt was used at Bodie in amalgamating pans to keep the quicksilver clean.

The forest near the southeastern shore of the lake furnishes lumber and mining timber for most of the surrounding country, being delivered by railroad to Bodie and thence distributed by team. Preparations are under way to more extensively irrigate the lands surrounding the lake, which are fertile where water is available, climatic conditions being considered.

Crystal Lake Gold Mining Company's Mill in Lake Cañon, near Lundy, Mono County. Elevation, 9500 feet. Photo by Walter W. Bradley.

The principal and practically the only mineral resource that has been exploited in the region are those of the gold-bearing formations. All the mines upon which any great amount of work has been done with recent years are here enumerated.

The **Crystal Lake Mine** (formerly known as the **May Lundy**), two miles above Lundy, is the largest mine in the neighborhood of Mono Lake. The deposit was discovered in 1879 and has been operated a large part of the time since then. Previous to 1888 the total production was about $876,000 and from that date until the present, it is estimated by R. T. Pierce, who has been manager of the property for

many years, to have been from $1,700,000 to $2,000,000. All records, however, were destroyed by fire a few years since.

Two veins, the May Lundy and West, are covered by a patented claim and about 20 locations. The May Lundy vein can be traced for some 6000′ and the other for about half that distance. The country rock is granite, in which the veins dip westerly at an average angle of 45°.

An adit about ¾ of a mile long cuts the May Lundy vein about 1500′ from the outcrop. In the upper levels the vein is about 2½′ wide and in the lower levels is about 3½′ wide. Drifting on the various levels has been done as follows: No. 1 tunnel, 100′; No. 2 tunnel, 900′; No. 3 tunnel, 1400′; Lake View level, 3100′; and about 1400′ on a level 200′ above the lowest adit. A great deal of stoping has been done.

Equipment is most complete. A 20-stamp mill is situated near the main adit. Electric power is supplied from a nearby stream falling 1000′ in a very short distance. Gold and a very little silver is carried in hard white quartz. The property is at present idle and it is impossible to obtain as much information as would be desirable. The writer is familiar with the property, however, from previous work.

Severe winters are the most serious obstacle to operations, the elevation being from 8000′ to 11,000′ at different parts of the property. The mine may be expected to appear on the producing list for some years in the future.

Log Cabin Mine. Situated in Sec. 1, T. 1 N., R. 25 E., at an elevation of about 9000′. Owners, H. H. Clark and Luther G. Brown of Los Angeles. It comprises 15 unpatented claims, which were located in 1908. The country rock is metamorphic slate and quartzite. The principal ledge of quartz is about two feet wide, with a northwesterly course. About ¼ mile SE. of the NW. corner of the section, an adit was driven approximately 300′ long, southerly along strike of formation to gain depth under an 80′ vertical shaft about ¼ mile farther south, which was sunk in quartz croppings about 2′ wide. A gasoline hoist is being erected on this shaft. About ¾ of a mile southeast from the adit is an old 40′ incline shaft sunk on 2′ of quartz, dipping NE. at an angle of 80°. Machinery and supplies are hauled from Benton, a distance of 50 miles, at a cost upwards of $0.65 per hundred pounds. Very rich float rock has been reported in this vicinity and the recent activity on this property has given it considerable local importance.

About a mile north from the Log Cabin are several old prospects upon which a little work has been carried on for years, among them are the following:

Charleston Mine. Situated in N. ½ of Sec. 36, T. 2 N., R. 25 E. Owner, J. P. Hammond of Mono Lake. This property consists of eight unpatented claims; discovered in 1886. Several adits have been run in the crushed and broken slate. The lower is the longest, running northerly about 500′ and having over a 100′ of branching drifts and crosscuts. In places there is 2′ of quartz. The upper adit and branches total about 200′, showing from 1″ to 12″ of quartz in places. There are other shallow works still higher. A small stamp mill adjoined the lower workings, but was recently destroyed by a snow-slide. No considerable production is reported.

Bibl.: Reports VIII, p. 385; XII, p. 177; XIII, p. 227.

Golconda Mine. Situated in S. ½ of Sec. 36, T. 2 N., R. 25 E. Owner, John Mattly et al. of Mono Lake. Development consists of several hundred feet of adits in the crushed slate formation. There are four unpatented claims. No production.

North of Mill Creek Cañon on the steep mountain flank facing Mono Lake are several old properties in what was previously known as the Jordan District. Considerable work was done here, particularly on the Goleta.

Goleta Mine. NE. ¼ of Sec. 11, T. 2 N., R. 25 E. Owner, J. S. Cain of Bodie. Seven patented claims. A 40-stamp mill was erected in 1896 and a great deal of development work done, one adit alone being 1500′ long. Operations ceased in 1901 and practically all equipment was removed. No account is to be had of the ore extracted in paying quantity.

Bibl.: Reports XII, p. 178, XIII, p. 228.

The **Parrett Mine** is about one mile west of Lundy, SW. ¼ of Sec. 19, T. 2 N., R. 25 E., and consists of 11 unpatented claims. Owned by Jasper Parrett estate. For thirty years it was worked by the owner, mostly by surface cuts, the longest adit being 200′. Ore was packed by burros to an arrastra operated, during the summer, by an 18′ overshot water wheel. Capacity of the arrastra is from 1½ to 3 tons per 24 hours. Ledges are from 8″ to 7′ wide, but only the smaller ones were worked, they are in metamorphic rock near granite. The ore is a hard, white quartz bearing free gold, galena, and pyrite. No accurate report of production is to be had, but it seems to have been enough to have supplied all necessities to the owner since the discovery in 1877.

Bibl.: Reports XII, p. 182; XIII, p. 230.

Casa Diablo Mine is situated in Secs. 21 and 22, T. 4 S., R. 32 E., 22 miles from Bishop by wagon road, nearest railroad station Hamil. Owned by Sierra Development Co., Chicago, Ill. Consists of 14 unpatented claims, discovered in 1895. Work was discontinued in 1911.

Total production of gold and silver is said to be about $50,000, most of which was turned out in 1910.

There are three ledges between granite walls dipping north at an angle of about 58° from horizontal, their widths vary from 8″ to 2½′. The average value is said to be $12 per ton, some running as high as $20. About 70% of the values are reported to be free milling, while the remainder is contained in sulphides, of which there is about 3% in the ore.

Development work consists of an adit 1600′ long and about 4000′ of drifts. Equipment consists of a 100 h.p. electric plant with 4 miles of transmission line; a 10-stamp mill with one Frue vanner, and a leaching plant. There is a 20 h.p. hoist and a compressor supplying 3 Lyner drills. Eight miles of pipe bring water from Rock Creek. There is also a saw mill providing lumber from pine timber 3 miles distant. Mine timber is supplied by piñon trees growing upon the property.

TRAVERTINE.

About one mile southeast of the town of Bridgeport is a deposit of travertine worthy of note. The property is patented and belongs to the California Travertine Co., E. P. Gray of Los Angeles, president.

In 1895 a quarry was opened and some of the rock shipped, principally for work on the City Hall at San Francisco. Two slabs 4½′ x 6′ were the largest of which there is record. The quarry is at the south end of the deposit and consists of an open cut about 200′ long, 20′ wide and the same depth. About 10′ of soft overburden covers the hard rock. A tunnel, now caved, at one time drained the cut, which is now partly filled with water. There are some 50 rough pieces on the dump and a few roughly dressed having the following dimensions: 3′ x 6′ x 2½′. The stone has a handsome appearance, being red to brown in color with fantastic figures. The deposit is about a half mile long and a quarter of a mile wide, nearly surrounded by older basic lava hills. The southern exposure forms a sloping bluff about 200′ above the creek bottom which drains the locality. Springs and marshy ground occupy the central portion of the deposit. A soft, friable local deposit is still forming at the eastern margin of the main deposit where hot springs arise. The recent deposits are in the form of ridges several hundred feet long coursing northeast and southwest. A cross section of one of these ridges is semicircular, the height and base each being about 30 feet. A crevice, about a foot wide and from 1′ to 4′ deep, follows along the crest of each ridge, carrying hot water from the springs. That these crevices are probably developed by the

settling of the sides of the ridges is indicated by the parallelism of the tortuous sides.

Bibl.: Report XIII, p. 640; U. S. G. S. Water Supply Paper 338, pp. 132-136.

MINERAL WATER.

There are a number of mineral springs in Mono County, some of which would become popular resorts were they accessible to a larger population. Among these have already been mentioned Fales Hot Springs, near Bridgeport, and the springs around Mono Lake. The following is a list of mineral springs of the county:

Artesian Springs, at Oasis, owned by J. H. Forman, Oasis. Used for irrigation.

Banner Spring, in the Inyo National Forest, 11 miles west of south from Benton. Used for domestic purposes.

Benton Hot Springs, 300 yards northwest of Benton postoffice, owned by the Benton Mining Co. Used for irrigation.

Bertrand Ranch Springs, 6 miles east of north from Benton. Used for irrigation.

Black Lake Springs, 2 miles north of west from Benton, owned by Peter Gilhoed. Used for irrigation.

Buckeye Hot Spring, about 5½ miles south of west from Bridgeport, on the north bank of Buckeye Creek, and in the Mono National Forest. Temperature 140° F. Used occasionally for bathing.

California Travertine Co. Spring. (See under Travertine.)

Casa Diablo Hot Springs, 45 miles northwest of Bishop.

Fales Hot Springs, 13 miles northwest of Bridgeport, Samuel Fales, owner. It is on the road to Minden, Nevada. The temperatures range from 129° F. to 141°. There is a stage station and hotel there, and the springs are also utilized by camping parties.

Mono Basin Springs, at several points in and around the edge of Mono Lake.

Moran Spring, 13 miles west of south from Benton, in the Inyo National Forest.

River Spring, 10 miles west of north from Benton. A. Matlock of Bishop, owner. Used for irrigation.

Whitmore Tub Springs, in Long Valley, 38 miles northwest of Bishop. Unused.

Bibl.: U. S. G. S. Water Supply Paper 338, pp. 132-136, 145-147, 322, 336-337.

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CALIFORNIA STATE MINING BUREAU
FERRY BUILDING, SAN FRANCISCO
LETCHER HAMILTON State Mineralogist
San Francisco December, 1916

Mines and Mineral Resources

OF THE COUNTIES OF

Monterey, San Benito, San Luis Obispo, Santa Barbara, Ventura.

CHAPTERS OF STATE MINERALOGIST'S REPORT
BIENNIAL PERIOD 1915-1916

CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO
1917

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Mines and Mineral Resources

OF THE COUNTIES OF

Monterey, San Benito, San Luis Obispo, Santa Barbara, Ventura.

By WALTER W. BRADLEY, EMILE HUGUENIN, C. A. LOGAN, CLARENCE A. WARING, Field Assistants.

CALIFORNIA
STATE PRINTING OFFICE
1917

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PREFACE.

The group of counties presented in the chapters herewith, embrace the southern portion of the Coast Range Mountains, and, with the exception of San Benito County, lie along the coast extending southerly from Monterey Bay to 34 deg. north latitude. This district is characterized by a delightful and equable climate which with, its attractive surroundings has resulted in the establishment of numerous resorts, both along the coast and at several of the larger groups of mineral springs. This area includes several of the important oil fields of California, in the southern portion; and in the northern, numerous quicksilver mines of which the New Idria is now the greatest producer in California, as well as of the United States.

The region is traversed throughout its length by the Southern Pacific Railroad, and for most part is readily accessible.

This report represents the result of several months' field work by the several authors in their various areas during the late falls of 1914 and 1915. We have listed as far as possible all mineral resources, both developed and undeveloped.

Acknowledgement is here made of assistance rendered by the various owners and operatives of properties, both during the field work and in the subsequent preparation of this report.

MONTEREY COUNTY.

By CLARENCE A. WARING and WALTER W. BRADLEY, Field Assistants.

Field Work in September and November, 1914.

INTRODUCTION.

Situated as it is, Monterey County offers inducements which have only partially been realized. Extending from the Pajaro River to the Sixth Standard Parallel south, with an excellent bay, and a railroad the full length of the Salinas River Valley, the county has little to stand in the way of development. The more fertile valley lands of the Salinas, San Lorenzo, San Antonio and Nacimiento rivers are practically all held as large "ranchos" which would yield enormous revenue were they subdivided and subjected to intensive cultivation.

The mineral resources have been little more than prospected, and within its boundaries lie mineral deposits which will contribute enormously to the future wealth of the state.

DESCRIPTION.

Location.

Monterey County borders the central coast of California and is separated from Santa Cruz County, to the north, by the Pajaro River. It adjoins San Luis Obispo County to the south, while to the east it is bordered by San Benito, Fresno, and Kings counties.

Topography.

The principal topographic features of Monterey County are the great central Salinas Valley drainage basin, paralleling the coast and emptying into Monterey Bay; the Santa Lucia Range along the western coast; and the southwestern slope of the Diablo Range on the eastern border.

Geology.

The geology of most of Monterey County is mapped and described in our Bulletin No. 69, on the Petroleum Industry of California. The Santa Lucia Range has a core of granitic rock. This is exposed in Santa Lucia Peak at an elevation of 5967 feet, and throughout the territory between Carmel River and Sur River, either along the coast or in the river cuts. Limestone and gneiss overlie the granite in places and make up Pico Blanco (Photo No. 1), Ventana Cone (Photo No. 2), Marble Peak (Photo No. 3), Twin Peak and Cone Peak (Photo No. 4). Most of the area from Mill Creek southward to Three Peaks and bounded on the northeast by Nacimiento River is made up of Franciscan sandstone and shale with intrusions of serpentine. It is in the region of these serpentine intrusions, in the later intrusive acid

dikes, that the important mineral deposits of the Los Burros dist are found. There is evidence of much faulting and the precipit coast (see Photo No. 4) follows a fault line. Monterey sandstone conglomerate flank the mountains on the southwest side of Nac ento River and dip towards the valley. Most of the older sedim exposed east of the Nacimiento consist of Monterey shale, whic considerably folded east of Jolon.

Along the coast, resting unconformably on the granite and F ciscan rocks, are raised beach deposits. The settlement at G (see Photo No. 5) is located on the more recent of these terr This terrace is noticeable in Willow Creek, one-half mile back its mouth and also along the coast north of Gorda. These terr are important in their relation to placer gold. It is thought tha placer deposits near Jolon originated in a similar manner.

MINERAL RESOURCES.

Embracing an area of 3330 square miles and supporting a po tion of 24,146 (census of 1910), this stock-raising and agricult county produced twelve mineral substances in 1913, value $178,679.

The production table, opposite, shows the total recorded ou and value of the various mineral resources since 1893. The does not show the output of single companies which produced b copper, coal, feldspar, fuller's earth, petroleum, quicksilver, sandstone.

ASPHALTUM.

Deposits of asphaltum occur in three districts in Monterey Cou In the region southwest of Bradley, near the Nacimiento River, s stone impregnated with oil is exposed and has been quarried for us the roads and bridges about King City.

East of Parkfield at the foot of Table Mountain and on the side of Little Cholame Creek oil-impregnated rocks are exposed w have been a stimulus to oil prospecting.

The **Nylar** asphalt quarry two miles west of Lonoak could furnish considerable road material but has not been worked recen

For further information concerning these deposits the reade referred to Bulletin No. 69, on the Petroleum Industry of Califor

CLAY.

The Mineral Earths Supply Company, J. C. Jens, 1112 Anza S San Francisco, owner, shipped a few thousand tons of crude clay, fo pottery use, from their pit near Chualar.

Lime	Tons
	2,000
	2,049
	7,744
	8,000
	5,463
	6,516
	4,550
	10,658
	2,500
	2,000
	6,000
	6,500
	63,980
	Dportio

Limestone		Macadam		Mineral water		Glass sand		Stone industry (rubble)		Unapportioned.
Tons	Value	Tons	Value	Gallons	Value	Tons	Value	Tons	Value	
		500	$1,500							
				5,000	$1,000					
2,000	$2,000			2,000	200					
2,049	1,640			21,000	1,050			20,037	$14,025	
7,744	6,970	43	860	1,500	750			12,196	7,398	
8,000	10,800			20,000	4,000			4,000	2,775	
5,463	7,500	3,407	2,503	15,000	3,250	4,500	$15,750	10,610	6,366	
		1,800	900	15,000	1,750	4,500	12,225	7,750	4,300	
6,516	9,000	2,853	2,300	55,000	1,250	5,980	4,987	1,445	867	
4,550	21,500			25,000	1,000	8,295	7,272			
				5,000	1,000	9,257	8,127			1900
				24,000	12,000	750	1,125			1909 in-
				120,000	12,000	11,665	8,178			clusive,
		92,420	31,727			6,805	5,120			$344,789
10,658	45,678	20,446	10,328	10,000	2,000	6,496	4,872	83,384	33,023	
2,500	7,500	23,058	15,284			7,594	5,890	107,345	32,203	
2,000	6,000							35,117	27,011	
6,000	8,000			20,000	7,000	9,016	7,916		6),119	
6,500	13,000			20,000	7,000	9,141	9,192		12,556	78,332
				26,000	7,900	9,210	7,633		39,232	9,450
				8,200	2,505	*			32,799	350,137
63,980	$139,588	144,527	$65,402	392,700	$65,200	92,618	$68,261	281,884	$272,644	$482,708

pportioned.

[redacted] that the important mineral deposits of the Los Burros district

[ineral Earths Supply Company, J. C. Jens, 1112 Anza St., ncisco, owner, shipped a few thousand tons of crude clay, for use, from their pit near Chualar.

COAL.

The **Monterey Coal Co.**, or **Pacific Coal and Clay Co.**, did considerable prospecting on a bed of lignite in Priest Valley a few years ago. The coal is of Upper Miocene age and is overlain by the Etchegoin formation. It is of lower grade than either that at the Stone Cañon mine or the Trafton mine in San Benito county.

Bibl.: Rept. XII, Cal. State Min., 1894, pp. 59–60; U. S. Geol. Surv. Bull., 581-D, 1914, pp. 158–160.

The mine of the **Stone Cañon Consolidated Coal Company** is located near the center of Sec. 14, T. 22 S., R. 13 E., M.D.M., at an elevation of 2748 feet. E. W. Mason of San Francisco, secretary.

The deposit consists of an 18-foot bed of a good grade of lignite dipping 45° N. and is overlain by Monterey sandstone. It contains no pyrite, but some sulphur, and is good for steaming purposes. The bed flattens out to about a 20° dip on the 200-foot level.

The deposit is opened up by a two-compartment incline shaft. When visited in December, 1913, one of the compartments was being used. The plant is fitted with eight 250 h.p. steam boilers which run three 250 h.p. electric generators. All hauling and lighting is done by electricity. Air drills are used and telephones are installed at each level. A new heavily timbered two-compartment shaft has been started about 300 feet east of the old one. Water for the boilers was pumped from the mine and treated with lime and soda to get rid of the sulphur.

The coal was shipped by a 20-mile spur track to McKay, on the Southern Pacific Railroad three miles north of San Miguel. The mine is reported to have ceased operating since the heavy January floods of 1914 washed out the spur tracks.

An analysis of Stone Cañon coal, as made by M. R. Campbell of the U. S. Geological Survey, and published in U. S. G. S. Bull 431, p. 245, follows:

Air Drying Loss 2.2.

	Form of analysis			
	As received	Air dried	Dry coal	Pure coal
Proximate -				
Moisture	7.0	4.9		
Volatile matter	46.7	47.7	50.2	53.8
Fixed carbon	40.1	41.0	43.1	46.2
Ash	6.23	6.37	6.69	
Ultimate—				
Sulphur	4.17	4.26	4.48	4.80
Hydrogen	6.28	6.18	5.98	6.35
Carbon	66.01	67.49	70.94	76.08
Nitrogen	1.17	1.20	1.26	1.35
Oxygen	16.14	14.50	10.70	11.47
Heat value—				
Calories	6,915	7,070	7,430	7,965
British thermal units	12,450	12,730	13,380	14,340

Bibl.: Report VIII of Cal. State Min., pp 403–404, 1888. U. S. Geol. Surv. Bull., 431, pp. 243–8, 1911; Bull. 581, pp. 155–8, 1914; Bull. 285, pp. 223–5, 1906; Bull. 316, pp. 435–8, 1907.

COPPER.

L. E. Bedell of Parkfield, has some copper prospects located in Sec. 21, T. 23 S., R. 15 E., east of Parkfield. The copper occurs as malachite in serpentine.

The Native Copper Co. of Coalinga, Harry Jaynes, secretary, has a group of claims in Sec. 26, T. 23 S., R. 15 E., 7 miles east of Parkfield. Native copper in serpentine is found there. Development work has been by tunnels. Idle the past two years except for assessments.

CHROMITE.

Detached masses of chromite are found in the serpentine on Table Mountain near Parkfield. None has yet been produced commercially.

DIATOMACEOUS EARTH (Kieselguhr).

Jens Deposit. Owned and operated by J. C. Jens, 1112 Anza St., San Francisco, but formerly operated under the name of the Mineral Earths Supply Co. It comprises 120 acres of patented land in Sec. 20, T. 23 S., R. 10 E., 6 miles northwest of Bradley, on the Southern Pacific Railroad. Material from this property has been on the market since 1905. The deposit is a flat-lying bed with an average depth of 240 feet, as shown by bore-holes, and underlaid by a black, bituminous shale. It is uniform in character, and not interstratified with other

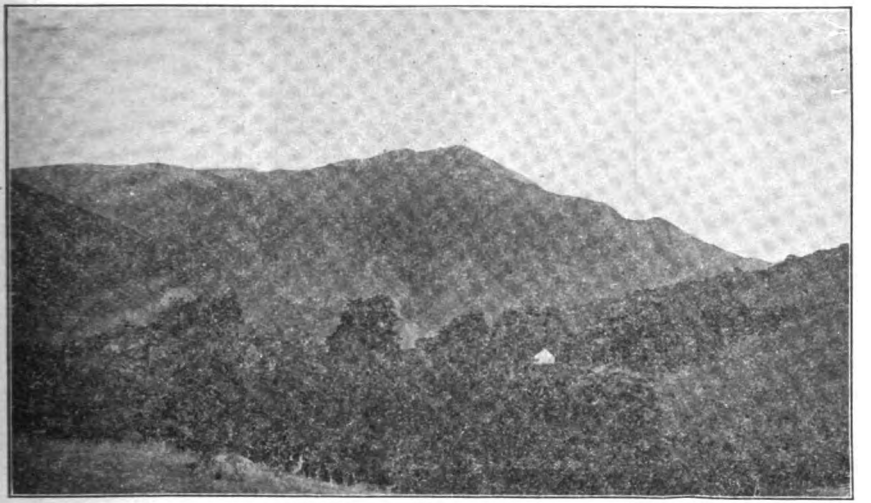

Photo No. 1. West face of Pico Blanco, five miles from the west coast of Monterey County. The limestone capping dips to the northeast.

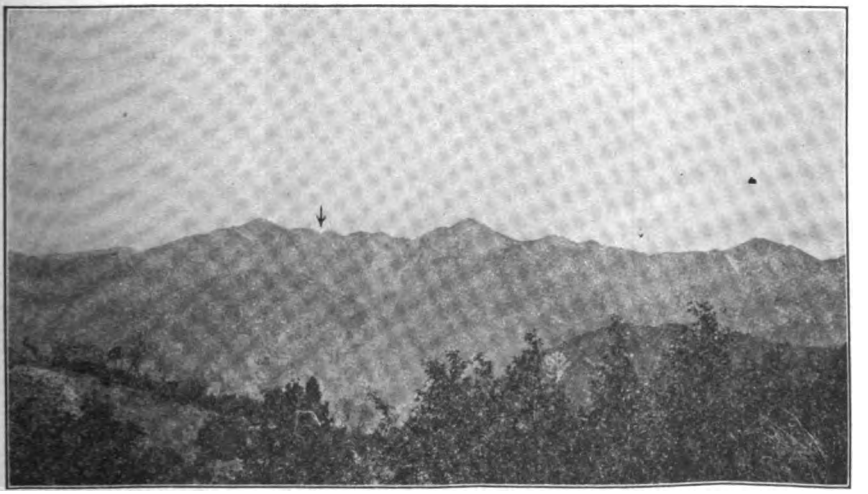

Photo No. 2. View northward, towards the Ventana (Spanish for window; arrow shows position of gap), from Slate's trail at summit of Partington Ridge. These mountains contain considerable limestone.

material. There is practically no overburden. The diatomaceous earth is white in color, and very fine. It averages about 28 pounds per cubic foot, being slightly heavier than the Lompoc earth from Santa Barbara County, on account of containing 5% alumina, which acts as a binder. For this reason it is adapted for use as building blocks for interior fireproof walls. It contains 85% silica. The quarry is worked mainly in the summer time. Jens also reports a small production of fuller's earth from Monterey County.

Photo No. 3. View southeastward from Slate's trail, Monterey County. Marble Peak, in the foreground to the left, has an elevation of over 4,000 feet, and is capped with limestone and marble, dipping about 35° NW. It is three miles down Lion Gulch to the coast. The fog in Lion Gulch to the extreme right is at an elevation of 1,500 feet.

Photo No. 4. Looking northward up the coast from Cape San Martin, Monterey County. The steep bluffs are composed of Franciscan sandstone and serpentine. Cone Peak in the distance is made up of limestone and gneiss.

Photo No. 5. Looking west, from an elevation of 1,200 feet, on the main Pine Ridge trail from Gorda. The village of Gorda is situated on a raised beach about one-quarter mile wide.

FELDSPAR.

Jens Quarry. This is a patented property, owned and operated by J. C. Jens, 1112 Anza St., San Francisco, but formerly operated under the name of the Mineral Earths Supply Co. The product has been on the market since 1907; this quarry, with two or three others in Tulare County, being the only producers of feldspar in the state. The

quarry is in Sec. 34, T. 15 S., R. 5 E., 4 miles east of Chualar, on the Southern Pacific Railroad, with which it is connected by a good wagon road. The deposit lies along a contact between limestone and granite. It is a massive orthoclase, 150 feet wide, and can be traced for a mile and a quarter in length. The feldspar is remarkably clean and massive, and of a pale cream color to almost white. The quarry cut is 40 feet deep, and a number of churn drill holes put down in the

Photo No. 6. Jens Feldspar Quarry, near Chualar, Monterey County. Showing massive orthoclase feldspar, 150 feet wide. Photo by J. C. Jens.

bottom to a depth of 42 feet show the same character of material below. About 600 tons of the product is shipped yearly to pottery makers. An average of seven or eight men are employed during the summer months.

An analysis of the feldspar, by E. W. Rice, is as follows:

SiO_2—65.66%	CaO—1.50%
Fe_2O_3—0.40%	K_2O—11.85%
Al_2O_3—21.34%	MgO—Trace
	Loss—.48%

FULLER'S EARTH (See Jens, under Diatomaceous Earth).

GOLD.

LOS BURROS DISTRICT.

The Los Burros Mining District is in the extreme southwestern part of Monterey County in T. 23 and 24 S., R. 5 E., M.D.M. It is best reached from the railroad at King City, by stage to Jolon and then by trail.

The first work in the district was in 1887 when W. D. Cruikshank discovered a small quartz vein carrying free gold. The discovery led to the development, on a considerable scale, of the Last Chance Mine, now owned by the Buclimo Mining Company. The property has been worked intermittently ever since.

Discoveries of placer gold in 1902 were made on Willow and Dogvine creeks and the Gorda and Plaskett mines were started. Placer work extended to all the nearby ravines.

From the years 1888 to 1915, inclusive, the district is estimated to have produced over $150,000 in gold.

Bibl.: Rept. VIII, Cal. State Min., 1888, pp. 405–410; Rept. XI, Cal. State Min., 1893, pp. 259–262; Rept. XII, Cal. State Min., 1894, p. 184; Rept. XIII, Cal. State Min., 1896, p. 234; Mining and Scientific Press, vol. 104, pp. 696–698, 1 fig., May 18, 1912.

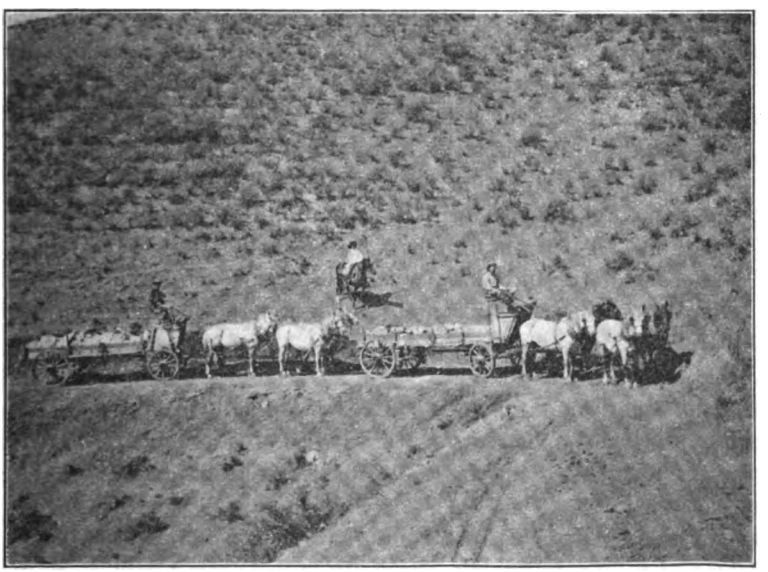

Photo No. 7. Hauling feldspar from Jens Quarry near Chualar, Monterey County. Photo by J. C. Jens.

The **Brewery Mine**, of which J. M. Krenkel of Gorda is manager, is located in Sec. 2, T. 24 S., R. 5 W., M.D.M. The gold is free in a quartz vein in slate and is said to average about $8.00 per ton.

The **Brooklyn Mine** is being developed by open cuts. Owned by Jas. H. McNeil of Gorda.

The **Buclimo Mining Company**, C. E. Gilman, San Francisco, president, has taken over the Last Chance and the New York and Cruikshank properties, in Sec. 2, T. 24 S., R. 5 W., M.D.M. The claims, at an elevation of about 2800 feet, are 50 miles southwest of King City,

the nearest railroad station. A good automobile road leads through Jolon to the Nacimiento River, whence the territory is accessible only by a steep, narrow, mountain trail over which mail is packed once a week. Freight by trail costs 1½ cents per pound to Los Burros, and 2 cents to Gorda.

The names of the claims are as follows: Last Chance, East Extension No. 1, West Extension No. 1, Mary S., Mary S. Extension, Gold Gulch Nos. 2, 4 and 5, Good Gold, Flat View (Camp site), Ora F. Nos. 1 and 2, Rankin, Perry, Luckie Jim and Pansy Fraction (timber claim). The topography is rugged and broken up by intrusions of serpentine. Water is obtained from the mine workings and from Spruce Creek. The average annual rainfall in the region is about 39 inches. Redwood and pine timber are obtained from the government reserve and cost about $18.00 per thousand, laid down at the mine.

The gold occurs in 3 parallel quartz veins in slate near its contacts with serpentine. The ore is free milling on the surface, but sulphides are encountered below the water level. The width of the veins varies from 10 inches to 3 feet. They strike N. 45° W. and dip about 35°. The ore occurs in pockets and is said to run about 2% sulphurets. It is said to average from $20 to $50 per ton in free gold. The present workings consist of a 197-foot incline shaft on the ledge, with 2 levels, and 360 feet of tunnels. An 1800-foot tunnel is being driven 300 feet east of the old shaft with the intention of tapping the ledge at a depth of 485 feet and to furnish drainage. Equipment consists of steam hoist, steam pump and bucket. Two shifts were reported to be working in July, 1916.

The mill equipment consists of a 5-foot Huntington mill and ore crusher, a Frue concentrator, Hendy self-feeder, 11-foot apron and 20 feet of 12-inch sluice pans. J. M. Krenkel, of Gorda, is manager of the property.

Other claims in the same region, reported on in 1888, have been abandoned. The following are included: Black Crystal, Stonewall, Ajax and Scorpion.

The **Bushness Mine** is located on Spruce Creek. Mr. John Bushness has run a 50-foot tunnel on a quartz vein in slate. A one-stamp mill on the property is run by a gas engine. The ore in places carries values as high as $35.00 per ton. Some placer work is carried on during the rainy season and one 104-dollar nugget is said to have been found. Mr. Roberts is doing some prospecting and placering below Mr. Bushness' claims.

The **Gorda Mine** is located on Spruce Creek about one mile below the Buclimo mines. It is in Sec. 3, T. 24 S., R. 5 E., M.D.M., at an elevation of 2000 feet.

Water is obtained from springs on the north side of Spruce Creek. Considerable pine and redwood timber grows on the claims.

The workings consist of a 50-foot drift in loose Franciscan sandstone along the south side of Spruce Creek. Mr. Geo. Reed of Gorda manages the workings and has three men employed. Owned by the Gorda Gold Mining Co., Gorda, Monterey County, Cal.

The **Howard Mine**, formerly the Plaskett Mine, leased by W. C. Howard of San Francisco from L. M. Plaskett of Gorda, is located in Sec. 20 of T. 23 S., R. 5 E., at an elevation of about 900 feet. Considerable redwood and pine timber grows on the property. Water is obtained from the headwaters of Plaskett Creek by 1800 feet of two-inch galvanized iron pipe.

The gold is obtained from a quartz vein in Franciscan sandstone, varying in width from two to eight feet. The ore is taken from a 45-foot incline shaft. The gold is extracted by a 3½-foot Huntington mill, which is run by a gas engine.

The **King** claim has an 18-inch vein. Development consists of two tunnels 100′ and 150′ deep and a 180-foot incline shaft. This claim used an arrastra in the early days.

The **Manchester** or **Blue Jay** claim has two 10-inch veins along the slate-serpentine contact. The ore carries free gold in quartz. It has a 135-foot tunnel with a 35-foot shaft and 64 feet of drift. Five-stamp mill operated by a 5 h.p. gasoline engine. Owned by Samuel Pugh of Gorda.

The **Mariposa Mine**, owned by Samuel O. Pugh of Gorda, is located in Sec. 2 of T. 24 S., R. 5 W., at an elevation of about 2700 feet. It is near Spruce Creek and includes the following claims: Blue Jay Nos. 1 and 2, San Lucas, Protection, and McKinley. The gold occurs free in a quartz ledge which carries some arsenopyrite. A 60-foot incline shaft and 30 feet of drift following the vein have been driven in course of assessment work. Ten tons of ore on the dump.

The **Oregon Mine** adjoins the Mariposa mine and consists of the Oregon and Cool Spring claims. It is located in Sec. 2, T. 24 S., R. 5 W., at an elevation of about 2700 feet. J. M. Krenkel of Gorda owns the mine. The gold occurs free in a quartz ledge which carries some hematite near the surface. The lower part of the vein carries considerable arsenopyrite. A tunnel 128 feet to the vein with 80 feet of drifting and a 50-foot raise to the surface have been driven in course of assessment work.

The **Queen** claim has a 10-inch vein in slate with three tunnels 16′, 40′ and 70′ deep, respectively.

JOLON DISTRICT.

The **Ruby Placer Mine** is located about three miles northwest of Jolon, on the Milpitas rancho in Old Man's Cañon. It is owned by Messrs. H. and W. T. Hess of San Francisco.

The topography of the region is rounded and the rock consists of loosely consolidated, nearly horizontally bedded gravels and sands which lie unconformably on the Monterey shales and sandstones. These gravels cover considerable areas to the northwest, east and southeast of Jolon. They cap the hills in many instances and in places are 150 feet thick.

In the spring of 1914 the Hess brothers installed a hoist with dragline bucket. Water was obtained from dams in the cañons where winter flood waters were held. The gravel was washed through a rotary tube screen run by a gas engine. Several experiments were made and although it is said the color in the pan ran as high as 50¢ per cubic yard, the recovery with the screen and riffle board was too poor to make it a paying proposition.

Bibl.: Rept. VIII, Cal. State Min., 1888, p. 405.

PARKFIELD DISTRICT.

On the **Cholame Grant,** 7 miles southeast of Parkfield, there is a series of gulches with gravel deposits which have yielded some placer gold. It is locally known as "Gold Hill." L. Patriquin of Parkfield has a lease from R. E. Jacks Co., owner.

SUMMARY.

Gold in Monterey County is found in quartz veins in the metamorphic rocks and as placer gold in Pleistocene gravels. Gold in the quartz veins is free milling down to the water level and rich pockets have been found. The veins are narrow, however, and considerable wall rock must be worked. Below the water level, which is usually about 150 feet below the surface, sulphides are encountered. The value of these sulphides has not been fully ascertained but some specimens examined showed no secondary enrichment.

Placer gold has been obtained both from raised beaches along the west coast and from loose raised gravel deposits west of Jolon. Deposits of considerable extent remain which only await a profitable method for extraction.

LIME and LIMESTONE.

The **Mineral Earths Supply Company** shipped several hundred tons of limestone during the year 1914 from north of King City.

Deposits of considerable magnitude exist in the **Santa Lucia** mountains about three miles from the coast and extending roughly from

Bixby's Creek southward to Cone Peak. Pico Blanco (see Photo No. 1) is capped with limestone and isolated deposits occur overlying the Santa Lucia granite and interbedded with gneiss throughout the ranges southward. Marble Peak at the head of Lion Gulch contains considerable limestone and some marble, which dip about 35° NW. The deposits are interbedded with gneiss and faulting has broken them up to such an extent that a detailed examination would be necessary to determine their economic value. Deposits of possible economic importance occur on the ranch of Mr. John Little of Monterey, south of Point Sur; and on the 640-acre ranch of Mrs. C. L. Koch of Pacific Grove, in Sec. 36, T. 18 S., R. 1 E., which includes in part the deposit on Pico Blanco. A landing place suitable for shipping the latter deposit is said to exist north of Point Sur and 5 miles from Pico Blanco.

MAGNESITE.

L. E. Bedell of Parkfield has made locations on a deposit of magnesite in Sec. 28, T. 23 S., R. 15 E., east of Parkfield. Undeveloped.

MARBLE.

L. Patriquin et al. of Parkfield, have an undeveloped deposit of white marble in Sec. 6, T. 23 S., R. 14 E., near Parkfield. The ground is under lease to E. G. Lewis of Atascadero, who is drilling nearby for oil.

MINERAL WATER.

The following data on the mineral springs of Monterey County is taken from U. S. Geological Survey, Water Supply Paper No. 338.

"**Dolan's Hot Spring.** A warm and mildly sulphuretted spring exists on North Fork of Big Creek, about 1½ miles from the ocean and 7 miles by trail southward from Slates Hot Springs. The water issues in a deep portion of the cañon, which is heavily timbered with redwoods, and as the place is known only locally and is not easily accessible, the spring has not been made use of and has seldom been visited."

"**Paraiso Hot Springs.** Paraiso Hot Springs are situated near the head of a small valley that opens eastward to Salinas Valley. Underground water lies at a shallow depth near the springs, beneath an area of several acres within which at least five mineral springs rise. The largest of these, which is known as the Soda Spring, has an observed temperature of 111°, and a discharge of perhaps 8 gallons a minute. About 40 yards away two small Sulphur Springs rise with temperatures of 88° and 102°, and 100 yards farther east there are two drinking springs each of which yields perhaps one-fourth gallon

a minute. These are known as the Iron Spring and the Arsenic Spring and have temperatures respectively of 68° and 65° F.

"The springs at this place were known to the Catholic Mission Fathers, who at one time lived there. Their extensive modern use dates back more than 20 years, and their accessibility has made them an objective point for automobile parties. In 1908 accommodations were provided in hotels and cottages for about 200 guests, while tub and plunge baths at the Soda and the Sulphur springs, and a swimming plunge that was also supplied by these springs, gave ample opportunity for use of the waters. Analyses of the springs, made a number of years ago, are available and are here presented in the standard form.

Analyses of Water from Paraiso Hot Springs, Monterey County, Cal.
(Constituents are in parts per million.)

	1		2		3		4		5	
Temperature	48°C.(118°F.)		48°C.(118°F.)		46°C.(114°F.)		21°C. (70°F.)		21°C. (70°F.)	
Properties of reaction:										
Primary salinity	81		85		69		51		82	
Secondary salinity	2		0		10		0		17	
Persalinity	9		0		0		0		1	
Primary alkalinity	0		2		0		11		0	
Secondary alkalinity	17		13		21		38		0	
Subalkalinity	22		12		39		28		51	
Constituents	By weight.	Reacting values.	By weight.	Reacting values.	By weight.	Reacting values.	By weight.	Reacting values.	By weight.	Reacting values.
Sodium (Na)	253	11.00	252	10.96	233	10.13	234	10.18	179	7.78
Potassium (K)	2.9	.07	3.1	.08	6.4	.16	80	2.05	58	1.48
Calcium (Ca)	41	2.04	32	1.60	28	1.40	30	1.50	23	1.15
Magnesium (Mg)	7.5	.62	-------	-------	38	3.13	74	6.09	9.8	.81
Iron (Fe)	7.3	.26	19	.68	9.7	.35	12	.43	3.9	.14
Aluminum (Al)	5.1	.56								
Sulphate (SO_4)	493	10.27	463	9.64	520	10.83	23	.48	22	.46
Chloride (Cl)	38	1.07	39	1.10	29	.82	342	9.65	387	10.92
Carbonate (CO_3)	79	2.63	56	1.87	94	3.13	304	10.13	-------	-------
Arsenate (AsO_4)	-------	-------	-------	-------	-------	-------	Trace	Trace	-------	-------
Silica (SiO_2)	50	1.66	45	1.49	44	1.46	156	5.18	176	5.84
	977	-------	917	-------	1,002	-------	1,255	-------	859	-------
Carbon dioxide (CO_2)	25	1.14	(a)	-------	17	.77	(a)	-------	-------	-------
Hydrogen sulphide (H_2S)	-------	-------	-------	-------	60	3.52	-------	-------	-------	-------

(a) Present.

1. Hot soda spring. Analyst and authority, Winslow Anderson, 1889.
2. Hot soda spring. Analyst, A. Cihi, 1871. Authority, U. S. Geol. Survey Bull. 32.
3. Hot sulphur spring. Analyst and authority, Winslow Anderson, 1889.
4. Arsenic spring. Analyst, A. Cihi. Authority, advertising matter.
5. Iron spring No. 2. Analyst, A. Cihi. Authority, advertising matter.

"The Hot Soda Spring is primarily saline in character with secondary alkalinity as a subdominant property. The term "soda," usually referring to primary alkaline waters, is a misnomer. The Hot Sulphur Spring differs from the Hot Soda Spring chiefly by

eason of higher secondary salinity and its content of hydrogen ulphide. The analyses of the Arsenic and Iron springs are of loubtful authenticity. It is of interest that only a trace of arsenic vas found in the Arsenic Spring and very little iron in the Iron Spring. Both have primary salinity for the principal property. High magnesium with respect to calcium is indicated for the Hot Sulphur and Arsenic springs.

"The hills on each side of the little valley at Paraiso Springs consists of gravelly sandstone that dips gently away from Salinas Valley. Granitic bowlders scattered along the ravines indicate that crystalline rocks are exposed to the west. Although a fault is mapped through Salinas Valley, it is not believed that such structure has given rise to Paraiso Springs. It seems more probable that some local fold or bedrock obstruction here forces underground water to the surface, and that its thermal character may be due to the depth from which it rises, in a locality of unusually high temperature gradient."

"**Slate's Hot Springs.** In the Coast Ranges of Monterey County thermal springs of note issue at four places. The southernmost of these is at Slates Hot Springs, on Mr. J. A. Little's ranch. The water here issues at ten principal points in a distance of 125 yards, halfway up the face of the bluffs that here border the ocean. A small private bathhouse has been built near the easternmost spring. The waters range in temperature from 110° to 121° F., are mildly sulphuretted, and the run-off streams are lined with abundant green algous growth. Small deposits of alum, gypsum, and carbonate of lime or magnesia were noted at the edge of one spring. The waters taste distinctly sweetish.

"About one-fourth mile northwest of the main group, on the left bank of Hot Creek, is another spring, 98° in temperature. This spring yields perhaps 5 gallons a minute and is used for laundering clothes.

"It is said that the location of the springs was described by an Indian to Mr. Thomas B. Slate, who made his way southward with difficulty along the steep, brushy slopes, and succeeded in finding only the warm spring beside the creek. Later, however, he came down the coast in a boat, found the springs on the bluff, and settled near them in 1868. The locality is occasionally made a camping place by deer hunters, but as it is about seventeen miles by trail beyond the southern end of the wagon road, it is not often visited.

[1]H. W. Fairbanks, Stratigraphy at Slate's Springs, with some further notes on the relation of the Golden Gate series to the Knoxville. Am. Geologist, vol. 18, pp. 350–356, 1896.

"The formation exposed along the bluffs is of slates that have been described by Fairbanks[1] as being probably of Jurassic age. They are overlain by 30 or 40 feet of gravel that is deposited on an ocean terrace along this portion of the coast. The heated water apparently emerges at the base of the gravel, though small warm flows also issue from the slate, close to the surf. It is said that when garden land on the terrace back of the springs has been irrigated for several weeks by a mountain stream the seepage water has so reduced the temperature of the hot springs that they are only tepid."

"**Hot Springs on North Fork of Little Sur River.** Several thermal springs rise in the bed and along the banks of North Fork of Little Sur River, about two miles above the point at which the stage road crosses the stream. The springs in the stream bed form a warm pool, and on its right bank two or three flows, having a maximum temperature of 114°, issue from crevices in the rock and fill a small natural basin. The springs are in a narrow, rugged section of the stream cañon, in a granitic area, and possibly rise along fractures that have been produced by local faulting. The water is mildly sulphuretted but it is not otherwise noticeably mineralized. A considerable amount of fibrous algous growth, from white to reddish purple in color, is found in the stream and the adjacent pools.

"During the nineties the water was piped to a grove of redwoods in a flat some distance below the springs, and it was the intention to build a hotel and bathhouse. High water washed out the pipe line, however, and in 1908 the attempt to develop the springs had not yet been renewed."

"**Tassajara Hot Springs.** A large amount of hot water issues at Tassajara Hot Springs, which are in the cañon of Arroyo Seco, in the southern part of Monterey County. About seventeen thermal springs may be counted here, in the bed of the creek and along its southern bank. They range in temperature from about 100° to 140° and from mere seepages to flows of seven or eight gallons a minute.

"The thermal waters issue from a gneiss that is exposed along the creek for a distance of 200 yards or more. Above and below this exposure the rock is granitic and in some places contain small garnets. The crystalline rocks are overlain by a series of shale, sandstone, and limestone, whose structure in the area north of Arroyo Seco is well shown by the beds of massive buff-colored sandstone that dip northeastward at an angle of about 45°. A western limb of this structure was not seen, though it may exist in the mountains farther coastward. The observed dips at least suggest that Tassajara Hot Springs issue at a locality where Arroyo Seco crosses a zone of intense pressure in the crystalline rocks.

"The springs received their name from an Indian or Mexican word that means "the place where meat is cured by drying," and dates from the early days of the cattle industry. The springs have thus been known and used for many years, and they were early visited by campers, when the only access was by means of a difficult trail. Several years ago a well-graded wagon road was built southward from Jamesburg across the mountains and down into the cañon, and the springs are now easily reached by stage. In 1904 a stone hotel was built, and other improvements have been added yearly, so that in 1909 there were ample accommodations for 75 people, though a larger number has been taken care of by the use of tents. Water from two of the largest springs has been piped to tub and plunge baths, and a vapor bath has been constructed over the hottest spring, which issues in the creek bed.

"Analyses of two of the thermal waters were made. These waters are noticeably sulphuretted, and the analyses show them to be only moderately mineralized. The water of the arsenic spring has a distinctly yellow color, which in a few other springs has been ascribed to alkaline sulphides in solution.

"At the north edge of the creek, a few yards above the hot springs, there are two cool springs in which iron is deposited. An analysis of the easternmost of these springs is tabulated with the hot springs.

Analyses of Water from Tassajara Hot Springs, Monterey County, Cal.
(Analyst and authority, F. M. Eaton, 1909. Constituents are in parts per million.)

	1		2		3	
Temperature	59°C. (138°F.)		39°C. (103°F.)		18°C. (64°F.)	
Properties of reaction:						
Primary salinity	63		65		19	
Secondary salinity	0		0		16	
Persalinity	0		0		0	
Primary alkalinity	30		26		0	
Secondary alkalinity	7		9		65	
Subalkalinity	138		104		----------	
Constituents	**By weight**	**Reacting values**	**By weight**	**Reacting values**	**By weight**	**Reacting values**
Sodium (Na)	81	3.51	75	3.26	14	0.59
Potassium (K)	4.6	.12	4.8	.12		
Calcium (Ca)	5.3	.27	4.0	.20	33	1.64
Magnesium (Mg)	Trace	Trace	1.3	.11	11	.87
Iron (Fe)	1.5	.05	2.0	.07	0.8	.06
Aluminum (Al)					1.9	.21
Sulphate (SO_4)	110	2.29	109	2.27	36	.75
Chloride (Cl)	6.5	.18	5.0	.14	12	.32
Carbonate (CO_3)	41	1.37	38	1.28	61	2.03
Arsenate (AsO_4)	----------	----------	(a) 0	.00	----------	----------
Silica (SiO_2)	118	3.90	116	3.84	(?)	----------
	368	----------	375	----------	170	----------
Carbon dioxide (CO_2)	0	.00	0	.00	(b)	----------
Hydrogen sulphide (H_2S)	25	1.47	(b)	----------	(?)	----------

(a) Not detected in 1 liter of water. (b) Present.
1. Lower of two main basins. 2. Arsenic spring. 3. Iron spring.

"The two hot springs were apparently from the same general source, showing only slight difference in composition. Primary salinity and primary alkalinity are the chief stable properties, but the waters are characterized by high subalkalinity, of which silica is the chief component. The carbonate radicle reported is presumably calculated from the alkalinity determination and doubtless includes sulphides and possibly silicates. The apparent absence of arsenic in the so-called arsenic spring is noteworthy.

"The iron spring is of markedly different character from the hot springs, being less than half as concentrated and having secondary alkalinity as the dominant property. Subalkalinity is not reported, but this property is probably relatively low. It is probably of essentially surface origin, and not directly related to the thermal waters.

"The following notes concerning algous growths in the creek below the hot springs are here given, as the growths are related to the sulphuretted character of the water. Although they are common to thermal sulphur springs, the relatively large volume of water in the creek at Tassajara Hot Springs, its comparatively slow cooling, and the presence of both swift currents and of quiet pools, affords an unusually good opportunity to observe the variation in character of the growth.

"At the main springs, where the temperature of the water was 110° to 140°, the material was mainly fibrous, and white, green, and reddish-brown in color.

"About 75 yards below, at a temperature of 96°, there was a dark-green layer on the bottom of pools, with a small amount of white material on the surface of the green. Where the current was swiftest a purple-brown, furry growth, one-eighth to one-quarter inch thick, covered the rocks.

"At 125 yards, where the temperature was 91°, a green, leathery growth covered portions of the bottom, with white, feathery streamers attached to it where the current was rapid.

"At 200 yards, in a temperature of 87°, a thick, leathery growth coated the entire stream channel, being green and white on its upper surface, pale purplish-red inside, and black on the under surface. A number of pale purple, feathery, and white threadlike streamers extended from it.

"At 250 yards, in a temperature of 83°, there was a layer of green material in the pools, and white material in the swifter water.

"At 275 yards, where the temperature was 81°, the lower limit of white growths was reached. Below it a dark green moss coated the

rocks for a distance of about 50 yards to a point where the temperature was 78°. Below this point there was no notable growth in the channel.

"The material showed a tendency toward brighter colors in the hotter water and more somber ones in the cooler places. White material (probably due to the deposition of sulphur) was more common in the hottest water and in the lowest portions of the algous growth. Smooth, leathery growths lined the pools, while fibrous growths were formed in the swiftest currents. The discharge of the stream was approximately 100 gallons a minute. The water first rose at a point about 50 yards above the main springs. Above this point the stream channel was dry."

NICKEL.

Reported from localities in the mountains but no prospects developed.

QUICKSILVER.

Dutro Mine. Idle for several years; 100′ shaft and 40′ drift caved. Situated at head of west fork of San Carpojo Creek in SW.¼ of SE.¼ of Sec. 28, T. 24 S., R 6 E. Owner, F. D. Martinez, Santa Maria.

Bibl.: Bull. No. 27, p. 124.

Parkfield Mine (formerly Cholame-Parkfield). Lewis and L. S. Patriquin, and J. W. Anderson, Parkfield, owners. This group of four claims and two fractions is in Sec. 2, T. 23 S., R. 14 E., 5 miles north of Parkfield; elevation 3000′ (bar.) at the middle tunnel. It was first worked about forty years ago by a Mr. Pitts, who is said to have produced 60 flasks of quicksilver, using a small mud-plastered furnace.

The country rocks are serpentine and Franciscan metamorphic sandstone. The ore body is a zone containing parallel stringers of cinnabar with the intervening rock and its fractures more or less impregnated with the mineral. It is in part stockwerk. The vein filling is quartz, opaline silica, and chalcedony, and much of the serpentine is silicified. The cinnabar occurs as distinct crystals, not as "paint." There is also some metacinnabarite. There are two ore zones with a ridge of serpentine between them, the north one being 100′ wide, and the other wider. The strike is a little north of west and the dip about 65° N. In these areas the surface soil yields cinnabar by panning. On the south vein at the west end, an old tunnel in 800′ crosscuts six shoots, none of which have been drifted on. There is another adit in 950′, about 500′ of which is a drift. On the north vein, the middle adit crosscuts the ore zone for over 100′. Experiments are being made with a view to concentrating the surface soil

the product to be retorted. About $6,000 worth of development work was done in 1913 by H. M. Newhall & Co. of San Francisco, under a bond which has since expired.[2]

Bibl.: Bull. No. 27, p. 123.

Table Mountain Claim. G. W. White, Parkfield, owner. This prospect is on Table Mountain in Sec. 30, T. 23 S., R. 16 E., about nine miles east of Parkfield; elevation 3350′ (bar.) Cinnabar occurs with opaline silica in serpentine. Idle except for assessments. An old adit is being cleaned out.

Bibl.: Bull No. 27, p. 124.

Several **quicksilver prospects** are reported in the southwest corner of Monterey County north of Mount Mars, but no real development work has so far been carried on.

SALT.

Salt is extracted from the sea water near Moss Landing. It is reported that the Vierra Brothers produce about 2,000 tons annually by solar evaporation.

GLASS, SAND.

