

# THE LOS BURROS DISTRICT, MONTEREY COUNTY, CALIFORNIA.

By JAMES M. HILL.

## INTRODUCTION.

The following notes concerning the metal prospects of the Los Burros district, in the southwestern part of Monterey County, Calif., are based on observations made during a visit of a few days to this section of the Santa Lucia Range in February, 1921. The author is under obligation to the few operators in the region for their many courtesies, particularly to the owners of the Gorda properties and the caretaker at the Buclimo mine.

The district lies on the west side of the rugged Coast Range, near the south line of Monterey County, in Tps. 23 and 24 S., R. 25 E. Mount Diablo meridian. Most of the properties are near the Government mail trail between Jolon, east of San Antonio River, and Gorda, a small ranching settlement on the coast about midway between Monterey and San Luis Obispo. It is reached from King City, a station on the Coast Line of the Southern Pacific Railroad at the south end of Salinas Valley, by 45 miles of road and 14 miles of rough, steep trail. Travel except on the trails is next to impossible, because of the dense tangle of scrub oak, madrona, and manzanita. There is a fair stand of spruce and pine on the upper slopes of the mountains, and redwood is found in the canyon bottoms on the coast side of the range at elevations as great as 2,000 feet. Most of the prospects are confined to the drainage basin of Willow Creek and the headwaters of Alder Creek, a smaller stream south of Willow Creek.

## TOPOGRAPHY.

The Coast Range in this region is 12 miles wide and has a rather even sky line approximately 3,300 feet above the sea and 2,000 feet above the low country to the east. The summit of the range is 5 to 6 miles east of the coast line. This narrow mountain wall is intricately cut by deep, narrow gorges, and in consequence the surface is extremely rugged, as is well shown on the Cape San Martin topographic map issued by the United States Geological Survey.

The only flat areas in the mountain region are remnants of old beaches, now found elevated above the sea. The highest remnants

noted are at an elevation of 900 feet, but the largest, upon one of which Gorda is located, are about 100 to 200 feet above sea level. South of Cape San Martin, however, there are well-developed beaches which stand 500 feet above sea level.

### GEOLOGY.

The whole district is underlain by rocks of the Franciscan formation. No intrusive rocks other than the serpentized basic dikes so characteristically associated with the Franciscan were noted, though intrusive granite occurs in the mountains at the headwaters of Nacimiento River. No attempt was made to map the irregularly distributed masses of serpentine, but there appear to be two more or less continuous belts or dikes, lying about 2,000 feet apart and trending in a west-northwest direction, which run through the south-central part of the district. The most conspicuous exposures of the southern belt were noted along Spruce Creek, in the vicinity of the Gorda mine, and at the head of Alder Creek, near the Buclimo camp. The northern belt is well exposed along the south wall of the canyon of the South Fork of Willow Creek. The serpentized rocks are almost completely altered, but a few specimens taken from the center of a particularly large outcrop indicate that the original rock was a peridotite.

The Franciscan formation as exposed here is made up of dark greenish-gray arkosic, micaceous sandstones, in general fine grained but passing into fine conglomerates that are usually noted as lenses rather than as continuous beds. Although sandstone predominates, a large amount of the rock weathers like shale, because of the fineness of the constituent grains and the parallel distribution of the mica. The most abundant constituent of the sandstone is quartz, but orthoclase and plagioclase feldspar is only slightly less abundant. The dark color of the rocks is due to an unusual amount of hornblende and biotite. Near the serpentine areas the sandstone is altered to contorted schist, much crushed and sheared and cut by veinlets of quartz and calcite. In places in the vicinity of the basic dikes considerable bodies of massive sandstone have been thoroughly impregnated with minute crystals of garnet and pyrite.

All the rocks weather rusty brown, but there is a noticeable difference between the colors developed by weathering of the rocks in the deeper canyons and those near the summits of the ridges. The sandstone is massive, with little evidence of bedding, but weathers rapidly in small angular pieces that disintegrate readily into a brown sandy clay. The conglomerate lenses are usually composed of small rounded or egg-shaped pebbles of pinkish feldspar, white quartz, and black slate. In a few places, however, lenses of coarse arkosic sandstone, with small, flat, angular pieces of black slate, were noted.

Only one small lens of radiolarian chert was seen; this lies at the head of Alder Creek a short distance from the New York mine.

There seem to be two rather distinct facies of the Franciscan formation in this district. The rock exposed in the lower parts of the canyon weathers in larger and more angular blocks of darker color than the overlying rocks that are exposed along the mail trail near the Buclimo mine and on the upper part of the ridge north of Willow Creek canyon. So far as known, serpentine does not occur in the overlying rocks. These upper rocks weather in small fragments, more like shales, though fresh exposures show that they are fine-grained sandstones, composed of essentially the same materials as the slightly coarser sandstones of the lower series.

The heavy growth of underbrush and the deep accumulations of broken rock and soil, even on steep slopes, make study of the structure very difficult. Practically all the readings taken on the west side of the summit gave strikes of N. 50°–70° W. and dips of 20°–60° NE. East of the summit the strike is more nearly N. 45° W. and the dip 65°–70° NE. It is judged that this particular part of the Santa Lucia Range is a monoclinally tilted block, lying between a fault whose escarpment forms the northeastward-facing wall along Nacimiento River and another fault represented by the scarp along the coast. These faults trend approximately N. 40° W. The trace of a major fault trending N. 70° W. is indicated by a series of benches and depressions on the south wall of the South Fork of Willow Canyon, about midway between the two larger serpentine dikes. The structure is probably complex in detail, for much evidence of minor movement, both parallel to and across the general structure lines, is seen in every exposure.

#### HISTORY OF MINING.

The Los Burros district was organized in 1876,<sup>1</sup> though little but placer mining was done in the region until 1887, when the Last Chance (Buclimo) deposit was discovered by W. D. Cruikshank. Before that time a small quantity of gold was produced yearly by Chinese, who washed the gravels of San Antonio River in the vicinity of Jolon, and a little ragged coarse placer gold had been recovered from the ravines of the Santa Lucia Range near the coast. Cruikshank's discovery at the head of Alder Creek caused only a mild excitement, for the region was rugged, and transportation of supplies and equipment was difficult. In four months after the discovery of the Last Chance sufficient free gold had been saved from the surface workings to pay for the installation of a 3-stamp mill and small boiler on the property. The developments, consisting of open cuts, shafts, and drift tunnels that attained no great depth, showed three

<sup>1</sup>Irelan, William, California State Min. Bur. Eighth Ann. Rept., pp. 405–410, 1888.

nearly parallel quartz veinlets, lying parallel to the bedding of sandstones. A group of claims, including the Mars, Manchester, Grand Pacific, and Ophir, was located near the original discovery, and the Stonewall and Brewery, farther west on Willow Creek, were located during the same year.

Apparently little was done in the district after 1888, except at the Last Chance mine, for the next record of the State mineralogist is for the year 1892.<sup>2</sup> By that time the Last Chance had reached a depth of 160 feet.

Practically all the mining in the district was confined to the mines on Alder Creek until 1902, when the discovery of a few very large gold nuggets on Spruce Creek led to the organization of the Gorda Mining Co., which has done some work to locate the veins that were the source of this coarse gold. About the same time placer gold was found in the gravels of Willow Creek, and very rich quartz float was found on the Plaskett property, called the Ocean View. The Bushnell vein, on the point between Willow Creek and its North Fork, at an elevation of 1,600 feet, was discovered about 1904, and more recently croppings showing copper-stained pyritic sandstone have been prospected in the canyon of the South Fork of Willow Creek, about 2 miles north of the Last Chance mine. The Last Chance and several other properties in the vicinity are now controlled by the Buclimo Mining Co., and the original names have been more or less lost. This company found the upper workings in such state that it began to drive a long crosscut from Alder Creek to tap the veins at a depth of about 400 feet, but this project was not completed.

The total production of the Los Burros district is estimated at \$90,000.<sup>3</sup> The records of the United States Geological Survey show a production of \$4,746 in gold and silver for the period 1905-1908, most of it from siliceous gold ores. During another period of activity from 1912 to 1914 a total of 329 tons of siliceous ore was treated, and the total production of the district, including a small quantity of placer gold, was valued at \$14,419. There is no record of production from the district since 1917.

In the winter of 1920-21 a little development work was done on the Bushnell, Gorda, and New York properties and some surface work at the Melville and Hammond prospects, on the south side of Willow Creek.

#### ORE DEPOSITS.

The principal mineralization of the district is in the vicinity of the serpentine belts, and the greatest amount is at the head of Alder Creek, near the Buclimo, Grizzly, and New York properties. In

<sup>2</sup> California State Mineralogist First Biennial Rept., for the two years ending Sept. 15, 1892, p. 259.

<sup>3</sup> California State Mineralogist Fifteenth Ann. Rept., p. 597, 1916.

this locality relatively narrow quartz stringers, from half an inch to 2 inches in width, that strike N. 70°–85° W. and usually dip 60°–85° N., lie parallel to the major structural features. Calcite and siderite in minor amounts are associated with the quartz in most places. Oxidation is relatively shallow, and in some pits sulphides are found directly at the surface. The oxidized surface ores are largely limonite-stained bodies of crushed sandstone, with more or less quartz, and carry free gold. The sulphide ores, which were visible at only a few places in 1921, consist of sandstone cut by veinlets of quartz and a little calcite, which have been crushed and later mineralized. The sulphides are pyrite, arsenopyrite, and minor amounts of chalcopyrite, sphalerite, and occasionally a speck of galena. The sulphides are usually confined to the immediate vicinity of the quartz veinlets, though in a few places finely disseminated pyrite, with much less chalcopyrite, is diffused through the sandstone for several feet from the veinlets. Practically all the gold produced from the lodes in the district has been extracted from relatively small lenses of oxidized ore, which required only amalgamation for treatment. It is doubtful if the sulphide ores are sufficiently rich to stand the cost of transportation and treatment by smelting.

At the New York property, on Ajax Mountain near the summit, two narrow veinlets, about 18 inches apart, constitute the lode. The crushed, contorted rocks between the veinlets carry pyrite and arsenopyrite, with very minor amounts of chalcopyrite and galena. Complete oxidation on this lode has extended to a depth of 50 feet, and mining to that depth has yielded some fairly good free-gold ore. Two tunnels, a few hundred feet in total length, have been driven in the sulphide zone. The sulphides are in very small crystals and appear to have been deposited subsequently to a period of crushing of the original quartz veins. Arsenopyrite predominates over pyrite.

The Grizzly ledge, in the bottom of the Alder Creek valley, between the New York and Buclimo properties, measures 3 to 4 feet between walls. The ledge matter is crushed sandstone, with stringers of oxidized quartz and a little calcite. The incline on the ledge, which dips 75° N., is said to be 80 feet deep but was partly filled with water at the time of visit.

The Buclimo (Last Chance) workings were not accessible. From the surface work it is judged that at least four nearly parallel lodes exist on the property. These strike N. 80° W., and, to judge from the northerly dips at the surface, the ledges may come together with depth. It is said that from the surface to the tunnel level, 85 feet below, the lode has been stoped for a width of 10 feet and a length of 500 feet. A little ore, presumably from the tunnel level, found in a mill bin showed quartz-calcite veinlets, with pyrite and arsenopyrite in crushed, somewhat mineralized dark-colored sandstone and

shale. The upper workings are reported to be abandoned now, and a long crosscut tunnel has been started from the level of Alder Creek, near the Grizzly incline. This crosscut is more than 1,800 feet long but has not reached the vein. It was run in a direction almost parallel to the vein and the strike of the sandstone beds. The first 200 feet of the crosscut is in medium-coarse sandstone; next there is 100 feet of black chert; and the remainder of the tunnel is in nearly black sandstone that is almost fine grained enough to be termed slate. This tunnel shows the formations to be very much broken and faulted, most of the movement being parallel to the bedding in dip as well as in strike, but with many planes of minor movement showing parallel strike but much steeper dip than the bedding.