The **California Glass Insulator Company,** H. G. Munn, of Long Beach, president, obtains glass sand from the dunes near Del Monte. Several hundred tons were shipped to their glass factory at Long Beach during 1913.

The **Carmel Development Company,** J. F. Devendorf, manager, Carmel, owns a deposit of white sand in the dunes along the shore of Carmel Bay. Some shipments for glass-making have been made.

The **Pacific Improvement Company,** A. D. Shephard, Crocker Building, San Francisco, general manager, produces annually several thousand tons of glass sand. The sand is loaded on the railroad cars directly from the sand dunes west of Pacific Grove by small steel dump cars on an elevated tramway.

SAND.

Lapis Sand Plant. The E. B. and A. L. Stone Co., H. E. Keifer, general manager, with offices in the Rialto building, San Francisco, has a plant from which sand is shipped for structural work (such as plaster and concrete), at Lapis Siding on the Southern Pacific R. R., on the shore of Monterey Bay. Operations were begun in 1907, and the plant has a daily capacity of 1000 to 1200 tons, using a locomotive

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[2]Since the above was written, a letter received from Mr. Patriquin states that a 12-pipe retort has been constructed, and ore reduction began on April 15, 1915. About 1½ tons of ore averaging 5% quicksilver are being retorted per 24 hours. —W. W. B., Jan. 15, 1916.

crane and screening to three products. From the dunes a fine material is obtained which is utilized for sand blast work.

Quality Sand and Gravel Co., J. W. Leeper, manager, 503 Market street, San Francisco, is installing a plant to handle gravel and sand for structural purposes, at Neponsett station on the Southern Pacific R. R., near the mouth of the Salinas River.

SILVER.

Veins of galena and sulphuret of iron, thought to contain silver, were early reported in a white granitic rock at the Alisal Rancho, in Monterey County. Nothing in recent years has been learned of the deposits which were reported in the foothills on the east side of Salinas Valley about twenty-five miles from Mission San Carlos.

The silver of value thus far discovered has been taken from the placer gravels with the gold, along the west coast.

Bibl.: Cal. Sen. Doc. No. 9, 1854, by J. B. Trask, p. 18.

SAN BENITO COUNTY

By WALTER W. BRADLEY and C. A. LOGAN, Field Assistants.
Field Work in September, 1914, and December, 1915.

HISTORY and GEOGRAPHY.

Crespi visited the region in 1772 and gave its chief stream the name of San Benedicto, in honor of Saint Benedict, but the name was later contracted to San Benito. The county dates its official existence from February 12, 1874.

With a population slightly over 8000 and an area of 1476 square miles, San Benito County is bounded on the north by Santa Clara and Santa Cruz counties, on the east by Merced and Fresno counties and on the south and west by Monterey. Most of the population resides in the few towns near the railroad in the northern part of the county.

The county consists topographically of a long, narrow valley flanked on each side by chains of the Coast Range, through which occasional passes give access to neighboring counties. Through this central valley the San Benito River flows the entire length of the county in a northwesterly direction, having Tres Pinos Creek as its chief tributary, with many smaller streams flowing in from east and west. The western range of mountains takes its name from Gabilan or Fremont Peak, which has an elevation of 3169 feet; the chain on the east is called the Diablo Range and rises in many of its peaks to elevations of nearly 5000 feet. Many small, fertile valleys lie on the mountain flanks, and in these live most of the people to be found in the southern half of the county. Fruit raising is an important industry near the railroad. Hay is raised in great quantity and the county claims to have the greatest hay shipping point in the state at Hollister. As in the other counties so early settled by Spanish and Mexican pioneers, cattle-raising became the leading interest at an early date and is still of prime importance.

Transportation facilities are limited. The Southern Pacific operates a branch line from Gilroy to Tres Pinos via Hollister, the county seat. Auto stages operate between Hollister and Sargent via San Juan Bautista and also give connection with the railroad at San Jose. Stage lines operate between Tres Pinos and San Benito daily, and via Panoche Pass to New Idria triweekly. The road crosses the river at many places where there are no bridges, and heavy rains therefore delay traffic, as the streams rise suddenly, and easily become unsafe to cross. The southern section of the county has no transportation facilities, but can be reached through Coalinga or Kern City; New Idria, east of the mountains, reaches the railroad easiest at Mendota.

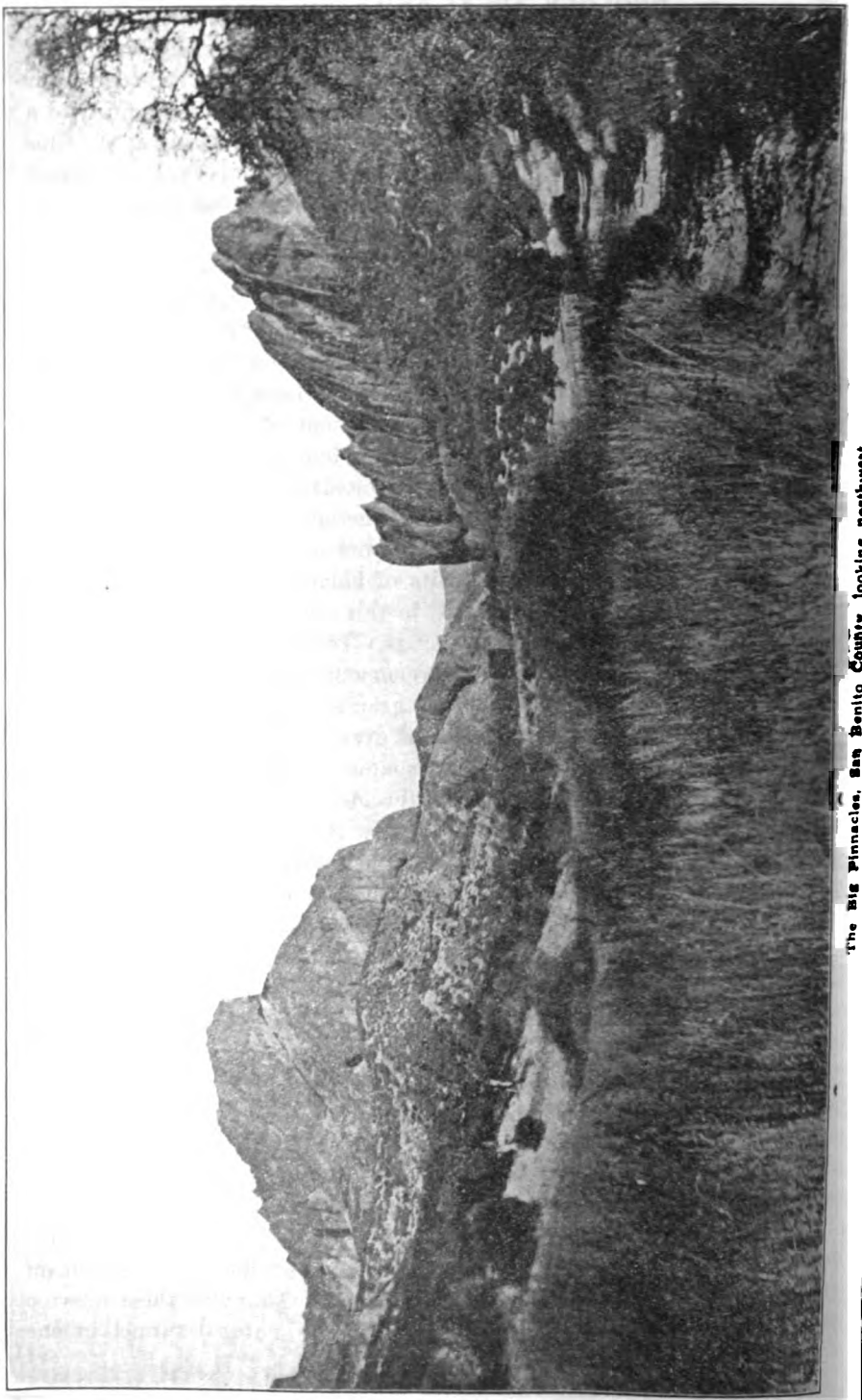
GEOLOGY, AREAL AND STRUCTURAL.

The county's geology has never been fully covered by any writer, but various geologists have visited sections of it and have recorded their observations. The writers' observations were necessarily confined to a hurried study of those mineral deposits which were working at the time of our visits or promised to become of especial interest because of present conditions. The following lines give an idea of general relations, and no attempt is made to go into details:

Structurally, the county shows two mountain piles of apparently diverse geologic formation, striking northwest and separated by a narrow valley filled with younger formations and detritus. Traversing the valley is the San Andreas Fault Zone, along which fresh movement occurred at the time of the San Francisco earthquake of 1906. On the southwest of this zone, forming the basement of the Gabilan Range and outcropping at places through the whole length of the county, granite and associated schists occur. Associated with these, over several square miles surrounding and including Gabilan Peak, are notable beds of metamorphosed limestones with which, as described particularly farther on, are deposits of barite and dolomite.

Volcanic activity is not indicated in this section, but as we go south toward The Pinnacles conditions change. To within a few miles of The Pinnacles National Monument (a government reserve) the higher mountain country is shown to consist of granite; the northern branch of Chalone Creek carries only detritus of granitic origin. But just south of this stream, rocks of shallow igneous origin appear.

The Big Pinnacles, situated near the Monterey-San Benito counties boundary, deserve mention. Apparently intense vulcanism here has resulted in the piling up of a great mass of peculiar tightly consolidated agglomerate which is now separated by a narrow cañon into two mountains but whose position, composition, and nearness to a great fault zone suggest their original unity and the cause which quite probably separated them. The accompanying photographs taken by the writer give a clear conception of the appearance of the rock formation close up, and a view of the mountain pile. The larger fragments of the breccia are 3″ to 6″ across. The southeast scarp is known as The Knife Blade and rises in a smooth vertical face to a distance stated locally to be 800 feet above the stream, with a reputed surface area on the cañon side of twenty acres. The northwestern mass is called The Palisades and rises in three roughly defined terraces with steep faces, reputed to be 500 feet apart vertically. The cañon between The Knife Blade and The Palisades is in places scarcely 6 feet wide at the bottom. Into the chasm great blocks from the mountain have fallen. Many of these are too large to reach the bottom and have formed a natural tunnel in one



The Big Pinnacles, San Benito County, looking northwest.

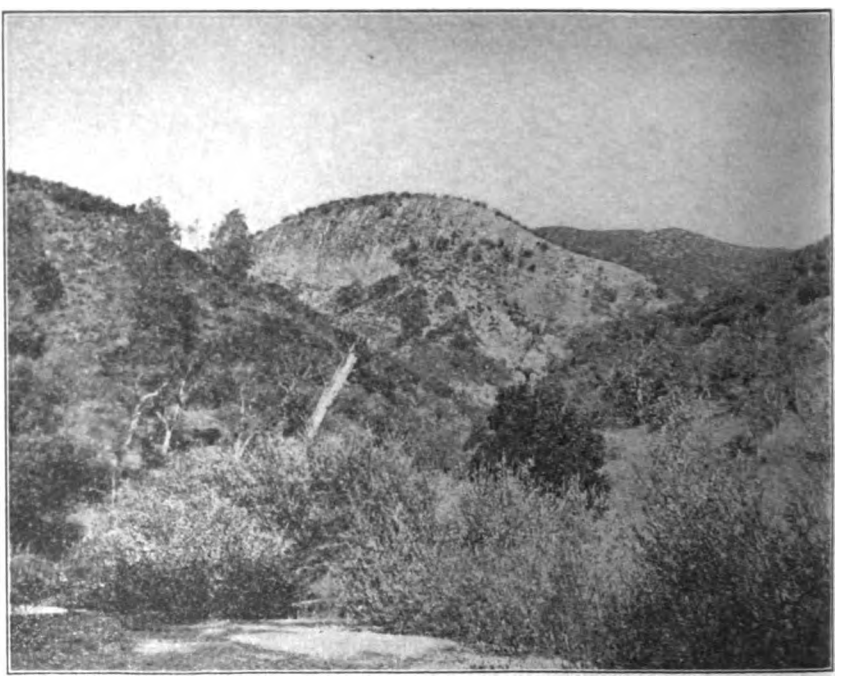
place, through which a little stream flows. This tunnel offers the easiest means of crossing the divide. The trip through it involves a climb of several hundred feet with candles. The gorge is about a quarter of a mile long and courses north, with a bend to the northeast. The elevation of the valley floor is about 1500 feet.

Rock formation of The Pinnacles, San Benito County.

Beginning at The Pinnacles are fine-grained volcanics exhibiting flow structure at places and apparently rhyolitic. The Pinnacles appear to be composed of fragments of this material mixed with a more basic rock of reddish color. These light gray eruptives are found south of the South Chalone Peak, where a more basic material, suggesting andesite, appears. On the ridge one mile northeast of North Chalone a tunnel has been driven into the hill a distance of 540 feet and is entirely in this light gray eruptive, which shows no marked fracturing or other sign of movement after it cooled. Over this tunnel on the surface the material shows flow lines and dendrites of secondary manganese.

Southeast of South Chalone in the Topo country the granite basement has been eroded and the resulting sand has been covered by Monterey sand carrying bitumen and giving rise to bituminous sandstones. Diatomaceous earth occurs here also as a portion of the Monterey formations.

From the Topo Valley south and east to near Lookout Mountain the Tulare formation of Pliocene age is much in evidence because of the numerous gypsum beds in it. The gypsum occurs, where mined, with a thinnish overlying stratum of clay, with small sandstone streaks and gypsum pebbles. The district is cut up into gently sloping residual mountains and the gentle dip of the gypsum beds (5° or 6°) suggests a low anticline. The county from Topo Valley to Priest Valley has been prospected considerably for oil but the results of this work have been mostly negative, as far as commercial production is concerned, although traces of gas and oil were obtained at several wells. Upper Miocene beds



A mountain split in two; effect of an immense earth slide. Near Pinnacles, San Benito County, California.

predominate east of the fault zone to near the San Benito River. Small deposits of coal are found at places in this. The river for quite a distance, as followed by the road from Hernandez to the Fresno County line, flows over a coarse, well-cemented conglomerate. Dark clay shales are exposed in the Niesen mine tunnel in Sec. 31, T. 18 S., R. 12 E. and along the cañon. These strata are probably of Cretaceous age.

The Franciscan metamorphics appear about two miles north of the San Benito River. The country from here to New Idria is serpentine, deeply weathered into rounded knobs bare of grass and carrying only a few pines. The geology of this district, which is noted for its deposits

of quicksilver, is discussed in detail under the title of Quicksilver in this report. Franciscan rocks instead of granite form the visible basement of the Diablo Range, which extends along the eastern portion of the county, outcropping at many places along the summit, though mostly covered on the mountain flanks by younger formations. From New Idria to Little Panoche Creek, the geology has been studied in considerable detail by Robert Anderson with especial reference to the occurrence of oil. His report in Bulletin 603, United States Geological Survey, may be studied with profit by those interested in petroleum. The geology from here northward exhibits no striking variations from the usual Coast Range occurrences. Little if any volcanic activity is recorded in the region. Some manganese deposits occur along the mountain tops in association with Franciscan cherts, and as we approach the northwest corner of the county some interesting occurrences of stibnite occur, in a region distinguished by extreme volcanic activity in the past, which gave rise to several prominent peaks.

MINERAL RESOURCES.

The county's mineral resources are diversified, but have remained largely undeveloped because of the lack of transportation facilities and possibly also because many deposits are on land held under agricultural patents by people not interested in mining.

Production of the following metals and mineral substances has been made in greater or less quantity: Antimony, asphalt, bituminous rock, bituminous coal, dolomite, gems, gypsum, lime and limestone, manganese, mineral water, rock, quicksilver, and petroleum. Quicksilver has given the county its reputation in the mining world. The county is the largest producer of mercury in the United States. The next important item in mineral production is the crushed rock industry. San Benito has the largest single producer of this class of material in the state. Limestone and lime were produced in some quantity from 1894 to 1907, but no production has been reported since, although the limestone resources are immense in quantity and of very high quality. Gypsum production has gone on since 1894, but the table does not show the full amount produced recently in the county, as a considerable tonnage mined in the Bitterwater Valley has been credited to Monterey County.

Small tonnages of asphalt, coal, antimony and manganese have been produced, and interest in the two latter minerals is strong at present on account of high prices. Mineral water has been produced in small quantity for twenty years. Benitoite, a new gem not found elsewhere as yet, has been mined in the southern part of the county. Dolomite deposits have been opened within the past year in the county and have yielded considerable amounts of a high-grade product to fill a Pacific coast demand.

Undeveloped deposits of barite, high grade clay, coal, infusorial earth, iron, magnesite, manganese and petroleum exist in the county. Their development at present is greatly hampered by lack of transportation facilities. Prospects of gold and copper have been worked, but no showing of either metal in mineable quantity has as yet been made.

ANTIMONY.

Antimony is found in the northeast corner of the county in the mountains of the Diablo Range. There appear to be several distinct lines of croppings which carry the ore in siliceous gangue in brecciation zones where the volcanic fragments of light colored tuff and associated igneous rocks, classified by different writers as trachytes, asperites, and rhyolites, are seen cemented together by the mineralized solutions. The ore occurs in lenses. The strike of the lines of outcroppings is nearly due northwest and the lenses lie with long dimensions along these lines, and with varying dips. There has been very little work done at depth on any of these deposits except at one property. Considerable work was done here about 1875 on quicksilver prospects which pinched out when it was attempted to work them at depth; it was noticed, however, that stibnite was quite common and this led to prospecting for further quantities. In the '80's an antimony smelter was erected near the old Shriver Mine but no success ever was attained in treating the ores.

Ambrose Mine. (See Rip Van Winkle.)

Appeal Mine. This is an extension of the Shriver. It is now owned by T. H. French, of Hollister, and no work has been done on it since 1896. One shipment of antimony was reported from the property in 1893.

Bibl.: State Mining Bureau, Bull. 38, p. 260; Rep. X p. 516.

Florence Mine Group. This group of 6 claims is situated in the SE. ¼ of Sec. 8, T. 12 S., R. 7 E., 14 miles northeast of Hollister on the side of Henrietta Peak. The group includes part of the holdings of the old Stayton Quicksilver Mine. The ground was located for that metal in 1870. There was some indication of cinnabar in the surface zone, but investigation showed a decrease of cinnabar and a noticeable increase of antimony ore below the surface. The ground has lain idle for a long time. It was relocated in October, 1915, by George W. Clark, W. H. Florence and wife, G. E. Ray, and Ernest Stayton. Only surveying had been done at time of this report.

French Antimony Group comprises 4 claims in the NW. ¼ of Sec. 5, T. 12 S., R. 7 E., one mile north of the Florence Group, and relocated about the same time and by the same group of people. The property was formerly worked for quicksilver by the Gypsy Mining Company. Little success is said to have attended their efforts. Stibnite seems to

be the commoner mineral on this slope of the mountains, although on the east cinnabar has been worked successfully. The antimony ore occurs in prominent croppings which strike due northwest and are contained in a quartzitic gangue not notably different from the occurrence at the mines noted below. No recent work has been done to develop the antimony, though there are some old workings left by the quicksilver miners.

Bibl.: State Mining Bureau, R. X, p. 515–517.

Gleason Mine, owned by Wiley Garner, of Hollister, is situated in Sec. 6, T. 12 S., R. 7 E., 14 miles northeast of Hollister. The property was first worked over 30 years ago. The work was strictly superficial. A lens of brecciated rock, mineralized by solutions carrying silica and stibnite was uncovered. It was 20′ long, 12′ wide and 2′ thick. It yielded 10 tons of about 50% stibnite. No other work sufficient to develop further ore bodies was attempted until the fall of 1915, when L. H. Day and H. W. Underwood, of Hollister, drove a tunnel 10 feet below this lens and uncovered some stibnite of good grade showing an oblique width of 3 feet directly below the old lens. Their work had not been carried far enough to show the amount of ore, but the indications were that the stibnite uncovered was the tip of the old lens. The outcrop is prominent, and quartzitic rock carrying needles of stibnite can be broken from it in many places. The grade of this scattered ore is too low for working profitably. The mineable lenses occur in places where brecciation is plainly noticeable and where fragments of shattered rhyolite or kindred rock, now mostly softened and altered, have been cemented by the mineralized solution. The outcrop strikes northwest and the lens lies with its long dimension along the strike, and a dip of 45° NE.

Bibl.: State Mining Bureau, Bull. 38, p. 260.

On the **Rancho Santa Ana y Quien Sabe,** about 4 miles south of the Gleason Mine, croppings of high-grade stibnite are reported but there has been no attempt to develop them. Cebrian Bros., Tres Pinos, Cal., owners.

Rip Van Winkle Mine, formerly known as the Ambrose Mine, was relocated in June, 1915, by its former owner, Joseph Bishop, of Hollister, after lying idle for 25 years. Bishop worked the property formerly through two tunnels, one of which, about 365 feet long, is now partly caved and is not being used. The other tunnel had been driven to a distance of about 400 feet in December, 1915. A short raise started years ago has been abandoned.

The croppings at this mine, as at all the others located for antimony in the district, strike northwest and dip northeast about 60° or 70°, showing prominently through the hill. The mineralized zone consists

of a quartzose gangue, enclosing small bunches of stibnite 2′ or 3′ wide, which occur along the strike at irregular intervals and are connected by narrow stringers sometimes only an inch wide. The ore lies mostly on the footwall side, and there may be several feet in width across the vein which are nearly barren. The distance which Bishop has followed the vein with success indicates a more persistent ore occurrence than is usually found in Coast Range deposits.

The ore is mined by hand and hand sorted. The owner has sold several small lots in San Francisco since June, 1915. Teaming to Hollister costs $5.00 per ton, with a charge of $3.76 per ton for freight from Hollister to San Francisco.

Bibl.: State Mining Bureau, Bull. 38, p. 260; R. X, p. 517.

Shriver Mine, in Sec. 31, T. 11 N., R. 7 E., is located on one of the three prominent lines of outcroppings noted in the district, and lies between the Bishop and Garner properties. The "vein" is in places 16 feet wide and strikes northwest with a dip of 60° to 70° NE. A large amount of underground work, described in detail in past reports, was done partly in a search for cinnabar and partly for stibnite, but no satisfactory body of either was found. The property is now owned by T. H. French of Hollister.

Bibl.: State Mining Bureau, Reports VIII, p. 485; X, p. 516; XI, p. 371; Bull. 38, p. 260.

ASPHALT.

Natural asphalt occurs in Sec. 29, T. 17 N., R. 8 E., and has been utilized in a very small way in the past.

Matthews Quarry, John Matthews, owner, King City, Cal., is located in the above section. Here the granite basement of the Gabilan Range was eroded, giving rise to a talus slope on the east, with a thickness of about 10 feet. Monterey sand and shale have been deposited over this and the heavy oil rising along the Monterey shales has been handled for street work. A production of 225 tons was reported for the period from 1899 to 1904. The deposit is about 10 miles northeast of Metz, near a good road.

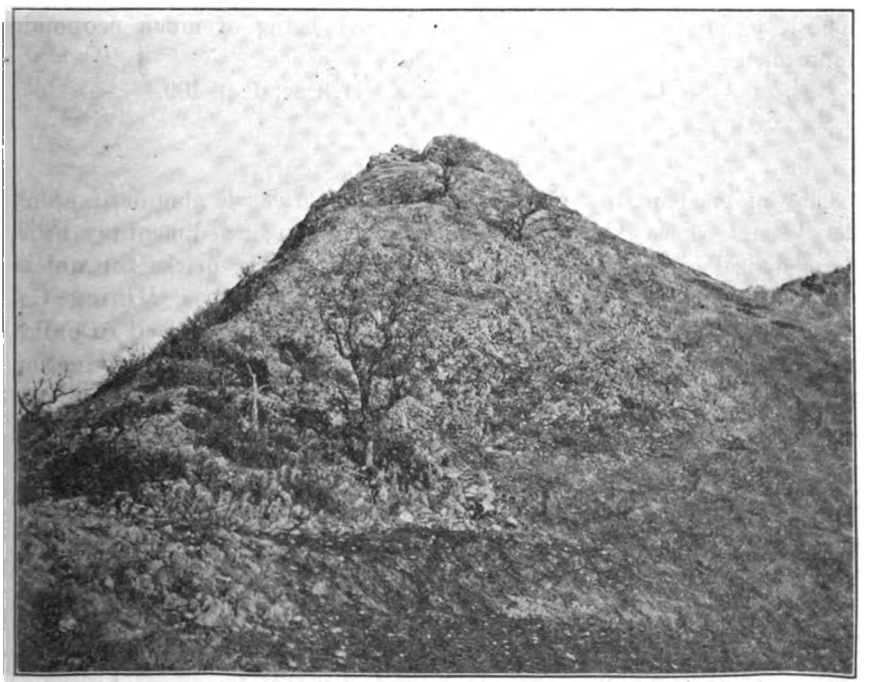
Bibl.: U. S. G. S. Annual Report XXII, Part I, p. 409.

BARITE.

On the **Bardin Ranch,** which includes a part of Gabilan Peak (also known as Fremont Peak), some outcrops of barite have recently attracted attention. These croppings were investigated as early as 1864 by miners who believed for a time that they had discovered silver ore, but who abruptly ceased prospecting when they found no silver values. In the summer of 1915, L. H. Day and H. W. Under-

wood, of Hollister, took an option on the property and made a few shallow prospect cuts.

The best defined cropping is on the southwest flank of Gabilan Peak, where a body of high-grade barite with a maximum width of 6 feet strikes about 20° NE., 60 feet. It is enclosed between steeply dipping walls of highly silicified limestone and has not been prospected enough to permit a reliable estimate of the amount available. About 1750 feet, a little north of west from the first cropping, occurs another small body of barite, on the same slope of the ridge; 1500 feet further west, still another. These are all of the outcrops mentioned by the people who were prospecting there. When the writer visited the region



Gabilan (Fremont) Peak, San Benito County, showing outcrop of barite under oak tree in center.

he observed, besides the above, an outcrop on the north flank of Gabilan Peak, about half way to the summit, another small patch one-half mile north of the peak and a third on the hill southwest of the Steinbach orchard, associated with limestone. The material is pure white and highly crystalline. When struck by the pick it gives off the characteristic fetid odor. Assays made show 98.6% and 99.7% barium sulphate, according to Mr. Day. The location is about 9 miles from San Juan Bautista and fourteen miles from Betabel station, with

a fair road most of the way. Bardin Bros., of Salinas, are the owners. The deposit is being opened up by Wm. A. Farish, Jr., of San Francisco.

BITUMINOUS ROCK.

Matthews Quarry, John Matthews, King City, owner; also known as Topo Paving Co. This is a small quarry in bituminous sandstone, formed where Monterey shales occur, covering a talus slope which has resulted from the weathering of the granite basement, directly below. The quarry is partly in the granite sand and partly in the Monterey formation, the bitumen having penetrated down in the talus. The deposit is in Secs. 32 and 33, T. 17 S., R. 8 E., 10 miles from Metz. The distance from the railroad and the comparatively small size of the deposit precludes the possibility of it ever being of much economic importance.

Bibl.: U. S. G. S. Annual Report XXII, Part I, p. 409.

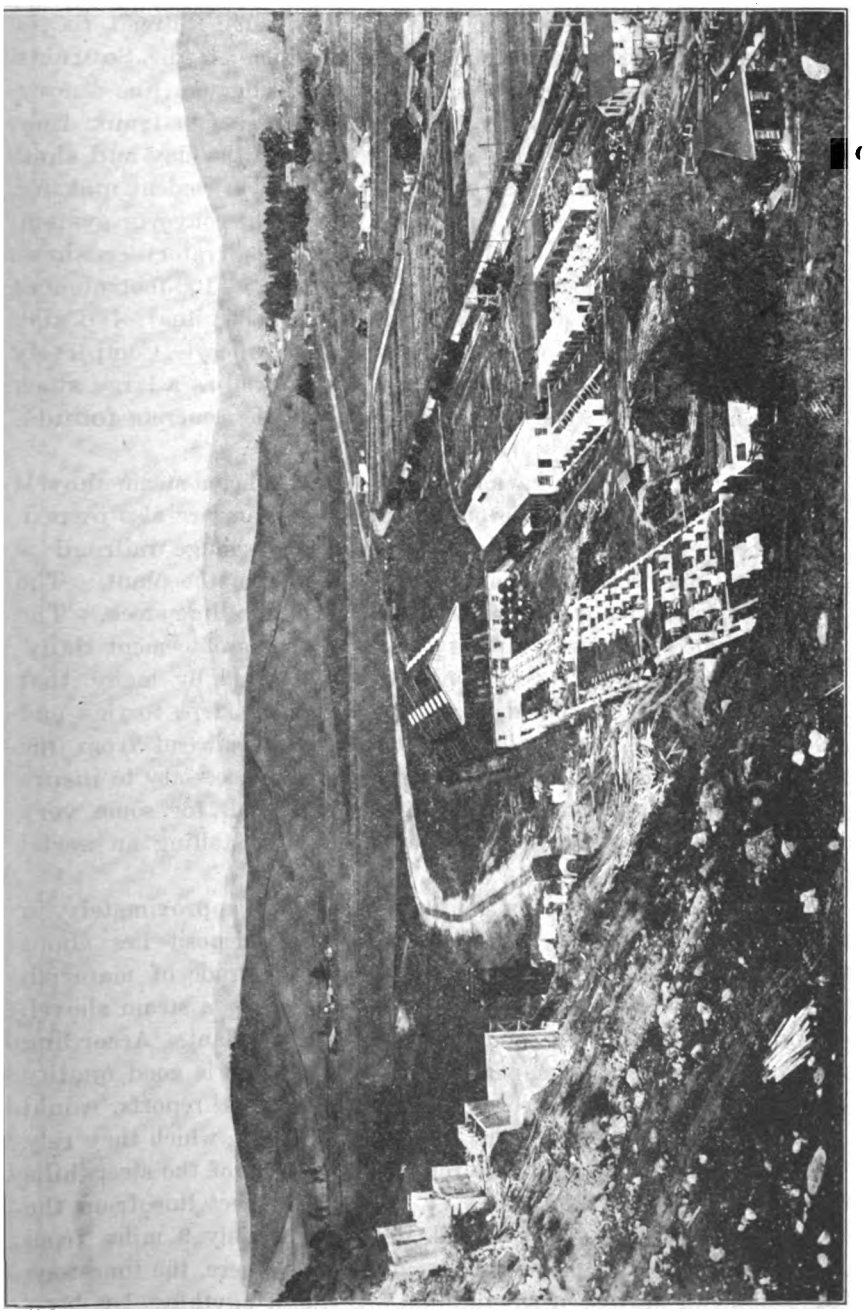
BRICK.

Clay of good quality for making common bricks is abundant along the streams where they course through the younger sedimentary beds. A good deal of this was utilized years ago to make bricks for quicksilver furnaces. Late in 1915 the Alpine Quicksilver Mining Co. burned about 260,000 bricks on lower Clear Creek, to be used in building their new 20-ton Scott furnace and condensers. No production other than for local use of this kind has ever been reported from the county.

CEMENT.

The deposits of limestone in this county which are suited for the manufacture of Portland cement are large, and are fairly well situated as regards mining and transportation. Particular mention is made of the larger deposits under the head of Limestone, and the reader will note, by reference to that section, that many of these beds are owned by large cement manufacturers. Only one corporation, however, has so far undertaken the erection of a cement plant in the county.

Old Mission Portland Cement Co., Baron Kemp Van Ee, president, Crocker Building, San Francisco, Cal., began in 1903 the erection of a cement plant just outside the town of San Juan Bautista, but work was interrupted by financial difficulties and the establishment has never been completed. In connection with the cement factory a lime plant was erected. This is fully described under the heading of Lime. Including the factory site, the company owns 1453 acres of land in San Benito County, on which are three limestone deposits. They also



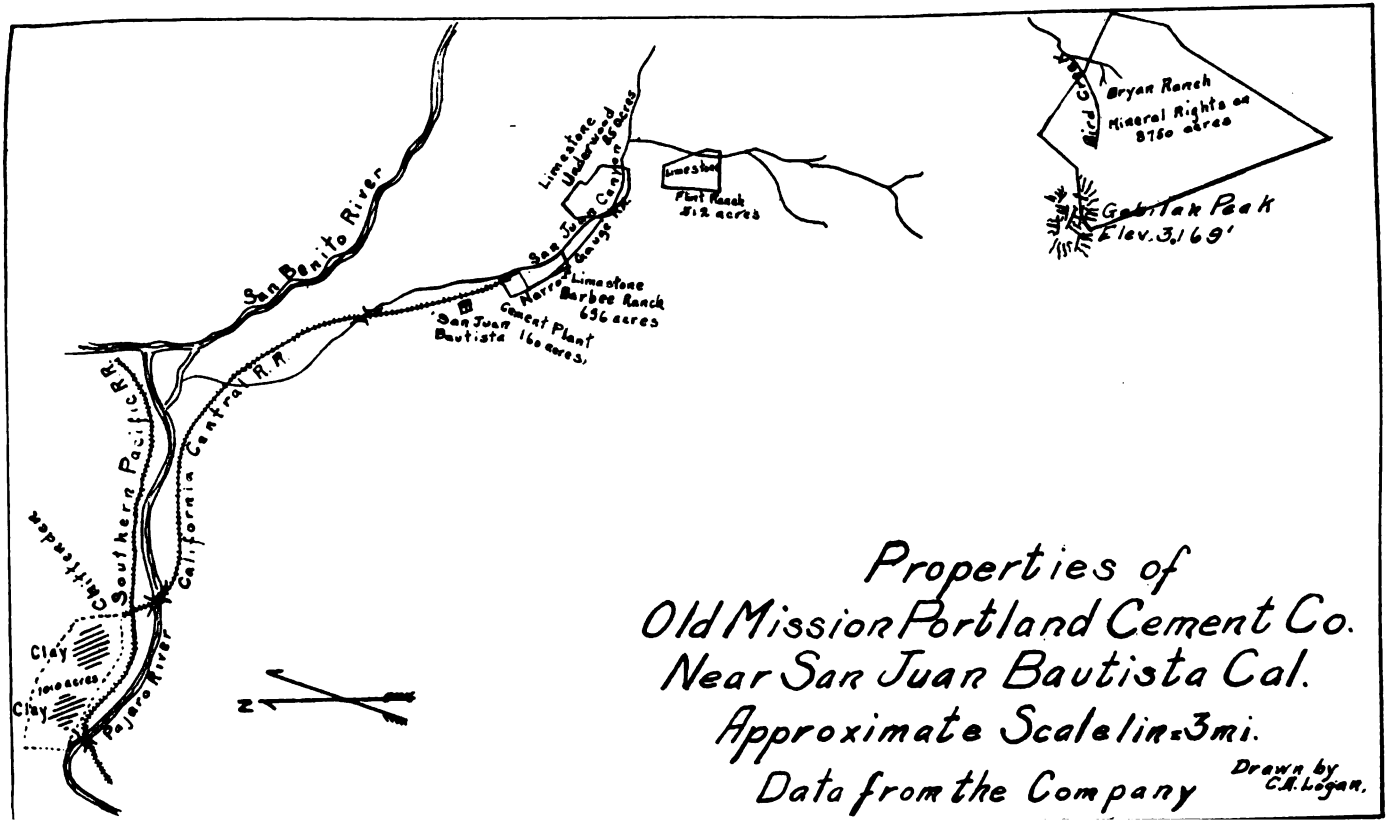
Partially constructed plant of the Old Mission Portland Cement Company, San Juan Bautista, California. Photo by S. D. Lemar.

have mineral rights on 8750 acres on and near Gabilan Peak, with water rights in San Juan Cañon, and a narrowgauge railroad to the limestone deposit. From the plant to Chittenden, on the Southern Pacific Railroad, the company constructed a broadgauge line known as the California Central Railroad. This gave access to trunk lines for transporting the prospective output, and tapped the clay and shale deposits near Chittenden, which were to be utilized in cement making.

Practically all of the heavier equipment, except the conveyor system, is on the ground; this includes 1 No. 8 and 5 No. 4 gyratory crushers, 7 ball tube mills, to be steel-lined for wet process, 6–100-foot cement kilns (which it is planned to convert into 4–150-foot kilns), 4–6′x60′ dryers, and about $50,000 worth of electrical machinery. Completely equipped office, laboratory and machine shops, as well as a large stock house, are finished and ready for work, but only the concrete foundations of the cement factory are laid.

For quarrying the limestone and clay beds, two Marion steam shovels were provided. Two dinkey locomotives and ore cars are also owned, to handle the quarried limestone, and the narrowgauge railroad is built to the Underwood limestone bed, 2½ miles from the plant. The broadgauge line is equipped with locomotive and rolling-stock. The plant is designed to have a capacity of 3000 barrels of cement daily, working by the wet process. Hopes are entertained by many that construction will be completed soon, but no definite steps to this end have been taken. Extension of the narrowgauge railroad from the Underwood to the Flint limestone deposit would be necessary to insure a satisfactory reserve, and this extension would call for some very heavy construction, which might be obviated by installing an aerial tramway system.

The location of the various holdings are shown approximately in the accompanying sketch. The Barbee limestone deposit lies about ½ mile from the plant and appears to be a good grade of material, but is situated too low to be economically handled by a steam shovel. The Underwood deposit lies about 2½ miles from the plant. According to analyses made by the company, the limestone here is good quality and the amount available, according to their engineers' reports, would run the plant for possibly 3 years. The Flint deposit, which they rely on for their principal supply, outcrops along the top of the steep hills above the San Juan Cañon about 1½ miles in a direct line from the Underwood beds. The Gabilan Peak deposits, possibly 9 miles from the plant, are largest of all; but as mentioned elsewhere, the limestone there exhibits all degrees of silicification. Little, if anything, has been done by the company in exploring these beds or analyzing the lime-



Properties of Old Mission Portland Cement Co. Near San Juan Bautista Cal.

Approximate Scale 1 in = 3 mi.

Data from the Company

Drawn by C.H. Logan.

stone, and even if a large tonnage of the Gabilan beds should prove fit for cement, provision would still have to be made for transportation, partly by railroad and partly by tramway.

CHROMITE.

In the serpentine areas in the Coast Range Mountains, chromite is occasionally found. One such area which is quite extensive south and southeast of New Idria will be noted by reference to the geological map (Plate II). Within this area an abundance of chromite is found as small float, especially in the ravines and stream gravels. It does not, as far as observed by the writer, occur in any considerable masses but seems to be disseminated in boulders and small masses throughout portions of the serpentine. Centuries of weathering and erosion have concentrated this mineral in the stream gravels. About 1875 a party of four men, with teams not otherwise engaged at the time, hauled out to Hollister a carload or two of the coarser of this natural concentrate, shipped it to San Francisco and thence by sailing vessel to Baltimore. The workable deposits were so scattered, and limited in extent, and the margin of profit was so small (they did actually make a slight profit) that they discontinued the experiment.

The chromite here is characterized by specks and films of a green oxidation product. In early days this was erroneously reported as nickel and also as "hornsilver," though the color is a more vivid green than the latter mineral.

Bibl.: Rept. IV, p. 136; VI, Pt. I, p. 100; VIII, pp. 483, 490; Bull, 27, p. 126; Bull. 38, pp. 269, 362; Bull. 67, p. 81; MIN. RES. W. OF ROCKY MTS., 1868, p. 224; CAL. SEN. DOC. No. 9, 1854 (J. B. Trask), p. 18; U. S. GEOL. SURV., Bull. 603, p. 208; Mon. 13, p. 294.

CLAY.

R. W. Chappell, of Berkeley, owns an undeveloped deposit of clay on the San Justo Ranch, 3 miles south of Hollister. The clay is gray-green in color, plastic, and free from sand. It has been tested and found to be suited for pottery work. A well is said to have been drilled 80 feet entirely in this clay.

Bibl.: Bull. 38, p. 226.

COAL.

Small veins of bituminous and subbituminous coals have been observed at many places in the county. Work was done in 1878 near Emmett on a vein of "jet" about 6″ wide. Mention is also made of coal on the Rancho Cienega del Gabilan. Other deposits were observed at an early date and slightly prospected on Panoche Creek, near the Fresno County border, where 3 veins, the largest said to be 4 feet thick,

occur interstratified with shale; and on the Ashurst Ranch, in the Vallecitos country. There is no record of production from any of these beds.

Mascovich Coal Mine, formerly called the Trafton Mine, is now owned by N. P. Mascovich of San Benito. It is situated in the NW. ¼ of Sec. 21, T. 17 S., R. 10 E., at an elevation of 2300 feet, near the head of James Creek. The nearest railroad point is Metz, distant 22 miles in a southwesterly direction.

It was first opened by Trafton in 1870. He drove one shaft on the vein 128 feet, but did not accomplish much in actual production, and the mine laid idle until about 1907, when the Monterey Coal Co. took it on lease. They did some work in the old shaft and sank another to a depth of 70 feet. The mine was equipped with a hoist and a steam engine which used coal from the mine for fuel. Some coal was mined, but the company was unable to make any money on the venture and the owner was compelled to take back the property. He has since sunk the shaft started by the Monterey Coal Co. to 158 feet and has driven a siphon tunnel 80 feet to drain the shaft. He allows the shaft to stand full of water in order to lessen the effect of oxidation. The track has been removed from the shaft and no work done in it since 1913.

The coal vein has an average thickness of 6 feet and has been followed on the surface for 1200 feet. It strikes N. 10° E., and dips 37½° to 40° W. The relation of the associated strata is shown in the accompanying sketch. The coal is apparently of Eocene age. It compares very favorably with other coals mined in California in composition. The analysis shows 54% of fixed carbon and a heat value of 13,220 British thermal units, or 7345 calories, and comes low in the bituminous group.

Mascovich has begun a cross-cut tunnel in the side hill below the outcrop which he figures will give 500 feet of backs when it taps the vein. The width of the vein, averaging 6 feet, should make mining cheap, and the proposed tunnel should permit of cheap handling. Lack of transportation facilities nearby have so far prevented successful operations.

Bibl.: U. S. G. S. Bull. 431, p. 243.

COPPER.

Copper indications have been found in the vicinity of The Big Pinnacles and on Lewis Creek, which forms the southern boundary of the county.

Copper Mountain Mining Company, of Salinas, Cal., has 21 lode claims, 3 mill sites, a water right, 2 dump sites and a townsite located

Cross Section
Mascovich Coal Mine
San Benito County, Cal.
Scale: 1 in = 20 ft.
By C.A. Logan.
N

in Sec. 33, T. 16 S., R. 7 E., near the Monterey County line. The development consists of 40 feet of open cut 12 feet wide, in which is a lens of rock showing malachite stains and possibly some chalcopyrite. The lens showed a thickness of 18″ and a length of 6′; above on the same hill to the north are 2 tunnels each 10 feet long, showing copper stains at the portals, and an open cut of 30 feet. The country rock is granitic. The property is equipped with 6 redwood tanks 3½′x 3′, for leaching the ore, but as far as could be learned no copper has been recovered. Idle when visited.

Lewis Creek Claim, located on the stream of that name, in Secs. 2, 3 and 4 of T. 19 S., R. 10 E., was prospected ten years ago or more by G. W. Spencer, of Hollister, and F. W. Saffel, of Lonoak. The development comprises a tunnel 100 ft. long, which missed the ledge. The outcrop was traced about 4 miles and showed chalcopyrite, with walls of sandstone and serpentine. Idle for years.

Bibl.: Bull. 23, p. 146; Bull. 50, p. 172.

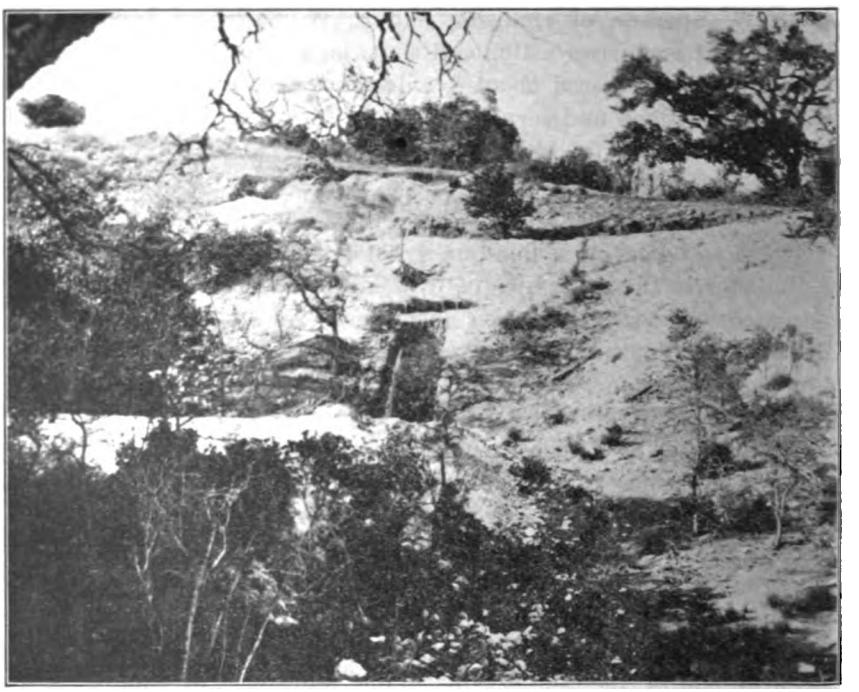
DOLOMITE.

Extensive bodies of a fine quality of dolomite are found southwest of Hollister in the lower hills of the Gabilan Range. The deposits are associated with the limestones mentioned previously, and show the effects of metamorphism due to intrusions and earth movements as observed at Gabilan Peak. Since the impetus given the steel industry in the past year, a limited demand has arisen on the Pacific Coast for dolomite, which is used in making refractory basic linings in open hearth steel furnaces. Dolomite has been shipped from two properties in San Benito County to Los Angeles and San Francisco.

Baldi and Rothschild, under the name of **San Benito Quarries Co.,** 401 Front St., San Francisco, Cal., have a lease on a dolomite deposit on the O'Hara Ranch, which is 11 miles southwest of Hollister. Their quarry has an elevation of 1650 feet and is opened on the top and slopes of one of the rolling hills a few miles east of Gabilan Peak. The dolomite is quite pure, carrying very little silica and said to show 21.55% MgO. The overburden is very light, consisting of 1′ to 4′ of soil. The greater part of the dolomite shipped so far from this quarry was taken from the top of the knoll, where a pit 40′ in diameter was opened. The dolomite was carried out in wheelbarrows and loaded on wagons, which hauled it to Hollister. During part of the past summer (1915) 10 men were employed at the quarry and 9 teams were kept busy hauling, the daily shipments averaging about 40 tons. In spite of the laborious method of mining and the low price obtained, a fair profit per ton was realized. The accompanying photograph

shows the method of tunneling into the deposit to avoid the overburden and the upper, impure part of the bed.

A. A. Haskins, of Hollister and Colma, has opened a dolomite quarry under lease on the property of the San Benito Vineyards Co., 10 miles southwest of Hollister. The opening is on a sidehill, about half a mile west of the Baldi and Rothschild holdings. It has an elevation of 1550 feet. Ascending the hill above the open cut, croppings of fairly pure dolomite occur on the slope for perhaps 300 feet, followed by a zone of metamorphic dolomite and limestones, giving way at the summit to croppings of granitic schist. Eastward, down the slope 200 feet

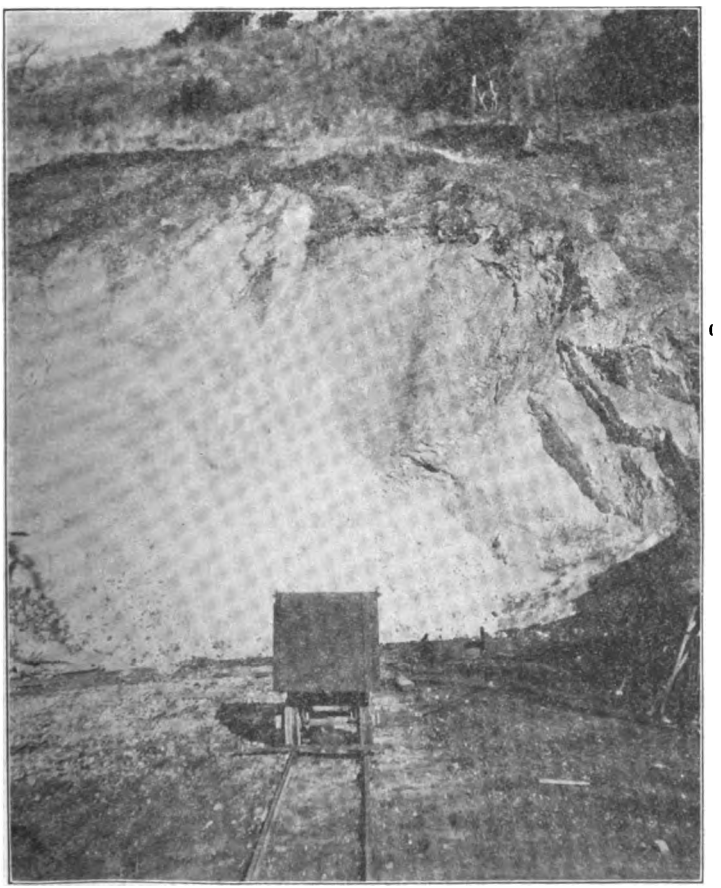


Dolomite Deposit, 11 miles from Hollister, San Benito County, showing method of tunneling into the deposit to avoid overburden and the impure upper portion of deposit.

below the summit, fairly pure dolomite occurs, merging rapidly into highly silicified dolomitic limestone.

Mr. Haskins has opened a cut 36 feet wide with a face 30 feet high and has gone into the hill about 40 feet. The photograph illustrates the method of working. From the car the dolomite is dumped into a chute which feeds the ore into the wagon or auto truck used for hauling to the railroad at Hollister. The light overburden, one to three feet, is removed with scrapers, and the dolomite is blasted loose after drilling with hand tools. The material is high grade, pure white and crystalline,

and carries better than 40% $MgCO_3$, with an insignificant amount of silica. The deposit has been opened in such a way as to allow of very cheap mining, and a good road to Hollister favors fairly cheap hauling. Mr. Haskins has erected a small loading bin at the depot at Hollister. The material is raised to this bin by a bucket elevator and goes from the bin into the cars on the siding below. Several hundred tons were awaiting shipment there in December.



Haskins Dolomite Quarry, near Hollister, San Benito County.

On the property of **Leopold Palmtag**, adjacent to the ranch of the San Benito Vineyards Co., dolomite is reported to occur in considerable quantity, no doubt a part of the same deposit mined at the two properties above described. This dolomite had not been prospected and was not visited by the writer.

A. J. Fazzi, of Hollister (San Francisco office, No. 1017 Crocker Building), has a lease on a dolomite deposit on the E. L. Martin ranch.

8 miles southwest of Hollister. Preparations are being made (June, 1916) to ship material from this deposit. The following analysis by A. A. Hanks, San Francisco, shows it to be a high grade dolomite:

$CaCO_3$	54.54%
$MgCO_3$	42.78
Fe_2O_3 and Al_2O_3	0.80
SiO_2	1.00
	99.12%

DIATOMACEOUS EARTH.

Deposits of diatomaceous or infusorial earth have been noted in two places in the southern part of the county but have never been prospected.

On the property of the **Leonard Estate** in Sec. 28, T. 17 S., R. 8 E., adjacent to the bituminous sandstone quarry of the Topo Paving Company and also on the land held by that company, diatomaceous earth outcrops in rounded knolls for a distance of over a mile. It is considered to belong to the Monterey formation of Miocene age. There is little likelihood of any work being done on the deposit on account of its distance from the railroad, there being many deposits, notably in Santa Barbara and San Luis Obispo counties, which lie adjacent to rail or water transportation.

On the **N. D. Page** property, about one mile from San Benito, there are also some outcrops of diatomaceous earth which have never been prospected.

GEMS.

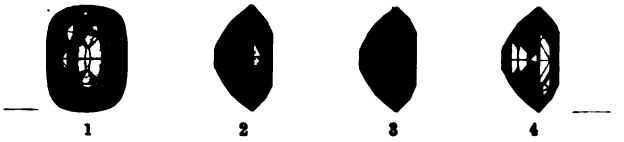
Benitoite—Dallas Mining Co., owner; R. W. Dallas, president, No. 1 Webb Bldg., Coalinga, Cal. Two patented claims in Sec. 25, T. 18 S., R. 12 E., 12 miles southeast of Idria, at an elevation of 4600 feet (U. S. G. S.). This is the only known occurrence of the gem mineral benitoite; and there is only one other known occurrence of the neptunite which accompanies it, that is, in Greenland. The deposit was discovered in 1907, and the bluestones at first thought to be sapphires; but they have been identified by Prof. G. D. Louderback,[1] as a distinctly new mineral.

Benitoite crystallizes in the rhombohedral division of the hexagonal system, in the form of prisms with trigonal pyramids. It is transparent and the color varies from colorless to deep blue, being strongly dichroic (see Plate I). The hardness is 6.5 and sp. gr. 3.64–3.65. The name was given it because of its occurrence near the head waters of the San Benito River, in San Benito County, and near a peak of the same name. "Benito" is a Spanish form of benedictus, blessed.

The benitoite (a titano-silicate of barium, $BaTiSi_3O_9$) occurs associated with natrolite (white—$Na_2Al_2Si_3O_{10}$ $2H_2O$) and neptunite

[1]Bull. Dept. Geol., U. of Cal., Vol. 5, pp. 149–153.

PLATE I.