The Melville claims, on the ridge between Alder and Willow creeks, appear to be a westward continuation of the Buclimo. A large open cut just below the trail exposes a much crushed zone of sandstone about 10 feet wide, with stringers of quartz that strike N. 70° W. and dip 50° N. It is said that all the material from this zone shows some gold.

The Brewery tunnels are north of the trail, about 200 feet down the slope toward Willow Creek from the mail-trail ridge and 1 mile west of Melville's cabin. They were caved at the time of visit but apparently were run on a ledge that strikes N. 80° W. and in the cuts dips 60° S. As exposed in the cuts the ledge matter is 6 feet wide and consists of fine-grained black sandstone, with veinlets of quartz and a little siderite. No sulphides were seen on the dump, but small casts of cubical outline filled with limonite indicate that the mineralization is similar to that at the Buclimo.

In the canyon of the South Fork of Willow Creek F. C. Hammond has several prospects on N. 80° W. zones of mineralization in the slates and sandstones. The metalliferous minerals here consist largely of disseminated pyrite and chalcopyrite in hard dark-colored sandstone along a series of nearly vertical tight fractures. No arsenopyrite was noted. There is practically no oxidation on any of the ledges, though a little iron and copper stain is to be seen directly at the surface. At one of Mr. Hammond's claims, on the ridge between South Fork and Willow Creek, pyrite and a little chalcopyrite are disseminated along a shear zone in garnetized sandstone about 25 feet from a lens of serpentine. Very minor amounts of copper silicate and limonite coat the joints at the surface.

The Gorda property is on Spruce Creek in sec. 4, T. 24 S., R. 5 E. In 1902 several exceptionally large ragged gold nuggets were found in the stream bed near by. Considerable money was spent in equipping the property for hydraulic work, and a little more gold was obtained. The talus and soil cover, however, were so deep that the

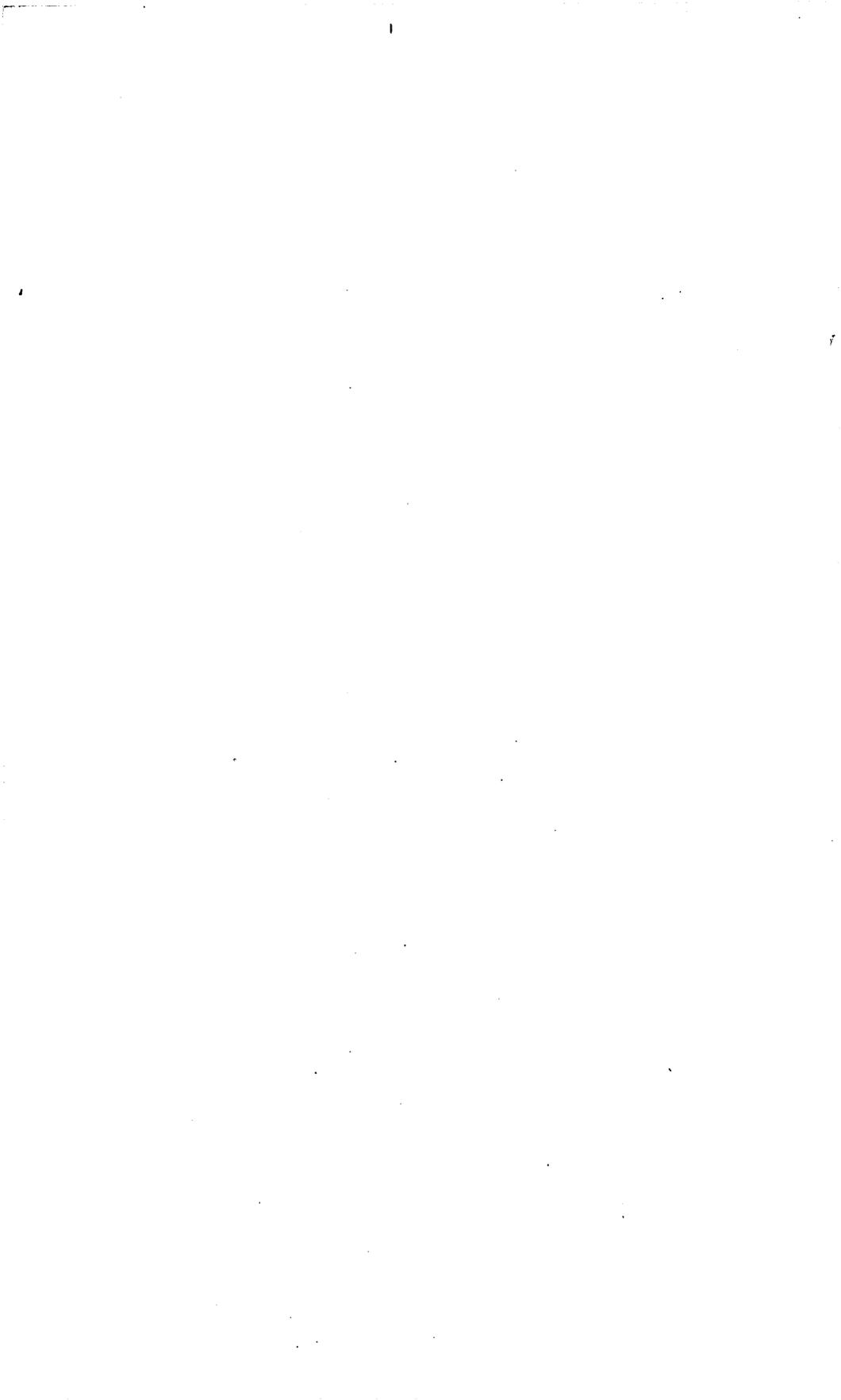
stream gravels had not been reached except over a short distance. A number of tunnels have also been run in talus to locate the rim of the covered channel, and some work has been done in the sandstone on the north wall of the gulch in the hope of discovering the source of the coarse gold, but this objective had not been reached in 1921. The sandstone cut by this tunnel is peculiar in that it contains small flat fragments of black slate, minute red garnets, and a small amount of finely disseminated pyrite. The mineralization is localized in the sandstone within 150 feet of a considerable outcrop of serpentine.

The Bushnell property is on the point between the Middle and North forks of Willow Creek. The developments consist of an inclined shaft and a crosscut tunnel, 330 feet in all. The incline is sunk 130 feet on the intersection of a north-south fracture that dips  $50^{\circ}$  E. and a N.  $50^{\circ}$  E. stringer that dips  $50^{\circ}$  SE. It is reported that about \$9,000 in free gold was milled from the ore obtained in sinking this shaft. At the tunnel level the north-south fracture is barren; the N.  $50^{\circ}$  E. fissure ranges in thickness from a knife-edge to 8 inches and is filled with white quartz, calcite, and fragments of wall rock, the whole much crushed and shattered. A little free gold is visible in some of the quartz, but no sulphides, limonite, or other indications of the former presence of sulphides were noted in the ore.

The Ocean View (Plaskett) property, on the west slope of the ridge west of the North Fork of Willow Creek, in sec. 30, T. 23 S., R. 5 E., is developed by an 86-foot incline, with short drifts to the northwest at 40 and 80 feet and a 100-foot drift tunnel to the southeast on the 40-foot level. The ledge strikes N.  $45^{\circ}$  W. and dips  $10^{\circ}$  NE. at the surface but steepens to  $60^{\circ}$  at the bottom of the incline. It consists of crushed white quartz, slightly iron stained but with no visible sulphides. It is reported that \$18,000 in free gold was recovered from float picked up below the croppings and from ore obtained in sinking the incline. It is judged that the free gold occurred in a small lens, for the quartz exposed in the workings appears to be barren.

The placer gold found in small quantities in practically all the gulches but particularly on Spruce and Willow creeks was derived from the weathering of small veinlets similar to those disclosed in the properties described above. Most of the placer gold is in small ragged particles that have not traveled far from their source. The large nuggets found in Spruce Creek evidently came from a particularly rich pocket in the immediate vicinity.

The mineralization of the district is not particularly strong, and, although there may be further discoveries, near the surface, of pockets containing free gold, it is believed that all that can be expected below relatively shallow depths will be rather small bodies of pyritic ores of relatively low tenor.



# INDEX.

A.	Page.		Page.
Acknowledgments for aid .....	5-6	Bayley, W. S., General features of the brown hematite ores of western North Carolina .....	157-208
	42, 65-66, 131, 280-281, 323	General features of the magnetite ores of western North Carolina and eastern Tennessee .....	209-270
Alleghany County, N. C., titaniferous magnetites in .....	252	Becker, G. F., study of the Comstock lode by .....	43
Alluvium, nature of, in Pike County, Ark. .....	292-293	Belcher mine, Comstock lode, Nev., microscopic details of ore from .....	48, 52-54
Alta mine, Comstock lode, Nev., microscopic details of ore from .....	48-49	Bessemer City, N. C., hematite mines near .....	204-208
American area, Ark., location of .....	280, 289	Big Ore bank, N. C., description of .....	234-235
nature and relations of peridotite in .....	306-308	Bingen formation, nature and occurrence of, in Pike County, Ark. ....	291-292
American mine, Ark., map showing distribution of peridotite at .....	304	Black Lick, Ark., map showing distribution of peridotite at .....	304
operation of .....	288	Black Lick area, Ark., location of .....	280, 289
production from .....	318	nature and relations of peridotite in .....	308-310
Andes mine, Comstock lode, Nev., microscopic details of ore from .....	57	prospecting on .....	288
Andrews, N. C., brown hematite deposits northeast of .....	192-193	"Blue ground," in Ozark mine, Ark., plate showing .....	296
brown hematite deposits southwest of .....	185-187	polished, plate showing .....	297
Andrews area, N. C., hematite deposits in .....	188-192	use of name .....	295
structural features of .....	187-188	Borax. <i>See</i> Colemanite.	
Andrews schist, in Cherokee County, N. C., geologic features of .....	167	Branner, J. C., cited .....	304
in Cherokee County, N. C., hematite deposits in .....	182-183	Brasstown, N. C., hematite near .....	197, 198
Argentite, ores bearing, in the Monte Cristo mine, Ariz. ....	141-145	Brasstown belt, N. C., description of .....	197
Argentum mine, Candelaria, Nev., description of .....	4-5, 17-19	Breccia, volcanic, in Ozark mine, Ark., plate showing .....	296
Arkansas, southwestern, geologic map of part of .....	280	volcanic, polished, plate showing .....	297
Arkansas Diamond Co., acknowledgment to .....	280-281	Brewery tunnels, Los Burros district, Calif., description of .....	328
Arkansas mine, Ark., diamonds from, plate showing .....	320	Brownstown marl, nature and occurrence of, in Pike County, Ark. ....	292
equipment and operation of .....	286	Buclimo mine, Los Burros district, Calif., description of .....	327-328
production from .....	318	Burra mine, Ducktown, Tenn., composition of mine water from .....	107
Ash County, N. C., siliceous magnetite in .....	216-220	Bushnell mine, Los Burros district, Calif., description of .....	392
titaniferous magnetites in .....	251-252		
Atlas mine, near Sneffels, Colo., nature and origin of ores of .....	74-75	C.	
Avery County, N. C., siliceous magnetite in .....	220-231	C. & C. mine, Comstock lode, Nev., analysis of water from .....	59, 61
titaniferous magnetites in .....	253	microscopic details of ore from .....	47, 49, 50-51
B.		Callville Wash, Nev., course of .....	24
Bachelor mine, Ouray, Colo., nature and origin of ores of .....	70-72, 73	Candelaria silver district, Nev., alteration of wall rock in .....	15-16
Ballou "home place," Ashe County, N. C., magnetite deposit on .....	217, 218, 219	dacite tuff in .....	9-10
Bastin, Edson S., Bonanza ores of the Comstock lode, Virginia City, Nev. ....	41-63	geography of .....	2-3
Primary native-silver ores near Wickenburg, Ariz. ....	131-155	geology of .....	6-12
Silver enrichment in the San Juan Mountains, Colo. ....	65-129	history of mining in .....	3-5
		Jurassic (?) rocks in .....	7-8
		mines in .....	17-22
		olivine basalt in .....	11-12