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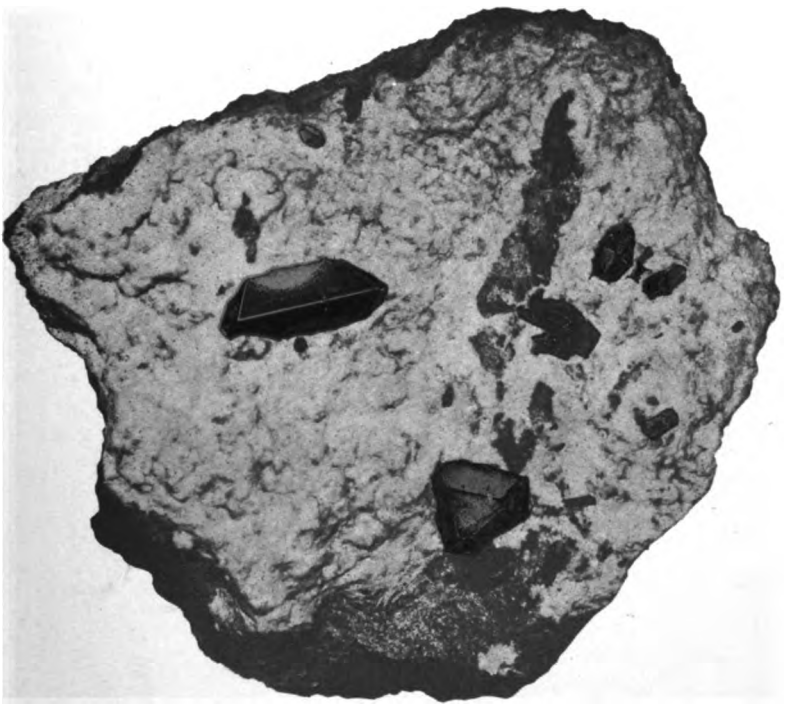


5

Benitoite.—1 and 2. Gem in ordinary reflected light, natural size; 3. in transmitted light, extraordinary ray; 4. in transmitted light, ordinary ray. 5. Crystals in matrix, ⅘ nat.

Courtesy of Dept. of Geol., Univ. of Cal.

(black, but in thin splinters blood-red—a titano-silicate of iron, manganese, potassium and sodium), in a zone of narrow veins in serpentine. The developments consist of two short adits and a vertical shaft 50 ft. deep, the latter having been operated with a horse-whim (see Photo No. 10). A number of the gems were cut and placed on the market, and proved quite attractive. However, the property has been allowed to lie dormant for the past five or six years, largely on account of unsatisfactory financial conditions and a slack demand for gem materials.

Bibl.: Bull. 67, p. 157; BULL. DEPT. GEOL. U. OF CAL., Vol. 5, pp. 149–153, 331–380; U. S. G. S. Bull. 603, p. 208; Min. Res. 1909, Pt. II, pp. 742–748; CENTRALBLATT FUR MIN. GEOL. Pal., 1909, pp. 293, 592; AM. JOUR. SCI., Vol. 27, p. 398; SCIENCE, 1908, p. 616.

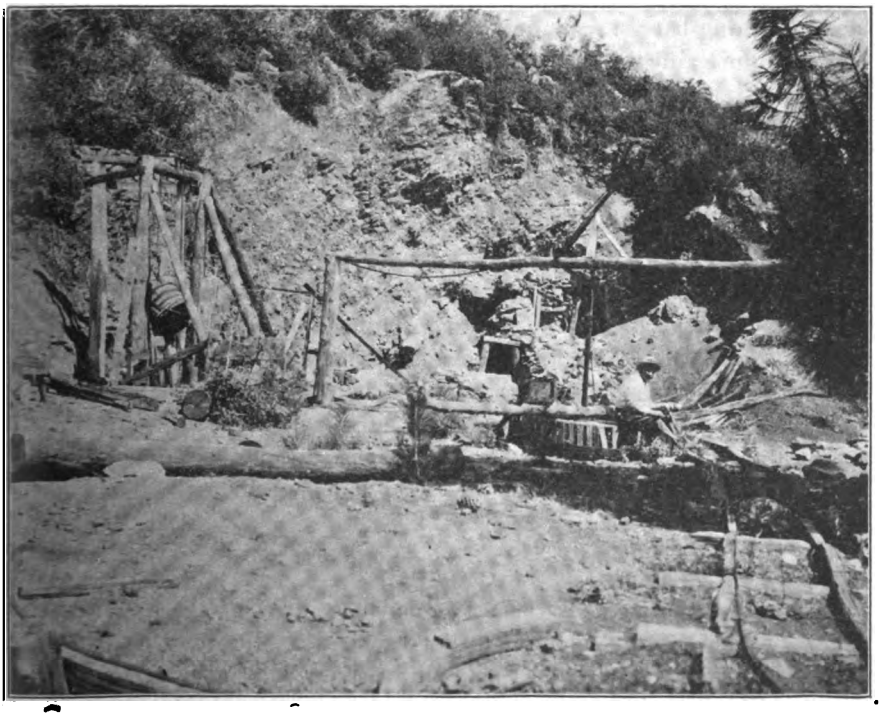


Photo No. 10. Benitoite Mine—Dallas Mining Co., San Benito County.

GOLD.

Several attempts to mine gold have been made in this county but have proven abortive, in spite of the fact that encouraging surface indications of the metal have been found in a number of districts.

In the '80's an attempt was made by a party of Frenchmen to do some placer mining in the Panoche Valley, but lack of water near by resulted in their failure to accomplish anything.

Chalone Mine and the adjacent Defiance Mine were opened by Thomas Flint, of Hollister, in 1890. They are situated on a volcanic ridge northeast of North Chalone Peak, probably in Sec. 14, T. 17 S., R. 7 E. Rock found on the surface here by a prospector assayed as high as $94.00 per ton, and it is said that numerous samples showed over $5 per ton. Encouraged by these showings, Mr. Flint financed the work of driving two prospect tunnels. The Chalone tunnel was driven a distance of 540 feet into the ridge about 400 feet below the summit. This tunnel is entirely in a light gray eruptive formation called liparite by former writers, being probably of rhyolitic composition and having a microcrystalline structure. Along the top of the wall is an obsidian of similar composition which shows flow structure. Mr. Flint reports that assays showed gold values of one to five dollars at several places in the tunnel, but no quantity of ore was found. There appeared no way of distinguishing barren from gold-bearing material. No faults were noted in the tunnel and the gold appeared to be a primary constituent of an unaltered igneous rock. The Defiance tunnel near by was driven about 400 feet with similarly discouraging results. The property has been abandoned and open for entry for years.

About 3 miles south of these prospects, L. H. Day, of Hollister, recently found quantities of gold in samples of andesitic rock taken from the surface.

The **San Justo Tunnel,** on the Flint Estate in San Juan Cañon, west of Hollister, was driven by Thomas Flint. Small ledges on the hill above gave samples assaying as high as $25 to $30 per ton of gold, but when a tunnel was driven with the intention of cutting these ledges at depth, only narrow and discontinuous stringers, carrying little or no gold value, were found. The tunnel reached a length of 300 feet and with no returns in sight, work was abandoned in 1896.

Bibl.: Reports XII, p. 227; XIII, p. 318.

GYPSUM.

Extensive gypsum beds form a conspicuous part of the Tulare sediments of Pliocene age, which mantle large areas of the country from the Topo Valley westward to the San Benito River, and southward to Lewis Creek. The deposits are mainly of the massive grey variety and are in the form of gently inclined beds, in places several hundred acres in extent, cut up by the numerous winter torrents into low residual mountains.

A number of deposits which have been worked in the past are described in the bibliography cited below. Among these are the **F. Q. Alvarez** deposit in Sec. 5, T. 19 S., R. 10 E., and Sec. 32, T. 18 S., R. 10 E., postoffice address, Bitterwater. No work recently.

Chambers Property, owned by Mrs. S. Chambers, of Bitterwater. This is located in Sec. 15, T. 18 S., R. 9 E. A very little work was done here years ago.

Bibl.: Bull. 38, p. 287.

Dunne Gypsum Quarries are located in Secs. 8 and 17, T. 18 S., R. 9 E., 13 miles from King City. J. F. Dunne, of Hollister, owner. This property has produced a large amount of gypsum in recent years, but the credit for its production went to Monterey County, as it was shipped from King City. Outcrops are visible here over two sections. The gypsum bed is covered by a soil overburden of 6′ to 12′, consisting of loose clayey detritus rich in gypsum, carrying gypsum pebbles and some small streaks of sandstone. Below this is a bed of massive grey gypsum, about 90% pure. The bed averages 6 feet in thickness and dips only 5° or 6° east on one side, and west on the other, indicating a gentle folding. Under this purer bed is another layer, carrying about 50% gypsum, but this has never been mined, and forms the floor in the quarry workings.

The overburden was removed with two-horse scrapers and the exposed bed was blasted with black powder, broken into blocks convenient for handling and hauled on wagons to King City, where it was shipped to Santa Cruz for use in plaster. Four teams and a small force of men were employed here until the end of 1914, when work is said to have been discontinued on account of the high cost of hauling. In the quarry last operated, a block 6′ thick, 150′ long and 50′ wide was taken out. Another opening shows a length of 1000′, a depth of 75′ and a thickness of 6′ removed. There are, besides, several smaller openings. Comparing these excavations with the reported production, it is at once evident that an immense tonnage has been mined here that was never credited to the county.

Bibl.: Rep. XIII, p. 504; Bull. 38, p. 287.

J. C. Tully, of Bitterwater, owns land adjacent to the Alvarez deposit, on which gypsum of similar character occurs. No work has been reported.

R. R. Tully, of Bitterwater, owns some gypsum beds in Sec. 11, T. 18 S., R. 10 E.

IRON.

The old **Quilty Iron Mine** in Sec. 6, T. 15 S., R. 6 E., two miles south of the old lime kilns of the Cienega Lime Co., was slightly prospected 15 years ago or more, but no work has been done lately. There are said to be extensive croppings of hematite on the property. It is situated about 15 miles from the railroad, Tres Pinos being the nearest station. Mrs. Quilty, Tassajara Springs, and J. S. Hawkins, Hollister, owners.

Surface indications, but no ore in place, are mentioned as having been noted on the **Williams Estate**, T. 17 S., R. 12 E., and in the country between Stayton and Panoche Pass.

Bibl.: R. VIII, p. 490; Bull. 38, p. 299.

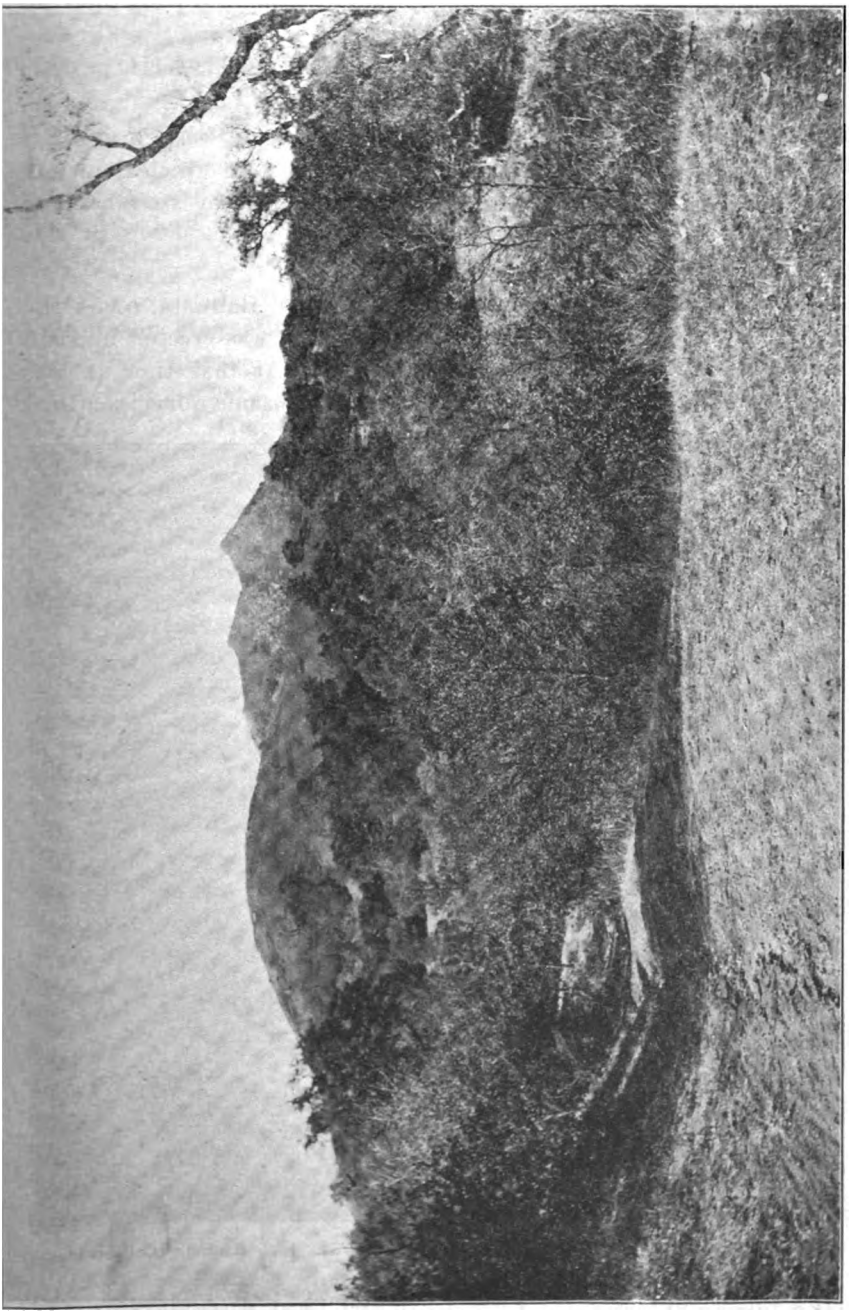
LIME AND LIMESTONE.

Limestone suited for cement making and for burning occurs prominently along the Gabilan Range from San Juan Bautista to the region of Pine Rock. Some lime has been made for local use in several places in the region, but at present there is no production, nor has there been any for a period of about 8 years. Since the last report was prepared by this Bureau on San Benito County, a number of limestone properties have changed hands. Deposits formerly owned by M. Barbee, S. Lavagnino and A. F. Underwood, of San Juan Bautista, and Thomas Flint, of Hollister, are now held by the Old Mission Portland Cement Co. More detailed mention of these properties is made under the section on Cement, in connection with a description of this company's other holdings.

Archer Lime Co. D. McPhail, Hollister, Cal., secretary. The property consists of 245 acres of land 14 miles southeast of Tres Pinos station, in Secs. 23 and 13, T. 14 S., R. 5 E. There are bold croppings of limestone here, standing up possibly 70 feet in places above the base. Mr. McPhail states that he has various analyses showing 96% $CaCO_3$ and 2¼% to 4% $MgCO_3$. The property has been mentioned favorably by engineers and no doubt contains an extremely large tonnage of good grade limestone, but has never been exploited as yet.

Connelly and Kruse limestone deposits, known also as the San Benito Lime Co., owned by Geo. Connelly and J. H. Kruse, 23d and Shotwell Sts., San Francisco, Cal., are situated in Sec. 23, T. 14 S., R. 5 E., adjacent to the property of the Archer Lime Co. There are in all 240 acres of land, on parts of which a good quality of limestone occurs. There is an old kiln of 50-ton capacity on the land, and years ago some good lime was made here, but no production has been reported for a long time.

Henry Cowell Lime and Cement Co., of No. 2 Market St., San Francisco, Cal., (with which is associated the Holmes Lime Co.) owns 1044 acres of land containing extensive limestone deposits, in Secs. 28, 29, 30 and 32, T. 14 S., R. 6 E., and Secs. 14 and 24, T. 14 S., R. 5 E., 13 miles from Tres Pinos, in the vicinity of Thompson Creek. About 16 years ago the Cienega Lime Co. operated 4 kilns of 50-barrel capacity each on this property, and burned considerable lime, which was hauled to Tres



Gabilan or Fremont Peak. This peak, and the adjacent ones, are composed largely of metamorphic limestones. Photo by S. D. Leman.

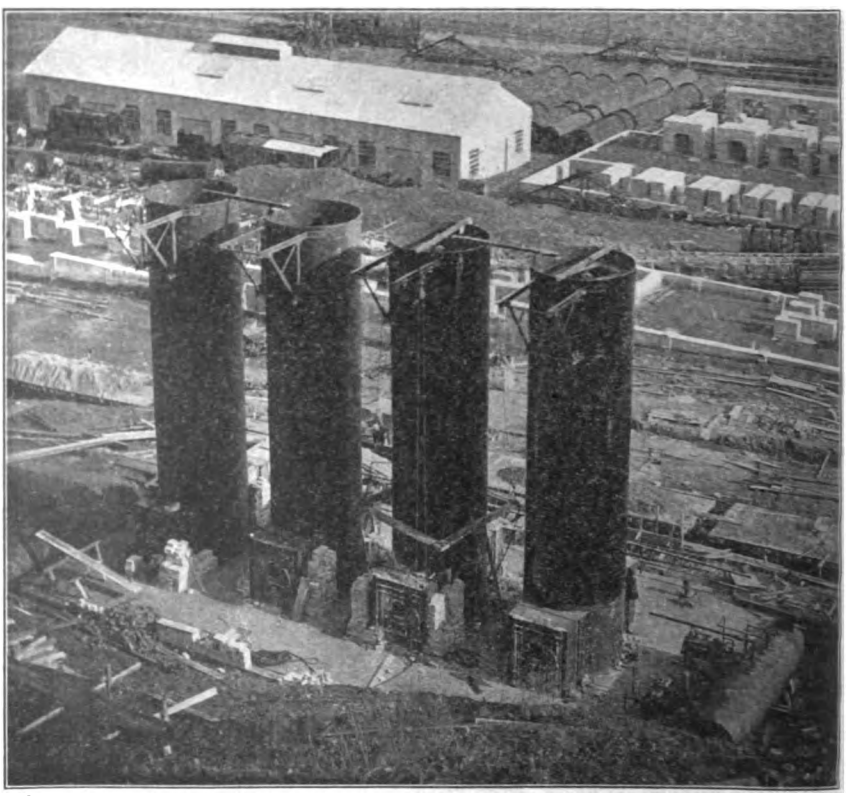
Pinos for shipment. Since the present owners came into possession no production has been reported.

Bibl.: Reports VIII, p. 488; XI, p. 370; XII, p. 393; XIII, p. 629; Bull. 38, p. 76.

U. G. Harlan et al., of Hollister, own 320 acres in Secs. 23 and 24, T. 14 S., R. 5 E., 13 miles southwest of Tres Pinos on which lime was burned up to about 8 years ago. Since that time the kiln is reported to have lain idle.

Bibl.: Bull. 38, p. 76.

Old Mission Portland Cement Co., of San Juan Bautista, owns the only modern lime kilns in the county. The plant was erected in 1913 in conjunction with the cement manufactory. At that time it was planned to supply limestone for burning from the same quarries which



Lime kilns, Old Mission Portland Cement Co.'s plant, San Juan Bautista, California. Photo by S. D. Leman.

were to furnish the material for cement. The failure to complete the cement plant and begin quarrying operations left the lime kilns without any material to work on, and they have so far made no production, only a ton or so of rock having been burned in one kiln for a test.

There are four continuous system kilns of 75 barrels per day capacity each, housed in a galvanized building. Burning is to be done with crude oil fuel. A 15-h.p. steam boiler is installed and will be used to keep up pressure on the oil feed. If the narrowguage railroad were in operation to the limestone deposits, it ought to be possible to burn lime and put it on the market cheaply from this plant, as transportation to the main line of the Southern Pacific is already provided for by the company's own line of broadguage railroad.

MAGNESITE.

Sampson Magnesite Lode Claims. This group of claims covers a deposit of magnesite on the west slope of Sampson Peak, in Sec. 15, T. 17 S., R. 11 E., 3 miles south of west from Idria; elevation 3900 feet (U. S. G. S.). Hugo Fischl and Ralph H. Moore, First National Bank Bldg., San Francisco, Cal., are owners. It is 60 miles from the railroad at Tres Pinos on the north, and 45 miles from Mendota on the east. The deposit is indicated by a massive outcrop on the point of a ridge running westerly from Sampson Peak down to Larious Creek (see Photo No. 13.) The light spots in the distance on the opposite side of the cañon from the magnesite are bare patches of serpentine. This deposit was first described by H. S. Gale.[2] It is within the extensive serpentine area already noted under Chromite (see geological map, Plate II).[3]

At the time of the writer's visit (September, 1914), development consisted of three adits of 100′, 100′, and 50′, respectively, also several short prospect holes; but only the upper adit showed magnesite in place. The dump of this adit can be seen in the photograph, on the south slope of the ridge a short distance below the main outcrop. Magnesite boulders and what look like small outcrops are abundant along the ridge down to the creek bottom, but from the lack of showing in the two lower tunnels it appears that the boulders are very likely float from the main mass above. Further development work will have to be done to prove if the main outcrop is simply a blanket mass on top of the ridge, or is the outcrop of a vein which continues with depth. The quality of the magnesite is good, as may be noted from the following analysis

[2] U. S. G. S., Min. Res. 1911, Pt. II, p. 1120.

[3] Since the above was written, we are informed by the owners that a large body of magnesite containing about 4% to 6% of iron has been found on the opposite side of Larious Creek.

made in the laboratory of the U. S. Geological Survey and taken from Gale's second report on the deposit.[4]

Analyses of Magnesite from Sampson Lode.

	No. 1 (per cent)	No. 2 (per cent)	No. 3 (per cent)	No. 4 (per cent)
SiO_2	0.14	0.81	11.98	2.50
Al_2O_3	.48	.00	.55	.13
Fe_2O_3		.52	.61	.44
CaO	.59	1.04	.60	.74
MgO	47.07	46.97	41.38	41.60
CO_2	50.60	50.60	45.26	34.80
Undetermined	1.06	.36	.52	20.10
	100.00	100.00	100.00	100.00
Loss on ignition		51.43	46.10	54.10

No. 1. A single block from main exposure.
No. 2. Average material from 12 samples from various points on main outcrop.
No. 3. Outcrop of magnesite from iron-stained siliceous veins on west side of Larious Creek.
No. 4. Hydromagnesite.

The bare patches of serpentine which are, in part, loose slide material and considerably weathered, are characterized by a white, powdery hydromagnesite disseminated throughout the mass in specks and small, rounded balls. The analysis of this mineral is given as No. 4 in the table. It effervesces readily and is soluble in cold hydrochloric acid.

The main economic drawback to utilization of these deposits at the present time is their distance from railroad transportation.

Bibl.: U. S. G. S. Min. Res. 1911, Pt. II, p. 1120; Bull. 355, p. 38; Bull. 540, pp. 503–509; Bull. 603, p. 208.

MANGANESE.

Several outcrops of manganese have been reported along the mountains near the Merced County line, but there has been only a little work done on one deposit in this region.

On the **Fries Estate,** in Secs. 5 and 8, T. 13 S., R. 8 E., 18 miles east of Tres Pinos, bold croppings of manganese oxides associated with chert are said to occur. Little is known about the amount of ore available, as no work has been done on the prospect. The writer did not visit this prospect. Mrs. Fries, Sr., and Peter Fries, Tres Pinos, owners.

Hendricks Mine, owned by N. C. Briggs and others, of Hollister, is in Sec. 24, T. 13 S., R. 8 E., 21 miles east of Tres Pinos. The holdings comprise 80 acres on which bunches of manganese oxides occur as part of prominent strata, forming the tops of the Diablo Range. Years ago ten tons of manganese ore were taken from the surface of this deposit and shipped to a glass manufactory in St. Louis. It was pronounced

[4] U. S. G. S., Bull. 540, pp. 507, 508.

very desirable and is said to have assayed 60% Mn. Cost of delivery to railroad prevented further work.

Bibl.: Bull. 38, p. 336.

William Lewis, of Tres Pinos, owns property 19 miles east of that town, adjacent to the Fries Estate, in Sec. 7, T. 13 S., R. 8 E., on which outcrops of manganese similar in mode of occurrence and quality to that on the Fries Ranch are found. No work whatever has been done there.

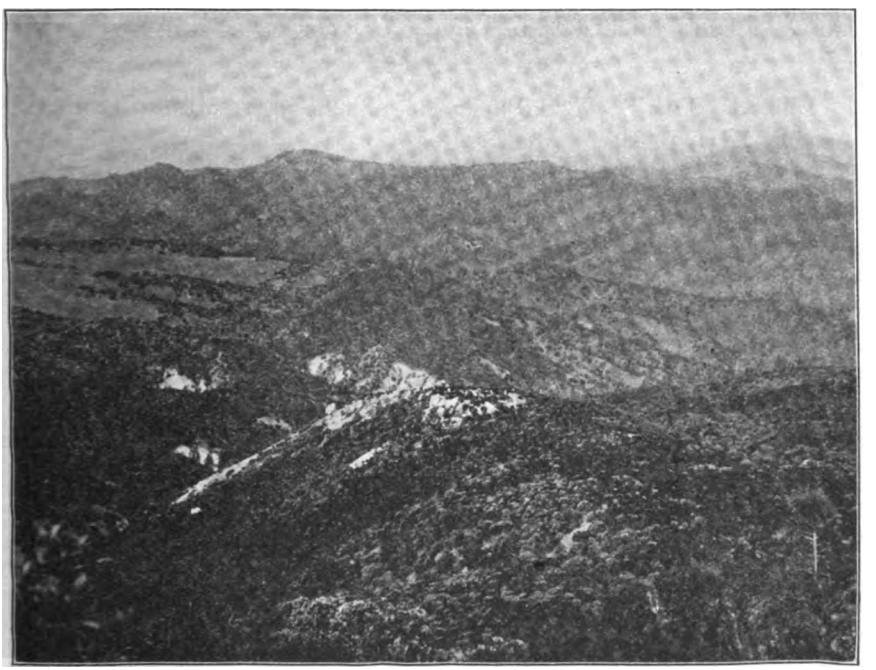


Photo No. 13. Magnesite outcrop of Sampson Magnesite Lode Claims, San Benito County—from southeast.

MINERAL WATER.

San Benito Mineral Spring Co. E. J. Anderson, owner, Hollister, Cal. This company markets annually a small production of mineral water obtained from a well about 4 miles southeast of Hollister. The well, which is 286 feet deep, was drilled in about 1890. Water rose to a point 100 feet below the surface, from which depth it has to be pumped. The analysis made by M. E. Jaffa shows a large amount of the sulphate radicle, which gives the water definite medicinal effects. It is sold artificially carbonated.

Analysis of Water from San Benito Mineral Well.
Analyst, M. E. Jaffa.

	Parts per million
Sodium)	750
Potassium)	
Calcium	99
Magnesium	16
Iron	8.9
Sulphate radicle	736
Chloride	566
Carbonate	178
Silica, organic matter, chemically combined H_2O	188

Bibl.: U. S. G. S., W. S. Paper 338, p. 306; STATE MINING BUREAU, R. XIII, p. 319.

PETROLEUM.

Many wells have been drilled in search of oil in the southern part of the county, and along the southeastern portion, adjacent to the Coalinga field. Five wells driven by the Standard Oil Co. in and near the Topo Valley failed to give more than a trace of oil. The chances of finding paying quantities of oil in this region have been discussed by several writers, whose consensus of opinion is that geological conditions do not justify the assumption that an oil reservoir of any size can be there. The same observation applies to the southern portion of the San Benito Valley.

Conditions for the occurrence of oil in quantity in the country, from New Idria north to Little Panoche Creek are considered much more favorable. While investigation has led to the conclusion that the district as a whole does not promise to be an extension of the Coalinga field, certain areas seem to hold possibilities of production with proper development. One of these areas not yet thoroughly tested lies north of San Carlos Creek, near Twomey Creek; another lies just west of Silver Creek in the northwestern part of T. 17 S., R. 12 E. Good seepages of oil have been found in several places along the south side of the two forks of the Vallecitos, notably in Secs. 6, 8, 16, and 24, T. 17 S., R. 11 E. Test wells in this region have not thoroughly prospected the oil bearing strata.

The subject of petroleum in California has been freely discussed in recent years by geologists of the California State Mining Bureau and the United States Geological Survey. It is therefore not considered necessary to dwell at length on the subject in this paper, the reader being referred to the publications noted below for more detailed information.

Bibl.: Rep. XII, pp. 356, 493; Bull. 19, p. 148; Bull. 69; U. S. G. S. Bull. 431; Bull. 581 D; Bull. 603; Monograph 13.

QUICKSILVER.

San Benito County ranks among the oldest and most important quicksilver producing counties in California. It contains the New Idria mine, which stands second only to the New Almaden mine, both in length of continuous operations and in point of total production to date. In fact, since the decline of the latter mine from its former importance, the New Idria for some years past has been the largest single producer

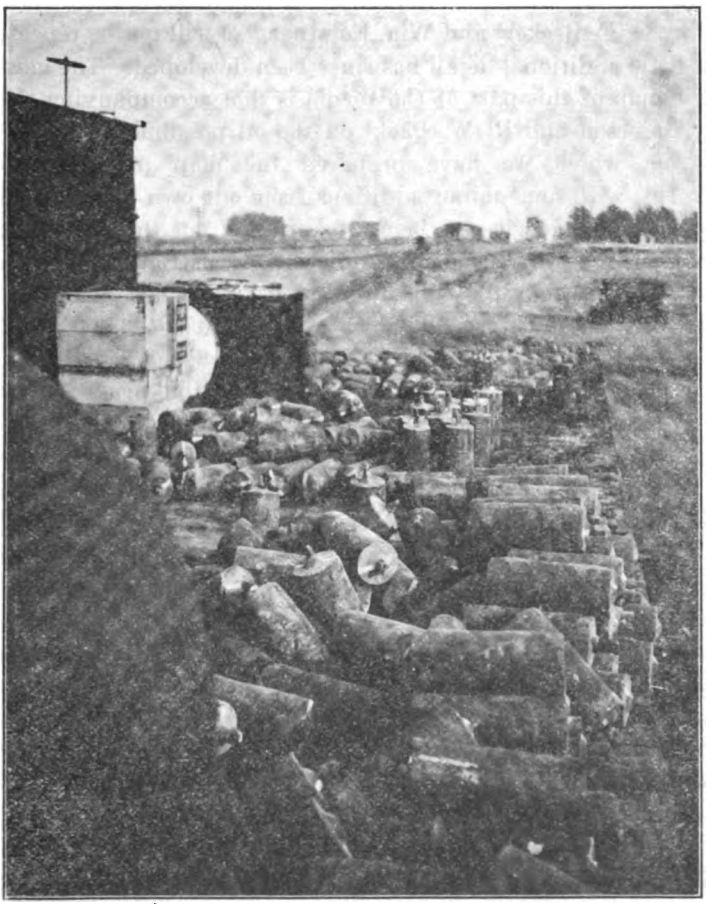


Photo No. 14. A shipment of 300 flasks of quicksilver from the New Idria Mine, San Benito County.

of quicksilver in the state. The total recorded yield of San Benito County to the end of 1915 has been 296,899 flasks, valued at $14,551,450.

There are three quicksilver districts in the county, all situated in the Diablo Range, which traverses the eastern part of the county in a northwest-southeast direction. The Stayton district is at the northern

end at the junction of San Benito, Santa Clara, and Merced counties. The New Idria district is in the southeast corner of San Benito County; and the third district, in which are the old Cerro Benito and Bradford mines, is situated between the other two. Only the New Idria district has been active recently, or has ever produced quicksilver to any notable extent, the others having been idle for many years.

The cinnabar ores of the Stayton district are characterized by associated stibnite. The general geology of this region, with particular reference to the quicksilver deposits, has been described in considerable detail by G. F. Becker[5] and Wm. Forstner,[6] so will not be repeated here, as but little additional detail has since been developed. The most recent geologic map of this part of California is that accompanying the report of R. Anderson and R. W. Pack[7] on the oil possibilities of the region, and from which we have prepared the map presented herewith (Plate II), with some minor additions from our own observations.

Considerable activity is being manifested at the present writing (March, 1916), throughout the quicksilver districts of the state, on account of the high price of this metal, resulting from the war in Europe. It has risen from a figure approximating $37.00 per flask, in July, 1914, to $300.00 per flask in February, 1916. Though the future is still uncertain—as long as the war lasts the price may go still higher, and it certainly will go down when peace is declared, if not before—yet, quicksilver will probably not again reach as low a value as in 1914 for some years to come. One item that would help to improve the domestic situation, is an increase in the tariff on imports. This would protect us against excessive shipments of Spanish and Austrian quicksilver, where labor especially is so much cheaper than in the western United States.

There have been practically no improvements in the metallurgy of quicksilver since Robert Scott in 1871 developed the fine-ore tile furnace, until the present attempts to apply concentration to some of our low-grade ores. These were briefly described by the writer,[8] as far as observed at certain mines in Napa and Colusa counties. An experimental plant is now in operation at the New Idria mine (*q. v.*) in this county. The State Mining Bureau is making a thorough investigation, including mill tests, to determine as far as possible the scope and value of concentration for quicksilver ores, both containing native mercury and cinnabar, including also the application of flotation to the recovery of slime cinnabar.

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[5]U. S. G. S., Monograph XIII, "Geology of the Quicksilver Deposits of the Pacific Slope," 1888.
[6]State Mining Bureau, Bull. 27, "Quicksilver Resources of California," 1903.
[7]U. S. G. S., Bull. 603, "Geology and Oil Resources of the West Border of the San Joaquin Valley," 1915.
[8]State Mining Bureau, "Mines and Mineral Resources of Colusa, etc.," by Walter W. Bradley, 1915, pp. 18, 55-56, 111-113, 118.

GEOLOGIC MAP OF
NEW IDRIA DISTRICT
SAN BENITO CO., CAL.

Scale of miles.

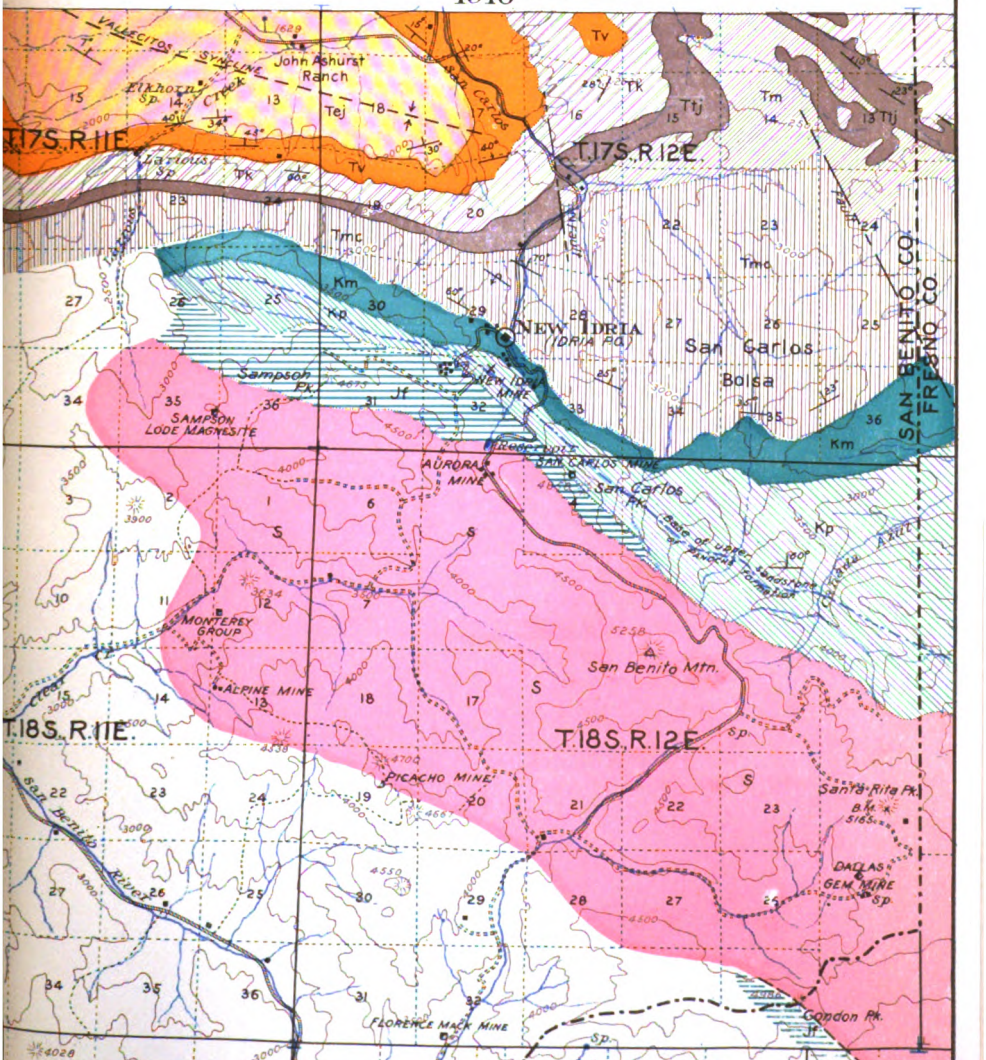
0 1 2 3 4 5 6

(After U.S.G.S. with additions by the authors.)

LEGEND

Tej	Etchegoin and Jacalitos	Tk	Kreyenhagen shale	Tm	Martinez (with Tmc Cantua sandstone)	Km	Moreno
Tv	Vaqueros	Ttj	Tejon			Kp	Panoche
Jf	Franciscan	S	Serpentine				

1916



Alpine Quicksilver Mining Co., formerly called the Esmeralda Quicksilver Mining Co., H. B. Leonard, San Benito, Cal., manager; D. McPhail, Hollister, Cal., secretary. The company owns 32 full claims in Secs. 13 and 14, T. 18 S., R. 11 E., 6 miles from Hernandez and 40 miles from Coalinga, the nearest railroad point.

These claims occupy the southwestern portion of the zone of highly metamorphosed, silicified serpentine which extends from the creek just east of Los Picachos Peak, to the old Clear Creek and Boston mines in Sec. 2, T. 18 S., R. 11 E. They have a total length of about 1½ miles along the strike of the outcrop zone and join the Monterey Group on the northeast. The original discovery was made by Silvester Tirado, who sold the early holdings to the present company about six years ago.

They have since made additional locations. The surface outcrop is ocherous and highly silicified, but as one descends into the mine the serpentine shows less and less alteration. A slip at the discovery point strikes S. 20° E., with a dip of 70° NE. Ore so far mined has been taken out in bunches along the locus of this slip for an inclined depth of 190 feet, along which the slickensided wall can be easily traced. The width of ore at the outcrop was about two feet. No surface work has been done to determine the extent of mineralization along the strike. The older work was caried on through a tunnel 150 feet long from which an inclined raise at an angle of about 45° followed the mineralized fault locus 100 feet to the upper tunnel, which was only a few feet long. Small stopes along the raise yielded some good ore which was treated in "D" retorts and pipe retorts, giving a nominal output. A small stope was also driven off the lower tunnel and a 15-foot drift from the raise between the levels, but the latter did not uncover ore. Later work has gone on through a new tunnel, which had been connected with the next level above by an inclined raise of 90 feet and which is 230 feet on the incline below the outcrop. At the time of our visit this had been driven 800 feet in an endeavor to cut the "vein" at depth, but was in serpentine the entire distance. This showed minor fractures filled with silica and calcite, but only small traces of cinnabar. Two crosscuts, driven 45 and 75 feet respectively, off this level, failed to show ore. Work had started on a stope four sets wide off the middle level (the old lower tunnel). This had entered a mineralized lens and had been carried 15 feet without having passed out of ore. The cinnabar made in a chalcedonic gangue varying in color from light to black, and also in the fractured serpentine with a gangue of silica and calcite, in narrow stringers. Hand specimens show bunches of grey and greenish chalcedony carrying cinnabar, associated with lumps of magnesite, through which tiny specks of cinnabar are sprinkled. Considerable native mercury in serpentine was also noted in this stope. This ore was of furnace grade, and in spots rich enough to retort. The writer also

observed a few tons of ore on the new dump, which could be handled in the furnace after drying.

The reduction plant formerly used, and still in order, consists of 8 "D" retorts and 2 pipe retorts, with 6 other pipe retorts which have been burnt by using too hot a fire. The new plant, which was being built when visited, in December, 1915, includes an improved Scott furnace of 20 tons capacity, and four brick condensers. The bricks were burned at a clay bed on the stream four miles from the mine, and heavy work was encountered in hauling them to the furnace site. This dis-

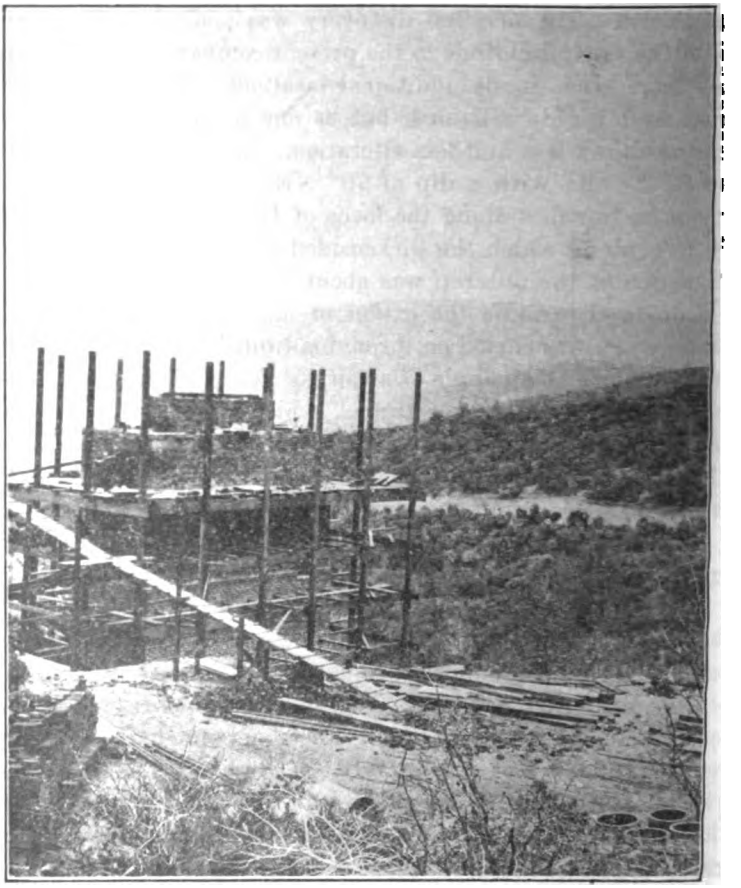


Photo No. 15. New 20-ton Scott furnace, Alpine Quicksilver Mine, San Benito County.

trict is handicapped by having roads which become nearly impassable after a rain, and mining development is bound to be retarded by the difficulty and cost of transportation. The furnace is located at an elevation of 3730 feet (barometric reading). The country is entirely serpentine, with the characteristic sparse growth of brush and only

scattered pine timber. The company will obtain its timber from its own land and pine wood for fuel will be cut near by, at a cost of $8.00 to $9.00 a cord, delivered.

Andy Johnson Mine. (See Flint Group.)

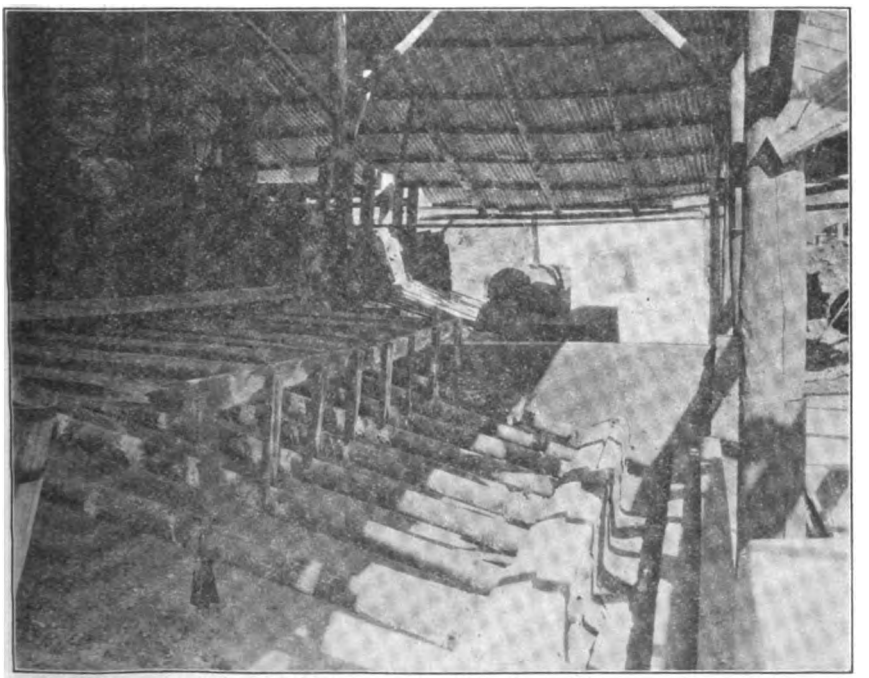


Photo No. 16. Condensing pipes of quicksilver retorts at the Alpine Mine, San Benito County.

Aurora Group (one time called **Morning Star**), and **Monterey Group,** owned by the Esmeralda Quicksilver Mining Co., Richard Phelan, president; R. W. Gilloghy, secretary; H. T. Hays, engineer; office, 942 Phelan Bldg., San Francisco, Cal. The Aurora Group consists of 38 claims, mainly in Sec. 12, but extending into Secs. 11, 13 and 14, T. 18 S., R. 11 E., 5 miles southeast of Idria, and just north of the Alpine mine. Both groups are within the serpentine area. Only a small amount of development work has been done on the Monterey, which it is stated will be equipped and worked in conjunction with the Aurora. In the latter the principal development is an adit, in between 300′ and 400′, and a raise connecting with the surface, where there are several open cuts. The cinnabar occurs in a vein-filling of chalcedonic silica dark green to white in color. The croppings have a course of S. 15° E. Though said to have been discovered in 1853, it has been worked only at irregular intervals. In 1911 a revolving furnace, similar to a cement

kiln (see Photo No. 17), was installed, but owing to mechanical difficulties it was operated only one day. The flue connections leading to the condensers can be seen at the upper end. In October, 1915, the furnace was repaired and refitted, and operated for a few weeks, until severe winter storms damaged the roads from Mendota, cutting off the supply of fuel oil. Operations will be resumed this spring (1916). The capacity is 50 tons per day. During these latest operations, ore was quarried from the outcrop.

Bibl.: Bull. 27, p. 131; MIN. RES. W. OF ROCKY MTS., 1874, p. 381; U. S. G. S. Mon. XIII, pp. 309, 466; Min. Res. 1914, Pt. I, p. 326.

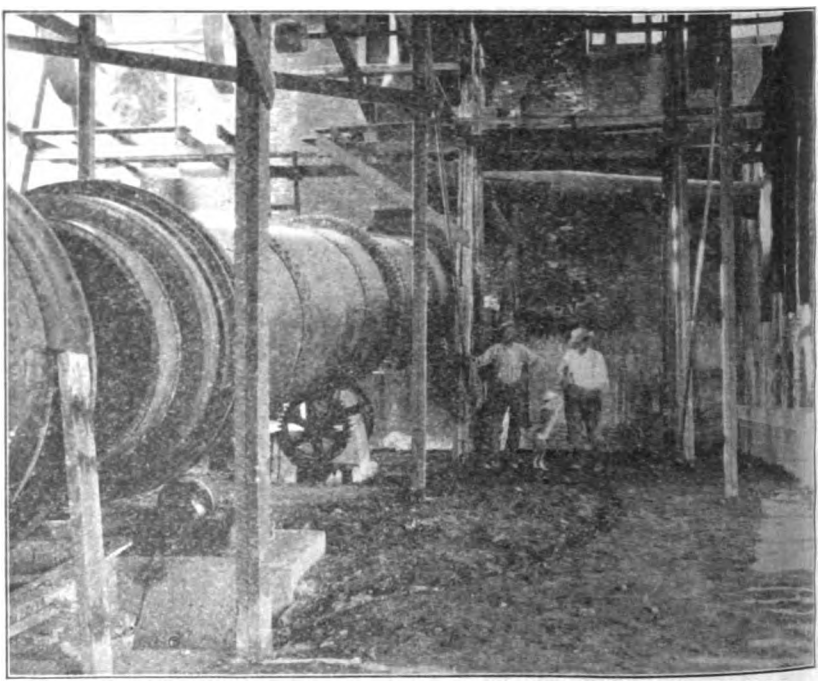


Photo No. 17. Rotary furnace, Aurora Quicksilver Mine, San Benito County.

Benta Group, situated in Secs. 20 and 29, T. 18 S., R. 12 E., were located in 1913 by M. G. Ramirez and S. Tirado, of Hernandez. There are two claims in the group, which joins the Ramirez or Los Picachos claims on the southwest. The claims are on the same series of highly siliceous croppings which show so prominently on the Ramirez property, but the serpentine appears less silicified. Only the annual assessment work consisting of 2 open cuts 10 feet each, has been done so far. A little cinnabar has been found, occurring in tiny veinlets with silica in the serpentine fractures. In Monterey National Forest, reached only by trail.

The **Bonanza Group** is another newly located quicksilver property. M. G. Ramirez and Ramon Tirado, of Hernandez, made locations here on two claims, naming them the Bonanza 1 and 2, in the winter of 1913. There is no variation in geology from the other properties near by, except that these claims are a little away from the line of croppings and exhibit a less highly silicified serpentine. They lie just southwest of the Benta claims, in Sec. 29, T. 18 S., R. 12 E., in the Monterey National Forest and are accessible only by trail, a distance of 2½ miles from the Florence Mack, or 5 miles southeast of the Alpine Mine. Prospecting work consisting of a 10-ft. tunnel has been done, but no cinnabar had been revealed at the time of the writer's visit.

Boston Mine. (See Flint Group.)

Bradford Mine, in Secs. 3, 4 and 9, T. 15 S., R. 8 E., has been idle for years. The property was fully described in the below noted report and there has been no work of any interest since that report was published.

Bibl.: Bull. 27, p. 131.

Butts Mine, Wm. Butts, Pine Rock, San Benito County, owner; Geo. Kline, Pine Rock, lessee. Located in Sec. 4, T. 16 S., R. 8 E., 21 miles south of Tres Pinos. The old workings of this mine, which have been abandoned for years, and which never yielded any mercury to speak of, were described by Forstner in Bull. 27. The new workings, which are now yielding some mercury, are located about ¼ mile north of the old mine. An open cut and tunnel totalling 75 feet, driven some time ago by Kline, in which it is reported that good ore was found, have caved in. A tunnel and open cut totalling 60 feet has been driven above this caved ground and about 20 feet below the outcrop. This has cut diagonally across a chert and sandstone breccia which carries ore for a width of about 18 inches. Cinnabar and metacinnabarite occur in the cementing material of the breccia with a calcite gangue. The work done is not sufficient to show conclusively that the deposit is in place and there is only one outcrop of the cinnabar-bearing breccia, but the strike of 35° northwest and dip of about 60° northeast (as closely as they can be measured in the shallow workings) agree with the general run of the country rocks and appear to confirm the supposition that the deposit is in place and not fragmental. The claim is at an elevation of about 2300 feet, with sandstone and shale country rock and metamorphics derived from these sediments.

Reduction is carried on in a "D" retort. Two men were employed during the summer. One man recently produced a flask of mercury in 19 days, working alone and carrying the ore on his back some distance to the retort.

Bibl.: Bull. 27, p. 133.

Cannon Mine, in Sec. 4, T. 15 S., R. 8 E., adjacent to the Bradford, and 18 miles from Tres Pinos, has been idle since the Bureau's last report.

Bibl.: Bull. 27, p. 133.

Cerro Benito Mine, owned by Thos. Flint, of Hollister, and situated in Sec. 31, T. 15 S., R. 10 E., 35 miles southeast of Tres Pinos, was one of the first mines opened in the county. A Knox and Osborn furnace was in operation here previous to 1874, and production up to 1876 is said to have been about 800 flasks. The mine showed little activity after that until about 1902, when some work rebuilding the furnace and reopening the tunnel was done; but no production since then has been reported. The geology of the property and the extent of the workings were so well covered in the first reference cited below, that there is no reason for covering these details in the present paper.

Bibl.: Bull. 27, p.134; MINERAL RESOURCES WEST OF ROCKY MTS., 1875, p. 14.

Clear Creek Mine. (See Flint Group.)

Don Juan and Don Miguel Mines in Sec. 36, T. 18 S., R. 11 E., and Sec. 31, T. 18 S., R. 12 E., have been dead for years and showed no sign of activity when field work for this report was done.

Bibl.: Bull. 27, p. 138.

Flint Group, owned by Thos. Flint, of Hollister, comprises the old mines known as the Andy Johnson, Boston, Fourth of July, and Clear Creek, and consists of 552 acres of patented land in Secs. 2, 11, 12 and 13, T. 18 S., R. 11 E., and Sec. 18, T. 18 S., R. 12 E. The Clear Creek, Boston, and Andy Johnson occupy the northwestern portion of the prominent zone of ocherous, silicified croppings which strike northwest from the Hernandez (Los Picachos) mine. They lie adjacent to Clear Creek, taking in the hills to an elevation of about 3700 feet (barometric reading) and 600 feet above the creek. The Andy Johnson claim adjoins the recently located Capitola on the southeast, where some very rich surface ore is being retorted. These properties have been idle so long that definite data concerning them is not obtainable. The Andy Johnson, according to Mr. Flint, was worked by an open cut and was noted for the amount of native mercury yielded, as much as a pint being taken at times from one spot. The Clear Creek mine was operated through a tunnel 600 feet long, from which underground operations on rather an extensive scale revealed good ore. All these workings caved in years ago. A furnace for reducing the ore was operated on the bank of Clear Creek, near the junction of the Alpine and New Idria roads, but this also has long since fallen to ruin, and definite information concerning the output of mercury from it is not to be had. The mines were closed in the early eighties when the price of quicksilver was so

ow as to practically prohibit mining. It is believed that considerable good ore remains in these properties. Most of the ground has not been thoroughly explored, and in view of the good showings of ore in other near by mines on the same series of outcroppings, it appears as though thorough prospecting would be justified on these holdings. The country is mantled by serpentine in deeply disintegrated and rounded knolls, carrying little vegetation except along the little watercourses. A fairly good road reaches the mines from Hernandez, 5 miles distant.

Bibl.: Bull. 27, pp. 131, 137, 138.

Florence Mack Mine. C. P. and Florence Smith, of Hernandez, and S. and D. D. Hogue, of Hanford, locators; G. W. Warner and S. M. Suffron, Paso Robles, lessees. The holdings consist of 6 full claims, with a total length of 6000 feet, in Sec. 32, T. 18 S., R. 12 E., on Saw Mill Creek, 7 miles from Hernandez and 30 miles from Coalinga, about one mile from the main highway joining Hollister and the latter town.

The development of the property was done largely by a Mr. Courtney, of Hanford, who prospected the property under bond in 1904 and the following years. The mineralized zone strikes northwest and dips 40° to 45° SW. The tunnels and crosscuts show a stratum of black clay shale or "mudrock" about two feet wide, carrying cinnabar values near the footwall, which is a fine-grained indurated sandstone or shale. This belt is cut by numerous pyrite stringers, carrying considerable cinnabar. There are three tunnels on each side of the creek, but the work was done mostly on the left or northwest side.