	Page.		Page.
Candelaria silver district, Nev., Ordovician (?) rocks in.....	6-7	Comstock lode, ores of, contemporaneous deposition of minerals comprised in.....	44
ores in, composition and tenor of.....	13-15	ores of, deposition from ascending solutions.....	42, 43, 44-45, 63
outline of report on.....	1-2	enrichment by descending solutions.....	44, 46, 63
production from.....	5	minerals in.....	43, 44
rhyolites in.....	10-11	microscopic features of.....	44-47, 63
silver veins in.....	12-17	silver in ores of, mode of occurrence of....	45-47
comparison of, with other Nevada silver deposits.....	16-17	sources of ores and waters examined.....	42
Tertiary rocks in.....	8-12	Corinth, Ark., prospecting for diamonds south of.....	288
Carpenter, E. E., acknowledgment to.....	5	Costner mine, N. C., description of.....	237
Carroll, Fred, acknowledgment to.....	66	Covellite, replacement of other minerals by.....	105, 109
Carter County, Tenn., titaniferous magnetites in.....	253, 253-254	Cranberry mine, N. C., analyses of ore from.....	222
Catawba County, N. C., hematite deposits reported in.....	204	history of.....	220, 221
magnetites in.....	233-234, 236	location of.....	220, 221
Central tunnel, Comstock lode, Nev., analysis of descending water from.....	60, 62	ore vein in.....	222-227
Cherokee County, N. C., geology of the brown hematite district in.....	167-168	Cranberry mine belt, N. C. and Tenn., reserves of magnetites in.....	229-231
grouping of the hematite deposits in....	166-167	Cranberry vein, continuation of, beyond the Cranberry mine.....	227-229
hematite deposits in the Nottely River ore belt.....	168-173		
in the Valley River ore belt.....	168-170, 174-193	D.	
sequence of Cambrian formations in....	159-160	Dannemora mine, N. C., ores of.....	256-257
Chloanthite, silver ores bearing, in the Monte Cristo mine, Ariz.....	138-139	Davis, J. van, property, near Peachtree, N. C., hematite on.....	198
Chromium, occurrence of, in magnetites.....	211	De Queen limestone, description of.....	290
Clark County, Nev. See Muddy Mountains, Nev.		Devil's Workshop mine, N. C., description of.....	206-208
Cobalt, Ont., nature of silver-depositing solutions at.....	150-154	Diamonds, from the Arkansas mine, Pike County, Ark., plate showing.....	320
ores of, compared with those of the Monte Cristo mine, Ariz.....	147-150	in Pike County, Ark., description of.....	319-321
Colemanite, deposit near Callville Wash, Nev., discovery of.....	34	history of discovery, and mining of.....	285-288
deposit near Callville Wash, Nev., nature of.....	38	minerals associated with.....	322
nature of ore in.....	38-39	mining of.....	321-322
origin of.....	39	occurrence of.....	316-318
plates showing.....	29	production of.....	318-319
strata inclosing.....	36-37	outlook for finding, in Scott County, Ark.....	278
structure and extent of.....	34-35	Dierks limestone, description of.....	290
deposits in White Basin, Nev., discovery of.....	32	Dockery mine, N. C., location of.....	174
nature and extent of.....	32-33	Dunton, Colo., composition of spring and mine waters near.....	118-119
origin of.....	33	location of.....	110
Comstock lode, depths from which samples of ores and waters were taken.....	44, 47, 58, 59	mines near.....	116-127
earlier investigations of.....	42-43	E.	
engineering and geologic problems concerning.....	41	Eliot hematite property, near Peachtree, N. C., description of.....	196
gold in ores of, mode of occurrence of....	45, 46	Emma mine, Dunton, Colo., nature of ores and waters of.....	116-120
mine waters of, analyses of.....	59-63	Enrichment, downward, in the Monte Cristo mine, Ariz.....	146
flooding by.....	57-58	Enterprise vein, Rico, Colo., nature of ores and waters of.....	115
temperatures of, at different depths....	58		
ores from depths of 2,500 feet or more in, microscopic details of.....	52	F.	
ores from moderate depths in microscopic details of.....	47-52	Fain-Hitchcock mine, N. C., description of.....	172-173
ores from small depths in, microscopic details of.....	52-57	Farish, F. G., acknowledgment to.....	66
		Farrar, D. F., analyses by.....	268
		Ferebee & Young mine, N. C., description of.....	188-189

Page.	Page.
Finney & Teegarden mine, Tenn., ore bodies and country rocks of..... 266-269	Horse Spring formation, exposures of limestone member of, in Clark County, Nev., plates showing... 28
Flower 7 mine, Comstock lode, Nev., microscopic details of ores from..... 57	nature and distribution of, in Clark County, Nev..... 28-30
Fulenwider mine, N. C., occurrence and origin of minerals near..... 238	Humboldt mine, Colo., nature of ores and waters of..... 79-83
Fuller, John T., acknowledgment to..... 280	
G.	
Gaston County, N. C., magnetites in..... 236-239	
Genesee mine, Colo., composition of waters in..... 105-108, 109	
nature and alteration of ores in..... 104-109	
Gold Branch, N. C., hematite on..... 200-201, 203	
Gorda prospect, Los Burros district, Calif., description of..... 328-329	
“Goose-egg” structure in limestone beds, near Callville Wash, Nev., plate showing..... 38	
Gould & Curry mine, Comstock lode, Nev., microscopic details of ores from..... 54-55, 57	
Graton, L. C., cited..... 232-233	
Graybeal property, near Lansing, N. C., magnetite deposit on..... 217, 218, 220	
Green, Guy, mine, N. C., description of... 179-180	
Grizzly ledge, Los Burros district, Calif., description of..... 327	
H.	
Hale & Norcross mine, Comstock lode, Nev., microscopic details of ores from..... 47, 55-56	
Hall-Starbuck mine, N. C., location of..... 174	
Hammond prospects, Los Burros district, Calif., description of..... 328	
“Hardebank,” in Mauney mine, Ark., plate showing..... 296	
micrographic plates showing..... 296	
nature and occurrence of..... 305-306	
use of name..... 296	
Hayes-Hoblitzell mine, N. C., description of. 181-182	
view in, plate showing..... 164	
Heaton & Russell mine, N. C., description of. 178	
hydraulic jet in, plate showing..... 164	
ore vein in, plate showing..... 165	
view in, plate showing..... 164	
Hellier, W. G., acknowledgment to..... 42	
Hematite, brown, analyses of... 175, 181, 182, 184, 189, 191, 192, 205, 206, 207	
brown, distribution of..... 158	
earlier reports on..... 157-158	
mining of..... 163, 169-170, 188-189, 190-191	
nature of..... 163	
origin and age of..... 160-163	
residual deposits of..... 163	
Hill, James M., The Los Burros district, Monterey County, Calif..... 323-329	
Hinds, J. I. N., analyses by..... 245, 267, 268	
Hiwassee and Nottely rivers, N. C., hematite deposits between..... 201-204	
Hiwassee River, N. C., hematite deposits north of..... 197-198	
hematite deposits south of..... 198-199	
Holland, L. F. S., acknowledgement to..... 6	
Holmes mine, Candelaria, Nev., history of... 4, 18	
	I.
	Irving, J. D., cited..... 73
	J.
	Jenkins, L. L., hematite property of..... 183-185
	Jumbo No. 3 vein, Rico, Colo., nature and alteration of ores in..... 112-113
	K.
	Keith, Arthur, cited..... 164
	Kerr, W. C., and Hanna, G. B., cited. 234, 237, 251
	Kimberlite area, Ark., exposures of peridotite dike in..... 304-305
	location of..... 280, 289
	metamorphosed Trinity clay in..... 305
	Kimberlite Diamond Mining & Washing Co., acknowledgment to..... 280-281
	Kimberlite mine, Ark., map showing distribution of peridotite at..... 304
	operation of..... 287-288
	trenches on, plate showing..... 320
	Kimberlites, of Arkansas, analyses of..... 316
	of South Africa, analyses of..... 316
	origin of pipes of..... 312-313
	King, Clarence, study of the Comstock lode by..... 42-43
	Knopf, Adolph, The Candelaria silver district, Nev..... 1-22
	Kunz, G. F., and Washington, H. S., cited... 319
	L.
	Lansing mine, N. C., ore of..... 242-248
	Lesley, J. P., cited..... 239-240
	Liberty Bell mine, Colo., ores of..... 89-92
	Limonites, occurrence of, in Gaston County, N. C..... 236-237
	<i>See also</i> Hematite, brown.
	Lincoln County, N. C., magnetites in..... 233-236
	Lincolnton, N. C., hematite deposits reported near..... 204
	Little Missouri River below Prairie Creek, peridotite on..... 304
	Little Mountain mine, N. C., description of. 206-208
	Longwell, C. R., geologic work of, on the Muddy Mountains, Nev..... 25-26
	Los Burros district, Calif., geology of..... 324-325
	history of mining in..... 325-326
	location of..... 323
	ore deposits in..... 326-329
	placer gold in..... 329
	topography of..... 323-324
	Lucky Hill mine, Candelaria, Nev., description of..... 5, 20-22
	Luther, George H., hematite prospect of, near Andrews, N. C..... 185
	McCarter place, Ashe County, N. C., magnetite ore on..... 251, 252
	McCormick, Thomas, acknowledgment to... 42
	McHan mine, N. C., description of..... 180-181