The lower and chief tunnel on this side enters the hill almost east and west. Near the portal the first crosscut north about 40 feet shows no ore. About 50 feet from the portal this tunnel branches, the chief working running 20° west of north. A crosscut 125 feet long east and west shows stringers of small size, striking north and south and carrying cinnabar. One hundred feet from the portal a crosscut 45 feet long was driven to follow a highly pyritized zone one foot wide striking northwest. Pyrite stringers about 2″ wide, nearly solid, occur here, giving out, however, at a length of 6′ to 8′. They carry good quantities of cinnabar. Fair ore in the vein was struck in this tunnel at a distance of 154 feet, and was followed to a shaft, 50 feet farther. This shaft and the tunnel, at a distance of 50 feet beyond the shaft, were inaccessible and efflorescences on the tunnel sides obscured observation. The present lessee was unable to give the length driven in the tunnel or the depth of shaft.

The second tunnel runs N. 20° E., 100 feet. It shows mudrock, 2 feet wide, carrying cinnabar near the footwall. A crosscut 20 feet southwest follows FeS_2 stringers 1″ wide carrying cinnabar. The main crosscut runs 120 feet NW.-SE. and at its end is a small hole cut down on the

vein; a 20′ branch crosscut connects with the raise from the lower tunnel, 60 feet below.

The upper tunnel is 40 feet above the second and 50 yards west. It is a crosscut tunnel, exposing at the breast the same 2′ stratum of black clay shale, but no cinnabar is in evidence.

There is a large tonnage of low-grade ore on the dump at this mine, which has been lying for some time and should prove susceptible to concentration. A considerable portion of it would make furnace ore. The lessees plan to concentrate it in sluices. The sedimentary country rocks and the nature of the vein filling distinguish the mine from those 2 miles or more north. It is completely outside the serpentine belt. The

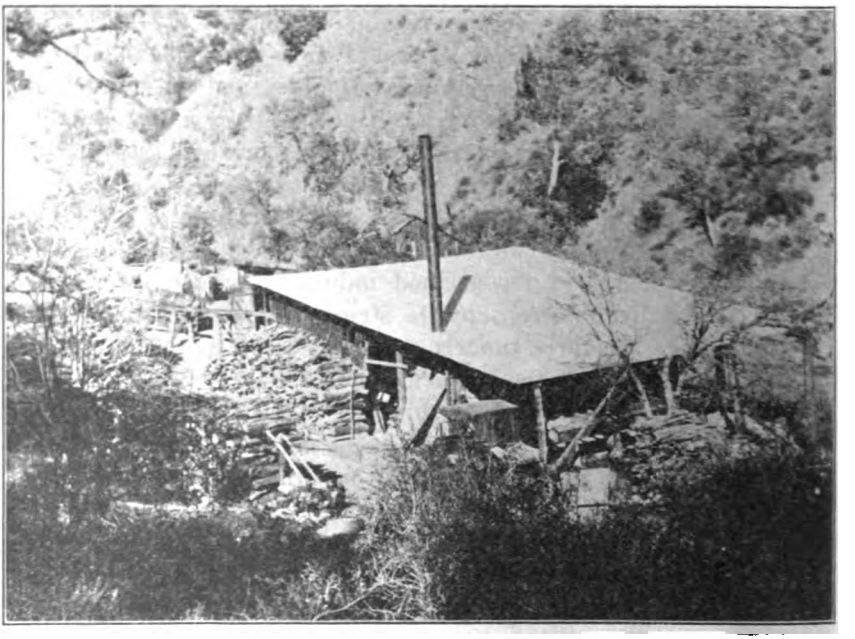


Photo No. 18. Retort plant, Florence Mack Quicksilver Mine, San Benito County.

old tunnels south of the creek were short and appear to have been driven too high. The vein crosses the creek and has been exposed on the southeast side by a short tunnel driven by the present lessees; one of the old tunnels, driven in 1906 scarcely 10 feet above and to the left of the new opening, failed completely to uncover ore.

A force of 7 men was employed in December, 1915. A 12-pipe retort plant, with a daily capacity of 250 lbs. of ore per pipe, had just been completed and the first charges of ore were being treated when the writer visited the mine. It was observed that no water had been provided to cool the exit pipes, and the fire seemed to be too hot for good recovery. The ore is highly pyritiferous and so requires great care to

avoid roasting it too hot. The lessees were inclined to believe that arsenopyrite was responsible for their failure to recover much mercury; but an examination of some of the ore in the laboratory of the State Mining Bureau failed to reveal any arsenic sulphide. While the ore uncovered at that time was scarcely high-grade enough to retort profitably without concentration, the operators would probably get better results if they had a supply of water to cool the condensing pipes, and used a slower fire.

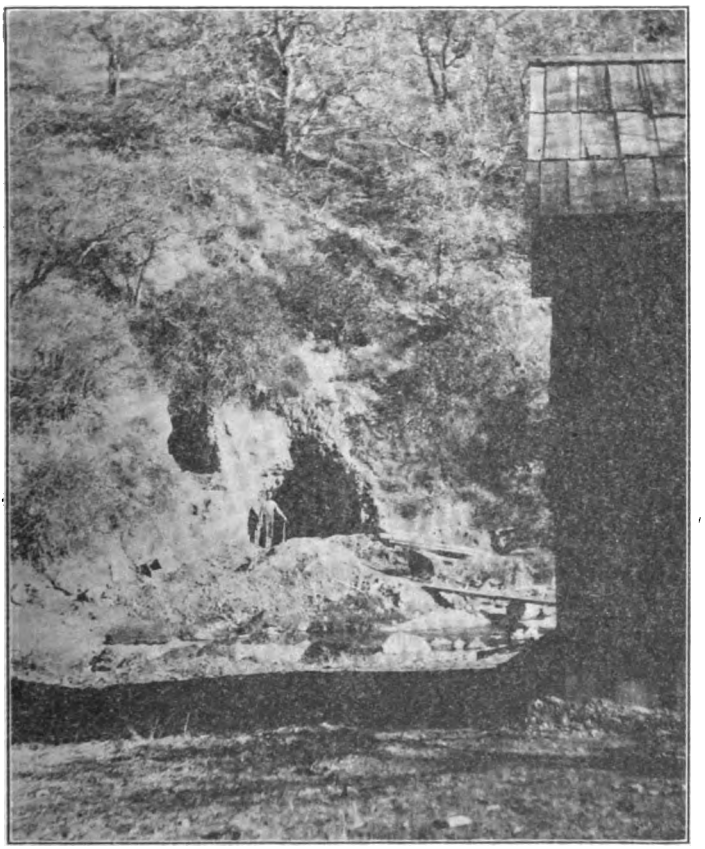


Photo No. 19. Old and new prospect tunnels, Florence Mack Quicksilver Mine. The old (upper) tunnel was a few feet too high and failed to uncover the vein; the lower tunnel showed a fair prospect of cinnabar.

Fourth of July Mine. (See Flint Group.)

French Ranch, H. French, Hollister, owner, now embraces the old properties formerly known as the **Santa Cruz** and **Mariposa Mines,** in Secs. 20, 21, 28 and 29, T. 11 S., R. 7 E. Some surface indications of cinnabar here caused prospecting in the seventies, but a little work revealed the fact that the cinnabar did not persist, and stibnite was

found to be the principal mineral. For further mention of the district, see the discussion on Antimony in this report.

Bibl.: Rep. XII, p. 365; Bull. 27, p. 147.

Hernandez Quicksilver Mining Co., known also as **Los Picachos**, or the **Ramirez Consolidated**; M. G. Ramirez, San Juan Bautista, manager; Silvester Tirado, Hernandez, superintendent. Six patented claims form the group. They lie in Secs. 19 and 20, T. 18 S., R. 12 E., and are accessible only by trail, being 5 miles from the Alpine and 2 miles north of the Florence Mack. The elevation of the new furnace is about 4780 feet (aneroid). Through this property, striking northwest and extending to the northern end of the Flint Group, 5 miles distant, is a wide and prominent mineralized zone, revealed on the surface by deeply altered, bold, siliceous outcroppings, stained a rusty color by the iron present. The softer parts of this rock have been weathered out, leaving a metamorphic composed principally now of silica, showing in different places a great number of phases—chalcedony, quartz, flint, and agate. At the Hernandez this zone of croppings is nearly ½ mile wide, ending abruptly about 1500 feet southeast of the furnace.

The mine was opened in the days of the old quicksilver boom by a tunnel driven northward from the southern slope a distance of 3000 feet, designed to cut the ore exposed in the outcrop at depth. As far as can be learned, this work never led to any appreciable production. In later years operations have been confined to the exploration of the outcrop near the surface in the southeastern part of the holdings, although there are other prospects of cinnabar in the mile of outcrops embraced in the claims, which would seem to warrant prospecting. The present company has been in possession since 1904, but work has been desultory and actual progress in development almost negligible. For about four years past, a small yearly production of metal has been made in a bench of four pipe retorts. The ore has come from the southern and eastern sides of the outcrop near the surface. Inclined shafts, one of 160 feet and two of 50 feet each, have been driven, besides which some rich ore has been taken from the face of the outcrop. The bluffs at the furnace face southwest and stand up about 100 feet above the furnace, showing cinnabar in many places. The ore being treated at the time of the writer's visit came partly from an incline about 45 feet deep. This had been sunk on a lens of ore which had a thickness of about 3 feet, a width of 40 feet and had been worked out 50 feet along the strike. The shoot struck N. 35° W., with a dip 50° to 60° NE., and appeared to be about 100 feet long on the strike, judging by the shape of the portion mined. In this lens cinnabar had been deposited in various ways. It occurs with stringers of pyrite, apparently occupying minor fissures; it is also seen as a coating in fracture planes. The most characteristic occurrence, however, is where a layer of cinnabar about

$\frac{1}{8}$" thick, in association with pyrite, had been deposited from solution on the main fissure wall; superimposed on this and indicating a second period of deposition was a layer of silica crystals of equal thickness. The ore from this lens had yielded as high as 150 pounds of mercury per ton.

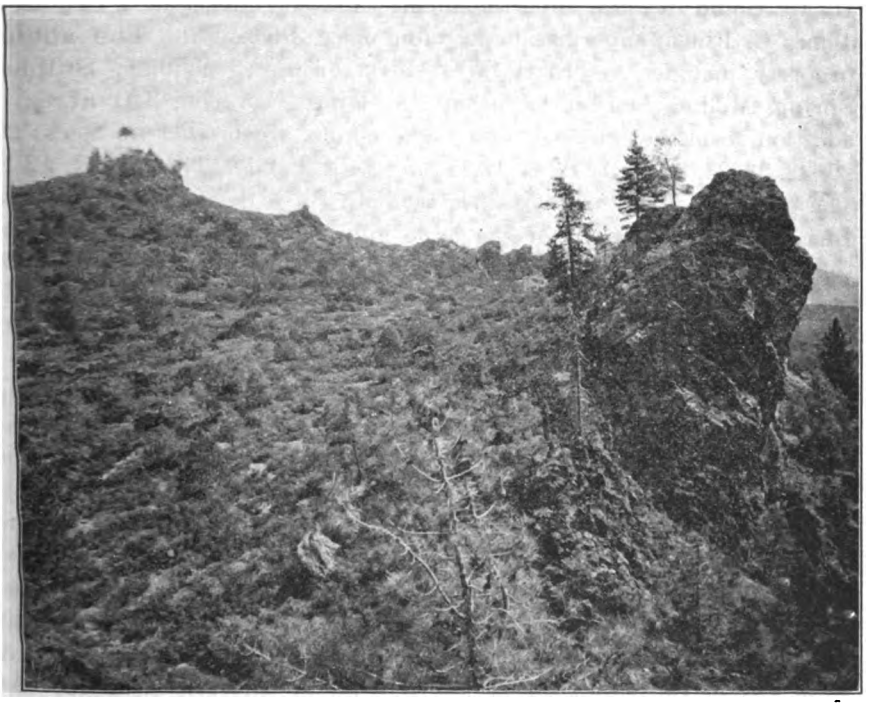


Photo No. 20. Characteristic outcrops; Los Picachos Peak, Hernandez Quicksilver Mine, San Benito County, California.

A fine-ore furnace of 4 tons capacity with 2 brick condensers had just been finished but had not yet been tested. It was expected to burn about as much fuel as a bench of 12 pipe retorts, with much greater capacity. The district north and east is sparsely timbered and watered, being mantled by serpentine, but there is a fair growth of timber to the south, outside the serpentine belt. Dry wood for fuel costs $3.00 to $4.00 per cord. In the summer 5 men are employed.

Bibl.: Bull. 27, p. 145; GEOL. SURV. OF CAL. (Whitney), Geol. Vol. II, p. 121.

Lone Star Mine, Geo. Wapple, Hollister, owner; Judge M. T. Dooling and M. Forcade, Tres Pinos, lessees. Located in the Rancho Real de las Aguilas, 18 miles southeast of Tres Pinos, near Los Muertos Creek. A tunnel said to be 800 feet long has been driven. Rock purporting to come from this mine showed a little cinnabar in altered

and iron stained serpentine, but no ore in any amount was reported. There was no reduction equipment. The country rocks are highly altered and silicified sedimentaries.

New Idria Quicksilver Mining Co., W. B. Buckminster, vice president and general manager; home office, 141 Milk St., Boston, Mass.; H. W. Gould, general superintendent, Crocker Bldg., San Francisco; James G. Finch, superintendent; mine office, Idria, Cal. The mining property includes the Idria, West Idria group (3 claims), Sulphur Spring, Molino, San Carlos group (6 claims), covering 240 acres in addition to other patented land. The claims are located in Secs. 28, 29, 32, 33, 34, 35, T. 17 S., R. 12 E., and Secs. 3 and 4, T. 18 S., R. 12 E. The elevation at the office is 2500 feet (U. S. G. S.) and 4000 feet at Idria Peak, the summit of the mine hill (see Photo No. 21). More than 95% of San Benito County's recorded production of 296,899 flasks of quicksilver from 1858 to 1915 (inc.) came from the New Idria property. The mine has been in continuous operation since 1850. The present company has been in possession since April, 1895.

There are two main ore areas (so to speak), the New Idria group and the San Carlos group, the latter of which lies over 2 miles to the southeastward of the former. The principal output to date has come from the New Idria, though at the present writing (March, 1916), ore is also being drawn from the San Carlos mine through the "Molino Tunnel" and trammed around the hill to the Idria furnaces. The portal of the Molino tunnel is about midway between the two main groups. This adit was driven southeasterly about 4000 feet in length and cut the ore body some distance below the old San Carlos workings. A raise was driven, and connections were completed early in 1915. At several places in the Molino adit near cinnabar-bearing veins, pyrite in small crystals was encountered, stated to assay $1.40 per ton in gold. The ore occurs in the Franciscan metamorphic shale and sandstone, near the contact of the large serpentine area.

An idea of the size and shape of the main New Idria ore-body, or rather "ore-zone," may be gained from the outline shown on Plate III, which was traced from the mine map by courtesy of the superintendent, Mr. Finch. On account of the very large number of adits, crosscuts, drifts, levels and intermediate levels, no attempt was made to reproduce them, which would only have complicated the drawing. For similar reasons, the outline of the ore zone was taken at three separated levels, only: the 2d, 5th and 10th. This shows a roughly elliptical shape in the upper levels, narrowing, lengthening eastward, and curving toward a crescent shape in the lower levels. The No. 7 level (not shown) has a distinctly crescent outline. This zone has a general dip to the southeast

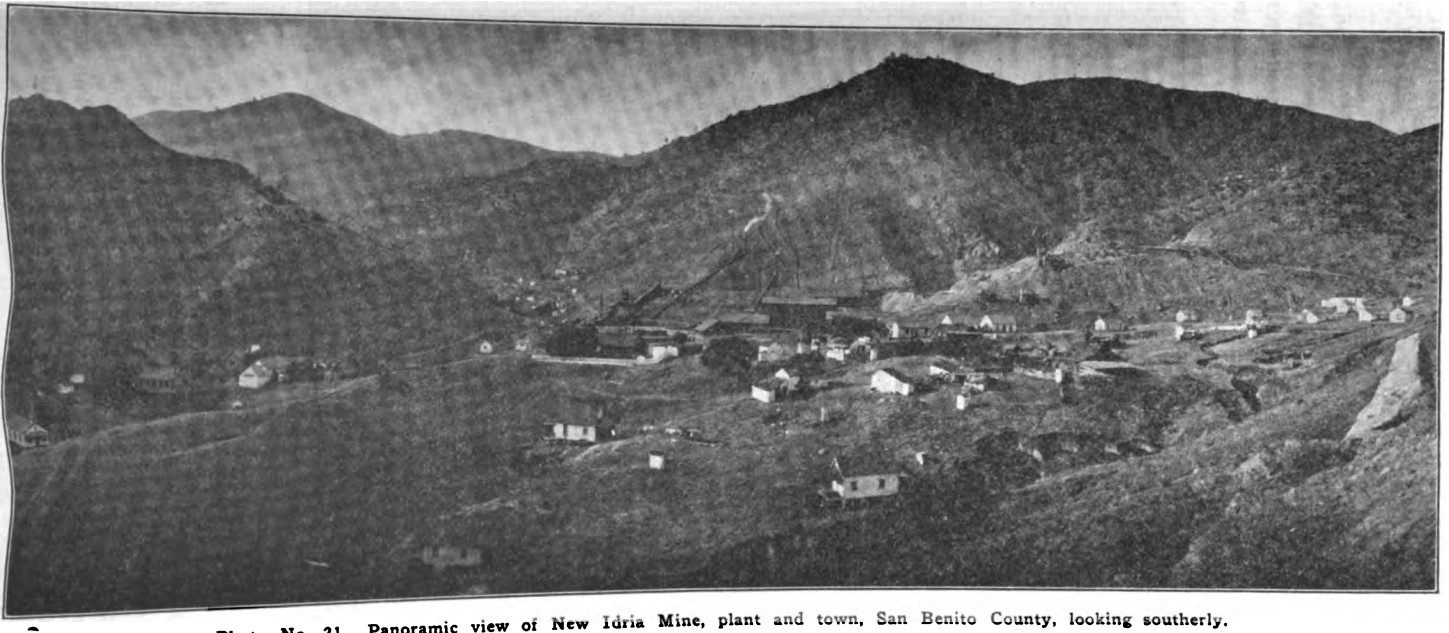


Photo No. 21. Panoramic view of New Idria Mine, plant and town, San Benito County, looking southerly.

of about 60° to 65°. It varies up to 235 feet wide between walls and 800 feet long on the No. 5 level, and averages about 120 feet wide, with a length of nearly 1200 feet on the No. 10 level.

The term "ore zone" is deemed by the writer a better designation in this case than "ore-body," because all of the rock within the outlines noted is not ore. The ore occurrences are not altogether regular. There are various veins, cross-veins, stock-works and impregnations.

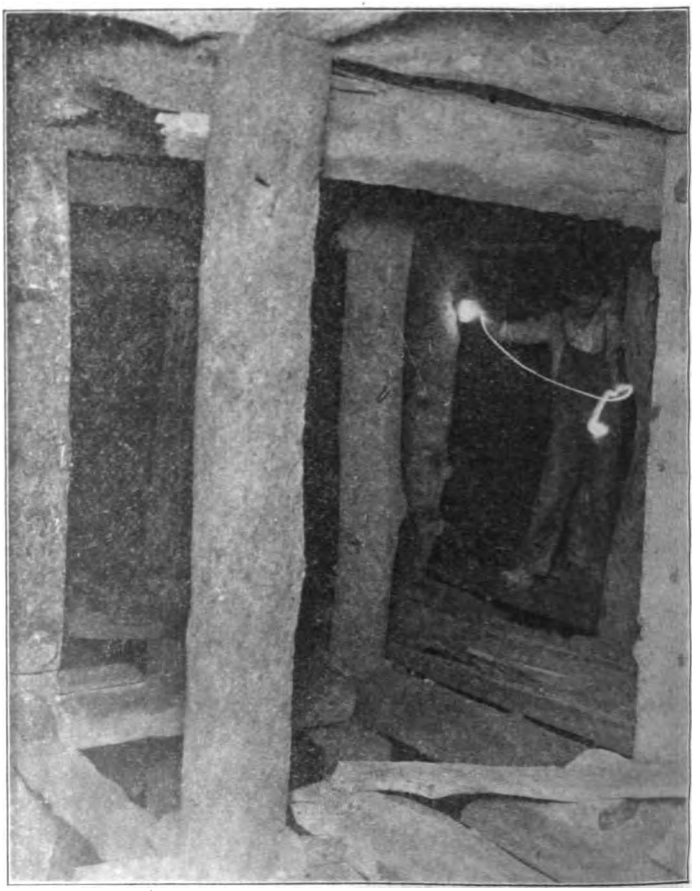


Photo No. 22. Flashlight view in square set stope (30' wide) between No. 2 and No. 2½ levels, New Idria Mine.

The main ore-body within the area is stock-works in slate and shale, and in places an impregnated sandstone, somewhat harder than the others. As will be noted from the map (Plate II), the mine is in the Franciscan metamorphic sandstones and shales and some distance from the contact of the large serpentine area already mentioned. The hanging wall is marked by a black clay "alta," outside of which is slate, then sandstone

PLATE III

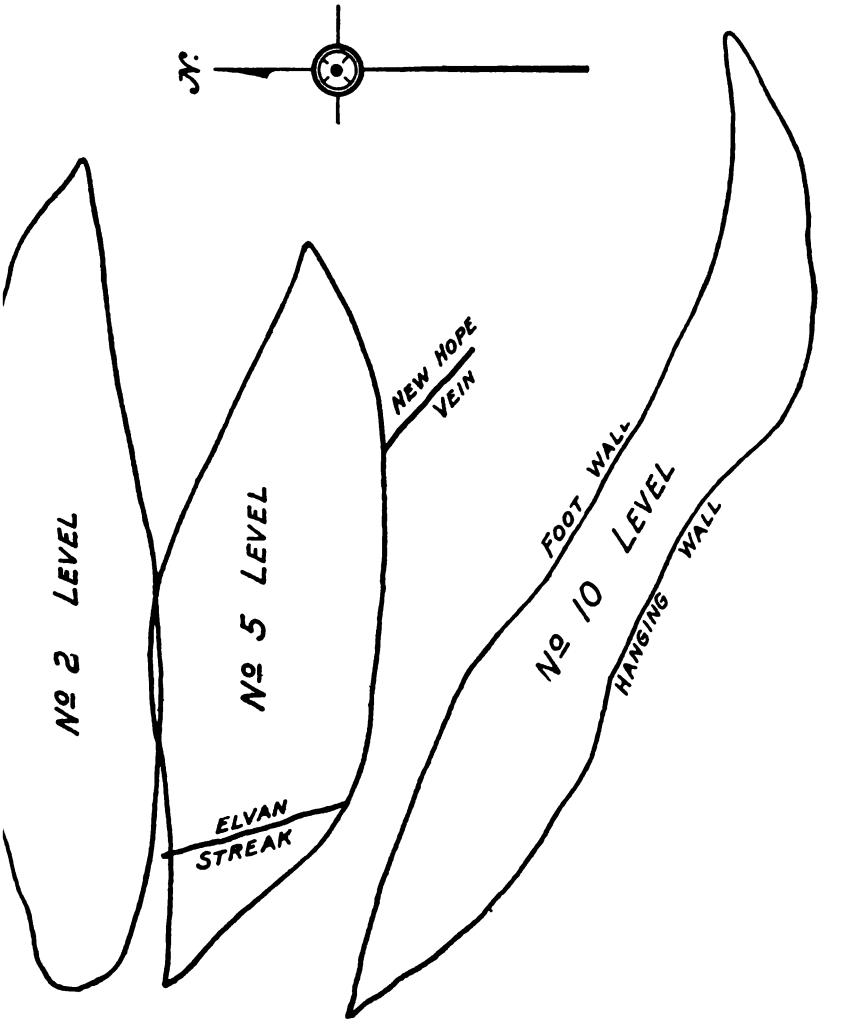
OUTLINE OF ORE BODY

NEW IDRIA QUICKSILVER MINE

SAN BENITO CO. CAL.

Scale :- 1 inch = 200 feet.

(Traced from the mine map, Sep't 1914.)



and finally serpentine beyond. The footwall is not as distinctly defined as the hanging, the value frequently not showing a sharp stopping off line.

The mine workings are complicated and numerous, due to the irregularity of the ore shoots. Considerable timbering is required, especially in the larger stopes, where the square set system is employed (see Photo No. 22). The stope shown is 5 sets (6 feet each) wide, or 30 feet. Others are up to 50 feet square. The two more important ore shoots developed are at opposite ends of the zone. The "Bodie shoot" is at the east end, the other being known as the West End shoot and has been an important producer, especially below the No. 5 level. There are two other veins, known as the Elvan Streak and the New Hope, which are quite distinct from the main ore-body. The former cuts across the main zone, while the latter cuts across the hanging wall to the ore-body but stops at the "alta." At the time of Becker's visit (1884)* development had not yet proceeded to the point that these relations were as evident as they now are. The Elvan streak is described as a "clean-cut fissure, filled with decomposed attrition products which are impregnated with cinnabar." This gouge material is misnamed "talc" by the miners. At one point associated with this vein was a considerable amount of metacinnabarite, which it is stated, amounted to several tons. The New Hope vein was distinctly of metacinnabarite, in the upper levels, where it was very rich; but it has not been worked in the lower levels. In the main zone pyrite, though not abundant, is associated with the cinnabar, and the gangue minerals are quartz, calcite and gypsum. From the north end of the New Idria to the south end of the San Carlos, the ore-bearing area has been proven for a length of 2½ miles.

As already stated, the mine workings are rather complex, if one attempts to consider them in detail. Development is mainly by adits, with connections by raises and winzes. There are ten main levels, No. 1 to No. 10, and a number of intermediates. The No. 10 tunnel, which is the main haulage way for delivery of ore to the furnaces, is 3175 feet in length to the vein, at which point it is 1060 feet vertically below the outcrop. There is a total of 15 to 20 miles of underground development in the company's property, including 5000′ in the San Carlos, 5000′ in the Molino, 600′ in the Creek tunnel and over 3 miles of open working tunnels (crosscuts) in the New Idria. The system of mining in use is that of overhand stoping, and timbering with square sets. Pneumatic stopers and drills are employed; and a certain amount of hand-sorting is done within the mine. Material from some of the former waste dumps is also being sent to the furnaces. On the No. 9 level there is a grizzly 22′ long of ½″ bar iron on edge, spaced ½″ apart at the top and 1¼″ at

*U. S. G. S., Mon. XIII, p. 305.

the bottom. At that point there are two chutes, one for fine ore and the other for coarse, leading to No. 10 level, where the cars are loaded and hauled in trains by mules to the furnaces. There is a winze from No. 2 level to No. 9, in which a gasoline hoist operates a skip for tools and timber down to the No. 7. A 25-h.p. distillate engine furnishes the power.

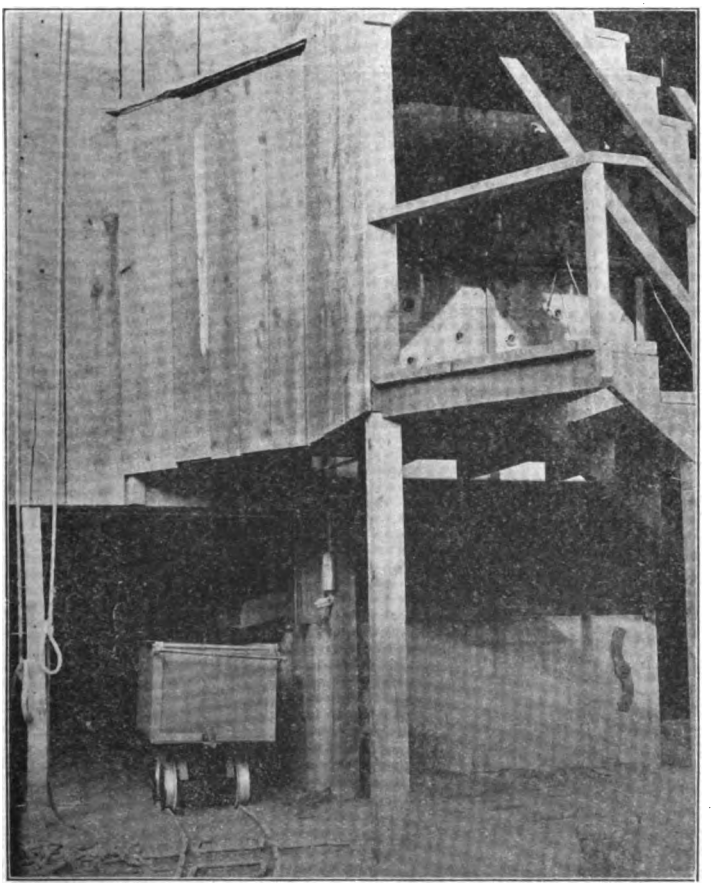


Photo No. 23. No. 4 furnace (small) at New Idria Quicksilver Mine. A 1-tile, fine-ore furnance for treating soot.

Power for driving the compressors, dynamo for lights and furnace blowers, is obtained from San Carlos Creek for about six months of the year. The reservoir is above a series of falls, near the Aurora mine, and gives a head of 975 feet. A General Electric generator 4-45-975, driven by a 27-inch Pelton wheel furnishes current for lights and blowers. The main compressor is driven by a 30-inch Pelton-Doble water-wheel. When the water is short this compressor is driven by a 60-h.p. distillate engine, and there is a 40-h.p. distillate engine for a

smaller, auxiliary compressor. At the 1914 prices distillate cost 12c.-13c. per gallon at the mine. At the portal of No. 2 level there is a steam-driven sawmill of 2000 b.m. ft. daily capacity; also, a timber framer run by a 9-h.p. distillate engine. The latter consumes 53 gallons of distillate per month. There is also a saw especially set for cutting wedges. Round timbers are used—both pine and cedar. Some timber is cut on land owned by the company, and some also cut eleven miles

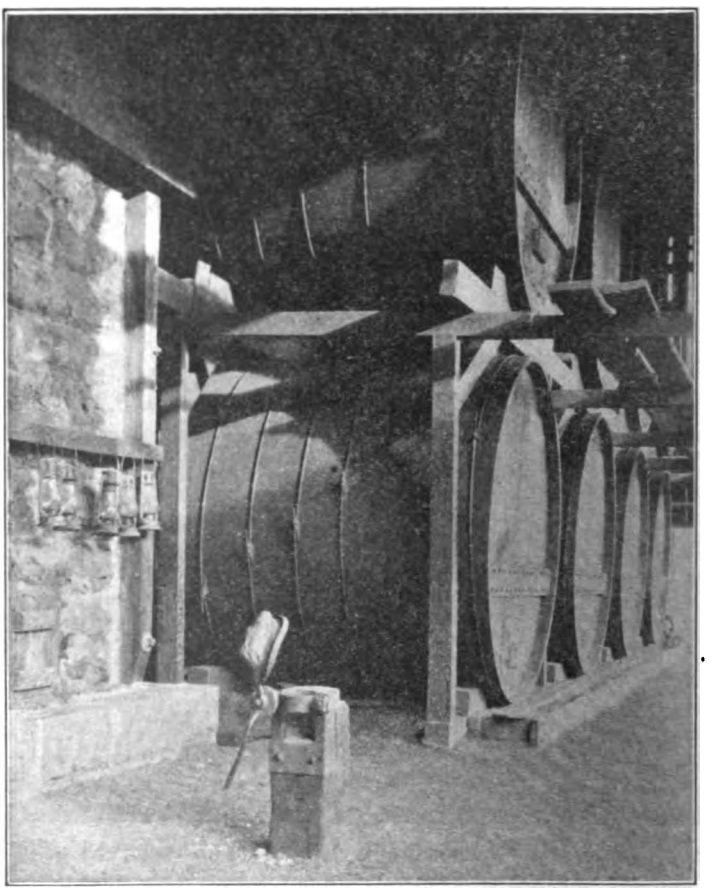


Photo No. 24. Barrel condensers, New Idria Mine.

to the south of Idria, within the Monterey National Forest, under contract with the United States Forest Service. The blacksmith shop at this level is equipped with a Waugh drill sharpener. The No. 2 adit is the main entry to the mine for timbers and other supplies, from which they are distributed to the levels below by means of the winze and hoist previously mentioned.

The reduction equipment of the New Idria company includes two

Idria coarse-ore furnaces of 88 tons daily capacity each, a 60-ton Scott fine-ore furnace and a smaller Scott furnace of 9 tons capacity. In the panoramic view (Photo No. 21), the coarse-ore furnaces are in the large building in the center against the hill, the fine-ore furnace being to the left, from the stack of which the streak of white smoke is seen. The New Idria coarse-ore furnace is of a design developed by Mr. B. M. Newcomb, for many years general superintendent of the property, and is described by Forstner,[10] with drawings accompanying. The fine-ore furnaces are of the Scott pattern. The smaller one is worthy of special mention here. It was made the subject of a brief footnote in a recent report by the writer.[11] This furnace (see Photo No. 23), is one tile (3′) long and 25 tiles high (28′ 1½″), with a 3″ spacing between the tiles instead of 6″, as in the larger Scott furnaces. Also, the tiles are set on a 50° slope instead of a 45°. The furnace has a capacity of 9 tons and was built to treat furnace soot instead of retorting it, as is done at most quicksilver mines. The soot is first washed with water in a series of boxes, with compartments, which discharge to each succeeding one alternately at top and bottom. This frees much of the enclosed quicksilver. The soot is then dried on a large iron pan, with inclined bottom, and steam-heated. With each one ton of dried soot are mixed 8 tons of fine ore, and the mixture fed to No. 4 furnace. The condensers near the furnaces are of stone, the others being of wood in barrel form (see Photo No. 24). The flues and stacks are also of wood-stave construction (see Photo No. 25). The furnaces are fired by crude oil; but in starting up a cold furnace, wood is first used before turning on the oil, until the fuel box is heated enough to keep the oil vapor afire. This lessens the danger of back-firing, or the flame going out temporarily and filling the furnace with gas, which would explode on the oil being relighted. On the basis of approximately 75c. per barrel at Mendota, crude oil for fuel costs $2.75 to $3.00 per barrel at the mine.

Since the writer's visit to New Idria, we are informed that in December, 1915, two New Standard concentrating tables had been installed between the grizzlies and the No. 1 (fine-ore) furnace. The fine ore, after passing through the grizzly, is fed onto a shaking screen of 8-mesh, the coarser material going direct to the Scott furnace and the through product to the concentrators. In two 8-hour shifts, these two machines were (December, 1915), handling a total of 36 tons of ore, and making 4½ tons of a concentrate carrying approximately 6%-7% mercury, from an original ore of about 0.5% mercury. By thus eliminating the very fine material from the ore, which has a tendency to interfere with the furnace draught and to hold back the volatilization of the quicksilver, the capacity of the Scott furnace has been raised to about 75 tons daily.

[10]Bull. 27, p. 213.
[11]"Mines and Mineral Resources of Colusa, Glenn, etc.," p. 56.

On account of the large percentage of fines coming from the mine, some of this ore was being added to the coarse-ore furnace charge. Naturally this interfered in a more marked degree with the capacities of the two coarse-ore furnaces than the extreme fines did with the Scott. The elimination of practically 32 tons daily of the extreme fines by concentration has thus relieved the No. 2 and No. 3 furnaces of fine ore, giving them, also, freer action and increased capacity. The concentrates after drying are charged with ore to the Scott furnace.

The following summary of operations during the year 1914, compared with the figures for 1913 and 1912, is taken from a published[12] extract from the annual report of the New Idria company for that year:

	1914	1913	1912
Development, feet	12,367	9,182	11,0[illegible]
Ore treated, tons	62,578	76,993	78,5[illegible]
Quicksilver recovered, flasks	6,550	9,700	9,6[illegible]
Average price per flask	$41		
Total revenue	$295,361	$363,054	$377,48[illegible]
Operating expenses	340,371	298,041	303,72[illegible]
Loss	45,010	*65,013	*73,76[illegible]
Dividends	10,000	40,000	120,0[illegible]
Previous surplus	144,600	119,587	165,82[illegible]
Surplus carried forward	89,590	144,600	119,58[illegible]

*Profit.

"Storms involved the expenditure of about $20,000 in repairing the property and roads, and extraordinary development and lower grade ore all contributed to the decreased earnings. The known ore-bodies have been nearly depleted above No. 7 level. Development was principally done on No. 9 and No. 10 levels, which produce most of the ore. The Molino adit, to develop the San Carlos deposits" was completed and the raise started to connect them.

In 1914, up to July, 400 men were employed, when the number was curtailed and one of the coarse-ore furnaces shut down; so that in September when the writer visited the property, there were 171 in the mine and 53 on top and around the furnaces—a total of 224 men on the payroll. Since then, however, due to the rise in the price of quicksilver, more are being employed, and all of the furnaces are operating.

Bibl.: Rep. I, p. 26; IV, pp. 336, 339; VIII, pp. 483–485; X, p. 515; XI, p. 373; XII, p. 365; XIII, p. 599; Bull. 27, pp. 9, 22, 125–129, 138–145, 213, 214, 234, 241, 245; Bull. 67, pp. 33, 35; M. & M. Res. Colusa, Glenn, etc., p. 56. U. S. G. S., Mon. XIII, pp. 64, 189, 215, 291–308, 465; Min. Res. 1882 to 1914. Min. Res. W. of Rocky Mts. (Raymond), 1868, p. 264; 1869, p. 10; 1870, p. 759; 1871, pp. 58, 528; 1872, p. 523; 1873, p. 497; 1874, pp. 28, 37; 1875, p. 13. Geol. Surv. of Cal. (Whitney), Geol. Vol. I. pp. 57–60; Vol. II, pp. 113–120. Trans. A. I. M. E., Vol. XXXIII p. 484.

Niesen Group, Jno. Niesen, Hernandez, owner. Two claims, the **Tiger** and Buck, in Sec. 31, T. 18 S., R. 12 E., and Sec. 36, T. 18 S., **R. 11 E.**, make up the property, which lies on the headwaters of the San **Benito** River, 5 miles from Hernandez and about 30 miles from Coalinga. **The** country rocks are the sedimentary formations, sandstones and **shales,** lying south of the serpentine area and are probably of Cretaceous **age.** They have been somewhat indurated by folding. The tunnel on

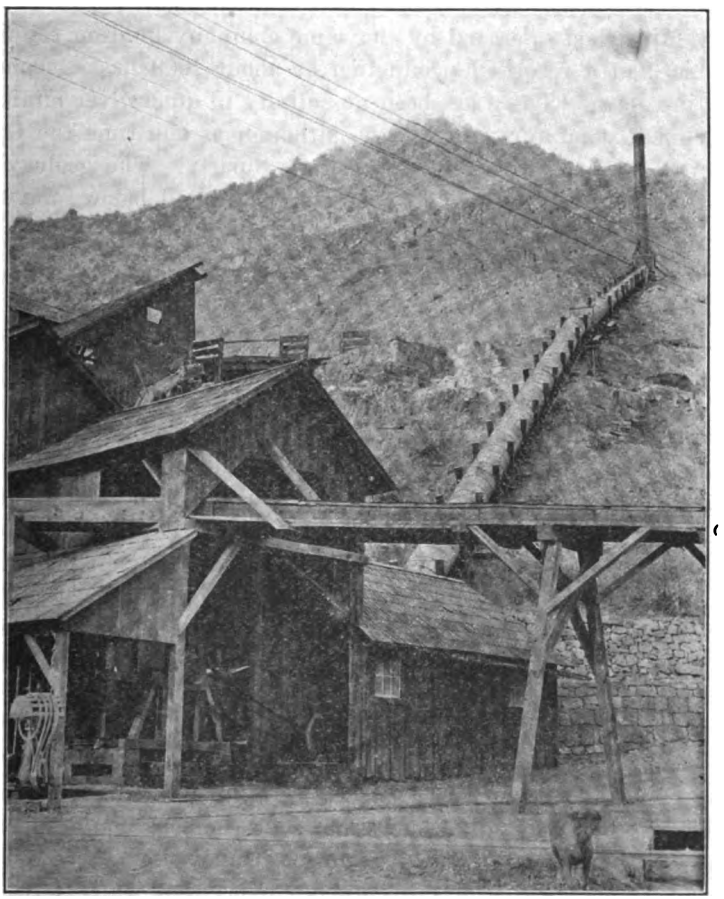


Photo No. 25. Blower and stack from fine-ore furnace, New Idria Quicksilver Mine.

the Tiger claim, which is the only development so far done, was driven 100 feet northeast and 75 feet east and is entirely in an indurated black clay shale, which shows abundant efflorescences of epsomite and some ferrous sulphate. A 2″ streak of gouge at the end of the drift carried a minute trace of cinnabar, and the writer noted one or two specks of cinnabar in rock brought out from the breast of the tunnel. There was

no other evidence of mineralization; no contact had been cut and surface indications were not such as to encourage exploration.

Stayton Mines lie in the extreme northeast corner of the county and partly in Merced County. They were worked considerably between 1870 and 1880 and are credited with some production from ore treated in a retort. The cinnabar disappeared at depth and the district lay idle until interest in antimony induced renewed prospecting and several claims were located on stibnite prospects here. (See Antimony.)

Gypsy Mine, last operated by the same company holding the Stayton claims, had a recorded production of about 1000 flasks, from ore handled in retorts. There has been no activity in quicksilver mining in the Stayton district for many years, although at one time the Gypsy was regarded as an extremely promising property. The geology and development are well covered in the references cited below, and there has been no work on the property since the last report.

Bibl.: Bull. 27, p. 147; Rep. VIII, p. 485; Rep. X, p. 515.

Tirado Group, Jose Tirado, Hernandez, owner. There are two claims, the Capitola and San Domingo, in Sec. 18, T. 18 S., R. 12 E., 2½ miles by trail northeast of the Alpine furnace. The locations were made late in 1914, as the result of discovery of some very rich float ore by Silvester Tirado. The claims follow the strike of the mineralized zone mentioned in describing other mines of the district. The Andy Johnson corners the San Domingo on the southwest and the Monterey claims nearly surround the Tirado claims, which cover ground overlooked for years by miners who have appropriated nearly all the mineral ground in the district. At only one spot has a cropping of rock apparently in place, and carrying cinnabar, been found. This is on a steep hillside near the southeast end of the San Domingo. The loose serpentine has been deeply eroded by a tributary of Clear Creek and it is in this stream that ore has been found.

The locator and two employees were busy at the time of my visit, cracking boulders, in which rich pockets of cinnabar were often found. These boulders undoubtedly came from some immense outcrop of the cinnabar bearing zone which had once stood above the surface of the serpentine, as do the tips of Los Picachos today, but which have been so eroded and mantled by the loose sliding serpentine as to be hidden now except for the one spot mentioned. The rock here is in part a siliceous breccia which appears to have been cemented by silica deposited from solution which apparently also bore cinnabar, or was followed by deposition of cinnabar in the cavities of the rock mass. The cinnabar is found at times in cavities as drusy coatings or in nearly solid masses 6″ or 8″ thick. Elsewhere the boulders resemble the croppings at Los Picachos. It would seem as if a rather rich ore shoot had been broken

up here by the creek branch, which has carved a deep cañon across the strike of the outcrop zone, and concentrated the high-grade ore in its stream bed.

Several tons of this ore were ready for burning in the 6-pipe retort which had just been completed, and work was going on to expose, if possible, some good showing of ore in place.

Wonder Mine, Manuel Gonzales, Idria, owner. This mine is about 2 miles west of Idria, at an elevation of 4000 feet (barometric reading), and was opened up in 1910. The cinnabar occurs in a soft, partly serpentinized sandstone, in part as an impregnation and also as seams 1″ to 1½″ in width. Some pyrite accompanies the ore. The strike of the vein is east of south. There are two adits, both being drifts, and on nearly the same level, one being in 250 feet, reaching a depth of about 100 feet below the outcrop. There are also 2 or 3 short crosscuts and some small overhand stopes. Wheelbarrows are used to carry the ore to the retort, which is of six 10-inch pipes set in rather crude walls of mud-plastered rubble masonry. Each pipe treats 100 lbs. of ore daily. Slightly over a half-cord of wood is burned per day. The wood is scrub oak and manzanita, cut close to the mine, and costs $1.50 to $2.00 per cord. There were four men at work, two being underground, one at the retort and one cutting wood.

STONE INDUSTRY.

Crushed rock and gravel are at present the only materials of this class handled in the county. Gravel is used only locally, but the rock-crushing plant operated at Logan supplies a wide market, both north and south.

Berberich Gravel Pit, owned by C. F. Berberich, of Hollister, comprises an area of six acres at the northern edge of the town. Wells have been drilled into this deposit, which showed a depth of 110 feet in gravel and indicate a practically inexhaustible supply. The material consists of clean gravel and sand, with very few cobbles over 3″ size, and with a soil overburden of only 1′ or 2′. The material sells for 50c. per yard at the pit. It has been used in paving the streets of Hollister and in a good many buildings in the town. Mr. Berberich has owned the deposit about six years and has displaced his competitors, whose pits are not so well located.

The County of San Benito operates a small pit a short distance south of Hollister, where material for road work is obtained. The gravel is not as clean nor as uniform in size as at the Berberich pit. A small crusher operated by a gasoline engine is used to crush the coarser cobbles.

Granite Rock Co., W. R. Porter, San Francisco, president; A. R. Wilson, Watsonville, vice president and manager. The plant is located at Logan on the Southern Pacific Railroad, near the Santa Cruz county line. The location of the plant and quarry is very favorable for cheap working and transportation. The granite forms the wall of the Pajaro River Cañon at this place and rises about 400 feet from the railroad tracks. The company owns 550 acres in all, about 100 acres of which can be worked.

A face of granite has been opened approximately half a mile long, but work at the time of the writer's visit was being carried on along a face of about 500 feet. The bench on which the steam shovels work is 150 feet vertically above the main line tracks. From this working level, the face rises 230 feet. An overburden of Monterey sand, shale and conglomerate increasing from 3 feet to 50 feet at the southeast, lies on the weathered granite. To dispose of this, a hydraulic plant is operated. Water is pumped under 200 lbs. pressure in a 5-inch pipe line from the Pajaro River to the summit of the hill, one-third of a mile. From here the sediment is hydraulicked off, running southeast down the dip of the granite dome to an impounding dam at the foot of the slope. At times lenses of tightly cemented conglomerate are found which have to be blasted. With the detritus removed, the face is attacked near the base with a heavy Ingersoll drill. A round of 3 or 4 holes, 22′ deep and 16′ to 18′ apart, is put in. One such round driven last summer was loaded with 17 boxes of dynamite. The mass of rock broken (and caved from the top as the result of shooting out the bottom) kept a steam shovel busy two months.

The crushing and classifying plant consists of two units. The smaller of these, which is the old plant, has a maximum daily capacity of 1200 tons. The new plant handles 2000 tons a day.

Marion steam shovels load the broken rock (which in the case of large blocks is blasted a second time) on cars hauled by dinkey engines. The course of the rock is essentially as described below for the new plant; in the old plant, gyratory crushers instead of rolls do the last stage of crushing. From the cars the rock up to 18-inch size passes over a 32-foot grizzly. The fines through this grizzly consist largely of dirt and rotten, weathered rock, but a trommel recovers some good rock. The waste passes to a bin of two carloads capacity. From here it can be sent by two "kickers" over a belt conveyor to an elevator, which lifts it to the quarry level, where it is hauled off to a dump, or it can be run down to a bunker above the railroad tracks. The company gives this rock away to any one paying the freight.

The merchantable rock goes over the grizzly to a No. 8 gyratory crusher; from this, 2″ rock and smaller is classified in a 22′ trommel and goes to elevators, thence over belt conveyors to the various bins, and

the coarse rock, 3″ to 4″ in size, passes to a No. 5 gyratory crusher. The oversize from this crusher is fed to a set of 54″ x 24″ Superior Rolls which crush to 2″ size. All the undersize from the No. 5 crusher and the product of the rolls is elevated to two large trommels which classify the different sizes ranging from dust to 2″. The graded product is fed directly to 4 of the bins and over belt conveyors to the other 8. The bunkers dump directly into the railroad cars below. Two motor car drags are used to handle loaded cars and fast time can be made in loading.

A crew of 48 men is employed. Seven work on the loading crew, five at the large, and four at the small crusher plant, with six on the steam shovels. Only one machine drill is required. The two steam shovels burn about 500 gallons of crude oil daily. The crusher plants are operated entirely by electricity, and 800 h.p. per day are consumed. In the large plant eleven motors are used. The No. 8 crusher uses 150 h.p.; the rolls are operated by a 100-h.p. motor, and another of same size runs the No. 5 crusher, an elevator, and a trommel. The tailings elevator requires 50 h.p. Equipment at the smaller plant includes one No. 7½ gyratory crusher, two No. 3 McCully, one No. 5, and one No. 3 Gates crushers, and 15′ x 4′ trommels, with necessary conveying and elevating equipment. There are 6 storage bins at this unit.

Besides two No. 50 Marion steam shovels, quarry equipment includes 3 "dinkey" locomotives and 40 cars. During the year the quarry is in actual operation about 10 months. Production annually exceeds 300,000 tons.

The rock is a well-weathered basic granite. Bunches of highly acid and highly basic constituents are present, apparently the result of magmatic separation. The crest of the dome appears to have been passed, but there is an immense reserve of rock to the northeast, and under the present workings the granite can be broken down to near the track level, 140 feet below. The rock is in demand for highway construction and is also used a great deal for ballasting railway road beds. The fact that the plant is the only one of any size for a long distance north or south and is in a position to deliver rock on the cars at a very low cost, makes the market for its product a wide one.

SAN LUIS OBISPO COUNTY.

By C. A. Logan, Field Assistant.
Field Work in November, 1915.

HISTORY and TOPOGRAPHY.

In September, 1772, the Mission of San Luis Obispo de Tolosa was established by the Catholic Fathers on the site of the county seat, and the village which grew up about it took the same name, which was also bestowed on the county when it was established as one of the original twenty-seven, shortly after the state joined the Union. While known principally as a cattle-raising and farming district, the county has also yielded a fair tribute to the miner's enterprise.

Bounded by Monterey County on the north, Kern on the east, Santa Barbara on the south and the Pacific Ocean on the west, the county comprises alternate mountain chains and narrow valleys which strike northwest and blend together at the southeast, as would the sections of an open fan. In the southwestern part of the county lies the valley of the Santa Maria River and the smaller troughs which flank the San Luis Range. These mountains meet the Pacific at Point Buchon and form the southern coast line. The higher peaks of the chain are in the northwest and are hardly 1900 feet in elevation. North and east lie the fertile valleys of Los Osos and San Luis, which are separated by a scarcely perceptible divide. Los Osos Valley in its northwestern part lies submerged in Morro Bay and the free sweep given to moist winds and fogs over these valleys helps farming greatly by lessening the need for irrigation.

Extending through these valleys from San Luis Obispo to Morro Bay is an independent line of volcanic cones, the most northwesterly of which, called Morro Rock, stands 600 feet out of the ocean at the entrance to Morro Bay. To the northeast lies the Sierra Santa Lucia, the principal range of mountains in the county and the divide between those waters which enter the Pacific directly on the one side, and the Salinas River on the other. Beyond the Santa Lucia lie the San Jose Valley and the Salinas River Basin, which are bounded by the San Jose Range. East and southeast of this minor chain are the valley of the San Juan River and the peculiar fault valley known as Carrizo Plain, which has an elevation of about 1500 feet and has no outlet, all its scanty run-off gathering near the center in Soda Lake. Finally, forming roughly the county's eastern boundary, are a few peaks of the Temblor Range, including McKittrick Summit, which is 4323 feet high, and Midway Peak, with an elevation of 3651 feet.

Year	Bituminous rock		Brick		Miscellaneous and unapportioned	
	Tons	Value	M	Value	Number and kind	Value
1876[2]					[6]100 tons copper	$7,287
1877						
1878						
1879						
1880						
1881						
1882						
1883						
1884						
1885						
1886						
1887	36,000	$180,000				
1888	43,000	215,000				
1889						
1890						
1891						
1892						
1893						
1894	9,432	32,263			[1]220 tons asphaltum (rock)	4,400
					500 cu. ft. Cal. onyx (arag.)	20,000
1895	6,354	17,600	750	$3,75	400 cu. ft. Cal. onyx (arag.)	4,000
1896	5,113	11,464				
1897	2,291	5,117			238 cu. ft. Cal. onyx (arag.)	1,000
1898	4,788	18,927	830	5,28		
1899	10,818	40,288	650	3,50	16 tons asphaltum (rock)	320
1900	3,346	12,905	500	4,00		
1901	9,472	33,070	650	5,20	2,000 tons asphaltum (rock)	30,000
1902	1,790	2,327	900	7,65	4,000 tons asphaltum (rock)	40,000
1903	3,365	7,572	750	6,00	100 barrels lime	100
1904						
1905	2,533	6,348	400	3,20		
1906	2,533	6,644	300	2,40		
1907	2,167	8,128	2,000	16,00	6,000 tons asphaltum (rock)	90,000
					300 barrels lime	600
1908	5,077	21,875	1,440	12,90		
1909	2,731	6,369	2,245	19,60	4,500 tons asphaltum (rock)	55,000
1910	1,982	4,016	900	8,00	13,000 tons asphaltum (rock)	165,000
1911	2,710	5,230	2,000	18,00		
1912	807	1,472				
1913	609	1,149	1,750	17,50		
1914	579	1,118				
1915	[5]					
Totals	157,497	$638,882	16,065	$132,98		$417,707

[6]Copper was weighed in tons of 2,360 pounds

[1]The total production of asphaltum up to 1

[2]Although a great deal of chrome iron ore w figure for 1880 represents the total ship-
ments from San Luis Obispo up to August, 188

[3]There are no records of annual mineral pro placers before this, and these placers have
no doubt yielded considerable gold never repo '70's.

[4]Concentrates. [5]Included with other minerals

TRANSPORTATION.

The Southern Pacific Railway traverses the county from north to south, crossing the Sierra Santa Lucia through Cuesta Pass, and going nearly south through San Luis Obispo, and thence to the coast near Pismo, giving rail connection with San Francisco and Los Angeles.

From San Luis Obispo the Pacific Coast Railroad (narrowgauge) has a line to Port San Luis on deep water, and another which serves the district lying between the county seat and Santa Maria.

The rest of the county not adjacent to the railroads relies on auto stages for mail and passenger service. Two such lines operate daily over easy grades from San Luis Obispo to Morro, Cayucos, Cambria and San Simeon. Pozo and the La Panza country are reached through Santa Margarita by triweekly trips. The eastern plains region communicates with the railroad at McKittrick. Freight service is given to the upper coast towns by the steamers of the Pacific Coast Steamship Company.

GEOLOGY.

The geology of that portion of the county from the southern boundary to latitude 35° 30′ N. and from the coast to longitude 120° 30′ W. has been covered in Folio 101 of the United States Geological Survey. For the geology of the oil districts in the county, the reader should consult Bulletin No. 69, recently issued by the California State Mining Bureau. Space does not permit of any lengthy discussion of the subject here, but in the description of the various mineral deposits some brief geological notes will be found. Features of greatest interest are the thermal sulphur springs and wells, the bituminous sandstones and the deposits of chromite and quicksilver.

MINERAL RESOURCES.

Gold production began before 1850 and copper was mined in small quantity in the early '60s. Antimony and manganese occur, but have so far yielded no ore in commercial quantities. Chromic iron or chromite has been mined along the entire length of the Sierra Santa Lucia, and quicksilver's chief ore, cinnabar, is reported over an equally wide range, though developed chiefly in the northwest. In the south and southwest, bituminous rock and asphaltum have been worked a good deal, and some heavy oils developed. Here, also, as well as around Paso Robles, are many thermal sulphur springs and wells. Granophyres, sandstone, volcanic ash and California onyx have been used for building purposes, but granite, although plentiful, is so far unutilized. Bricks have been made in considerable quantity. There are also found in the county deposits of diatomaceous earth, pumice, gypsum, limestone and some asbestos of uncertain quality, on which little or no

development work has been done. A small annual output of mineral water has been reported for several years.

No segregated figures for annual mineral production previous to 1880 are obtainable, and therefore the figures given in the table must not be taken as representing the total value of the mineral yield. All available records have been examined and only dependable figures are quoted.

ANTIMONY.

Marquat Estate, owner. Mrs. Bena Marquat, administratrix, San Luis Obispo, California. This prospect is described in the Tenth Annual Report of the State Mineralogist, page 579. It is located in the SW. ¼ of SW. ¼ of Sec. 2, T. 27 S., R. 9 E., 15 miles from San Simeon by road. While the writer of the above-mentioned report speaks of a ledge 8′ wide, the present owners of the land know nothing of such a large body. At the place where the prospecting has recently been done, there is a fissure zone about 3′ wide in tightly cemented Franciscan sandstone. The vein material is quartzitic with occasional seams of soft selvage, and the ore, which is stibnite, makes in a width of about 1′ next to the footwall, the rest of the vein at outcrop being barren as far as uncovered. A tunnel about 40′ long has been driven, but not so as to expose the vein. A shaft sunk on the vein to a depth of 18′ was full of water when visited. It is reported, however, that a foot of good ore was exposed when work stopped. Strike of vein NE., dip N. 70° W. An analysis of low-grade ore taken at random from the surface croppings shows 18.3% antimony. One shipment of ore was made many years ago to San Francisco.

ASPHALT.

Natural asphalt was formerly used a good deal in this state for paving and San Luis Obispo County was a considerable producer of it. Of late years, however, the natural product has been displaced by the material yielded in crude oil distillation, as the latter is more uniform in quality and more cheaply obtained.

As formerly worked, the asphalt was scooped up from the ground at the places where earth faults or folding had broken the strata and permitted seepage. Usually the material was mixed with dirt and had to be refined by melting the mass into vats and drawing off the hot liquid asphalt. The principal deposits were on Tar Spring Creek, 9 miles east of Arroyo Grande, and in the bituminous rock area near Edna. There has been no output of natural asphalt from either locality for many years.

Bibl.: State Mining Bureau Reports VII, p. 97; XII, p. 30; U. S. G. S. XXII Annual Report, Part I, p. 412; Mineral Resources 1883–4.

The California Liquid Asphalt Company, with offices at Santa Barbara, have a refinery at Hadley where "Atlas Brand" asphalt (as well as distillate, gasoline and kerosene) is produced. The capacity of the plant, which was erected in 1909, is 13,000 barrels of crude oil and it can turn out 1000 tons of asphalt per month. It is now idle (Dec., 1915), and has been so for several months. The product has a wide market, being sold extensively outside of the United States, especially in Canada and Germany, but the war has greatly curtailed sales, causing the cancellation of important contracts. The crude oil has formerly been obtained from the Santa Maria field but it is probable that when operations are resumed the product of the wells now operated by the Spokane-Parkfield Oil Company, about two and a half miles south of the refinery, will be utilized.

The oil is heated 16 to 18 hours to produce light road material and 24 hours to give heavy asphalt. The temperature ranges from 250° to 450° F.

The Ensign-Baker Refining Co. of Los Angeles also have a refinery at Hadley adjacent to that described above. The capacity of this plant is also 1000 tons of asphalt per month, with distillate produced as well. The plant was established in 1910 and was not in operation at the time the writer visited it. The oil used was brought in from the Santa Maria field. As the subject of oil refining comes more appropriately under the head of manufacturing than mining, the reader is referred to the literature noted below for such further details as may be desired, concerning processes and products.

Bibl.: California State Mining Bureau Bulletin No. 69. Western Engineering, Vol. 2, p. 223, and Vol. 3, p. 47 (1913). California Derrick, Vol. 6, January and February, 1914.

BITUMINOUS SANDSTONE.

Sands of the Pismo and Santa Margarita formations which have been saturated with and cemented together by natural asphalt, are of widespread occurrence in San Luis Obispo County. The asphalt comes from the underlying Monterey shales and when it seeps up into the overlying sand it changes the latter into a tough weather-resisting stratum.

The deposits have been most extensively developed near Edna, a station on the Southern Pacific about 6 miles south of San Luis Obispo. Other quarries have been opened along and near San Luis Bay; near the town of Arroyo Grande, and on Tar Spring Creek, 9 miles east of Arroyo Grande, where natural asphalt was also refined years ago.

For many years previous to the introduction of oil asphalt for paving, a large tonnage of bituminous sandstones was annually utilized for street work. At the present time, however, the refined product has almost completely displaced the natural sandstone and all the quarries which were worked in San Luis Obispo County, with one exception, have been idle for several years. There are ample reasons for this. Asphalt is cheaply obtained, is much more uniform in quality, and is in such concentrated form that it can be shipped considerable distances at a much less cost than the bulky bituminous rock. This last consideration of transportation costs has narrowed the possible market for bituminous sands to such a degree that it can only compete successfully with asphalt within a few miles of the quarries. Recently, too, a considerable setback has been given the industry by the tendency of the larger cities not to recognize bituminous rock in paving specifications.

Below are given a few analyses of bituminous sandstones found in San Luis Obispo County and also some others for purposes of comparison. To be most acceptable for paving, the natural asphalt, which acts as a binder in the bituminous rock, should be adhesive and not too hard; there should be from 10% to 18% of asphalt and the sand should be well distributed in screen size from dust (200 mesh) to 10 mesh or ¼", without an excess of either fine or coarse material. Few deposits, of course, can fill these specifications, though there have been some experiments carried on to modify the composition of the natural mixture by adding bitumen of certain quality or sand of a desired size. Among the analyses below, it will be noted that the material from the Bassett No. 7 Quarry, is a very nearly ideal natural sheet asphalt, requiring possibly a little added dust. That from the Jordan Ranch Quarry is almost a "Topeka Mix" and has been used very successfully.

Location	Per cent asphalt	Per cent screen sizes of sand—meshes per inch						
		Dust	80-200	50-80	30-50	20-30	10-20	Over 10, under ¼-inch
(Edna) Bassett No. 7	13.1	6.42	21.0	25.0	23.92	6.00	1.00	3.5
(Edna) Jordan Ranch	11.0	5.28	3.64	9.08	18.00	11.48	12.28	29.31
Carpinteria	19.3	1.68	14.28	48.78	15.48	.41	------	------
Kasmalia	40.0	49.0	*	*	*	*	*	*
Ideal mixture	10.5	13.0	26.0	28.5	19.0	5.0	3.0	------

*Total other sand, eleven per cent.

The Consolidated Bituminous Rock Company, Nevada Bank Building, San Francisco, owns a large tract of land about one mile southwest of Edna, and has probably 40 acres containing workable

deposits of the bituminous sandstone. The formation makes prominent cliff-like walls on both sides of the narrow valley, and extends for some miles in a broad belt running nearly east and west. Several quarries have been worked in the material but now all except one are closed. This furnishes a good grade of material, without too much coarse gravel, and is very cheaply mined because of the nearness to the railroad, the small amount of overburden, and the very advantageous contract which the owners have with the local people who do the work. As it is the only such quarry operating in the county and is worked on a very small margin of profit, it would probably be unfair to publish any figures of production or costs.

The high walls permit open cut mining. Holes 9′ to 20′ deep are bored with augers and churn drills and a face 6′ to 8′ wide is broken at a round. Black powder is preferred for blasting because of its springing and heaving action on the mass, which is especially tough and hard to shatter when warmed by the sun. The large blocks resulting from the first blast are reduced either by hand or by more blasting to sizes small enough for one man to handle the rock. It is hauled to the cars in this state unless the order calls for sacked material, which has to be broken finer. Three men and six horses are employed at irregular intervals to fill such orders as are received.

The City Street Improvement Company, with office at 166 Geary St., San Francisco, owns a tract of land adjacent to the holding of the Consolidated Bituminous Rock Company, and have used a large tonnage of the material in the past for street work, but their quarries have been idle for years. There are croppings of the rock over an area of about 20 acres and the grade of material is generally good.

There are several other quarries of the bituminous sandstone which have been described in previous reports, but as none of these have been active recently, the reader should refer to the literature noted below for any details desired.

Bibl.: State Mining Bureau Reports VII; VIII, p. 533; X, p. 571; XII, p. 29; XIII, p. 37. California Journal of Technology, Aug., 1913. U. S. G. S. Folio 101.

BRICK.

Clay of good quality for brickmaking is found at many places in the county and several small plants for the manufacture of hand-made brick were formerly operated, but all of these are now out of existence.

San Luis Brick Company, A. F. Fitzgerald, president, San Luis Obispo, California, operates the only plant now in the county. It is located one mile below the Southern Pacific depot near lines of both

the Southern Pacific and Pacific Coast Railroads. The clay is light colored and just enough sand to make a good quality of common brick and has little or no overburden. Mining is done with two-horse scrapers which deliver to cars operated by a steam winch. From the cars the clay passes to a 9′ "American" clay worker, from which it passes to a Bonnet elevator, where it is screened, the fines going to the home-made pugmill, thence to the "American" machine presser and cutter, and the coarse returning to the clay worker. The bricks are burnt in field kilns the size of which depend on orders in sight. Power is furnished by a steam engine with an auxiliary gasoline engine of 20 h.p. Ten acres surrounding the plant are owned by the company. When in operation the plant employs from 25 to 30 men, but no bricks have been made for two years. The plant was built in 1907 and total production is stated at 10,000,000. The brick industry of California has suffered a severe decline since the increased use of cement in building construction and the owners of this plant, in common with many others, now find little or no profit in the business.

CHROMITE.

Geology of chromite deposits.

Chromic iron ore occurs invariably associated with serpentine, or in stream placers resulting from erosion of serpentine areas, where the soft gangue is carried away and the heavy chrome particles are concentrated. In San Luis Obispo County serpentine areas are found along the entire extent of the Sierra Santa Lucia and the San Luis Range, and lenses of chrome iron have been found throughout the length of the county. The masses of ore are of all sizes, from small fragments to kidneys of many tons. These kidneys are disposed in all positions, some lying flat and some with a very steep dip, and there is no method of determining their size except by actual work. The only regularity they exhibit is a decreasing richness with depth.

The ore may occur in bodies which are lustrous black and crystalline, showing little trace of serpentine, or it may be of any grade down to the point where it occurs in small grains scattered sparingly through the serpentine. In the ore bodies that have been mined, while it may be said that the walls were "commercial," determined by the 50% standard set by buyers, it seems there must have been a pretty definite line of separation between good and poor ore, as there is nothing but very low grade, and little of that, to be found in any of the old workings.

Much has been written on the genesis of chromic iron deposits and the theory which seems to agree best with observed conditions is that the chromite is the result of magmatic separation while the peridotite (or allied intrusive rock) from which the serpentine is derived was

still fluid. It has been observed in certain deposits that the rock aggregate shows automorphic or fully developed chromite crystals under the microscope, imbedded in or imposing their outlines on the peridotite crystals which are thus shown to have crystallized later than the chromite. The purity of the chromite on the surfaces exposed to weathering is easily explained by the rapid weathering out of the serpentine gangue.

Bibl.: Harder, E. C., Bulletin 430, U. S. G. S. pp. 167–183; U. S. G. S. Folio No. 101.

History.

Although a great deal of chromite was mined in this county before 1880, it was not until that year that we find any records kept. Reference to the table of production shows that over 15,000 tons are reported to have been shipped out of San Luis Obispo up to August, 1880. But there was ore mined in districts which were more convenient to other shipping points, so there was probably a considerable production of which we have no record. The figures shown in this report credit the county with over 30,000 tons, having a value in excess of $442,000, or about double the production usually stated.

The properties developed in the past have been those on the north side of the San Luis Range and on the south, or San Luis Obispo, side of the Sierra Santa Lucia and at a distance of ½ mile to 15 miles from San Luis Obispo. The workings were nearly all superficial. Notable exceptions were the Pick and Shovel, Long Pine, and London mines. A great many short tunnels, 30′ to 70′ long, were driven, but the bulk of the ore was picked up in lumps off the surface or dug out in shallow placer workings. Many farmers when not employed at ranch work turned their time and that of their teams to good account by thus gathering and hauling chromic iron. Open-cutting was resorted to a good deal, and when a lens was exhausted this way it seems to have been the usual thing to start burrowing with short tunnels in search of more ore. The ore bodies were never continuous or extensive and seldom was any new body uncovered by sustained development; most were found accidentally, and such was the uncertainty regarding their size and the quality of ore that there was small incentive for outlay of capital.

The average price previous to 1881 was better than $12.00 per ton. Ore being quite plentiful, a little profit was possible. Probably the heaviest production occurred during 1882 and 1883. The price averaged $20.00 per ton and about 5000 tons were produced. Over a dozen mines were active at that time. The largest, the Pick and Shovel Mine, which is said to have contained 1200′ of tunnels, produced 5000 tons of ore, over 55% chromic oxide, up to 1890. About 1890 prices fell to around $8.00 on account of competition with high grade ores which

could be imported from Asia Minor, Greece, Austria and other foreign sources, about as cheaply as it could be sent from California. In 1890, the Pick and Shovel Mine was producing ore for $6.50 per ton at mine portal; hauling to depot was $2.00 more. The price paid at San Luis Obispo was $8.00 for ore containing 50% chromic oxide. At this price it cost $22.50 to deliver a ton at Baltimore, whereas foreign ores cost $25.00 and less, delivered.

High grade bodies, convenient to transportation, had now been pretty well exhausted. An effort was made to save the California industry by erecting a concentrating plant in 1893 at San Luis Obispo. This operated for three years and turned out about 2000 tons of concentrates from such ore as it could get for $8.00. Removal of the tariff proved a hard blow and production of chrome ceased in 1896 entirely.

There are no doubt many bodies of chromic iron in the county which may yet prove of commercial value. The present price of $15.00 for 40% ore, with occasional small orders, has stimulated interest, and a great many locations and options have been taken on old mines and likely prospects. A small market exists on the Pacific coast for chrome bricks in copper furnace linings but this is supplied from deposits near the smelter, and the present market for larger quantities is still in the east, where it is required for hardening steel, lining furnaces, and in the manufacture of chemicals and in tanning. It is justifiable to look for lower freight rates when the Panama Canal is in full operation. If American ores could again establish themselves in the market while foreign ores are kept out by the European war conditions, chromite may again be mined here.[1] The tendency toward increased production of chemical salts in this country is also a helpful factor.

In the following notes only such prospects and old properties as showed signs of possible activity at the time of our visit are mentioned. There are a great many properties which have produced chromite in the past and are described in the old reports, but most of these are now of minor interest.

Castro Mine. A. A. Wheeler, 1640 Clay street, San Francisco, Cal., owner. This mine is in Sec. 29, T. 29 S., R. 12 E. It is credited with considerable past production but, unlike the owners of many other properties, the Goldtree Bros., who were formerly in possession, did not consider the business a profitable one when the price went below $12.00, so surrendered work on this and their other claims before the deposits were exhausted.

Chorro Creek Chrome Mine. Located in Sec. 34, T. 29 S., R. 12 E., 4½ miles north of Goldtree, a station on the Southern Pacific. It contains 86.7 acres and belongs to W. C. H. Dibblee, Otto Wannack,

[1]Since the above was written a number of deposits have been opened up, and a considerable tonnage of ore is being shipped. (Nov. 1916.)

P. A. H. Arata et al., of San Luis Obispo. This is the old London mine, which produced considerable chromite in 1882 and 1883. There are a few tons of chromite of fair grade scattered over the surface of the hilltop in pieces up to the size of a brick, but no ore in place. The old works consist of superficial trenches. The property is near the summit of the Santa Lucia Range. There is also some ore in a little stream gulch down the mountain. Elevation 1800′ to 1900′. No new work.

Cypress Chrome Mine. This is a prospect containing 80 acres, adjoining the Chorro Creek Mine, and but recently located by the same parties who own the latter property. Located in a very brushy section where prospecting is difficult. No development.

El Devisadero Chrome Mine. Is located in Sec. 33, T. 29 S., R. 12 E., 5 miles northwest of Goldtree and is on patented land belonging to A. A. Wheeler, 1640 Clay St., San Francisco. There is a little float chromite in sight. Idle for years.

El Salto Chrome Mine. Joins El Devisadero on the south and is also the property of Mr. Wheeler. This property yielded several hundred tons of ore in the '80's and still shows a few tons of float ore of a good grade in pieces of all size up to 1 foot in diameter. The mine is now rather difficult of access on account of thick brush and the cutting action of the small streams, which have concentrated the ore here considerably. Idle.

Mrs. Froom, of San Luis Obispo, owns some old chrome properties in the southern part of Rancho Laguna, 4½ miles southwest of town. There are 5 old tunnels, of which one is still open for 50′. This is driven entirely in serpentine and shows some granules of chrome ore scattered through soft serpentine. There is also an old open cut with a face 40′ high, which has evidently yielded a lot of good ore. Under option to Messrs. Dibblee, Wannack, and Arata, of San Luis Obispo. A little work of a desultory nature was going on and some development was promised at the time of the writer's visit.

La Primera and La Trinidad Mines, in the E. ½ of Sec. 33, T. 29 S., R. 12 E., were worked up to 1890, by Goldtree Bros. Since then they have passed into the possession of A. A. Wheeler, of 1640 Clay street, San Francisco, and have remained idle. They are patented and each contains 20 acres. Open cuts and short tunnels were used in mining. In the latter, which are in some cases intact, the writer observed occasional small lenses of low-grade ore imbedded in the serpentine. The properties are one mile west of the Safety mine and at an elevation of 1200 feet.

Mutual Chrome Mine. This is a newly surveyed location of 80 acres, joining the Safety and Chorro Creek claims and having same

locators. It is in Sec. 35, T. 29 S., R. 12 E., 4½ miles from Goldtree and located on a very brushy mountainside where prospecting is difficult. There was no development at time of field work for this report, and no body of chromite had yet been found on the claim.

Pick and Shovel Mine, see Safety Chrome Mine.

Pierce and Benadom Group. W. W. Pierce, G. W. Benadom and Annie Pierce, Morro, San Luis Obispo County, locators. Comprises the Chromic Acid, Chromic Acid Extension, Rocky Road, Last Hope and Sweetwater claims, in T. 29 S., R. 11 E., and lying 5 to 7 miles northeast of Morro Rock in an air line. These claims have recently been located and their owners have been quite active in development. One claim has been leased to Lloyd Newell of San Luis Obispo, California, who is at present shipping some ore, having closed a contract to furnish several carloads. The ore is mined by methods similar to those in vogue thirty years ago, but at slightly lower cost, while the expense of hauling to the railroad at San Luis Obispo, a distance of nearly twenty miles, is very high. The recent rise in price, however, and the lowered standard of ore, will permit profitable working. The lessee estimates that he has in sight 1000 tons of ore of over 45% chromic oxide and 5% silica content.

Pine Mountain. In Secs. 3 and 10 of T. 26 S., R. 8 E., there are some undeveloped deposits of chromite of good quality, as well as some old surface workings, which furnished chromite in the past.

On the beach about 2 miles south of San Simeon chromite in small chunks and boulders can be observed at low tide. The quality is said to be inferior.

Rancho Santa Rita, 8 miles northeast of Cayucos, chromite of good quality occurs in surface ore and some of it was shipped between 1880 and 1890, but no work is now going on.

T. Steele, Rancho Santa Manuela, Arroyo Grande. A deposit of a good grade of massive chromite is found on this property about 6 miles northeast of Arroyo Grande on the creek of the same name.

James Wheeler and associates of Santa Margarita have recently located a number of claims for copper and chromite along the summit of the Santa Lucia Range, extending for about 2 miles along the ridge and at a distance of from 4 to 7 miles south of Santa Margarita. Such of the ore as was seen was of a rather low grade, being mixed with a good deal of serpentine, but the region is so hard to prospect that bodies of good ore might easily be present without having been found as yet.

About 1½ miles from the Marquat antimony mine, on government land then open to entry, massive chromite of very good quality was recently reported in boulders, the largest about one ton in weight.

On the **Souza Ranch** in the Los Osos Mountains, 5 miles southwest of San Luis Obispo, there are several old tunnels and surface trenches from which chrome was shipped years ago. Messrs. Wannack, Dibblee, and others of San Luis Obispo were closing an option on this ground at the time of the field work for this report.

Safety Chrome Mine. Locators, W. C. H. Dibblee, Otto Wannack, P. A. H. Arata et al., San Luis Obispo. This is the old Pick and Shovel Mine, which produced a great deal of chromite between 1880 and 1890 and was worked more extensively than any of the other chromite properties. The group contains 83.15 acres and is located in Secs. 34 and 35, T. 29 S., R. 12 E., about 4½ miles north of Goldtree Station, with which it is connected by road, about ⅓ of which would require rebuilding and repairing before it could be used.

Most of the old underground work is now inaccessible, but there is one tunnel 60′ long entirely in serpentine which is still standing. In the roof and sides of this tunnel small patches of low-grade chromite are seen. They are one or two feet in diameter and the chromite appears as small grains up to one-fourth inch in diameter, scattered through the soft serpentine, which crumbles under the pick. The high grade ore has been well picked out and scarcely a fragment is on the dump, but the past history of the property has been good and other, undeveloped lenses may be uncovered. A little work was going on in an attempt to open one old tunnel.

COPPER.

Many copper prospects were located in this county in 1864 and a small shipment of ore was made to Swansea in 1865. The absence of a local market, the high cost of mining and transportation, and the low grade of the California ores, proved great handicaps. At that time it cost $44.00 per ton to deliver ore at the Swansea smelter and 15% ore, which was a rather high standard for California, was worth under $50.00, so that it required only a slight drop in price to put California ore out of the market. A lessening demand for copper, especially in India, where it had been hoarded for years before gold displaced it as a standard of value, led to lower prices and California production nearly ceased.

Copper ores in San Luis Obispo County have been invariably found in or near serpentine areas, the vein material most frequently being quartzitic and the common ores chalcopyrite or malachite with serpentine walls. Several instances occur where native copper is found as fine shot and wires disseminated through the serpentine which is extremely stained with malachite. As might be expected in a country so intensely affected by earth movements, no persistent ore body has

been developed, and prospecting has been hindered by the fact that capitalists are not inclined to take risks on showings so far made. Some very good assays have been made, one sample from the San Luisito showing 30% copper and $5.00 per ton gold, and another from the old Silver Swan showing $135.00 in copper, gold and silver.

Los Osos Mine, Dennis Filipponi, San Luis Obispo, owner. Situated 8 miles southwest of San Luis Obispo in the Rancho de los Osos. This mine was located in 1864. It was opened to a depth of 230′ with a shaft on the vein, which was 4′ to 12′ wide, and there was also a tunnel 235′ long, which shows ore. One hundred tons of ore carrying 18% copper were shipped to Swansea, but poor prices stopped production and the works have been caved for years.

Bibl.: Bull. 50, pp. 172–173.

Silver Swan Mine. D. & J. Hazard, Cayucos, California, owners. Located 8 miles east of Cayucos, near the headwaters of Morro and Toro creeks. There are two claims known as the Emma and Grizzly. There has been considerable prospecting here and the mine is said to have produced some copper but no data could be obtained as to the amount. Opened by a tunnel about 300′ long.

Take-a-Chance Group. James Wheeler et al., Santa Margarita, California, owners. These claims, which have been recently located, lie along and near the summit of the Santa Lucia Range, 4 to 7 miles south and west of Santa Margarita at an elevation of 1500′ to 2000′. Some of the claims cover formerly abandoned locations. The copper is found as native metal in fine wires in serpentine; some of the rock is coated with malachite and in places the ore is chalcopyrite. No new work has been done, but it is reported that formerly one tunnel was driven into a body of serpentine, which carried low-grade sulphides for a distance of seventy-five feet, at which depth it disappeared. Other shorter tunnels gave similar results. The native copper is found in veins or stringers about one foot wide, and has been noticed in other claims previously reported. The above group included about 30 claims at time of the field work for this report.

W. K. Hobson, Cayucos, California, has 8 claims eight miles due east of Cayucos between Morro and Toro creeks. He has found croppings of both low-grade copper and chromic iron in serpentine, but has not yet done any development work.

Wm. Drought, Cayucos, California, has a claim in the same district, on which he has found croppings of manganese and copper.

Bibl.: Bull. 50, p. 173, Sky Scraper Mine.

GOLD.

Probably gold was mined in the placers of this county before 1848 and this shallow work is still carried on, but without any system, and usually for a few months in winter and springtime of each year, when water is plentiful in the gulches. Most of the claims worked now are located on the headwaters of the little streams which drain the country lying on the east slope of the San Jose Range, and which flow into the San Juan River in the region of La Panza, although some work is done also on the western slope, along the creeks emptying into the Salinas River.

No figures of the county's gold production previous to 1882 are obtainable, but probably the estimate of $100,000 for the unreported years is none too high, as for a time there were about 250 men mining there.

The gold is found in gravels which are from 12′ to 25′ deep and belong to the Monterey formation, which overlies the granite flanks of the San Jose Range. The rock as a rule is not very coarse, although boulders of good size occur in the upper gulches. There are only a few of the streams which flow perennially. The feasibility of dredging this gravel has been suggested and some property owners claim to have sufficient water supply to accommodate a small boat for ten months in the year.

Veins of quartz or other gold-bearing rocks in the granite are supposed to be the source of the placer gold, but no such veins have ever been exploited. The only serious attempt to mine gold any place in the county was made about five miles west of San Luis Obispo by the following company:

Cuesta Gold Mining and Milling Company, now defunct, on property of R. E. Jack and Mrs. Nellie Jack. Gold had been washed out of the surface dirt for a long time, and the old legend existed that this gold had helped to build the Mission. Finally, in 1908, a party named Johnson became convinced that he could successfully operate a stamp mill on the property. He obtained a lease on the mineral rights and erected a battery of three stamps. Before he had time to prove anything regarding the property's value, he sold his lease to the Cuesta Gold Mining and Milling Company. This company, carried away by values shown in the oxidized surface ore, immediately built a 10-stamp mill at an expense of about $25,000. The mill was operated about one month and produced $700. A tunnel was started, but as soon as the oxidized zone was passed, the values disappeared. Instead of a strong vein, only narrow stringers of quartz in diabase were found. After drifting 160′ and sinking 20′ the project was abandoned and in 1913 the plant was dismantled

and sold. Assays of the surface dirt are said to have run from $2.00 to $500.00 per ton.

Morning Star Placer Mining Co., Henry Chester, La Panza, California, manager. This company has a number of claims in Secs. 6, 7, 8, 17, 18, 19 and 20, of T. 30 S., R. 17 E.

Navajo Mines, Bert Alley, Pozo, California. Mrs. Alley claims that these properties contain a good deal of ground which will run 50¢ per yard and could be dredged with profit. They are worked at present by sluicing.

J. Smith, Santa Margarita, California, owns two claims from which a good deal of gold has been taken in recent years by sluicing.

INFUSORIAL EARTH.

Extensive beds of this material, which is composed of the siliceous casts of numberless organisms of microscopic size, are found widely distributed throughout the county in the Miocene strata locally named Pismo, Santa Margarita and Monterey formations.

One deposit covering 25 acres, according to an old report, in Sec. 23, T. 26 S., R. 10 E., was worked for a short time by a company in 1880, who attempted to market it as "Magic Polish," but were unable to make a success of it. This deposit is about 13 miles west of Paso Robles. The above company had a small mill which they used for grinding the earth.

There is another extensive deposit of the material extending along both sides of the track of the Pacific Coast Railway, for about two miles and over a mile farther northwest, beginning about one mile east of Hadley in the Rancho Corral de Piedra.

Other deposits of notable size are located both northwest and southeast of Pismo, and extend all the way to Arroyo Grande, being covered in places by the later Paso Robles sediments. There is a smaller deposit south of Morro. Nothing has ever been done commercially with any of these.

Bibl.: R. X., p. 583 and Bull. 38, p. 293; U. S. G. S. Folio 101; Bull. 315.

IRON.

A deposit of iron ore said to outcrop at intervals for over 4 miles is exposed in Prefumo Cañon, 5 miles west of San Luis Obispo, near the road and along the creek bank. Here it is about 10′ thick, stands nearly vertical and strikes northwest between Franciscan sedimentary rocks. The ore is reported to vary from limonite on the east to hematite on the west, the latter proving the better grade.

Twelve years ago, 20 tons were shipped from the east end and

10 tons from the west croppings to a firm in Los Angeles, and other lots have been shipped to the Union Iron Works in San Francisco. Mr. J. C. Welsh, of San Luis Obispo, has used small tools made from the ore, which proved satisfactory.

Analyses previously published show an average of 46.1% iron, 13.2% silica, 6% lime, 0.63% sulphur and 0.51% phosphorus. This is the limonite; the hematite is of higher quality, running about 50% iron. Not enough work has been done to give any idea of the size of the deposit.

The deposit is on a good road within 2 miles of the old Narrow Gauge spur to Bishop Peak quarry, and from here it is 8 miles to deep water transportation at Port Harford. Croppings of the ore are found on the properties of Mrs. P. B. Prefumo, The Welsh Estate, Dennis Filipponi, and others, of San Luis Obispo, California.

Bibl.: Bull. 38, p. 301; U. S. G. S. Folio 101, and Bull. 430.

LIMESTONE.

Many deposits of limestone of commercial size and good quality are found in various parts of the county. Most of these are at present too remote from transportation to be available except for restricted local use. Lime has been burned in small quantity in the Adelaide district in Secs. 18 and 19, T. 26 S., R. 10 E.; in Sec. 35, T. 32 S., R. 14 E., and on the Newson Estate, 2½ miles east of Arroyo Grande. Other unexploited deposits are mentioned in former reports, which are listed in the bibliography.

Specimens of crystallized limestone of brownish color and apparently very pure, were shown to the writer by J. W. Hobson of Santa Margarita, who says that an extensive deposit of the material crops over a width of 20′ for a distance of about one mile, running northwest, 2 to 3 miles north of Santa Margarita.

Bibl.: State Mining Bureau, R. VIII, p. 532; R. X, p. 584; Bull. 38, p. 79.

MANGANESE.

Manganese is found in several localities in the western and northwestern part of this county, but no ore has been shipped and little prospecting done. It occurs with lenses of radiolarian chert of Franciscan age and is secondary, being found as seam coatings and bunches in the chert. There are a great many of these chert lenses in the sedimentary formations which extend northwest from San Luis Obispo on the western side of the Sierra Santa Lucia, and in the Los Osos Range, and it is probable that many manganese deposits of small dimensions are to be found among them. Factors which

will determine their value are: cost of transportation, size of deposit, and grade of ores.

Bibl.: U. S. G. S. Folio 101; Bulletins 380, p. 271, and 427, p. 161

Manganese ore of good grade was prospected many years ago i Secs. 6 and 7, T. 31 S., R. 12 E. This is 6 miles from San Lui Obispo and there is a fair road most of the way.

Bibl.: State Mining Bureau Bull. 38, p. 336.

W. K. Hobson of Cayucos, who has several claims for chrome an copper, has found on one of them a prominent cropping of cher 12′ to 15′ wide, which carries bunches and coatings of manganes No assays or development have been attempted. The prospect 8 miles east of Cayucos on the west side of the Santa Lucia Rang between Morro and Toro creeks.

On the **Phelan Ranch**, R. and Jeff Phelan, Cambria, Californi owners, manganese ore has been slightly prospected. It is 6 mi from the Phelan Ranch house and about 10 miles from Port S Simeon (which has deep water transportation) and there is a f road for hauling, to within a mile of the prospect. Elevation, 170

The ore occurs in a prominent stratum of vari-colored chert, thick, which strikes N. 50° W. and dips into the hill at an an of 30° to 40° NE. The chert cropping is easily traced for 200 ya or more, and along this distance at frequent intervals occur bunc of manganite of good grade. The chert around these ore pock is colored black, presumably by iron, and a cursory view is apt give the impression of greater masses of ore than exist, altho there are several bodies of a few tons, showing fair ore through Examination of the hillside above the vein showed a great deal float ore scattered over the surface to the top of the hill, but t did not permit the field assistant to locate the source of this, wh was probably another lens higher up.

Small deposits of manganese are mentioned by H. W. Fairban as occurring (1) 8 miles west of Cayucos, (2) on the north side Clark Cañon, about 10 miles west of San Luis Obispo and (3) so east of Prefumo Cañon. These have never been developed.

MINERAL WATER.

Only a small quantity of mineral water is bottled in this cou for sale, although of course a great deal is consumed at the res of which no account is taken.

The Mary Hill Mineral Well is situated on a hill about ¼ m west of Paso Robles. The water is pumped and is bottled in

*Rep. XII, pp. 330, 513.

small way for local sale. In the natural state it is slightly carbon- [redacted] for medicinal use it is bottled [redacted]

rnia.

	AsO_4	SiO_2	Li	BO_2	Organic and volatile	Gas	
						CO_2	H_2S
-----	----------	66	Trace	Trace	----------	Trace	52
-----	----------	35	----------	----------	----------	127	23
-----	----------	66	Trace	Trace	----------	Trace	52
-----	----------	105	Trace	14	PO_4 1.3	195	7.1
-----	----------	107	----------	Trace	----------	137	.53
-----	----------	15	----------	Trace	----------	Trace	Trace
205	3.1	27	----------	----------	----------	----------	----------
-----	----------	29	----------	Trace	----------	100	31
91	----------	372	----------	----------	Inc. CO_2 205	$CaCO_3$ $MgCO_3$ $CaSO_4$ 10 H_2O not separately determined.	
-----	----------	15	----------	----------	105	300	

[redacted] an iron pipe 3′ above the ground and the water domes up over this noticeably. The equipment at present consists of 3 tubs for bathing, to which the water is conducted directly from the well.

will determine their value are: cost of transportation, size of deposit, and grade of ores.

El Paso Robles. The water is pumped and is boiled in

XII, pp. 330, 513.

small way for local sale. In the natural state it is slightly carbonated and for medicinal use it is bottled as it comes from the well. For a beverage, it is carbonated artificially. The analysis shows a cold water carrying a noticeable content of potassium, sodium and the carbonic acid radicle in addition to the characteristic reaction for sulphur.

The Paso Robles Bottling Co. have had an agreement for many years with the Paso Robles Hot Springs Hotel Co., whereby they bottle the water of the "Soda" Spring, which is one of the group near the Mud Baths. A good deal of this water, which is artificially carbonated, is used at the hotel and there is also a small local business reported. See Paso Robles Hot Springs.

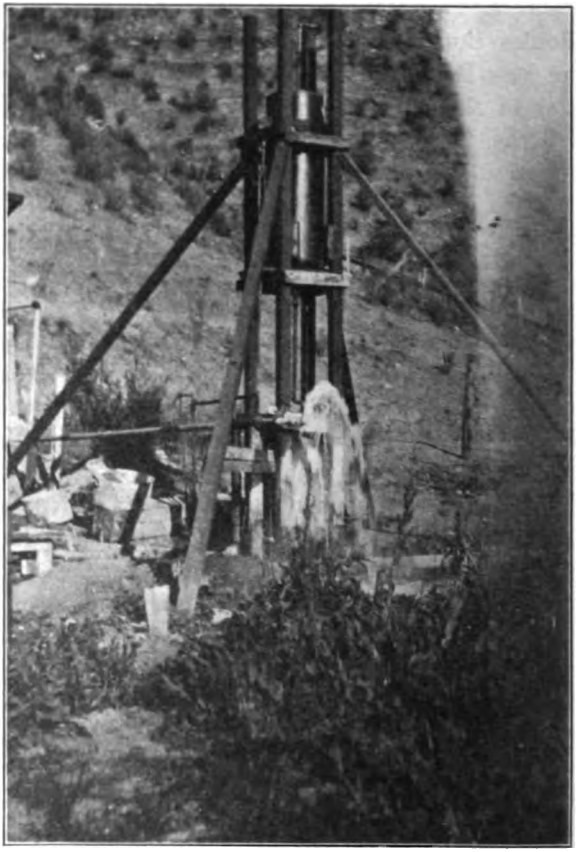
MINERAL SPRINGS and WELLS.

A surprising number of mineral springs, both hot and cold, which exhibit a wide variety of chemical salts in solution, occur in the different districts, but in the southwest and in and around Paso Robles the greatest progress has been made in making them available for public use. Transportation facilities are of course instrumental in this. Paso Robles is on the main line of the Southern Pacific, and the group of springs south of San Luis Obispo are easily reached through that city by way of the Pacific Coast Railway or automobile over the new state highway.

The hot sulphur waters are thought to be the product of chemical action in the Monterey bituminous shales, and in the case of the natural springs the outlets are determined by sharp folding and breaking of the strata. In the following pages only the better known springs in the county are described. There are numerous others, warm and cold, especially in the eastern and southeastern plains region, which are of value as watering-places for stock and for domestic supply, but not of particular interest to the ordinary reader.

Budan Spring, Mrs. E. Budan, San Luis Obispo, California, owner, is located 6 miles south of San Luis Obispo on the Pismo Road in what would be Sec. 32, of T. 31 S., R. 12 E. if the grant were divided according to the public survey. This is, properly speaking, an artesian well, it having been brought in during 1908, while boring for oil. The water issues under considerable pressure and there is a flow of possibly 5 miner's inches, although no measurements have ever been made. The temperature of the water is given as 178° Fahrenheit; it is too hot to be borne by the hand. The flow is through an iron pipe 3′ above the ground and the water domes up over this noticeably. The equipment at present consists of 3 tubs for bathing, to which the water is conducted directly from the well.

There are no accommodations for guests and the patronage is local, but additions are contemplated. The water is markedly but not disagreeably sulphuretted and the temperature is higher than at any other spring in the district. There is no reason why a little resort should not be profitable here.



Budan Spring, San Luis Obispo County.

Grand Central Sulphur Spring, E. J. Burlingham, Paso Robles, California, owner. In 1911 a well was started in a search for the warm sulphur water, which was known to exist in great quantity under the town. At a depth of 510′ a strong flow of the liquid resulted. The well is fitted with an 8″ casing and is capped to prevent waste of the water, the owner stating that the pressure exerted by the water is 45 pounds per square inch at the outlet. The property is located in the center of Paso Robles and is well fitted up for use by the public, the bath house being equipped with 11 tubs, hood sweat, mud bath, and other accessories. Considerable merit is claimed for the water, especially in the treatment of rheumatism and

stomach complaints, and a fair-sized business is done. The analysis of the water is shown in the appended table.

Huer-Huero Springs consist of 2 distinct groups. The northern group, the water of which is sulphuretted, cold, and carries some iron, is 13 miles southeast of Paso Robles and 1½ miles south of Creston, and is well liked as a camping ground. The New Springs are 2 miles farther south and yield a flow of 2 to 3 gallons per minute of "iron" water strongly sulphuretted. E. H. Ashwood owns both.

Cameta Warm Spring is located near the side of the Bakersfield road about 30 miles southeast of Paso Robles. The flow reported to be about 3 gallons per minute and the temperature 74° F. The spring is resorted to a little by local people who have piped the water to a shed nearby where they use it for bathing.

Bibl.: U. S. G. S. Water Supply Paper 338, p. 77.

Kessler Springs are located at the Kessler Onyx Quarry in Secs. 9 and 16, T. 31 S., R. 15 E., and are noteworthy because of the mineral deposits which have resulted from precipitation of the salts which they contain. The flow of water is small and the temperature about 60° F. Besides the carbonated spring there are some small saline springs here which during the dry season are noticeable on account of the small crusts of common salt which are formed in the creek bed. These springs are located 20 miles northeast of Arroyo Grande and are the property of the Kessler Estate. They have never been utilized.

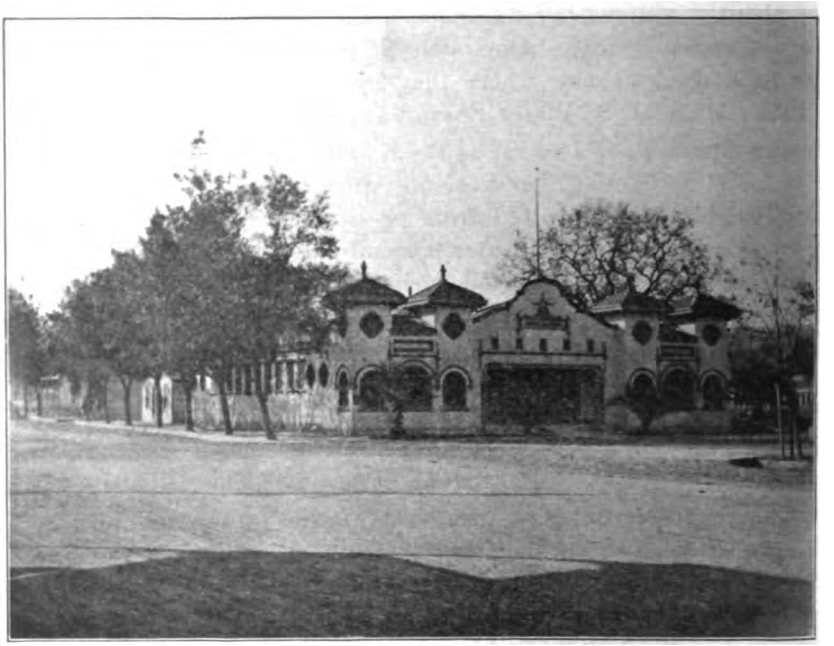
Bibl.: U. S. G. S. Water Supply Paper 338, pp. 164-165.

Municipal Baths Springs, located in Paso Robles and operated under the supervision of the city, get their supply from an artesian well 392′ deep with a 6″ casing. The flow of the well is stated by those in charge to be 380,000 gallons in 24 hours. No analysis of the water has been made as far as could be learned, that given in the literature being the same as the analysis of the "Main Sulphur Spring" published by the Paso Robles Hot Springs. The assumption that the waters are practically the same is reasonable, however, as the two wells are only a few hundred yards apart; it may be noted, though, that there is considerable difference in the depths of the two wells. The water at the Municipal Baths issues at a temperature of 108.6° F. and no use is made of the surplus which remains after supplying the resort.

The establishment is very substantial and elegant throughout, both in architecture and interior appointments. It is fitted with 12 porcelain tubs for hot sulphur water baths; 3 set-in tubs for hot mud baths, a plunge, and packing, cooling, and waiting-rooms for both

men and women. The building is of concrete, and the plant is valued at $25,000. A force of 4 men is employed and a gross business of $4,000 to $5,000 per annum is reported, regular courses of treatment being given. The waters are held to be especially efficacious in treating nervous, liver, and rheumatic trouble.

Newsom's Arroyo Grande Warm Springs are situated on the ranch of the Newsom Estate in T. 32 S., R. 13 E., 2½ miles east of Arroyo Grande. In 1864 D. F. Newsom, father of the present occupants, located the land as a homestead, but for a long time previous to that the waters had been resorted to by the Indians, who used them medicinally.

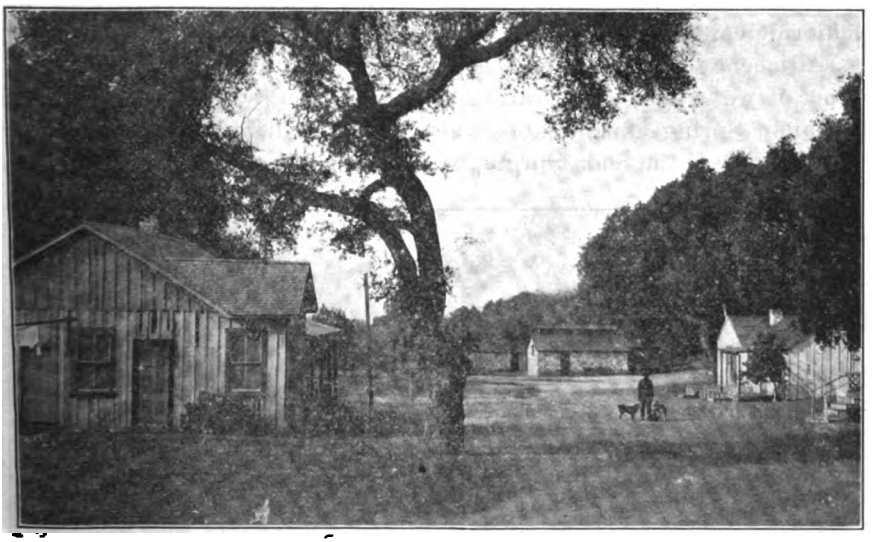


Municipal Baths, Paso Robles, California. Owned and operated by the city of Paso Robles.

The spring rises from the bed of the arroyo and yields about 15 gallons of water a minute at a temperature of 100.5° F. The water carries sensible amounts of iron, which is found in greater quantity in all the springs of this section than in those around Paso Robles. The establishment includes a small hotel, 6 cottages and the bathing equipment, which consists of 5 tubs and a small plunge. There are spacious and pleasant camping grounds, and in the summer and fall the resort is visited a good deal by families who camp out.

Bibl.: Winslow Anderson's "Mineral Springs of California," p. 207; U. S. G. S. Water Supply Paper 388, pp. 68–69.

Paso Robles Hot Springs, is one of California's finest health and pleasure resorts and has become very widely known. The main sulphur spring, as it is called, is a well 640′ deep, with a 10″ casing and an enormous flow of warm, sulphuretted water, which supplies the needs of the resort. The hotel and other buildings are situated in spacious grounds in the western part of Paso Robles. The establishment is



Newsom's Arroyo Grande Warm Springs Resort, San Luis Obispo County.

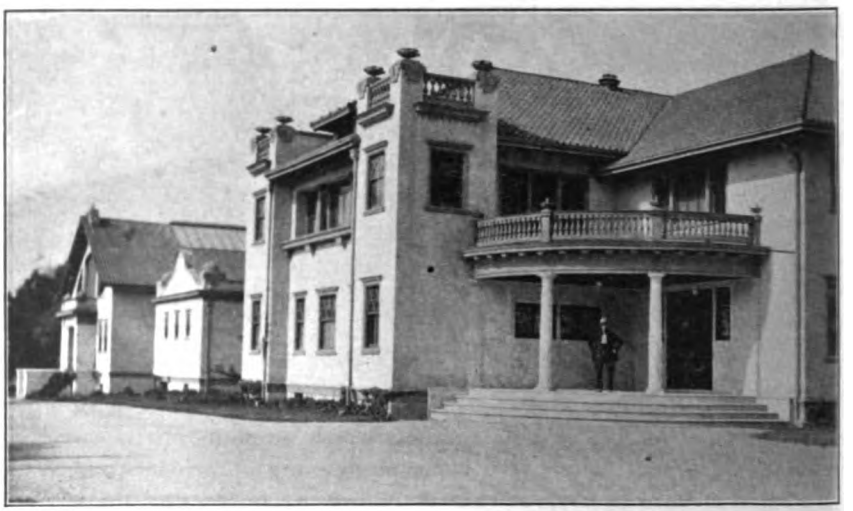
completely equipped in every respect for the entertainment of guests and for the treatment of the ailments which the mineralized waters are said to alleviate. There is a large plunge and a varied equipment of the most modern apparatus to be found at any resort, and there is kept in attendance a number of skilled operators who administer hot air and vapor baths, massage, exercises, and other courses of treatment to supplement the work of the mineral waters. The plant is valued in excess of $250,000. It is situated almost midway between Los Angeles and San Francisco on the Southern Pacific Coast Line, with very good train service, excellent climate and other advantages, which have made it extremely popular. The flow of the main spring is stated to be 2,000,000 gallons per day and the temperature of the water is 107.6°. There are several natural springs about 2½ miles north of the hotel and these are operated under the same management, being known as the Paso Robles Mud Baths.

Bibl.: U. S. G. S. Water Supply Paper 338, pp. 72–75.

Paso Robles Mud Bath Springs. These are situated near the Southern Pacific tracks and within 100 yards of the Salinas River. There is a new concrete bathhouse, equipped with packing rooms

and 12 concrete dips built into the mud springs and showing the constant ebullition of gases and mineral waters rising through the mud in the basins. The temperatures of the springs here vary from 104° to 122° F. The mud is the characteristic black tule material and there is spring activity apparent in it in other spots near the bathhouse. The water of these springs, as will be noted from the analysis, is markedly different in mineral content from that in the Paso Robles wells, showing particularly a much higher sulphate and chloride content.

Adjacent to the bathhouse is a 4″ well, 140′ deep, yielding a small flow of water at a temperature of about 118° F. This is named the Lithium Spring and is capped and used for drinking. Seventy-five yards away is the Soda Spring, which is a natural spring flowing four



Paso Robles Hot Springs Bathhouse, Paso Robles. Photo by C. A. Waring.

gallons a minute of water at a temperature of 77°. This water is artificially carbonated and bottled by the soda works at Paso Robles.

Bibl.: U. S. G. S. Water Supply Paper 338, pp. 73–76.

The Iron Spring (Paso Robles) is in a little cañon about 200 yards northwest of the bathhouse. The flow is small, hardly a gallon a minute and is utilized for drinking. Its temperature is only 64° F and it carries a little more iron than the other springs. The advertising matter credits all these springs with radio-active properties and special virtue is claimed for them in treating rheumatism.

Bibl.: Winslow Anderson, p. 123.

Pecho Warm Springs are due west of San Luis Obispo in Islay Creek, 2 miles from the ocean. The water is strongly sulphuretted; one spring has a temperature of 95° F., the other 72°. The total flow

is possibly 20 gallons per minute including that of a third small spring about ¼ of a mile away. These springs have been used locally for many years, but are unimportant.

Bibl.: U. S. G. S. Water Supply Paper 338, pp. 69–70.

San Luis Hot Springs, were formerly known as Sycamore Springs. They are owned by C. A. Griggs and are located 6 miles south of San Luis Obispo, being reached most conveniently through that city by auto stage. The flow of water was obtained from a well bored in search of oil. The endeavor to find this was abandoned in 1887 when the well had reached a depth of 937′, at which point a copious flow of hot sulphur water and gas resulted. Statements of the rate of flow are found, which credit the well with 144,000 gallons of water and 16,800 cubic feet of gas per diem, but these figures are no doubt high for present production, although gas still issues in considerable volume. The water has a temperature of 110° F.

The establishment is quite extensive and is located in pleasing surroundings, close to the coast but protected by steep hills, and offering every access to some of the most striking coast scenery in the state.

There is a hotel which has been recently refitted, a dance hall, cottages, and tenting grounds. Two plunges are provided for hot sulphur baths and there are over 20 tubs; the owner taking particular pride in those made of solid porcelain, of which he has 10 weighing over 1000 lbs. each. Mr. Craig promises other improvements in the near future.

Santa Ysabel Springs are located on the land of the Santa Ysabel Hot Springs Land and Water Company, at a distance of 4 miles southeast of Paso Robles. There are 2 springs at the bathhouse and some lesser ones farther up the cañon. Of the 2 principal springs, the larger flows about 220,000 gallons per diem and the water issues at a temperature of 94° F. The smaller one rises within a concrete basin and has only a small flow. There is a small bathhouse over the spring and the local people make some use of the water. From the spring the water flows into a storage reservoir and is utilized for irrigating a large surrounding acreage.

Bibl.: Winslow Anderson, p. 233. U. S. G. S. Water Supply Paper 388, pp. 76–77.

PETROLEUM.

There has been a great amount of unsuccessful drilling done in this county in search of oil. Such wells as did strike oil have made a small production of material so high in asphalt that pumping has been required. Much money would have been saved and many disappointments would have been obviated if more attention had been

paid to the geology of the county with reference to conditions affecting the possible location of underground oil reservoirs.

As the geology of the various oil districts and the present condition of the industry have been fully covered in the recently published Bulletin No. 69 of the California State Mining Bureau, it is not necessary to do more here than refer the reader to that publication and to the others noted below.

Bibl.: State Mining Bureau Bull. 19, p. 146; Bull. 69, p. 418 and pp. 429-434; R. VII, pp. 97-99; R. VIII, p. 530; XII, p. 356. U. S. G. S. Folio 101.

QUICKSILVER.

Cinnabar from the Sierra Santa Lucia had been used by the Indians for pigment for generations before the miner first sought it. In 1861 active search by prospectors began and the first location is said to have been made in 1862. The usual rush of miners followed and many claims were taken up. The county became an important producer in 1876, but, although many properties are mentioned as yielding, the records give only the individual outputs of the largest, so that we have no means of arriving at anything like an exact idea of the total output. At the properties, too, no systematic data was kept and hardly a person is now to be found who can give first-hand information concerning past operations.

With the exception of the Rinconada Group, all the mines which have produced quicksilver are located along the Santa Lucia Range from San Carpojoro Creek in the northwest corner of the county, to the middle of T. 27 S., R. 10 E., a distance of about 30 miles. All except the Oceanic and Polar Star are at elevations of over 1000′.