Page.	Page,
Madison County, N. C., distribution and mode of occurrence of brown hematite ores in.....	163-166
sequence of Cambrian formations in.....	159-160
titaniferous magnetites in.....	253
Magnetic City, Tenn., magnetite deposits near.....	228, 229
Magnetite-hematite ores of North Carolina and Tennessee, nature and distribution of.....	261-269
origin of.....	269-270
reserves of.....	270
Magnetite-marble ores, nature and occurrence of, in North Carolina.....	242-248
origin of.....	248-250
reserves of.....	250
Magnetite, siliceous, deposits of.....	214-242
siliceous nature of.....	213-214
Magnetites, chemical composition of.....	211, 218, 235, 239, 254, 256-257, 258, 267
in western North Carolina and eastern Tennessee, geology of the district containing.....	214-215
production and general distribution of.....	209-211
reserves of.....	229-231
varieties of.....	211-213
nontitaniferous, general features of.....	213
kinds and deposits of.....	215-250
titaniferous, composition of.....	258-260
deposits of.....	251-259
nature of.....	250-251
origin of.....	260-261
utilization of.....	261
Manganese, occurrences of, in western North Carolina and eastern Tennessee.....	171, 198-199, 202, 203, 211
Marble, N. C., brown hematite deposits east and south of.....	180-185
brown hematite deposits southwest of.....	178-180
Marble Creek, N. C., hematite deposits near.....	176-177
Martin Creek area, N. C., areas of marble in.....	199-201
hematite deposits in.....	200-201
Marvacar mine, N. C., description of.....	190-191
Mauney, Walter, acknowledgment to.....	281
Mauney mine, Ark., equipment and operation of.....	286-287
plate showing.....	296
production of.....	318
Mauney property, near Murphy, N. C., hematite mine on.....	202-203
Melville claims, Los Burros district, Calif., description of.....	328
Merrill, George P., acknowledgment to.....	42
Mexican mine, Comstock lode, Nev., microscopic details of ore from.....	51, 55
Millar, Austin Q., cited.....	320-321
Mine waters, action of, in the enrichment of silver ores.....	96-97, 109, 127-128
nature of.....	88, 105-108, 109, 112, 117-119, 123, 125-126, 128-129
test of, from the Humboldt mine, Colo.....	83
from the Monte Cristo mine, Ariz.....	146
from the Smugler-Union mine, Colo.....	88
Miser, Hugh D., and Ross, Clarence S., Diamond-bearing peridotite in Pike County, Ark.....	270-322
and Ross, Clarence S., Peridotite dikes in Scott County, Ark.....	271-278
Mitchell County, N. C., titaniferous magnetites in.....	253
Molybdenum, occurrence of, near Shell Creek, Tenn.....	229
Monte Cristo mine, near Wickenburg, Ariz., argentite-bearing ores in.....	141-145
bedrock formations at.....	131-132
chalcopyrite type of ore in.....	133
chloanthite-bearing silver ores in.....	138-139
distribution of rich silver ores in.....	133-134
downward sulphide enrichment in.....	146
gold ores in.....	145
mine waters in.....	146
niccolite-bearing silver ores in.....	134-137
ores carrying ruby silver in.....	139-141
ores of, compared with those of Cobalt, Ont.....	147-150
oxidation in.....	145-146
primary native-silver ores of.....	131-155
structural features of the veins in.....	132-133
Monteith mine, N. C., description of.....	200
location of.....	197, 199
Montvale, N. C., brown hematite deposits northeast of.....	177-178
brown hematite deposits southwest of.....	174-177
Morgan Creek, N. C., brown hematite deposits northeast of.....	178-180
brown hematite deposits southwest of.....	177-178
brown hematite reserves near.....	178
Mount Diablo mine, Candelaria, Nev., description of.....	4-5, 19-20
Mountain Top tunnel, Colo., nature of ores cut by.....	78-79
Mountain View mine, Butte, Mont., composition of mine water from.....	107
Muddy Creek formation, features of, in Clark County, Nev.....	30-31
Muddy Mountains, Nev., colemanite deposits in.....	23, 25
geography of.....	24-25
geology of.....	26-31
igneous rocks in and near.....	31
Murphy, N. C., brown hematite deposits northeast of.....	174-177
Murphy marble, quarry in, in western North Carolina.....	176
N.	
New River, North Fork of, N. C., magnetite deposits on.....	216-220
New York mine, Los Burros district, Calif., description of.....	326, 327
Newsboy mine, Ouray, Colo., ores of.....	73-74
Nicolite-bearing silver ores near Wickenburg, Ariz.....	134-137
Nitze, H. B. C., cited.....	235, 251, 254
Noble, L. F., Colemanite in Clark County, Nev.....	23-39
North Carolina, mountain district of, rocks associated with brown hematite ores in.....	158-163
western, magnetite ores in.....	209-270

Page.	Page.
Northern Belle mine, Candelaria, Nev., history of.....	3-4, 17-18
Nottely and Hiwassee rivers, N. C., hema- tite deposits between.....	201-204
Nottely River hematite belt, N. C., descrip- tion of mine in.....	172-173
location and nature of deposits in.....	170-172
reserves of ore in.....	171, 172, 193-194
Nottely-Valley River belt, N. C., geologic map of.....	162
O.	
'Ocean View mine, Los Burros district, Calif., description of.....	329
Ophir mine, Comstock lode, Nev., micro- scopic details of ore from.....	52
Ormond mine, N. C., description of.....	204-206
Ouray, Colo., composition diagram of spring water from.....	61
Ouray-Telluride region, Colo., geologic features of.....	66-67
origin and enrichment of ores in.....	92-97
Overton fanglomerate, nature and distribu- tion of, in Clark County, Nev. 27, 29-30	
Owensby, R. R., property, near Murphy, N. C., hematite deposits on and near.....	203
Ozark mine, Ark., equipment and operation of.....	287
plates showing.....	296
production of.....	318
P.	
Palmer, Chase, acknowledgment to.....	65-66
analyses by.....	59, 68, 108, 119
Peachtree area, N. C., brown hematite de- posits in.....	194-197, 198
Peg Leg mine, Tenn., location and ore vein of.....	228, 229
Peridotite, exposures of, in the Mauney mine, Ark., plate showing.....	296
hypabyssal intrusive, micrographic plates showing.....	296
Peridotite dike near Olio, Ark., micrographic plates showing.....	276
Peridotite dikes in Scott County, Ark., eco- nomic features of.....	278
location and history of.....	271-272
position and nature of.....	273-278
rocks associated with.....	272-273
Piedmont area, N. C., magnetite deposits in, distribution and general geology of.....	231-233
magnetite deposits in, origin of.....	239-242
reserves of.....	242
workings on.....	233-239
titiferous magnetites in.....	254-258
Piney Creek, N. C., magnetite deposits on.....	217, 218, 220
Pike County, Ark., diamond area, location of.....	279-280
peridotite area, bibliography of.....	281-285
field work on.....	280
geography of.....	288-289
geology of.....	290-316
history of diamond mining in.....	285-288
population and transportation in.....	289
Pike County, Ark., peridotite in, age of....	310-312
peridotite in, relation of, to other igneous rocks of Arkansas.....	310
Pike gravel member, Ark., description of....	290, 291
Potosi Mountain, Candelaria district, Nev., silver deposits on.....	22
Prairie Creek, Ark., peridotite dike near mouth of.....	303-304
Prairie Creek area, Pike County, Ark., geo- logic map of.....	280
location and topography of.....	279, 289, 293
peridotite in, hypabyssal intrusive type of.....	296-298
less common minerals in.....	300
micrographic plates showing.....	296
nature of.....	295-302
rocks associated with.....	293-295
type of, comprising tuffs and fine- grained breccias.....	301-302
veins in.....	302-303
volcanic breccia type of.....	298-300
Pratt, J. H., cited.....	217, 219
Proustite. <i>See</i> Ruby silver.	
Puett mine, N. C., description of.....	180
R.	
Ransome, F. L., cited.....	99, 104, 112
Rathmell, William, acknowledgment to....	66
Red Marble Gap, N. C., hematite deposit at..	193
Red Mountain region, Colo., composition dia- gram of descending mine water from.....	62
geologic features of.....	98-99
ores of.....	98-104
Rhodo, N. C., hematite deposit south of....	193
Rico-Aspen mine, Colo., ores of.....	114-115
Rico-Dunton region, Colo., geologic features of.....	110-111
Roaring Creek, N. C., magnetite deposit on..	253
Robinson mine, Colo., nature and alteration of ores in.....	101-104
Rockingham County, N. C., magnetic ore from.....	258
Roebing, Col. Washington A., acknowledg- ment to.....	281
Rosebud mine, Colo., downward enrichment in.....	126
location and development of.....	124-125
primary mineralization in.....	125
waters and gases in.....	125-126
Ross, Clarence S., Miser, Hugh D., and, Dia- mond-bearing peridotite in Pike County, Ark.....	279-322
Miser, Hugh D., and, Peridotite dikes in Scott County, Ark.....	271-278
Ruby silver, in the Monte Cristo mine, Ariz.	139-141
Ruby Trust tunnel, near Telluride, Colo., ores of.....	78
Rutile, presence of, in titaniferous iron ores.	258-259
S.	
San Juan Mountains, Colo., scope of report on.	65
silver enrichment in.....	65-129
Savage mine, N. C., description of.....	175
mammillary ore in, plate showing.....	164
Schaller, W. T., cited.....	320
Section 6 hematite deposits, N. C., descrip- tion of.....	174-175