The mines on the western slope of the mountains depend on small coast-wise steamers, which touch at San Simeon, to meet their transportation requirements, which are, however, not very exacting, as they ship quicksilver only once or twice a month. There is also a good road to San Luis Obispo. The properties around Klau and Adelaide reach the outside world through Paso Robles, which is about 15 miles west. Although the Santa Lucia is not what would be termed a high range of mountains, the grade over it here is steep and winding, and there is very little travel between Cambria and the eastern slope.

The mines may be roughly grouped in two classes, depending on the character of ore; to the first class belong the properties like the Oceanic, which exhibit sedimentary formations impregnated with cinnabar and carrying high percentages of pyrite; the other group has ores which are highly silicified metamorphics (including serpentine).

The nature of the ore occurrences in most of the mines, and the extreme instability of the quicksilver market in the past, have no

doubt been the chief factors in determining the ruinous policy of exploitation—it can hardly be called mining—which has been followed at a number of the properties visited. The approved method of procedure has been to find a rich pocket of ore, erect a wasteful retorting plant and burn high-grade ore only. The result has not been generally realized, perhaps, until the recent phenomenal rise in the price of mercury. Many owners find now to their chagrin that they have neither high-grade ore bodies rich enough to pay for retorting, nor furnaces to treat the numerous occurrences of low-grade material. Consideration of the costs entailed, and the length of time for which capital would be tied up in erecting and bringing a furnace plant to the producing stage, furnish ample explanation for the lack of activity in mercury mining, in spite of the alluring prices now ruling. It is estimated that the cost of furnace and condenser plants is about $1000 per ton of capacity, and $50,000 may therefore be taken as the outlay needed to bring a 50-ton plant to the producing stage. Exact figures of cost are not given freely as a rule, even when available. An additional $10,000, however, may be required to take care of cost of mining equipment, buildings, monthly mine payrolls, fuel, and other supplies, as well as interest on investment, during the period of furnace construction which may easily be 6 months, before a pound of mercury is recovered.

The inquiry for other means of operating on low-grade ore without such outlay of money and time, has directed attention to the possibilities of concentration. Experience in the past few years at certain California properties has shown that concentration is feasible under favorable circumstances. If the cinnabar occurs in a soft gangue, and crushing to a comparatively coarse mesh is used instead of fine grinding, there will be a fairly good recovery possible, as at the Oceanic Mine, described on another page. At the Oat Hill Mine in Napa County, as mentioned in a recent publication[3] of this bureau, old dump material is being concentrated at a very low cost because the ore is well weathered and requires no crushing; no estimate is given of the values lost in the coarser material, which goes through the sluice. Less favorable conditions are found at the Aetna Mine in Napa County, where it has been observed that a hard gangue and finer grinding result in considerable loss in the slime. It may also be observed that a low-grade ore carries the cinnabar, as a rule, in such a floury or finely crystalline state that considerable loss in the fines is possible without the grinding.

Retorting of concentrates is not very satisfactory as provisions have to be made to prevent packing and retorts are usually very

[3]Mines and Mineral Resources of Napa County, W. W. Bradley, 1915.

wasteful of mercury and costly to operate. It is very easy to burn out a set of pipes or lose all the mercury in an ore, by keeping too hot a fire. It can not be denied that the Scott furnace is still the best means of recovering mercury. Improvements in its use are going to be along the line of evolving better condenser systems and reducing fuel used and soot produced. Men of wide experience in the industry freely admit that they do not seem to be able to recover anything like the values indicated in numberless assays of their ore, nor are they prepared to say whether the lost values get away as mercury vapor, as minute particles of condensed mercury, or as part of some chemical combination.

Alice and Modoc Group (see Little Bonanza).

Bank Mine (see Cambria Mine).

Belt Quicksilver Mining Co., Rev. Mr. Buley, Paso Robles, California, president; office 912 Baker-Detwiler Bldg., Los Angeles. This company has a lease on the old La Libertad Mine, which is situated in Sec. 21, T. 27 S., R. 10 E., about 20 miles west of Paso Robles, at an elevation of 1900′. A great deal of work has been done here in the past, development having been carried on through 3 tunnels. Several large bodies of ore were stoped out. The company's report of March 1, 1915, states that there are 1000′ of drifts, raises and stopes. The work underground reveals an irregular ore body dipping at different angles, which had a width of 20′ to 25′ and has been worked by stopes of 40′ to 60′ in length. New work has been done in driving a crosscut 12′ long off the lowest drift. The face of this cut shows some ore. The cinnabar is in the form of small crystals with silica in a highly metamorphosed rock which has been classed as serpentine, but which owes its present vivid green coloring to ferrous sulphate and which shows a rather soft clayey texture. The ore is near the contact with a dark clay footwall which carries sandstone in small rounded boulders and shows calcite stringers, as well as the characteristic epsomite efflorences. The reduction equipment consists of a 12-pipe retort, in good order, and at the mine 3 ore cars and 700′ of track to the retort.

Bibl.: S. M. B. Bulletin 27, p. 159.

Cambria Quicksilver Mine, formerly known as the Bank Mine and owned by the Cambria Quicksilver Co., of Los Angeles, located in Sec. 36, T. 26 S., R. 8 E., 13 miles north of Cambria by road and 11 miles from San Simeon, the shipping point. The holdings consist of mineral rights on 360 acres.

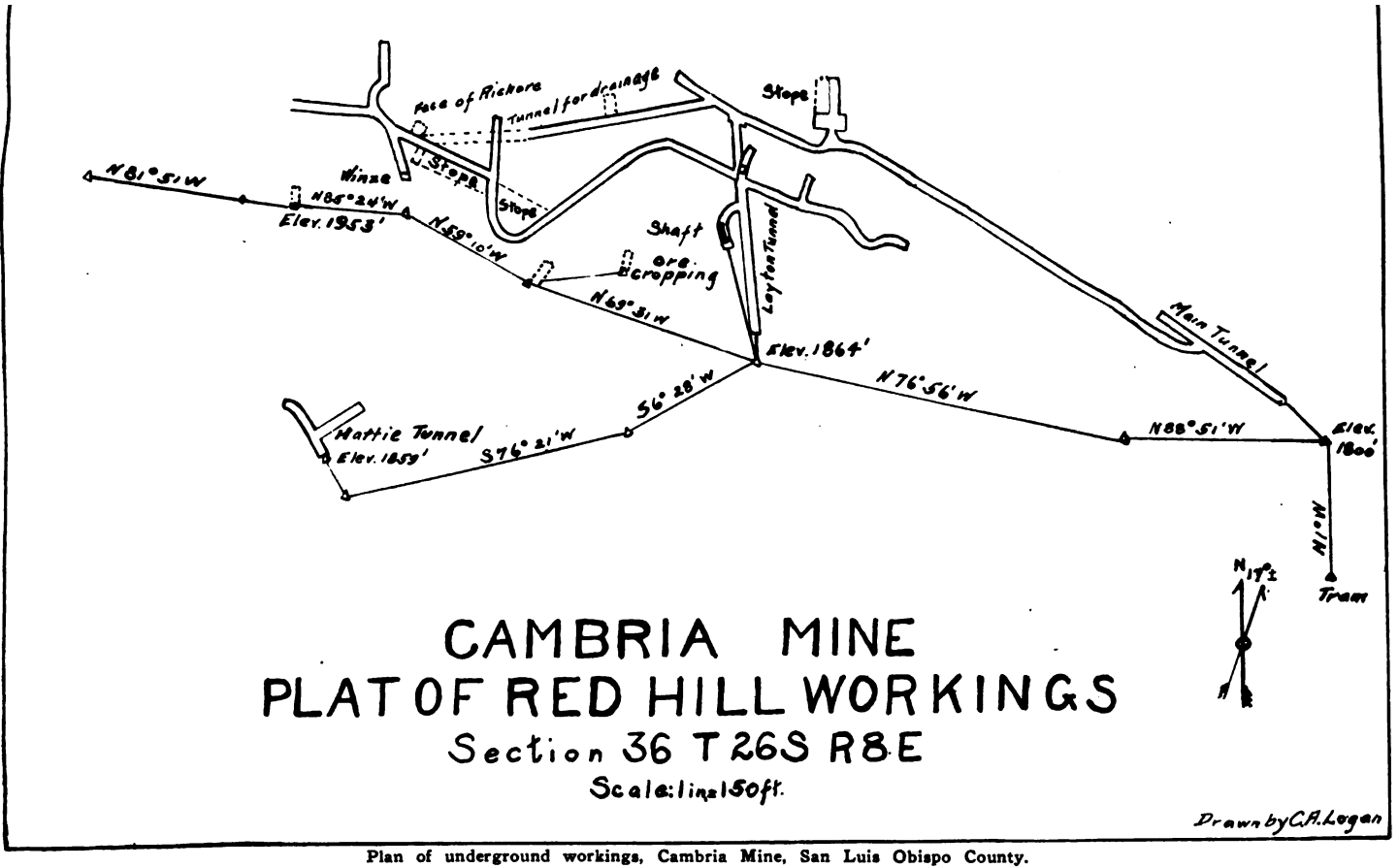
This mine made a good reputation as a quicksilver producer between 1905 and 1908. The mine was first exploited in 1903 by E. S. Rigdon. The surface showings were quite poor but exploration under ground revealed an ore-body of considerable size, and quite

Reduction Works, Cambria Quicksilver Co., San Luis Obispo County. Photo by E. W. Carson.

rich. The present company obtained the property in 1905, but they carried development work for a year before erecting a reduction plant. A tunnel 800′ long was driven to use in handling the ore and from this a cut 200′ long was driven into the ore-body which proved to be very flat and to consist of a zone of brecciated serpentine about 40′ thick, dipping northeast. When the company had carried development work underground to the point where they were convinced of the value of the ore body, they erected a furnace. During the 18 months ensuing, operations were very satisfactory. An ore body 180′ long, 40′ wide and 150′ in height was worked out by stoping and yielded 3927 flasks. Square setting was used but notwithstanding this the cost of production per flask was very low, being stated as $26.03. A very good recovery was made estimated at 85% to 90%; the ore carrying little or no iron sulphide and giving little trouble in the furnace. Early in 1908 the ore gave out, the body apparently being cut off either from faulting or sliding. Operations were suspended till the fall of 1915 but the same company remained in charge.

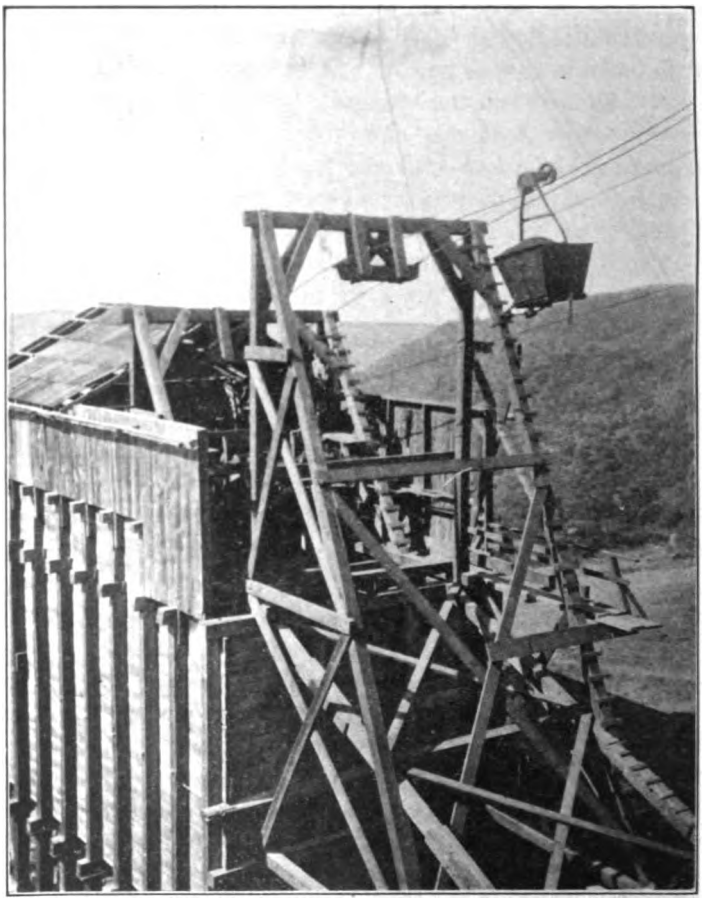
The owners and superintendent were of the opinion that the ore-body they had worked was a portion of a larger mass from which it had been broken, and there were certain observed conditions which seemed to confirm this. Accordingly, the latter year, vigorous prospecting began on a series of croppings north of and slightly higher then the old mine. Up to the time of the writer's visit, about 1400′ of new drifts had been driven on two levels and crosscuts totalling over 400′, as well as about 300′ of raises and winzes, had been put in. Considering that all this was done by hand drilling, and was at times in heavy ground, it is a good showing. The croppings, which show on the surface for 700′ have been followed underground for half that distance. Superficially a rather flinty and ocherous cropping, the appearance underground is that of an intensely brecciated serpentine carrying small stringers of rich ore in a siliceous gangue, and coatings of cinnabar on the serpentine fragments. The mineralized zone as revealed at that time was about 20′ in average width, with a dip of about 40° N. and a strike of few degrees north of west. Throughout its width prominent streaks of dark clay selvage occur, and in places form an "alta," but the country rock is serpentine on both sides. As already noted, the ground is heavy, and carries a good deal of water in places, as might be expected. Square setting with round timbers is employed and pretty close lagging is needed at times.

The furnace was put in operation in the summer of 1915 on surface ore of low grade from the croppings, but considerable difficulty resulted. The rock was clayey, highly altered serpentine, carrying considerable water. It seemed to Mr. Carson as if the clay held the



Plan of underground workings, Cambria Mine, San Luis Obispo County.

mercury after the decomposition of the cinnabar, and the degree of heat necessary to expel it was such that the values were driven through the entire condenser system and lost. That this condition really existed, or that the failure to make mercury was due to other causes is open to question and the work was not carried to a decisive point. In October, ore from underground was put in the furnace



Detail of tramway and ore-bin, Cambria Mine, San Luis Obispo County. Photo by E. W. Carson.

and production began. While not approaching as yet the grade of the old ore-body, some encouraging developments are reported for December, 1915.

The reduction equipment includes a 70-ton Scott furnace and 8 brick condensers in good condition, one "D" retort, and an 8" x 12" Hercules Blake crusher. From mine to crusher the ore is hand-trammed in one-ton cars. Storage equipment consists of two bins

with a total capacity of 1500 tons. To carry the ore from crusher to storage bins, a Broderick and Bascom two-bucket tramway system has recently been completed at a cost of $6,000. This handles the ore for a distance of 3000′ at the rate of 6½ tons an hour and dumps into the upper ore bin from which it is trammed to a lower bin and to the furnace.

The ore is roasted 36 hours at a considerably higher temperature than at the Oceanic Mine. The furnace and condensers are in excellent condition; the air is excluded as much as practicable from the furnace and in this way the formation of an excessive amount of soot is avoided. The operators believe that the longer roasting period gives more satisfactory results.

Labor is cheap; miners get $2.50 and muckers $2.00 per day. Total cost of mining, including overhead, in 1907, was $1.66 per ton; but it must be borne in mind that the cost of square set timbering adds largely to this item. A considerable increase in the cost of timber is noticeable in 8 years. In 1907, lagging cost $8.00 to $12.00 per thousand; they now cost $20.00. Timber which was then obtainable for 3½¢ to 5¢ a running foot, now costs 6¢. These advances and other slight increases in transportation will bring the present mining cost to about $2.00 per ton. Treatment cost $0.82 per ton, but this figure should be somewhat reduced under present conditions. Oakwood costs $6.00 per cord delivered, and the furnace burns 1½ cords per diem. The retort burns ¼ cord per day for about 7 days per month when the furnace is working steadily. Other general expense, aside from superintendent's salary, is 20¢ per ton, making a total operating cost for the former period of $2.68 per ton, and for the present of $3.00 per ton. Transportation to or from San Simeon, the shipping point, is $5.00 per ton.

Power for the train and the rock crusher is furnished by an Otto gas engine of 12½ h.p., burning distillate. The cost per horsepower-hour is stated at 1½¢. The rock crusher requires two-thirds of the power generated.

The total crew employed in November, 1915, was 34; 22 worked underground and 4 on top at the mine, and 8 were required at the furnace.

Bibl.: Bull. 27, p. 154, Bank Mine.

Capitola Quicksilver Mine. Lane, Pemberton, and Villegas of Klau, owners; W. W. Walker, San Luis Obispo and Geo. T. Liddle, Paso Robles, lessees. Adjacent to the Klau Mine in T. 26 S., R. 10 E.; about 15 miles west of Paso Robles. This property has been slightly explored by means of a tunnel about 100′ below the outcrop. At a distance of 300′ from the portal the work ceased, with the face of the tunnel exposing an ore-body of peculiar nature. The rock is sedi-

mentary, dark gray, and of clayey texture, carrying pyrite crystals as large as ½" on an edge, often in aggregates of several inches in diameter where the crystals are interlaced. This body carries some cinnabar in the clay but there has been no work yet done to determine its extent.

The country rock is clay and sandstone with inclusions of sandstone and calcite, as shown in the drift. The outcrop is highly ocherous and does not show any cinnabar to the naked eye, but is stated to pan 0.25% quicksilver. The croppings show the usual northwest strike.

The reduction plant consists of a 24" "D" retort with a capacity of 1000 pounds per day, and two concrete-covered condensers 4' x 4' x 6'. The very high pyrite content of the ore then exposed would necessitate extreme care in reduction, to avoid too high a temperature and consequent loss of mercury through failure to condense it, or through its recombination with sulphur to form artificial cinnabar. Since the writer's visit to this property, work has been resumed there by the lessees and the construction of a new retort is planned.

Claus Group, of four claims, is owned by C. P. and Cecilia Claus of Santa Margarita and is situated in Sec. 28, T. 30 S., R. 14 E., 11 miles southeast of that town and adjacent to the Rinconada Group. Claim No. 1 covers the old Pedro which has been prospected considerably, and Claim No. 4 has a 75' tunnel which shows a promise of ore. The geology of this district is well covered in a previous report dealing with the Rinconada Group, where developments justify more work. At the time of the field work for this report the assessment work was being done and some ore was being taken from near the surface and hauled to the pipe retorts on the Rinconada claims. This retort will be used if the ore on the Claus claims proves of retorting grade.

Bibl.: See Rinconada Group, Bull. 27, p. 166.

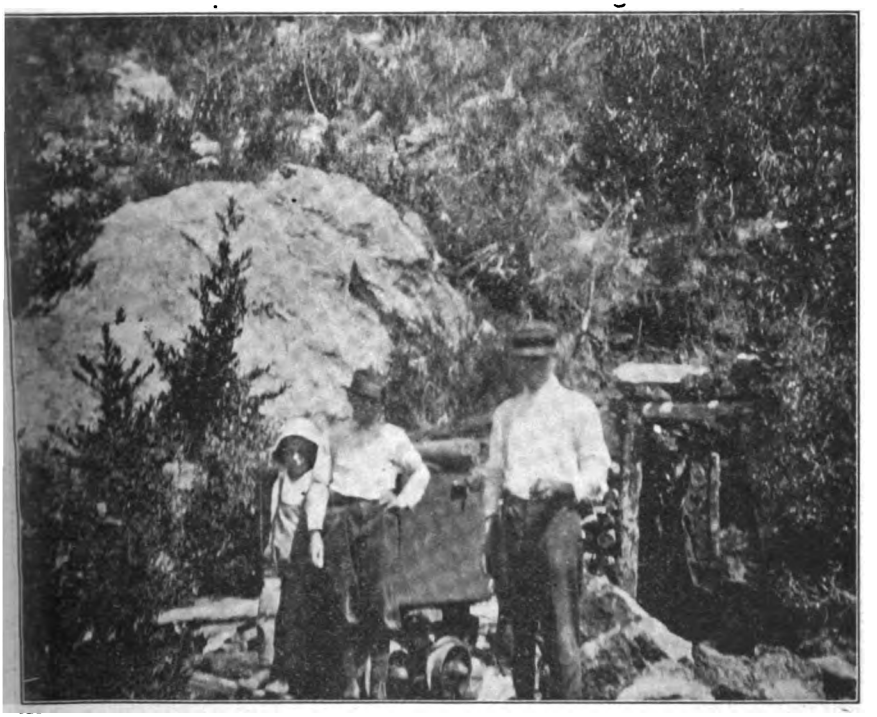
Cypress Mountain Group, W. S. Torrington, Paso Robles, California. There have been no new developments at this property, although assessment work is being done from year to year. The claims are in Secs. 1 and 2 of T. 27 S., R. 9 E., about sixteen miles from Cambria. All the work done in recent years has been of a superficial and desultory nature, and the old workings are mostly caved. Elevation, 2900 feet.

Bibl.: Bull. 27, p. 156.

Doty Group. Doty Bros. of Cambria, owners. The holdings comprise 5 unpatented claims in Sec. 14, T. 26 S., R. 8 E. A tunnel about 200' long has been driven in a black clay gouge without result, although indications of cinnabar are mentioned in a former report. There is no reduction equipment.

Bibl.: Bull. 27, p. 156.

Elizabeth and Winona Group, comprises two locations held by [rs. J. W. Bagby and others of Paso Robles, and is situated in ec. 17, T. 27 S., R. 10 E., at a distance of 13 miles from Cambria. 'he claims lie between the Little Bonanza and the Belt properties, nd exhibit similar croppings to those of the former. The work has



Outcrop and tunnel, Doty Mine, San Luis Obispo County. Photo by E. W. Carson.

been superficial, and in the past few years has been entirely suspended, although some prospecting was contemplated in the fall of 1915. There was a small production years ago but the 10-pipe retort is no longer usable.

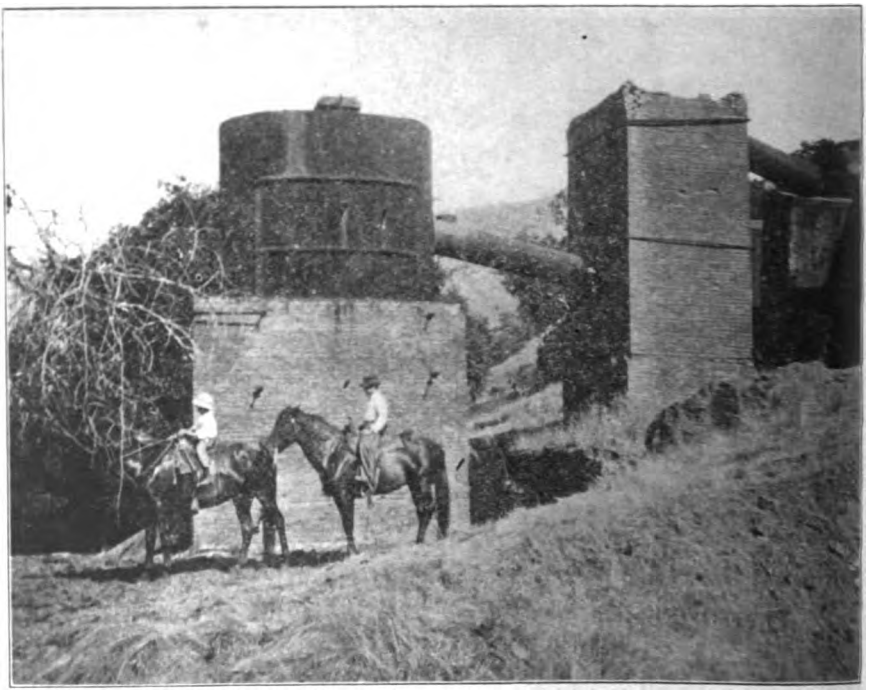
Bibl.: Bull. No. 27, p. 157.

Karl Mine (See Klau).

Keystone Mine is on patented land belonging to Phelan Bros. of Cambria, and is situated on the flank of Rocky Butte, in Sec. 13, T. 26 S., R. 8 E., 16 miles east of San Simeon by road. This property was located in the early seventies and has been credited in former reports with considerable production. The furnace and condensers, shown in the photograph, were completed late in 1874 and the mine produced about 60 flasks of quicksilver in 1875, according to the best information obtainable, but no one is accessible who has

first-hand knowledge of the work done. This is said to be the only production of which there is a record. The property has been idle ever since.

The furnace is of the old coarse-ore type of 5-ton capacity and there are 6 of the sheet-iron condensers. The whole plant is quite an interesting relic, as most of such equipment has long since disappeared. The underground workings consisted of a tunnel said to have been about 300′ long with a winze sunk from it to a depth of 50′, but both are inaccessible. The statement is made that the winze was in good ore when work was abandoned. The outcrop shows



Old coarse-ore quicksilver furnace, erected 1873. Keystone Mine, San Luis Obispo County. Photo by E. W. Carson.

cinnabar in highly altered serpentine, with a black clay "alta" and a serpentine footwall, striking E., and dipping 40° N. In November, 1915, the mine was under option, but it is hardly likely that any deal will be made at the price asked.

Bibl.: Report X, p. 581; MIN. RES. W. OF ROCKY MTS., R. W. Raymond, 1875, p. 14.

Kismet Group. Idle.

Bibl.: Bull. No. 27, p. 159.

Klau Mine, known forty years ago as the Sunderland, and more recently as the Karl or Sierra Morena, has produced considerable quicksilver during different periods of activity. The property owned includes three claims and a mill site, as well as the mineral rights on adjacent land. It is in Sec. 33, T. 26 S., R. 10 E., at an elevation of 1400′ on the eastern side of the Sierra Santa Lucia, 16 miles west of the nearest railroad station, Paso Robles. The original location was made in 1868 and it was among the list of producing quicksilver properties in 1874, but no definite record of output is available till 1876, when the mine yielded 1590 flasks of mercury with a furnace of only 15 tons daily capacity. Total recorded production from 1876 to 1879 was 2777 flasks.

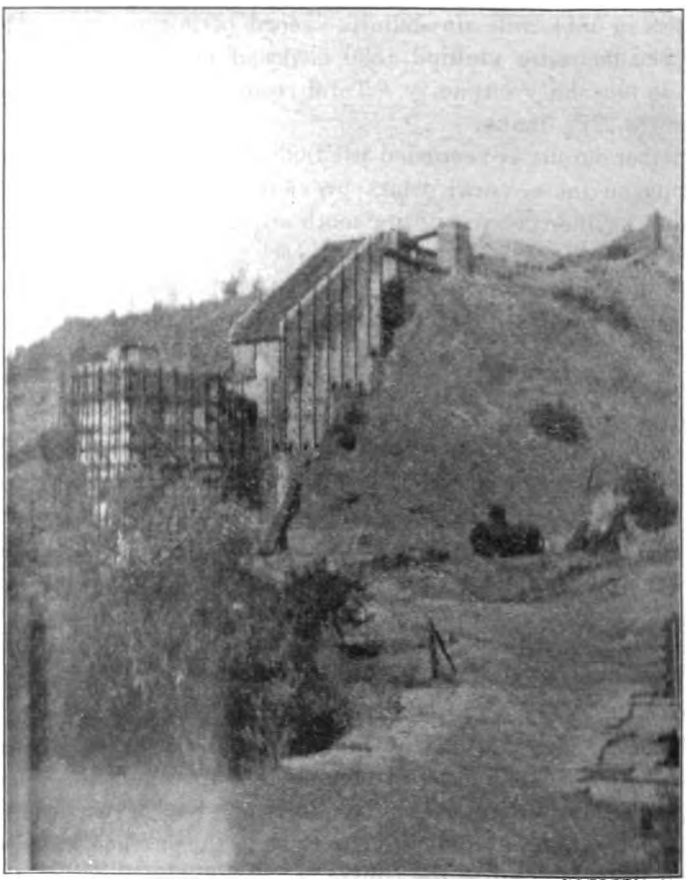
No further output is recorded till 1895, although development work was going on for several years previous, the failure to strike ore being due to ill-advised mining methods, according to local report. Intermittent work was done without very much production till 1901. In the following year the Klau came to the front, being the fourth largest producer in the state and the chief mine of the county in point of output. The county's mercury production that year was 3312 flasks, and the larger portion of this came from the Klau, as the Oceanic furnace was not started till the fall of the year. Work continued, with an 8-tile, 60-ton Scott furnance and 8 condensers till 1908, in which year the production was made from cleaning out old condensers. Another period of inactivity ensued. In 1911 the wooden structure over the furnace and condensers was burned; no production was made during the next three years.

The geology of the mine was fully covered in our Bulletin No. 27. In view of the careful examination made by the writer of that report, and the inaccessibility of many of the old workings, which have been abandoned for years, as well as the lack of time, the present writer did not attempt an examination underground. It is stated that the inclined shaft reached a depth of 800′ and that a large amount of drifting and crosscutting from the shaft failed to reveal ore. These workings became so extensive that a raise to the surface was required to give ventilation, and in the course of putting this through, the best ore-body ever found in the mine was uncovered.

In 1915 the property was leased to George Herring of Paso Robles. The work he did during the year was all superficial. He devoted his attention to searching for small, rich pockets along the top of the croppings and was successful in finding several such, from which the ore was broken and hand-sorted, the richer material being hauled on a sled to the retort. This method of handling brought the total cost per ton up to about $6.00, but the picked ore was so good that a

net operating profit as high as $28.00 per ton was realized, some of the best rock going 1½% mercury.

Besides the furnace, there is a 13-pipe retort which was used by the lessee. This has a capacity of 2½ tons of ore and requires ¾ of a cord of oak wood in 24 hours. Wood for fuel is abundant near at hand and costs $4.00 per cord delivered at the retort. Six men were employed at $2.00 to $2.50 per day each.



Furnace and condensers, Klau Quicksilver Mine, San Luis Obispo County.

The outcroppings are prominent and have been followed for half a mile. Where work has last been done they show a strike a little N. of E. and dip 40° to 50° S. The surface ore is highly siliceous, in contrast to that taken from underground which was clayey and highly pyritiferous, and apparently dipped northeastward, according to old reports. There is undoubtedly a large tonnage of ore in this property which would pay for extraction and furnace treatment. It

will probably be necessary to spend considerable money to unwater the shaft and reopen the old workings if it is desired to use them again. The furnace might develop weakness on being fired up after such a long exposure to the elements.

The property has been sold for $15,000, since the above report was prepared, to E. S. Rigdon and others, of Cambria, and Wm. Bagby of Paso Robles.

Bibl.: Reports X, p. 580; XII, p. 366; XIII, p. 600; Bulletin No. 27, p. 157. U. S. G. S., Monograph XIII; Mineral Resources 1876 et seq., 1902; 1906, p. 492; 1908; 1910; 1912, p. 943; MINING & SCIENTIFIC PRESS, Nov. 12, 1904.

La Libertad (see Belt Q. M. Co.).

Lehman Mine. Located in Sec. 13, T. 27 S., R. 9 E., 12 miles from Cambria and owned by F. Lehman, Cambria. The development consists of a tunnel nearly 200′ long which, when visited, had uncovered no ore of value, although some promising indications are reported for the subsequent month. One man was employed driving the tunnel.

Bibl.: Bulletin 27, p. 161.

Little Bonanza Group, comprises the celebrated Josephine; the first quicksilver mine worked in the county. Of late years the property has been known as the Alice and Modoc and has been described at some length in Bulletin No. 27 of this bureau. Two patented claims are in Sec. 17, T. 27 S., R. 10 E., about twenty miles east of Paso Robles and near the top of the Santa Lucia divide, at an elevation of 2000′; R. W. Putnam, San Luis Obispo, owner; E. S. Rigdon and E. Bianchini, Cambria, lessees.

The original discovery is said to have been made in 1862 by Mexicans. The temporary closing of the New Almaden Mine prompted the purchase of this property by Messrs. Barron & Company. Considerable money was spent in development and an 8-ton furnace was put up. An adverse report on the property by its superintendent, and the reopening of the New Almaden, led to the abandonment of the Josephine. Later work, however, disproved the fanciful theory of the superintendent that the earth's heat had expelled all the mercury in the ore. Several bodies of ore have been worked out by stoping; two in particular showing a thickness of 10′, but little has been done since the work described in our Bull. 27.

The present lessees have put the 12-pipe retort in order and at the time of the writer's visit had already reduced several flasks of quicksilver. The ore was being taken from some of the old workings which had not been exhausted, particularly from the bottom of one of the lenses, which showed some very good indications. The cin-

nabar occurs as crystals in a gangue of mixed carbonates of magnesium and calcium which is highly silicified.

There are two newly observed ore croppings which have been found since our visit; one 60′ west of the upper stope and one 600′ west of the lower open cut. The lessees have begun prospecting these with the hope of uncovering new lenses of workable quality.

Bibl.: R. X; Bull. 27, p. 154; MIN. RES. W. OF ROCKY MTS., Raymond, 1875.

Madrone Mine. John Carmine, Cayucos, California, owner. This is in Sec. 22, T. 27 S., R. 10 E., adjacent to the Belt quicksilver mine. It was worked about 1900 and considerable mercury recovered by retorting, but no depth was attained in any of the operations. The croppings are not particularly different from those in the Belt or Little Bonanza. Some small rich bunches of ore are present both in the characteristic siliceous gangue and in a softer ocherous material, and the wall rocks are similar to those in the two properties above.

In addition to the mineral found in place, there are several bodies of material scattered over the property where free mercury can be panned out. It is found in the loose incoherent soil and must be the weathered product of a one-time outcrop. Samples of this, taken from several places by Mr. Merrifield, the former superintendent, gave from 1½ to 2½ pounds of mercury per ton in the retort. There would seem to be justification for more extensive work on this property.

Bibl.: Bull. 27, p. 161.

Mahoney Mine is situated in Sec. 33, T. 26 S., R. 10 E., 14 miles west of Paso Robles at an elevation of 1140′. Miss Mary O'Tool of San Jose is the owner. The tunnel is said to be 400′ long but was inaccessible when visited on account of water. Recently leased to P. A. H. Arata and R. W. Putnam of San Luis Obispo.

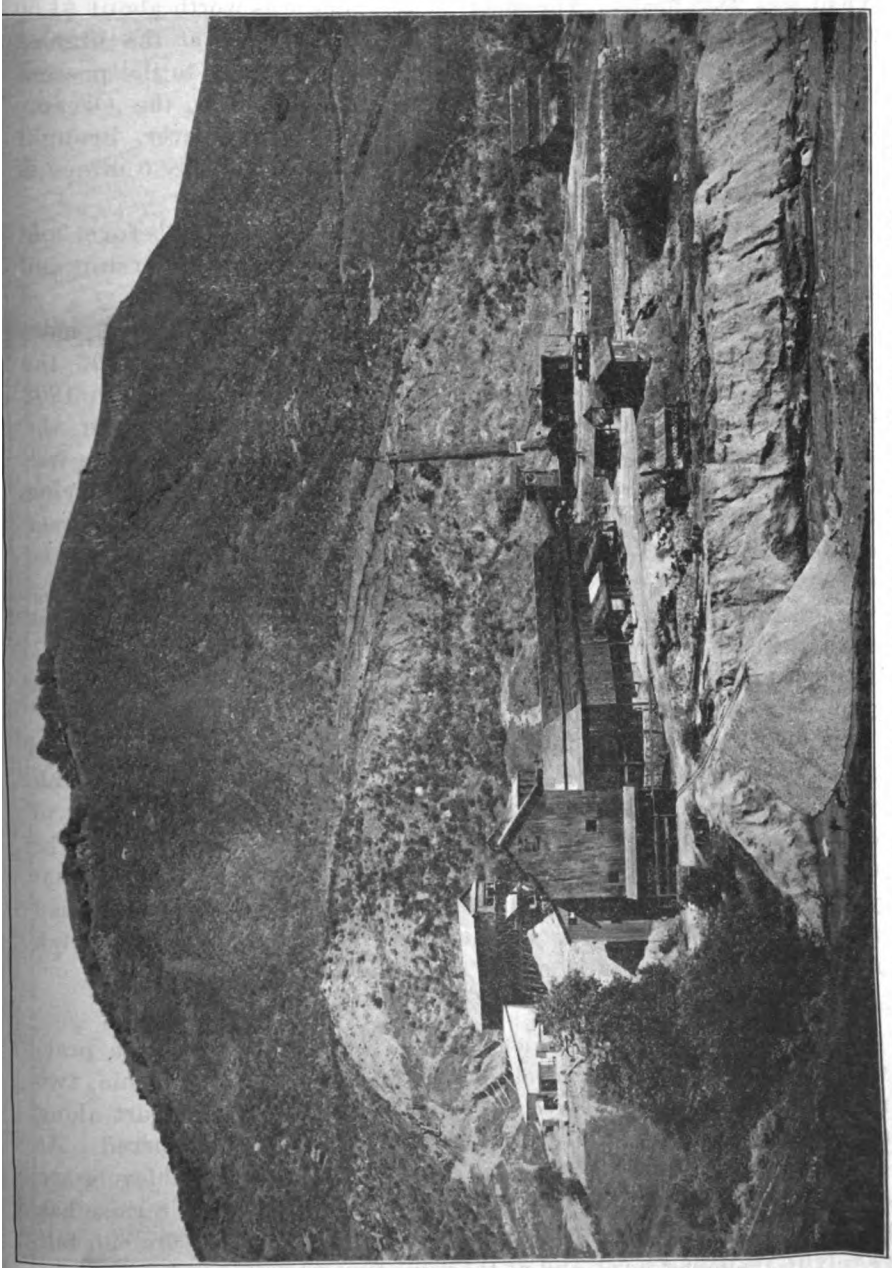
Bibl.: Bull. 27, p. 161.

North Star Mine. Idle for years.

Oceanic Mine is 5 miles from the town of Cambria and comprises three patented claims containing 60 acres, as well as the mineral rights on 400 acres of adjoining land. The property is in Secs. 15 and 21, T. 27 S., R. 9 E., on Santa Rosa Creek and owned by Murray Innes, who is in personal charge of operations at the mine.

The patent for the three original claims was granted in 1865 and was signed by President Lincoln. The mine has an interesting and instructive history.

In 1872 it was taken hold of by a corporation who began developments on a very ambitious scale. A large force of men were hired and 600 acres of timber land purchased. Seven tunnels were driven up in 1874–75. First recorded production occurred in 1876, when the



Reduction plant and mill, Oceanic Quicksilver Mine, San Luis Obispo County. Photo by courtesy of Murray Innes.

and a body of good ore was opened. A Louis Janin furnace was put yield was 2358 flasks. The metal at this time was worth about $1.50 per pound and the quicksilver mining industry was at the highest pitch of prosperity which it has ever enjoyed previous to the present war-boom. During the period of 1876-1879 inclusive, the Oceanic produced 7391 flasks. Sharp declines in price, however, brought quicksilver to less than 40¢ a pound in 1882 and left only 6 mines in the state which could produce without loss.

The Oceanic had practically closed down three years before, and remained idle till 1902, when a new company assumed ownership and erected a 50-ton Scott furnace.

Production was resumed soon after, and was maintained more steadily than at any other property in the county. In 1906 the Oceanic was one of the six chief producers in California and in 1908 it is also mentioned as one of the nine leaders, in spite of the depressed condition of the industry. In 1909 and 1910 the mine was operated by lessees and in the latter year was the only producing quicksilver property in the county. About this time the coarser sandstone ore gave out. The rock on the hanging wall side of the old vein (and easterly on the strike) proved, on exploitation, to be a finer-grained material, carrying cinnabar in much smaller percentage than the old ore. It was erroneously named a shale "mudrock." Failure was the result of all attempts and pessimists decided that the mine was worked out.

In 1912, the present owner took control of the property and assumed personal charge of the mine. He had done considerable work in Arizona and his success there with low-grade bodies of copper ore, led him to believe that he could do something with the Oceanic. He rebuilt the furnace and made a small production that year, besides developing an immense ore body of low grade. He had to work on such a narrow margin of profit that cheap mining, high recovery, and low reduction cost were imperative.

Method of Mining.

The method of mining which he used was new to California practice. It is known as sublevel slicing. As used at the Oceanic, two main or working levels have been driven 150′ vertically apart along the strike of the ore body for 300′. These are well timbered. At vertical intervals of 25′ between the two main levels, sublevels are driven. Mining begins on the far end of the block, where a raise has been cut through. The angle of drilling is such that the ore can fall freely to the lower level, and at the same time permit easy handling of the machines. Holes are driven above and below on a slice and the two rounds of shots break through it, and so on through the block.

East Limit of Ore Body
Open Cut
Old Workings
Mostly Caved
Main Tunnel and Upper Working Level
Lower Working Level
Rich Sandstone (Stoped out)
Fine Sandstone (Present ore)
Serpentine Tongue
Section along the Strike
OCEANIC MINE
San Luis Obispo County
Scale: 1 inch = 150 ft.
C. M. Logan, Del. 1916.

The ore is a peculiar fine-grained sandstone of dark gray color which contains enough calcite to cause marked slaking on exposure. It is high in iron sulphides and the cinnabar values are so finely disseminated as to be invisible underground, but if specimens are taken from any part of the ore block, and are reduced on a buckboard and panned, a surprising prospect is obtained. The ore is quite uniform in value. No defined hangingwall has been uncovered; the cinnabar decreases gradually as the stratum is crossed and the hangingwall may be termed a commercial one, its position being determined by the price of quicksilver. At prices prevailing before the European war it was possible to work an average width of 15′ to 20′.

At the lower main level the ore is shovelled into cars and handtrammed to the shaft. This shaft extends vertically 300′ below the upper level, but at present is used only for hoisting the distance of 150′ to the upper main levels. This level, which comprises 1200′ of old tunnel as well as 300′ of new work, tops the present ore-body about 300′ vertically below the outcrop. Parallel drifts in addition to the 5 sublevels and the numerous crosscuts of 15′ each (which are being driven on the sublevels to facilitate operations and furnish alternate chute spaces) add a great deal to the total of underground work.

The ore is trammed by hand 800′ to the tunnel portal, where a 9″ x 16″ Fort Wayne crusher reduces it to 2″ size. From here the aerial tramway takes it ½ mile to the furnace, into which it is fed direct, with the exception of the small tonnage concentrated.

Concentration.

The concentration plant consists of a 3½′ Huntington mill and a Deister table. It was originally installed for the purpose of handling wet ores and does this nicely, but at present is being used to increase the capacity of the furnace. It handles 15 tons in 24 hours and yields a twenty-to-one concentrate which contains an average of 80% of the values so that its product adds the equivalent of 12 tons daily to the furnace capacity. The ore is crushed to 14-mesh and does not slime appreciably because of the friable nature of the gangue, which releases the small cinnabar crystals easily. The owner does not claim to be attempting a close recovery with this little plant, but aims rather to make a rough concentrate. The concentrates are sun dried in summer, but for winter, a dryer was being evolved at the time of the writer's visit, which utilized the hot exhaust of the distillate engine. This is later reported to be satisfactory. The concentrates are fed into the furnace daily with the ore, not however all at once.

Furnace and Condensers.

The reduction plant comprises a 50-ton Scott furnace with 7 condensers and a two "D" retort for handling the soot.

The high percentage of iron sulphide in the ore has made many changes necessary in furnace practice, but is not without its compensations. The acid fumes quickly eat away any metal with which they come in contact and cause rapid deterioration of the condensers. Sulphide ores are self-burning and when action is once well started a great saving of outside fuel can be effected. An excess of air is also undesirable as it raises the temperature in the furnace too high and creates a strong draft, with a large excess of soot. Under the usual system of reduction this ore would give a high percentage of loss on account of excessive heat and draft, and the recombination of mercury with sulphur in the fumes, would form artificial cinnabar and subsulphides.

Mr. Innes has changed the reduction system from roasting to retorting. The only air which gets into the furnace now filters through cracks. The temperature of the fire box is rather dull red heat and there is barely draft enough to keep the vapor moving, it often being necessary to aid the circulation with a small fire which is located near the stack outlet. The fumes leave the first condenser at a temperature of 180° F.

Two of the brick condensers have recently been replaced by redwood ones. It may be interesting to note here the opinion of Robert Scott, the father of the Scott furnaces. He believes that the failures of the brick condensers in this case is largely due to poor brick, rather than destructive effects of the acid fumes. The redwood has so far proved satisfactory and is believed to cool the fumes much more efficiently than brick. Probably all the condensers here, except the first, will soon be changed to redwood. Very little mercury is saved beyond the fourth condenser. Expansion and rapid cooling are depended on entirely to condense the mercury, all partitions and baffling having been done away with. Another feature introduced by Mr. Innes is a fume trap which closes the top of the furnace, preventing leakage of harmful fumes through the feeding space, and the loss of mercury.

Costs.

Power for mine and mill is furnished by distillate engines of which there are 6, having an aggregate of 114 h.p. The air compressor and hoist are operated by a 40 h.p. and a 25 h.p. engine and at the mill one engine of 21 h.p. operates the Huntington mill and Deister table. The cost per horsepower-year is $25.00. Labor underground and at the furnace costs $2.50 per day and 2 foremen are paid $4.50 each. Forty men are employed; 20 underground and 7 on top at the mine,

3 at the mill and 7 on the furnace, besides 2 foremen. The development has been all in ore and has cost $2.00 per ton. This figure may be taken as the maximum mining cost per ton. Now that the ore is blocked out and put in such shape that slicing is under way, the cost of mining will be very low, possibly 50¢ per ton, because one machine man can drill and shoot a big tonnage per shift in the soft friable ore. Hammer drills, requiring only one man, make drilling costs low.

The figures given below for concentration and reduction costs apply to conditions as they existed in November, 1915.

Concentration Costs.

Wages of 3 millmen at $2.50 per day	$7 50
Cost of power (estimated, basis $25 h.p.-year), 21 h.p. at .068	1 43
Total cost to concentrate 15 tons daily	$8 93
Cost per ton	$0.597

This figure has little significance when it is borne in mind that 3 millmen could take care of a tonnage several times as great with only a slight added expense for power.

Reduction Costs.

3 Furnacemen at $2.50	$7 50
3 Chargemen at $2.50	7 50
1 Foreman	4 50
1 Helper	2 00
1 Cord pine wood, delivered	5 50
Estimated cost of soot treatment per ton of ore, $0.03; per day's run, 50 tons	1 50
Total cost for 50 tons	$28 50
Cost per ton	$0 57

Bibl.: Rep. IV, p. 336 (table); VIII, p. 531; X, p. 580; XII, p. 366; XIII, p. 600; Bull. 27, pp. 151, 162, 243. U. S. G. S., Mon. XIII., p. 382. Min. Res. W. of Rocky Mts., 1875, p. 14; 1876, p. 20. Mining and Reduction of Quicksilver at the Oceanic Mine, Cambria, Cal., by C. A. Heberlein, A. I. M. E., Bull., Feb. 1915.

Pine Mountain Group. Located in Secs. 3, 10 and 11, T. 26 S., R. 8 E., 11 miles east of Port San Simeon and at an elevation of from 2800′ to 3600′. The property was well covered in previous reports by this bureau. There has been no work here for many years. The holdings are now occupied by the cattle ranges of the Hearst estate.

Bibl.: Bulletin 27, p. 163.

Polar Star Mine, comprises two claims, the Polar Star No. 1 and No. 2, located by A. L. Carpenter of San Luis Obispo. The property is in Sec. 13, T. 25 S., R. 6 E., in the cañon of San Carpojoro Creek, 3 miles above its mouth and fifteen miles north of Port San Simeon.

*Cost of superintendence not included, as owner supervises operations. The figures for wood consumption may be figured as including waste and loss, inevitable in using this class of fuel.

The property was worked in 1877 and later by Mexicans, and some good float ore was retorted. Between 1890 and 1900 it was worked by E. S. Rigdon and others, who did some hydraulicking in an attempt to expose a vein. This has not yet been uncovered, although the surface dirt for several hundred feet up the steep hillside is said to carry cinnabar to the extent of 0.1%. The geology has been described in past reports. The writer found no ore in place, but in the creek bed in the center of the claims he found a boulder of over a ton in weight which shows prospects of cinnabar, and some pieces of the ore which were left by the last operators show good amounts of the sulphide. The rock in which the cinnabar makes its appearance is extremely hard being apparently a highly metamorphosed and silicified sandstone. The large boulder no doubt came from either hillside nearby.

Quien Sabe Group of claims, located by Chas. Stilts and J. Rigdon of Cambria is situated in Sec. 14, T. 26 S., R. 8 E., on the west slope of Rocky Butte and near the Doty Mine. Practically no work has been done to hold the claims. The property is fully described in past reports.

Bibl.: Bull. No. 27, p. 165.

Rinconada Mine consists of four patented claims named the San Jose, Rincon, Tres Amigos and Livermore, located in Secs. 21 and 28, T. 30 S., R. 14 E., 11 miles southeast of Santa Margarita. It is sometimes referred to as the San Jose Valley Mine. Mrs. Theresa Bell of San Luis Obispo is the owner.

The property was located in 1872 and in 1876 was equipped with a furnace of the old sheet iron type, with 5 sheet iron condensers. The designer attempted to keep the mercury vapor separated from the fuel smoke, but the only definite result achieved was the salivation of all the furnace employes. It is said that little if any quicksilver was recovered. The plant was abandoned in 1883. When it was reopened in 1897, two benches of 10-pipe retorts each were put up. Some rich ore was treated and a small production was made, no definite figures of which are now obtainable.

The upper tunnel, said to be 75′ long, is now caved and inaccessible. Two intermediate tunnels were driven 40′ and 25′ respectively, and there is a lower tunnel 200′ long as well as several small tunnels and open cuts. The geology has been previously described and there has been no recent work sufficient to uncover further points of interest.

The ore so far worked occurred in small rich bunches, at times nearly solid cinnabar. A former employee at the retort states that some ore gave 5 flasks from 2½ tons and in a few cases as much as 65 to 80 pounds were obtained from a single charge in one pipe. Some samples which have been assayed carried a little silver and iron

sulphide with $2.60 per ton in gold, besides the quicksilver. A little ore has been mined recently and hauled to the retort on a sled, but had not yet been reduced. The capacity of the retorts is 3½ tons per diem. Fuel is easily obtainable nearby.

Bibl.: Bull. 27, p. 166; R. X, p. 581; R. XII, p. 366; R. XIII, p. 531.

Sierra Morena (see Klau Mine).

Sunset View Quicksilver Mine. Idle for years.

Bibl.: Bull. 27, p. 167.

Tartaglia Group, formerly known as the George and Josephine Group, are owned by J. Tartaglia of Klau. This property lies adjacent to the Bell Quicksilver holdings, in Secs. 18 & 20, T. 27 S., R. 10 E. The original discovery was made in 1862. A furnace was erected and the dump indicates that considerable ore was burnt, but there is hardly a vestige of the plant left and no figures of past production are obtainable. The works were all superficial and the ore revealed was similar to that in the Little Bonanza croppings nearby. Only assessment work is contemplated at present. The claims are 20 miles west of Paso Robles, at an elevation of about 1900′.

Bibl.: Bull. 27, p. 157.

Vulture Mine is situated on Vulture Mountain, in Sec. 24, T. 27 S., R. 9 E., 10 miles east of Cambria. The amount of work done has been insufficient to uncover any ore, although there are prospects of cinnabar. Since the last report on this prospect, only a little superficial and desultory work has been performed and there was nothing new to record when the writer visited the district. E. S. Rigdon, F. Lehman, and others of Cambria are the owners.

Bibl.: Bull. 27, p. 167.

Warren Ranch, adjoining the Oceanic Mine. Float ore occurs over an area ¼ mile wide down a steep hillside from near the summit. Murray Innes, of the Oceanic Mine drove a 60′ tunnel into the hill in an effort to find an ore-body in place. Wm. Spargo also drove two tunnels totalling about 200′, but no deposit of any value was uncovered in either instance.

William Tell Mine in Sec. 32, T. 26 S., R. 10 E., shows no new development since the last report.

Bibl.: Bull. 27, p. 168.

Wittenberg Mine in Sec. 8, T. 27 S., R. 9 E., has been idle for a number of years.

Bibl.: Bull. 27, p. 168.

SALINES.

Salinas River, from the Spanish meaning salty, was so named because of the saline springs found along its course and near its source.

Soda Lake, or Dry Lake, as it is often called, lies in Carrizo Plain, T. 31 S., R. 20 and 21 E. It contains about 3000 acres, practically all of which have been located by the Consolidated Chemical Company, which has 23 claims. The lake receives the drainage of the Carrizo Plain, a peculiar depression formed by the faulting down of a large district. The salts leached out by the rain water have formed a layer, usually very thin, but in places filling deeper channels. Under this crust is a mud layer containing considerable of the salines in solution, but there has been no work below this to show whether any deeper strata of salt exist or not.

The deposit is principally sodium sulphate, but crystals of bloedite, a hydrous sulphate of magnesium and sodium, which has been found at only one other place in the country, have been identified here. The region has been carefully studied by the United States Geological Survey, with special reference to the occurrence of potassium there; but analysis showed there was only a negligible quantity of it present. There is not much call at present for natural sodium sulphate, although it is used under the name of Glauber Salt in medicine, and on a small scale for making glass, dyeing, and coloring. The price ranges from $11.00 to $18.00 per short ton, and has shown no improvement in the past year.

Consolidated Chemical Co. has a plant at Dry Lake for evaporating the saline water and recovering the solid salt. There are several large open tanks and a windmill, as well as other equipment, the original total expenditure having been about $25,000. Transportation is a big obstacle toward operating here, even if a market should be found. While McKittrick is only about 16 miles away, steep mountains intervene. The amount of salines available have been calculated at over one million tons. The analysis follows as published by the U. S. G. S.:

Insoluble	0.40
Al_2O_3	.04
MgO	1.66
CaO	.45
Na_2O	40.50
K_2O	.28
H_2O	3.65
CO_2	____
SO_3	46.12
Cl	9.27
	102.37
Less O	2.09
	100.28

Bibl.: Reports, VIII, p. 532; X, p. 563; Bull. 24, p. 136. U. S.

STONE INDUSTRY.

Many varieties of stone have been used in the county for building purposes and road construction, harbor work and culverts. A large tonnage was required for use on the state highway recently constructed, and the search for material near at hand led to the opening of several new plants within the past year to supply crushed rock, sand and gravel. While the region has a plentiful supply of stone suitable for cutting and polishing, the distance of the deposits from transportation and the lack of a nearby market of any importance, render the possibility of their exploitation very doubtful.

BUILDING AND MONUMENTAL STONES.

Bishop's Peak Quarry, owned by L. H. Nichols, 1015 Monadnock Building, San Francisco, was formerly operated at two openings on the side of Cerro Obispo, which lies just outside of San Luis Obispo, and was served by a spur track from the narrowgauge railway. No work has been done here for several years. The rock, an andesite granophyre of dark gray color and subconchoidal fracture, has been used extensively for foundations and curbing, and a few buildings in San Luis Obispo, including one of the schools, are built entirely of it.

Bibl.: Bull. 38, p. 153; U. S. G. S. Folio 101.

Caen Quarry, formerly operated in two places, in Sec. 36, T. 32 S., R. 13 E., M. D. M. and in Sec. 26, T. 12 N., R. 35 W., S. B. M., has been idle for years. The material here is a yellow, calcareous cemented, volcanic tuff, which possesses considerable strength and is easily cut to shape for building stone. It was quarried in large blocks which were sawed up into desired sizes and hauled to the railroad two miles away. The quarry was last operated about ten years ago and the tuff was used a little for buildings in Arroyo Grande, San Luis Obispo, and Los Angeles. The greatest faults of the tuff are its porosity and the ease with which it stains. The photograph above shows this material in the arches and windows of the public library.

Bibl.: Bull. 38, p. 159; U. S. G. S. Folio 101.

Lee Quarry, in Sec. 17, T. 30 S., R. 12 E., on the north side of Cerro Romaulda, furnished a large tonnage of rock similar to the material from Bishop's Peak, but has been idle for 25 years.

Bibl.: Bull. 38, p. 160; R. XIII, p. 623; U. S. G. S. Folio 101.

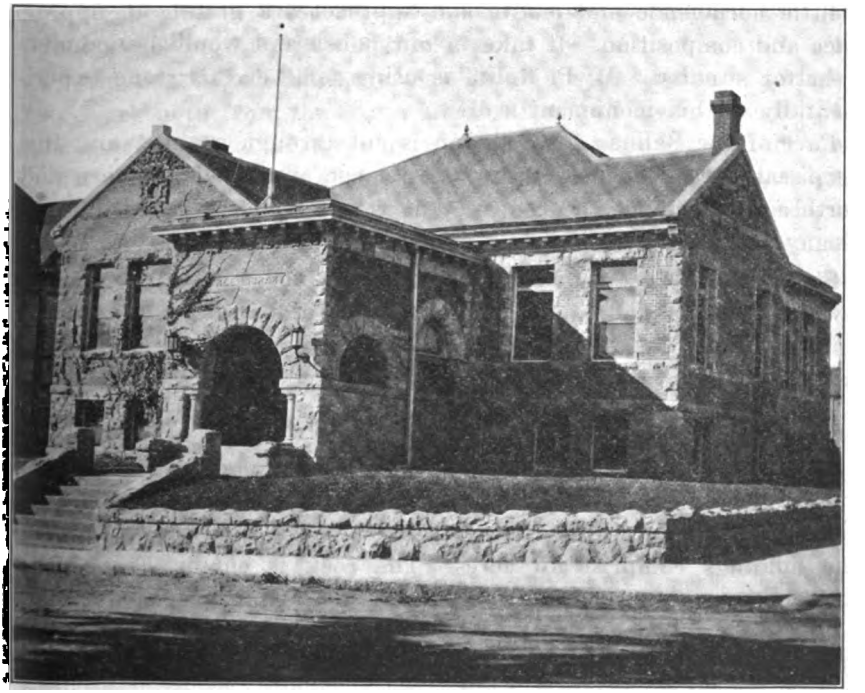
Moore Quarry, in Sec. 31, T. 12 N., R. 35 W., S. B. M., owned by P. Moore of Arroyo Grande was worked by the same company which operated the Caen Quarry, and furnished the same kind of material, though perhaps of better quality. The property has been idle for

years and the equipment has been removed. The deposit is not far from Los Berros, on the Pacific Coast Railway.

Bibl.: Bull. 38, p. 160; U. S. G. S. Folio 101.

Morro Rock, which is an island at the entrance of Morro Bay and is the farthest northwest of the buttes which form a line from below San Luis Obispo to the ocean, is composed of a granophyre which has been used a good deal at Port Harford for breakwater construction. The quarry is on a government reservation and is now idle.

Bibl.: Bull. 38, p. 161; U. S. G. S. Folio 101.



Free Public Library, San Luis Obispo. Local building materials were used in its construction.

H. J. Griffith does a small business cutting stone at San Luis Obispo. For the bases of all of his monuments, where the stone does not require polishing, he uses the andesite granophyre from Bishop's Peak. His equipment includes a gasoline engine and air hammer drill.

Sunset Monument and Building Works, M. P. Rolita, proprietor, San Luis Obispo. The owner and occasionally an extra man are employed in making monuments, curbing, coping, and house foundations. The rock from Bishop's Peak is used for all unpolished

work and is rather well liked for curbing, especially on account of the way it fractures. Hand tools are used. The rock is of two shades and degrees of hardness, because of the difference in weathering.

On the ranch of **Dan Tomasini,** 7 miles from Morro, there is an extensive deposit of a rhyolitic rock of light brown color, which shows to advantage when rough dressed. M. P. Rolita is using a little of it for monument work, but it is too remote from transportation for active exploitation.

Walter Ranch, Chas. Walter, owner, 8 miles from Morro. A deposit of a fine-grained, light-colored rock occurs which contains a little hornblende and biotite and approaches a granite in appearance and composition. It takes a fair polish and would be valuable if better situated. M. P. Rolita is using some of this stone experimentally in his monument work.

Part of the Salinas River cañon is cut through **granite,** and this deep-seated rock is uncovered over a large area in the eastern and northeastern part of the county; but is too remotely situated to be of any economic value at present.

Sandstone of good quality for building construction occurs at several places in the county but has never been utilized except for making railroad culverts. The best material is found between Cambria and Cayucos on the coast and close to deep water transportation.

CRUSHED ROCK, SAND AND GRAVEL.

Dougherty Quarry is owned by A. A. Dougherty of San Luis Obispo and is 3 miles south of that city, in Sec. 9, T. 31 S., R. 12 E. Development was initiated in September, 1914, by Otto Wannack. The holdings comprise 15 acres. The rock is chiefly Franciscan sandstone, which crops in a steep wall, permitting easy quarrying. Holes 15′ to 22′ deep are put down by hand and the face blasted off by dynamite. The big blocks are broken to one-man size. Before tramming to the crusher the material is sorted into two grades: the blue, well-cemented sandstone and a softer, brownish rock, which comes from the top and is not as clean as the blue.

The stone is reduced to about 3″ size and is stored partly in a 500-ton bin and partly over trestles in big piles in the open. Power is furnished by gasoline engines at a cost of 2¢ per h.p.-hour. There are 7 engines, including one of 80 h.p. and one of 50 h.p. Other equipment includes one 7½″ x 3″ gyratory crusher, 24 cars, 500-ton bin, and buildings for office, boarding-house, and sleeping quarters. A spur track from the Pacific Coast Narrow Gauge Railroad furnishes transportation. The capacity of the plant is 300 tons per day. Past

production has been at the rate of about 50,000 tons per annum. A crew of 75 men are employed at wages ranging from 25¢ per hour up. There is little overburden and, considering the small investment in plant, the cost of production per ton is not extremely high.

The bulk of rock sold has been for use on the state highway system. The hard, blue material is excellent for concrete and is used for the central roadbed; the brown sandstone is used for shoulder-work and for macadam, where the duty is not so heavy.

I. C. Hodson of Santa Barbara sells to the California Highway Commission a small tonnage of sand for concrete work. The material comes from the Santa Maria River, two miles from the town of the same name and near the railroad. Hand shoveled into the cars, and only a few men employed.

Pacific Coast Coal Company, San Luis Obispo, sells sand for concrete work both from the Santa Maria River and Avila Beach. The sand is taken from the river during the dry season, being shovelled by hand into cars. At Avila Beach a narrow strip along the shore near tide-water is worked in the same way, both places being adjacent to the Pacific Coast Railway tracks. About 12 men are employed a part of the time. During 1915 over 20,000 tons of this sand was used in state highway construction and proved very good for concrete.

Santa Maria Rock Company, now defunct, operated a small rock crushing plant on Nipomo Creek, which supplied a few thousand tons of material for highway construction early in 1915.

On the **Frank Tate Ranch,** 2 miles northeast of San Luis Obispo, a small rock crushing plant, equipped with a gyratory crusher, was put up early in 1915. The rock was an extremely hard and tough basic intrusive which fractured in long splintery pieces. The man who was operating the plant found it so costly to reduce the material that he was forced to abandon work after selling a few thousand tons, although the Highway Commission was paying $1.00 per ton and he was getting the material on a very low royalty basis.

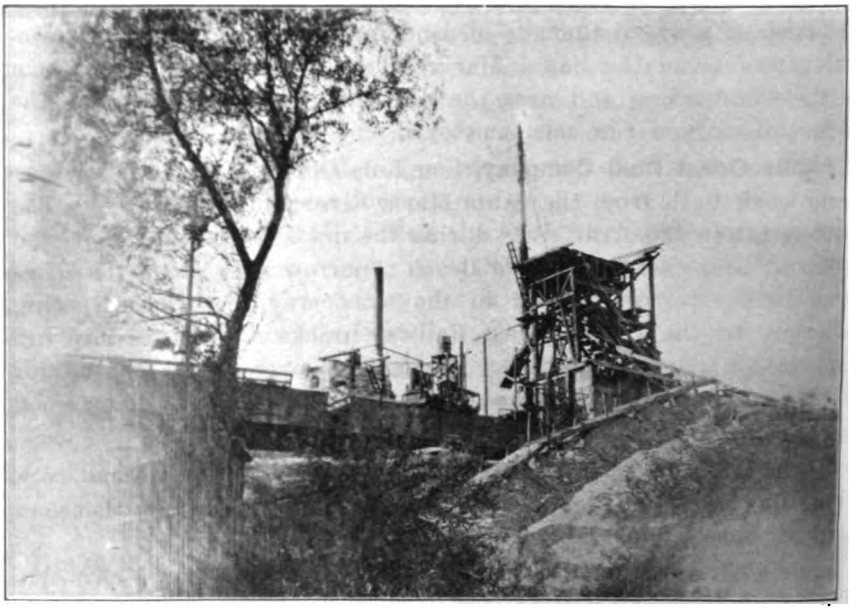
Templeton Sand Plant, operated by the California State Highway Commission at Templeton, occupies about 15 acres on the Salinas River at the edge of the town.

The plant was built in February, 1915, and supplies sand for highway work for several hundred miles along the coast route.

A drag-line scraper, of 24 cubic feet capacity, takes the sand from the river bed and delivers it to the top of the plant, where it goes through a chute to a trommel. The latter screens it, rejecting everything over $\frac{3}{8}''$. At the trommel the sand is washed to remove the small amount of clay and to facilitate handling. From the trommel

the coarse goes to the dump, being kept for use later as gravel, and the fine goes down a chute directly to the railroad cars on the spur track built to the plant. Storage at the plant is not required nor provided for. The sand is a clean angular material, mostly quartz, and ranges up to ¼″ in size, without much coarser stuff.

A 50 h.p. boiler fired by crude oil furnishes power for the 32 h.p. hoist which operates the drag-line scraper. The trommel is 7′ long and is operated by a 5 h.p. motor. Water for washing the sand and



Templeton sand plant. Operated by the California Highway Commission.

for other purposes is pumped from the river 300′ away by an American centrifugal pump, operated by a 7½ h.p. induction motor. Small tanks provide storage for fuel oil and water. The boiler requires from 150 to 175 gallons of crude oil per day, depending on weather conditions. Three men are employed at $2.50 to $3.50 per diem. A maximum capacity of 385 tons per day is possible.

The sand is furnished by the commission to the contractors at 20¢ per ton and gravel at 25¢, which figures, they claim, represent the cost of production. The total output from February to December, 1915, was about 25,000 tons.

SANTA BARBARA COUNTY.

By EMILE HUGUENIN, Field Assistant.

Field Work in November, 1915.

INTRODUCTION.

Santa Barbara County, created February 18, 1850, is one of the original twenty-seven counties of the state and takes its name from the mission that was founded upon its shores in 1786.

This county consists of 2740 square miles including the islands of Santa Cruz and Santa Rose, which lie 20 miles off the coast forming a natural breakwater 70 miles long. It is bounded on the north by San Luis Obispo County, on the east by Ventura County, and on the south and west by the ocean; having a coast line of about 100 miles.

The population, according to the census of 1910, was 27,738 and is now estimated at over 30,000 as there has been a rapid increase in the last few years. Its assessed valuation in 1915 was $35,062,648.

The city of Santa Barbara, the county seat with a population of approximately 18,000, lies on the shores of the channel. Due to the equable climate and beautiful surroundings it almost doubles in population during the winter months as people from many parts of the United States winter there.

TOPOGRAPHY.

Santa Barbara County is traversed by two main mountain ranges, the more prominent of which is the San Rafael Mountains. This complex range is divided into two groups by the Sisquoc River and is the continuation of the Coast Range Mountains. It has a structural trend of N. 50° W., and its peaks vary in elevation from 3000′ to 7000′; Big Pine Mountain 6828′, San Rafael Mountain 6581′, Strawberry Peak 6548′, and McKinley Mountain 6228′, being the most prominent ones.

The Santa Ynez Range, bordering the channel, rises directly from the sea to elevations which vary from 1000′ in the west to over 4000′ in the east where it joins the San Rafael Mountains. These two divergent ranges form a triangular hilly basin which opens out toward the coast. The Santa Ynez Range is more regular than the San Rafael Mountains and its topography reflects the structure even more than does that of the greater range.

The Casmalia, Solomon, and Purisima Hills, of much less importance than the two main ranges, are distinct structural and topographic units rising from the broad plain between the foothills of the San Rafael Mountains and the Santa Ynez Range and having the same general trend as the bordering ranges.

The principal valleys are the Santa Maria, Los Alamos, Lom
Santa Ynez and Cuyama valleys. The Santa Maria Valley is a br
flood plain extending from the San Rafael Mountains on the nort
the Solomon Hills on the south and opening out to the sea on the w
The general direction of the valley is north of west. The Los A
Valley lies between the low rounded Solomon Hills on the [illegible]
higher more abrupt Purisima Hills on the south, running almo
west. The Lompoc Valley is an alluvial flat several miles wide e
ing westward from the Purisima Hills to the sea. The Santa
Valley is a long narrow valley ranging in width from a few hu
feet to over a mile, running westward and opening out into the L
Valley. The Cuyama Valley covers a large area in the northe
portion of the county. It is a wide structural valley extendin
San Luis Obispo County on the north, and bounded on the south
Cuyama Mountains.

STREAMS.

The two principal drainage systems of the county are the
Maria, or Cuyama River, and the Santa Ynez River. The former
natural boundary between Santa Barbara and San Luis Obispo
ties. It rises in the high mountains in the northwestern part of Ve
County and flows, in general, westward, draining the Cuyam
Santa Maria valleys.

The Santa Ynez River, which rises in the mountains north of
Barbara, flows westward between the Santa Ynez and San Rafael
tains, entering the sea at Surf. Both of these streams carry very
water and run dry during the summer.

The Los Alamos Creek, next in importance, flows westward, dr
the Los Alamos and San Antonio valleys.

WATER SUPPLY.

The City of Santa Barbara has driven a 5′ x 6′ tunnel, 19,560′
through the Santa Ynez Range. The south portal of this tunnel is
Mission Cañon, 4 miles north of Santa Barbara, at an elevation of
The north portal is in the Santa Ynez Cañon, 1216′ in elevation.
was commenced at both ends of the tunnel in April, 1904, and
completed July, 1913. This tunnel forms a drainage for the wate
in storage in the mountain, and the flow encountered here was fo
eral years sufficient to supply the city, which consumes 2,000,000
daily. This storage water has gradually been decreasing, and it
necessary to supplement it by diverting water from the river t
the tunnel.

e and lime	Sandstone		Stone industry, value	Unapportioned and miscellaneous	
Value	Cubic feet	Value		Amount and kind	Value
				Gold	$2,000
				Gold	$41,423
				Gold	10,293
				Gold	2,478
				Gold	896
				Gold	4,000
	5,000	$500		12 ounces platinum	44
				Gold	8,592
				Gold	3,000
				Gold	1,000
$3,602	224,820	117,260	$82,662		
	72,000	27,100	33,400		
25,000	74,200	21,500		Gold	200
30,000	82,654	34,240	4,395		
40,000					
12,000	5,000	3,600			
7,500	29,600	18,330	57,792	52 flasks quicksilver	2,070
				Gold	725
16,000	36,195	25,230	9,732	Silver	2
				Gold	250
30,000	39,740	37,566	4,950	flasks quicksilver	2,289
33,160	10,525	6,545	10,990		
6,619	31,120	10,648	5,316	Unapportioned, 1900-1909	89,254
7,898	39,720	15,888	6,085	70 flasks quicksilver	3,225
8,174	58,976	29,507	6,602	50 flasks quicksilver	2,301
16,434	4,500	1,670	17,480	12,000 tons clay	16,000
11,663					
25,910	4,500	1,670	11,450	12,000 tons clay	16,000
19,623					
11,263	9,286	1,850	15,300	Miscellaneous	70,000
10,006	29,900	6,488	13,900	Other minerals	61,600
$314,855	757,736	$359,592	$279,945		$262,785

It is proposed to construct a dam 150′ high, about 1000′ east of and above the north portal of the tunnel, in the Santa Ynez River. A concrete foundation 10′ in height, and a diverting tunnel 982′ long from the dam to the main tunnel, have already been constructed. It is estimated that the completed dam will form a reservoir of sufficient capacity to supply the city over a period of 2 years, exclusive of rainfall.

In the Santa Maria Valley are a number of artesian wells. Guadaloupe is supplied principally with water from these wells. Montecito, a suburb of Santa Barbara, derives its water supply from wells sunk close to the coast.

CLIMATE.

The climate of Santa Barbara County is equable throughout the year, excessive heat and cold being very rare. The western coast region is subject to heavy fogs and strong ocean winds. The southern coast is more sheltered, and fogs occur rarely. The rainfall varies from rather light in the valleys to 30 inches on the coast, being confined to the winter and spring months.

TRANSPORTATION.

The county is traversed by the Southern Pacific railroad which follows the coast line, with branch lines from Guadaloupe to Betteravia and from Surf to Lompoc. The Pacific Coast Railroad, a narrowgauge line, runs from Port Hartford in San Luis Obispo County, through Santa Maria to Los Olivos, with branches from Santa Maria to Betteravia and Sisquoc. This company also operates an electric line from Guadaloupe to Santa Maria, which connects Santa Maria with the S. P. R. R. Several auto stage lines make the interior towns easily accessible to the railroad and to the larger cities.

MINERAL RESOURCES.

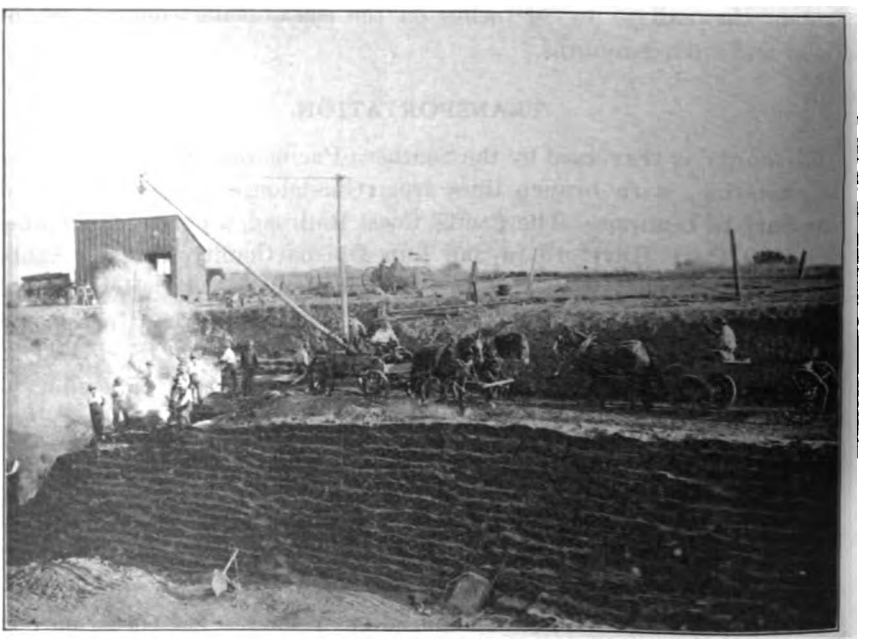
As will be seen by referring to the Table of Mineral Production, by far the most important mineral yielded is petroleum. The total value of the petroleum produced up to December 31, 1915, amounts to over 80% of the total mineral production of the county. The actual output of minerals is in excess of that shown by the table. Los Prietos Mines are known to have produced quicksilver as early as 1874, though no record of the production has been kept. Gypsum, which does not appear listed in the table, was shipped from the Pt. Sal Mine for several years previous to 1880. Many prospectors have worked the auriferous sands along the beaches from Pt. Arguello to Pt. Sal, of which no records were kept.

The total recorded production of the county up to the end of 1915 is $42,740,545. The products in order of their value are: petroleum,

natural gas, asphalt and bituminous rock, mineral water, sandstone, limestone and lime, infusorial earth, brick, stone industry and gold. Quicksilver, platinum and silver are combined under the head of miscellaneous and unapportioned. In addition are known occurrences of barytes, chromite, copper, gypsum and manganese.

ASPHALT and BITUMINOUS ROCK.

These have been grouped under one heading as they were used for the same purposes, both in refining to obtain pure asphalt and for use as road material. There are many deposits of asphalt and bituminous rock in the county, only one of which is worked. All of the asphalt produced is that derived as a by-product in refining crude oil, as it was found impossible to produce asphalt of as pure and even a grade from the crude material as that produced at oil refineries.



Bituminous sands at Higgins Mine, Carpinteria. Photo by A. Sattler.

Harris Mine, formerly worked by the Pacific Asphalt Company, is located 4½ miles north of Harris Station on the Los Alamos Grant. No work has been done on this deposit for 10 years. Property is under lease to the Pinal Dome Oil Company.

Bibl.: R. XIII, p. 39; R. of Minerals of Santa Barbara County; U. S. G. S. 22d Annual Rep., Part I, p. 428.

Higgins Mine, Mrs. Mary Higgins, owner, is 1 mile southeast of Carpinteria station, between the railroad and the sea. Beds of bituminous sands varying in width from 12′ to 20′ lie flat in a shallow V-shaped trough of underlying shales that opens westward toward the sea. This is a continuation of the deposit known as Los Conchas Mine, formerly worked by the Alcatraz Asphalt Company, and is the only deposit at present worked in the county.

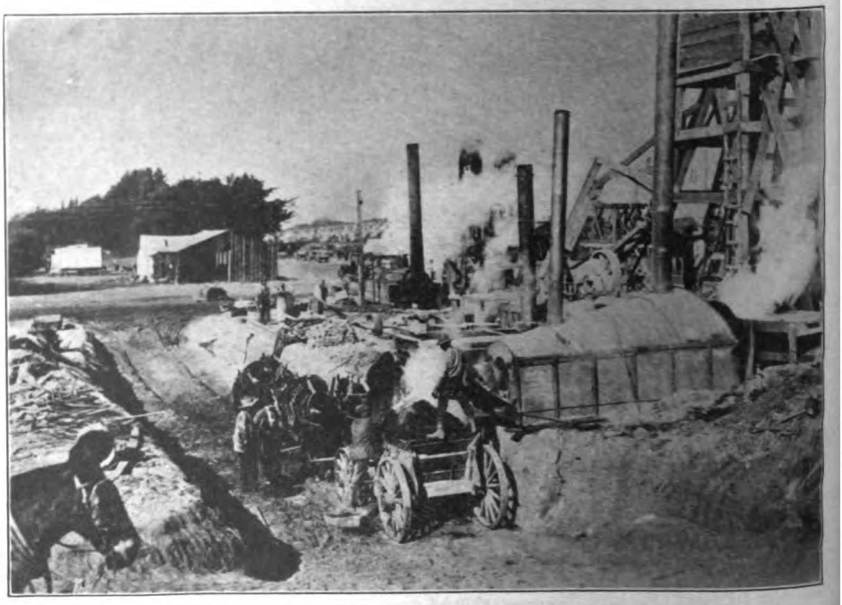
The sands are covered with a soft soil overburden 4′ thick and are easily worked. The overburden is stripped off, used for filling, and the bituminous sands dug out with hot spades. This material is said to contain from 18% to 20% bitumen.

Mining bituminous sands at Higgins Mine for paving Goleta Road. Photo by A. Sattler.

The crude material is heated in revolving cylinders called "torpedoes," and mixed with sand and crushed rock in the following proportions: 2 parts crude material, 2 parts crushed rock, 1 part sand. The charge is heated to 375°, ten minutes time being required to effect a thorough mixture. The rock used is crushed to 1″. Each "torpedo" handles 1¼ yards per charge. A spur track of the S. P. R. R. runs into the property.

Over 20,000 tons of this material have been used on the roads in Santa Barbara County in the past few years. The Goleta and Carpinteria roads are fit examples of the excellency of this material for road

Mining with hot spades at Higgins Mine. Photo by A. Sattler.



Plant for treating bituminous sands at the Higgins Mine. Photo by A. Sattler.

use, as they were laid down with only a 4″ covering over a dirt base, several years ago and are yet in excellent condition.

Worked by A. Sattler and E. P. Stevens of Carpinteria, lessees.

Kaiser Asphalt Mine, formerly operated by the Consolidated Asphalt Company, has been idle for many years and the company was disorganized. The property is now owned partly by the New Pennsylvania Oil Company, and partly by the Rice Ranch Oil Company.

Large bed-like deposits of asphalt varying from 20′ to 70′ thick, capped with sandstone, occur in the Graciosa Hills. These deposits were mined by shaft and tunnels, and the material treated at a small refinery erected at the mine. It was never a commercial success.

Bibl.: R. XIII, p. 38; R. of Minerals of Santa Barbara County; U. S. G. S. 22d Annual Report, Part I, pp, 427, 428.

Well drilled in bituminous shales at Carpinteria. Filled with liquid asphalt.

Las Conchas Mine, owned by W. H. Crocker et al., San Francisco, adjoins the Higgins Mine on the west (see above). It was the first deposit of asphalt worked in the county. Upper State street, Santa Barbara, was paved with the material 30 years ago and is still in good condition. A refinery was erected by the Alcatraz Asphalt Company and the deposit worked many years. Practically exhausted. Idle.

Bibl.: R. XIII, p. 38; R. of Minerals of Santa Barbara County, Bull. 11, p. 51; U. S. G. S. 22d Annual Report, Part I, p. 444.

La Patera Mine is on the Den Ranch, 2 miles southwest of Goleta. This deposit of bituminous rock was mined by the Alcatraz Asphalt Company, and the material treated at the company's refinery at Carpinteria. Exhausted in 1898. Yielded 60% bitumen.

Bibl.: R. XII, p. 30; XIII, p. 39; R. of Minerals of Santa Barbara County; U. S. G. S. 22d Annual Report, Part I, p. 442.

More Asphalt Mine, owner, J. F. More of Goleta, is situated 2 miles south of Goleta along the coast at More's Landing. A deposit of bunch-like veins of bituminous rocks, exposed along the beach by the banks caving away. These veins are very irregular, and of great width and unknown depth. The deposit was worked for many years by quarrying but is now idle, with no prospect of resuming. The first asphalt used for street work in San Francisco was that shipped from here over thirty years ago.

Bibl.: R. XIII, p. 39; R. of Minerals of Santa Barbara County, 1906. U. S. G. S. 22d Annual Report, Part I, p. 441.

Santa Maria Asphalt Company's Mine, 10 miles southeast of Santa Maria, is the property of the Rice Ranch Oil Company. Asphaltum and bituminous rock outcrop over many acres. Worked by open cuts and tunnels many years ago. Company disorganized. Idle.

Bibl.: Rep. XII, p. 32; XIII, p. 39.

Sisquoc Mine, situated on the Sisquoc Rancho, 20 miles southeast of Santa Maria, was worked by the Alcatraz Asphalt Company over 20 years ago. Large lens-like deposits of bituminous sands, averaging 200′ thick, cover an area of approximately 6 square miles. It has been estimated that this area contains over 50,000,000 cu. yds. of the bituminous sands. A large refinery was constructed for treating the sands but was not a success. Plant removed and mine abandoned. Owned by Sisquoc Rancho Company.

Bibl.: R. XIII, p. 42; R. of Minerals Santa Barbara County.

BARYTES.

Eagle Mine, owners P. D. Jesse et al., Santa Maria, is in Secs. 5 and 6, T. 10 N., R. 30 W., S. B. M. A vein of pure white barytes, averaging 20′ or more in width, is exposed for several hundred feet along the top of ridge above the North Fork of La Brea Creek, at an elevation of 2800′. The vein occurs in a tough gray sandstone, strike E. and W., with the trend of the ridge, and dips steeply to the north. Samples of the barytes are said to have analyzed 97% $BaSO_4$. Deposit reached by 20 miles of trail and road to Sisquoc, the nearest point of transportation.

Bibl.: R. of M. S. B. Co., 1906.

BRICK.

Grant Brick and Tile Company, P. Grant and E. P. Stevens, owners. Brick yard at west end of Montecito St., Santa Barbara. No production for past two years. Idle.

Bibl.: Bull. 38, p. 257.

Milpas Street Brick Yard, Santa Barbara, W. T. Coleman, owner. A clay bank 5′ to 10′ high is quarried by pick and shovel and the clay hauled in 1800 lb. car up incline track 100′ to a machine press. The bricks are air-dried and burned in open kilns. Crude oil is used. Plant equipped to handle 30M to 40M bricks daily. Work 5 months during the year, employing 16 men.

Bibl.: Bull. 38, p. 257.

CHROMITE.

Deposits of chromite occur in the hills southwest of Pt. Sal and in the San Rafael Mountains, south of Santa Ynez. As these occurrences are small and inaccessible they have never been developed.

COPPER.

Croppings of copper ore occur along the south slope of the San Rafael Mountains northeast of Los Olivos. The ore is azurite and chalcopyrite associated with quartz in mineralized shales. The croppings may be traced for four miles striking east and west with the trend of the range. Several claims (listed below) have been taken along these croppings and a little development work done, but there has been no production. This region is rather inaccessible being 12 miles or more from Los Olivos, the nearest railroad station.

Copper King Mine, owned by P. B. Montanaro, Los Olivos, consists of 2 unpatented claims in Sec. 5, T. 7 N., R. 29 W., S. B. M. An 1100′ tunnel was driven in to cut a quartz ledge containing chalcopyrite. This mine is very inaccessible, being located near top of ridge. Worked for assessment only.

Bibl.: R. of M. S. B. County, 1906.

Laguna Ranch Mine, owned by the Laguna Ranch Company, has been leased by P. B. Montanaro, Los Olivos. This deposit is on the Laguna Ranch, 3 miles directly west of the Copper King claims. The ore at the surface is azurite and malachite, associated with quartz in a zone of mineralized shales 40′ wide. The strike of the vein is E.-W., and dips about 45° N. The development consists of 2 tunnels, each 40′ long. Worked for assessment only.

DIATOMACEOUS EARTH (See Infusorial).

GOLD.

Gold and platinum occur in the black sands that are deposited more or less continuously along the beaches from Pt. Arguello north to the mouth of the Santa Maria River. The most important deposits are at Surf, and north of Pt. Sal. These sands were worked by washing over amalgam plates many years ago and some gold and platinum produced. Several different types of machines were tried for the profitable extraction of the precious metals none of which thus far have been successful.

The black sands lie in strata of from ½″ to 2″ thick and are covered by layers of gray beach sands up to several feet thick. During heavy storms the lighter beach sands are at times washed away and the black sands exposed.

Bibl.: R. VIII, p. 537; X, p. 598.

Albernathy Mine, on the beach north of Pt. Sal, was worked many years ago by washing the black sands over plates. The gold occurs in minute flakes and it was found impossible to extract at a profit. Abandoned.

Bibl.: R. XIII, p. 348; R. of M. Santa Barbara Co., 1906.

Anna Moore Mine (quartz). Located on the San Lucas Ranch in the Santa Ynez Mountains, 30 miles northwest of Santa Barbara. Development consists of a short tunnel driven on a vein that showed traces of gold. Abandoned.

Bibl.: R. XIII, p. 348.

Bear Creek Placer Mine is along the beach extending from the mouth of Bear Creek to Surf. L. Leonard is sampling the beach sands to determine the extent and value of the auriferous sands. He is to put into operation a machine of special design for the extraction of the precious metals. It is said that the black sands at this place vary in value from $2 to $40 per cu. yard.

GYPSUM.

Pt. Sal Mine; owners, the Casmalia Rancho Lands Co., E. Marshall, 111 West Fourth St., Los Angeles, president. The mine is situated ½ mile southeast of Pt. Sal Landing, in a rugged cañon. The deposit is an irregular vein of pure white gypsum grading into alabaster. The vein occurs in clay. The gypsum was mined through several tunnels in the early 80's. The workings are all caved and it is impossible to approximate the extent of the vein.

The gypsum was hauled to Pt. Sal Landing and lowered by cable to

ships moored outside of the rocks. Shut down over 20 years ago, as it could not compete with the gypsum mines on the Mexican coast.

Bibl.: R. VIII, p. 538; R. of M. Santa Barbara Co., 1906; Bulletin 38, p. 288.

Santa Barbara Cañon. An extensive undeveloped deposit of pure gypsum and alabaster is exposed along the east side of the Santa Barbara Cañon, 5 miles south of Quartel P. O. in the Cuyama Valley. Various claims have been taken on this deposit at different periods but they have all been adandoned as the gypsum is very inaccessible, being over 50 miles to the nearest railroad.

Bibl.: Bull. 38, p. 288.

INFUSORIAL EARTH.

The deposits of infusorial earth in the vicinity of Lompoc are said to be the purest found in the state. There are many extensive deposits in this vicinity; the only ones at present being worked are those east of San Miguelito Cañon in the foothills of the Santa Ynez Range. These deposits have been thoroughly described by Ralph Arnold and Robert Anderson in the U. S. G. S. Bulletin 315 "Diatomaceous Deposits of Northern Santa Barbara County." Other deposits are exposed in the low hills south of Surf, and along the coast south of Goleta; however, they are not as pure as the deposits in the vicinity of Lompoc.

James Guerra has a large undeveloped deposit of flaky, white diatomaceous shales on the Santa Rita Ranch, 5 miles east of Lompoc, on the north bank of the Santa Ynez River. Formerly owned by the Bank of Lompoc.

Bibl.: Bulletin 38, p. 295.

Kieselguhr Company of America, home office 11 Broadway, New York. A. H. Krieger, general manager. This company has taken over the Ballam Brothers Mine and the Dimock Mine, 2 miles southeast of Lompoc, and are at present the only producers of infusorial earth in the county. Extensive beds of soft, white earth in a very pure state, varying from thinly bedded to massive, form a capping over the hills, overlaying hard brown siliceous shales, conformable with them, striking E.-W. and dipping 30° S.

This material is being quarried by open cuts. It is taken up in large blocks and air dried at the quarry, taking from 40 to 50 days to reduce the water content to 5%. It is then hauled by motor trucks to the plant at Lompoc where it is ground to powder and transferred to the different warehouses by a pneumatic system. When blocks are required the material is transported in its natural state direct

from the quarry, sawed into the required sizes and dried before shipment. Waste material, too fine to be dried, is utilized in making brick, tile, and other refractory materials.

The quarry is worked only during the dry months, employing over 100 men.

Bibl.: Bulletin 38, pp. 293–296. For full detail of the Kieselguhr Industry see "Metallurgical and Chemical Engineering, Vol. XII, No. 2, p. 109.

More Ranch, J. F. More, owner. Beds of infusorial earth are exposed along the coast at More's Landing, 2 miles south of Goleta, striking N. 25° E. and dipping 45° to 50° NW. This material is not as pure nor as extensive as that of the Lompoc deposits and has never been developed.

F. N. Rudolph, of Lompoc, has a large undeveloped deposit of infusorial earth one mile southeast of Lompoc, adjoining the Kieselguhr property on the east.

Salsipuedes Ranch Deposit, owned by the Hollister Estate Company, 35 West Carrillo St., Santa Barbara. An undeveloped deposit of pure white infusorial earth, from thin bedded to massive, occurs on the Salsipuedes Ranch, 3 miles southeast of Lompoc. This deposit is over 100′ thick and very extensive, capping the low hills south of the Santa Ynez River. The owners are now preparing to develop it.

Bibl.: Bull. 38, p. 296.

Silica Products Company has a deposit of infusorial earth on Tract No. 79 of Lompoc Rancho, ¾ mile south of La Salle, a station on the Lompoc branch of the S. P. R. R. This deposit overlays beds of hard silicified shales. A plant for grinding and brick making was erected and considerable development and experimental work done. No production. The plant was partially destroyed by a cloudburst in February, 1915. Idle. E. J. Mitchell, president, Stockton, California.

Sykes Ranch, lots 155 and 158 of the Lompoc Rancho. Richard Sykes, Montecito, owner. Beds of infusorial earth cap a low rounded hill ½ mile east of the S. P. R. R. near Honda Station. These beds are quite extensive, striking east and west and dipping flatly to the north. Deposit composed of flaky white material, fairly uniform in character. Diatomaceous shales are exposed for a few hundred feet along the coast east of this deposit and are probably a continuation of the same beds, but are not as pure at this place. Undeveloped.

Sunnyside Mine, Jessie Telford, owner, is 2 miles southeast of Lompoc in a side cañon of San Miguelito Creek. Some development work done here many years ago, but now idle.

Bibl.: Bull. 38, p. 296, R. of M. S. B. Co., 1906.

LIMESTONE.

J. C. Lind of Lompoc owns a deposit of limestone on the south side of San Miguelito Cañon, six miles southwest of Lompoc, opposite that on the property of the Union Sugar Company. The deposit was sampled and the limestone analyzed by the Union Sugar Company. Found to contain a high percentage of magnesium which prohibits its use for the refining of sugar. Undeveloped.

Bibl.: R. of M. S. B. Co., Bull. 38, p. 80.

Thomas W. Moore, Santa Barbara, has an undeveloped deposit of limestone in Veronica Valley, 3 miles west of Santa Barbara. This limestone is coarsely crystalline and of a yellowish color. The owner

Limestone Quarry of the Union Sugar Co., southwest of Lompoc.

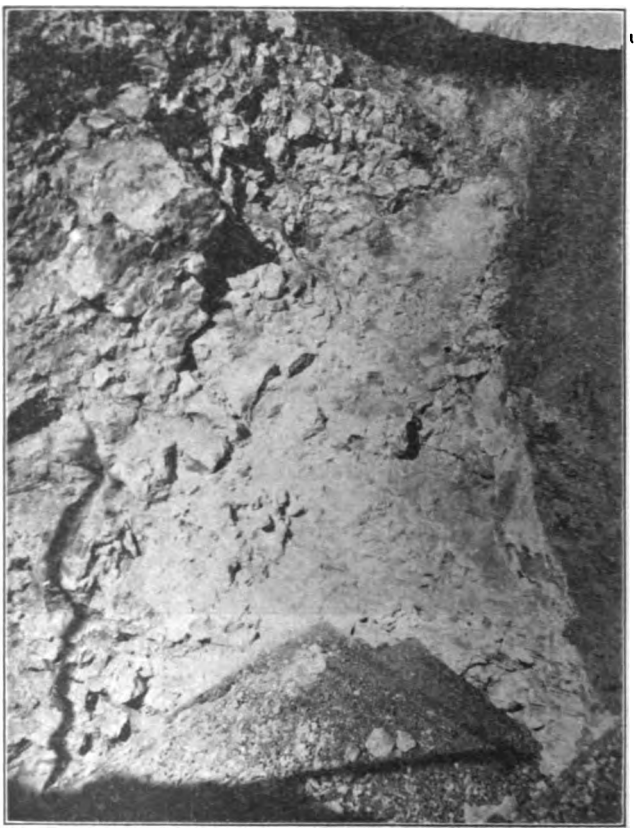
has had numerous tests made on it and reports that it is of no commercial value. It is said, however, that the cement used in the construction of the Mission Santa Barbara was made from this limestone.

Bibl.: Bull. 38, p. 80; R. of M. S. B. Co.

Moraga Ranch Deposit. A deposit of a fine grained white limestone, almost pure calcium carbonate, outcrops along a side hill, of the upper Mono Cañon, in Sec. 4, T. 6 N., R. 20 W., S. B. M. Some development work was done here several years ago by the Lomo Blanco Lithographic Stone Company of Los Angeles. The limestone was found to be cut by numerous small siliceous veins which made it unfit for lithographic work. Company disorganized and property abandoned.

Bibl.: R. of M. Santa Barbara Co., 1906; Bull. 38, p. 80.

Union Sugar Company, Betteravia, operates a limestone quarry 6 miles southwest of Lompoc on the north side of San Miguelito Cañon, at an elevation of 1150′. The limestone occurs in a massive ledge varying in width from 15′ to 35′. The formations here are broken and distorted and the limestone outcrops in 5 distinct deposits over the 40 acres owned by the company. The deposits grade from a siliceous limestone conglomerate to a pure white fossiliferous limestone. It overlays blue shales. Three of the deposits are now



Face of limestone quarry, showing limestone conglomerate at left and contact with blue shale at right.

being quarried, two having already been exhausted. Twelve men are employed. The stone is broken by hand to cobble size, and hauled in 1800 lb cars to bins, from which the stone is dumped into wagons, 10 ton capacity, and hauled to Lompoc. Forty tons are daily hauled to Lompoc by 2 teams. Produce approximately 6,000 tons yearly, working 8 months. Over 90,000 tons have been shipped from the quarry to the sugar factory at Betteravia, where it is made

into quicklime. Operated continuously since 1900. It is estimated that the remaining supply of limestone will be exhausted within the next 5 years.

Bibl.: Bull. 38, p. 81; R. of M. S. B. Co., 1906.

MANGANESE.

Manganese occurs in the San Rafael Mountains, 10 miles in an air line, east of Los Olivos. The manganese is said to outcrop over an area of several acres along the top of a high ridge. This deposit is very inaccessible and has never been developed.

MINERAL SPRINGS.

The mineral springs of Santa Barbara County are confined mostly to the southern slopes of the Santa Ynez Range and its foothills. The value of mineral water produced in 1915 was more than double the value of that produced in any other county. Practically all of the water produced was marketed for medicinal purposes, having a great value in the alleviation and eradication of many chronic diseases. There should be a great increase in this production, as the medicinal springs become better known and developed. They compare favorably with some of the best curative waters of Europe.

Burton Mound Sulphur Springs. Numerous small sulphuretted springs, visible at low tide, issue from the sands along the beach at Santa Barbara. A large sulphur spring, over which the Hotel Potter is built, was formerly utilized by pumping its waters to a drinking fountain in the lobby. Due to the objectionable odor the pipe was sealed and no use is made of the spring.

Bibl.: R. XIII, p. 517; U. S. G. S. Water Supply Paper 338, p. 277.

Bythenia Springs. Owner, J. M. McNulty, Santa Barbara. Situated on the Hope Ranch, 3½ miles west of Santa Barbara and ½ mile northwest of Veronica Springs. The water rights are leased to the Santa Barbara Mineral Water Company, 1933 Howard St., San Francisco. The company ships the water in barrels to San Francisco, where it is bottled and marketed for medicinal purposes. For analysis of Bythenia water see page 150.

Bibl.: U. S. G. S. Water Supply Paper 338, p. 295.

Las Cruces Hot Springs, on the Las Cruces Ranch, north of Gaviota. A group of 4 warm sulphuretted springs flowing about 50 gallons per minute issues from a clay bank on a hillside. The water is piped to the ranch houses for local use. Not utilized commercially. The Hollister Estate Co., Santa Barbara, owner.

Bibl.: R. XIII, p. 345; U. S. G. S. Water Supply Paper 338, p. 68.

Montecito Hot Springs. A group of 11 mildly sulphuretted hot springs, ranging in temperature from 110° to 120° with a total flow of approximately 50 gallons per minute. These springs issue from seams in thick bedded sandstone on the steep south slopes of Santa Ynez Mountains, 6 miles northeast of Santa Barbara. Elevation at springs, 1500′. A resort was formerly conducted on this property but it is now owned by a private club of Montecito residents who use it as a summer camp. Some of the water is piped to the houses of the club members at Montecito.

Bibl.: R. XII, p. 345; U. S. G. S. Water Supply Paper 338, p. 66.

Moore Spring, the property of Thomas W. Moore, Santa Barbara, is in the Veronica Valley, 3 miles west of Santa Barbara and opposite the Veronica Medicinal Springs. A large spring flows out of soft clay below a limestone ledge. (See Limestone—T. W. Moore, deposit.)

This spring has not as yet been developed, but Mr. Moore expects to market the water shortly. For analysis see page 150. Like the Bythenia and Veronica mineral waters it belongs to the purgative class of water, being characterized by its high content of magnesium sulphate (Epsom salts).

Pinkham's Santa Barbara Mineral Springs are 2½ miles west of Santa Barbara on the Hope Ranch, overlooking Veronica Valley. A group of 5 mineral springs seep from soft clay near top of low mesa. The largest of the group is housed in a concrete tank from which it is syphoned down to two 50,000 gal. wooden tanks and a small bottling plant. Bottle approximately 1,500 gals. yearly. S. C. and R. F. Pinkham, owners, 1135 State St., Santa Barbara. For analysis see page 150.

Bibl.: R. of M. S. B. Co., 1906; U. S. G. S. Water Supply Paper 338, pp. 295–296.

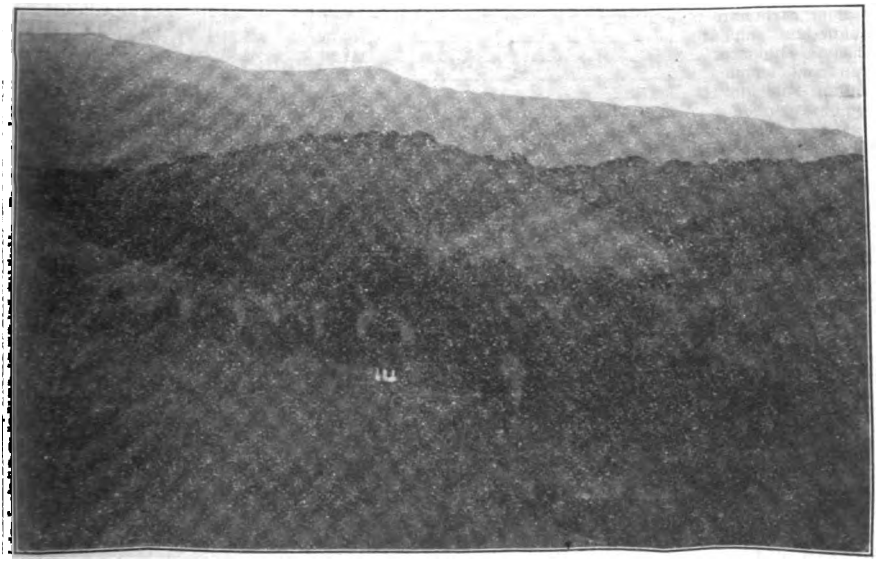
San Marcos Cold Springs, owned by the Miramar Hotel Company, and situated 20 miles northwest of Santa Barbara near the San Marcos Pass at an elevation of 1100 ft. One large flowing cold spring, slightly mineralized, issues from thick bedded sandstone. The water rights are leased to the Cold Springs Water Company of Santa Barbara, who are marketing the water at Santa Barbara for table uses.

Analysis of this water—Prof. J. A. Dodge, Analyst. (Constituents are in grains per U. S. gallon.)

Silica	0.35
Sodium chloride	1.54
Sodium carbonate	1.92
Calcium carbonate	3.02
Magnesian carbonate	0.67
Calcium sulphate	5.74
Potash and lithium	Trace
	13.24

A group of warm sulphuretted springs are located about a mile west of this cold spring, but the water is not utilized.

Bibl.: U. S. G. S. Water Supply Paper 338, p. 67.



Veronica Valley. Location of Veronica, Bythenia, and Moore mineral springs.

Veronica Springs, Veronica Medicinal Springs Water Company, Santa Barbara, owner; F. H. Kimball, president. A group of 5 mineral springs situated on the west side of Veronica Valley, 3 miles west of Santa Barbara and ½ mile north of the ocean.

These are commercially the most important springs of the county, as the waters have been marketed for 20 years with an increasing demand. The water is an alkali saline water of purgative qualities and of unusual strength, which makes it of great medicinal value (see analysis, page 150). The main spring is located 180′ in elevation above the floor of the valley and is housed in a bottomless concrete tank. The water is piped to 9 storage tanks, total capacity

of which is 500,000 gals., syphoned into a 50-barrel tank-wagon and hauled to the bottling plant at Santa Barbara. It is here sterilized by boiling and then bottled. The plant is bottling 1,200 gallons daily, employing 10 men. Two men employed at the springs.

The company is to erect in the near future a hotel and cottages at these springs to be conducted as a health resort.

Bibl.: Bull. 38, p. 294; U. S. G. S. Water Supply Paper 338, pp, 294–295, 296.

Analyses of Medicinal Springs of Santa Barbara County.

Constituents are in grains per U. S. gallon.

	1 Bythenia	2 Moore	3 Pinkham	4 Veronica
Potassium sulphate	2.72		38.55	
Sodium carbonate	7.27		8.65	
Magnesium sulphate	1,146.70	968.25	50.40	1,192.70
Calcium sulphate	111.28	62.86	32.64	69.43
Iron and alumina	1.46	.35	2.02	.35
Sodium sulphate	333.10	172.56	662.34	344.54
Sodium chloride	194.47	242.02	45.42	233.66
Magnesian nitrate	278.01			407.63
Magnesian carbonate	35.45		90.03	
Silica	1.64	4.26	.87	1.51
Sodium nitrate		70.79		
Organic and volatile		234.90		
Lithium chloride			.23	
Magnesian chloride			35.40	53.90
Calcium chloride			108.03	
Calcium phosphate			1.97	
Calcium carbonate			1.61	15.72
Potassium carbonate				15.71
Totals	2,112.10	1,755.99	1,149.38	2,495.42

1. Analyst—E. W. Hilgard; authority, advertising matter.
2. Analyst—Pacific Wasserman Laboratories; authority, Thomas W. Moore.
3. Analyst—J. M. Curtis & Sons; authority, advertising matter.
4. Analyst—U. S. Bureau of Chemistry; authority, F. H. Kimball.

NATURAL GAS.

The production of natural gas in Santa Barbara County ranks second to petroleum. Sufficient natural gas is produced in the Santa Maria Field for the operation of a number of casing-head gasoline plants and also to supply consumers in Santa Maria, Betteravia and Guadaloupe. (See Santa Maria Gas and Power Co., below).

In 1914, over 55% of the production of casing-head gasoline in California was credited to the 8 plants in the Santa Maria Field, where this industry is the most active. For that year the average yield in gasoline per thousand cubic feet of gas used, was 1.35 gallons. The quantity produced was 4,225,334 gallons valued at $323,701.[1]

[1]Mineral Resources of the United States, 1914, Pt. II, pp. 804–805.

Thus it will be seen that of the total recorded value of natural gas produced, over 85% was for the value of gasoline produced from this gas.

The following plants are in operation in Santa Barbara County: American Gasoline Company, 1 plant; Pinal Dome Oil Company, 2 plants; Purity Gasoline Company, 1 plant; Rice Ranch Oil Co., 1 plant; Union Oil Company, 2 plants; Western Gasoline Company, 1 plant.

A complete description of the methods employed in the manufacture of casing-head gasoline is contained in Bulletin No. 88 of the U. S. Bureau of Mines, "The Condensation of Gasoline from Natural Gas."

The total quantity of gas produced in the oil fields is not known; many of the companies are using the gas for light and power at the fields and the flow is not measured. For further detail see Bull. 69, pp. 113–115.

Cone's Wells, Summerland. Two 2½" wells, 125' deep, drilled in 1893, a few hundred feet north of the railroad track yielded sufficient gas to provide light and fuel for 20 families. The flow gradually diminished and stopped entirely several years ago.

Bibl.: R. X, p. 601; R. XIII, p. 569; Bull. 11, p. 56.

Darling Brothers Wells, Summerland. Two 2" wells, 150' deep, ¼ mile north of the beach. First well drilled in 1891, second in 1895. Free flow of gas up to 1911, when it became necessary to pump. Now supplying 24 families at Summerland.

Bibl.: R. X, p. 601; XIII, p. 569; Bull. 11, p. 56; U. S. G. S. Bull. 321, pp. 39, 50.

Santa Maria Gas and Power Company, R. E. Eaton, manager, is supplied with natural gas from the Pinal Dome Oil Company, Union Oil Company, and the Brookshire Oil Company. It is distributing from 35 to 40 million cu. ft. per month to consumers in the towns of Santa Maria, Betteravia and Guadaloupe. They expect to greatly increase the output on obtaining a franchise to supply consumers in San Luis Obispo County.

PETROLEUM.

Santa Barbara County ranks fourth in the production of petroleum in this state, having produced in 1915 a total of 5,634,534 bbls., valued at $3,442,700. The three oil producing districts of the county, Santa Maria, Lompoc and Summerland fields, were recently described by R. P. McLaughlin and C. A. Waring in Bulletin 69, "The Petroleum Industry of California," so that no further description will be entered here. A list of references follows.

Bibl.: R. VII, p. 89; XII, p. 537; XIII, p. 582; R. of M. S. B. Co., 1906; Bulls. 11, 19, 32, 63, 69.

PLATINUM.

Platinum occurs with gold in the black sands that are deposited along the beaches at Surf and north of Pt. Sal. Some platinum was produced from these deposits years ago. (See Gold.)

QUICKSILVER.

Quicksilver was discovered in Santa Barbara County at the Los Prietos Mines in 1860. Seven years later cinnabar was found in the Acachuma Cañon in the San Rafael Mountains. At both of these localities it has been mined intermittently for many years. No records of the production previous to 1880 are available. The unusual increase in the price of this metal during the latter part of 1915 has stimulated interest in the old mines and this year (1916) will undoubtedly show increased activity in the development of these properties.