	Page.		Page.
Shaw mine, N. C., magnetic ore of.....	257-258	Trinity formation, nature and occurrence of, in Pike County, Ark.....	290-291
Sierra Nevada mine, Comstock lode, Nev., microscopic details of ore from...	52	Tuff from Arkansas mine, micrographic plate showing.....	297
Silver, native, ores near Wickenburg, Ariz..	131-155	Tuscarora belt, N. C., ores of.....	255-256
Silver bicarbonate, experiments in precipi- tating metallic silver from, by nic- colite, smaltite, etc.....	152-154	U.	
Smith, F. M., operations of, in borax.....	34	Union Consolidated mine, Comstock lode, Nev., analyses of water from..	59, 61, 69
Smuggler-Almont mine, Colo., downward enrichment in.....	122-124	microscopic details of ore from.....	52
location and development of.....	120-121	Ute vein, Rico, Colo., ore minerals from "contact" above.....	115-116
primary mineralization in.....	121, 122	V.	
Smuggler-Union mine, Colo., ores and waters of.....	83-89	Valley River, N. C., brown hematite deposits between Marble and.....	180-185
South Africa, comparison of diamond-bear- ing rocks of, with those of Ar- kansas.....	314-316	brown hematite deposits southeast of..	185-187
dikes and sills of kimberlite in.....	313	Valley River hematite belt, deposits and mines in.....	174-193
material in the vents in.....	313	general features of.....	168-170
petrography of the kimberlite in.....	314	reserves in.....	193-194
pipes of kimberlite in.....	312-313	Vanadium, absence of, from titaniferous magnetites of North Carolina and Tennessee.....	259-260
Southern Iron Mining Co., hematite deposit opened by.....	186	Virginus vein in Revenue tunnel, Colo., ores of.....	75-76
hematite deposit opened by, plates showing.....	165	Von Richthofen, study of the Comstock lode by.....	42, 43
Springs, hot, near Ouray, Colo., composition and origin of waters from.....	67-69	W.	
Stromeyerite, replacement of other minerals by.....	100, 103-104, 109	Wagner, P. A., cited.....	312-314
Suddeth, A. E., property of, near Peachtree, N. C., hematite on.....	198	Walker, J. W., hematite property, N. C., description of.....	191-192
Swan, G. W., hematite property of, near Andrews, N. C.....	188	Walker, Lena, hematite mine, N. C., opera- tion of.....	187
T.		Washburn place, near Andrews, N. C., hematite deposit on.....	192-193
Tatham Creek, N. C., hematite mines and deposits on.....	190-192	Wedge mine, Ouray, Colo., ores of.....	70, 72-73
Teegarden mine, Tenn., location and ore vein of.....	228, 229	Welch mine, N. C., description of.....	179
Telluride-Ouray region, Colo., geologic fea- tures of.....	66-67	Wickenburg, Ariz., primary native-silver ores near.....	131-155
origin and enrichment of ores in.....	92-97	Wilder mine, Tenn., location and ore vein of.....	228, 229
Temperatures, underground, on the Com- stock lode, Nev.....	58	Williams, J. F., cited.....	310
Tennelina, N. C., brown hematite deposits at.....	163-166	Willis, Bailey, cited.....	239
Tennessee, eastern, magnetite ores in.....	209-270	Wilson, N. E., analyses by.....	59-60
Terrace deposits, nature of, in Pike County, Ark.....	292, 294-295	Y.	
Thayer, Ezra, acknowledgment to.....	131	Yancey County, N. C., titaniferous magne- tites in.....	253
Titanium, ores containing, in North Carolina .....	250-261	Yankee Boy mine, near Telluride, Colo., ores of.....	76-78
Tonopah, Nev., composition diagrams of mine waters from.....	61, 62, 69	Yankee Girl mine, Colo., nature and altera- tion of ores in.....	99-104
		Yellow Ridge mine, N. C., ores of.....	238-239