Acachuma Mine. Formerly worked by the Red Rock Quicksilver Mining Company, is in Sec. 2, T. 7 N., R. 29 W., S. B. M., 12 miles east of Los Olivos at the head of the Acachuma Creek. The development consists of several tunnels totaling 2000 ft. The ore body is mineralized serpentine and shales striking N. 40° W. and dipping 50° E. Said to average 30 ft. in width. The ore was treated in a 12-pipe retort, 2 miles below the mine, on Acachuma Creek. A good wagon road runs from Los Olivos to the retort. This mine has been worked mostly by tributers. Idle. C. Woods, Santa Ynez, owner.

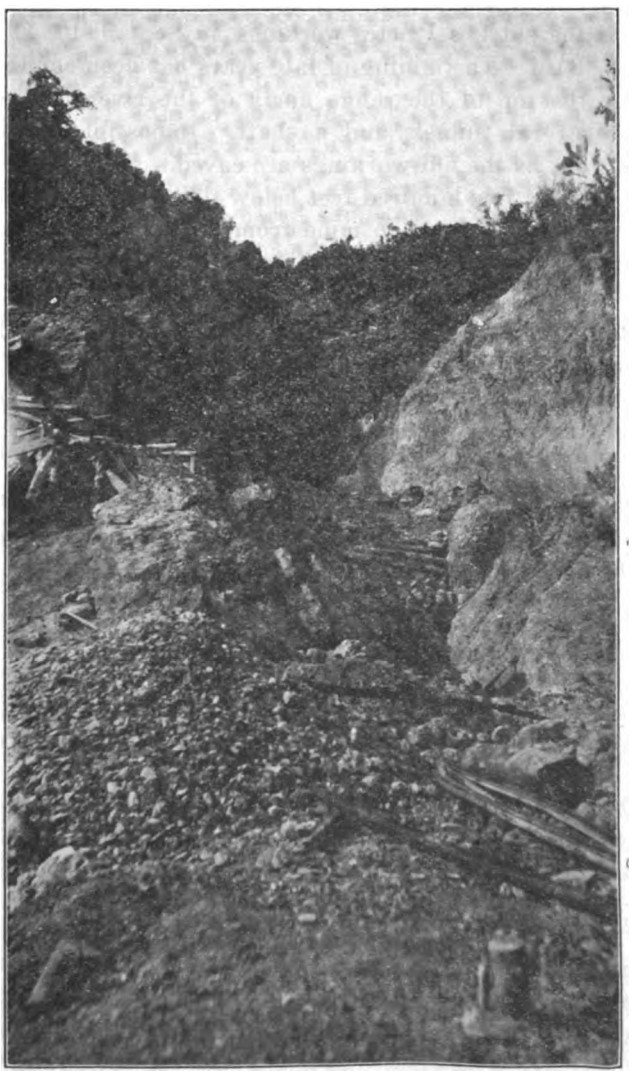
Bibl.: R. of M. S. B. Co., 1906; Bull. 27, p. 196.

Los Prietos Mines are 8 miles in an air line directly north of Santa Barbara, in that portion of the Santa Ynez Mountains north of the river. This group of mines is located on a belt of mineralized serpentine, that extends along the range for several miles. Strike N. 50° W., dip southward. The width of the ore body varies from 40′ to 200′ and it is a well defined ledge. The ore, cinnabar, is disseminated through the ledge matter, and is in general low grade, averaging about 0.5%. Occasionally rich pockets or shoots are encountered in which the ore will run up to 13%. This deposit was discovered in 1860 by José Moraga, but was not worked to any extent until 1874, when the price of quicksilver rose to $126 per flask of 75 lbs. A large furnace (now in ruins) was erected on the Santa Ynez River below the mine, and over 200 men were employed. Operations ceased in 1876 due to a decline in the price of quicksilver and prolonged litigation over the title to the property. Reopened in 1877 but has never since been worked on a large production basis. The property is somewhat inaccessible and can only be approached by trail over the Santa

Ynez Mountains 13 miles from Santa Barbara or by wagon road, 40 miles.

The Nejalyegua y Los Prietos Land Grant was purchased in recent years by the United States government, and several locations on the old workings have been filed.

Bibl.: R. VIII, p. 537; X, p. 596; XII, p. 366. Bull. 27, p. 196; U. S. G. S. Monograph XIII, p. 382.



Upper workings at Snow Group (Los Prietos Quicksilver Mines), Santa Barbara County.

Millborn-McAvoy Mercury Mine, formerly part of Los Prietos Mines, is situated in Sec. 12, T. 5 N., R. 27 W., S. B. M., two miles east of the north portal of the Santa Barbara Water Tunnel. Development consists of 3 tunnels and several open cuts. The greatest vertical depth below outcrop is 600 ft. No equipment. Ruins of an old furnace below the tunnels. Idle. Worked for assessment only. The 2 claims were located in 1908 by present owners, C. L. Millborn and J. M. McAvoy, 434 East Thirtieth St., Los Angeles.

Carl H. Snow et al., of Summerland, California, have a group of 10 claims at the old Los Prietos workings, in Secs. 9, 10, 11, T. 5 N., R. 27 W., S. B. M. The mining of late years has been confined to the claims near the top of the range north of the river. Development consists of several tunnels and a shaft. Impossible to determine amount of work as the old workings are caved. A 10-pipe retort was erected on a flat a few hundred feet below the mine, to which ore was hauled by team. Old road to mine from river. Worked for assessment only. Reported to have been recently taken over by E. S. Rigdon of San Luis Obispo, Calif.

Santa Rosa Quicksilver Mine, owners, D. D. Davis and C. R. Clark, Los Olivos, is 12 miles northeast of Los Olivos in Sec. 3, T. 7 N., R. 29 W., S. B. M. Adjoins the Acachuma Mine and is a continuation of the same deposit. Two men working, driving tunnel to cut ore body. The ore will be treated at the Acachuma retort.

Steward Quicksilver Mine adjoins the Acachuma Mine. Some development work done here over 10 years ago, but no quicksilver was produced. Abandoned.

Bibl.: R. of M. Santa Barbara Co., 1906.

SANDSTONE.

"The high ridge of the Santa Ynez Mountains from Point Concepcion eastward is formed by a great monocline of sandstone of supposed Vaqueros age that dips toward the sea on the south at an angle of 25°."[2] On the range back of Santa Barbara this sandstone is very massive and dips to the north. Huge boulders of this sandstone in the Mission and Refugio cañons have been quarried for many years.

The increasing use of concrete in the county has almost entirely displaced the sandstone industry, so that very little building stone is now quarried.

Erickson Quarry in T. 9 N., R. 34 W., S. B. M., J. B. Arellanes of Santa Maria, owner. Beds of a tough gray sandstone are exposed in a

[2]Ralph Arnold and Robert Anderson, U. S. G. S. Bull. 317, p. 14.

railroad cut near Casmalia Station. Some of this rock was used for masonry work on the railroad years ago. Idle.

Bibl.: R. XIII, p. 637; R. of M. Santa Barbara Co., 1906; Bull. 69, p. 133.

Hogan Quarry, in Sec. 2, T. 4 N., R. 27 W., S. B. M., is 3 miles north of Santa Barbara in the Sycamore Cañon. T. M. Hogan, 826 Orange Ave., owner. Beds of hard gray sandstone, a couple of hundred feet thick outcrop in Sycamore Cañon for several hundred feet. Stone from this quarry was used in building the breakwater at Santa Barbara; also in the portals of the Bay-Shore cut-off tunnels at San Francisco, and the Sespe, Piru, and Santa Clara railroad bridges in Ventura County. Idle for past five years.

Bibl.: R. of M. Santa Barbara Co., 1906.

Mission Cañon, 2 miles north of Santa Barbara. Large boulders of a hard, fine-grained buff-colored sandstone are occasionally quarried by hand, by the Franciscan monks, for building purposes, about the Santa Barbara Mission.

Bibl.: Bull. 38, p. 133.

Orella Estate Quarry, in Sec. 12, T. 5 N., R. 31 W., S. B. M. A quarry of sandstone boulders at the head of Refugio Cañon on the Santa Ynez Range, 8 miles north of Orella station on the S. P. R. R. The boulders are quarried by Geo. Robson of the Santa Barbara Monumental Works. Three carloads of this stone recently shipped to Los Angeles, was the only production recorded during the past five years. Idle.

Bibl.: Bull. 38, p. 133.

STONE INDUSTRY.

Under this heading are grouped crushed rock, sand and gravel.

C. A. Reed, superintendent of streets at Lompoc, employs a few men to quarry chert beds in a side cañon of San Miguelito Creek, 2½ miles southwest of Lompoc, for use in the streets at Lompoc. A force of men is also engaged hauling gravel from China Creek, near Lompoc, for use on the roads. An average of 30 men are employed for this city street and road work.

Santa Barbara Unit Brick and Tile Company, 10 State St., Santa Barbara, use some gravel and clay in the manufacture of artificial stone and tile. Ten men employed at plant. This company is the successor to The Miracle Pressed Stone Company.

Southern California Acclimatizing Association, R. Riedel, 315 State St., Santa Barbara, manager, operates a quarry in Sec. 1, T. 4 N., R. 27 W., S. B. M., 6 miles northeast of Santa Barbara. Beds of a

hard, cemented red conglomerate, containing a high percentage of quartz pebbles, are exposed for 700 ft. along the Mountain Drive back of Montecito.

This material is quarried by churn drilling the full depths of the face (50 ft.) and blasting with Giant powder. The plant for crushing and sizing the rock consists of a jaw-type crusher—capacity 20 yds. per hour, revolving screen sizing the rock into 5 classes, and bucket elevator. It is operated by a small gasoline engine. From 12 to 20 men are employed. The stone is mostly used for road material and is said to be very fine for that purpose.

VENTURA COUNTY.

By Emile Huguenin, Field Assistant.

Field Work in December, 1915.

INTRODUCTION.

Ventura County, created March 22, 1872, is one of the coast counties and lies between parallels 34° and 34° 50′ north latitude, having a coast line of about 50 miles. It is bounded on the north by Kern County, on the east by Los Angeles County, on the south by Los Angeles County and the Pacific Ocean, and on the west by Santa Barbara County. The total area is 1878 square miles. The population as shown by the census of 1910 was 18,347 and is now estimated at over 22,000. Its assessed valuation in 1915 was $32,159,977.

The city of Ventura, originally called San Buenaventura, is the county seat and lies on the shores of the Santa Barbara Channel. It has a population of approximately 4000. The cities of Oxnard and Santa Paula, next in importance, are of almost equal population. Fillmore has grown from a town of a few hundred to over 1000 in the past five years, due to the activity in the oil fields of that vicinity.

Ventura County is essentially an agricultural county. The increasing production of petroleum in the past few years is rapidly bringing it forward on the list of mineral producing counties.

TOPOGRAPHY.

The northern portion of this county is characterized by the convergence of several important mountain ranges which make of it a high and rugged region. Its lofty peaks range in elevation from 6000′ to 9000′, the most prominent of which are Mt. Pinos, elevation 8826′; Mt. Frazer, 8026′; Pine Mt., 7488′; and Alamo Mt., 7371′. To the northwest extend the San Emigdio Mountains, which form the connection between the Coast Range and the Sierra Nevada Mountains. To the west extend the San Rafael Mountains, while farther southward, the Santa Ynez Mountains diverge from this group, running westward through Santa Barbara County. The southern part of the county is characterized by a series of parallel folds, the axes of which lie east and west, forming low mountain ranges of no great continuity.

The principal valleys are the Santa Clara, Ojai, Simi, and Las Posas.

The Santa Clara is a flat river wash, the level floor of which ranges in width from a mile at Piru to over 5 miles at Saticoy, where it opens out into the wide Oxnard terrace. It is bounded on the north by Sulphur Mountain, and the more rugged mountains to the east, that form the divide between it and the San Joaquin Valley. On the

south it is bounded by the Santa Susana Mountains, Oak Ridge and South Mountains.

The Ojai Valley, north of the Santa Clara Valley, and separated from it by Sulphur Mountain, is an intermontane depression which evidently had its origin in a system of profound faults.[1] The trend of the valley is east and west. A low ridge across its length divides this depression into two parts, called Upper Ojai Valley and Lower Ojai Valley. The lower valley is drained by the San Antonio Creek which flows westward into the Ventura River, while the Upper Valley is drained by Sisar Creek flowing eastward into the Santa Paula Creek, a tributary of the Santa Clara River.

The Simi Valley lies between the Oak Ridge Mountains on the north and the Simi Hills on the south. The Las Posas Valley is a continuation of the same drainage basin and westward joins the Santa Clara Valley, where it opens into the wide marine terrace.

STREAMS.

The two principal drainage systems of the county are the Santa Clara River and the Ventura River. Next in importance, but subordinate to these is the Calegnas Creek, which drains the Simi and Las Posas Valleys.

The Santa Clara River rises in Los Angeles County and flows westward 75 miles, emptying into the sea south of the city of Ventura. Its principal tributaries from east to west are the Castac, Piru, Sespe, and Santa Paula Creeks, all of which flow from the north. This stream runs almost dry in summer but in the winter is subjected to floods, often doing great damage in the valley.

The Ventura River receives its principal water supply from the Matilija Creek, which rises on the southern slopes of Pine Mountain and flows southward, entering the sea at the city of Ventura. This river carries sufficient water throughout the year for irrigation purposes and to supply the city of Ventura.

CLIMATE.

The climate in the southern portion of the county is delightful throughout the year, the summer heat being tempered by cool ocean breezes. Farther east in the valleys it becomes very hot during the dry season. The mountainous region in the northern portion of the county receives a coating of snow in the winter. The rainfall is confined to the winter and spring months.

[1] George H. Eldridge, The Santa Clara Valley Oil District, U. S. G. S. Bull. 309, p. 3.

Year	
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1910	
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1914	
1915	
Total	

*Una

TRANSPORTATION.

The county is traversed by the S. P. R. R., with a branch line from Ventura to Nordhoff. At Montalvo, five miles east of Ventura, the main line divides into two branches, one going to Los Angeles via Las Posas and Simi Valleys, the other through the Santa Clara Valley, joining the San Joaquin Valley line at Saugus. The northern portion of the county is extremely inaccessible, only a few trails penetrating this mountainous region from the south. Access to the gold and borax districts is obtained over the new State Highway from Bakersfield to Los Angeles via the Tejon Pass. A fine line of automobile stages over this highway now makes those districts easily accessible.

MINERAL RESOURCES.

Ventura County was the 21st county in the State in respect to the value of its mineral production for 1915 (Bulletin 71, Mineral Production for 1915).

By referring to the Table of Mineral Production for Ventura County it will be seen that the value of petroleum produced was over 99% of the total value of minerals produced that year; natural gas, brick, and sandstone together making up the remainder.

The total recorded production of the county up to the end of 1915 is $11,572,339; its products, in order of their values, being, petroleum, $9,461,583; unapportioned and miscellaneous, which include borax and mica, $1,048,387; stone industry, $410,296; asphalt and bituminous rock, $374,216; brick, $121,170; natural gas, $67,352; sandstone, $58,849; gold, $22,871; and clay, $7,615.

The actual output of minerals has been greatly in excess of that shown by this table. The production of borax from the time of its discovery in this county in 1898 up to 1907 amounted to over 35,000 tons, valued at over $1,000,000.[2] The greater part of this production has been recorded in the general tables of mineral production of the State, over this period, under the heading "Unapportioned." This was for the purpose of concealing the identity of single mines operating in a county. Considerable gold was produced previous to 1880. See "Gold."

In addition to the above minerals are known occurrences of gypsum, infusorial earth, limestone, mineral water, mineral paint, and phosphates.

[2] U. S. G. S. Bull. 540, p. 434.

ASPHALT and BITUMINOUS ROCK.

The manufacture of asphalt by refining from crude petroleum has entirely replaced its production from the natural asphalt and bituminous rock deposits, and no work has been done on the various deposits in the last decade.

Brea Cañon Mine, W. R. H. Welden, Ventura, owner, is on the Canada Larga ranch 5 miles north of Ventura. Narrow veins of bituminous rock, which open out into pockets or kidneys, are irregularly distributed over an area of 200 acres. This rock is said to contain 40% asphaltum. Mined by tunnel. Discovered in 1887 and worked from 1890 to 1893, taking out almost 1000 tons which were sold at $10 per ton. Inability to compete with the asphaltum produced from crude petroleum in the refineries caused the cessation of operations.

Bibl.: R. XIII, p. 44; Bull. 11, p. 48.

Cañon Del Diablo Mine, is 5 miles northwest of Ventura on the Cañada de San Miguelito Ranch. This deposit of bituminous rock was worked for 7 or 8 years by the Ventura Asphalt Company, and was practically exhausted 10 years ago. The Taylor Estate, Ventura County, owner.

A detailed report on this mine is given by Prof. E. W. Hilgard in the 10th Annual Report of the State Mineralogist.

Bibl.: R. X, p. 763; XIII, p. 44.

Ojai Mine is in Secs. 3 and 10, T. 4 N., R. 22 W., S. B. M., 3 miles west of Nordhoff in the Upper Ojai Valley. Deposit of decomposed sandstone and shales impregnated with a heavy viscous bitumen which is seeping out from bituminous shales. Undeveloped. J. S. Briggs and F. W. Ewing, Ventura, owners.

Bibl.: R. XIII, p. 45; U. S. G. S. 22nd Annual Report, Part I. p. 446.

Punta Gorda Mine, ¼ mile north of the S. P. R. R. at Punta Gorda, is in Sec. 1, T. 4 N., R. 25 W., S. B. M. Asphaltum occurring in bunch-like and very irregular veins in bituminous shales and clays which strike east and west, dipping steeply to the north. Development consists of 140′ tunnel and 100′ shaft at face of tunnel. Worked by Punta Gorda Asphalt Mining and Paving Co. in 1895. Company disorganized and mine abandoned. Property of Henry D. Abbott and Thomas Gaynor, of Punta Gorda.

Bibl.: R. XII, p. 33; XIII, p. 45; U. S. G. S. 22nd Annual Report, Part I, pp. 445–446.

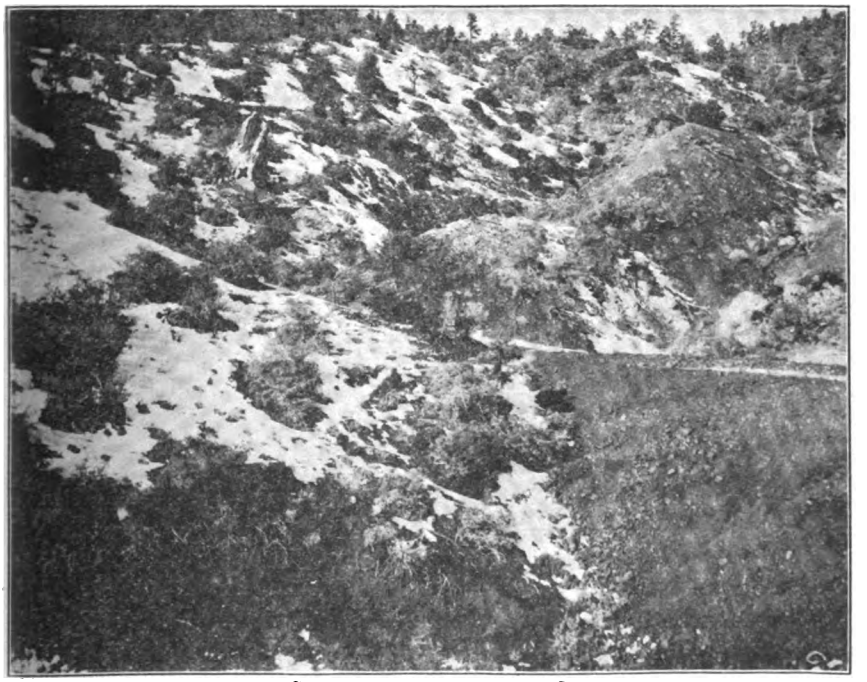
Rincon Mine. A deposit of bituminous sands 1½ miles northeast of Punta Gorda. Development consists of a small tunnel and open

cut. Deposit was found to be too limited in extent for profitable extraction and was never worked.

Bibl.: R. XII, p. 33; R. XIII, p. 45.

BORAX.

Colemanite, a borate of lime, was first found in Ventura County, in 1898. The deposits are confined to a narrow belt along the eastern slopes of Mt. Pinos, in the extreme northeast corner of the county, and are classed among the few important borax deposits of the United States. However, they are about 60 miles from the nearest railroad, and can only be worked at a profit under the best conditions.



Outcrop of colemanite-bearing beds, at Stauffer, Ventura County. Photo by F. W. Sperry.

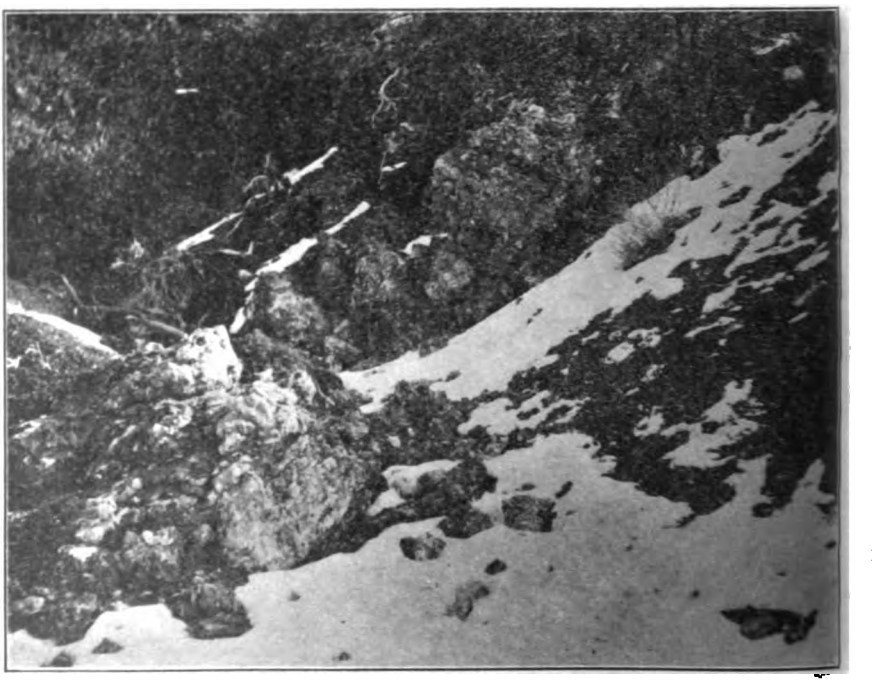
The colemanite deposits occur within a series of bedded rock formations that have been extensively folded and faulted. In general, the trend of their outcrop is northeast and southwest and the beds dip southeastward.

The colemanite ore has not been found to any extent in outcrops on the surface. Quoting Mr. Hoyt S. Gale, of the U. S. Geological Survey, who made a detailed study of these deposits, "The chief characteristic of the outcrops seems to be the occurrence of gypsum,

in stringer form, mainly interlaminated in the bedding of the fissile and crumpled shales, as a rule closely associated with beds of basaltic lava and in the principal ore bodies, with ledges of massive travertine-like limestone."

For further detail on the geology of these deposits see U. S. G. S. Bulletin 540, p. 436 and Prof. Paper 85a.

A number of claims have been taken along this belt, but only 3 mines have developed.



Gypsiferous shales containing colemanite, Stauffer, Ventura County. Photo by F. W. Sperry.

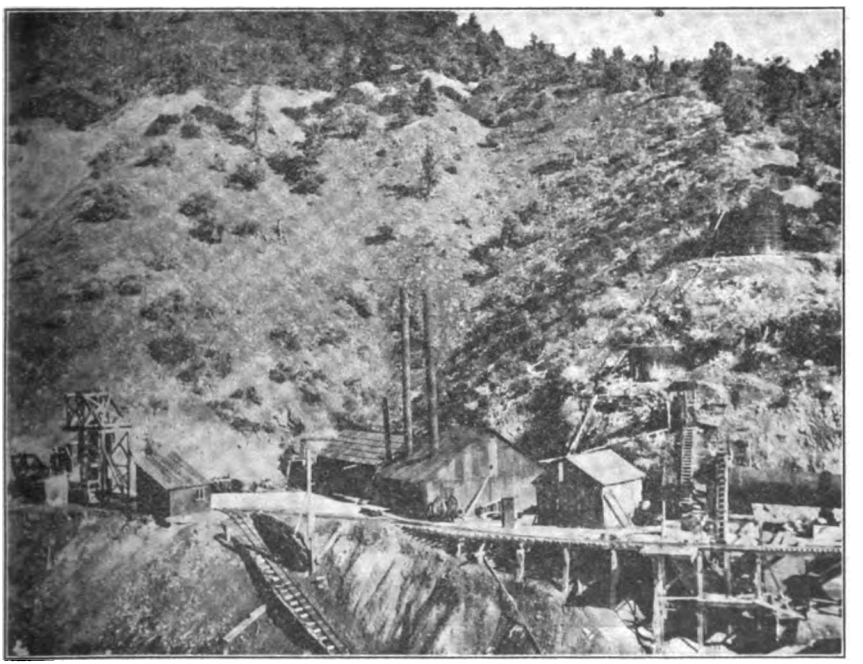
Columbus Mine, formerly owned by the Calm Brothers, of Los Angeles, consists of one patented claim (160 acres) and 10 unpatented claims. It is the northeasternmost of the 3 mines of this district. The ore body is worked through a 400-foot, 3-compartment shaft, and a 100′ main tunnel. The underground workings are said to be very extensive but were inaccessible at the time of my visit, as the mine was flooded.

Located in 1899, and operated continuously from 1902 to 1907. Sold in 1912 to the National Borax Company. They erected an extensive plant, including a rotary roaster 6′ x 60′, jaw-type crusher, screens, etc. Crude oil was used for fuel, and it was planned to construct a pipe line 16 miles to Lebec for transporting the oil.

Shut down in 1913 and has been idle since. Sold to the United States Borate Co., of West Virginia, C. B. Zabriskie, president.

Bibl.: U. S. G. S. Bull. 540, p. 448.

Frazier Mine was the first property located in the district for borax. It is the southwesternmost of the 3 mines, lying between Seymour and Bitter Creeks. It consists of 20 patented claims. The main workings are confined to Sec. 14, T. 8 N., R. 21 W., S. B. M. The ore body is worked by a number of tunnels, the main one being



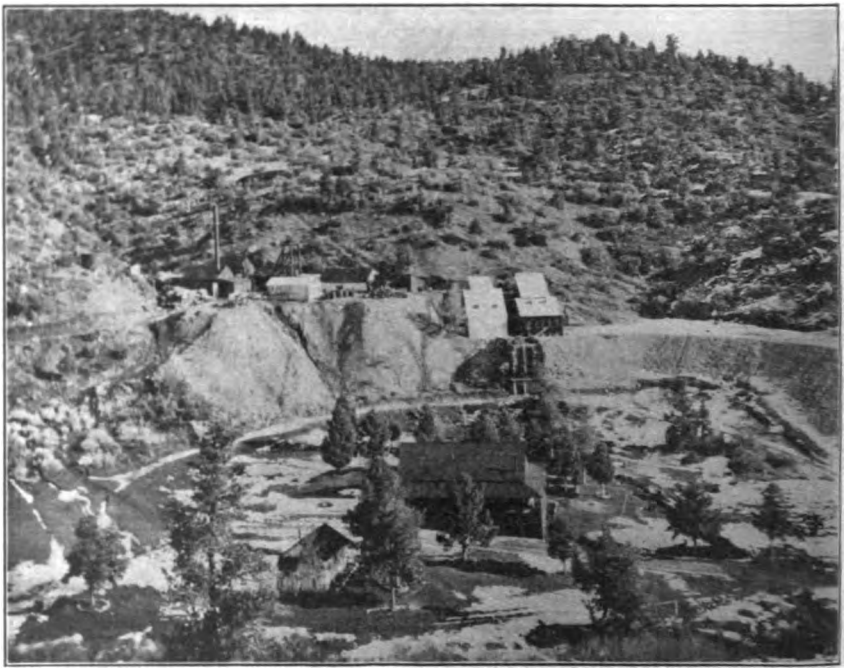
Columbus Mine, at Stauffer. Rotary roaster at extreme right of photo. Photo by F. W. Sperry.

1700′ long. These are driven along the course of the vein. The ore bodies are lenticular, often averaging 14′ in width. The ore is essentially massive colemanite and is shipped from the mine without treatment. It is said that over 25,000 tons of colemanite were produced up to the time the mine was shut down in 1907. Stirling Borax Company of Los Angeles, owners. Idle.

Bibl.: U. S. G. S. Bull. 540, p. 443.

Russell Mine lies between the Columbus and Frazier Mines, in Seymour Cañon, and consists of 200 acres. Owned by The Russell Borate Mining Company, 624 California St., San Francisco. The workings consist of a main shaft, 200′ deep, with levels at 50′, 100′

and 200′. The 200′ level is the main working level. It is 450′ long, running N. 16° W., and strikes the ore body at 319′. From this point a drift is run along the ore, whose strike is N. 75°–80° W. and dip 60° S. At 368′ from shaft another drift was driven, exposing an ore body on 3 sides for 50′ on each side. A 50′ winze was sunk from the 200′ level. The old stopes are caved and it is impossible to determine their extent.



Russell Borate Mine, at Stauffer, Ventura County. Photo by F. W. Sperry.

The ore body consists of glassy crystalline colemanite, varying from white to black in color and mostly massive. It is closely associated with limestone.

A borax drying furnace, of 25 tons per 24 hours capacity, was partially constructed in 1913, but never completed. The mine was shut down that year, due to a decline in the price of borax, and has not been reopened. It is dewatered daily, pumping about 30,000 gallons from the 200′ level. Two men employed. Fred W. Sperry, Stauffer, superintendent.

Bibl.: U. S. G. S. Bull. 540, p. 445.

BRICK and TILE.

Peoples Lumber Company, Ventura, is the only producer of brick and tile operating in the county. The clay used is plowed down from a hill on the northern border of the city and hauled ½ mile in a large side dump wagon to the brick yard. Red drainage tiles of different sizes, and common bricks are pressed by machine and burned in open kilns. Crude oil is used for fuel. Ten men are employed during the season (3 months), making about 250 M bricks and 25 M tiles.

Bibl.: Bull. 38, p. 259.

CEMENT, NATURAL ROCK.

(See Limestone.)

GOLD.

The gold deposits of Ventura County are confined to the high mountainous region in the northeastern portion of the county, embracing Mt. Frazer on the north, and McDonald Peak on the south, and known as the Piru District. The gold occurs in fissure veins in the mountains, which are composed largely of granite, syenite, schist and slate, and in the gravels of the Piru drainage basin.

It is said that the first gold discovered in California was that found in the placers of this district in 1841 by Andres Castillero, who afterwards discovered the New Almaden Quicksilver Mines in Santa Clara County. In 1842 gold was shipped from the placers to the U. S. Mint at Philadelphia.[3] The gravels were worked in a crude way for many years and considerable gold was taken out. The mining of late years, however, has been confined to the quartz veins. This region suffers the disadvantage of being over 50 miles from the main lines of transportation and practically inaccessible during the winter and spring months. The new State Highway from Bakersfield to Los Angeles via Tejon Pass makes that district much more accessible and should greatly aid in its development.

Bunker Hill Mine is on the western slope of Frazer Mountain, at an elevation of 6000′. The mine was developed by tunnels and open cuts and has been idle for many years. It is one of a group owned by Fred M. Wilcox et al., 618 Investment Bldg., Los Angeles. See White Mule Mine.

Bibl.: R. XII, p. 314; XIII, p. 497.

Castac Mine, consisting of 3 patented claims, is in Sec. 22, T. 7 N., R. 19 W., S. B. M. Underground workings consist of over 3000′

[3]See Hittell's History of California, Vol. II, p. 313.

of tunnels and drifts. Five-stamp mill on Piru River below mine; aerial tramway for hauling ore from mine to mill. Sold in 1911 to the Castac Mining Co., its present owners. The company is doing some development work and is to add 5 more stamps to the mill. L. B. Bowker, Santa Paula, president.

Bibl.: R. VIII, p. 683; R. XII, p. 315; R. XIII, p.497.

Contact Mine, located in 1897 by Thomas and L. Harris of Ventura, is in Secs. 34 and 35, T. 8 N., R. 20 W., S. B. M. Vein strikes N.–S., dips 40° W., varying in width from a few inches to 4′, said to average 14″. The workings consist of 3 tunnels driven along the vein at different levels and connected by winzes. The greatest vertical depth of the vein exposed below the outcrop is 700′. A 2-stamp mill has been erected on Long Dave Creek, below the mine. Worked only during the dry season by the two brothers.

Fairview Mine adjoins the Bunker Hill and White Mule Mines on Frazer Mountain, and is one of the group owned by Fred M. Wilcox et al. See White Mule Mine.

Bibl.: R. XII, p. 315; R. XIII, p. 497.

Foley Mine, John Foley, Gorman, owner, is on the western slope of Frazer Mountain at an elevation of 7000′. A couple of shallow shafts were sunk over 20 years ago. Idle.

Bibl.: R. VIII, p. 682; R. XIII, p. 497.

Frazer Mine, located in 1867, was the first quartz mine worked in the district. It is on the southern slope of Frazer Mountain, at an elevation of 7000′. The development work consists of 7 tunnels, totalling over 2200′. A 10-stamp mill was erected many years ago, but has fallen into disuse and is badly in need of reconstruction. In 1893 mine was sold to the Frazer Mining Company, of Los Angeles. Operated up to 1895 and has been idle since. Owner, J. E. Bicknell Estate, 304 S. Broadway, Los Angeles.

Bibl.: R. VIII, p. 682; R. XII, p. 315; R. XIII, p. 497.

White Mule Mine is on Frazer Mountain, adjoining the Bunker Hill and Fairview Mines. These 3 mines are owned by Fred M. Wilcox et al., 618 Investment Bldg., Los Angeles, California. Development consists of a vertical shaft 319′ deep and drainage tunnel 180′. There is a 5-stamp mill and sawmill for cutting mine timbers on the property. The 3 properties are worked for assessment only. Idle.

Bibl.: R. VIII, p. 682; R. X, p. 316; R. XIII, p. 497.

GYPSUM.

Ojai Gypsum Mine is 3 miles east of Nordhoff on the low divide that separates the two Ojai valleys. Worked in 1890 by the Tacoma Calcium Company, who sunk a 100′ shaft and drove over 1000′ of drifts. After cutting into the face, the gypsum was found to contain numerous small seams or stringers of black clay. This made hand sorting necessary and the property was abandoned. Caved. Idle.

Bibl.: R. VIII, p. 688; Bull. 38, p. 288; U. S. G. S. Bull. 223, p. 122.

South Mountain Deposit, owner, Joshua Stockton, Santa Paula. Deposit of soft white gypsum, interbedded with diatomaceous shales, 4 miles south of Santa Paula on the south slope of the mountains at an elevation of 2000′. The gypsum is massive but granular in texture, and impure. Undeveloped.

Sunset Plaster and Cement Co., Fillmore, worked a deposit of gypsum in Secs. 12 and 13, T. 3 N., R. 20 W., S. B. M., 4 miles by road south of Fillmore. Bed of massive white gypsum striking E.–W. and dipping flatly to the north, interbedded with diatomaceous shales. Mined by open cut and hauled to Fillmore, where a plant for the manufacture of wall plaster was erected. The gypsum became very impure with depth. After having produced about 10,000 tons the mine was abandoned. Worked from 1911 to 1914. Idle.

INFUSORIAL EARTH.

South Mountain Deposit. Thinly laminated beds of yellowish white diatomaceous earth, striking E.–W., dipping 60° N., outcrop along the south slope of the mountain at an elevation of 2000′. This earth is permeated with a strong odor of petroleum and is rather impure. Hot gases are exuding from between the beds at several places. The temperature of the rocks at the most violent of these exudations is 146° F. and a light coating of sulphate salts is being deposited on them.

Joshua Stockton and Merle J. Rodgers have 10 unpatented claims along the top of this mountain, consisting of 1400 acres. Undeveloped.

LIMESTONE.

The only known limestone deposits in the county of any commercial value are those limestone beds outcropping in the Matilija Cañon. This limestone is said to be a natural rock cement.

"A limestone which in nature contains sufficient clay, or other substance, mixed with the carbonate of lime, so that it only requires

proper burning and grinding to form a cement, is called a water-lime or natural cement rock." (Bulletin No. 38, p. 171.)

Argilla Claims, located in 1904 by E. Duryea, Hollingsworth Bldg., Los Angeles, are in Secs. 23 and 24, T. 5 N., R. 24 W., S. B. M. Massive bed of limestone exposed on south side of cañon, striking east and west, dipping south. This deposit has been frequently sampled and the rock is said to be an excellent natural cement. An analysis of an average sample as given by E. Duryea is as follows:

	Per cent
Silica	16.015
Aluminum and iron oxide	5.330
Lime	42.630
Magnesia	1.119
Carbon dioxide	34.190

The deposit is 23 miles north of Ventura and 8 miles northeast of Nordhoff, with a good wagon road running almost to the property. Undeveloped.

Matilija Claims. Joshua Stockton and Merle J. Rodgers, Ventura, owners. Beds of hard, blue limestone are exposed along top of ridge north of the Matilija Cañon, above Stingley's Hot Springs and opposite the claims of E. Duryea. Trail to claims from the Matilija cañon. Inaccessible. Undeveloped.

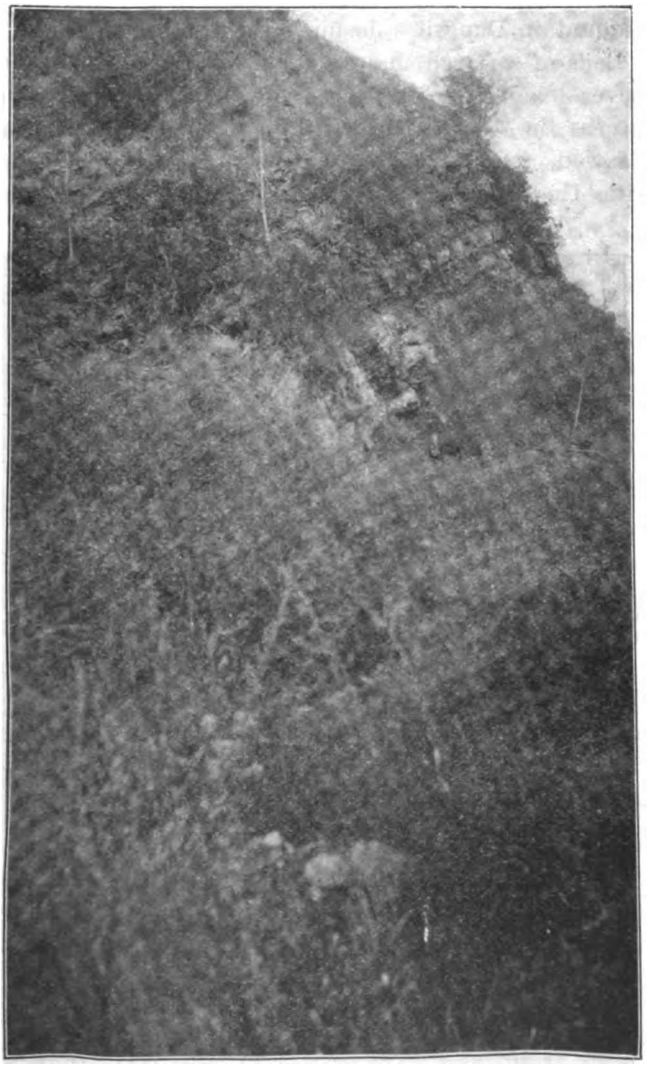
Ventura Cement Company Deposit. Joseph Roth, Ventura, president. Exposure of limestone beds (natural cement rock) outcropping in a side cañon south of Matilija Creek, one mile above Vickers Hot Springs. The company owns 400 acres, patented, in Secs. 22, 23, 26, and 27, T. 5 N., R. 25 W., S. B. M. Analyses (see below) of this limestone have been made by the U. S. Testing Laboratory at St. Louis and the Riverside Portland Cement Company.

Analyses of Natural Cement Rock.

	Per cent	Per cent
Silica	10.82	8.66
Alumina	4.34	3.29
Magnesia	1.66	1.27
Carbon dioxide	36.47	37.89
Lime	47.13	45.80
Totals	100.42	99.91

Authority Joseph Roth.

Sugar Lime Rock Company, formerly of Oxnard, have moved to Los Angeles. All of the limestone used by the sugar refineries of Ventura County is at present quarried in San Bernardino County.



Outcrop of natural cement rock on property of Ventura Cement Co., Matilija, Cañon.

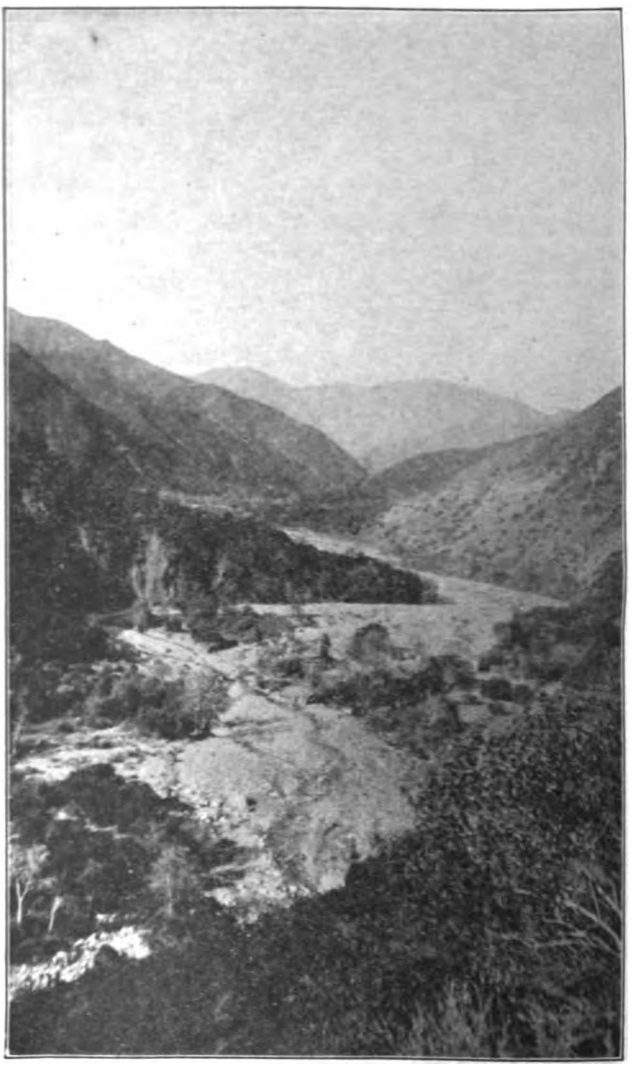
MICA.

A deposit of muscovite, exposed along the northeastern slope of Alamo Mountain, in Secs. 12, 13, and 24, T. 7 N., R. 20 W., was developed by the Mount Alamo Mica Company in 1907. A small grinding plant was erected on the Piru River, but as the mica occurred only in small plates the property was abandoned. Total production amounted to less than 200 tons.

Bibl.: Bull. 38, pp. 337, 338.

MINERAL PAINT.

South Mountain Deposit. Joshua Stockton and Merle J. Rodgers, owners. Beds of soft red shales over a thickness of 60′ and extending for several hundred feet, are exposed on the south slope of the mountain near the top. The material is of a uniform brick-red color, is easily sawed, and pulverizes readily upon crushing, leaving little or no grit. Undeveloped.



Matilija Cañon, looking northward. Site of Lyons, Stingley's, and Vickers Springs.

MINERAL SPRINGS.

The mineral springs of Ventura County are confined mostly to the Matilija and Sespe cañons, and are of the same general character, ranging from hot to cold, and more or less sulphuretted. No mineral water is shipped out of the county, but the springs have been used for many years for bathing and medicinal purposes. Hotels and baths were erected at some of these springs over 40 years ago. Health resorts are conducted at a few of the larger and more important groups. Many of the springs are not utilized, due to their inaccessibility.

Lyon Springs is situated in the Matilija Cañon, 7 miles northwest or Nordhoff, between the Matilija and Vickers springs (see below). A summer resort was conducted here for many years. A large sulphuretted spring rises in a ravine to the south of the main cañon. The water was piped 1000′ to a stone reservoir and then to a boiler to heat for bathing purposes. Property idle for several years. Mrs. G. A. Lyons, Nordhoff, owner.

Bibl.: U. S. G. S. Water Supply Paper 338, p. 278.

Matilija Hot Springs, 6 miles northwest of Nordhoff in Matilija Cañon, ¼ mile above its junction with the north fork. Sim Meyers, Ventura, conducts a summer resort at these springs with hotel and cottage accommodations for 200 people.

A group of four warm sulphuretted springs rises from between upturned beds of hard, buff-colored sandstone. The main sulphur spring has a temperature of 116° F. and is piped to a large swimming plunge and tub baths. The three smaller springs are used for drinking purposes.

Analyses of Matilija Hot Springs.

Constituents are in grains per U. S. gallon.

	Mother Eve	Fountain of Life	Hot Sulphur	Lithia
Calcium carbonate	5.66	1.30	.51	.60
Magnesium carbonate	3.66	.11	1.18	1.40
Sodium carbonate	6.56	5.20	----	5.50
Sodium chloride	3.52	15.00	1.60	.70
Silica	1.00	1.10	1.60	2.10
Calcium sulphate	3.63	----	----	----
Sodium sulphate	2.90	----	1.00	.90
Total solid matter	10.07	22.71	12.00	11.20
Sulphur gas*	90	30	33	----

Analyst not known. Authority, advertising material.
*Probably hydrogen sulphide expressed in cubic inches per U. S. gallon.

Bibl.: U. S. G. S. Water Supply Paper 338, pp. 63, 64.

Sespe Hot Springs, situated in Sespe Cañon, 22 miles northwest of Fillmore. A group of hot sulphuretted springs issue from the

bank above the creek. These springs are on Government land and can be reached only by trail. They are not utilized.

Bibl.: R. XIII, p. 524; U. S. G. S. Water Supply Paper 338, p. 66.

Stingley's Hot Springs are in Matilija Cañon ½ mile west of Lyons Springs. A group of warm sulphuretted springs issuing from the bed of the cañon, were formerly used for bathing purposes. The waters of the creek are now flowing over these springs and the property has been abandoned.

Bibl.: U. S. G. S. Water Supply Paper 338, p. 63.

Sulphur Mountain Springs are situated in Sisar Cañon, ¼ mile west of its junction with Santa Paula Cañon. A large, cold sulphuretted spring flows from a tunnel on the hillside 150′ above the creek. This water is piped to a swimming plunge and baths. A smaller spring issues from the bank on the opposite side of the creek and is used for drinking purposes. A resort established in 1905 is conducted by the Sulphur Mountain Springs Co., A. C. Hardison, Santa Paula, secretary.

Bibl.: R. XIII, p. 524; U. S. G. S. Water Supply Paper 338, p. 279.

Sulphur Spring, northeast of Nordhoff, on property of Chas. Orr, is sometimes called Ojai Sulphur Spring. It is a small sulphuretted spring rising in a pool on the north slope of the Ojai Valley. The country rock is hard white sandstone, of the same character as that exposed in Matilija Cañon 5 miles to the west. The spring is not utilized commercially.

Bibl.: U. S. G. S. Water Supply Paper 338, p. 278.

Vickers Hot Springs. A group of mildly sulphuretted hot springs flowing out from a low bank of crushed shales and gravel at the north edge of the Matilija creek, 9 miles northwest of Nordhoff. A hotel and baths were constructed in 1873 for a health resort. The buildings were washed away by floods in 1884, following which the property was abandoned.

Bibl.: U. S. G. S. Water Supply Paper 338, p. 62.

Wheeler's Cold Spring, is in Sespe Cañon, several miles above the Sespe Hot Springs, and nine miles by trail north of Wheelers Hot Springs. A large flowing cold spring issues out of a clay bank and is utilized for irrigating alfalfa. A small summer camp is conducted here during the fishing and hunting seasons by the Wheeler's Hot Springs Company, Webb W. Wilcox, manager.

Wheeler's Hot Springs. W. C. Blumberg Estate, owner; are 7½ miles northwest of Nordhoff, in the north fork of Matilija Cañon. A group of three warm springs flows out of clay banks on both sides of

the creek. The larger of the three, consisting of about 11 small springs within a radius of a few feet, has a temperature of 100° F. and flows about 35 gallons per minute. This is piped to a swimming tank. The other two springs (Bucket Spring and Genoveva Spring) have temperatures of 62° and 75° respectively, each flowing about ½ gallon per minute. They are used for drinking purposes.

A resort has been conducted here since 1890, open throughout the year, with hotel and cottage accommodations for several hundred people. Electric lights are supplied by a 25-h.p. motor run by a small water-power plant. Webb W. Wilcox, manager.

Analyses of Wheeler's Hot Springs.

Constituents are in grains per U. S. gallon.

	Wheeler's Hot	Bucket	Genoveva
Calcium carbonate	1.01	1.71	16.31
Magnesium carbonate	.90	1.38	----------
Sodium carbonate	22.83	21.50	----------
Calcium sulphate	----------	----------	6.80
Magnesium sulphate	----------	----------	5.67
Potassium sulphate	.60	.45	.90
Sodium chloride	23.58	23.44	.68
Sodium sulphate	.92	1.92	7.85
Iron carbonate	Trace	Trace	Trace
Silica	1.60	1.75	1.60
Totals	51.44	52.15	39.79

Analyses by Wade and Wade, Los Angeles. Authority, advertising matter.

Bibl.: U. S. G. S. Water Supply Paper 338, pp. 64–66.

MOLYBDENITE.

Small kidney-like deposits of molybdenite associated with copper ores are said to occur on Frazer Mountain and on McDonald Peak. As the region was covered with snow at the time of our trip through the county, the deposits were inaccessible.

NATURAL GAS.

The Santa Clara Valley oil fields are producing natural gas which is utilized in part at the wells, and for the manufacture of casing-head gasoline, also to a small extent, for mixing with artificial gas to supply consumers in Ventura, Oxnard and Santa Paula.

The only casing-head gasoline plant in the county is that of the Montebello Oil Company, operating south of Fillmore.[4]

Ventura Power Company has a group of 9 gas wells 3 miles north of Ventura, only 5 of which are now producing. These wells were drilled several years ago and the flow has been gradually diminishing.

[4]For further details see Bull. 69, pp. 113–115; U. S. G. S. MIN. RES., 1914, Pt. II, pp. 804–805.

Now producing from 2 M to 3 M cubic feet per 24 hours. This natural gas is mixed with artificial gas and supplied to consumers in Ventura, Oxnard, and Santa Paula.

PETROLEUM.

The producing oil fields of Ventura County are confined to the Santa Clara Valley and the hills north of the Simi Valley. The best grade of petroleum produced in the state is found in this county. There has been a rapid increase in the production in the last few years due to the extensive development carried on by the Montebello Oil Company in Shields Cañon. The yield for 1915 was 1,017,220 bbls. valued at $869,723.

As the petroleum industry of this county has recently been described in detail by R. P. McLaughlin and C. A. Waring of the State Mining Bureau, in Bulletin No. 69, "The Petroleum Industry of California," no further description will be entered here.

Bibl.: R. VII, p. 101; R. VIII, p. 684; R. XII, p. 357; R. XIII, p. 585. Bulletins 11, 19, 32, 63 and 69.

PHOSPHATES.

Small deposits of white phosphates in a soft, earthy sandstone, occur along the top of South Mountain, 4 miles south of Santa Paula, on the homestead of **Joshua Stockton.** These phosphates are in thin strata scattered through the soft sandstone which crumbles readily in the hand. The owner reports that samples of this material sent to Los Angeles for analysis contained 5% Calcium Phosphate.

PLATINUM.

An occurrence of lode platinum has been reported recently from near Stauffer, but we have so far been unable to confirm it.

SANDSTONE.

The sandstone industry of the county has greatly decreased in the past few years, and only one quarry remains at which any stone has recently been cut.

For many years building stone was quarried from the huge boulders and broken slabs of the Sespe brownstone in Sespe Cañon. This is a hard brown sandstone, uniform in texture and color and very resistant to weathering as shown by the bold outcropping ledges and the fresh surfaces of the broken slabs.

Massive beds of white, siliceous sandstone outcrop in Matilija Cañon. Some building stone was cut from boulders of this tough sandstone at Wheeler's Hot Springs for local use.

Santa Susana Quarry is in Sec. 16, T. 2 N., R. 17 W., S. B. M., 2 miles east of Santa Susana. Massive beds of buff-colored sandstone were quarried by the S. P. R. R. Co. and the stone used for rip-rap work on the roadbed. The sandstone proved to be too soft for this use. Idle.

Bibl.: Bull. 38, p. 327.

Sespe Cañon Brownstone Quarry, Geo. J. Henley et al., owners, is in Sec. 35, T. 5 N., R. 20 W., S. B. M. The quarry is 5 miles north of Brownstone Station, from which the stone is shipped. Large boulders and broken slabs are quarried by hand. Very little stone has been cut from the ledges, as the many boulders can be quarried at less expense. Worked for assessment only. For further details on the Sespe Brownstone, see Bull. 11, p. 26; Bull 19, p. 94.

Mr. Henley has taken a claim (120 acres) in Sec. 1, T. 4 N., R. 20 W., embracing a large exposure of hard, white, siliceous sandstone. This white sandstone rests conformably on the brownstone and has been described by W. L. Watts in Bulletin 11, p. 26. Worked for assessment only.

STONE INDUSTRY.

Under this heading are grouped crushed rock, sand and gravel. No production has been recorded since 1911, except a small amount of rip-rap in 1915. Ventura County has recently appropriated $1,000,000 for the construction of highways in the county so there should be a revival of this industry in the near future.

Camarillo Quarry is in Sec. 5, T. 1 N., R. 20 W., S. B. M., 2 miles southeast of Camarillo. Opened in 1907 by the S. P. R. R. and was worked continuously until 1910. The company erected a large plant, consisting of a gyratory crusher, revolving screens, bucket elevator, etc., and a steam power plant for operating same. Coal was used for fuel. A spur track was built from Camarillo to the quarry.

The rock is a pinkish gray felsite, very irregular in character, grading into soft clay. Many thousand tons were used for ballast along the coast line of the S. P. R. R., but proved to be too soft for such use. The company is about to abandon the quarry and remove the plant.

Bibl.: Bull. 38, p. 327.

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